KIPS

ENTRY TESTS
SERIES

PRACTICE BOOK

KIPS SATs
Self Assessment Tests

PHYSICS

3rd *Edition*

MDCAT + ETEA

- 1964 Practice MCQs
- Questions from Past Papers
- Answer Keys with Explanatory Notes
- Topic-wise Practice Exercises
- Unit-wise Self-Assessment Tests
- Pre-Assessment Test (Diagnostic Test)
- Post-Assessment Test

A Kitab Dost Publication

CONTENT

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- **This Pre Prep Assessment is designed to help you to pinpoint the weak areas in your background. Sit aside 1 hour to take this test. Check your answers with those at the end of the test. Then evaluate yourself.**

PRE–PREP ASSESSMENT »

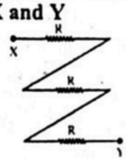
Q.1 **A man of mass 90 kg is standing in an elevator whose cable broke suddenly. If the elevator falls freely, the force exerted by the floor on the man is:**

A. 90 N
B. 900 N
C. 0 N
D. Any negative value

Q.2 **The amplitude and the periodic time of a S.H.M. are 5cm and 6sec respectively. At a distance of 2.5cm away from the mean position, the phase will be**

A. $\pi/3$
B. $\pi/6$
C. $\pi/4$
D. $5\pi/12$

Q.3 **Three resistances each having value 'R' are connected as shown in figure what is the equivalent resistance between X and Y**



A. R
B. $\frac{R}{3}$
C. 3R
D. R^3

Q.4 **When monochromatic light falls on photosensitive material, the number of photoelectrons emitted per second is n and their maximum kinetic energy is K_{max}. If the intensity of the incident light is doubled, then.**

A. Both n and K_{max} are doubled
B. Both n and K_{max} are halved
C. N is doubled but K_{max} remains the same
D. K_{max} is doubled but n remains the same

Q.5 **An observer moves towards a stationary source of sound, with a velocity one fifth of the velocity of sound. What is the percentage increase in the apparent frequency?**

A. Zero
B. 0.5%
C. 5%
D. 20%

Q.6 **The resistance of hot tungsten filament is about 10 times the cold resistance. What will be the resistance of 100 W and 200 V lamp when not in use?**

A. 40 Ω
B. 20 Ω
C. 400 Ω
D. 200 Ω

Q.7 **A magnetic needle is kept in a non-uniform magnetic field. It experiences**

A. A torque but not a force
B. Neither a force nor a torque
C. A force and a torque
D. A force but not a torque

Q.8 **A machine gun fires a bullet of mass 40 g with a velocity 1200 ms^{-1}. The man holding it can exert a maximum force of 144 N on the gun. How many bullets can he fire per second at the most?**

A. One
B. Four
C. Two
D. Three

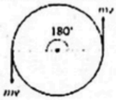
Q.9 A force $\vec{F}=(5\hat{i}+3\hat{j}+2\hat{k})N$ is applied over a particle which displaces it form its origin to the point $\vec{R}=(2\hat{i}-\hat{j})m$. The work done on the particle in joules is

A. −7
B. +7
C. +10
D. +13

Q.10 A body of mass m, accelerates uniformly from rest v_1 in time t_1.. The instantaneous power delivered to the body as a function of time t is

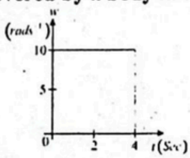
A. $\frac{mv_1 \hat{t}}{t_1}$
B. $\frac{mv_1^2 t}{t_1^2}$
C. $\frac{mv_1 t^2}{t_1}$
D. $\frac{mv_1^2 t}{t_1}$

Q.11 If a particle covers half the circle of radius R with constant speed, then



A. momentum change is mvr
B. change in K.E. is 1/2 mv^2
C. change in K.E. is mv^2
D. change in K.E. is zero

Q.12 The angular displacement covered by a body in the following graph is



A. 40 rev
B. 20 rev
C. 30 rad
D. 40 rad

Q.13 Restoring force in SHM is

A. conservative
B. non-conservative
C. frictional
D. centripetal

Q.14 An organ pipe, open at both ends and another organ pipe, closed at one end, will resonate with each other, if their lengths are in ratio of

A. 1 : 1
B. 1 : 4
C. 2 : 1
D. 1 : 2

Q.15 When source is moving towards observer with velocity u_s then the modified frequency 'f_c' will be

A. $f_c = f\left[\frac{v-u_s}{v}\right]$
B. $f_c = f\left[\frac{v}{v+u_s}\right]$
C. $f_c = f\left[\frac{v}{v-u_s}\right]$
D. $f_c = f\left[\frac{v+u_s}{v}\right]$

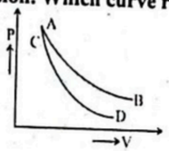
Q.16 **A rope of length 5 m is stretched to a tension of 80 N. If its mass is 1 kg, at what speed would a 10 Hz transverse wave travel down the string?**

A. 2 m/s
B. 5 m/s
C. 20 m/s
D. 50 m/s

Q.17 **The ratio of adiabatic bulk modulus and isothermal bulk modulus of a gas is $(\gamma = C_p/C_v)$.**

A. 1
B. γ
C. $\frac{\gamma}{(\gamma-1)}$
D. $\frac{(\gamma-1)}{\gamma}$

Q.18 **In the figure curves AB and CD represent the relation between pressure P and volume V of an ideal gas. One of the curves represents on isothermal expansion and the other represents an adiabatic expansion. Which curve represents an adiabatic expansion?**



A. Curve AB
B. Curve CD
C. Both "A" and "B"
D. None of these

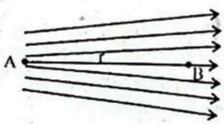
Q.19 **The force between two charges situated in air is F. The force between the same charges if the distance between them is reduced to half and they are situated in a medium having dielectric constant 4 is:**

A. F/4
B. 16F
C. 4F
D. F

Q.20 **If the force between the electron in the first Bohr orbit and the nucleus (proton) in hydrogen atom is F, then the force between them when the electron is in the second orbit is:**

A. 4F
B. F/9
C. F/4
D. F/16

Q.21 **The given figure shows the electric lines of force emerging from a charged body. If the electric fields at A and B are E_A and E_B respectively and if the displacement between A and B is r, then:**



A. $E_A > E_B$
B. $E_A = \frac{E_B}{r}$
C. $E_A < E_B$
D. $E_A = \frac{E_B}{r^2}$

Q.22 **A capacitor has a capacitance of 4F in presence of air. Find the capacitance in μF when a medium of dielectric constant 8 is placed between the plates**

A. 32
B. 16
C. 2
D. None

Q.23 Two wires made of the same material and of the same length are connected in parallel to the same voltage supply. Wire P has a diameter of 2 mm. Wire Q has a diameter of 1 mm. What is the ratio $\frac{\text{current in P}}{\text{current in Q}}$?

A. $\frac{1}{4}$
B. 4
C. 2
D. $\frac{1}{2}$

Q.24 An electric iron is marked 20 volts 500W. The units consumed by it in using it for 24 hours will be ________

A. 12
B. 24
C. 5
D. 1100

Q.25 The masses of three wires of copper are in the ratio of 1 : 3 : 5 and their lengths are in the ratio 5 : 3 : 1. The ratio of their electrical resistance is:

A. 1 : 3 : 5
B. 1 : 15 : 125
C. 5 : 3 : 1
D. 125 : 15 : 1

Q.26 There are three bulbs of 60W, 100W and 200W which bulb has thickest filament.

A. 100W
B. 200W
C. 60W
D. All

Q.27 When a charged particle moving with velocity $\vec{v}$ is subjected to a magnetic field of induction $\vec{B}$, the force on it is non-zero. This implies that:

A. angle between $\vec{v}$ and $\vec{B}$ is either zero or 180°
B. angle between $\vec{v}$ and $\vec{B}$ can have any value other than 90°
C. angle between $\vec{v}$ and $\vec{B}$ is necessarily 90°
D. angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°

Q.28 The magnetic field in a certain region is given by $40\hat{i} - 18\hat{k}$. How much flux passes through a 5.0 cm^2 area loop in this region if loop lies flat in YZ plane?

A. 90×10^{-4} Wb
B. 2×10^{-2} Wb
C. 2×10^{2} Wb
D. 9×10^{-4} Wb

Q.29 A small piece of wire is passed through the gap between the poles of a magnet in 0.1 sec. An e.m.f. of 4×10^{-8} V is induced in the wire, the magnetic flux between the poles is:

A. 10 Wb
B. 4×10^{-9} Wb
C. 0.1 Wb
D. 4×10^{-2}Wb

Q.30 What is the charge induced in coil of 100 turns of resistance 100Ω, if magnetic flux changes from 2 T m^2 to – 2 T m^2?

A. 4 C
B. 2.8 C
C. 2 C
D. 0.4 C

Q.31 A coil having an area A_o is placed in a magnetic field which changes from B_o to $4B_o$ in time interval t. The e.m.f. induced in the coil will be:

A. $3A_oB_o/t$
B. $3B_o/A_ot$
C. $4A_oB_o/t$
D. $4B_o/A_ot$

Q.32 The coils of a stepdown transformer have 500 and 5000 turns. In the primary coil an AC of 4 A at 2200 volt is sent. The value of the current and potential difference in the secondary will be.

A. 20 A, 22V
B. 0.4 A, 22000 A
C. 40 A, 220V
D. 40 A, 22000V

Q.33 If a full wave rectifier circuit is operating from 50 Hz mains, the fundamental frequency in the ripple will be

A. 50 Hz
B. 100 Hz
C. 70.7 Hz
D. 25 Hz

Q.34 In full wave rectification, the output D.C. voltage across the load is obtained for______________

A. The positive half cycle of input A.C.
B. The negative half cycle of input A.C.
C. The complete cycle of input A.C.
D. All of the above.

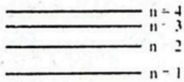
Q.35 A radio station emits 10 kW power of 90.8 MHz. Find the number of photon emitted per second

A. 1.6×10^{28}
B. 1.6×10^{29}
C. 1.6×10^{30}
D. 1.6×10^{32}

Q.36 If If n number of photon are striking on a metal surface, then total momentum exerted is ___________

A. nh/λ
B. $2nh\lambda$
C. zero
D. n f×t

Q.37 Four lowest energy levels of H atom are shown in the figure. The number of possible emission lines would be



A. 3
B. 4
C. 5
D. 6

Q.38 Plutonium decays with a half-life of 24000 years. If plutonium is stored for 72000 years, the fraction of it that remains is:

A. 1/8
B. 1/4
C. 1/3
D. 1/2

Q.39 The radioactivity of a certain radioactive element drop '64 of its initial value in 30 seconds. Its half-life is

A. 4 seconds
B. 3 second.
C. 5 seconds
D. 2 seconds

Q.40 α Particle is bombarded on $_7N^{14}$ as a result $_8O^{17}$ is formed. The particle emitted is

A. Neutron
B. Proton
C. Electron
D. Positron

Q.41 An aeroplane flying 490 m above ground level at 100 m/s, releases a block. How far on ground will it strike

A. 1 km
B. 2 km
C. 0.1 km
D. 0.01 km

Q.42 A particle of mass having velocity 'v' makes head on elastic collision with another particle of the same mass and initially at rest. The velocity of the first particle after the collision is

A. v
B. –v
C. $\frac{v}{2}$
D. 0

Q.43 A particle of mass m at rest is acted upon by a force F for a time t. its K.E after an interval t is

A. $\frac{F^2t^2}{m}$

B. $\frac{F^2t^2}{3m}$

C. $\frac{F^2t^2}{2m}$

D. $\frac{Ft}{2m}$

Q.44 The angle described in 2sec by an object rotating at a rate of 600 rpm is

A. $20\pi\ rad$

B. $40\pi\ rad$

C. $5\pi\ rad$

D. Zero

Q.45 An empty vessel is partially filled with water. Then the frequency of vibration of air column in the vessel

A. Remain same

B. Decrease

C. Increase

D. First increase then decrease

Q.46 There are two strings of equal length and diameter but the densities are in the ratio 1:2 they are stretched by a tension T. The ratio of their fundamental frequencies will be:

A. $\sqrt{2}:1$

B. 1:4

C. 1:2

D. 2:1

Q.47 A polyatomic gas (γ=4/3) is compressed to 1/8 of its volume adiabatically. If its initial pressure is Po, its new pressure will be:

A. $16P_0$

B. $6P_0$

C. $8P_0$

D. $2P_0$

Q.48 A gas is compressed from a volume of $2m^3$ to a volume of $1m^3$ at a constant pressure of $100N/m^2$. Then it is heated at constant volume by supplying 150 J of energy. As a result, the internal energy of the gas

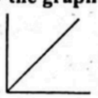
A. Decreases by 250 J

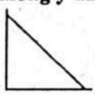
B. Increases by 50 J

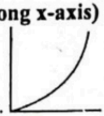
C. Increases by 250 J

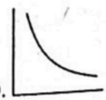
D. Decreases by 50 J

Q.49 The variation of electric potential due to a point charge with distance is represented by the graph (where V along y-axis and r along x-axis)

A. 

B. 

C. 

D. 

Q.50 The charge of an electron is 1.6×10^{-19} C. How many electrons strike the screen of a cathode ray tube each second when the beam current is 16 mA

A. 10^{19}

B. 10^{17}

C. 10^{-19}

D. 10^{-17}

Q.51 An electron enters a region where the electric field E is perpendicular to the magnetic field B. It will suffer no deflection if__________

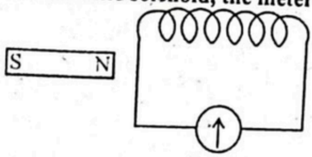
A. E = Bev

B. B = eE/v

C. E= Bv

D. E = Bev/2

Q.52 In pushing the magnet towards the solenoid, the meter shows deflection towards



A. Left
B. Right
C. No deflection
D. Vibration

Q.53 A radioactive substance is at t=0, the number of atoms is 8×10^4. Its half-life period is 3 years. The number of atoms 1×10^4 will remain after interval

A. 19 years
B. 24 years
C. 9 years
D. 6 years

Q.54 In the nuclear decay

$$^{A}_{Z}X \longrightarrow {}^{A}_{Z+1}Y \longrightarrow {}^{A-4}_{Z-1}B^{*} \longrightarrow {}^{A-4}_{Z-1}B$$

The particle emitted in the sequence are

A. α,β,γ
B. β,α,γ
C. γ,β,α
D. β,γ,α

ANSWER KEY

1	C	11	D	21	A	31	A	41	A	51	C
2	B	12	D	22	A	32	C	42	D	52	B
3	C	13	A	23	B	33	B	43	C	53	C
4	C	14	C	24	A	34	C	44	B	54	B
5	D	15	C	25	D	35	B	45	C		
6	A	16	C	26	B	36	A	46	A		
7	C	17	B	27	D	37	D	47	A		
8	D	18	B	28	B	38	A	48	C		
9	B	19	D	29	B	39	C	49	D		
10	B	20	D	30	A	40	B	50	B		

EXPLANATORY NOTES

Q.1 $T = mg - mg \Rightarrow T = 0$

Q.2 Equation of motion is $y = 5\sin\frac{2\pi t}{6}$. For y = 2.5 cm $2.5 = 5\sin\frac{2\pi t}{6} \Rightarrow \frac{2\pi t}{6} = \frac{\pi}{6} \Rightarrow$

$t = \frac{1}{2}$ sec and phase $= \frac{2\pi t}{6} = \frac{\pi}{6}$

Q.3 Series combination $R_e = R + R + R = 3R$

Q.4 Intensity determine the number of emitted electrons, on the other hand frequency determine the energy and there is no relation between intensity and energy.

Q.5 $f = \frac{v + v/5}{v} f = \frac{6f}{5}$

% increase in frequency = 20%

Q.6 $R_{hot} = \frac{V^2}{P} = \frac{200 \times 200}{100} = 400\Omega$

Cold resistance $= R_{hot}/10 = 400/100 = 40\Omega$

Q.7 In non-uniform magnetic field, dipole experiences both force and torque.

Q.8 Change in momentum for each bullet fired is

$= \frac{40}{1000} \times 1200 = 48N$

If a bullet fired exerts a force of 48N on man's hand so man can exert maximum force of 144 N

Number of bullets that can be fired $= \frac{144}{48} = 3$

Q.9 Work done $W = \vec{F}.\vec{s}$

$\vec{s} = 2\hat{i} - \hat{j}$

$W = 5\hat{i} + 3\hat{j} + 2\hat{k}(2\hat{i} - \hat{j}) = 10 - 3 = 7J$

Q.10 $P = \vec{F}.\vec{v} = mav = m\left(\frac{v_1}{t_1}\right)\left(\frac{v_1}{t_1}t\right) = \frac{mv_1^2 t}{t_1^2}$

Q.11 As momentum is vector quantity so change in momentum $\Delta P = mv - (-mv) = 2mv$. But kinetic energy remains always constant so change in kinetic energy is zero.

Q.12 $\theta = \omega \times t = 10 \times 4 = 40 rad$

Q.13 Restoring force is conservative force.

Q.14 $f_1 = f_2$

$\frac{v}{2\ell_1} = \frac{v}{4\ell_2}$

$\ell_1 : \ell_2 = 2:1$

Q.15 $f_e = \left(\frac{v}{v-u_s}\right) f$

Q.16 $v = \sqrt{\frac{F}{m/\ell}} \Rightarrow v = \sqrt{\frac{80\times 5}{1}} = 20ms^{-1}$

Q.17 $E = P$ For isothermal process

$E = \gamma P$ For adiabatic process

So, $\frac{\gamma P}{P} = \gamma$

Q.18 CD curve is more steeper, it represents rapid process.

Q.19 $F_{med} = \frac{F_{vac}}{\varepsilon_r}$

Q.20 $F = \frac{kq^2}{r^2}$

For second orbit

$r_2 = 4r_1$

$F' = \frac{F}{16}$

Q.21 $E = \frac{kq}{r^2}$

$r_A < r_B$

$E_A > E_B$

Q.22 $\frac{1}{\varepsilon_r} = \frac{C_v}{C_m} \Rightarrow C_m = \varepsilon_r C_v = 4\times 8 = 32$

Q.23 $R = \frac{\rho L}{A} = \frac{\rho L}{\pi\left(\frac{D}{2}\right)^2} \Rightarrow R \propto \frac{1}{D^2} \Rightarrow \frac{R_p}{R_q} = \frac{D_q^2}{D_p^2}$

$V = IR \Rightarrow \frac{I_p}{I_q} = \frac{R_q}{R_p} = \frac{D_p^2}{D_q^2} = \frac{(2)^2}{(1)^2} = 4$

Q.24 Number of units $= \frac{P(W)\times t(h)}{1000} = \frac{500\times 24}{1000} = 12$

Q.25 $R = \rho\frac{L}{A}$

$R = \frac{\rho L^2}{V}\left(\because A = \frac{V}{L}\right)$

$R = \frac{\rho d L^2}{m}\left(\because V = \frac{m}{d}\right)$

$R \propto \frac{L^2}{m}$

$R_1 : R_2 : R_3 = \frac{5^2}{1} : \frac{3^2}{3} : \frac{1^2}{5} = 125 : 15 : 1$

Q.26 For parallel combination

$$P=\frac{V^2}{R}\Rightarrow P\propto\frac{1}{R}\qquad (V=\text{constant})$$

Q.27 $F=qvB\sin\theta$ other than 0° and 180° it gives non zero values.

Q.28 $B=40\hat{i}+0\hat{j}-18\hat{k}$

$$A=\left(5\hat{i}+0\hat{j}+0\hat{k}\right)\times10^{-4}\,m^2$$

$$\phi_B=\vec{B}.\vec{A}$$

$$=40\times5\times10^{-4}$$

$$=2\times10^{-2}\,Wb$$

Q.29 $\varepsilon=\dfrac{N\Delta\phi}{\Delta t}$

$$\Delta\phi=\varepsilon\times\Delta t\qquad(\because N=1)$$

Q.30 $\varepsilon=\dfrac{N\Delta\phi}{\Delta t}$

$$IR=\frac{N\Delta\phi}{\Delta t}$$

$$\frac{Q}{\Delta t}R=\frac{N\Delta\phi}{\Delta t}\Rightarrow Q=\frac{N\Delta\phi}{R}$$

Q.31 $\varepsilon=\dfrac{N\Delta\phi}{\Delta t}$

$$\varepsilon=\frac{3A_oB_o}{\Delta t}$$

Q.32 $\dfrac{E_s}{E_p}=\dfrac{N_s}{N_p}\Rightarrow E_s=\dfrac{N_s}{N_p}E_p=\dfrac{500}{5000}\times2200=220\,V$

As $E_si_s=E_pi_p\Rightarrow i_s=\dfrac{E_p}{E_s}i_p$

Or $i_s=\dfrac{N_p}{N_s}i_p=\dfrac{5000}{500}\times4=40A$

Q.33 $f'=2f_{(\text{fundametal})}$

Q.34 In full wave rectification, complete cycle of A.C is rectified.

Q.35 $P=\dfrac{E}{t}=\dfrac{nhf}{t}\Rightarrow\dfrac{n}{t}=\dfrac{p}{hf}$

$$\frac{n}{t}=\frac{10\times10^3}{\left(6.63\times10^{-34}\right)\left(90.8\times10^6\right)}$$

$$\boxed{n=1.6\times10^{29}\text{photons per second}}$$

Q.36 As $p=\frac{h}{\lambda}$ for 1 photon

$\therefore p=\frac{nh}{\lambda}$ for n photon

Q.37 No. of possible spectral lines $=\frac{n(n-1)}{2}=\frac{4(4-1)}{2}=2(3)=6$

Q.38 Undecayed atoms $=\frac{1}{2^n}$

$\because n=$ number of half lives

Undecayed atoms $=\frac{1}{2^3}=\frac{1}{8}$

Q.39 $N=N_o\left(\frac{1}{2}\right)^{t/T}\Rightarrow\frac{N_o}{64}=N_o\left(\frac{1}{2}\right)^{30/T}\Rightarrow T=\frac{30}{6}=5\sec$

Q.40 ${}_7N^{14}+{}_2\alpha^4\rightarrow{}_8O^{17}+{}_1H^1\Rightarrow$ Proton will be emitted.

Q.41 $S=u\times\sqrt{\frac{2h}{g}}=100\times\sqrt{\frac{2\times490}{9.8}}=1000m=1km$

Q.42 If masses are same their velocities will alter, so velocity of 1st ball after collision = velocity of 2nd ball before collision = 0

Q.43 Kinetic energy $E=\frac{P^2}{2m}=\frac{(Ft)^2}{2m}=\frac{F^2t^2}{2m}$ [As $P=Ft$]

Q.44 $\theta=\omega t=\frac{600\times2\pi}{60}\times2=40\pi\ rad$

Q.45 $f_n=n\left(\frac{v}{4l}\right)\Rightarrow\left(f\propto\frac{1}{l}\right)$, length of column decrease so frequency will be increase.

Q.46 $f=\frac{1}{2\ell}\sqrt{\frac{T}{m}}=\frac{1}{2\ell}\sqrt{\frac{T}{\rho V}}\Rightarrow f\propto\frac{1}{\sqrt{\rho}}$ $\quad\because\rho=\frac{m}{V}$

$\frac{f_1}{f_2}=\sqrt{\frac{\rho_2}{\rho_1}}=\sqrt{\frac{2}{1}}$

Q.47 $\frac{P_2}{P_1}=\left(\frac{V_1}{V_2}\right)^\gamma\Rightarrow P_2=P_1\left(\frac{V_1}{V_2}\right)^\gamma=P_1(8)^{4/3}=16P_1$

Q.48 As we know, $\Delta Q=\Delta U+\Delta W$ (1st law of thermodynamics)

$\Rightarrow\Delta Q=\Delta U+P\Delta V$

$150=\Delta U+100(1-2)=\Delta U-100\ \because\ \Delta U=150+100=250J$

Q.49 $V=\frac{kq}{r}\Rightarrow V\propto\frac{1}{r}$

Q.50 $i=\frac{ne}{t}\Rightarrow16\times10^{-3}=\frac{n\times1.6\times10^{-19}}{1}\Rightarrow n=10^{17}$

Q.51 qvB=Eq

E=Bv

Q.52 When magnet is pushed toward solenoid, change in flux with respect to time will increase and induced current will also increase, so it shows deflection of meter towards right.

Q.53 By formula

$$N = N_o\left(\frac{1}{2}\right)^{t/T} \text{ or } 10^4 = 8\times10^4\left(\frac{1}{2}\right)^{t/3} \text{ or}\left(\frac{1}{2}\right)=\left(\frac{1}{2}\right)^{t/3} \text{ or}\left(\frac{1}{2}\right)^3=\left(\frac{1}{2}\right)^{t/3} \Rightarrow 3=\frac{t}{3}$$

Hence t=9 years

Q.54 Charge number increases by 1, so it is β-emission

Charge number decreases by 2, so it is α-emission

No change in charge number so it is γ-emission

1 TOPIC — FORCE AND MOTION

PRACTICE EXERCISE

Q.1 A cyclist moves along a circular path of radius 70m. If he completes one round in 11s, calculate the total length of a path.

A. 40m
B. 440m
C. 0m
D. 11m

Q.2 A body is projected horizontally from the top of a cliff with a velocity of 9.8m/s. What time elapses before horizontal and vertical velocities become equal? Take g = 9.8m/s^2

A. 9.8s
B. 0s
C. 10s
D. 1s

Q.3 Two bullets are fired simultaneously, horizontally and with different speeds from the same place. Which bullet will hit the ground first?

A. The faster one
B. Depends on their mass
C. The slower one
D. Both will reach simultaneously

Q.4 A body is moving along a straight path. What will happen to the body in the absence of an external field?

A. It will stop
B. It will move with the same speed in a different path
C. It will move with the same speed along the same straight path
D. It will move with a reduced speed along the same path

Q.5 A person is standing in a bus. When the bus starts moving forward suddenly __________

A. The person moves forward
B. The person remains stationary
C. The person is unaffected
D. The person moves backward

Q.6 A ship of mass 3×10^7kg initially at rest is pulled by a force of 5×10^4N through a distance of 3m. Assuming that the resistance due to water is negligible, the speed of the ship is?

A. 1.5m/s
B. 60m/s
C. 0.1m/s
D. 5m/s

Q.7 Which of the following is an example of inelastic collision?

A. Collision between two vehicles
B. Collision between glass balls
C. A bullet fired into a wooden block
D. Collision between two railway compartments

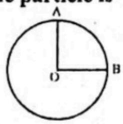
Q.8 Mud thrown on a wall and sticking to it is an example for __________

A. Inelastic collision
B. Elastic collision
C. Super elastic collision
D. Perfectly inelastic collision

Q.9 A Body moves 6 m north. 8 m east and 10m vertically upwards, what is its resultant displacement from initial position

A. $10\sqrt{2}m$
B. $\frac{10}{\sqrt{2}}m$
C. 10 m
D. $10\times2m$

Q.10 A particle starts from center O towards A then moves along AB and stop at B. if R=100m then displacement of the particle is



A. 100 m
B. $100\sqrt{2}$ m
C. $\frac{100}{\sqrt{2}}$m
D. None

Q.11 The instantaneous acceleration is the limit of average acceleration as $\Delta t \rightarrow 0$ is given by

A. $\vec{a}_{ins} = \lim_{\Delta t\to 0}\frac{\Delta\vec{d}}{\Delta t}$
B. $\vec{a}_{ins} = \lim_{\Delta t\to 0}\frac{\Delta t}{\Delta\vec{v}}$
C. $\vec{a}_{ins} = \lim_{\Delta t\to 0}\frac{\Delta\vec{v}}{\Delta t}$
D. $\vec{a}_{ins} = \lim_{\Delta t\to 0}\frac{\Delta\vec{a}}{\Delta t}$

Q.12 If an object is moving with constant velocity of $20ms^{-1}$ towards north then its acceleration will be

A. 5 m.s^{-2}
B. 10 m s^{-2}
C. 9 m s^{-2}
D. 0 m s^{-2}

Q.13 The retardation is defined as

A. Increase in velocity per unit time
B. Decrease in velocity per unit time
C. Decrease in speed per unit time
D. Increase in speed per unit time

Q.14 Consider the acceleration, velocity and displacement of a tennis ball as it falls to the ground and bounces back. Directions of which of these changes in the process

A. Velocity only
B. Acceleration, velocity and displacement
C. Displacement and velocity
D. Displacement and acceleration

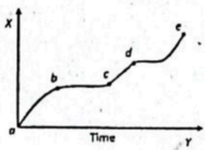
Q.15 A particle goes from x = −2m, y = 3m, z = 1m to x = 3m, y = −1m, z = 4m. Its displacement is:

A. $(1m)\hat{i}+(2m)\hat{j}+(5m)\hat{k}$
B. $(5m)\hat{i}-(4m)\hat{j}+(3m)\hat{k}$
C. $-(5m)\hat{i}+(4m)\hat{j}-(3m)\hat{k}$
D. $-(1m)\hat{i}-(2m)\hat{j}-(5m)\hat{k}$

Q.16 Length of the path of a particle is equal to the magnitude of the displacement of that particle. Shape of the path possible

A. Circle
B. Arc of a circle
C. Parabola
D. Straight line

Q.17 The displacement versus time graph for a body moving in a straight line is shown in figure. Which of the following regions represents the motion when no force is acting on the body?



A. ab
B. cd
C. bc
D. de

Q.18 **The shortest distance between two points is called**

A. Acceleration
B. Velocity
C. Speed
D. Displacement

Q.19 **Two cars are moving in opposite directions with speed v. What is the magnitude o' their relative velocity?**

A. 0
B. v
C. v/2
D. 2v

Q.20 **A man in a car moving with velocity of 36 km/hr. His speed with respect to the car is**

A. 10 m/s
B. Zero
C. 36 m/s
D. Infinite

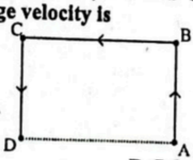
Q.21 **A body can have constant velocity when it follows a.**

A. Elliptical path
B. Parabolic path
C. Circular path
D. Rectilinear path

Q.22 **A man leaves his house for a cycle ride. He comes back to his house after half ai hour after covering a distance of one km. What is his average velocity for the ride?**

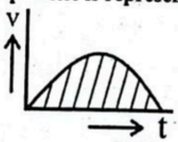
A. 2 km per hour
B. 0
C. 1/2 km per hour
D. 1/2 km per second

Q.23 **A particle moves along the sides AB, BC and CD of a square of side 25m with velocity of $15ms^{-1}$. Its average velocity is**



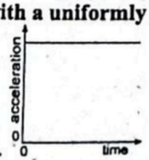
A. $15ms^{-1}$
B. $7.5ms^{-1}$
C. $10ms^{-1}$
D. $5ms^{-1}$

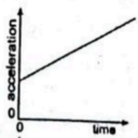
Q.24 **The Figure shows the velocity time graph of a one-dimensional motion. Which of the following characteristic of the particle is represented by the shaded area?**

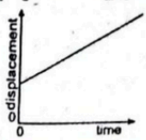


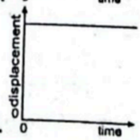
A. Distance covered
B. Speed
C. Momentum
D. Acceleration

Q.25 **Which graph represents the motion of a car that is travelling along a straight road with a uniformly increasing speed?**

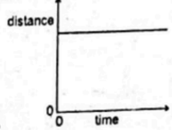
A. 

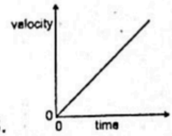
B. 

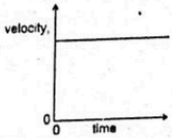
C. 

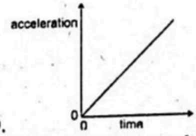
D. 

Q.26 A particle is moving in a straight line with uniform acceleration. Which graph represents the motion of the particle?

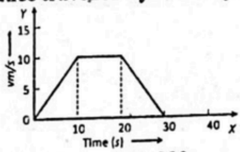
A. 

B. 

C. 

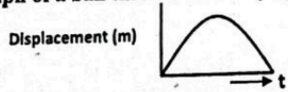
D. 

Q.27 In the following graph, distance travelled by the body in metres is

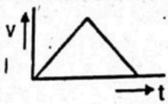


A. 200
B. 300
C. 250
D. 400

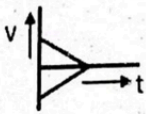
Q.28 Displacement time graph of a ball thrown vertically upward is shown in figure



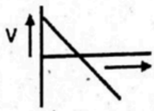
Which of the following represents v-t graph?



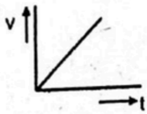
A.



B.



C.



D.

Q.29 When two bodies stick together after collision, the collision is said to be
A. Perfectly elastic
B. Partially elastic
C. Completely inelastic
D. None of these

Q.30 If the force acting on a body is doubled, then acceleration becomes
A. Half
B. Doubled
C. One fourth
D. Constant

Q.31 When force of 1 N is applied on a body of mass 100 g then the acceleration would be
A. 5 m s^{-2}
B. 0.5 m s^{-2}
C. 10 m s^{-2}
D. 0.1 m s^{-2}

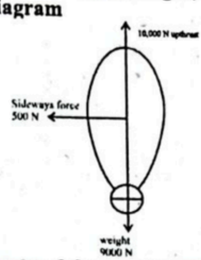
Q.32 A mass of 10 kg moves with an acceleration of 10 m s^{-2}, the force on it is
A. 5 N
B. 100 N
C. 50 N
D. 25 N

Q.33 Which law of motion defines force?
A. 1st law
B. 2nd law
C. 3rd law
D. All of these

Q.34 **A Force of 12 N gives an object an acceleration of 4 m/s^2. The force required to give it an acceleration of 10 $m\ s^{-2}$ is**

A. 15 N
B. 25 N
C. 20 N
D. 30 N

Q.35 **A balloon is acted upon by three forces, weight, upthrust and sideway force due to the wind, as shown in the diagram**



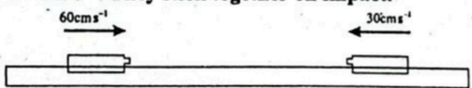
What is the vertical component of the resultant force on the balloon?

A. 500 N
B. 1000 N
C. 10000 N
D. 10500 N

Q.36 **When a force of 4 N acts on a mass of 2 kg for a time of 2 sec, what is the rate of change of momentum?**

A. 2 $kg\ m\ s^{-2}$
B. 4 $kg\ m\ s^{-2}$
C. 8 $kg\ m\ s^{-2}$
D. 16 $kg\ m\ s^{-2}$

Q.37 **Two equal masses travel towards each other on a frictionless air track at speeds of 60 $cm\ s^{-1}$ and 30 $cm\ s^{-1}$. They stick together on impact.**



What is the speed of the masses after impact?

A. 15 $cm\ s^{-1}$
B. 30 $cm\ s^{-1}$
C. 20 $cm\ s^{-1}$
D. 45 $cm\ s^{-1}$

Q.38 **Which is a statement of the principle of conservation of momentum?**

A. A force is equal to the rate of change of momentum of the body upon which it acts.
B. The momentum of a body is the product of the mass of the body and its velocity
C. In a perfectly elastic collision, the relative momentum of the bodies before impact is equal to their relative momentum after impact
D. The total momentum of a system of interacting bodies remains constants, providing no external force acts

Q.39 **The average force necessary to stop a hammer with 25 N s momentum in 0.05 s expressed in 'N' is**

A. 500
B. 125
C. 50
D. 25

Q.40 **In which of the following cases forces may not be required to keep the**

A. Particle going in a circle
B. The momentum of the particle constant
C. Particle going along a straight-line
D. Acceleration of the particle constant

Q.41 **A force of 6 N acts on a mass of 1kg which acquire velocity of 30ms^{-1}. The time for which the force acts is**

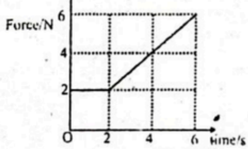
A. 26 s
B. 6 s
C. 5 s
D. 2 s

Q.42 A force of 100 Dynes acts on mass of 5g for 10 sec. The velocity produced is______

A. 2 cm/sec B. 200 cm/sec

C. 20 cm/sec D. 2000 cm/sec

Q.43 The graph shows how the force acting on a body varies with time. Assuming that the body is moving in a straight line, by how much does its momentum change?



A. $40\,kg\,ms^{-1}$ B. $36\,kg\,ms^{-1}$

C. $20\,kg\,ms^{-1}$ D. $16\,kg\,ms^{-1}$

Q.44 A gun after firing recoils due to

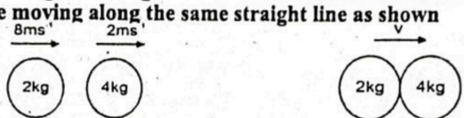
A. Conservation of energy B. Conservation of momentum

C. Backward thrust of gases produced D. Newton's first law of motion

Q.45 A player takes 0.1 s in catching a ball of mass 150 g moving with velocity of 20 m/s. The force imparted by the ball on the hands of the player is:

A. 0.3 N B. 3 N C. 300N D. 30 N

Q.46 A ball of mass 2 kg travelling at 8 ms^{-1} strikes a ball of mass 4 kg travelling at 2 ms^{-1}. Both balls are moving along the same straight line as shown

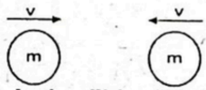


After collision, both balls move at the same velocity v. What is the magnitude of the velocity v?

A. 4 ms^{-1} B. 6 ms^{-1}

C. 5 ms^{-1} D. 8 ms^{-1}

Q.47 Two similar spheres, each of mass m and travelling with speed v, are moving towards each other.



The spheres have a head on elastic collision. Which statement is correct?

A. The spheres stick together on impact B. The total kinetic energy before impact is zero

C. The total kinetic energy after impact is mv^2 D. The total momentum before impact is 2 mv

Q.48 Two railway trucks of masses m and 3m move towards each other in opposite directions with speeds 2v and v respectively. These trucks collide and stick together. What is the speed of the trucks after the collision?

A. $\frac{v}{4}$ B. v C. $\frac{v}{2}$ D. $\frac{5v}{4}$

Q.49 The collision between the two bodies is elastic if bodies are?

A. Solid and soft B. Solid and hard

C. Hard and elastic D. Soft and elastic

Q.50 When a very heavy ball 'B_1' collide with a stationary target 'B_2' of negligible mass, after collision the final velocity of ball 'B_2' will

A. Become zero B. Become half

C. Become doubled as compared to B_1 D. Same as the B_1

Q.51 **A shell explodes into four unequal parts. Which one of the following is conserved?**
A. Potential energy
B. Kinetic energy
C. Momentum
D. Both potential and kinetic energy

Q.52 **A handball is tossed vertically upward with a velocity of 19.6 meters per second. Approximately how high will it rise?**
A. 15 m
B. 20 m
C. 25 m
D. 30 m

Q.53 **Which shows the correct relation between time-of-flight T and maximum height H?**
A. $H = \frac{gT^2}{8}$
B. $H = \frac{8g}{T^2}$
C. $H = \frac{8T^2}{g}$
D. $H = \frac{8}{gT^2}$

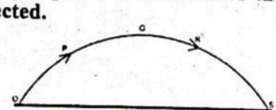
Q.54 **At maximum height on the trajectory which of projectile becomes zero**
A. Acceleration
B. Vertical velocity
C. Velocity
D. Horizontal velocity

Q.55 **Time taken by a projectile to reach maximum height is t =**
A. $\frac{v_i \sin\theta}{2g}$
B. $\frac{v_i \sin\theta}{g}$
C. $\frac{v_i \sin 2\theta}{g}$
D. $\frac{2v_i \sin\theta}{g}$

Q.56 **Two projectiles are projected at angle of 20^0 and 70^0 with same velocity which one have longer range**
A. Which is fired at 20^0
B. Both have same range
C. Which is fired at 70^0
D. None of these

Q.57 **The path followed by a projectile is known as its**
A. Range
B. Trajectory
C. Cycle
D. Height

Q.58 **A projectile is launched at point O and follows the path OPQRS, as shown. Air resistance may be neglected.**



Which statement is true for the projectile when it is at the highest point Q of its path?
A. The horizontal component of the projectile's acceleration is zero
B. The kinetic energy of the projectile is zero
C. The horizontal component of the projectile's velocity is zero
D. The momentum of the projectile is zero

Q.59 **A projectile is fired horizontally with an initial speed of 20 m/s. Its horizontal speed 3s later is**
A. 20 m/s
B. 6.67 m/s
C. 60 m/s
D. 29.4 m/s

Q.60 **For which of the following angles range is maximum?**
A. 43°
B. 30°
C. 60°
D. None

Q.61 **A bullet is fired horizontally from a rifle at a distant target. Ignoring the effect of air resistance, what is the horizontal and vertical acceleration of the bullet?**

	Horizontal	**Vertical**
A.	$9.8\ ms^{-2}$	$9.8\ ms^{-2}$
B.	0	$9.8\ ms^{-2}$
C.	$9.8\ ms^{-2}$	$0\ ms^{-2}$
D.	0	0

FORCE AND MOTION

PAST PAPER MCQ'S

Q.62 A ball is just allowed to fall from the window of a moving train, it will hit the ground following. (ETEA 2005)

A. Circular path
B. Hyperbolic
C. Straight line path
D. Parabolic path

Q.63 A particle mover along the straight line. The distance x describes in time, t is given by the equation $x = t^3$ the acceleration at t =1 (ETEA 2005)

A. A = 1
B. A = 2
C. A = 3
D. A = 4

Q.64 The vertical velocity of ball thrown upward __________ with time. (MCAT 2008)

A. Decreases linearly
B. Doubles
C. Remains constant
D. Decreases parabolically

Q.65 An __________ missile is called a ballistic missile. (MCAT 2008)

A. Un-powered and guided
B. Powered and guided
C. Un-guided and powered
D. Un-powered and un-guided

Q.66 A body is moving with an initial velocity of 2 kms^{-1}. After a time of 50 secs its velocity becomes 1.5 kms^{-1}. Its acceleration will be: (MCAT 2009)

A. 30 m s^{-2}
B. 20 m s^{-2}
C. 40 m s^{-2}
D. 10 m s^{-2}

Q.67 In elastic collision, when a massive body collides with light body at conditions $m_1 >> m_2$ and $v_2 = 0\ ms^{-1}$, then the change in velocity will be written as: (MCAT 2009)

A. $v_1' \approx -v_1$; $v_2' \approx v_1$
B. $v_1' \approx v_1$; $v_2' \approx 2v_1$
C. $v_1' \approx v_1$; $v_2' \approx 0$
D. $v_1' \approx -v_1$; $v_2' \approx 0$

Q.68 If a force of 12N is applied on a body and its momentum is changed form 60 $kgms^{-1}$ to 36 kg ms^{-1}, then find the time during, which this force acts: (MCAT 2010)

A. 1 second
B. 12 seconds
C. 2 seconds
D. 24 seconds

Q.69 Time of projectile's flight is (MCAT 2010)

A. $\frac{v_i^2 \sin^2\theta}{g}$
B. $\frac{v_i^2 \sin\theta}{g}$
C. $\frac{2v_i \sin\theta}{g}$
D. $v_i^2 \sin^2\theta$

Q.70 If the velocity of the body changes by equal amount in equal intervals of time, the body is said to have: (MCAT 2010)

A. Variable acceleration
B. Uniform velocity
C. Uniform acceleration
D. Negative acceleration

Q.71 For finding the height of projectile, the equation used is: (MCAT 2010)

A. $2S = a\,(v_f^2 - v_i^2)$
B. $S = 2a\,(v_f^2 - v_i^2)$
C. $2aS = v_f^2 - v_i^2$
D. $a = 2S\,(v_f^2 - v_i^2)$

Q.72 One ball is thrown vertically upward with a velocity of 9.8 m/s. If the takes 10 seconds to reach the highest point, then the acceleration of the ball is (ETEA 2011)

A. 9.8ms^{-2}
B. 980 ms^{-2}
C. 98ms^{-2}
D. –9.8ms^{-2}

Q.73 A ball is dropped from the roof of a very tall building. What is its velocity after falling for 5.0s? (ETEA 2014)

A. 1.96 ms^{-1}
B. 9.80 ms^{-1}
C. 49.0 ms^{-1}
D. 98.0 ms^{-1}

Q.74 **A projectile is launched at 45° to the horizontal with initial K, Energy, E. Assuming air resistance to be negligible, what will be the kinetic energy of the projectile when it reaches its highest point?** **(ETEA 2014)**

A. 0.71E
B. 0.50E
C. 0.87E
D. E

Q.75 **Weight rather than mass be used in calculating** **(ETEA 2015)**

A. Moment of inertia of a body
B. The stress in wire due to load hanging from it
C. The binding energy of the nucleus
D. The gravitational force between the two bodies

Q.76 **The ratio of displacement along diameter and total distance along circle:** **(MDCAT 2017)**

A. $1 : \pi$
B. $2 : \pi$
C. $\pi : 1$
D. $\pi : 2$

Q.77 **Arshad is driving down 7th street. He drives 150 meter is 18 seconds. Assume he does not speed up or slow down. What is his speed?** **(MDCAT 2017)**

A. 0.38m/s
B. 8.33m/s
C. 126m/s
D. 58.33m/s

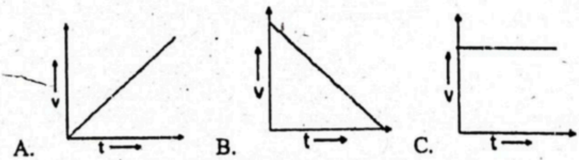
Q.78 **The distance travelled by a moving car with velocity 15 m/s in 2 seconds, decelerates at $2m/s^2$ is equal to** **(MDCAT 2017)**

A. 30m
B. 16m
C. 34m
D. 26m

Q.79 **The value of ratio of displacement to distance is:** **(MDCAT 2017)**

A. Always one
B. More than one
C. Always less than one
D. Equal or less than one

Q.80 **Which of the following v-t graph represents the constant acceleration:** **(MDCAT 2017)**



A.
B.
C.
D. All of these

Q.81 **The numerical ratio of displacement to distance is:** **(ETEA 2017)**

A. Always less than one
B. Always equal to one
C. Always more than one
D. Equal to or less than one

Q.82 **A bullet of mass m moving with a velocity v is fired into large wooden block of mass M of the bullet remains embedded in the wooden block, the velocity of the system will be:** **(ETEA 2017)**

A. $\frac{M}{M+m}v$
B. $\frac{m}{M+m}v$
C. $\frac{M}{M-m}v$
D. $\frac{m}{M-m}v$

Q.83 **If slope of velocity time graph is not constant at different points, then body is moving with** **(MDCAT 2018)**

A. Uniform velocity
B. Average acceleration
C. Increasing acceleration
D. Constant acceleration

Q.84 **A cyclist is traveling at $15ms^{-1}$ she applies brakes so that she doesn't collide with the wall in front of her distance of 18m. Calculate the magnitude of deceleration.** **(MDCAT 2018)**

A. $6.3ms^{-2}$
B. $13ms^{-2}$
C. $5.3ms^{-2}$
D. $12.5ms^{-2}$

Q.85 **Newton first law of motion is also known is** **(MDCAT 2018)**

A. Law of inertia
B. Law of universal gravity
C. Law of electromagnetism
D. Law of conservation

Q.86 **If two objects of equal masses 'm' are moving towards each other with the same speeds 'v' then what will be the total final momentum after elastic head-on collision?** **(MDCAT 2019)**

A. – mv kg/s
B. 2 mv kg/s
C. mv kg m/s
D. 0 kg m/s

Q.87 **For projectile motion in the absence of air resistance:** **(MDCAT 2019)**

A. Vertical speed is constant
B. Horizontal acceleration is zero
C. Horizontal force is constant
D. Vertical acceleration is zero

Q.88 **The range of the projectile depends upon the velocity of the projection and the angle of the projection i.e 45°. For a fixed velocity, when the angle of projection is larger than 45°. Which of the following is correct?** **(MDCAT 2019)**

A. Both the height and the range attained by the projectile will be less
B. The height attained by the projectile will be less but the range is more
C. Both the height and the range attained by the projectile will be more
D. The height attained by the projectile will be more but the range is less

Q.89 **The slop of distance – time graph will always be:** **(NMDCAT 2020)**

A. Negative
B. Positive
C. Zero
D. Maximum

Q.90 **At what angle of projection of a projectile the range becomes half of its maximum value?** **(NMDCAT 2020)**

A. 15°
B. 20°
C. 30°
D. 40°

Q.91 **If we drop an object, its initial velocity is zero. How far will it fall in time 't'?** **(NMDCAT 2020)**

A. $9.8t^2$
B. $4.9\ t^2$
C. $0.49t^2$
D. $98\ t^2$

Q.92 **The newton – second is unit of:** **(NMDCAT 2020)**

A. Work
B. Power
C. Impulse
D. Momentum

Q.93 **Which one of the following is the angle of projection of a projectile if its range is equal to its height?** **(NUMS 2020)**

A. 48°
B. 60°
C. 90°
D. 76°

Q.94 **The product of force and time is equal to:** **(NUMS 2020)**

A. Angular momentum
B. Force
C. Change in momentum
D. Velocity

Q.95 **At what angle of projection of a projectile the range becomes half of its maximum value.** **(NMDCAT 2021)**

A. 15°
B. 20°
C. 20°
D. 40°

Q.96 Vertical velocity vs time graph for a projectile motion (NMDCAT 2021)
A. Varies linearly
B. Follow a parabolic path
C. Is constant
D. Is linear

Q.97 The magnitude of displacement is (NMDCAT 2021)
A. Size of object A
B. Straight line distance between initial and final position
C. Size of object B
D. Any distance between initial and final position

Q.98 If the displacement = 15m and time = 10seconds the average velocity is (NMDCAT 2021)
A. 12.5m/s
B. 1.5 m/s
C. 2.5m/s
D. 3m/s

Q.99 Decrease in velocity per unit time is called (NMDCAT 2021)
A. Acceleration
B. Deceleration
C. Positive acceleration
D. Uniform acceleration

Q.100 The slope of velocity-time graph represents (NMDCAT 2021)
A. Displacement
B. Acceleration
C. Force
D. Momentum

Q.101 An object is accelerating (NMDCAT 2021)
A. Only when its speed changes
B. Only when its direction changes
C. When its speed or direction changes
D. If its velocity is large

Q.102 What is the slope of a straight-line graph of position vs. time? (NMDCAT 2021)
A. Velocity
B. Displacement
C. Distance
D. Acceleration

Q.103 The coefficient of restitution for a perfectly elastic collision is (NMDCAT 2021)
A. 1
B. 0
C. ∞
D. –1

Q.104 What is the accelerating force on the Diwali rocket if it ejects 0.05 kg of gases per second at a velocity of 400 m/s? (NMDCAT 2021)
A. 20 N
B. 20 dynes
C. 1000 N
D. 22 dynes

Q.105 If mass is 2 kg and velocity is 35 m/s, then momentum is (NMDCAT 2021)
A. 70 kg m/s
B. 90 kg m/s
C. 17.5 kg m/s
D. 105 kg m/s

Q.106 If Velocity time graph shape is parallel to Y-axis the acceleration (NMDCAT 2021)
A. Maximum
B. 0
C. Infinity
D. Minimum

Q.107 What is the shape of velocity-time graph for constant acceleration? (UHS 2022)
A. Parabola line
B. Incline curve
C. Straight line
D. Decline curve

Q.108 Which of the following is the correct definition of variable velocity? (UHS 2022)
A. Unequal distances are covered in equal intervals of time
B. Equal displacements are made in unequal intervals of time
C. Unequal displacements are made in equal intervals of time
D. Equal intervals of time

Q.109 A stone thrown horizontally from the top of a tall building follows a path that is: (UHS 2022)
A. Circular
B. Hyperbolic
C. Made of two straight line segments
D. Parabolic

Q.110 Which of the following is incorrect? (UHS 2022)
A. Reaction force on a body is always balanced by the action force
B. Reaction and action forces are always equal
C. Action and reaction forces never act on the same body
D. Newton's third law is always valid in all situations

Q.111 When a heavy coin falls a short distance towards the ground it does not reach terminal velocity. Why is this so? (UHS 2022)
A. The coin has not hit the ground
B. The weight of coin is equal to air resistance
C. The weight of coin increases as air resistance increases
D. The weight of coin is more than air resistance

Q.112 Two balls collide each-other, it has been observed that be collision is elastic. Which statement advocates the observation? (SZABMU 2022)
A. K.E before collision = K.E after collision
B. Momentum before collision = Momentum after collision
C. K.E before collision ≠ K.E after collision
D. Momentum before collision ≠ momentum after collision

Q.113 The gradient of velocity time is equal to: (SZABMU 2022)
A. Distance B. Force
C. Acceleration D. Speed

Q.114 At what pair of angles for a projectile the ranges are equal? (SZABMU 2022)
A. 20°, 60° B. 60°, 30°
C. 40°, 60° D. 25°, 55°

Q.115 Two cars travelling on straight road in opposite direction with speed 70 kmh^{-1} and 60 kmh^{-1}, their relative velocity will be: (SZABMU 2022)
A. 10 kmh^{-1} B. 130 kmh^{-1}
C. 65 kmh^{-1} D. 5 kmh^{-1}

Q.116 Two bodies having same mass undergo elastic collision then their velocities after collision will be: (SZABMU 2022)
A. $v_1' = 0 \quad v_2' = v_1$ B. $v_1' = v_2 \quad v_2' = 0$
C. $v_1' = v_1 \quad v_2' = v_2$ D. $v_1' = v_2 \quad v_2' = v_1$

Q.117 The angle of a projection of a projectile for which its maximum height and horizontal range are equal is: (SZABMU 2022)
A. 86° B. 46°
C. 66° D. 76°

Q.118 Slope of distance time graph can never be: (SZABMU 2022)
A. Positive B. Negative
C. Constant D. Zero

Q.119 At highest point in a projectile motion, the velocity will be: (SZABMU 2022)
A. $v_x = 0 \quad v_y = 0$ B. $v_x = 0 \quad v_y =$ constant
C. $v_x =$ constant $\quad v_y =$ constant D. $v_x =$ constant $\quad v_y = 0$

Q.120 A body covers displacement of 10m towards North and returns back to initial point by covering 10m towards south, its total displacement is: (ETEA 2022)
A. 20m North B. 10m South
C. 0m along North-south D. 0m

Q.121 In Newton's first law of motion which quantity remains constant: (ETEA 2022)
A. Velocity B. Angular displacement
C. Amplitude D. Amount of work

Q.122 Law of inertia satisfies: **(ETEA 2022)**
A. Condition of equilibrium
B. Condition of variable force
C. Condition of force in contact
D. Condition of conservation of mass

Q.123 A projectile is launched, its velocity is maximum at; **(ETEA 2022)**
A. Point of projection
B. Highest point
C. Between launching and highest point
D. All points

Q.124 The net displacement divided by the total time (t) is known as: **(ETEA 2022)**
A. Instantaneous velocity
B. Uniform velocity
C. Average velocity
D. Variable velocity

Q.125 The velocity time graph of a motion starting from rest with uniform acceleration is a straight line: **(ETEA 2022)**
A. Not passing through origin
B. Parallel to time axis
C. Parallel to velocity axis
D. Passing through origin

Q.126 A projectile is thrown at an angle of 45° with horizontal and its range is R_1. Another projectile is thrown at an angle of 45° with vertical and its range is R_2. The relation between R_1 and R_2 is; **(ETEA 2022)**
A. $R_2 = 2R_1$
B. $R_1 = 2R_2$
C. $R_1 = R_2$
D. $3R_1 = R_2$

Q.127 During a projectile path, air friction affects: **(BMU 2022)**
A. Initial velocity of launch
B. Horizontal motion only
C. Vertical motion only
D. Both horizontal and vertical motions

Q.128 Which of the following pairs has the same direction always? **(BMU 2022)**
A. Force, displacement
B. Force, velocity
C. Force, acceleration
D. Force, momentum

Q.129 The third law of motion explains: **(BMU 2022)**
A. The effect of force
B. The existence of force
C. The existence of two forces
D. The existence of a pair of forces in nature

Q.130 A stone is dropped from a building's top 80 m high from the ground. In how much time will it touch the ground? **(BMU 2022)**
A. 2 s
B. 4 s
C. 8 s
D. 10 s

Q.131 If two equal masses are in motion with same individual speeds, we can conclude that: **(BMU 2022)**
A. Their momentums are same
B. Their momentums can be different from each other
C. Their kinetic energies can be different from each other
D. Their total energies are same

Q.132 A body is dropped from certain height and falls freely. Its velocity after 5 seconds will be: **(DUHS 2022)**
A. 0.4 m/s
B. 9.4 m/s
C. 0.49 m/s
D. 4.9 m/s
E. 49 m/s

Q.133 A bullet is fired horizontally with 20m/s. In the absence of air friction, its horizontal velocity after 2 seconds will be: **(DUHS 2022)**
A. 10 ms^{-1}
B. 5 ms^{-1}
C. 60 ms^{-1}
D. 40 ms^{-1}
E. 20 ms^{-1}

Q.134 A box of mass m = 6kg slides with speed v = 4m/s across a frictionless floor, it suddenly explodes into two pieces. One piece, with mass m_1 = 2kg moves in the same direction with speed v_1=8 m/s. The velocity of the second piece is: (DUHS 2022)

A. 6 m/sec
B. 3 m/sec
C. 1 m/sec
D. 4 m/sec
E. 2 m/sec

Q.135 A helicopter of weight 'W' is ascending with zero acceleration. The upward force 'F' on it is: (DUHS 2022)

A. F > W
B. $F = \sqrt{W}$
C. $F = 0$
D. $F = W$
E. F < W

Q.136 When a body moves with uniform velocity than it's: (DUHS 2022)

A. Average velocity is zero
B. Instantaneous velocity is greater than average velocity
C. Instantaneous velocity is zero
D. Instantaneous velocity is equal to average velocity
E. Instantaneous velocity is less than average velocity

Q.137 The rate of change of linear momentum of a body is equal to: (DUHS 2022)

A. Net force
B. Net displacement
C. Net torque
D. Net inertia
E. Net velocity

Q.138 An elastic collision is the one in which: (NUMS 2022)

A. Kinetic energy and momentum is conserved
B. Kinetic is conserved but total energy is not conserved
C. Momentum is conserved but kinetic energy is not conserved
D. Both kinetic energy and momentum are not conserved

Q.139 The time rate of change of velocity is called: (NUMS 2022)

A. Force
B. Acceleration
C. Power
D. Energy

Q.140 In projectile motion, the range of projectile will be maximum at an angle of: (NUMS 2022)

A. 30 degrees
B. 45 degrees
C. 60 degrees
D. 90 degrees

Q.141 Which of the following is NOT TRUE? (NUMS 2022)

A. Action and reaction have same nature
B. Action and reaction have same line of action
C. Action and reaction never act on same body
D. Action and reaction can cancel each other.

Q.142 Two busses moving at 100 km/h and 80 km/h respectively cross each other while moving in opposite direction. Velocity of one bus relative to other bus is: (NUMS 2022)

A. 100 km/h
B. 20 km/h
C. 80 km/h
D. 180 km/h

Q.143 Which of the following pair of angles have same range for a projectile? (NUMS 2022)

A. 10° and 20°
B. 75° and 15°
C. 45° and 60°
D. 0° and 30°

Q.144 The angle of projection of a projectile for which its maximum height and horizontal range are equal is: (NUMS 2022)

A. 45° B. 90° C. 0° D. 76°

Q.145 The explosion of explosive material is application of: (NUMS 2022)

A. Law of conservation of energy B. Law of conservation of mass

C. Law of conservation of momentum D. Newton's third law of motion

ANSWER KEY

PRACTICE EXERCISE

1	B	16	D	31	C	46	A	61	B
2	D	17	B	32	B	47	C		
3	D	18	D	33	A	48	A		
4	C	19	D	34	D	49	B		
5	D	20	B	35	B	50	C		
6	C	21	D	36	B	51	C		
7	A	22	B	37	A	52	B		
8	d	23	D	38	D	53	A		
9	A	24	A	39	A	54	B		
10	A	25	A	40	B	55	B		
11	C	26	B	41	C	56	B		
12	D	27	A	42	B	57	B		
13	B	28	C	43	C	58	A		
14	C	29	C	44	B	59	A		
15	B	30	B	45	D	60	A		

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62	D	77	B	92	C	107	C	122	A	137	A
63	A	78	D	93	D	108	C	123	A	138	A
64	A	79	D	94	C	109	D	124	C	139	B
65	D	80	A	95	A	110	A	125	D	140	B
66	D	81	D	96	A	111	D	126	C	141	D
67	B	82	B	97	B	112	A	127	D	142	D
68	C	83	C	98	B	113	C	128	C	143	B
69	C	84	A	99	B	114	B	129	D	144	D
70	C	85	A	100	B	115	B	130	B	145	C
71	C	86	D	101	C	116	D	131	B		
72	D	87	B	102	A	117	D	132	E		
73	C	88	D	103	A	118	B	133	E		
74	B	89	B	104	A	119	D	134	E		
75	D	90	A	105	A	120	C	135	D		
76	A	91	B	106	C	121	A	136	D		

EXPLANATORY NOTES

PRACTICE EXERCISE

1. Radius of the circular path, $r = 70m$
Time takes to complete one round, $t = 11s$
Total length of the path, $s = 2\pi r = 2\times22/7\times70 = 440m$.

2. Horizontal velocity at any instant, $v_x = u = 9.8m/s$
Vertical velocity at any instant, $v_y = 0 + gt = 9.8t$
$9.8 = 9.8t$
$t = 1s$.

3. Both the bullets will reach simultaneously because
$T = \sqrt{(2h/g)}$ Time t does not depend on horizontal speed.

4. Galileo stated that on a horizontal plane an object should move with a constant velocity in a straight-line path. Therefore, a body moving along a straight path will continue to move in the same direction with the same speed even in the absence of external forces.

5. A person standing in a bus moves backward when the bus moves forward. When the bus moves forward, the lower part of his body begins to move along with the bus while the upper part of his body continues to remain at rest due to inertia. That is why a person falls backward when the bus starts.

6. $a = F/m = (5\times10^4)/(3\times10^7)$
Speed attained by the ship, $v = \sqrt{2as} = 0.1m/s$.

7. If there is a loss of kinetic energy during a collision, it is called an inelastic collision. Collision between two vehicles is an example for inelastic collision.

8. If two bodies stick together after the collision and move as a single body with a common velocity, then the collision is said to be perfectly inelastic collision. A mud thrown on a wall sticks to the wall, hence it is an example for perfectly inelastic collision.

9. $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k} \quad \therefore \; r = \sqrt{x^2 + y^2 + z^2}$
$r = \sqrt{6^2 + 8^2 + 10^2} = 10\sqrt{2}\, m$

10. Displacement is the shortest distance between initial and final positions of the body.
$\vec{d} = OB = 100m$

11. $\vec{a}_{in} = \lim_{\Delta t \to 0} \dfrac{\Delta \vec{v}}{\Delta t}$

12. Since velocity is constant so acceleration is zero.

13. Definition of retardation.

14. Only direction of displacement and velocity gets changed, acceleration is always directed vertically downward.

15. $\vec{A} = -2\hat{i} + 3\hat{j} + \hat{k}$, $\vec{B} = 3\hat{i} - \hat{j} + 4\hat{k}$
Displacement $= \vec{d} = \vec{B} - \vec{A}$
$\vec{d} = 3\hat{i} - \hat{j} + 4\hat{k} + 2\hat{i} - 3\hat{j} - \hat{k}$
$\vec{d} = 5\hat{i} - 4\hat{j} + 3\hat{k}$

16. When length of the path of a particle is equal to the magnitude of the displacement of that particle, shape of the path possible is Straight line.

17. In part *cd* displacement-time graph shows constant slope *i.e.* velocity is constant. It means no acceleration or no force is acting on the body.

18. The shortest distance between two points is called displacement
19. For bodies moving in opposite direction, relative velocity is given by $v_r = v_1 + v_2 \Rightarrow v_r = v + v = 2v$
20. In this case, man is at rest with respect to car.
21. At straight path, body can have constant velocity because direction of motion will remain same.
22. Displacement covered is zero so average velocity will be zero in this case.
23. $s = 75m,\ v = 15ms^{-1} \Rightarrow t = \frac{s}{v} = \frac{75}{15} = 5s$, Now $\vec{v}_{avg} = \frac{\vec{d}}{t} = \frac{25}{5} = 5ms^{-1}$
24. Area under v-t graph represents distance covered by the body.
25. As velocity of an object is increasing uniformly so it's acceleration is constant.
26. When change in velocity is uniform then uniform acceleration will be produced.
27. Distance = Area covered between graph and displacement axis $= \frac{1}{2}(30+10)10 = 200$ meter.
28. In this case, initial velocity will be maximum, velocity will be zero at highest position, then velocity will increase when body comes back.
29. When bodies stick its all K.E lost, so collision is perfectly inelastic. $K.E_i \neq K.E_f$ because, $K.E_f = 0$.
30. $F = ma \Rightarrow a \propto F$
31. $a = \frac{F}{m} = \frac{1}{0.1} = 10\ m\ s^{-2}$
32. $F = ma = 10 \times 10 = 100$ N
33. Newton's 1st law of motion defines force.
34. $\frac{F'}{F} \propto \frac{a'}{a} \Rightarrow F' \propto \frac{10}{4} \times 12 = 30N$
35. Since forces are antiparallel

$F = F_{upthrust} - F_{weight}$

so $= 10000 - 9000 \Rightarrow F = 1000$ N

36. Rate of change of momentum is equal to applied force. So, $F = \frac{\Delta p}{\Delta t}$
37. $m_1v_1 + m_2v_2 = (m_1 + m_2)\ v$

$(m)(60) + m(-30) = (m+m)v$

$30m = 2mv \Rightarrow v = 15\ cm\ s^{-1}$

38. Statement of law of conservation of momentum.
39. $\Delta p = F \times t \Rightarrow F = \frac{\Delta p}{t} = \frac{25}{0.05} = 500$ N
40. If momentum remains constant then force will be zero because $F = \frac{\Delta p}{\Delta t}$
41. $F = \frac{\Delta p}{t} \Rightarrow t = \frac{mv}{F} = \frac{1 \times 30}{6} = 5s$

42. $F = \frac{mv}{t} \Rightarrow v = \frac{F \times t}{m} = \frac{100 \times 10}{5} \Rightarrow v = 200\,cms^{-1}$

43. Area under "F - t" graph represents change in momentum.
$\Delta p =$ area of triangle + area of trapezium.
$$\Delta p = 2 \times 2 + \frac{1}{2}(6+2) \times (4) \Rightarrow \Delta p = 20\,kgms^{-1}$$

44. A gun after firing recoils due to conservation of momentum.

45. $F = \frac{mv}{t} = \frac{0.15 \times 20}{0.1} = 30\,N$

46. For inelastic collision, momentum is still conserved.
Momentum before collision = momentum after collision
$m_1u_1 + m_2u_2 - (m_1 + m_2)v$
$(2)(8) + (4)(2) = (2+4)v \Rightarrow v = 4\,ms^{-1}$

47. Kinetic energy is conserved for elastic collision.
$\frac{1}{2}mv^2 + \frac{1}{2}mv^2 = mv^2$

48. This is a perfectly inelastic collision.
$m(2v) + 3m(-v) = (m+3m)v_1$
$-mv = 4mv_1$
$v_1 = -\frac{1}{4}v$

49. Kinetic energy will remain conserved if energy loss due to compression is zero. It is possible in case of solid and hard object.

50. In this case
$m_1 >> m_2$ and $v_2 = 0$
$so\ v_2' = 2v_1$

51. Momentum will be conserved.

52. $h = \frac{v_i^2}{2g} = \frac{(19.6)^2}{2 \times 9.8} = 19.6m$

53. $H = \frac{v_i^2 \sin^2\theta}{2g} \Rightarrow H = \frac{4g}{4g}\ \frac{v_i^2 \sin^2\theta}{2g}$
$H = \left(\frac{2v_i \sin\theta}{g}\right)^2 \times \frac{g}{8} \Rightarrow H = \frac{gT^2}{8}$

54. At maximum height projectile have minimum velocity as $v_y = 0$

55. $T = \frac{v_i \sin\theta}{g}$ is the time taken to reach maximum height?

56. For complementary angles ranges are same.
If $\theta_1 + \theta_2 = 90°$, then $R_1 = R_2$

57. Path followed by projectile is known as its trajectory.

58. The horizontal component of the projectile's acceleration is zero
59. Horizontal component of projectiles' velocity remains same.
60. For an angle closer to 45°, range will be maximum; so, in this case at $\theta = 43°$; rang will be maximum as compared to range at other angles.
61. For the projectile's, horizontal acceleration will be zero and vertical acceleration = 9.8 ms^{-2}.

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62. It has an initial horizontal velocity, which is same as that of train. It acquires a vertical component under the force of gravity.
63. $s = x = t^3$, $v = s/t = t^3/t = t^2$
    $A = v/t = t^2/t = t$, $A = t = 1$
64. The vertical velocity of ball thrown upward Decreases linearly with time.
65. An unpowered and unguided missile is called ballistic missile
66. $v_f = v_i + a_t$

$$a = \frac{v_f - v_i}{t} = \frac{1.5\times10^3 - 2\times10^3}{50} = \frac{-0.5\times10^3}{50} = -10m/s^2$$

67. When a massive body collide with a light body then
    $v_1' \approx v_1 \Rightarrow v_2' \approx 2v_1$
68. $F = \frac{\Delta p}{\Delta t} \Rightarrow \Delta t = \frac{p_f - p_i}{F}$

$$\Delta t = \frac{36-60}{12} = \frac{-24}{12} = 2\sec$$

Time is always taken as positive.

69. $T = \frac{2v_i \sin\theta}{g}$
70. Definition of uniform acceleration.
71. For finding the height of projectile, the equation used is
    $2as = v_f^2 - v_i^2$
72. $a = \frac{v_f - v_i}{t} = \frac{0-9.8}{10} = \frac{-98}{10} = -9.8ms^{-2}$
73. $v_f = gt$
74. Initial K.E = E
    K.E at highest point $= \frac{1}{2}mv^2\cos^2\theta = (E)\cos^2 45° = Ex(0.7)^2 = 0.49E = 0.50E$
75. $w = mg$
76. $|\vec{d}| = 2r$ (along diameter)
    $S = 2\pi r$ (distance along circle)

$$\frac{|\vec{d}|}{S} = \frac{2r}{2\pi r} = 1:\pi$$

77. $|\vec{v}_{uni}| = \frac{|\vec{d}|}{t} = \frac{150}{18} = 8.33\,ms^{-1}$

78. $S = \frac{1}{2}at^2 + v_i t = \frac{1}{2}(-2)(2)^2 + (15\times 2)$

$S = -4 + 30 = 26\,m$

79. Value of ratio of displacement to distance is equal to 1 for straight path and less than 1 for others path.

80. $Slope = a = \frac{\Delta v}{\Delta t} = constant$

81. $\frac{|\vec{s}|}{s} \leq 1$ if initial and final point is same on a straight line then equal to 1 generally distance is greater than 1.

82. $(m+M)V = mv + Mu \Rightarrow (m+M)V = mv + M(0) \Rightarrow V = \frac{m}{m+M}v$

83. The acceleration either increase or decrease.

84. $2as = v_f^2 - v_i^2 \qquad \because v_f = 0$

$a = \frac{-v_i^2}{2s} = \frac{-15^2}{2\times 18} = 6.25\,ms^{-2}$

85. Newton first law of motion is also known is law of inertia.

86. By using law of conservation of linear momentum.

Total final momentum = Total initial momentum

Total final momentum= mv – mv =0

87. $F_x = ma_x = 0$

$a_x = 0 \Rightarrow v_x = constant$

88. When $\theta > 45°$

$H = \frac{vi^2 \sin^2\theta}{2g} \Rightarrow H \propto \sin^2\theta$

Above relation shows that if 'θ' increases 'H' also increases.

Now range is maximum at 45°

If $\theta > 45°$ range will decrease.

89. Distance of moving body can't be zero and negative so slope of dt graph is positive.

90. $R = R_{max}\sin 2\theta$

If $R = \frac{R_{max}}{2}$

$\frac{R_{max}}{2} = R_{max}\sin 2\theta \Rightarrow \frac{1}{2} = \sin 2\theta \Rightarrow \theta = 15°$

91. $s = v_i t + \frac{1}{2}gt^2$

$v_i = 0$

$S = \frac{1}{2}gt^2 = \frac{1}{2}\times 9.8t^2 = 4.9t^2$

92. $I = F \times \Delta t = Ns$
93. $4H = R \tan\theta$
94. $F \times \Delta t = \Delta p$
95. $R = R_{max} \sin 2\theta$

$R_{max}/2 = R_{max} \sin 2\theta$

$\sin 2\theta = 1/2$

$2\theta = \sin^{-1}(1/2)$

$\theta = 15°$
96. Vertical velocity vs time graph for a projectile motion varies linearly
97. It is straight line distance between initial and final position
98. $v_{av} = \frac{15}{10} = 1.5\, ms^{-1}$
99. Decrease in velocity per unit time is called deceleration
100. The slope of velocity-time graph represents acceleration
101. An object is accelerating when its speed or direction changes.
102. The slope of a straight-line graph of position vs. time is velocity.
103. The coefficient of restitution for a perfectly elastic collision is 1.
104. $F = \frac{m}{t} v = \frac{0.05}{1} \times 400 = 20$
105. $P = mv = 2 \times 35 = 70\, kg\, ms^{-1}$
106. Slope of vt graph $= a = \frac{\Delta v}{\Delta t} = \frac{\Delta v}{0} = \infty$
107. Shape of v-t graph for constant acceleration is straight line
108. Variable velocity is unequal displacement in equal interval of time.
109. When a stone thrown horizontally from top of tall building due to presence of gravity it follows the projectile motion: Projectile motion follows the trajectory of parabolic path thought the journey.
110. Action and reaction force never balance each other they act on two different bodies.
111. The coin weight is more than air resistance so it does not reach terminal velocity.
112. In elastic collision K.E of the system remains conserved.
113. Gradient $= \frac{\Delta y}{\Delta x} = \frac{\Delta v}{\Delta t} = a$
114. If $\theta_1 + \theta_2 = 90°$ then $R_1 = R_2$

$60° + 30° = 90°$ then $R_1 = R_2$
115. If cars travelling in opposite direction

$v_{rel} = v_A + v_B$

$= 70 + 60 = 130\, kmh^{-1}$
116. $m_1 = m_2 = m$

$v_1' = v_2 \quad v_2' = v_1$
117. $H = R$

$\frac{v_i^2 \sin^2\theta}{2g} = \frac{v_i^2 \sin^2\theta}{g}$

$\frac{\sin^2\theta}{2} = 2\sin\theta\cos\theta$

$\tan\theta = 4 \Rightarrow \theta = \tan^{-1}(4) = 76°$

118. Slope$=\dfrac{\Delta d}{\Delta t}$ = Positive because distance is scalar.

119. Conceptual information.

120. $\vec{d}=\vec{r}_2-\vec{r}_1=10-10=0m(NS)$

121. Newton's laws of motion are valid for inertial frame of reference (a = 0 and v = constant) only.

122. Newton's laws of motion are valid for inertial frame of reference (a = 0) only.
So, $F_{net} = 0$ which is condition of equilibrium.

123. In projectile motion velocity is maximum at point of projection and at point of landing while velocity is minimum at highest point of projectile.

124. $v_{av}=\dfrac{\Delta d}{\Delta t}$

125. As motion of body starts from rest so v-t graph starts from origin.

126. $\theta_1 = 45°$ with horizontal
$\theta_2 = 90° - 45° = 45°$
If $\theta_1 + \theta_2 = 90°$ then $R_1 = R_2$
$45° + 45° = 90°$ so $R_1 = R_2$

127. Air friction affects both horizontal and vertical motions then height, time of flight and range of projectile decreases.

128. $a \propto F$

129. Action and reaction are equal in magnitude but opposite in direction.

130. $h=\frac{1}{2}gt^2 \Rightarrow 80=\frac{1}{2}\times 10\times t^2$
$t^2=16 \Rightarrow t=4s$

131. Momentums of two equal masses moving with same individual speed can be different from each other when travelling in opposite direction.

132. $h=\frac{1}{2}gt^2=\frac{1}{2}\times 10\times 25=125m$
$v=\sqrt{2gh}=\sqrt{2\times 9.8\times 125}=49\,ms^{-1}$

133. In projectile motion, horizontal component of velocity remains constant $v_f=v_i=20\,ms^{-1}$

134. According to law of conservative of momentum
$mv=m_1v_1+m_2v_2$
$6\times 4=2\times 8+4v_2$
$24=16+4v_2$
$v_2=2ms^{-1}$

135. A helicopter of weight 'W' is ascending with a = 0. It means $F_{net}=0$ so upward $F=W$

136. Book information.

137. $\dfrac{\Delta p}{\Delta t}=F$

138. Definition.

139. $\vec{a} = \dfrac{\Delta\vec{v}}{\Delta t}$

140. When $\theta = 45°$ then $R_{max} = \dfrac{v_i^2}{g}$

141. Newton's third law

142. $v_{rel} = v_1 + v_2 = 100km/h + 80km/h = 180km/h$

143. For complimentary angles, ranges are equal.
$\theta_1 + \theta_2 = 90°$

144. $R\tan\theta = 4H \Rightarrow H\tan\theta = 4H \Rightarrow \tan\theta = 4 \Rightarrow \theta = \tan^{-1}(4) = 76°$

145. Information.

2 TOPIC — WORK AND ENERGY

PRACTICE EXERCISE

Q.1 A truck and a car are moving with equal velocity. On applying brakes, both will stop after a certain distance, then?
A. Truck will cover less distance before stopping
B. Car will cover less distance before stopping
C. Both will cover equal distance
D. None of the mentioned

Q.2 What sort of energy does flying bird possess?
A. Potential energy
B. Kinetic energy
C. Elastic energy
D. Both potential and kinetic energy

Q.3 When the velocity of an aero plane is doubled, the momentum ___________
A. Remains unchanged
B. Is conserved
C. Becomes zero
D. Increases uniformly

Q.4 A machine gun fires 60 bullets per minute, with a velocity of 700m/s. If each bullet has a mass of 50g, find the power developed by the gun.
A. 1225W
B. 12250W
C. 122.5W
D. 122W

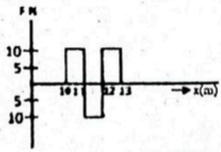
Q.5 A bullet fired from a gun can pierce a target due to its ___________
A. Mechanical energy
B. Heat energy
C. Kinetic energy
D. Acceleration

Q.6 Kinetic energy with any reference must be ___________
A. Zero
B. Positive
C. Negative
D. Either negative or positive

Q.7 At what angle work done will be maximum?
A. 0°
B. 45°
C. 90°
D. 30°

Q.8 Which one of the following is a greater work?
A. +100 J
B. −1000 J
C. −100 J
D. +200 J

Q.9 The figure shows the force distance curve of a body moving along a straight line. The work done by the force:



A. 10 J
B. 30 J
C. 20 J
D. 40 J

Q.10 Work done will be zero if angle between Force and displacement is:
A. 0°
B. 270°
C. 60°
D. 360°

Q.11 A force 2i + j has moved its point of application from (2,3) to (6,5). What is work done?
A. −10
B. −18
C. +10
D. +18

Q.12 At what angle the work done will be half of its maximum value
A. 0°
B. 30°
C. 45°
D. 60°

Q.13 A man pushes a wall with 50 (N) and it displaces it zero (m), his work is
A. Negative
B. No work
C. Positive
D. May all possible

Q.14 If a mass of 5 Kg is lifted upto 5m height, what will be the work done against the gravitational field
A. 245 J
B. 25 J
C. 49 J
D. 98 J

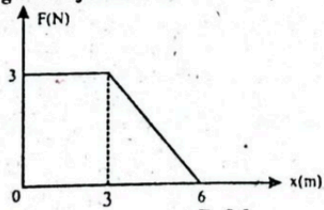
Q.15 A person walks 2 m with an acceleration of 5 m s^{-2}, holding an object of mass 2 kg. The net work done on the object is
A. 20 J
B. 10 J
C. 5 J
D. 0 J

Q.16 A force of $3\hat{i}+2\hat{j}+4\hat{k}$ N gives displacement of 10 $\hat{j}$ m. The work done is
A. 20 J
B. 26 J
C. 32 J
D. Zero

Q.17 A body travels displacement of 10 m by force of 5 N If work done is 25 J then angle between $\vec{F}$ and $\vec{d}$ is
A. 0°
B. 45°
C. 30°
D. 60°

Q.18 A person holds a bucket of weight 60 N. He walks 7 m along the horizontal path and then climbs up a vertical distance of 5 m. The work done by the gravity is:
A. 300 N-m
B. 720 N-m
C. 420 N-m
D. None of these

Q.19 A force F acting on an object varies with distance x as shown in fig. The work done by the force in moving the object from x = 0 to x = 6 m is



A. 18 J
B. 9 J
C. 13.5 J
D. 4.5 J

Q.20 If force and displacement of particle in direction of force are doubled. Work would be
A. Double
B. 1/4 times
C. Half
D. 4 times

Q.21 A person is holding a bucket by applying a force of 10N. He moves a horizontal distance of 5m and then climbs up a vertical distance of 10m. Find the total work done by him?
A. 50J
B. 100J
C. 150J
D. 200J

Q.22 A gardener pushes a lawn roller through a distance of 20m. If he applies a force of 20kg weight in a direction inclined at 60° to the ground, find the work done by him. ($g=9.8m/s^2$)

A. 400J
B. 250J
C. 1960J
D. 2514J

Q.23 If velocity is double, then.

A. Momentum increase 4 times and K.E increases 2 times
B. Momentum increases 2 times and K.E increase constant
C. Momentum and K.E remain same
D. Momentum increases 2 times and K.E increases 4 times

Q.24 What will be the ratio of kinetic energies of alpha particle and proton if their linear momentum will be same?

A. 18 : 1
B. 4 : 1
C. 1 : 4
D. $10^4 : 1$

Q.25 The Bodies of one kg and four kg have same kinetic energy. The ratio in their momenta will be

A. 1 : 2
B. 1 : 4
C. 1 : 16
D. 1 : 1

Q.26 The velocity and momentum of a moving body are 10,000 cm s^{-1} and 10,000 g cm s^{-1} respectively. The K.E will be

A. 5×10^7 J
B. 5×10^8 J
C. 5×10^{-2} J
D. 5×10^0 J

Q.27 If momentum of a moving object is doubled then its kinetic energy will be

A. Doubled
B. Four times
C. Halved
D. Same

Q.28 The momentum and kinetic energy of a ball is numerically equal. The numerical value of velocity is

A. 1 m s^{-1}
B. 3 m s^{-1}
C. 2 m s^{-1}
D. 4 m s^{-1}

Q.29 Kinetic energy of a body moving with speed of 10 m s^{-1} is 30 J. If its speed becomes 30 m/s its K.E will be

A. 10 J
B. 90 J
C. 180 J
D. 270 J

Q.30 Car X is traveling at half the speed of car Y. Car X has twice mass of car Y. Which statement is correct?

A. Car X has half the kinetic energy of car Y
B. Car X has twice the kinetic energy of car Y
C. Car X has one quarter of the kinetic energy of car Y
D. The two cars have the same kinetic energy

Q.31 A ball of mass 2 kg and another of mass 4 kg are dropped together from a 60 feet tall building. After a fall of 30 feet each towards earth, their respective kinetic energies will be in the ratio of:

A. $\sqrt{2}:1$
B. 1 : 2
C. 1 : 4
D. $1:\sqrt{2}$

Q.32 A bomb of mass 30 kg at rest explodes into two pieces of masses 18 kg and 12 kg. The velocity of 18 kg mass is 6 m s^{-1}. The K.E of other mass is

A. 324 J
B. 256 J
C. 486 J
D. 524 J

Q.33 **The kinetic energy acquired by a body of mass m is travelling some distance s, starting from rest under the actions of a constant force, is directly proportional to**

A. m^{o}
B. m
C. m^2
D. $m^{1/2}$

Q.34 **When force and displacement are in the same direction, the kinetic energy of the body**

A. Increases
B. Remains constant
C. Decreases
D. Becomes zero

Q.35 **A truck and a car are moving with equal velocity. On applying brakes, both will stop after a certain distance, then?**

A. Truck will cover less distance before stopping
B. Both will cover equal distance
C. Car will cover less distance before stopping
D. None of the mentioned

Q.36 **Potential energy per unit volume is given by**

A. mgh
B. gh
C. $\frac{mgh}{\rho}$
D. ρgh

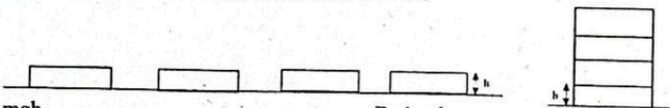
Q.37 **A body is falling from a height h. After it has fallen a height h/2, it will possess**

A. Only potential energy
B. Half potential and half kinetic energy
C. Only kinetic energy
D. More kinetic and less potential energy

Q.38 **Energy stored in the spring of watch is**

A. Electrical energy
B. potential energy
C. Kinetic energy
D. Elastic potential energy

Q.39 **Initially four identical uniform block, each of mass m and thickness h, are spread on a table, work require to stack them on one another is**



A. mgh
B. 4mgh
C. 3mgh
D. 6mgh

Q.40 **A stone is thrown up from the surface of earth when it reaches at maximum height. Its total energy is equal to**

A. mgh
B. $\frac{1}{2}mv^2$
C. Zero
D. 2 mgh

Q.41 **From an automatic gun a man fires 360 bullet per minute with a speed of 360 km/hour. If each weighs 20 g, the power of the gun is**

A. 75W
B. 600W
C. 300W
D. 600W

Q.42 **A person walks 2m with an acceleration of $5ms^{-2}$, holding an object of mass 2kg. The work done on the object is**

A. 20 J
B. 10 J
C. 5 J
D. 0 J

Q.43 **100 joules work has been done by an agency in 10 seconds. What is power of agency?**

A. 1000-watt
B. 10 watt
C. 100
D. 0.10 watt

Q.44 A 500N force is applied on an object and it moves with velocity $10ms^{-1}$. If value of power is 2500 watt. Then what will be the angle between force and displacement

A. 0° B. 90°
C. 60° D. 23°

Q.45 The time taken by an engine of power 10 kW to lift a mass of 200 kg to the height of 40 m is

A. 2 s B. 8 s
C. 4 s D. 16 s

Q.46 To travel at a constant speed, a car engine provides 24 kW of useful power. The driving force on the car is 600 N. At what speed does it travel?

A. 25 ms^{-1} B. 2.5 ms^{-1}
C. 4.0 ms^{-1} D. 40 ms^{-1}

Q.47 A force of 1000 N is needed to lift the hook of a crane at a steady velocity. The crane is then used to lift a load of mass 1000 kg at a velocity of $0.50 ms^{-1}$. How much of the power developed by the motor of the crane is used in lifting the hook and the load? (Take g as $10 ms^{-2}$).

A. 5.0 kW B. 5.5 kW
C. 20 kW D. 22 kW

Q.48 Which of the following is correct order?

A. 1kwh > 1erg > 1J B. 1J > 1erg > 1kwh
C. 1kwh > 1J > 1erg D. 1kwh = 1J = 1erg

Q.49 A man M_1 of mass 80 kg runs up a staircase in 15 s. Another man M_2 also of mass 80 kg runs up the same staircase in 20 s. The ratio of the power developed by them will be:

A. 1 B. 16/9
C. 4/3 D. none of these

Q.50 An engine pumps up 100 kg of water through a height of 10 m in 5s. Given that the efficiency of the engine is 60%, what is the power of the engine? (Take g = 10 m s^{-2})

A. 33 kW B. 0.33 kW
C. 3.3 kW D. 0.033 kW

Q.51 An engine pumps out 40 kg of water in one second. The water comes out vertically upwards with a velocity of 3 m s^{-1}. What is the power of engine in kilowatt?

A. 1.2 kW B. 120 kW
C. 12 kW D. 1200 Kw

Q.52 An elevator's motor produces 3000 W power. The speed with which it can lift a 1000 kg load is:

A. 30.6 m s^{-1} B. 0.306 m s^{-1}
C. 3.06 m s^{-1} D. 300.6 m s^{-1}

Q.53 The power needed to lift a mass of 5000g to height of 1 m in 2 second is

A. 2.45-watt B. 24.5 watt
C. 245-watt D. 2.45 k watt

Q.54 An engine pulls a car of mass 1500 kg on a level road at a constant speed of 5 ms^{-1}. If the frictional force is 500 N, what power does the engine generate?

A. 5.0 kW B. 10 kW
C. 2.5 kW D. 12.5 kW

Q.55 **Work done on a body equals change in its __________ energy.**

A. Total

B. Kinetic

C. Potential

D. All of these

Q.56 **If a certain force acts on an object and changes its kinetic energy from 65 J to 130 J, then work done by the force will be:**

A. 92.5 J

B. 65J

C. 97.5 J

D. 130 J

Q.57 **The amount of work required to stop a moving object is equal to:**

A. The velocity of the object

B. The kinetic energy of the object

C. The mass of the object times its velocity

D. The mass of the object times its acceleration

Q.58 **The work energy principle is valid for**

A. Change in K.E

B. Change in E.P.E

C. Change in P.E

D. All type of energies

Q.59 **Mathematical form of work energy principle is**

A. $Fd = \frac{1}{2}mv_i^2 - \frac{1}{2}mv_f^2$

B. $Fd = \frac{1}{2}mv_f - \frac{1}{2}mv_i$

C. $Fd = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

D. $Fd = \frac{1}{2}mv_f^2 + \frac{1}{2}mv_i^2$

2 Topic WORK AND ENERGY

PAST PAPER MCQ'S

Q.60 A force $2\hat{i} + \hat{j}$ has moved its point of application from (2,3) to (6,5). What is work done? **(MCAT 2008)**

A. –10 B. –18
C. +10 D. +18

Q.61 100 joules work has been done by an agency in 10 seconds. What is power of agency? **(MCAT 2008)**

A. 1000-watt B. 10 watt
C. 100 D. 0.10 watt

Q.62 Work done on a body equals change in its __________ energy. **(MCAT 2008)**

A. Total B. Kinetic.
C. Potential D. All of these

Q.63 If a certain force acts on an object and changes its kinetic energy from 65 J to 130 J, then work done by the force will be: **(MCAT 2009)**

A. 92.5 J B. 65J
C. 97.5 J D. 130 J

Q.64 The consumption of energy by 60-watt bulb in 2 seconds is: **(MCAT 2010)**

A. 20J B. 30J
C. 120 J D. 0.02 J

Q.65 Which one of the following is a non-conservative force? **(MCAT 2010)**

A. Electric force B. Gravitational force
C. Elastic spring force D. Frictional force

Q.66 If velocity is double, then. **(MCAT 2010)**

A. Momentum increase 4 times and K.E increases 2 times
B. Momentum increases 2 times and K.E increase constant
C. Momentum and K.E remain same
D. Momentum increases 2 times and K.E increases 4 times

Q.67 The heat energy dissipated by 40 watts also in one hour is **(ETEA 2010)**

A. 1440 J B. 14400 J
C. 144000 J D. 1440.000 J

Q.68 The gravitational potential energy per unit mass is called: **(ETEA 2010)**

A. Gravitational potential B. Absolute P.E
C. P.E D. Potential hill

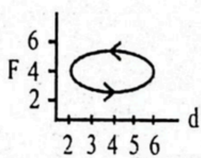
Q.69 A 6.0 kg block is released from rest 80m above the ground. When it has fallen 60m its kinetic energy is approximately: **(ETEA 2015)**

A. 4800 J B. 3500 J
C. 1200 J D. 120 J

Q.70 Potential energy per unit volume is given by **(MDCAT 2016)**

A. mgh B. gh C. $\frac{mgh}{\rho}$ D. ρgh

Q.71 Total work done in figure **(MDCAT 2017)**



A. 24 Nm B. 8 Nm
C. 16 Nm D. Zero Nm

Q.72 Work done will be zero if angle between Force and displacement is: (MDCAT 2017)

A. 0°
B. 270°
C. 60°
D. 360°

Q.73 If mass 'm' is dropped from height 'h' vertically, f is the force of friction during downward motion and 'v' is the velocity at bottom, following equation will be hold: (MDCAT 2017)

A. $\frac{1}{2}mv^2 = mgh + fh$
B. $fh = mgh + \frac{1}{2}mv^2$
C. $mgh = \frac{1}{2}mv^2 - fh$
D. $mgh = \frac{1}{2}mv^2 + fh$

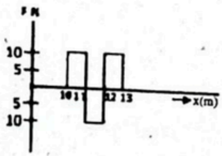
Q.74 At what angle work done will be maximum? (MDCAT 2017)

A. 0°
B. 45°
C. 90°
D. 30°

Q.75 Which one of the following is a greater work? (MDCAT 2017)

A. +100 J
B. –1000 J
C. –100 J
D. +200 J

Q.76 The figure shows the force distance curve of a body moving along a straight line. The work done by the force: (MDCAT 2017)



A. 10 J
B. 30 J
C. 20 J
D. 40 J

Q.77 A man of mass 60 kg climbs up a 20m long staircase to the top of a building 10m high. What is the work done by him: Take $g = 10ms^{-2}$ (ETEA 2017)

A. 12 KJ
B. 6 KJ
C. 3 KJ
D. None he above

Q.78 When a force retards the motion of a body the work done is: (ETEA 2017)

A. Zero
B. Negative
C. Positive
D. Positive or negative depending upon the magnitude of force and displacement

Q.79 An engine pumps out 40 kg of water in one second. The water comes out vertically upwards with a velocity of $3ms^{-1}$, the power of engine in kilowatt is: (ETEA 2017)

A. 1.2 kW
B. 12 kW
C. 120 kW
D. 1200 kW

Q.80 Two boys weighing in the ratio 4:5 goes up stair taking time in the ratio 5:4. The ratio of their power is: (ETEA 2017)

A. 1
B. 16/25
C. 25/16
D. 4/5

Q.81 Energy consumed by 60-watt bulb in 2 minutes is equal to (MDCAT 2018)

A. 7.2 kilo joules
B. 120 joules
C. 720 joules
D. 72000 joules

Q.82 A stone of mass 2.0 kg is dropped from a rest position 5.0m above the ground. What is its velocity at a height of 3.0m above the ground? (MDCAT 2018)

A. 12.5m/s B. 9.3m/s
C. 6.3m/s D. 16.0m/s

Q.83 The rate at which work is being done is called: (MDCAT 2018)

A. Power B. Density
C. Energy D. Force

Q.84 A man has a mass of 80 kg. He ties himself to one end of rope which passes over a single fixed pulley. He pulls on the other end of the rope to lift himself up at an average speed of $50cms^{-1}$. What is the average useful power at which he is working? (ETEA 2018)

A. 40W B. 0.39kW
C. 4.0kW D. 39kW

Q.85 If the momentum of a body decreases by 20% the percentage decreases in K.E will be: (ETEA 2018)

A. 44% B. 36%
C. 28% D. 20%

Q.86 A man carries a 1 kg body 10m horizontally on a level ground. The work zone by the man is: (ETEA 2018)

A. 10 J B. 1 J
C. 0 J D. 5 J

Q.87 An automobile is moving forwards with uniform velocity due to the force exerted by its engine. If that force is double with the velocity remaining constant what happens to its total power? (MDCAT 2019)

A. It does not change B. It is halved
C. It is squared D. It is doubled

Q.88 Which of the following statement shows that no work is done? (MDCAT 2019)

A. Pushing a car to start it moving B. Lifting the weights
C. Writing an essay on a page D. The moon orbiting the earths

Q.89 A 1.75 m heighted weight-lifter raises weights with a mass of 50 kg to a height of .5m above his head. How much work is being done by him? ($g=10ms^{-2}$) (NMDCAT 2020)

A. 2125J B. 2500 J
C. 50J D. 1225 J

Q.90 When the speed of your car is halved, by what factor does its kinetic energy decreases? (NMDCAT 2020)

A. ½ B. 1/4
C. 1/8 D. 1/6

Q.91 Which of the following force is non-conservative force? (NMDCAT 2020)

A. Fractional force B. Gravitation force
C. Electric force D. Elastic spring force

Q.92 The area under force – displacement graph gives us: (NUMS 2020)

A. Displacement B. Power
C. Work D. Acceleration

Q.93 Kilowatt-hour is unit of: (NUMS 2020)

A. Electric energy B. Power
C. Momentum D. Torque

Q.94 A field in which the work is done in a moving a body along a closed path is zero is called (NMDCAT 2021)

A. Electric field
B. Conservative field
C. Electromagnetic field
D. Gravitational field

Q.95 When a force is parallel to the direction of motion of the body, then work done on the body is (NMDCAT 2021)

A. Zero
B. Minimum
C. Infinity
D. Maximum

Q.96 If a body a mass of 2 kg is raised vertically through 2m, then the work done will be (NMDCAT 2021)

A. 38.2 J
B. 392.1 J
C. 39.2 J
D. 3.92 J

Q.97 The relation between horsepower and watt is (NMDCAT 2021)

A. 1 hp = 546 watts
B. 1 hp = 746 watts
C. 1 hp = 1000 watts
D. 1 hp = 946 watts

Q.98 The area under the force displacement graph represents (NMDCAT 2021)

A. Area
B. Work done
C. Power
D. None of these

Q.99 A machine does 2500 J of work in 1 min. What is the power developed by the machine? (NMDCAT 2021)

A. 21 W
B. 42 W
C. 150 W
D. 2500 W

Q.100 A moving car possesses (NMDCAT 2021)

A. Sound energy
B. Mechanical energy
C. Heat energy
D. Chemical energy

Q.101 kWh is the unit of (NMDCAT 2021)

A. Force
B. Power
C. Time
D. Energy

Q.102 2kg mass is uplifted by the machine through the height of 200m for 10 sec calculate power deliver to the load. ($g = 10 m/s^2$) (NMDCAT 2021)

A. 40W
B. 400W
C. 440W
D. 200W

Q.103 Light body A and heavy body B have equal K. E of translation. Then (NMDCAT 2021)

A. A has lager momentum than B
B. B has larger momentum than A
C. A and B have same momentum
D. None

Q.104 If momentum is increased by 13% then K.E increase by (NMDCAT 2021)

A. 37%
B. 2.27%
C. 3.47%
D. None

Q.105 The consumption of energy by a 60 W bulb in 2s is: (UHS 2022)

A. 120 J
B. 30 J
C. 60 J
D. 0.02 J

Q.106 Ignoring details associated with friction, extra forces exerted by arm and leg muscles, and other factors, we can consider a pole vault as the conversion of an athlete's running kinetic energy to gravitational potential energy. If an athlete is to lift his body 5m during a vault, what speed must he have when he plants his pole? (UHS 2022)

A. 5 ms^{-1}
B. 10 ms^{-1}
C. 15 ms^{-1}
D. 20 ms^{-1}

Q.107 A particle of mass m at rest is acted upon by a force P for time t. Its kinetic energy after time t is: (UHS 2022)

A. P^2t^2/m
B. $P^2t^2/2m$
C. $P^2t^2/3m$
D. $P^2t^2/4m$

Q.108 The unit of kinetic energy is same as that of: (SZABMU+ETEA 2022)

A. Work
B. Power/Time
C. Time/Power
D. Work/Time

Q.109 Kilowatt hour is a unit of: (SZABMU 2022)

A. Energy
B. Energy × time
C. Power
D. (Power) (energy)

Q.110 The unit of power in British engineering system is: (SZABMU 2022)

A. Horse power
B. Watt
C. Js^{-1}
D. Js

Q.111 Work done will be negative if the angle between force and displacement is: (SZABMU 2022)

A. 0°
B. 45°
C. 60°
D. 180°

Q.112 1 Nms^{-1}=________ (SZABMU 2022)

A. 1 kWh
B. 1 Js
C. 1 Watt
D. 1 Js^{-2}

Q.113 In inter-conversion of energy, the work done against the friction is: (SZABMU 2022)

A. f + h
B. f – h
C. fh
D. f/h

Q.114 A car of mass 800 kg accelerates from $20ms^{-1}$ to $30ms^{-1}$, the increase in K.E will be: (SZABMU 2022)

A. 2 J
B. 200 kJ
C. 200 J
D. 2 kJ

Q.115 When five times momentum of a body is equal to the kinetic energy of the same body then its velocity is equal to: (ETEA 2022)

A. 5 m/s
B. 10 m/s
C. 15 m/s
D. 20 m/s

Q.116 The equation for kinetic energy is: (ETEA 2022)

A. $K.E = \frac{p}{2m}$
B. $K.E = \frac{1}{2}m\vec{v}.\vec{v}$
C. $K.E = \frac{1}{2}m\vec{v}.\vec{F}$
D. $K.E = \frac{1}{2}m\vec{v}.\vec{w}$

Q.117 Electricity consumption is calculated commercially in: (ETEA 2022)

A. Kilo-watt
B. Kilo-watt hour
C. Mega watt
D. Giga watt

Q.118 A cyclist comes to a skidding stop in 10m. During this process, the opposing force on the cycle due to the road is 200N. How much work does the road do on the cycle? (ETEA 2022)

A. –1800J
B. –2000J
C. 2000J
D. 1900J

Q.119 An electric motor is used to operate an elevator. The motor does 140000J of work in 70 s. What is the output power of the motor? (BMU 2022)

A. 0.50 mW
B. 2.0 W
C. 2.0 kW
D. 9.8 MW

Q.120 A body of mass 5kg is moving with a momentum of 10 Ns, a force of 0.2 N acts on it in the direction of motion of the body for 10s. The increase in its K.E is: (BMU 2022)

A. 2.8 J
B. 3.2 J
C. 3.8 J
D. 4.4 J

Q.121 If mass and speed of a moving object is doubled, the K.E will be: (DUHS 2022)

A. Eight times
B. Four times
C. Doubled
D. Sixteen times
E. Six times

Q.122 One kilowatt hour is equal to: (DUHS 2022)

A. 36×10^{6}J
B. 36×10^{-6}J
C. 3.6×10^{5}J
D. 36×10^{-5}J
E. 36×10^{5}J

Q.123 The rate of doing work is zero, when the angle θ between force and velocity is: (DUHS 2022)

A. $\theta = 60°$
B. $\theta = 180°$
C. $\theta = 0°$
D. $\theta = 45°$
E. $\theta = 90°$

Q.124 1hp is equal to: (NUMS 2022)

A. 476 watts
B. 847 watts
C. 746 watts
D. 467 watts

Q.125 The product of force and velocity is equal to: (NUMS 2022)

A. Kinetic energy
B. Potential energy
C. Power
D. Work done

Q.126 One kilowatt-hour is equal to: (NUMS 2022)

A. 36 MJ
B. 3.6 MJ
C. 38 MJ
D. 3.8 MJ

Q.127 The amount of work done is moving a body at certain point in a gravitational field to a position of zero potential such that the body is never accelerated is called: (NUMS 2022)

A. Kinetic energy
B. Potential energy
C. Gravitational potential energy
D. Absolute potential energy

Q.128 If the speed of a body is doubled, its kinetic energy become: (NUMS 2022)

A. mv^2
B. $2mv^2$
C. $16mv^2$
D. $4mv^2$

Q.129 An electric motor of power 2hp is installed in an industrial unit. Its power to (NUMS 2022)

A. 1500 W
B. 742 W
C. 148 W
D. 1492 W

ANSWER KEY

PRACTICE EXERCISE

1	B	14	A	27	B	40	A	53	B
2	D	15	A	28	C	41	A	54	C
3	B	16	A	29	D	42	D	55	A
4	B	17	D	30	A	43	B	56	B
5	C	18	A	31	B	44	C	57	B
6	B	19	D	32	C	45	B	58	D
7	A	20	D	33	A	46	D	59	C
8	B	21	B	34	A	47	B		
9	A	22	C	35	C	48	C		
10	B	23	D	36	D	49	C		
11	C	24	C	37	B	50	C		
12	D	25	A	38	D	51	A		
13	B	26	D	39	D	52	B		

PAST PAPER MCQ'S

60	C	73	D	86	C	99	B	112	C	125	C
61	B	74	A	87	D	100	B	113	C	126	B
62	D	75	B	88	D	101	D	114	B	127	D
63	B	76	A	89	D	102	B	115	B	128	B
64	C	77	B	90	B	103	B	116	B	129	D
65	D	78	B	91	A	104	D	117	B		
66	D	79	A	92	C	105	A	118	B		
67	C	80	B	93	A	106	B	119	C		
68	A	81	A	94	B	107	B	120	D		
69	B	82	C	95	D	108	A	121	A		
70	D	83	A	96	C	109	A	122	E		
71	D	84	B	97	B	110	A	123	E		
72	B	85	B	98	B	111	D	124	C		

EXPLANATORY NOTES

PRACTICE EXERCISE

1. Being lighter than a truck, the car has less kinetic energy. On applying brakes with the same force, the car will cover less distance before coming to rest.
2. A flying bird possesses both kinetic and potential energies because it is at a certain height above the ground and moving with a certain velocity.
3. If velocity of the aeroplane is doubled, its momentum is also doubled. However, combined momentum of air and aeroplane is conserved. As the momentum of aeroplane increases, the momentum of air also increases by an equal amount in the opposite direction.
4. Mass of the bullets = $60\times50 = 3000\text{g} = 3\text{kg}$
   $v = 700$ m/s $t = 1\text{min} = 60\text{s}$
   Power = W/t = (Kinetic energy)/t = 12250W.
5. The kinetic energy of a body by virtue of its motion is called kinetic energy. A moving object can do work. Therefore, a bullet fired from a gun can pierce a target due to its kinetic energy.
6. $KE = 1/2\ mv^2$
   It is always positive.
7. $W = Fd\cos\theta$
   $\theta = 0°$
   $w = Fd\cos(0) \Rightarrow w = Fd$
8. –1000 J is a greater work in given options.
9. $W = (10)(1) - (10)(1) + (10)(1) = 10\text{ J}$
10. $W = Fd\cos\theta = Fd\cos 270° = 0$
11. $\vec{d} = (6-2)\hat{i} + (5-3)\hat{j}$
    $\vec{d} = 4\hat{i} + 2\hat{j}$
    $W = \vec{F}.\vec{d}$
    $= (2i + \hat{j}).(4\hat{i} + 2\hat{j}) = 8(\hat{i}.\hat{i}) + 2(\hat{j}.\hat{j})$ $\hat{i}.\hat{i} = \hat{j}.\hat{j} = 1$
    $= 8 + 2 = 10$
12. $W = \frac{W_{max}}{2}$
    $W = W_{max}\cos\theta \Rightarrow \frac{W_{max}}{2} = W_{max}\cos\theta \Rightarrow \theta = \cos^{-1}\left(\frac{1}{2}\right) = 60°$
13. $W = Fd\cos\theta$
    since $d = 0 \Rightarrow W = 0$
14. $\theta = 0° \Rightarrow W = mgh \Rightarrow W = 245J$
15. $W = Fd = (ma)d = 2\times5\times2 = 20J$

16. $W=\vec{F}.\vec{d} \quad =\left(3\hat{i}+2\hat{j}+4\hat{k}\right).\left(10\hat{j}\right)\Rightarrow W=20J$

17. $W=Fd\cos\theta$

$$\theta=\cos^{-1}\left(\frac{W}{Fd}\right)=\cos^{-1}\left(\frac{25}{10\times5}\right)=\cos^{-1}\left(\frac{1}{2}\right)\Rightarrow\theta=60^{\circ}$$

18. $W_T=W_{horizontal}+W_{verticle}$

$W_T=0+60\times5$

$W_T=300\,Nm$

19. $W=$ Area under $F-x$ graph

$W=\frac{1}{2}$ (Sum of parallel sides) (Perpendicular distance between parallel sides)

$=\frac{1}{2}(6+3)(3)=13.5J$

20. Work = (Force) (Displacement). If force and displacement both are doubled then work would be four times.

21. $F = 10N, s = 5m, \theta = 90^{\circ}$

Work done, $W_1= Fs\cos\theta = 10 \times 5 \times \cos90^{\circ} = 0$

For vertical motion, the angle between force and displacement is 0

Here, $F = 10N, s = 10m, \theta=0^{\circ}$

Work done, $W_2=10\times10\times\cos0 = 100J$

Total work done $= W_1+W_2 = 100J$.

22. $F = w = mg = 20 \times 9.8N$

$s = 20m \quad , \quad \theta = 60^{\circ}$

$W = Fs\cos\theta = 20 \times 9.8 \times 20\times\cos\theta\ 60^{\circ}$

$W = 1960J$

23. If velocity is doubled then $v' = 2v$

$P = mv$

$P' = m(2v) = 2mv$

$P' = 2p$

$K.E=\frac{1}{2}mv^2$

$K.E'=\frac{1}{2}m(2v)^2$

$=4\left[\frac{1}{2}mv^2\right]$

$K.E' = 4K.E$

24. Mass of $\alpha-$paricle$=6.644\times10^{-27}kg$

mass of proton $= 1.672\times10^{-27}kg$

$p_{\alpha}=p_p$

$K.E=\frac{p^2}{2m} \quad , \quad K.E\propto\frac{1}{m}$

$$\frac{K.E_{\alpha}}{K.E_p}=\frac{m_p}{m_{\alpha}}=\frac{\cancel{1.672\times10^{-27}}}{4\left(\cancel{1.672\times10^{-27}}\right)}=\frac{1}{4}$$

25. $K.E_1 = K.E_2$

$p_1^2 \propto m$

$$\frac{p_1^2}{p_2^2} = \frac{m_1}{m_2} \Rightarrow \frac{p_1}{p_2} = \sqrt{\frac{m_1}{m_2}} \Rightarrow \frac{p_1}{p_2} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

26. $$K.E = \frac{1}{2}pv \Rightarrow K.E = \frac{1}{2}\left(\frac{10{,}000\times10^{-2}}{1000}\right)(10{,}000\times10^{-2})$$

$$= \frac{1}{2}\left(\frac{10000}{1000}\right) = 5\,J \Rightarrow K.E = 5\times10^{0}\,J$$

27. $K.E = \frac{p^2}{2m}$, if $p' = 2p$

$$K.E = \frac{(2p)^2}{2m} = \frac{4p^2}{2m} = 4K.E \Rightarrow K.E' = 4K.E$$

28. $P = K.E$

$$\cancel{m}v = \frac{1}{2}\cancel{m}v^2$$

$$2v = v^2 \Rightarrow v = 2\,ms^{-1}$$

29. $$\frac{K.E_1}{K.E_2} = \frac{v_1^2}{v_2^2}$$

$$K.E_2 = K.E_1\frac{v_2^2}{v_1^2} \Rightarrow K.E_2 = 30\times\frac{900}{100} = 270\,J$$

30. $v_x = \frac{v_y}{2}, m_x = 2m_y$

$$K.E_x = \frac{1}{2}m_x v_x^2 = \frac{1}{2}(2m_y)\left(\frac{v_y}{2}\right)^2 = \frac{1}{2}(2m_y)\left(\frac{v_y^2}{4}\right) = \left(\frac{1}{2}m_y v_y^2\right)\frac{1}{2} = \frac{K.E_y}{2}$$

31. As both balls falling from same height so speed is same $v = \sqrt{2g(h_1 - h_2)}$

$$\frac{K.E_1}{K.E_2} = \frac{\frac{1}{2}m_1v^2}{\frac{1}{2}m_2v^2} = \frac{2}{4} = \frac{1}{2}$$

32. $m_1v_1 = m_2v_2 \therefore v_2 = \frac{18\times6}{12} = 9\,ms^{-1} \Rightarrow KE = \frac{1}{2}\times12(9)^2 = 486\,J$

33. $K.E = \frac{1}{2}mv^2 \Rightarrow K.E \propto v^2$ $\therefore$ does not depend upon mass for a single body (As mass is constant)

34. When force and displacement are in the same direction, the kinetic energy of the body increases. The increase in kinetic energy is equal to the work done on the body.

35. Being lighter than a truck, the car has less kinetic energy. On applying brakes with the same force, the car will cover less distance before coming to rest.

36. $\frac{P.E}{V}=\frac{mgh}{V}=\rho gh$

37. $P.E=mgh$

$P.E'=\frac{mgh}{2} \quad \left(\because h'=\frac{h}{2}\right) \Rightarrow P.E'=\frac{P.E}{2}$

So at h/2, body has half P.E and half K.E.

38. Spring has elastic potential energy.

39. $W=mg(0h)+mg(1h)+mg(2h)+mg(3h)$

$W=0+mgh+2mgh+3mgh \Rightarrow W=6mgh$

40. At maximum height:

$T.E=K.E+P.E$

$=0+mgh=mgh$

41. Power of gun $=\frac{\text{Total K.E. of fired bullet}}{\text{time}}$

$=\frac{n\times\frac{1}{2}mv^2}{t}=\frac{360}{60}\times\frac{1}{2}\times2\times10^{-2}\times(100)^2=600W$

42. $W=Fd\cos\theta$

Since angle between $\vec{F}$ & $\vec{d}$ is 90^0 so $W=0$

43. $P=\frac{W}{t}=\frac{100}{10}=10W$

44. $P=\vec{F}.\vec{v}$

$P=Fv\cos\theta$

$\theta=\cos^{-1}\left(\frac{P}{Fv}\right)=\cos^{-1}\left(\frac{2500}{500\times10}\right)\Rightarrow\cos^{-1}\left(\frac{1}{2}\right)=60^{\circ}$

45. $P=\frac{W}{t}=\frac{mgh}{t}$

$t=\frac{200\times9.8\times40}{10\times10^3}=7.84s\Rightarrow t=8s$

46. $P=\vec{F}.\vec{v}$

$P=Fv\cos\theta\Rightarrow\theta=0^{\circ}$

$P=Fv\Rightarrow v=\frac{P}{F}=\frac{24000}{600}=40\ ms^{-1}$

47. $F=F_{Hook}+F_{mass}$

$F=1000+1000\times10=11000N\Rightarrow P=Fv$

$P=11000\times0.50=5500W=5.5kW$

48. $1kwh > 1cal > 1J > 1erg > 1eV$

49. $P = \frac{mgh}{t}$

As, $M_1 = M_2 = m$
h = same
$\frac{P_1}{P_2} = \frac{t_2}{t_1} = \frac{20}{15} = \frac{4}{3}$

50. $(P) = \frac{mgh}{t}$

$P = \frac{100\times10\times10}{5\times0.6} \Rightarrow P = 3333.3\,W \Rightarrow P = 3.3\,kW$

51. $P = \frac{mgh}{t}$

$P = mgv = 40\times10\times3 = 1200\,W = 1.2\times10^3\,W = 1.2KW$

52. $P = Fv$

$P = mgv \Rightarrow v = \frac{P}{mg} = \frac{3000}{1000\times10} = 0.306ms^{-1}$

53. $P = \frac{mgh}{t} = \frac{\frac{5000}{1000}\times10\times1}{2} = \frac{50}{2} = 24.5W$

54. $P = Fv = 500\times5 = 2500 = 2.5kW$

55. According to Work-energy principle
W.D on a body=change in K.E
W.D on a body=change in P.E (W.D on spring)
W.D on a body=change in T.E (W.D on mass-spring system)

56. According to work-energy principle
$W.D = \Delta K.E = 130 - 65 = 65J.$

57. Work energy principle(statement)

58. Work energy principle is valid for all kinds of mechanical energies

59. Amount of work = change in K.E

PAST PAPER MCQ'S

60. $\vec{d} = (6-2)\hat{i} + (5-3)\hat{j}$

$\vec{d} = 4\hat{i} + 2\hat{j}$

$W = \vec{F}.\vec{d}$

$= (2i + \hat{j}).(4\hat{i} + 2\hat{j})$

$= 8(\hat{i}.\hat{i}) + 2(\hat{j}.\hat{j})$ $\quad\quad \hat{i}.\hat{i} = \hat{j}.\hat{j} = 1$

$= 8 + 2 = 10$

61. $P = \frac{W}{t} = \frac{100}{10} = 10W$

62. According to Work-energy principle
W.D on a body=change in K.E
W.D on a body=change in P.E (W.D on spring)
W.D on a body=change in T.E (W.D on mass-spring system)

63. According to work-energy principle
$W.D = \Delta K.E = 130 - 65 = 65J.$

64. $P = \frac{W}{t}$
$W = P \times t = 60 \times 2 = 120J.$

65. Frictional force is a non-conservative force

66. If velocity is doubled then $v' = 2v$

$K.E = \frac{1}{2}mv^2$

$P = mv$

$P' = m(2v) = 2mv$

$P' = 2p$

$K.E' = \frac{1}{2}m(2v)^2$

$= 4\left[\frac{1}{2}mv^2\right]$

$K.E' = 4K.E$

67. $W = P \times t$ $P = 40watt$ $t = 60 \times 60 = 3600sec$ $W = P \times t = 40 \times 3600 = 144000\ J$

68. Gravitational potential = U/m

69. $v = \sqrt{2gh}$, $K.E = \frac{1}{2}mv^2$

70. $\frac{P.E}{V} = \frac{mgh}{V} = \rho gh$

71. Work done in closed path is zero.

72. $W = Fd\cos\theta = Fd\cos 270° = 0$

73. $mgh = \frac{1}{2}mv^2 + fh$

74. $W = Fd\cos\theta$
$\theta = 0°$
$w = Fd\cos(0)$
$w = Fd$

75. –1000 J is a greater work in given options.

76. $W = (10)(1) - (10)(1) + (10)(1) = 10\ J$

77. $W.D = mgh = 60 \times 10 \times 10 \times 6000J = 6\times10^3 J = 6KJ$

78. Force and displacement are opposite in direction.

79. $P = Fv = mgv = 40 \times 10 \times 3 = 1200 = 1.2kW$

80. $\frac{P_1}{P_2} = \frac{W_1/t_1}{W_2/t_2} = \frac{W_1 \times t_2}{W_2 \times t_1} = \frac{m_1 g h_1 \times t_2}{m_2 g h_2 \times t_1}$

Here $h_2 = h_1 = h$

$\frac{P_1}{P_2} = \frac{m_1 \times t_2}{m_2 \times t_1} = \frac{4\times4}{5\times5} = \frac{16}{25}$

81. $W = P \times t = 60 \times 120 = 7200J = 7.2KJ$

82. $v_i = 0$

$v_f = \sqrt{2g(h_2 - h_1)}$

$v_f = \sqrt{2 \times 9.8(2)} \Rightarrow v_f = 6.26 ms^{-1}$

83. $P = \frac{W}{t}$

84. $P = W/t = F.v = mg.v (As\ m = 80kg, g = 9.8ms^{-2}, v = 50m/sec = 0.5m/sec)$

$P = mg.v = 80 \times 9.8 \times 0.5 = 392W = 0.39kW$

85. $K.E = \frac{P^2}{2m} \Rightarrow \%K.E = 2(\%P) - \frac{p^2}{100} \Rightarrow 2(20\%) - \left(\frac{400}{100}\right) \Rightarrow 40\% - 4\% = 36\%$

86. $w = \vec{F}.\vec{d} = mgh\cos\theta$

87. $P = \vec{F}.\vec{v}$

$P \propto F \Rightarrow P' \propto F'$

if $F' = 2F$

$P' = 2P$

88. Work done in a closed path is zero.

89. $W = mgh = 50 \times 10 \times (1.75 + 0.5) = 1125J$

90. $K.E = \frac{1}{2}mv^2 \Rightarrow v' = \frac{v}{2}$

$K.E' = \frac{1}{2}m\left(\frac{v}{2}\right)^2 = \frac{K.E}{4}$

91. Frictional force is path dependent so, it is non-conservative force.

92. The area under force – displacement graph gives us work.

93. Kilowatt-hour is unit of electric energy.

94. A field in which the work is done in a moving a body along a closed path is zero is called conservative field

95. $\theta = 0°$

$W = Fd\cos 0 = Fd$

96. $W = P.E = mgh = 2 \times 9.8 \times 2 = 39.2J$

97. 1 hp = 746 watt

98. The area under the force displacement graph represents work done

99. $P = \frac{mgh}{t} = \frac{2500}{60} = 42W$

100. A moving car possesses mechanical energy

101. kWh is the unit of energy

102. $P = \frac{mgh}{t}$

103. $P = \sqrt{2mK.E}$

104. $K.E = \frac{p^2}{2m}$

New momentum = 1.13 P

$K.E' = \frac{(1.13P)^2}{2m} = 1.27\,K.E$

$\%\,change\ in\ K.E = \frac{K.E' - K.E}{K.E} \times 100.$

$= \frac{1.27\,K.E - K.E}{K.E} \times 100 = 27.69\%$

105. W = P × t = 60 × 2 = 120 J

106. $mgh = \frac{1}{2}mv^2$

$v = \sqrt{2gh}$

107. $K.E = \frac{P^2}{2m} = \frac{F^2t^2}{2m}$

108. Unit of K.E and work is Joule (J).

109. kWh is unit of energy.

110. Information.

111. $W = Fd\cos\theta$

If θ = 180° then work done will be negative.

112. $P = \frac{W}{t} = \frac{J}{s} = \frac{Nm}{s} = 1\,\text{Watt}$

113. W = fh

114. $\Delta K.E = \frac{1}{2}m\left(v_f^2 - v_i^2\right) = \frac{1}{2} \times 800(900 - 400) = 400 \times 500 = 200000 = 200\,kJ$

115. 5P = K.E

$5\cancel{m}v = \frac{1}{2}\cancel{m}v.v$

v = 10m/s

116. $K.E = \frac{1}{2}mv^2$

$v^2 = \vec{v}.\vec{v}$

$K.E = \frac{1}{2}m(\vec{v}.\vec{v})$

117. Information.

118. W = – Fd = –200 × 10 = –2000 J

119. $P = \frac{W}{t} = \frac{140000}{70} = 2000W = 2kW$

120. Let initial momentum be p

$p = mv_i$

$10 = 5v_i \Rightarrow v_i = 2ms^{-1}$

$a = \frac{F}{m} = \frac{0.2}{5} = 0.04\,ms^{-2}$

$v_f = v_i + at = 2 + (0.04 \times 10) = 2.4ms^{-1}$

Increase in K.E $= \frac{1}{2}m\left(v_f^2 - v_i^2\right) = \frac{1}{2} \times \left(2.4^2 - 2^2\right) = 4.4J$

121. $K.E' = \frac{1}{2}(2m)(2v)^2 = 8\left[\frac{1}{2}mv^2\right] = 8K.E$

122. $1\text{kWh} = 3.6 \times 10^6\text{J} = 36 \times 10^5\text{J}$

123. $P = Fv\cos\theta$

$0 = Fv\cos\theta$

$\theta = \cos^{-1}(0) = 90°$

124. $1\text{hp} = 746\text{W}$

125. $P_{ins} = F.v$

126. $1\text{KWh} = 3.6\text{ MJ}$

127. Definition.

128.

$K.E = \frac{1}{2}mv^2$

$v' = 2v$

$K.E' = \frac{1}{2}m\left(2v^2\right) = 2mv^2$

129. $1\text{hp} = 746\text{W}$

$2 \times 1\text{hp} = 2 \times 746\text{W} = 1492\text{W}$

3 TOPIC ROTATIONAL & CIRCULAR MOTION

PRACTICE EXERCISE

Q.1 **A 60 kg man stands on a spring scale in a lift. At some instant he finds that the scale reading has changed from 60 kg to 50 kg for a while and then comes back to the original mark. What should he conclude?**

A. The lift was in constant motion upwards

B. The lift was in constant motion downward

C. The lift while in motion downwards suddenly stopped

D. The lift while in motion upwards suddenly stopped

Q.2 **A satellite is currently orbiting Earth in a circular orbit of radius R; its kinetic energy is K_1. If the satellite is moved and enters a new circular orbit of radius $2R$, what will be its kinetic energy?**

A. $\frac{K_1}{4}$ B. $\frac{K_1}{2}$

C. K_1 D. $2K_1$

Q.3 **The angular momentum of a rotating body changes from A_0 to $4A_0$ in 4 seconds. The torque acting on the body is**

A. $\frac{3}{4}A_0$ B. $4A_0$

C. $3A_0$ D. $\frac{3}{2}A_0$

Q.4 **The torque of 100Nm acting on a wheel at rest, rotates it through 200 radians in 10s. The angular acceleration of wheel in rads^{-2} is**

A. 4 B. 2

C. 6 D. 8

Q.5 **A bucket containing water is tied to one end of a rope of length 2.5m and rotated about the other end in a vertical circle. What should be the minimum velocity of the bucket at the highest point, so that the water in the bucket will not spill**

A. 2.5 ms^{-1} B. 4ms^{-1}

C. 5ms^{-1} D. 7ms^{-1}

Q.6 **Find the magnitude of the centripetal acceleration of a particle on the tip of a fan blade of length 0.30 metre, rotation at 1200 rev/minute**

A. 40 m/s^2 B. 4737.6 m/s^2

C. 245 m/s^2 D. 20 m/s^2

Q.7 **The racing cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that each makes a complete circle in the same length of time. The ratio of the angular speed of the first car to that of the second car is**

A. $m_1 : m_2$ B. 1:1

C. $r_1:r_2$ D. $m_1 r_1 : m_2 r_2$

Q.8 **The ratio of angular speeds of minute hand and hour hand of a watch is**

A. 6 : 1 B. 12 : 1

C. 1 : 12 D. 1 : 6

Q.9 **The angular velocity of a particle rotating in a circular orbit 100 times per minute is**

A. 1.66 rad/s B. 10.47 rad/s

C. 10.47 deg/s D. 60 deg/s

Q.10 **Angular speed of a particle increases from 2rads^{-1} to 4 rads^{-1} across any two diametrically opposite positions. Its angular acceleration will be?**

A. 6 rads^{-2}
B. $\frac{\pi}{6}$5rads^{-2}
C. $\frac{6}{\pi}$ rads^{-2}
D. π rads^{-2}

Q.11 **Radian is a unit of angular displacement which can also be measured in degrees. How many radians are equal to one degree?**

A. $\frac{180}{\pi}$
B. $\frac{2\pi}{180}$
C. $\frac{\pi}{180}$
D. $\frac{\pi}{57.3}$

Q.12 **If a rotating body is moving counter clockwise, direction of angular velocity will be**

A. Along linear velocity
B. Towards the center
C. Along the axis of rotation
D. Away from center

Q.13 **The ratio of angular frequency and linear frequency is**

A. 2π
B. π
C. $\frac{1}{2}$
D. $\frac{\pi}{2}$

Q.14 **A flywheel gains a speed of 540 rpm in 6 second. Its angular acceleration is**

A. 3 π rad s^{-2}
B. 6 π rad s^{-2}
C. 9 π rad s^{-2}
D. 12 π rad s^{-2}

Q.15 **The angular speed of a fly wheel making 120 revolutions/minute is**

A. 2π rad/s
B. 4π rad/s
C. $4\pi^2$rad/s
D. π rad/s

Q.16 **For positive angular displacement the rotation would be**

A. Clockwise
B. Anti-clockwise
C. Parallel
D. Perpendicular

Q.17 **Ten seconds after an electric fan is turned on, the fan rotates at 300rev/min. Its average angular acceleration is**

A. 30 rad/s^2
B. 30 rev/s^2
C. 3.14 rad/s^2
D. 500 rev/s^2

Q.18 **The angular speed in radian/hour for daily rotation of the earth is**

A. 2π
B. 4π
C. $\frac{\pi}{6}$
D. $\frac{\pi}{12}$

Q.19 **The shaft of a motor rotates at a constant angular speed of 360rev/min. Angle turned through in 1 sec in radian is**

A. π
B. 6π
C. 3π
D. 12π

Q.20 **The angular velocity of the minute hand of a clock is**

A. $\frac{2\pi}{60}$rad s^{-1}
B. $\frac{\pi}{24}$rad s^{-1}
C. $\frac{2\pi}{3600}$rad s^{-1}
D. $\frac{\pi}{3600}$rad s^{-1}

Q.21 If a wheel of radius r turns through an angle of 30°, then the distance through which any point on its rim moves is

A. $\frac{\pi}{3}r$
B. $\frac{\pi}{6}r$
C. $\frac{\pi}{30}r$
D. $\frac{\pi}{180}r$

Q.22 A body moving along the circumference of a circle, completes two revolutions. If the radius of the circular path is r, total angular displacement covered is

A. πr
B. $2\pi r$
C. zero
D. 4π

Q.23 When a body moves in a circle, the angle between its velocity $\bar{v}$ and angular velocity $\bar{\omega}$ is always

A. 0°
B. 180°
C. 360°
D. 90°

Q.24 An object is moving along a circular path of radius 4m. What will be its angular displacement if it moves 14m on this circular path?

A. 5.5 radians
B. 5.0 radians
C. 3.5 radians
D. 4.5 radians

Q.25 Which of the following gives the relationship between linear velocity and angular velocity?

A. $v = r\omega$
B. $v = s\omega$
C. $v = r\theta$
D. $v = s\theta$

Q.26 A body moves in a circle with increasing angular velocity. At time t= 6sec, the angular velocity is 27rad/s. What is the radius of circle made by the body where linear velocity is 81cm/s?

A. 6cm
B. 9cm
C. 3cm
D. 7cm

Q.27 A wheel of radius 1 m covers an angular displacement of 180. Its linear displacement is

A. 3.14 m
B. 6.28 m
C. π rad
D. 0.157 m

Q.28 Linear velocity or tangential velocity of any particle moving in a circular path of radius 2 m with angular velocity 8 rads^{-1} will be:

A. 16 ms^{-1}
B. 10 ms^{-1}
C. 4 ms^{-1}
D. 6 ms^{-1}

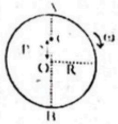
Q.29 The linear and angular velocities of a particle moving about the centre of a circle of radius r, are related by

A. $\bar{v} = \bar{\omega} \times \bar{r}$
B. $\bar{v} = \bar{r} \times \bar{\omega}$
C. $\bar{v} \times \bar{\omega} = \bar{r}$
D. $\bar{\omega} \times \bar{v} = \bar{r}$

Q.30 If a car moves with a uniform speed of 2 m s^{-1} in a circle of radius 0.4 m. Its angular speed is

A. 4 rad s^{-1}
B. 1.6 rad s^{-1}
C. 5 rad s^{-1}
D. 2.8 m s^{-1}

Q.31 A disc of radius R=20 cm is rotating about its axis with an angular velocity $\omega = 20\,\text{rad}\,s^{-1}$ on a horizontal smooth surface. The linear speed of point. C on the disc is



A. $1ms^{-1}$
B. $4ms^{-1}$
C. $2ms^{-1}$
D. $4\pi ms^{-1}$

Q.32 The length of the second hand of a watch is 1 cm. The velocity vector of the tip of the second hand in cm per second is

A. 2π
B. $\frac{2\pi}{60}$
C. $\frac{2\pi}{12\times 60}$
D. $\frac{2\pi}{24\times 60}$

Q.33 If the position vector of a particle is $\vec{r} = \left(3\hat{i} + 4\hat{j}\right)$ meter and its angular velocity is $\vec{\omega} = \left(\hat{j} + 2\hat{k}\right)$ rad/sec then its linear velocity is (in m/s).

A. $-\left(8\vec{i} - 6\vec{j} + 3\vec{k}\right)$
B. $\left(3\vec{i} - 6\vec{j} + 8\vec{k}\right)$
C. $-\left(3\vec{i} - 6\vec{j} + 6\vec{k}\right)$
D. $\left(6\vec{i} - 8\vec{j} + 3\vec{k}\right)$

Q.34 For a particle in uniform circular motion the relation $a_t = r\,\alpha$ of accelerations hold. The acceleration 'a_t'

A. Is centripetal acceleration
B. Is tangential acceleration
C. Is radial acceleration
D. Both A and B

Q.35 A point on the rim of a wheel 4 m in diameter has a velocity of 1600 cm s^{-1}. The angular velocity of the wheel is

A. 2 rad s^{-1}
B. 4 rad s^{-1}
C. 6 rad s^{-1}
D. 8 rad s^{-1}

Q.36 The acceleration of a motor car is 8 m/s^2. If the diameter of its wheel be 2m. It's angular acceleration will be

A. 8 rad/s^2
B. 10 m/s^2
C. 16 rad/s^2
D. 10 rad/s^2

Q.37 When a wheel 1m in diameter makes 30 rev/min, the linear speed of point on it's rim in m s^{-1} is

A. 2π
B. $\frac{\pi}{2}$
C. 3π
D. 4π

Q.38 A body is moving in a circular path with constant speed. The magnitude of tangential and centripetal acceleration are:

	Tangetial	Centripetal
A.	rv^2	0
B.	0	v^2/r
C.	0	0
D.	v^2/r	v^2/r

Q.39 Work done due to centripetal force for circular motion will be:

A. Reduced
B. Half
C. Maximum
D. Zero

Q.40 A 500 *kg* car takes a round turn of radius 50 *m* with a velocity of 36 *km/hr*. The centripetal force is

A. 250 N
B. 1000 N
C. 750 N
D. 1200 N

Q.41 A cycle wheel of radius 0.4 *m* completes one revolution in one *second* then the acceleration of a point on the cycle wheel will be

A. 0.8 m/s^2
B. $1.6\pi^2 \text{ m/s}^2$
C. 0.4 m/s^2
D. $0.4\pi^2 \text{ m/s}^2$

Q.42 A stone of mass m tied to a string of length *l* is rotated in a circle with the other end of the string as the centre. The speed of the stone is v. If the string breaks, the stone will move

A. Toward the centre of circle
B. Away from centre of circle
C. Along the tangent
D. All of these

Q.43 The mud flies off the tyre of a fast-moving car in the direction

A. Parallel to the moving tyre
B. Anti-parallel to the moving tyre
C. Tangent to the moving tyre
D. None of these

Q.44 The force required to bend the normally straight path of a particle into a circular path is called __________ force.

A. Traveling
B. Centrifugal
C. Bending
D. Centripetal

Q.45 Which of the following is the correct vector form of centripetal force?

A. $m\omega\bar{r}$
B. $m\omega^2\bar{r}$
C. $-\frac{m\omega^2}{r}\hat{r}$
D. $-m\omega^2\bar{r}$

Q.46 A body rotates with uniform speed in a circle of radius *r* and takes time *T* to complete one revolution. What are the magnitudes of the angular velocity ω, the linear velocity v and the acceleration a?

	Angular velocity, ω	Linear velocity, v	Acceleration, α
A.	$\frac{1}{T}$	$\frac{4\pi r}{T}$	$\frac{2\pi r}{T^2}$
B.	$\frac{2\pi}{T}$	$\frac{2\pi r}{T}$	$\frac{4\pi^2 r}{T^2}$
C.	$\frac{2\pi}{T}$	$\frac{2\pi r}{T}$	$\frac{2\pi r}{T^2}$
D.	$\frac{2\pi}{T}$	$\frac{4\pi r}{T}$	$\frac{4\pi^2 r}{T^2}$

Q.47 A particle revolves round a circular path with a constant speed. The acceleration of the particle is

A. Along the circumference of the circle
B. Along the radius
C. Along the tangent
D. Zero

Q.48 **A car is moving with high velocity when it has a turn. A force acts on it outwardly because of**

A. Centripetal force
B. Gravitational force
C. Centrifugal force
D. All the above

Q.49 **A cyclist turns around a curve at 15 miles/hour. If he turns at double the speed, the tendency to overturn is**

A. Quadrupled
B. Halved
C. Unchanged
D. Doubled

Q.50 **A body of mass 5 kg is moving in a circle of radius 1m with an angular velocity of 2 radian/sec. The centripetal force is**

A. 10 N
B. 20 N
C. 30 N
D. 40 N

Q.51 **The direction of centripetal force is**

A. Towards the center
B. Along the tangential velocity
C. Away from center
D. Along the axis of rotation

Q.52 **A car of mass 1000kg traveling at 40 ms^{-1} rounds a curve of radius 100m. what is the Fc**

A. 100 N
B. 1.6×10^6N
C. 1.6×10^4N
D. 8×10^4N

Q.53 **If the radius of the circular path of a moving body is half without changing speed of rotation then the Fc becomes**

A. Half
B. One third
C. Doubled
D. One forth

Q.54 **A stone of mass 250 g is tied to the end of a string of length 1.0 m. It is whirled in a horizontal circle with a frequency of 30 rev./min. What is the tension in the string?**

A. $\frac{\pi^2}{4}$N
B. π^2N
C. $\frac{\pi^2}{2}$N
D. $2\pi^2$N

Q.55 **A particle of mass m is executing uniform circular motion on a path of radius r. If p is the magnitude of its linear momentum. The radial force acting on the particle is**

A. mp^2/r
B. rm/p
C. p^2/rm
D. pmr

Q.56 **A stone ties to the end of a string 1m long is whirled in a horizontal circle with a constant speed. If the stone makes 22 revolution in 44 seconds, what is the magnitude and direction of acceleration of the stone**

A. $\pi^2/4\ ms^{-2}$ and direction along the radius towards the centre
B. $\pi^2\ ms^{-2}$ and direction along the radius towards the centre
C. $\pi^2\ ms^{-2}$ and direction along the radius away from the centre
D. $\pi^2\ ms^{-2}$ and direction along the tangent to the circle

3 Topic ROTATIONAL AND CIRCULAR MOTION

PAST PAPER MCQ'S

Q.57 The force required to bend the normally straight path of a particle into a circular path is called ________ force. **(MCAT 2008)**

A. Traveling
B. Centrifugal
C. Bending
D. Centripetal

Q.58 Linear velocity or tangential velocity of any particle moving in a circular path of radius 2 m with angular velocity 8 rads^{-1} will be: **(MCAT 2009)**

A. 16 ms^{-1}
B. 10 ms^{-1}
C. 4 ms^{-1}
D. 6 ms^{-1}

Q.59 A wheel of radius 1 m covers an angular displacement of 180. Its linear displacement is **(MCAT 2010)**

A. 3.14 m
B. 6.28 m
C. π rad
D. 0.157 m

Q.60 When a body moves in a circle the angle between its linear velocity and angular velocity is always: **(ETEA 2010)**

A. 0°
B. 180°
C. 360°
D. 90°

Q.61 Radian is a unit of angular displacement which can also be measured in degrees. How many radians are equal to one degree? **(MCAT 2011)**

A. $\frac{180}{\pi}$
B. $\frac{\pi}{180}$
C. $\frac{2\pi}{180}$
D. $\frac{\pi}{57.3}$

Q.62 The centripetal acceleration of a car travelling at constant speed around a frictionless circular track: **(ETEA 2013)**

A. Is zero
B. Has constant magnitude but varying direction
C. Has constant direction but varying magnitude
D. Has varying magnitude and direction

Q.63 A wheel starts from rest and has an angular acceleration of 4.0 rad/s². When it has made 10 rev its angular velocity is: **(ETEA 2016)**

A. 16 rad/s
B. 22 rad/s
C. 32 rad/s
D. 250 rad/s

Q.64 A child riding on a large merry-go-round, travels a distance of 3000m in a circle of diameter 40m. The total angle through which she revolves is: **(ETEA 2016)**

A. 50 rad
B. 75 rad
C. 150 rad
D. 314 rad

Q.65 The angular velocity for daily rotation of the earth is: **(ETEA 2016)**

A. $\frac{\pi}{3}$ radian hr^{-1}
B. $\frac{\pi}{6}$ radian hr^{-1}
C. $\frac{\pi}{12}$ radian hr^{-1}
D. 12π radian hr^{-1}

Q.66 A body moves in a circle with increasing angular velocity. At time t= 6sec, the angular velocity is 27rad/s. What is the radius of circle made by the body where linear velocity is 81cm/s? **(MDCAT 2017)**

A. 6cm
B. 9cm
C. 3cm
D. 7cm

Q.67 **Angular speed of minutes hand of mechanical watch is:** (MDCAT 2017)

A. $\pi / 30 \text{ rad min}^{-1}$
B. $\pi / 2 \text{ rad min}^{-1}$
C. π rad min
D. None of these

Q.68 **A body is moving in a circular path with constant speed. The magnitude of tangential and centripetal acceleration are:** (MDCAT 2017)

	Tangential	Centripetal
A.	rv^2	0
B.	0	v^2/r
C.	0	0
D.	v^2/r	v^2/r

Q.69 **A centripetal force F acts on a body moving with angular speed ω. If the angular speed is tripled, then the magnitude of centripetal force becomes:** (ETEA 2017)

A. 8 F
B. 9 F
C. 3 F
D. 4 F

Q.70 **A fly wheels rotates at a constant speed of 3000 rpm (rev/min). The angle described by the shaft in radian in one second is:** (ETEA 2017)

A. 2π
B. 30π
C. 100π
D. 300π

Q.71 **A wheel starts rotating from rest with angular acceleration of 2 rads^{-2} till its angular speed becomes 6 rad/s. The angular displacement of the wheel will be equal to** (MDCAT 2018)

A. 4 rad
B. 12 rad
C. 9 rad
D. 7 rad

Q.72 **Which of the following gives the relationship between linear velocity and angular velocity?** (MDCAT 2018)

A. $v = r\omega$
B. $v = s\omega$
C. $v = r\theta$
D. $v = s\theta$

Q.73 **An object is moving along a circular path of radius 4m. What will be its angular displacement if it moves 14m on this circular path?** (MDCAT 2019)

A. 5.5 radians
B. 5.0 radians
C. 3.5 radians
D. 4.5 radians

Q.74 **If during circular motion, tangential velocity of a body becomes double, then centripetal force becomes:** (NMDCAT 2020)

A. Double
B. One half
C. Four times
D. One fourth

Q.75 **Under what condition an object will have zero displacement but non zero distance?** (NMDCAT 2020)

A. Linear motion
B. Circular motion
C. Random motion
D. Oscillation

Q.76 **1 radian is equal to** (NMDCAT 2020)

A. 57.1°
B. 57.2°
C. 57.3°
D. 57.4°

Q.77 **A 10N force moves a body around a circular path of radius 50 cm. What is work done in completing one revolution?** (NUMS 2020)

A. 5J
B. 0
C. 31.42 J
D. 500 J

Q.78 **Number of revolutions in 720 degrees.** (NMDCAT 2021)

A. 4 revolutions
B. 3 revolutions
C. 2 revolutions
D. 9 revolutions

Q.79 Car moves in circular path due to (NMDCAT 2021)
A. Centripetal force B. Frictional force
C. Gravitational force D. None

Q.80 Radian is used to measure (NMDCAT 2021)
A. Small angles B. Large angles
C. Both D. None

Q.81 If earth covers 360 degrees in 24 hours, then how many degrees are in two hours (NMDCAT 2021)
A. 15° B. 30°
C. 45° D. 60°

Q.82 Earth completes one revolution about its own axis (NMDCAT 2021)
A. 24 hours B. 6 months
C. 12 months D. None

Q.83 A fireman wants to slide down a rope. The breaking load of the rope is 3/4 th of the weight of the man. With what acceleration should the fire man slide down? (Acceleration due to gravity is 'g') (UHS 2022)
A. g B. g/4
C. 3g/4 D. 0

Q.84 The number of revolutions in 3π radians is (UHS 2022)
A. 1/60 B. 3/2
C. 2 D. 6

Q.85 If a flywheel is rotating at 3.0 rad/s, the time it takes to complete on revolution is about (UHS 2022)
A. 0.67 s B. 1.3 s
C. 1.0 s D. 2.1 s

Q.86 A fighter plane is moving in a vertical circle of radius r. Its minimum velocity at the highest point of the circle will be? (UHS 2022)
A. $\sqrt{3gr}$ B. $\sqrt{2gr}$
C. $\sqrt{gr}$ D. $\sqrt{gr/2}$

Q.87 Which one of the following provides centripetal force in a circular motion of body? (SZABMU 2022)
A. Vertical component of weight B. Horizontal component of weight
C. Weight of the body D. Force of friction

Q.88 How many radians are in one degree? (SZABMU 2022)
A. 0.0174 rad B. 0.174 rad
C. 1.745 rad D. 0.00174 rad

Q.89 Which one of the following is the angular velocity of an electric motor if it runs at 400 rpm? (SZABMU 2022)
A. 51.2 rads^{-1} B. 41.9 rads^{-1}
C. 45.2 rads^{-1} D. 38.5 rads^{-1}

Q.90 The tension in string at top of vertical circle is: (SZABMU 2022)
A. Zero B. mg
C. 2 mg D. 3 mg

Q.91 The centripetal force in terms of angular velocity is given by (SZABMU 2022)
A. $F_c = m r\omega$ B. $F_c = m r\omega^2$
C. $F_c = m r\alpha^2$ D. $F_c = m r\alpha$

Q.92 Which one of the following is angular speed in radian per hour for daily rotation of our earth? (SZABMU 2022)
A. 2π B. 4π
C. π/6 D. π/12

Q.93 Which one is not a vector quantity? (ETEA 2022)
A. Angular displacement
B. Impulse
C. Moment of inertia
D. Momentum

Q.94 When angular speed of a body is doubled, the centripetal acceleration becomes: (ETEA 2022)
A. Doubled
B. Thrice
C. Four times
D. Remains the same

Q.95 According to the right-hand rule, the direction of angular displacement is along the? (BMU 2022)
A. Curl of fingers
B. First finger
C. Pointing thumb
D. Second finger

Q.96 The ratio of angular speed of a minute hand to hour hand of the watch is? (BMU 2022)
A. 1:6
B. 6:1
C. 1:12
D. 12:1

Q.97 In the SI system of units, the centripetal force is measured in: (BMU 2022)
A. J
B. N
C. T
D. W

Q.98 The best example of uniform circular motion is: (BMU 2022)
A. The motion of the earth around the sun
B. The motion of a mass attached with a string on a vertical circle
C. The motion of a minute hand in the clock
D. The motion of a spinning top

Q.99 A cyclist moving on a circular track skid because: (DUHS 2022)
A. The limiting friction is perpendicular to the centripetal force
B. The limiting friction is greater than the required centripetal force
C. The limiting friction is opposite to the centripetal force
D. The limiting friction is equal to required centripetal force
E. The limiting friction is less than the required centripetal force

Q.100 Every particle of a rotating disc moves with: (DUHS 2022)
A. Constant linear velocity
B. Constant angular velocity
C. Constant tangential velocity
D. Constant linear displacement
E. Constant linear momentum

Q.101 A body is moving in a circle with constant speed, with radius of circle is 'r' and time period 'T' the centripetal acceleration is given by: (DUHS 2022)
A. $a_c = \frac{4\pi r^2}{T^2}$
B. $a_c = \frac{4\pi^2 r}{T^2}$
C. $a_c = \frac{4\pi r}{T}$
D. $a_c = \frac{4\pi^2 r^2}{T}$
E. $a_c = \frac{4\pi r^2}{T}$

Q.102 The angular momentum of a particle changes from 0 to 720 J s in 4s. The magnitude of torque is: (DUHS 2022)
A. 2880 N-m
B. 180 N-m
C. 360 N-m
D. 1440 N-m
E. 90 N-m

Q.103 1 radian = (NUMS 2022)
A. 53.7°
B. 73.5°
C. 57.3°
D. 37.5°

Q.104 The minimum required velocity to put a satellite into the orbit is called: (NUMS 2022)

A. Terminal velocity
B. Escape velocity
C. Critical velocity
D. Average velocity

Q.105 A rotating wheel complete 12 rev in 4s. Find the average angular velocity its rad/sec. (NUMS 2022)

A. 24.6 rad/s
B. 18.5 rad/s
C. 10.4 rad/s
D. 18.8 rad/s

Q.106 When an object experience circular motion, the directional of centripetal acceleration is: (NUMS 2022)

A. Toward center
B. Along tangent
C. Along the direction of motion
D. Opposite the direction of motion

ANSWER KEY

PRACTICE EXERCISE

1	C	11	C	21	B	31	C	41	B	51	A
2	B	12	C	22	D	32	B	42	C	52	C
3	A	13	A	23	D	33	A	43	C	53	A
4	A	14	A	24	C	34	B	44	D	54	A
5	C	15	B	25	A	35	D	45	D	55	C
6	B	16	B	26	C	36	A	46	B	56	B
7	B	17	C	27	A	37	B	47	B		
8	B	18	D	28	A	38	B	48	C		
9	B	19	D	29	A	39	D	49	A		
10	C	20	C	30	C	40	B	50	B		

PAST PAPER MCQ'S

57	D	67	A	77	B	87	D	97	B
58	A	68	D	78	C	88	A	98	C
59	A	69	B	79	B	89	B	99	E
60	D	70	C	80	B	90	A	100	B
61	B	71	C	81	B	91	B	101	B
62	B	72	A	82	A	92	D	102	B
63	B	73	C	83	B	93	C	103	C
64	C	74	C	84	B	94	C	104	C
65	C	75	B	85	D	95	C	105	D
66	C	76	C	86	C	96	D	106	A

EXPLANATORY NOTES

PRACTICE EXERCISE

1. Initially the lift is moving upward with constant velocity, then it is retarded and finally it is at rest; so initial weight = final weight = 60 kg. During upward retardation or downward acceleration, the weight decreases (Also as we know T = m(g−a))

2.
$$v' = \sqrt{\frac{GM}{2r}} = \frac{v}{\sqrt{2}}$$

As $K.E' = \frac{1}{2}mv'^2 \Rightarrow K.E' = \frac{K.E}{2}$

3. $\tau = \frac{\Delta L}{\Delta t} = \frac{4A_0 - A_0}{4} = \frac{3A_0}{4}$

4. $\theta = \frac{1}{2}\alpha t^2$

$$\alpha = \frac{2\theta}{t^2} = \frac{2\times 200}{(10^2)} = \frac{400}{100} = 4$$

5. $v = \sqrt{gr}$

6.
$$a = r\omega^2$$

$$a = (0.30)\left(\frac{1200\times 2\pi}{60}\right)^2 = 4737.6 ms^{-2}$$

7. Both cars complete one rotation after same time interval so have same angular velocity.

Hence $\frac{\omega_1}{\omega_2} = 1:1$

8. $$\frac{\omega_{min\,hand}}{\omega_{hour.hand}} = \frac{\frac{1rot}{hour}}{\frac{1rot}{12hours}} = 12:1$$

9. $$\omega = \frac{100rot}{1\min ute} = \frac{100(2\pi)rad}{60s} = 10.47 rads^{-1}$$

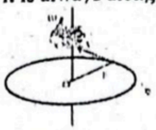
10. For semicircle angle covered must be π rad

$$2\alpha\theta = \omega_f^2 - \omega_i^2 \Rightarrow \alpha = \frac{4^2 - 2^2}{2(\pi)} = \frac{12}{2\pi} = \frac{6}{\pi} rads^{-2}$$

11. $2\pi rad = 360°$

$$1° = \frac{2\pi}{360} rad \Rightarrow 1° = \frac{\pi}{180} rad$$

12. Angular velocity is a axial vector so it is always along the axis of rotation



13. $\frac{\omega}{f}=\frac{2\pi f}{f}=2\pi$

14. $\alpha=\frac{\Delta\omega}{\Delta t}=\frac{540\times 2\pi}{60\times 6}=\frac{540\times 2\pi}{360}=3\pi\ rad/s^2$

15. $\omega=120\,rev/min=120\times\frac{2\pi}{60}\,rad/sec=4\pi\ rad/sec$

16. According to convention in anti-clock wise rotation angular displacement is taken as positive.

17. $\omega_i=0\ rad\,s^{-1}$

$\omega_f=300\,rev/min=10\pi\,rads^{-1}$

$\alpha=\frac{\omega_f-\omega_i}{t}=\frac{10\pi}{10}\Rightarrow\alpha=3.14\,rads^{-2}$

18. $\omega=\frac{\theta}{t}=\frac{2\pi}{24}=\frac{\pi}{12}$

19. $\theta=\omega t=\frac{360\times 2\pi}{60}\times 1\Rightarrow\theta=12\pi$ radian

20. $\theta=\frac{2\pi}{T}=\frac{2\pi}{60\times 60}\Rightarrow\theta=\frac{2\pi}{3600}rads^{-1}$

21. $\theta=30^\circ=\frac{\pi}{6}rad$

$S=r\theta\Rightarrow S=r\times\frac{\pi}{6}$

22.

one revolution = 2π radiation

two revolution = 4π radiation

$S=r\theta$

$\theta=\frac{s}{r}=\frac{2\pi r}{r}\times 2$

$\theta=4\pi$

23. $\bar{v}$ and $\bar{\omega}$ always perpendicular to each other

24. $S=r\theta\Rightarrow\theta=\frac{S}{r}=\frac{14}{4}=3.5\,rad$

25. $v=r\omega$

26. $v=r\omega\Rightarrow r=\frac{v}{\omega}=\frac{81}{27}=3cm$

27. $S=r\theta$ $\qquad\theta=180^\circ$

$=1\times\pi$ $\qquad\theta=180^\circ\times\frac{\pi}{180^\circ}=\pi\,rad$

$=\pi m=3.14m$

28. $v=r\omega=2\times 8=16m/s$

29. Relation between linear and angular velocity in vector form is $\vec{v}=\vec{\omega}\times\vec{r}$

30. $\omega=\frac{v}{r}=\frac{2}{0.4}=5\,rads^{-1}$

31. $v=r\omega \quad \because r=\frac{R}{2}$

$=10\times10^{-2}\times20\Rightarrow v=2ms^{-1}$

32. $v=r\omega$

$\because \omega=\frac{2\pi}{60}\,rad\,s^{-1}$

$v=1cm\times\frac{2\pi}{60}=\frac{2\pi}{60}\,cm\,s^{-1}$

33. $\vec{v}=\vec{\omega}\times\vec{r}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 0 & 1 & 2\\ 3 & 4 & 0\end{vmatrix}=-8\hat{i}+6\hat{j}-3\hat{k}=-\left(8\hat{i}-6\hat{j}+3\hat{k}\right)$

34. $a_t=r\alpha$

Here a_t is tangential acceleration

35. $\omega=\frac{v}{r}=\frac{16}{2}=8\,rad\,s^{-1}$

36. $a_t=r\alpha \qquad \because r=\frac{d}{2}=\frac{2}{2}=1m$

$\alpha=\frac{a}{r}=\frac{8}{1}\Rightarrow\alpha=\frac{rad}{sec}=8\,rad/se^{-2}$

37. $v=r\omega\Rightarrow v=\frac{1}{2}\times\frac{30\times2\pi}{60}\Rightarrow v=\frac{\pi}{2}\,ms^{-1}$

38. For constant speed $\Delta v=0$, $\qquad a_t=\frac{\Delta v}{\Delta t}=0\Rightarrow a_c=\frac{v^2}{r}$

39. $W=Fd\cos\theta$

$\theta=90^\circ\Rightarrow W=Fd\cos90^\circ=0$

40. $v=36\frac{km}{h}=10\frac{m}{s}\therefore F=\frac{mv^2}{r}=\frac{500\times100}{50}=1000N.$

41. $a_c=r\omega^2=r\left(\frac{\theta}{t}\right)^2=0.4\times\left(\frac{2\pi}{1}\right)^2=0.4\times4\pi^2=1.6\pi^2ms^{-2}$

42. When centripetal force vanishes, objects move along straight path i.e along tangent to circle.

43. The mud's flies off the tyre of a fast-moving car in the direction tangent to the moving car.

44. Definition of centripetal force.

45. $\vec{F}=-mr\omega^2\hat{r}=-mr\omega^2(\frac{\vec{r}}{r})=-m\omega^2\vec{r}$

46. As we know, $\omega=\frac{2\pi}{T}$ Also, $v=r\omega=r(\frac{2\pi}{T})=\frac{2\pi r}{T}$, And,

$a_c=r\omega^2=r(\frac{2\pi}{T})^2=\frac{4\pi^2r}{T^2}$

47. When body revolve with uniform speed then a_t and α remain zero. Only centripetal acceleration presents in the body which is directed along the center of the circle.

48. A car is moving with high velocity when it has a turn. A force acts on it outwardly because of Centrifugal force

49. $F_c = \frac{mv^2}{r}$, So, $F_c \propto v^2$

If v increases to double then tendency to overturn will become four times

50. $F_c = mr\omega^2 = 5(1)(2)^2 = 20N$

51. Centripetal force is towards the centre of circle.

52. $F_c = \frac{mv^2}{r} = \frac{1000(40)^2}{100} = 1.6\times10^4 N$

53. $F_c = mr\omega^2$ here ω is constant

So, $F_c \propto r$

54. $F_c = mr\omega^2 = \frac{250}{1000}\times1\times\frac{4\pi^2}{60\times60}\times30\times30 \Rightarrow F_c = \frac{\pi^2}{4}N$

55. Radial force $= \frac{mv^2}{r} = \frac{m}{r}\left(\frac{p}{m}\right)^2 = \frac{p^2}{mr}$ [As $p = mv$]

56. $a_c = \frac{v^2}{r} = \omega^2 r = 4\pi^2 n^2 r = 4\pi^2\left(\frac{22}{44}\right)^2 \times 1 = \pi^2 m/s^2$ and its direction is always along the radius and towards the centre.

PAST PAPER MCQ'S

57. Definition of centripetal force.

58. $v = r\omega$

$= 2\times8 = 16 m/s$

59. $S = r\theta$ $\theta = 180^\circ$

$= 1\times\pi$ $\theta = 180^\circ\times\frac{\pi}{180^\circ} = \pi\,rad$

$= \pi m = 3.14m$

60. $\vec{v} = \vec{\omega}\times\vec{r} \Rightarrow \vec{v}\perp\vec{\omega}$

61.

$2\pi rad = 360^\circ$

$1^\circ = \frac{2\pi}{360} rad \Rightarrow 1^\circ = \frac{\pi}{180} rad$

62. $\vec{a}_c = \frac{v^2}{r}\vec{r}$

63. $2\alpha\theta = \omega_f^2 - \omega_i^2$

64. $\theta = \frac{S}{r} = \frac{3000}{D/2} = \frac{3000}{40/2} = \frac{3000}{20} = 150 rad$

65. $\omega=\frac{\theta}{t}=\frac{2\pi \text{ radian}}{24}:\ \omega(\text{earth})=\frac{\pi}{12}\text{rad/hr}$

66. $v=r\omega$

$r=\frac{v}{\omega}=\frac{81}{27}=3\text{cm}$

67. $\omega=\frac{\theta}{t}=\frac{2\pi}{60}=\frac{\pi}{30}\frac{\text{rad}}{\text{min}}$

68. For constant speed $\Delta v=0$

$a_t=r\alpha\Rightarrow\alpha=0$

$a_t=0\Rightarrow a_c=\frac{v^2}{r}$

69. $F=mr\omega^2,\ F'=mr\omega^2=F^2=mr(3\omega)^2=F'=9mr\omega^2=F'=9F$

70. $\theta=\omega t=3000rpm=3000rev/\min t=3000\times\frac{2\pi}{60}=50\times2\pi=100\pi$

71. $2\theta\alpha=\omega_f^2-\omega_i^2\ \because\omega_i=0$

$\theta=\frac{\omega_f^2}{2\alpha}=\frac{6^2}{2(2)}=\frac{36}{4}=9\text{ rad}$

72. $v=r\omega$

73. $S=r\theta$

$\theta=\frac{S}{r}=\frac{14}{4}=3.5\text{rad}$

74. $F_c=\frac{mv^2}{r}\Rightarrow F_c\propto v^2$

75. During circular motion for complete rotation displacement = zero and distance = 2 πr.

76. $360°=2\pi$ rad.

$1rad=\frac{360°}{2\pi}\Rightarrow1rad=57.3°$

77. Centripetal force does zero work.

78. $2\pi=360°=1rev$

$720°=\frac{1}{360}\times720=2rev$

79. Car moves in circular path due to frictional force between tyre and road.

80. $1\text{rad}=57.3°$

So, radian is used to measure large angles.

81. 24 hours = 360°

2 hours $=\frac{360}{24}\times2=30°$

82. Earth completes one revolution about its own axis in 24 hours.

83. $T=m(g-a)$

$\frac{3}{4}\cancel{m}g=\cancel{m}(g-a)$

$a=g-\frac{3}{4}g=\frac{4g-3g}{4}=\frac{g}{4}$

84. $\theta = \frac{3\pi}{2\pi} = \frac{3}{2}$

85. $t = \frac{\theta}{\omega} = \frac{2\pi}{3} = 2.1s$

86. At highest point in vertical circle $v_{min} = \sqrt{gr}$

87. Friction force between tyres and road provides necessary centripetal force.

88. $1° = 0.0174$ rad

89. $\omega = 400 \text{ rpm} = \frac{400 \times 2\pi}{6} = 41.9 \text{ rad s}^{-1}$

90. $T = mg - m\frac{v^2}{r} \quad \left(g = \frac{v^2}{r}\right)$

$= mg - mg = 0$

91. Book formula.

92. $\omega = \frac{\theta}{t} = \frac{2\pi}{24} = \frac{\pi}{12}$ rad/hr

93. Moment of inertia is scalar quantity.

94. $\omega' = 2\omega$

$F = mr\omega^2$

$F' = 4F$

95. Right hand rule.

96. $\frac{\omega_{min}}{\omega_{hour}} = \frac{\frac{2\pi}{60}}{\frac{2\pi}{12 \times 60}} = \frac{12}{1} = 12:1$

97. SI unit of centripetal force is N.

98. Minute hand in the clock moves with constant angular velocity.

99. Cyclist skid due to lack of required centripetal force.

100. According to relation $v = r\omega$

Disc is a rigid body. If a rigid body is rotating then ω is constant then v is different.

101. $a_c = r\omega^2 = r\left(\frac{2\pi}{T}\right)^2 = \frac{4\pi^2 r}{T^2}$

102. $\tau = \frac{\Delta L}{\Delta t} = \frac{720 - 0}{4} = 180Nm$

103. Information

104. Definition

105. $\omega = \frac{\theta}{t} = \frac{12 \times 2\pi rad}{4s} = 6\pi rads^{-2} = 6 \times 3.14 = 18.8 rads^{-2}$

106. Direction of centripetal acceleration is towards center of circle.

4 TOPIC

WAVES

PRACTICE EXERCISE

Q.1 A simple pendulum is attached to the roof of a lift. If the time period of oscillation, when the lift is stationary is T, then the frequency of oscillation when the lift falls freely, will be ________

A. Zero
B. T
C. 1/T
D. ∞

Q.2 The length of a simple pendulum executing simple harmonic motion is increased by 21%. The percentage increase in the time period of the pendulum of increased length is?

A. 50%
B. 21%
C. 30%
D. 10.5%

Q.3 If a simple pendulum oscillates with amplitude of 50mm and time period of 2s, then its maximum velocity is?

A. 0.10m/s
B. 0.16m/s
C. 0.24m/s
D. 0.32m/s

Q.4 A spring of force constant k is cut into two pieces, such that one piece is double the length of the other. Then the long piece will have a force constant of ________

A. (2/3) k
B. (3/2) k
C. 3k
D. 6k

Q.5 The phase difference between the acceleration of a particle executing simple harmonic motion and the instantaneous velocity is?

A. π
B. 0.707π
C. $\pi/2$
D. 2π

Q.6 A siren emitting sound of frequency 800Hz is going away from a static listener with a speed of 30m/s. Frequency of the sound to be heard by the listener is (Take velocity of sound as 330m/s).

A. 733.3Hz
B. 644.8Hz
C. 481.2Hz
D. 286.5Hz

Q.7 Lights can travel in a vacuum but not sound, because ________

A. Speed of sound is very slow than light
B. Light waves are electromagnetic in nature
C. Sound waves are electromagnetic in nature
D. Light waves are not electromagnetic in nature

Q.8 When sound travels from air to water, which parameter does not change?

A. Wavelength
B. Frequency
C. Velocity
D. Temperature

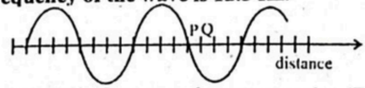
Q.9 A whistle giving out 450Hz approaches a stationary observer at a speed of 33m/s. The frequency heard by the observer in Hz is (speed of sound = 330m/s).

A. 409
B. 429
C. 517
D. 500

Q.10 A boat at anchor is rocked by waves, whose crests are 100m apart and velocity is 25m/s. The boat bounces up once in every ________

A. 2500s
B. 75s
C. 4s
D. 0.25s

Q.11 **The diagram shows a transverse wave at a particular instant. The wave is traveling to the right. The frequency of the wave is 12.5 Hz.**



At the instant shown the displacement is zero at point 'P'. What is shortest time to elapse before the displacement is zero at point 'Q'?

A. 0.01 s B. 0.03 s
C. 0.08 s D. 0.10 s

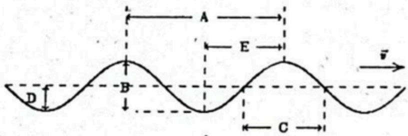
Q.12 **In a transverse wave the distance between a crest and a trough is equal to**

A. $\frac{\lambda}{2}$ B. $\frac{\lambda}{4}$
C. λ D. 2λ

Q.13 **If a wave travelling at a speed of 130 m/s and has a wavelength of 5m. Then find out the frequency of the wave?**

A. 650 Hz B. 3.8×10^2 Hz
C. 20 Hz D. 26 Hz

Q.14 **A sinusoidal wave is traveling toward the right as shown. Which letter correctly labels the amplitude of the wave?**



A. A B. B
C. D D. C

Q.15 **The sound of lightning flash is heard 3 second after the flash is seen. The distance of the lightning is 1020 metre. The speed of sound is:**

A. 340 m/s B. 1400 m/s
C. 332 m/s D. none of these

Q.16 **When water waves pass from deep water into shallow water how do the frequency, wave length and speed change**

Frequency	Wavelength	Speed
A. Increases	Decreases	No change
B. No change	Increases	Increases
C. No change	Decreases	Decreases
D. None of these		

Q.17 **Which of the following waves can be transmitted through solids, liquids and gases?**

A. Transverse waves B. Mechanical waves
C. Electromagnetic waves D. Longitudinal waves

Q.18 **If two sound waves having a phase difference of 60°, then they will have a path difference of**

A. $\frac{\lambda}{6}$ B. λ
C. $\lambda/3$ D. 3λ

Q.19 **All the points above the mean position in a rope**

A. Crest B. Trough
C. Compression D. Rarefaction

Q.20 The distance between consecutive compression and rarefaction in a spring

A. λ
B. 2λ
C. $\lambda/2$
D. $\lambda/4$

Q.21 Velocity of sound in vacuum is:

A. 332 ms^{-1}
B. Zero
C. 320 ms^{-1}
D. 224 ms^{-1}

Q.22 Increase in velocity of sound in the air for 1°C rise in temperature is:

A. 1.61 ms^{-1}
B. 0.61 ms^{-1}
C. 61.0 ms^{-1}
D. 2.00ms^{-1}

Q.23 The velocity of sound in air would become double than its velocity at 0°C at temperature:

A. 313°C
B. 819°C
C. 586°C
D. 1172°C

Q.24 Laplace found that the alternate compressions and rarefactions produced in sound waves follow:

A. Isothermal law
B. Isochoric law
C. Adiabatic law
D. All of the above

Q.25 What is added when two waves superimpose?

A. Amplitude
B. Wavelength
C. Velocities
D. None of these

Q.26 Which parameter get affected after superposition?

A. Amplitude
B. Wavelength
C. Frequency
D. Direction

Q.27 The frequency of the first harmonic of a string stretched between two points is 100 Hz. The frequency of the third overtone is

A. 200 Hz
B. 400 Hz
C. 300 Hz
D. 600 Hz

Q.28 "Stationary waves" are so called because in them

A. The particles of the medium are not disturbed
B. There occurs no flow of energy along the wave
C. The particles of the medium do not execute SHM
D. The interference effect can't be observed

Q.29 The frequency of the nth mode of vibration of a string stretched by a tension T and having mass m and length is given by

A. $f_n = \frac{n}{2}\sqrt{\frac{T}{m\ell}}$
B. $f_n = \frac{n}{2\ell}\sqrt{\frac{T}{m}}$
C. $f_n = \frac{n}{2}\sqrt{\frac{\ell T}{m}}$
D. $f_n = \frac{n}{2}\sqrt{\frac{T}{m}}$

Q.30 If the string vibrates in 'n' loops, the wavelength is given by

A. $\lambda_n = \frac{2}{nl}$
B. $\lambda_n = \frac{l}{2n}$
C. $\lambda_n = \frac{2l}{n}$
D. None of these

Q.31 If the successive overtones of a vibrating string clamped at its ends are 280 Hz and 350 Hz, the frequency of fundamental is:

A. 350 Hz
B. 140 Hz
C. 280 Hz
D. 70 Hz

Q.32 If the number of loops of a stationary wave are increasing, then

A. λ increases
B. λ remains same
C. λ decreases
D. λ may increase or decrease

Q.33 A string of length 2m fixed between two supports vibrates in two loops. The distance between node and antinode is:

A. 50 cm
B. 100 cm
C. 200 cm
D. 10 cm

Q.34 The distance between two particles in a wave motion in the same phase is

A. $\frac{\lambda}{4}$
B. $\frac{\lambda}{2}$
C. $\frac{3\lambda}{4}$
D. λ

Q.35 The phase between two consecutive antinodes is:

A. $\frac{\pi}{4}$
B. $\frac{\pi}{2}$
C. π
D. 2π

Q.36 When the string vibrates in three loops then the length 'l' of the string is expressed as

A. $l=\frac{3\lambda}{4}$
B. $l=\frac{3\lambda}{2}$
C. $l=\frac{\lambda}{2}$
D. $l=\frac{2\lambda}{3}$

Q.37 Consider a stretched string under tension and fixed at both ends. If the tension is doubled and the cross-sectional area halved, then the frequency becomes

A. Twice
B. Half
C. Four times
D. Eight times

Q.38 When the antinodes are all at their extreme displacements, the energy stored is

A. K.E
B. P.E
C. Thermal energy
D. All of these

Q.39 When an observer moves towards source with a velocity u_o, then the modified frequency 'f_A' becomes

A. $f_A = f(v-u_o)$
B. $f_A = f\left(\frac{v+u_o}{v}\right)$
C. $f_A = \left(\frac{v+u_o}{2}\right)f$
D. $f_A = \left(\frac{V-u_o}{V}\right)f$

Q.40 Doppler's effect is not applicable for:

A. Microwaves
B. Ultrasonic
C. Electromagnetic waves
D. Standing waves

Q.41 Doppler shift in frequency does not depend upon

A. The actual frequency of the wave
B. The velocity of the source
C. The distance of the source from the listener
D. The velocity of the observer

Q.42 The source is moving towards a stationary observer then the pitch of the sound will

A. Sometimes increases and sometimes decreases
B. Decrease
C. Remains constant
D. Increase

Q.43 **The apparent frequency of the whistle of an engine changes in the ratio 6:5 as engine passes a stationary observer. If the speed of sound is 352 m/s. Then the speed of engine will be**

A. 22 m/s
B. 27 m/s
C. 32 m/s
D. 36 m/s

Q.44 **A source of sound moves towards a stationary observer with a speed one third that of sound. If the frequency of the sound from the source is 100 Hz, the apparent frequency of the sound heard by the observer is**

A. 67 Hz
B. 100 Hz
C. 150 Hz
D. 75 Hz

Q.45 **If a Radar system designed in accordance with the Doppler's effect, if an airplane is moving away from a Radar, the wavelength of the reflected wave from the air plane would be:**

A. Smaller than the transmitting wave
B. Same as that of the transmitting wave
C. Larger than the transmitting wave
D. Either smaller or larger than the transmitting wave

Q.46 **Stars moving towards earth shows**

A. Blue shift
B. Red shift
C. No shift
D. May be 'A' may be 'B' depending upon speed of stars

Q.47 **Bats navigate and find food by**

A. Ultrasonic
B. Echo location
C. Amplitude
D. Refraction

Q.48 **Which one of the following explains that all the galaxies are receding from us?**

A. White shift
B. Black holes
C. Neutrons stars
D. Red shift

Q.49 **A whistle giving out 450Hz approaches a stationary observer at a speed of 33m/s. The frequency heard by the observer in Hz is (speed of sound = 330m/s).**

A. 409
B. 517
C. 429
D. 500

Q.50 **The source of sound generating of a frequency of 3 kHz reaches an observer with a speed of 0.5 times the velocity of sound in air. The frequency heard by the observer is?**

A. 1 kHz
B. 4 kHz
C. 3 kHz
D. 6 kHz

Q.51 **A whistle producing sound waves of frequencies 9500 Hz and it is approaching a stationary person with speed v ms^{-1}. The velocity of sound in air is 300 ms^{-1}. If the person can hear frequencies upto a maximum of 10,000 Hz, the maximum value of v upto which he can hear the whistle is**

A. 30 m s^{-1}
B. 10 m s^{-1}
C. 15 m s^{-1}
D. 20 m s^{-1}

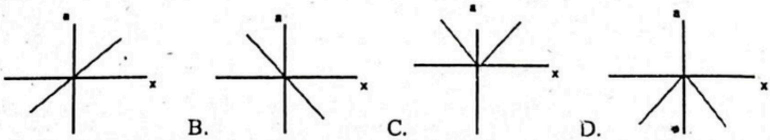
Q.52 **Total distance traveled by vibrating body in one vibration is equal to:**

A. A
B. 4A
C. 2A
D. Zero

Q.53 A particle oscillating in simple harmonic motion is:

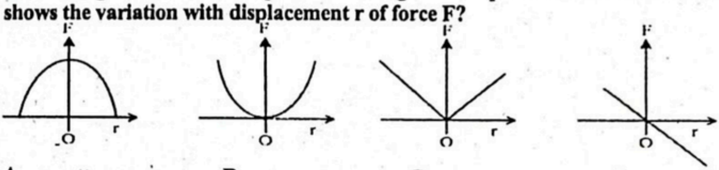
A. Never in equilibrium because there is always a force
B. In equilibrium at the center of its path because the acceleration is zero there
C. Never in equilibrium because it is in motion
D. In equilibrium at the ends of its path because its velocity is zero there

Q.54 Which one is the correct graph between acceleration 'a' and displacement 'x' for SHM?



A. B. C. D.

Q.55 A restoring force F acts on a particle moving with simple harmonic motion. Which graph shows the variation with displacement r of force F?



A. B. C. D.

Q.56 The distance covered by a body in one complete vibration is 20 cm. What is the amplitude of body?

A. 10 cm
B. 15 cm
C. 5 cm
D. 7.5 cm

Q.57 A body moves with simple harmonic motion and makes n-complete oscillations in one second. What is its angular frequency?

A. $n\, rad\, s^{-1}$
B. $\frac{1}{n} rad\, s^{-1}$
C. $2\pi n\, rad\, s^{-1}$
D. $\frac{2\pi}{n} rad\, s^{-1}$

Q.58 The SI unit of force constant is identical with that of

A. Force
B. Surface tension
C. Pressure
D. Loudness

Q.59 A mass of 0.5 kg is suspended from a spring. The spring is stretched by 0.0980m. Its spring constant will be

A. 1 Nm^{-1}
B. 5 Nm^{-1}
C. 50 Nm^{-1}
D. 0.5 Nm^{-1}

Q.60 Which of the following is a necessary and sufficient condition for S.H.M.?

A. Proportionality between acceleration and displacement from equilibrium position
B. Constant acceleration
C. Proportionality between restoring force and displacement from equilibrium position
D. Constant period

4 Topic

WAVES

PAST PAPER MCQ'S

Q.61 A standing wave pattern is formed when the length of string is an integral multiple of_________ wavelength. (MCAT 2008)

A. Triple
B. Half
C. Full
D. Double

Q.62 Transverse waves cannot be setup in _________ (MCAT 2008)

A. Metals
B. Fluids
C. Solids
D. Soil

Q.63 Speed of the waves is equal to: (MCAT 2009)

A. $f\lambda$
B. λ/T
C. Both A and B
D. λT

Q.64 What is it that we use to calculate the speeds of distant stars and galaxies? (MCAT 2009)

A. Doppler Effect
B. Beats
C. Interference
D. All of the above

Q.65 Speed of light, radio waves and microwaves in vacuum is: (MCAT 2009)

A. $3 \times 10^5\ ms^{-1}$
B. $3 \times 10^6\ ms^{-1}$
C. $3 \times 10^3\ ms^{-1}$
D. $3 \times 10^8\ ms^{-1}$

Q.66 An organ pipe closed at one end has a length of 25 cm. Wavelength of the fundamental note is (MCAT 2010)

A. 25 cm
B. 100 cm
C. 50 cm
D. 75 cm

Q.67 Two waves of same amplitude are traveling in the same direction and are out of phase, their resultant wave is: (MCAT 2010)

A. Zero
B. Equal to sum of their amplitudes
C. Equal to difference of their amplitudes
D. Equal to half of their amplitude

Q.68 The spectrum of a star's light is measured and the wavelength of one of the lines as the sodium's line is found to be 589 nm. The same line has the wavelength of 497 nm when observed in the laboratory. This means the star is (MCAT 2011)

A. Moving away from the earth
B. Stationary
C. Moving towards the north
D. Revolving around the planet

Q.69 When the source of sound moves towards the stationary observer, the value of apparent frequency 'f_o' is: (MCAT 2012)

A. $f_o = \left(\dfrac{v+u}{v}\right)f$
B. $f_o = \left(\dfrac{v}{v+u_2}\right)f$
C. $f_o = \left(\dfrac{v}{v-u}\right)f$
D. $f_o = \left(\dfrac{v-u}{v}\right)f$

Q.70 The displacement 'x' of a particle at time 't' is given by x= 10 sin 4t the particle oscillates with period. (ETEA 2014)

A. $\pi/10$s
B. $\pi/5$s
C. $\pi/4$s
D. $\pi/2$s

Q.71 In a vibrating cord the point where the particles are stationary is called (ETEA 2014)

A. Crest
B. Anti-node
C. Node
D. Trough

Q.72 An observer moves with velocity 'u_o' toward a stationary source, then the number waves received in one second is (MCAT 2015)

A. $f' = f\left(\frac{v}{v+u_o}\right)$ B. $f' = f\left(\frac{v+u_o}{v}\right)$

C. $f' = f\left(\frac{v}{v-u_o}\right)$ D. $f' = f\left(\frac{v-u_o}{v}\right)$

Q.73 The ratio between the velocity of sound in air at 4 atm and that at 3 atm pressure would be: (ETEA 2015)

A. 1 : 1 B. 4 : 1

C. 1 : 4 D. 3 : 1

Q.74 The red shift measurement of Doppler effect of galaxies indicate that the universe is (MDCAT 2016)

A. Expanding B. Stationary

C. Contracting D. Oscillating

Q.75 In stationary wave (ETEA 2016)

A. There is not transfer of energy B. Energy is constant at all points

C. Phase is the same for al points D. Both 'A' & 'B'

Q.76 If a wave travelling at a speed of 130 m/s and has a wavelength of 5m. Then find out the frequency of the wave? (MDCAT 2017)

A. 650 Hz B. 3.8×10^2 Hz

C. 20 Hz D. 26 Hz

Q.77 A metallic wire of 2m length hooked between two points has tension of 10N. If mass per unit length of wire is 0.004 kg/s then fundamental frequency emitted by wire on vibration is: (MDCAT 2017)

A. 12.5 Hz B. 24 Hz

C. 48 Hz D. 6.25 Hz

Q.78 A source of sound moves towards a stationary observer with speed one third speed of sound. If the frequency of the sound from the source is 100 Hz, the apparent frequency of the sound heard by the observer is: (MDCAT 2017)

A. 60 Hz B. 200 Hz

C. 100 Hz D. 150 Hz

Q.79 In a stationary wave the distance between consecutive antinodes is 25 cm. If the wave velocity is 300 ms^{-1} then the frequency of the wave will be: (ETEA 2017)

A. 150 Hz B. 300 Hz

C. 600 Hz D. 750 Hz

Q.80 The speed of sound in air at NTP is 300m/s. If the air pressure become 4 times then the speed of the sound will be (ETEA 2017)

A. 150m/s B. 300m/s

C. 600m/s D. None

Q.81 Standing waves are produced in 10m long stretched string. If the string vibrates in 5 segments and wave velocity is $20ms^{-1}$. Its frequency is: (ETEA 2017)

A. 2 Hz B. 4 Hz

C. 5 Hz D. 10 Hz

Q.82 A shock wave is produced due to an earthquake which makes the building move in the direction of the shock wave. Which progressive wave would this be? (MDCAT 2018)

A. Longitudinal wave B. Material wave

C. Transverse wave D. Particle wave

Q.83 Which one of the following varies when an object execute simple harmonic motion? (ETEA 2018)

A. Angular frequency
B. Total energy
C. Force
D. Amplitude

Q.84 Which one of the following is not a characteristic of stationary wave? (ETEA 2018)

A. Half wavelength is half the distance between the adjacent nodes
B. Amplitude is not the same
C. Phase is identical between two adjacent nodes
D. Energy of the stationary waves travels outwards

Q.85 The wavelength of the electromagnetic wave having frequency of 3 kHz will be? (MDCAT 2019)

A. 80 km
B. 100 km
C. 140 km
D. 120 km

Q.86 What will be the expression for the observed frequency, if the source is moving towards the observer? (MDCAT 2019)

A. $f_o = \left(\frac{v}{v-u_s}\right)f$
B. $f_o = \left(\frac{v}{v \pm u_s}\right)f$
C. $f_o = \left(\frac{v}{v+u_s}\right)f$
D. $f = \left(\frac{v}{v-u_s}\right)f_o$

Q.87 The speed of sound in air is 332 m/s. The speed of sound at 22 °C will be: (NMDCAT 2020)

A. 345.2m/s
B. 340 m/s
C. 350m/s
D. 330 m/s

Q.88 Astronomers calculate speed of distant stars and galaxies using which of the following phenomena? (NMDCAT 2020)

A. Beats
B. Interference
C. Superposition principle
D. Doppler effect

Q.89 In a ripple tank, 40 waves pass through a certain point in 1 second. If the wavelength of the wave is 5cm. then speed of the wave is: (NMDCAT 2020)

A. $0.5\ ms^{-1}$
B. $1\ ms^{-1}$
C. $1.5\ ms^{-1}$
D. $2\ ms^{-1}$

Q.90 Trough of a wave acts as: (NUMS 2020)

A. Concave lens
B. Convex lens
C. Convex mirror
D. Plane mirror

Q.91 Doppler's effect shows? (NMDCAT 2021)

A. Change in frequency due to relative motion between source and observer
B. Change in amplitude due to relative motion between source and observer
C. Change in frequency due to motion of source only
D. Change in frequency due to motion of observer only

Q.92 Distance Between two Consecutive node is (NMDCAT 2021)

A. Wave length
B. Wave length by 2
C. Wave length by 4
D. twice of Wave length

Q.93 Stationary waves (NMDCAT 2021)

A. Move forward
B. Move backwards
C. Don't Move
D. Move in both direction

Q.94 Crest and trough are found in? (NMDCAT 2021)

A. Transvers wave
B. Longitudinal wave
C. Progressive wave
D. None

Q.95 Ratio of fundamental frequency of Open Organ pipe to closed organ pipe is (NMDCAT 2021)

A. 1 : 2 B. 2 : 1
C. 1 : 4 D. 4 : 1

Q.96 A whistler with velocity 33 ms^{-1} approaches towards a stationary observer with frequency 450Hz what is the apparent frequency heard by the observer: (NMDCAT 2021)

A. 500 B. 400
C. 430 D. 450

Q.97 Ripple tank is used to study features of (NMDCAT 2021)

A. Particle B. Wave
C. Light D. Solid

Q.98 Waves which deal with fast moving elementary particle (NMDCAT 2021)

A. Transverse Waves B. Longitudinal waves
C. Matter waves D. Periodic waves

Q.99 Infrasonic wave has frequency (NMDCAT 2021)

A. Less than 20Hz B. Greater than 20Hz
C. 20Hz D. Greater than 20 kHz

Q.100 A long spring, when stretched by a distance x, has potential energy V. On increasing the stretching to nx, the potential energy of the spring will be: (UHS 2022)

A. nV B. n^2V
C. V/n D. V/n^2

Q.101 Which of the following increases by increasing amplitude? (UHS 2022)

A. Wavelength B. Zero
C. Frequency D. Loudness

Q.102 An airplane travels at a speed of 0.5v is the speed of sound. The airplane approaches a stationary observer. The frequency of sound emitted by the aircraft is 200 Hz. Which frequency does the observer hear? (UHS 2022)

A. 400 Hz B. 100 Hz
C. 120 Hz D. 180 Hz

Q.103 If the wavelength of light coming from a galaxy shifts towards the red end of spectrum, then galaxy is: (UHS 2022)

A. Approaching Earth B. Receding the Earth
C. Stationary D. Approaching Earth or is stationary

Q.104 The shortest distance between any two points in phase on a wave is called: (UHS+BMU 2022)

A. Displacement B. Amplitude
C. Wavelength D. Frequency

Q.105 When will the oscillations stop in the absence of resistive forces? (UHS 2022)

A. Never B. After 10 minutes
C. In 10 minutes D. Immediately

Q.106 The mechanical waves are not by: (UHS 2022)

A. Electric and magnetic fields B. Coil of springs
C. Ropes D. Water

Q.107 Reducing mass M of a suspending body to one fourth will change the frequency of oscillations be: **(UHS 2022)**

A. One fourth
B. Double
C. Quadrupled
D. Half

Q.108 A distance star is receding from Earth with a speed of $1.40 \times 10^7 ms^{-1}$. It emits light of frequency 4.57×10^{14}Hz. The speed of light is $3.0 \times 10^8 ms^{-1}$. The Doppler effect formula can be used with light waves. What will be the frequency of this light when detected on Earth? **(UHS 2022)**

A. 2.04×10^{13}Hz
B. 4.37×10^{14}Hz
C. 4.57×10^{14}Hz
D. 4.79×10^{14}Hz

Q.109 Wavelength of wave is defined as: **(SZABMU 2022)**

A. Distance between two consecutive crests
B. Distance between two alternate crests
C. Distance between two alternate troughs
D. Distance between two crest and two troughs

Q.110 Which of the following factor does not affect the speed of sound in air? **(SZABMU 2022)**

A. Pressure
B. Density
C. Temperature
D. Medium

Q.111 Maximum displacement of particles from its mean position is called: **(SZABMU 2022)**

A. Frequency
B. Amplitude
C. Wavelength
D. Crest

Q.112 The ultrasonic waves have frequency higher than: **(SZABMU 2022)**

A. 20 Hz
B. 20 kHz
C. 200 Hz
D. 2000 kHz

Q.113 The increase in the speed of sound for each degree rise above 0°C is: **(SZABMU 2022)**

A. $0.61 ms^{-1}$
B. $0.51 ms^{-1}$
C. $0.41 ms^{-1}$
D. $0.31 ms^{-1}$

Q.114 Continuous, regular and rhythmic disturbance in a medium resulting periodic vibration of a source causes________ in the medium. **(SZABMU 2022)**

A. Complex waves
B. Stationary waves
C. Electromagnetic waves
D. Periodic waves

Q.115 The energy of simple harmonic oscillator at a displacement "x" is partly kinetic and partly potential. The total energy of a simple harmonic oscillation remains constant everywhere. Which one of the following options will be correct about the simple harmonic oscillator? **(ETEA 2022)**

A. Kinetic energy is maximum at extreme position
B. Potential energy is maximum at extreme position
C. Both kinetic and potential energies are minimum at mean position
D. Potential energy is maximum at mean position

Q.116 The speed of a wave on a particular string is $24ms^{-1}$. If the string is 6.0m long, to what driving frequencies will it resonate? **(ETEA 2022)**

A. 1 Hz, 2Hz, 3Hz
B. 2 Hz, 4Hz, 6Hz
C. 3 Hz, 6Hz, 9 Hz
D. 5 Hz, 10Hz, 15Hz

Q.117 The apparent change in the frequency of sound caused by the relative motion of either the source of sound or listener or both is called **(ETEA 2022)**

A. Compton effect
B. Zeeman effect
C. Stark effect
D. Doppler effect

Q.118 The time period of a simple pendulum with mass m is T. When the pendulum's mass m is replaced by another ball of mass 3 times the older mass such that the length of pendulum is not changed then its new time period will be: **(ETEA 2022)**

A. T
B. 3T
C. T/3
D. 2T

Q.119 The velocity of a wave is v, its time period is T and f is its frequency. Then the correct equation for frequency is: **(ETEA 2022)**

A. $T = v f$
B. $1f = v + T$
C. $1f = 1/T$
D. $T = v/T$

Q.120 Two transverse travelling waves are presented by these equations $y_1 = A_o \sin(kx - \omega t)$ and $y_2 = A_o \sin(kx - \omega t - \phi)$. These two waves differ in: **(DUHS 2022)**

A. Amplitude
B. Frequency
C. Wavelength
D. Phase
E. Directional of propagation

Q.121 The intensity level (sound level) of faintest audible intensity is: **(DUHS 2022)**

A. 160 decibel
B. 0 decibel
C. 140 decibel
D. 120 decibel
E. 60 decibel

Q.122 A sound waves travels from one medium to another, which one of the following characteristics of sound remain unchanged? **(DUHS 2022)**

A. Amplitude
B. Velocity
C. Pitch
D. Quality
E. Wavelength

Q.123 Distance between two consecutive antinodes in standing wave is **(DUHS 2022)**

A. $\frac{\lambda}{4}$
B. λ
C. 2λ
D. $\frac{\lambda}{2}$
E. $\frac{3\lambda}{2}$

Q.124 If the given spring of spring constant K is cut into three identical segments the spring constant of each segment is: **(DUHS 2022)**

A. 1K
B. K/2
C. K/3
D. 3K
E. 4K

Q.125 The most appropriate mathematical expression representing simple harmonic motion is: **(DUHS 2022)**

A. $a \propto x$
B. $a \propto -x$
C. $a = x$
D. $a = k\,x$
E. $a = -x$

Q.126 An object moving faster than the speed of sound. This object is called: **(DUHS 2022)**

A. Sonic
B. Supersonic
C. Hypersonic
D. Ultrasonic
E. Infrasonic

Q.127 The horizontal distance travelled by wave during one complete cycle is called **(NUMS 2022)**

A. Frequency
B. Wavelength
C. Amplitude
D. Time period

Q.128 If the period of oscillation of mass (M) a suspended from a spring is 1s, then the period of 16M will be: **(NUMS 2022)**

A. 1s
B. 2s
C. 3s
D. 4s

Q.129 Loudness of the sound is directly related to **(NUMS 2022)**

A. Intensity of sound
B. Frequency of sound
C. Wavelength of sound
D. Pitch of sound

Q.130 The increase in the speed of sound in air for reach rise above 0°C is: **(NUMS 2022)**

A. 0.41 m/s
B. 0.51 m/s
C. 0.81 m/s
D. 0.61 m/s

Q.131 Crest of a wave acts as: **(NUMS 2022)**

A. Concave lens
B. Convex lens
C. Convex mirror
D. Plane mirror

Q.132 The speed of sound in air does not depend on: **(NUMS 2022)**

A. Density of medium
B. Pressure
C. Temperature
D. Plane mirror

ANSWER KEY

PRACTICE EXERCISE

1	A	16	C	31	D	46	A
2	D	17	D	32	C	47	B
3	B	18	A	33	A	48	D
4	B	19	A	34	D	49	D
5	C	20	A	35	C	50	D
6	A	21	B	36	B	51	C
7	B	22	B	37	A	52	B
8	B	23	B	38	B	53	B
9	D	24	C	39	B	54	B
10	C	25	A	40	D	55	D
11	A	26	A	41	C	56	C
12	A	27	B	42	D	57	C
13	D	28	B	43	C	58	B
14	C	29	B	44	C	59	C
15	A	30	C	45	C	60	A

PAST PAPER MCQ'S

61	B	76	D	91	A	106	A	121	B
62	B	77	A	92	B	107	B	122	C
63	C	78	D	93	C	108	B	123	D
64	A	79	C	94	A	109	A	124	D
65	D	80	B	95	B	110	A	125	B
66	B	81	C	96	A	111	B	126	B
67	A	82	A	97	B	112	B	127	B
68	A	83	C	98	C	113	A	128	D
69	C	84	D	99	A	114	D	129	A
70	D	85	B	100	B	115	B	130	D
71	C	86	A	101	D	116	B	131	B
72	B	87	A	102	A	117	D	132	B
73	A	88	D	103	B	118	A		
74	A	89	D	104	C	119	C		
75	A	90	A	105	A	120	D		

EXPLANATORY NOTES

PRACTICE EXERCISE

1. In a freely falling lift, $g = 0$

$f = 1/2\pi \times \sqrt{\frac{g}{\ell}} = 1/2\pi \times \sqrt{\frac{0}{\ell}} = 0.$

2. $\%\text{age increase in } T = \left(\sqrt{1+\%\text{age increase in } \ell} - 1\right) \times 100$

$\%\text{age increase in } T = \left(\sqrt{1+\frac{21}{100}} - 1\right) \times 100$

$\%\text{age increase in } T = \left(\sqrt{\frac{121}{100}} - 1\right) \times 100 = 10\%$

3. $v_{max} = \omega A = 2\pi/T \times A$

$v_{max} = (2 \times 3.14 \times 0.05)/2 = 0.16 m/s.$

4. Force constant, $k = F/x$

The length of the long piece is $2x/3$

So, its force constant is

$k' = F/(2x/3) = 3F/2x = 3/2 \times k.$

5. The phase difference between the instantaneous velocity and acceleration of a particle executing simple harmonic motion is $\pi/2$.

6. $f' = v/(v + v_s) \times f = 330/(330 + 30) \times 800 = 733.3$ Hz.

7. Light can travel in a vacuum because light waves are electromagnetic in nature.

8. Frequency remains unchanged when sound travels from air to water.

9. $f' = v/(v - v_s) \times f$

$f' = 330/(330-33) \times 450 = 500$Hz.

10. $\lambda = 100$ m, $v = 25$ m/s

$T = \lambda / v = 100/25 = 4$s.

11. $T = \frac{1}{12.5} = 0.08s$

for shortest time $= \frac{0.08}{8} = 0.01s$

12. Distance between two consecutive crests = λ

Distance between consecutive crests and trough = $\frac{\lambda}{2}$

13. $v = f\lambda \Rightarrow f = \frac{v}{\lambda} = \frac{130}{5} = 26Hz$

14. Maximum displacement from mean position

15. Speed $= \frac{\text{distance}}{\text{time}}$

$= \frac{1020}{3} = 340 ms^{-1}$

16. Frequency does not depend upon nature of material.
17. Longitudinal waves can be transmitted through all the three types of media
18. $\Delta\varphi = 60° = \pi/3$

$\Delta x = \lambda/2\pi \times \Delta\varphi = \frac{\lambda}{2\pi} \times \frac{\pi}{3} = \frac{\lambda}{6}$

19. Wave characteristics.
20. Wave characteristics.
21. (Because speed of sound depends on medium).
22. $v_t = v_o + 0.61t$

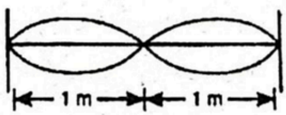
So 1°C rise in temperature, velocity increases to 0.61 m/s.

23. $\frac{v_1}{v_o} = \sqrt{\frac{T}{273}} \Rightarrow 2\frac{v_o}{v_o} = \sqrt{\frac{T}{273}}$

$4 = \frac{T}{273}$

$T = 1092K = 1092 - 273 = 819C°$

24. According to Laplace, compression & rarefactions of sound waves follow adiabatic law.
25. When two waves super impose, amplitude is added.
26. After super position, amplitude is added.
27. Third over tone mean fourth harmonic $f_4 = 4f_1$
28. Energy in a wave moves because of the motion of particle of the medium. The node always remains at rest so energy cannot flow past these point.
29. $f_n = \frac{n}{2\ell}\sqrt{\frac{T}{m}}$
30. $\lambda_n = \frac{2\ell}{n}$
31. $f' = f_2 - f_1$
32. $\lambda_n = \frac{2\ell}{n} \Rightarrow \lambda_n \propto \frac{1}{n}$
33. $\frac{\lambda}{2} = 1 \Rightarrow \lambda = 2\,\text{metre}$



Distance between nearest node and antinode is

$\frac{\lambda}{4} = \frac{2}{4} = 0.5\,\text{m} = 50\,\text{cm}$

34. Phase difference between two in phase points is $\lambda, 2\lambda, 3\lambda, ...$
35. Distance between two consecutive antinodes is $\frac{\lambda}{2} = x$ and phase different

$= \frac{2\pi x}{\lambda} = \frac{2\pi}{\lambda} \cdot \frac{\lambda}{2} = \pi$

36. $\lambda_n = \frac{2\ell}{n} \Rightarrow n = 3 \Rightarrow \lambda = \frac{2\ell}{3} \Rightarrow \ell = \frac{3\lambda}{2}$

37. $f = \frac{1}{2l}\sqrt{\frac{T}{m}}$ where $m = \frac{\rho V}{l} = \frac{\rho(Al)}{l} = \rho A$

So, $f \propto \sqrt{\frac{T}{A}}$ and $f' \propto \sqrt{\frac{2T}{\frac{A}{2}}} \Rightarrow \frac{f'}{f} = 2$ OR $f' = 2f$

38. At extreme point energy stored is P.E.

39. $f_A = \left(\frac{v + u_o}{v}\right) f$

40. Doppler's effect is applicable on light and sound waves.

41. Doppler shift in frequency does not depend upon distance of the source from listener.

42. As source is moving towards stationary observe.

$\because f' = \frac{v}{v - \upsilon_s} f \Rightarrow f' > f$ so pitch will increase.

43. $\frac{f'}{f''} = \frac{v+u}{v-u} = \frac{352+u}{352-u} = \frac{6}{5}$

$5(352+u) = 6(352-u)$

$1760 + 5u = 2112 - 6u$

$11u = 352 \Rightarrow u = 32\,\text{ms}^{-1}$

44. $f_A = \left(\frac{v}{v - u_s}\right) f \Rightarrow f_A = \left(\frac{v}{v - \frac{v}{3}}\right) 100 \Rightarrow f_A = \frac{3}{2} \times 100 = 150\,\text{Hz}$

45. Source is moving away from observer so apparent frequency decreases and wavelength increases.

46. When star is moving towards earth, according to Doppler's shift wavelength decreases, as blue light has smaller wavelength so blue shift appears.

47. Bats use echolocation to navigate and find food in the dark. To echolocate, bats sends out sound waves from their mouth or nose. When sound waves hit an object they produce echoes. Bats use this, to avoid flying into objects.

48. When galaxies or stars are receding from us its emitted light wavelength increase. So last colour of spectrum is red.

49. $f' = v/(v - v_s) \times f$

$f' = 330/(330 - 33) \times 450 = 500\text{Hz}$

50. $f' = v/(v - v_s) \times f = v/(v - 0.5v) \times 3\text{kHz} = 6\text{kHz}$

51. $f_A = \left(\frac{v}{v-u_s}\right)f$

$10,000 = \left(\frac{300}{300-v}\right)9500$

$v = 15ms^{-1}$

52. Total distance in one vibration =4A as A+A+A+A=4A in complete vibration
53. At center of its path, no net force acts on it
54. $a \propto -x$, So graph lies in 2nd and 4th quadrant.
55. $F \propto -x$
56. $S = \frac{20}{4} = 5cm$
57. $\omega = 2\pi f$ $\quad \because f = n$

$\omega = 2\pi n \frac{rad}{s}$

58. $F = kx \Rightarrow k = \frac{F}{x} = Nm^{-1}$ is same as that of surface tension.
59. As, $F = kx$

$k = \frac{F}{x} = \frac{mg}{x} \quad \because F = w = mg$

$= \frac{0.5 \times 9.8}{0.0980} = 50Nm^{-1}$

60. Characteristic of SHM

PAST PAPER MCQ'S

61. A standing wave pattern is formed when length of string is an integral multiple of half wavelength e.g, $\ell_n = n\frac{\lambda_n}{2}$ here $n = 1,2,3,.........$
62. Transverse waves cannot be set up in fluids, because they required rigidity of material.
63. $v = \frac{\lambda}{T} = f\lambda$
64. We use Doppler's effect to calculate speed of distant stars and galaxies.
65. Radio waves and microwaves in vacuum travels with speed of light ($3\times10^8ms^{-1}$)
66. $\lambda = \frac{4\ell}{n} = \frac{4\times25cm}{1} = 100cm$
67. When two waves are out of phase superpose of same amplitude their resultant will be zero.
68. $\lambda' = 589nm$, $\lambda = 497nm$

$\lambda' > \lambda$ so star is moving away from earth.

69. When source move towards stationary observer $f_o = \left(\frac{v}{v-u}\right)f$.

70. $2\pi f = 4$

$\frac{2\pi}{T} = 4 \to T = \frac{\pi}{2}$ sec

71. Definition.

72. When observer moves toward stationary source $f' = f\left(\frac{v+u_o}{v}\right)$.

73. $\frac{v_{4atm}}{v_{3atm}} = 1:1$ speed of sound is independent of pressure.

74. λ_{red} = large, at red shift, universe is expanding.

75. Because stationary wave is not a energy carrier.

76. $v = f\lambda \Rightarrow f = \frac{v}{\lambda} = \frac{130}{5} = 26\text{Hz}$

77. $f = \frac{1}{2\ell}\sqrt{\frac{F}{m}} = \frac{1}{2(2)}\sqrt{\frac{10}{0.04}} = 12.5\text{Hz}$

78. $f' = \left(\frac{v}{v-u_s}\right)f \Rightarrow \left(\frac{v}{v-\frac{v}{3}}\right)100 = \left(\frac{v}{\frac{3v-v}{3}}\right)100 = \frac{3v}{2v}\times 100 = 150\,\text{Hz}$

79. $\frac{\lambda}{2} = \frac{25}{100} \Rightarrow \lambda = 0.5m \Rightarrow f = \frac{v}{\lambda}\frac{300}{0.5} = 600Hz$

80. Speed of sound is independent of pressure.

81. As n = 5, ℓ = 10m $\Rightarrow \lambda n = \frac{2\ell}{n} = \frac{2\times 10}{5} = 4m$

$f = \frac{v}{\lambda} = \frac{20}{4} = 5Hz$

82. Definition of longitudinal waves.

83. $F \propto -x$

84. Energy of stationary wave travels outwards is not characteristics of stationary waves.

85. $c = f\lambda \Rightarrow \lambda = \frac{c}{f} = \frac{3\times 10^8}{3000} = 100\text{km}$

86. $f_o = \left(\frac{v}{v-u_s}\right)f$

87. $v_t = v_o + 0.6t°C = 332 + 0.6\times 22 = 332 + 13.2 = 345.2\text{ms}^{-1}$

88. Doppler's effect is applicable for light waves also. Speed of distant stars is measured by Doppler's effect.

89. $v = f\lambda = (40)(0.05) = 2m/s$

90. Trough of a wave like a concave lens in geometry.

91. Doppler's effect shows change in frequency due to relative motion between source and observer.
92. Distance Between two Consecutive node is wave length by 2
93. Stationary waves don't Move
94. Crest and trough are found in transvers wave
95. $\dfrac{f_o}{f_c} = \dfrac{\frac{v}{2\ell}}{\frac{v}{4\ell}} = 2:1$
96. $f' = \left(\dfrac{v}{v-u_s}\right)f = \dfrac{333}{333-33} \times 450 = 500\,Hz$
97. Ripple tank is used to study features of wave
98. Waves associated with moving particles are matter waves.
99. Infrasonic wave has frequency less than 20Hz
100. $P.E = V = \dfrac{1}{2}Kx^2$

$V' = \dfrac{1}{2}K(nx)^2$

$V' = n^2 V$

101. Loudness of sound is determined by its amplitude when amplitude increase sound become louder.
102. $f' = \left(\dfrac{v}{v-u_s}\right)f = \left(\dfrac{v}{v-0.5v}\right) \times 200 = 400Hz$
103. Information.
104. Definition.
105. Fact.
106. Information.
107. $f = \dfrac{1}{2\pi}\sqrt{\dfrac{k}{m}}$
108. $f' = \left(\dfrac{v}{v+u_s}\right)f$
109. Definition.
110. Speed of sound in air is independent of pressure $v \propto P^{0}$.
111. Definition.
112. Definition.
113. $v_t = v_o + 0.61t$
114. Definition.
115. In SHM, at extreme position $x = x_o$,

$P.E = \dfrac{1}{2}Kx_o^2 = \text{maximum}$

K.E = 0

116. $f_1 = \frac{v}{2\ell} = \frac{24}{2\times6} = 2Hz$

$f_2 = 2f_1 = 4Hz$

$f_3 = 3f_1 = 6Hz$

117. Definition.

118. $T = 2\pi\sqrt{\frac{\ell}{g}}$ (This relation shows that 'T' of simple pendulum is independent of mass)

119. For one vibration $f = \frac{1}{T}$

120. Phase concept.

121. The faintest audible sound, corresponding to a sound pressure of about 0.0002 dyne per sq cm, is arbitrarily assigned a value of 0 dB.
The loudest sounds that can be tolerated by the human ear are about 120 dB. The level of normal conversation is about 50 to 60 dB.

122. On medium changing, frequency of wave (directly proportional to pitch) remains constant.

123. Information.

124. If spring constant 'K' is cut into three equal segments then length of each segment is L/3 so spring constant to each segment is 3K according to relation $K \propto \frac{1}{L}$.

125. SHM condition.

126. Definition.

127. Definition.

128. $T = 2\pi\sqrt{\frac{m}{k}}$ $\quad (T \propto \sqrt{m})$

129. Loudness ∝ intensity of sound.

130. $v_t = v_o + 0.61t$

131. On the white paper, the crest and trough act as alternate light and dark lines. The trough of the water wave acts as a concave lens and the crest acts a convex lens.

132. Speed of sound is independent of pressure.

5 TOPIC THERMODYNAMICS

PRACTICE EXERCISE

Q.1 Heat was given to a body, which raises its temperature by 1°C is ________
A. Water equivalent
B. Temperature gradient
C. Thermal capacity
D. Specific heat

Q.2 The thermal capacity of 40g of aluminum (specific heat = 0.2 cal°g^{-1} C^{-1}) is ________
A. 40cal°C^{-1}
B. 160 cal°C^{-1}
C. 200 cal°C^{-1}
D. 8 cal°C^{-1}

Q.3 80g of water at 30°C is poured on a large block of ice which is at 0°C. The mass of ice that melts is ________
A. 30g
B. 80g
C. 150g
D. 1600g

Q.4 Mud houses are cooler in summer and warmer in winter because ________
A. Mud is a good conductor of heat
B. Mud is a superconductor of heat
C. Mud is a bad conductor of heat
D. Mud can adapt according to temperature

Q.5 Heat capacity of a substance is infinite. It means ________
A. Heat is given out
B. Heat is taken out
C. No change in temperature
D. Heat is first given out and then taken out

Q.6 The change in internal energy, when a gas is cooled from 927° to 27° is?
A. 100%
B. 300%
C. 200%
D. 75%

Q.7 Two cylinders of equal size are filled with equal amount of ideal diatomic gas at room temperature. Both the cylinders are fitted with pistons. In cylinder A the piston is free to move, while in cylinder B the piston is fixed. When same amount of heat is added to cylinder A raises by 20 K. What will be the rise temperature of gas in cylinder B?
A. 28K
B. 20K
C. 15K
D. 10K

Q.8 The relation for the 1st law of thermodynamics can be expressed as:
A. $\Delta Q = \Delta W$
B. $\Delta Q = \Delta U + \Delta W$
C. $\Delta Q = \Delta U$
D. $\Delta Q = \dfrac{\Delta U}{\Delta W}$

Q.9 Examples of first law of thermodynamics are
A. Working of bicycle pump
B. Brakes applied by an automobile
C. Human metabolism
D. All of these

Q.10 1st law of thermodynamics is consequence of conservation of
A. Work
B. Heat
C. Energy
D. All of these

Q.11 Which statement about the first law of thermodynamics is correct?
A. The heating of a system equal to the increase of its internal energy plus the work done on the system
B. The increase in the internal energy of a system equal the heating of the system minus the work done by the system
C. The increase in the internal energy of system equal the heating of the system plus the work done by the system
D. The work done on a system equals the increase of its thermal energy plus the heating of the system

Q.12 **The melting point of copper is 1,080°C and its heat of fusion is 200 kJ/kg. If a copper coin at this temperature is completely melted by the absorption of 2,000 J of heat, what is the mass of the coin?**

A. $\frac{1}{1,080}$ kg
B. $\frac{1}{540}$ kg
C. $\frac{1}{108}$ kg
D. $\frac{1}{100}$ kg

Q.13 **In a thermodynamic system working substance is an ideal gas, its internal energy is in the form of**

A. Kinetic energy only
B. Potential energy
C. Kinetic and potential energy
D. None of these

Q.14 **An ideal gas undergoes an expansion in volume from 1.3×10^{-4} m³ to 3.6×10^{-4} m³ at a constant pressure of 1.3×10^{5} Pa. During this expansion, 24 J of heat is supplied to the gas. What is the overall change in the internal energy of the gas?**

A. Decrease of 54 J
B. Decrease of 6 J
C. Increase of 6 J
D. Increase of 54 J

Q.15 **Which one is true for internal energy?**

A. It is sum of all forms of molecular energies of a system
B. It is proportional to transnational K.E of the molecules
C. It is a state function of a system
D. All are correct

Q.16 **If two system X and Y are in thermal equilibrium. If X is heated at constant volume and Y is heated at constant pressure, and again finally maintained at thermal equilibrium, then heat Q given to the systems X and Y and internal energy U stored in the systems X and Y are**

A. $Q_x = Q_y$ and $U_x = U_y$
B. $Q_x = Q_y$ and $U_x < U_y$
C. $Q_x < Q_y$ and $U_x < U_y$
D. $Q_x < Q_y$ and $U_x = U_y$

Q.17 **The internal energy of a body is maximum when its temperature is**

A. 0 K
B. 273 K
C. –273 K
D. –273 °C

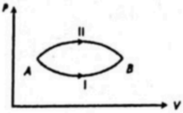
Q.18 **An ideal gas is pressed at a constant temperature. Its internal energy**

A. Decreases
B. First increases and then decreases
C. Increases
D. Remains the same

Q.19 **Two different samples have the same mass and temperature. Equal quantities of energy are absorbed as heat by each. Their final temperatures may be different because the samples have different:**

A. Heat capacities
B. Volumes
C. Thermal conductivities
D. Coefficients of expansion

Q.20 **A system goes from A to B via two processes I and II as shown in figure. If ΔU_1 and ΔU_2 are the changes in internal energies in the processes I and II respectively, then**



A. $\Delta U_{II} > \Delta U_I$
B. $\Delta U_I = \Delta U_{II}$
C. $\Delta U_{II} < \Delta U_I$
D. Relation between ΔU_I and ΔU_{II} cannot be determined

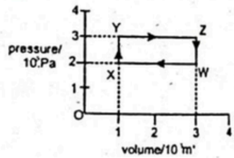
Q.21 **By rubbing the objects together, their internal energy:**
A. Increases
B. Remains constant
C. Decreases
D. Becomes zero

Q.22 **A perfect gas is compressed to $\frac{1}{4}$th of its original volume. The initial pressure of the gas 1 atmosphere if the compression is isothermal, the final pressure in atmosphere will be**
A. 4
B. $\frac{1}{4}$
C. 16
D. $\frac{1}{16}$

Q.23 **Temperature remains constant, the pressure of gas is decreased by 20%. The percentage change in volume**
A. Increases by 20%
B. Decreases by 20%
C. Increases by 25%
D. Decreases by 25%

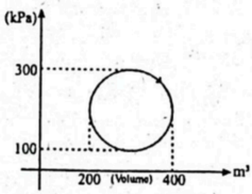
Q.24 **The work done in the isochoric process is**
A. Constant
B. Zero
C. Variable
D. Depends on situation

Q.25 **A gas undergoes the cycle of pressure and volume changes $W \rightarrow X \rightarrow Y \rightarrow Z \rightarrow W$ shown in the diagram.**



What is the net work done by the gas?
A. –600 J
B. 0 J
C. 200 J
D. –200 J

Q.26 **Calculate the heat absorbed by the system in going through the process as shown in figure.**

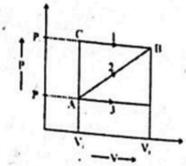


A. 31.4 J
B. 31.4×10^6 J
C. 3.14 J
D. None

Q.27 Work done by air when it expands from 50 litres to 150 litres at a constant pressure of 2 atmospheres is

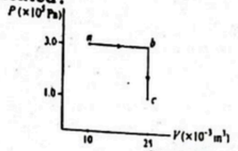
A. 2×10^{4} joules
B. $2\times10^{5}\times100$ joules
C. 2×100 joules
D. $2\times10^{-5}\times100$ joules

Q.28 A system is taken from state A to B through three different paths 1, 2, 3. The work done is maximum in



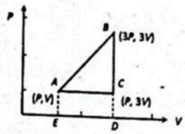
A. process 3
B. process 2
C. process 1
D. equal in all processes

Q.29 What's the total work performed on the gas as it's transformed from state *a* to state *c*, along the path indicated?



A. 1,500 J
B. 4,500 J
C. 3,000 J
D. 5,000 J

Q.30 An ideal gas is taken around *ABCA* as shown in the above *P-V* diagram. The work done during a cycle is



A. 2PV
B. 1/2PV
C. PV
D. Zero

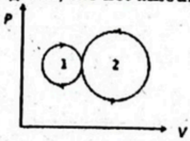
Q.31 The equation $W = P(V_2 - V_1)$ represent work done by a gas in

A. Free expansion
B. An isothermal expansion
C. An adiabatic expansion
D. An expansion at constant pressure

Q.32 Find the change in internal energy of the system when a system absorbs 2 kilocalorie of heat and at the same time does 500 joules of work

A. 8200 J
B. 5600 J
C. 7900 J
D. 6400 J

Q.33 In the following indicator diagram, the net amount of work done will be



A. Positive
B. Negative
C. Zero
D. Infinity

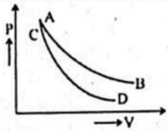
Q.34 A system is described in terms of thermodynamics variables
A. Pressure (P)
B. Temperature (T)
C. Volume (V)
D. All of these

Q.35 The concept of temperature is related to
A. Zeroth law of thermodynamics
B. Second law of thermodynamics
C. First law of thermodynamics
D. Third law of thermodynamics

Q.36 Which of the following statement is correct for any thermodynamic system?
A. The internal energy changes in all processes
B. The change in entropy can never be zero
C. Internal energy and entropy are state functions
D. The work done in an adiabatic process is always zero

Q.37 Thermodynamic is the study of relationship between
A. Heat & Surrounding
B. Heat& other form of energy
C. Heat & Liquid
D. Heat & chemical energy

Q.38 In the figure curves AB and CD represent the relation between pressure P and volume V of an ideal gas. One of the curves represents an isothermal expansion and the other represents an adiabatic expansion. Which curve represents an adiabatic expansion?



A. Curve AB
B. Curve CD
C. Both "A" and "B"
D. None of these

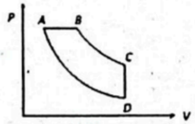
Q.39 Heat added at constant volume of a gas is used to
A. To do external work
B. To increase its internal energy
C. Either "A" or "C"
D. Both "A" and "C"

Q.40 When heat is given to a gas in an isobaric process then
A. The work is done by the gas
B. Internal energy of the gas increases
C. Both 'A' and 'B'
D. None of these

Q.41 If the volume of a gas is deceased by 10% during isothermal process than its pressure will
A. Decrease by 10%
B. Decrease by 11.11%
C. Increase by 10%
D. Increase by 11.11%

Q.42 In which process work done is maximum, when gas expand.
A. Isothermal
B. Adiabatic
C. Isobaric
D. Isochoric

Q.43 In pressure-volume diagram given below, the isochoric, isothermal, and isobaric parts respectively, are

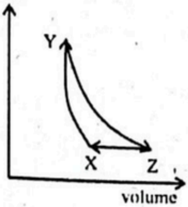


A. AB, BC, CD
B. DC, CB, BA
C. CD, DA, AB
D. BA, AD, DC

Q.44 A gas does 10J of external work in adiabatic process while expanding, then the change in internal energy is:

A. 10 J
B. – 10 J
C. 20 J
D. 0 J

Q.45 A fixed mass of an ideal gas undergoes the changes represented by $X \rightarrow Y \rightarrow Z \rightarrow X$ as shown below



	XY	YZ	ZX
A.	Isothermal compression	Adiabatic expansion	Pressure reduction at constant volume
B.	Adiabatic compression	Isothermal expansion	Pressure reduction at constant volume
C.	Isothermal compression	Adiabatic expansion	Compression at constant pressure
D.	Adiabatic compression	Isothermal expansion	Compression at constant pressure

Q.46 During the adiabatic expansion of 2 moles of a gas, the internal energy of the gas is found to decrease by 2 joules, the work done during the process on the gas will be equal to

A. 2 J
B. 1 J
C. –2 J
D. –1 J

Q.47 Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2 in three different ways. The work done by the gas is W_1, if the process is purely isothermal. W_2 if purely isobaric and W_3 if purely adiabatic then

A. $W_2 > W_1 > W_3$
B. $W_1 > W_2 > W_3$
C. $W_2 > W_3 > W_1$
D. $W_1 > W_3 > W_2$

5 Topic THERMODYNAMICS

PAST PAPER MCQ'S

Q.48 What is the factor upon which change in internal energy of an ideal gas depends? **(MCAT 2013)**

A. Change in volume
B. Change in temperature
C. Changed in volume and temperature
D. Path followed to change internal energy

Q.49 The amount of heat required to raise the temperature of 1kg of substance through 1 K is called; **(ETEA 2014)**

A. Heat capacity
B. 1 Joule
C. Specific heat
D. One calorie

Q.50 If one mole of an ideal gas is heated at constant pressure, then the first law of thermodynamics can be written as: **(MDCAT 2018)**

A. $C_p\Delta T = C_v\Delta T + P\Delta V$
B. $C_p\Delta T = C_v\Delta T + V\Delta P$
C. $C_v\Delta T = C_p\Delta T + P\Delta T$
D. $\Delta C_vT = \Delta C_vT + P\Delta V$

Q.51 *If* $C_v = 5/2\,R$, C_P will be **(MDCAT 2018)**

A. $\frac{5}{5}R$
B. $\frac{5}{2}R$
C. $\frac{2}{7}R$
D. $\frac{7}{2}R$

Q.52 The amount of heat required to raise the temperature of 10 moles of water from 70K to 80K (molar heat capacity of water 75.24J) is: **(ETEA 2018)**

A. 0.7524J
B. 7524J
C. 95.24J
D. 572.4J

Q.53 The sum of all forms of molecular energies (kinetic and potential) of a substance is termed as? **(MDCAT 2019)**

A. Internal energy
B. Heat energy
C. Elastic energy
D. Absolute energy

Q.54 In which process the entire of heat supplied to the gas is converted to the internal energy of the gas? **(NMDCAT 2020)**

A. Isochoric process
B. Isobaric process
C. Isothermal process
D. Adiabatic process

Q.55 The internal energy of a system during an isothermal process: **(NMDCAT 2020)**

A. Decreases
B. Increases
C. Become zero
D. Remain constant

Q.56 In a certain process, 400J of heat energy is supplied to a system and at the same time 150J of work is done by the system. The increase in internal energy of system is_______. **(NUMS 2020)**

A. 150J
B. 300J
C. 250J
D. 500J

Q.57 The rapid escape of air from a burst tyre is an example of: **(NUMS 2020)**

A. Isothermal
B. Adiabatic
C. Isothermal
D. Isochoric

Q.58 $C_p - C_v$ value, find if 3moles of gas is gives **(NMDCAT 2021)**

A. 3R
B. 2R
C. 5R
D. 7R

Q.59 **Thermodynamics is that branch of Physics in which we study** **(UHS 2022)**
A. Relations between heat and mechanical energies
B. Relations between heat and ionization energies
C. Relations between chemical and mechanical energies
D. Relations between kinetic and potential energies

Q.60 **When a gas is compressed isothermally, the product of its pressure and volume during the process is:** **(UHS 2022)**
A. Not constant
B. Constant
C. Zero
D. Proportional to entropy

Q.61 **Temperature of given mass of a gas is changed from 150°C to 300°C during an isobaric process, volume of the gas will become:** **(UHS 2022)**
A. Half
B. Double
C. Remains same
D. Less than double

Q.62 **The thermodynamic process during which volume of the system remains constant is called:** **(SZABMU 2022)**
A. Isothermal
B. Isobaric
C. Isochoric
D. Adiabatic

Q.63 **The conditions for application of Boyle's law holds good in:** **(SZABMU 2022)**
A. Adiabatic process
B. Isothermal process
C. Isobaric process
D. Isochoric process

Q.64 **The internal energy of a system during an isothermal process:** **(SZABMU 2022)**
A. Decreases
B. Increases
C. Become zero
D. Remain constant

Q.65 **Two bodies A and B of temperature $T_A = 100°C$ and $T_B = 0°C$ are brought in thermal contact with each other. Which one in the followings is possible at thermal equilibrium?** **(SZABMU 2022)**
A. $T_A = 0°C, T_B = 100°C$
B. $T_A = 60°C, T_B = 50°C$
C. $T_A = 45°C, T_B = 45°C$
D. $T_A = 60°C, T_B = 40°C$

Q.66 **In an isolated thermodynamic system:** **(ETEA 2022)**
A. No heat transfers to the environment
B. Neither heat nor any mass are transferred to the environment
C. No dissipated energy and heat are transferred to the environment
D. No mass transfers to the environment

Q.67 **Thermal equilibrium in environment occurs due to:** **(BMU 2022)**
A. Heat generation
B. Heat dissipation
C. Heat flow
D. Heat absorption.

Q.68 **Specific heat capacity of a gas is measured in:** **(DUHS 2022)**
A. $JkgK^{-1}$
B. Jkg^2K
C. $Jkg^{-1}K^{-1}$
D. $Jkg^{-1}K$
E. JkgK

Q.69 First law of thermodynamics is mathematically represented as: (DUHS 2022)

A. $\Delta W = \Delta Q + \Delta U$
B. $\Delta U = \Delta W - \Delta Q$
C. $\Delta Q = \Delta W - \Delta U$
D. $\Delta Q = \Delta U - \Delta W$
E. $\Delta U = \Delta Q - \Delta W$

Q.70 First law of thermodynamic is based on: (NUMS 2022)

A. Law of conservation of momentum
B. Law of conservation of mass
C. Law of conservation of charge
D. Law of conservation of energy

Q.71 The thermodynamics process during which the pressure is kept constant is called: (NUMS 2022)

A. Isochoric process
B. Adiabatic process
C. Isobaric process
D. Isothermal process

ANSWER KEY

PRACTICE EXERCISE

1	C	11	B	21	A	31	D	41	D
2	D	12	D	22	A	32	C	42	C
3	A	13	A	23	C	33	B	43	B
4	C	14	B	24	B	34	D	44	B
5	C	15	D	25	C	35	A	45	D
6	D	16	D	26	B	36	C	46	A
7	A	17	B	27	A	37	B	47	A
8	B	18	D	28	C	38	B		
9	D	19	A	29	B	39	B		
10	C	20	B	30	A	40	C		

PAST PAPER MCQ'S

48	B	58	A	68	C
49	A	59	A	69	E
50	A	60	B	70	D
51	D	61	D	71	C
52	B	62	C		
53	A	63	B		
54	A	64	D		
55	D	65	C		
56	C	66	B		
57	B	67	C		

EXPLANATORY NOTES

PAST PAPER MCQ'S

1. Heat required to raise the temperature of a body through 1°C is called thermal capacity.
2. Thermal capacity = mc
   Thermal capacity = $40g \times 0.2cal\ g^{-1}\ C^{-1} = 8\ cal°C^{-1}$.
3. Heat used in melting m gram of ice = Heat lost by 80g water
   $mL = 80 \times 1 \times 30$
   $m = (80 \times 1 \times 30)/80 = 30g$.
4. Mud is bad conductor of heat. It does not allow heat to come in from outside in summer and it does not allow heat to go out from a house in winter.
5. Whatever amount of heat is taken in or given out by a substance of infinite heat capacity, there is no change in its temperature.
6. $U = nC_v T$
   $\Delta U/U \times 100 = \Delta T/T \times 100$
   $\Delta U/U \times 100 = (1200 - 300)/1200 \times 100 = 9/12 \times 100 = 75\%$.
7. For gas in cylinder A, $Q = nC_p\ \Delta T_1$
   For gas in cylinder B, $Q = nC_v\ \Delta T_2$
   $\Delta T_2 = C_p/C_v\ \Delta T_1 = 7/5 \times 20 = 28K$.
8. Thermodynamic equation $\Delta Q = \Delta U + \Delta W$
9. Examples of 1st law of thermodynamics.
10. Fact.
11. Statement of 1st law of thermodynamics.
12. $$\Delta m = \frac{Q}{H_f} = \frac{2000J}{200000JKg^{-1}}$$
    $$\Delta m = \frac{Q}{H_f} = \frac{1}{100}kg$$
13. Ideal gas possesses only kinetic energy.
14. $V_1 = 1.3 \times 10^{-4} m^3$

    $V_2 = 3.6 \times 10^{-4} m^3$

    $P = 1.3 \times 10^5 Pa$

    $Q = 24 J$

    $\Delta U = ?$

    $\Delta U = Q - W$

    $= Q - P\Delta V$

    $= 24 - 1.3 \times 10^5 \left(3.6 \times 10^{-4} - 1.3 \times 10^{-4}\right)$

    $\Delta U = -6J$

15. All options are related to internal energy.

16. Internal energy is same and $Q_p > Q_v$ so $Q_y > Q_x$

17. Internal energy $\propto$ translational <K.E> $\propto$ T

18. $U \propto T$

19. $C = \frac{Q}{m\Delta T}$, $\Delta T \propto \frac{1}{C}$

20. As internal energy is a state function therefore change in internal energy does not depends upon the path followed i.e. $\Delta U_I = \Delta U_{II}$

21. By rubbing objects, temperature increases hence internal energy increases.

22. Boly's law

23. According to Boyle's law $P_1V_1 = P_2V_2$ As the pressure is decreased by 20%,

$$P_2 = P_1 - \frac{20P_1}{100} = \frac{4}{5}P_1 \Rightarrow P_1V_1 = \frac{4}{5}P_1V_2 \Rightarrow V_2 = \frac{5}{4}V$$

$$\text{\% Change in volume} = \frac{V_2 - V_1}{V_1} \times 100 = \frac{\frac{5}{4}V_1 - V_1}{V_1} \times 100 = 25\%$$

24. $W = P\Delta V = P(0) = 0$

25. $W = \Delta P \Delta V = 1\times10^5 \times 2\times10^{-3} = 2\times10^2 = 200J$ W = positive because work done by yz path is more than xw path.

26. $Q = \Delta U + W$

In cyclic process i.e $\Delta U = 0$

$Q = W = Area\ of\ P-V\ graph = \pi r^2$

$= \pi(P_r)(V_r)$

$= 3.14(100\times10^3)(100) \Rightarrow 31.4\times10^6 J$

27. $W = P\Delta V = 2\text{atm}\times(150-50)\text{litre} = 2\times1.01\times10^5\,\text{Pa}\times100\times\frac{1}{1000}\text{m}^3 \Rightarrow W = 2\times10^4 J$

28. Area of PV graph = W

Area under process 1 > area under process 2 > area under process 3

29. $W = p\Delta V = 3\times10^5\times15\times10^{-3} = 4500J$

30. Work done = Area enclosed by triangle $ABC = \frac{1}{2}AC\times BC = \frac{1}{2}\times(3V-V)\times(3P-P) = 2PV$

31. $W = P\Delta V = P(V_2 - V_1)$. This equation is for work done by gas at constant pressure.

32. $\Delta Q = 2\text{k cal} = 2\times10^3\times4.2\text{J} = 8400\text{J}$ and $\Delta W = 500\text{J}$. Hence from

$\Delta Q = \Delta U + \Delta W$, $\Delta W = \Delta Q - \Delta U = 8400 - 500 = 7900\text{J}$

33. The cyclic process 1 is clockwise whereas process 2 is anticlockwise. Clockwise area represents positive work and anticlockwise area represents negative work. Since negative area (2) > positive area (1), hence net work done is negative.

34. Thermodynamics variables.
35. Zeroth law of thermodynamics describes temperature.
36. U and S are state functions.
37. In thermodynamics we deal with conversion of heat energy into other form of energy.
38. Adiabatic process.
39. Isochoric process.
40. Properties of isobaric process.
41. $\because P \propto \frac{1}{V} \Rightarrow p_1V_1 = p_2V_2 \Rightarrow V_2 = V - 10\% = \frac{9V}{10}$

    $p_1 = p_2\frac{9}{10} \Rightarrow p_2 = \frac{10p_1}{9}$

    $\%P = \frac{P_2 - P_1}{P_1} \times 100 = \frac{\frac{10P_1}{9} - P_1}{P_1} \times 100 = \frac{1}{9} \times 100 = 11\%.$
42. $W_{isobaric} > W_{isothermal} > W_{adiabatic} > W_{isochoric}$
43. Graph of isochoric, isothermal and isobaric process.
44. $\Delta Q = \Delta U + W \Rightarrow 0 = \Delta U + W \Rightarrow -\Delta U = W \Rightarrow \Delta U = -10J$
45. During $X \longrightarrow Y$, $V\downarrow, P\uparrow$ During $Y \longrightarrow Z$ $P \propto \frac{1}{V}$

    During $Z \longrightarrow X$ $P = \text{constant}$ $V\downarrow$
46. $Q = \Delta U + W$

    $0 = -2 + W \Rightarrow W = +2J$
47. $W_{isobaric} > W_{isothermal} > W_{adiabatic}$

PAST PAPER MCQ'S

48. Change in internal energy of an ideal gas depend upon temperature according to given options.
49. Definition.
50. $Q_p = \Delta U + W \Rightarrow C_p\Delta T = C_V\Delta T + P\Delta V$
51. $C_p - C_v = R \Rightarrow C_p = C_v + R$

    $= \frac{5R}{2} + R = \frac{5R + 2R}{2} = \frac{7R}{2}$
52. $Q = nc\Delta T = 10 \times 10 \times 75.24 = 7524J$
53. Definition of internal energy.
54. In isochoric process $\Delta V = 0$

    $Q = \Delta U + P\Delta V \Rightarrow Q = \Delta U$
55. $T \propto U$, $T = \text{constant}$, So $U = \text{constant}$
56. $Q = \Delta U + W$
57. The rapid escape of air from a burst tyre is an example of adiabatic.

58. $C_p - C_v = nR$

59. Definition.

60. In Isothermal compression, Boyle's is applicable so PV constant.

61. Charle's law.

$$\frac{V_1}{V_2} = \frac{T_1}{T_2}$$

62. Definition.

63. PV = Constant Boyle's law

T = constant

So, Boyle's law hold goal is isothermal process

64. In isothermal process

T = constant

$\Delta U \propto \Delta T$

So, T = constant

65. In thermal equilibrium, temperature becomes equal and $\Delta T = 0$

66. Definition

67. Heat flows from hot body towards cold body due to temperature difference.

68. $c = \dfrac{Q}{m\Delta T}$

69. $\Delta Q = \Delta W + \Delta U$

$\Delta U = \Delta Q - \Delta W$

70. Definition.

71. Definition.

6 TOPIC ELECTROSTATICS

PRACTICE EXERCISE

Q.1 Two charges 1C and -4C exists in air. What is the direction of force?

A. Away from 1C
B. Away from –4C
C. From 1C to –4C
D. From –4C to 1C

Q.2 A point charge 2nC is located at origin. What is the potential at (1,0,0)?

A. 12
B. 14
C. 16
D. 18

Q.3 If a body A is charged with charge q, and is touched with neutral body B and then with neutral body C. What will be the charge on C after the contact?

A. q
B. q/2
C. q/3
D. Q/4

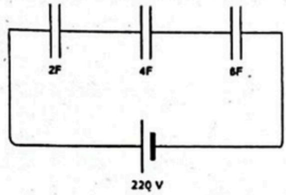
Q.4 What is the dielectric constant of the medium if the capacitance of a parallel plate capacitor increases from 40F to 80F on introducing a dielectric medium between the plates?

A. 20
B. 0.5
C. 2
D. 5

Q.5 What is the maximum energy that can be stored in a capacitor?

A. Depends on the maximum area of the capacitor
B. Depends on the maximum resistance offered
C. Depends on the maximum electric field
D. Depends on the maximum current passing through the capacitor

Q.6 What is the voltage across the 2F capacitor?

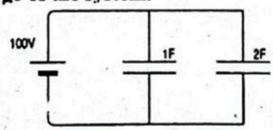


A. 240V
B. 200V
C. 220V
D. 120V

Q.7 What is the initial current while charging a capacitor?

A. High
B. Low
C. 0
D. Cannot be determined

Q.8 Calculate the total charge of the system.



A. 200C
B. 100C
C. 300C
D. 400C

Q.9 If the distance between two-point charges to becomes double then the coulomb's force will be

A. $\frac{F}{2}$
B. 4F
C. 2F
D. $\frac{F}{4}$

Q.10 **The force between two-point charges placed in air is F. If air is replaced by a medium of relative permittivity ε_r, the force is reduced to**

A. $\varepsilon_r F$
B. $\frac{\varepsilon_r}{F}$
C. $\frac{F}{\varepsilon_r}$
D. ε_r

Q.11 **Two identical metal balls with charges + 2Q and –Q are separated by some distance, and exert a force F on each other. They are joined by a conducting wire, which is then removed. The force between them will now be.**

A. F
B. F/2
C. F/4
D. F/8

Q.12 **When 10^{19} electrons are removed from a neutral metal plate, the electric charge on it is in (coulomb)**

A. 10^{+19}
B. –1.6
C. +1.6
D. 10^{-19}

Q.13 **Two-point charges $+3\mu C$ and $+8\mu C$ repel each other with a force of 40N. If a charge of $-5\mu C$ is added to each of the, then the force between them will become:**

A. –10 N
B. +20 N
C. +10 N
D. –20 N

Q.14 **Two-point charges +2 C and +6 C repel each other with a force of 12 N. If a charge of -2 C is given to each of these charges, the force will now be**

A. Zero
B. 8 N (repulsive)
C. 8 N (attractive)
D. 16 N (attractive)

Q.15 **Two electrons are removed from a conductor the charge on it is**

A. 1.6×10^{-19} C
B. -3.2×10^{-19} C
C. 3.2×10^{-19} C
D. neutral

Q.16 **The force between two charges is 120 N. If the distance between the charges is doubled, the force will be**

A. 60 N
B. 40 N
C. 30 N
D. 15 N

Q.17 **A positive charge is moved against an electric field. Its P.E**

A. Increases
B. Remains same
C. Decreases
D. May increase or decrease depending upon magnitude of charge

Q.18 **An electric field can deflect ______________**

A. Neutrons
B. X-rays
C. γ-rays
D. None

Q.19 **Which of given is not the unit of electric intensity**

A. NC^{-1}
B. NV^{-1}
C. Vm^{-1}
D. None of these

Q.20 **The magnitude of electric intensity E is such that an electron placed in it would experience an electrical force equal to its weight. E is given by**

A. mge
B. $\frac{mg}{e}$
C. $\frac{e}{mg}$
D. $\frac{e^2 g}{m^2}$

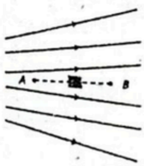
Q.21 The electric field intensity at a point 20 cm away from a charge of 2×10^{-5}C is

A. 4.5×10^{6}N/C
B. 3.5×10^{5}N/C
C. 3.5×10^{6}N/C
D. 4.5×10^{5}N/C

Q.22 The weight of proton (mass = 1.67×10^{-27} kg) on entering in a vertical electric field E is balanced by electric force. Then the electric field strength is

A. 10^{-9} V m^{-1}
B. 10^{-7} V m^{-1}
C. 10^{+7} V m^{-1}
D. 10^{-8} V m^{-1}

Q.23 Figure shows the electric lines of force emerging from a charged body. If the electric field at A and B are E_A and E_B respectively and if the displacement between A and B is r then



A. $E_A < E_B$
B. $E_A = E_B$
C. $E_A > E_B$
D. none of these

Q.24 Two metal plates have potential difference of 300 V and are 0.01 m apart. A charged particle of mass 1.96×10^{-15} kg is held in equilibrium between the plates of the capacitor. Then the electric field is

A. 3×10^{2} V m^{-1}
B. 3×10^{4} V m^{-1}
C. 3 V m^{-1}
D. 3×10^{-4} V m^{-1}

Q.25 The electric field strength between a pair of parallel plates is E. The separation of the plates is doubled and the potential difference between the plates is increased by a factor of four. What is the new electric field strength?

A. E
B. 4 E
C. 2 E
D. 8 E

Q.26 The electric field intensity at a point situated 4 meters from a point charge is 200 N/C. If the distance is reduced to 2 meters, the field intensity will be

A. 400 N/C
B. 800 N/C
C. 600 N/C
D. 1200 N/C

Q.27 The lines of force due to charged particles are

A. Always straight
B. Sometimes curved
C. Always curved
D. None of the above

Q.28 Two thin infinite parallel plates have uniform charge densities $+\sigma$ and $-\sigma$. The electric field in the space between them is

A. $\sigma/2\varepsilon_0$
B. σ
C. σ/ε_0
D. zero

Q.29 Gauss's law is applied to calculate the

A. Electric intensity due to different charge configuration
B. Electric intensity due to positive charges only
C. Electric intensity due to negative charges only
D. None of these

Q.30 Electric intensity due to an infinite sheet of positive charge is given by

A. $\vec{E} = \frac{\sigma}{2\epsilon_o}\hat{r}$
B. $\vec{E} = \frac{2\epsilon_o}{\sigma}\hat{r}$
C. $\vec{E} = \frac{\sigma}{\epsilon_o}\hat{r}$
D. $\vec{E} = \frac{q}{\epsilon_o}\hat{r}$

Q.31 **The capacity of a parallel plate capacitor is $5\mu F$. When a glass plate is placed between the plates of the capacitor, its potential becomes 1/8 of the original value. The value of dielectric constant will be**

A. 1.6 B. 8
C. 5 D. 40

Q.32 **Two charged spheres of radii 10 cm and 15 cm are connected by a thin wire. No current will flow, if they have:**

A. The same charge on each B. The same energy
C. The same potential D. The same field on their surface

Q.33 **A and B are two points in an electric field. If the work done in carrying 4.0 coulomb of electric charge from A to B is 16.0 joule the potential difference between A and B is**

A. Zero B. 4 V
C. 2.0 V D. 16V

Q.34 **Potential due to charge q at distance 1m is 5V, at distance 3m will be**

A. $\frac{5}{3}$V B. $\frac{7}{3}$V
C. $\frac{3}{5}$V D. $\frac{3}{7}$V

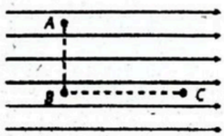
Q.35 **The electric potential at the surface of an atomic nucleus (Z = 50) of radius 9.0×10^{-15} m is**

A. 9 V B. 8×10^6 V
C. 9×10^5 V D. 80 V

Q.36 **A capacitor with air as the dielectric is charged to a potential of 100 volts. If the space between the plate is now filled with a dielectric of dielectric constant 10, the potential difference between the plates will be**

A. 1000 V B. 10 V
C. 100 V D. 0 V

Q.37 **Figure shows three points A, B and C in a region of uniform electric field E. The line AB is perpendicular and BC is parallel to the field lines. Then which of the following holds good. Where V_A, V_B and V_C represent the electric potential at points A, B and C respectively**



A. $V_A = V_B = V_C$ B. $V_A = V_B < V_C$
C. $V_A = V_B > V_C$ D. $V_A > V_B = V_C$

Q.38 **Value of potential at a point due to a point charge is**

A. A Inversely proportional to square of the distance
B. Inversely proportional to the distance
C. Directly proportional to square of the distance
D. Directly proportional to the distance

Q.39 **Equal amount of charge is given to two sphere A and B of radii 2cm and 3cm respectively. The potential V_A and V_B**

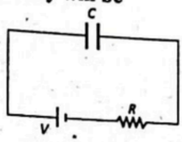
A. $V_A = V_B$ B. $V_A > V_B$
C. $V_A < V_B$ D. Depend upon number of material of sphere

Q.40 **Two charge +q and –q are situated at a certain distance. At the point exactly midway between them**
A. Electric field and potential both are zero
B. Electric field is not zero but potential is zero
C. Electric field is zero but potential is not zero
D. Electric field is not zero but potential is zero

Q.41 **An-α-particle is accelerated through a potential difference of 10^6 V. Its K.E will be**
A. 1 MeV
B. 4 MeV
C. 2MeV
D. 8MeV

Q.42 **A capacitor C "has a charge Q". The actual charges on its plates are**
A. Q, –Q
B. Q/2, –Q/2
C. Q, Q
D. Q, 0

Q.43 **As in figure shown, if a capacitor C is charged by connecting it with resistance R, then energy is given by the battery will be**



A. $\frac{1}{2}CV^2$
B. Less than $\frac{1}{2}CV^2$
C. More than $\frac{1}{2}CV^2$
D. Zero

Q.44 **A capacitor of capacitance 2μF is connected with a battery of 12 volt, the charge stored is equal to:**
A. 2.5×10^{-5} C
B. 2.4×10^{-6} C
C. 2.4×10^{-5} C
D. 2.5×10^{5} C

Q.45 **If a 2 μF capacitor has a charge of 20 μC, the potential difference between the plates is:**
A. 10 V
B. 20 V
C. 40 V
D. 50 V

Q.46 **If a 6 μF capacitor is charged to 200 V, the charge in coulombs will be**
A. 800 μC
B. 1200 μC
C. 900 μC
D. 1600 μC,

Q.47 **What is the area of the plates of a 3*F* parallel plate capacitor, if the separation between the plates is 5mm?**
A. $1.694 \times 10^9\ m^2$
B. $9.281 \times 10^9\ m^2$
C. $4.529 \times 10^9\ m^2$
D. 12.981×10^9 m

Q.48 **The capacity of a condenser in which a dielectric of dielectric constant 5 has been used, is *C*. If the dielectric is replaced by another with dielectric constant 20, the capacity will become**
A. $\frac{C}{4}$
B. $\frac{C}{2}$
C. $4C$
D. $2C$

Q.49 **The space between the plates of a capacitor is filled by a dielectric constant k. The capacitance of the capacitor**
A. Increases by a factor k
B. Decreases by a factor k
C. Increases by a factor k^2
D. Decreases by a factor k^2

Q.50 If an insulating material called dielectric is introduced between the plates, the capacitance of capacitor is:

A. $\frac{A\varepsilon_o\varepsilon_r}{2d}$ B. $\frac{A\varepsilon_o\varepsilon_r}{d}$ C. $\frac{Ad}{\varepsilon_o\varepsilon_r}$ D. $\frac{2Ad\varepsilon_o\varepsilon_r}{d}$

Q.51 Capacitance with air is 10F, if a dielectric of $\varepsilon_r = 100$ is inserted then new capacitance

A. 1000 F B. 10 μF
C. 10 F D. 100 F

Q.52 If the sheet of a bakelite is inserted between the plates of an air capacitor, the capacitance will

A. Decrease B. REMAINS unchanged
C. Increase D. become zero

Q.53 A dielectric material must be

A. Resistor B. Good conductor
C. Insulator D. Semi-conductor

Q.54 The capacitance of a capacitor is not affected by

A. Distance between plates B. Thickness of plates
C. Area of plates D. All of the above

Q.55 The quantity $\frac{1}{2}\varepsilon_o E^2$ has the significance of:

A. Energy/farad B. Energy/coulomb
C. Energy/volume D. Energy

Q.56 The energy stored between the plates of a capacitor in not represented by

A. $U = \frac{CV^2}{2}$ B. $U = \frac{q^2}{2C}$ C. $U = 2qV$ D. $U = \frac{qV}{2}$

Q.57 If the potential difference across the two plates of a parallel plate capacitor is doubled then its energy stored in it will be:

A. 2 times B. 4 times
C. 16 times D. Remains same

Q.58 If a 10 F capacitor is to have an energy content of 20 J, it must be placed across a potential difference of

A. 4 volts B. 2 volts
C. 9 volts D. 1 volt

Q.59 Energy stored in the electric field of a capacitor C when charged from a D.C source of voltage V is equal to joules

A. $0.5CV^2$ B. CV^2
C. $0.5\ C^2V$ D. 0.5 CV

Q.60 When 4 volts e.m.f. is applied across a 1 farad capacitor, it will store energy of

A. 2 joules B. 6 joules
C. 4 joules D. 8 joules

Q.61 A capacitor charging and discharging

A. Rapidly B. Exponentially
C. Linearly D. Logarithmically

Q.62 If RC is small, then capacitor will be charged and discharged

A. Slowly B. Quickly
C. With medium speed D. Both 'A' and 'C'

Q.63 Which of the following statement is true?

A. The current in the discharging capacitor grows linearly
B. The current in the discharging capacitor decays exponentially
C. The current in the discharging capacitor grows exponentially
D. The current in the discharging capacitor decreases constantly

6 Topic — ELECTROSTATICS

PAST PAPER MCQ'S

Q.64 A particle carrying charge of 2e falls through a potential difference of 3.0 V. Calculate the energy required by it: (MCAT 2009)

A. 9.6×10^{-19} J
B. 9.1×10^{-19} J
C. 1.6×10^{-19} J
D. 6.0×10^{-19} J

Q.65 The work done in moving a unit positive charge from one point to another point against the electric field is a measure of: (MCAT 2009)

A. Capacitance
B. Potential difference between two points
C. Intensity of electric field
D. Resistance between two points

Q.66 Electric intensity is a vector quantity and its direction is (MCAT 2010)

A. Perpendicular to the direction of field
B. Opposite to the direction of force
C. At a certain angle
D. Along the direction of force

Q.67 The magnitude of an electric field between two separated plates can be calculated by the relation (MCAT 2010)

A. $\Delta V = Ed$
B. $\Delta V = E/d$
C. $\Delta V = q_o d$
D. $E = \Delta V$

Q.68 The capacitor which charges and discharges quickly will have (ETEA 2011)

A. small value of RC
B. Large value of RC
C. Large value of time constant
D. None of these

Q.69 10 V potential difference is applied across the plates of 1 F capacitor. What is the energy stored in capacitor? (MCAT 2012)

A. 0.5 mJ
B. 0.05 mJ
C. 5 J
D. 50 J

Q.70 What will be the effect on the capacitance of a capacitor if area of each plate is doubled with separation between the plates is halved? (MCAT 2012)

A. Capacitance remains same
B. Capacitance becomes double
C. Capacitance becomes four times
D. Capacitance reduces of half

Q.71 What is the charge stored on a 5μF capacitor charged to the potential difference of 12V? (MCAT 2013)

A. 60μC
B. 2.4C
C. 2.4μC
D. 60.C

Q.72 The distance between the plates of a parallel plate capacitor is 2.0 mm and area of each plates is 2.0 m². A potential difference of 1.0×10^{-4} V is applied across the plates. Find the capacitance. (MDCAT 2014)

A. 4×10^{4}F
B. 3.54×10^{9}F
C. 8.85×10^{-9}F
D. 9.0×10^{-4}F

Q.73 In the direction indicated by an electric field line: (ETEA 2014)

A. The potential must increase
B. The potential must decrease
C. The electric field strength must increase
D. The electric field strength must decrease

Q.74 The potential difference between a pair of similar parallel conducting plates is known. What additional information is needed in order to find the electric field strength between the plates? (ETEA 2014)

A. Separation of the plates
B. Separation and decrease of the plates.
C. Permittivity of the medium separation of the plates.
D. Permittivity of the medium separation and area of plates.

Q.75 The unit of the electric field is: (ETEA 2015)

A. N/C B. V/m
C. J/C.m D. All of the above

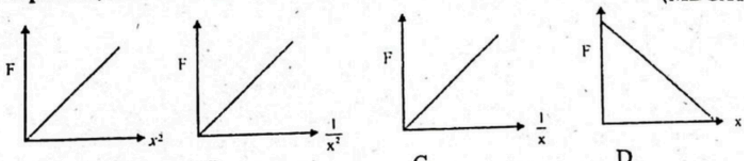
Q.76 If the length, width and separation between the plates of a parallel plate capacitor is doubled then its capacitance becomes (MDCAT 2016)

A. Double B. Half
C. Four time D. Eight time

Q.77 A charged capacitor stores 10C at 40V. Its stored energy is: (ETEA 2016)

A. 400J B. 4J
C. 0.2 J D. 200 J

Q.78 A point charge at a distance 'x' from another point charge experiences a force of repulsion, which one of the following graphs shows. How the force is related to 'x': (MDCAT 2017)



A. B. C. D.

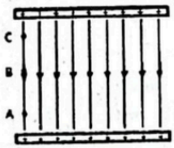
Q.79 The Coulomb force between two charges $q_1 = 2C$ and q_2 is 2N, the distance between charges is 3m. What is the charge of q_2? (MDCAT 2017)

A. $1 \times 10^9 C$ B. $1 \times 10^{-9} C$
C. $2 \times 10^9 C$ D. $4 \times 10^9 C$

Q.80 The electric field strength at the position $\vec{r} = (4\hat{i} + 3\hat{j})$m caused by a point charge of 5μC placed at origin is (MDCAT 2017)

A. $1240\hat{i} + 1280\hat{j}$ N/C B. $1440\hat{i} + 1080\hat{j}$ V/m
C. $1440\hat{i} + 1080\hat{j}$ N/m D. $1240\hat{i} + 1080\hat{j}$ N/C

Q.81 If a charge particle is placed one by one at point A, B and C then at which point it will experience a large force: (MDCAT 2017)



A. At point "A" B. At point "C"
C. At point "B" D. Same at all point

Q.82 The potential of the two plates of a capacitor are +10V and –10V. The charge on one of the plates is 40C. The capacitance of the capacitor is: (ETEA 2017)

A. 2F B. 4F
C. 0.5 F D. 0.25 F

Q.83 The ratio of the electric force between two protons to that between two electrons is of the order of: (ETEA 2017)

A. 10^{42}
B. 10^{39}
C. 10^{36}
D. 1

Q.84 Coulomb's law is given by the formula $F=k\,q_1\,q_2/r^2$. The magnitude of k having the unit of Nm^2C^{-2} for free space is equal to (MDCAT 2018)

A. 9×10^7
B. 6×10^7
C. 10×10^9
D. 9×10^9

Q.85 Force experienced per unit positive test charge at a point in an electric field is the definition of: (MDCAT 2018)

A. Electric potential energy
B. Electric field strength
C. Electric potential
D. Electric field

Q.86 A torch is rated 2.2 V, 0.25 A. Calculate the charge passing through the bulb in one second and energy transferred by the passage of each coulomb of charge. (MDCAT 2018)

A. 2.5 C and 0.55 J
B. 0.25 C and 2.2 J
C. 0.25 C and 2.2 V
D. 0.25 C and 0.55 J

Q.87 Electric potential due to 2 μC charge at distance of one meter is equal to (MDCAT 2018)

A. 18×10^4volt
B. 1.8×10^6volt
C. 1.8×10^9volt
D. 1.8×10^4volt

Q.88 Two determine the resistance of a voltmeter by discharging a capacitor through it, the instantaneous voltage is then given by the relation: (ETEA 2018)

A. $V_oe^{-t/RC}$
B. $V_oe^{-t/RC}$
C. $V_o/2$
D. $V_o/\sqrt{2}$

Q.89 There are two charges +3μC and +8μC the ratio of the force acting on them will be: (ETEA 2018)

A. 3:1
B. 1:1
C. 11:8
D. 3:8

Q.90 What is the magnitude of a point charge which produces an electric field of $2\,NC^{-1}$ at a distance of 60 cm? (ETEA 2018)

A. 8×10^{-11}C
B. 2×10^{-12}C
C. 3×10^{-11}C
D. 6×10^{-10}C

Q.91 The force between two charged bodies is "F". if one of the charge is doubled and the distance between them is halved, the force acting on each charged body is: (ETEA 2018)

A. 2F
B. 4F
C. 8F
D. 16F

Q.92 Electric field strength of a point charge is E and electric potential is V at a distance r from the point charge. What is the electric potential at a point for the same point charge where electric field strength is E/4? (MDCAT 2019)

A. V/4
B. 4V
C. V/2
D. 2V

Q.93 A particle carrying a charge of 5e falls through a potential difference of 25V. What would be energy acquired by the particle in 'J'. (MDCAT 2019)

A. 125×10^{-19}J
B. 1.6×10^{-19}J
C. $125 \times 1.6 \times 10^{-19}$J
D. 125 J

Q.94 Electric field strength at a point between oppositely charge plates is E. If the distance between plates is reduced to half, what will be the new value of electric intensity? (MDCAT 2019)

A. 4E B. E/2
C. E/4 D. 2E

Q.95 If the potential at a point which is 1m from a charge is 1volt, then the potential at a point which is 2m from the same charge will be: (NMDCAT 2020)

A. 2v B. 1v
C. 0.5v D. 3v

Q.96 The values of electric intensity will ______ due to the presence of dielectric medium: (NMDCAT 2020)

A. Increase B. Increase exponentially
C. Decrease D. Remains same

Q.97 In capacitors, energy is stored in the form of: (NMDCAT 2020)

A. Gravitational energy B. Kinetic energy
C. Electric intensity D. Magnetic energy

Q.98 Ohm time's farad is equivalent to: (NMDCAT 2020)

A. Time B. Charge
C. Distance D. Capacitor

Q.99 By increasing area of the plates and decreasing distance between them the capacitance of capacitor: (NUMS 2020)

A. Increases B. Decreases
C. Remains unchanged D. Depending upon temperature

Q.100 If we double the separation between two charges, then coulomb's force will become? (NUMS 2020)

A. Doubled B. Half
C. 4-times D. $1/4^{th}$

Q.101 Electric force and electric field intensity for a charge are (NMDCAT 2021)

A. Parallel to each other B. Opposite to each other
C. Perpendicular to each other D. At any orientation

Q.102 A charge Q placed at the centre of two charges + q and + q. the system is in equilibrium then net force experienced by Q. (NMDCAT 2021)

A. Zero B. F
C. At equilibrium, net force will be zero D. F/2

Q.103 In series combination of capacitors (NMDCAT 2021)

A. $C_1+C_2+C_3$ B. $\frac{C_1C_2}{C_1+C_2}$ C. $\frac{C_1+C_2}{C_1C_2}$ D. $\frac{1}{C_1+C_2+C_3}$

Q.104 Work done per unit coulomb is equal to (NMDCAT 2021)

A. Electric field B. Magnetic field
C. Electric potential D. None

Q.105 Work on charge is equipotential surface is (NMDCAT 2021)

A. +ve B. –ve
C. Zero D. None

Q.106 Capacitance of spherical capacitor is (NMDCAT 2021)

A. $4\pi Eab$ B. $4\pi E(b-a)$
C. $4\pi E/(b-a)$ D. None

Q.107 For n numbers of Capacitors, each of the capacitance Is "C" what will be the ratio between maximum and minimum capacitor? (NMDCAT 2021)

A. n B. n^2

C. n^3 D. n^4

Q.108 A capacitor is charged with a battery and energy stored is U. After disconnecting battery another capacitor of same capacity is connected in parallel to the first capacitor. Then energy stored in each capacitor is (UHS 2022)

A. U/2 B. U/4

C. 4U D. 2U

Q.109 What is the potential difference between two points in an electric field if it takes 600J of energy to move a charge of 2C between these two points? (UHS 2022)

A. 1200 V B. 800 V

C. 300 V D. 0 V

Q.110 Gauss law cannot be used to find which of the following quantity? (UHS 2022)

A. Electric field intensity B. Electric flux

C. Charge D. Permittivity

Q.111 Which one of the following statements is true? (UHS 2022)

A. Electrostatic force obeys inverse square law while gravitational force does not

B. Both gravitation force and electrostatic force are repulsive in nature

C. Gravitational force is much weaker than electrostatic force

D. Both electrostatic force and gravitational force don't obey inverse square law

Q.112 The Coulomb's constant k depends upon? (UHS 2022)

A. Nature of medium B. System of units

C. Types of charge D. Nature of medium and system of units

Q.113 A charged particle is moving in a uniform electric field. For the motion of the particle due to the field, which quantity has a constant non-zero value? (UHS 2022)

A. Acceleration B. Displacement

C. Rate of change of acceleration D. Velocity

Q.114 A capacitor of capacitance 'C' has a charge 'Q' and stored energy is 'W'. If the charge is increased to '2Q'. The stored energy will be: (UHS 2022)

A. 2W B. 4W

C. W/4 D. W/2

Q.115 Electric intensity due to charge distributions are calculated using which following law? (SZABMU 2022)

A. Ohm's law B. Faraday's law

C. Gauss's law D. Ampere's law

Q.116 The capacitance of capacitor does not depend on: (SZABMU 2022)

A. Area of plates B. Medium

C. Distance between plates D. Thickness of plates

Q.117 The SI unit of potential difference is: (SZABMU 2022)

A. Volt B. Coulomb

C. Watt D. eV

Q.118 Electric potential is defined as: (SZABMU 2022)
A. Work per unit charge
B. Force per unit charge
C. Power per unit charge
D. Force

Q.119 1eV is equal to: (SZABMU 2022)
A. 1.602×10^{-19}J
B. 16.02×10^{-19}J
C. 1620 J
D. 162.0×10^{-19}J

Q.120 The energy stored in a capacitor is given by: (ETEA 2022)
A. $U = \frac{1}{2}QV^2$
B. $U = \frac{1}{2}CV^2$
C. $U = \frac{1}{2}QC$
D. $U = \frac{Q}{2V}$

Q.121 Two charges on of which is $Q_1 = 3\mu C$ and second one is $Q_2 = -1\mu C$ are separated by 100 cm. The electric potential is zero at a point (ETEA 2022)
A. 25 cm from Q_2
B. 75 cm from Q_2
C. 50 cm from Q_1
D. 33.3 cm from Q_1

Q.122 The electric field intensity at a point situated 4 m from a point charge is 200 N/C. If the distance is reduced to 2 m, what will be field intensity? (BMU 2022)
A. 400 N/C
B. 800 N/C
C. 600 N/C
D. 1200 N/C

Q.123 Which type of energy does the capacitor store? (BMU 2022)
A. Kinetic
B. Potential
C. Thermal
D. Light

Q.124 When the distance between two charged particles is halved, the Coulomb force between them becomes (BMU 2022)
A. One fourth of the initial force
B. Four times the initial force
C. Double the initial force
D. One half of the initial force

Q.125 In equation $E = -\frac{\Delta V}{\Delta r}$. Negative sign indicates that: (DUHS 2022)
A. 'E' point towards increasing 'V'
B. 'E' point towards decreasing 'V'
C. 'E' is perpendicular 'V'
D. 'E' is parallel to 'ΔV'
E. 'E' is opposite to 'ΔV'

Q.126 The electric field intensity between two uniformly, oppositely charged parallel plates is: (DUHS 2022)
A. $\frac{\sigma}{2\varepsilon_o}$
B. $\frac{\varepsilon_o}{\sigma}$
C. $\frac{2\sigma}{\varepsilon_o}$
D. $\frac{\sigma}{\varepsilon_o}$
E. $\frac{\varepsilon_o}{2\sigma}$

Q.127 If $2\mu F$ and $4\mu F$ capacitors are connected in series. Their equivalent capacitance will be: (DUHS 2022)
A. 8 μF
B. 0.75 μF
C. 1.33 μF
D. 6 μF
E. 2 μF

Q.128 **A proton of charge 1.6×10^{-19}C is moved through a P.D of 20 V. The energy gained by the proton is:** **(DUHS 2022)**

A. -32×10^{-19}J
B. 32×10^{-19}J
C. -32×10^{19}J
D. 32×10^{19}J
E. Zero

Q.129 **Two similar point charges, each of 1 coulomb, placed in free space 1m apart, repel each other with a force of:** **(DUHS 2022)**

A. 8.85×10^{-12} N
B. 1.602×10^{-10} N
C. 1 N
D. 6.67×10^{-11} N
E. 9×10^{9} N

Q.130 **If a slab of dielectric constant $\varepsilon_r = 2$ is inserted between the parallel plates of a charged 20 μF capacitor. Its capacitance will:** **(DUHS 2022)**

A. Remain the same
B. Be four times
C. Be doubled
D. Be halved
E. Become zero

Q.131 **Energy stored in a capacitor is given by:** **(NUMS 2022)**

A. $E = \frac{1}{2}CV^2$
B. $E = 2CV^2$
C. $E = CV^2$
D. $E = CV$

Q.132 **Electric field intensity is:** **(NUMS 2022)**

A. Force per unit mass
B. Force per unit tesla
C. Force per unit charge
D. Force per unit watt

Q.133 **It stores electrical potential energy:** **(NUMS 2022)**

A. Capacitor
B. Conductor
C. Inductor
D. Generator

ANSWER KEY

PRACTICE EXERCISE

1	C	16	C	31	B	46	B	61	B
2	D	17	A	32	C	47	A	62	B
3	D	18	D	33	B	48	C	63	C
4	C	19	B	34	A	49	A		
5	C	20	B	35	B	50	B		
6	D	21	A	36	B	51	A		
7	A	22	B	37	C	52	C		
8	C	23	C	38	B	53	C		
9	D	24	B	39	B	54	B		
10	C	25	C	40	D	55	C		
11	D	26	B	41	C	56	C		
12	C	27	C	42	A	57	B		
13	A	28	C	43	C	58	B		
14	A	29	A	44	C	59	A		
15	C	30	A	45	A	60	D		

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64	A	79	B	94	D	109	C	124	B
65	B	80	B	95	C	110	D	125	B
66	D	81	D	96	C	111	C	126	D
67	A	82	A	97	C	112	D	127	C
68	A	83	D	98	A	113	A	128	B
69	D	84	D	99	A	114	B	129	E
70	C	85	B	100	D	115	C	130	C
71	A	86	D	101	A	116	D	131	A
72	C	87	D	102	C	117	A	132	C
73	B	88	A	103	B	118	A	133	A
74	A	89	B	104	C	119	A		
75	D	90	A	105	C	120	B		
76	A	91	C	106	D	121	A		
77	D	92	C	107	B	122	B		
78	B	93	C	108	B	123	B		

EXPLANATORY NOTES

PRACTICE EXERCISE

1. Since the charges are unlike, the force will be attractive. Thus, the force directs from 1C to -4C.

2. $V=\frac{KQ}{r}=\frac{9\times10^9\times2\times10^{-9}}{1}=18V$

3. When A is touched with B, half of its charge will flow towards B so that charges on both becomes equal. Now the charge on A is q/2. Now when it is touched with C, again half of its charge will flow towards C, so that charge on both A and C is equal. Thus, charge on C will be q/4.

4. Capacitance without dielectric = 40 F.
Capacitance with dielectric = 80 F.
k = 80/40
k = 2.

5. The maximum energy that can be desirably stored in a capacitor is depends on the maximum electric field that the dielectric can withstand without breaking down. Therefore, capacitors of the same type have about the same maximum energy density, i.e. joules of energy per cubic meter.

6. Capacitors are in series.
1/C = 1/2 + 1/4 + 1/6, therefore, C = (12/11) F.
Q = C × V = 220 × (12/11) = 240C.
V across 2F capacitor = Q/C = 240/2 = 120V.

7. The initial current of a capacitor is very high because the voltage source will transport charges from one plate of the capacitor to the other plate.

8. The equivalent capacitance when capacitors are connected in parallel is the sum of all the capacitors = 1 + 2 = 3F. Q = CV = 3 × 100 = 300V.

9. If r = 2r

$$F=\frac{kq^2}{r^2}\Rightarrow F'=\frac{F}{4}$$

10. $F=\frac{kq_1q_2}{r^2}$

$$F'=\frac{1}{4\pi\epsilon_o\epsilon_r}\times\frac{q_1q_2}{r^2}\Rightarrow F'=\frac{F}{\epsilon_r}$$

11. When two balls are connected by a conducting wire the net charge is (2Q–Q) i.e Q and Q is divided equally between two balls.

$F\propto 2Q^2$ _____(i)

$F'\propto\left(\frac{Q}{2}\right)^2$ ---(ii)

Dividing equation (ii) by equation (i)

$$\frac{F'}{F}=\frac{Q^2/4}{2Q^2}=\frac{1}{8}$$

$$\boxed{F'=\frac{1}{8}F}$$

12. As electric charge on electron is

$Q=1.6\times10^{-19}\,C$

If 10^{+19} electrons removed from a neutral plate, then electric charge is + 1.6 C.

13. In second case, charges will be $-2\mu C$ and $+3\mu C$ Since $F\propto Q_1Q_2$ i.e.

$$\frac{F}{F'}=\frac{Q_1Q_2}{Q_1'Q_2'}=\frac{40}{F'}=\frac{3\times8}{-2\times3}=-4F'=10\,N\,(\text{Attractive})$$

14. Because +2C charge will become neutral with -2C charge. So, F = 0

15. If two electrons are removed from a conductor the charge on it is equal to 2 protons

$q=2e^+=2\times1.6\times10^{-19}$, $C=3.2\times10^{-19}\,C$

16.

$$F=\frac{kq_1q_2}{r^2}\Rightarrow F\propto\frac{1}{r^2}$$

$$r'=2r\Rightarrow F'=\frac{F}{4}=\frac{120}{4}=30N$$

17. When positive charge is moved against electric field its P.E increases. When negative charge is moved along electric field its P.E increases.

18. Neutron, x-rays and γ-rays are neutral.

19. $$E=\frac{F}{q}\Rightarrow NC^{-1}$$

$$E=\frac{\Delta V}{\Delta r}\Rightarrow Vm^{-1}$$

NC^{-1}, Vm^{-1} both are units of electric field.

20. $F_e=F_g$

$eE=mg$

$$E=\frac{mg}{e}$$

21. $$E=\frac{kq}{r^2}\Rightarrow\frac{9\times10^9\times2\times10^{-5}}{(20\times10^{-2})^2}$$

$$E=4.5\times10^6\,N/C$$

22. $$E=\frac{F}{q}=\frac{mg}{q}=\frac{1.67\times10^{-27}\times10}{1.6\times10^{-19}}=10^{-7}\,Vm^{-1}$$

23. Field will be stronger where filed lines are closer to each other i.e. $E_A>E_B$

24. As $E = \frac{\Delta V}{\Delta r}$

$E = \frac{300}{0.01} = 30000 = 3\times10^4\ Vm^{-1}$

25. $\vec{E} = \frac{\Delta V}{\Delta r} = \frac{4\Delta V}{2\Delta r} = 2$

26. $E = \frac{kq}{r^2} \Rightarrow r' = \frac{r}{2}$

$E' = 4E = 4\times200 = 800N/C$

27. Properties of electric field lines

28. According to 3rd application of gauss's law, the electric field between two equal and opposite charged plates is $E = \frac{\sigma}{\varepsilon_o}$

29. Gauss's law is used to determined electric field intensity due to different charge configuration.

30. $\vec{E} = \frac{\sigma}{2\epsilon_o}\hat{r}$

31. $V_{med} = \frac{V}{\varepsilon_r}$

$\varepsilon_r = \frac{V}{V_{med}} = \frac{V}{V/8} = 8$

32. Because current flows from higher potential to lower potential.

33. $\Delta V = \frac{W}{q} = \frac{16}{4} = 4\,V$

34. As we know,

$V = \frac{kq}{r} \quad \Rightarrow \quad \frac{V_1}{V_2} = \frac{q_1/r_1}{q_2/r_2}$

$V_2 = \frac{q_2}{r_2}\times\frac{r_1}{q_1}\times V_1 \Rightarrow V_2 = \frac{q}{3}\times\frac{1}{q}\times5 \Rightarrow V_2 = \frac{5}{3}$ volt

35. $V = \frac{1}{4\pi\varepsilon_o}\frac{Ze}{r}$

$V = \frac{9\times10^9\times50\times1.6\times10^{-19}}{9\times10^{-15}} \Rightarrow V = 8.0\times10^6\,V$

36. $C_{med} = \varepsilon_r \times C_{vac}$

$\frac{\cancel{\emptyset}}{V_{med}} = \varepsilon_r \times \frac{\cancel{\emptyset}}{V_{vac}}$

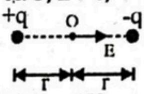
$V_{med} = \frac{V_{vac}}{\varepsilon_r} = \frac{100}{10} = 10\,V$

37. In the direction of electric field potential decreases.

38. $V=\frac{1}{4\pi\varepsilon_o}.\frac{Q}{r}\Rightarrow V\propto\frac{1}{r}$

39. $V=\frac{kq}{r}\Rightarrow V\propto\frac{1}{r}$

40. At O, $E\neq 0$, $V=0$



41. $K.E=q\Delta V$

where $q_\alpha=2e$

$K.E=(2e)(10^6V)=2\times10^6eV=2MeV$

42. Both plates has opposite charge having magnitude "Q".

43. Energy stored in a capacitor and some loss of energy in the form of heat in resistance.

44. $Q=CV$

$Q=2\times10^{-6}\times12\Rightarrow Q=2.4\times10^{-5}C$

45. $Q=CV$

$V=\frac{Q}{C}=\frac{20\times10^{-6}}{2\times10^{-6}}=10\,\text{volt}$

46. $Q=CV=(6\times10^{-6})\times200=1200\mu C$

47. We have $C=\frac{\varepsilon_0 A}{d}\Rightarrow A=\frac{Cd}{\varepsilon_0}=\frac{3\times5\times10^{-3}}{8.85\times10^{-12}}=1.69\times10^9m^2$

48. $C=\frac{K\varepsilon_0 A}{d};\frac{C_1}{C_2}=\frac{K_1}{K_2}\Rightarrow\frac{C}{C_2}=\frac{5}{20}\Rightarrow C_2=4C$

49. $C_{med}=\frac{A\varepsilon_o k}{d}\Rightarrow C_{med}\propto k$

50. $C=\frac{A\varepsilon_o\varepsilon_r}{d}$

51. As, $C_{med}=\varepsilon_r\times C_{vac}\Rightarrow C=100\times10\Rightarrow C=1000F$

52. When dielectric is inserted between plates then capacitance will increase

53. information

54. $C_{vac}=\frac{A\varepsilon_o}{d}$, Thickness of plates has no effect on the capacitance of a capacitor.

55. Energy density $=\frac{\text{energy}}{\text{volume}}=\frac{1}{2}\varepsilon_o E^2$

56. As we know,

$U_m=\frac{1}{2}CV^2=\frac{Q^2}{2C}=\frac{qV}{2}$ but $U_m\neq 2qV$

57. $E=\frac{1}{2}CV^2\Rightarrow E\propto V^2$

$V'=2V\ \Rightarrow\ E'=4E$

58. As we know,

$$E=\frac{1}{2}CV^2 \Rightarrow V=\sqrt{\frac{2E}{C}}$$

$$V=\sqrt{\frac{2\times 20}{10}} \Rightarrow V=\sqrt{4}=2 \text{ volt}$$

59. Energy $=\frac{1}{2}CV^2$

60. $U=\frac{1}{2}CV^2=\frac{1}{2}\times 1\times (4)^2=8J$

61. A capacitor charging and discharging exponentially.

62. RC = time constant
If RC is small then time constant will also small then capacitor will be charged and discharged quickly.

63. In discharging of capacitor, current increases exponentially.

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64. $\Delta K.E=q\Delta V$
$=(2e)(3V)=6eV$
$=6\times 1.6\times 10^{-19}=9.6\times 10^{-19}J$

65. Definition of potential difference

66. $\vec{E}=\frac{\vec{F}}{q_o} \quad \therefore\ E=F$

67. $\Delta V=Ed$

68. Smaller value of time constant, RC leads to more discharge.

69. Energy stored $=\frac{1}{2}CV^2=\frac{1}{2}(1)(10)^2=50J$

70. $C=\frac{A\varepsilon_o}{d} \Rightarrow C'=\frac{(2A)\varepsilon_o}{\frac{1}{2}d}=4C$

71. $Q=CV=(5\times 10^{-6})(12)=60\mu C$

72. $C=\frac{A\varepsilon_o}{d}=\frac{2\times 8.85\times 10^{-12}}{2\times 10^{-3}}=8.85\times 10^{-9}F$

73. $E=\frac{-\Delta V}{\Delta r}$

74. $E=\frac{V}{d}$

75. $E=\frac{\Delta V}{\Delta r}=\frac{V}{m}=\frac{J}{Cm} \Rightarrow E=\frac{F}{q}=\frac{N}{C}$

76. Length $=L'=2L$, Width $=W'=2W \Rightarrow A'=2L\times 2W=4A \Rightarrow C'=\frac{(4A)\varepsilon_o}{2d}=2C$

77. $U=\frac{1}{2}QV=\frac{1}{2}\times10\times40=200J$

78. $F=\frac{kq_1q_2}{r^2}\Rightarrow F\propto\frac{1}{r^2}$

79. $F=\frac{kq_1q_2}{r^2}\Rightarrow 2=\frac{(9\times10^9)(2)q_2}{3^2}\Rightarrow q_2=1\times10^{-9}C$

80. $\vec{r}=(4\hat{i}+3\hat{j})m\Rightarrow|\vec{r}|=\sqrt{4^2+3^2}=5m$

$\vec{E}=\frac{kq}{r^2}\hat{r}=\frac{kq}{r^2}\frac{\vec{r}}{r}=\frac{(9\times10^9)(5\times10^{-6})(4\hat{i}+3\hat{j})}{(5)^2\times5}=(1440\hat{i}+1080\hat{j})V/m$

81. In uniform electric field then at point A, B, C a charge particle will experience same force.

82. $C=\frac{Q}{\Delta V}\quad \Delta V=V_+-(-V)\quad \Delta V=20V\quad C=\frac{40C}{20V}=2F$

83. $e=P\quad Fe=\frac{ke^2}{R^2}\qquad Fp=\frac{ke^2}{R^2}\qquad \frac{Fe}{Fp}=\frac{ke^2}{R^2}\times\frac{R^2}{ke^2}=1$

84. $k=9\times10^9\,Nm^2C^{-2}$

85. $\vec{E}=\frac{\vec{F}}{q_o}$

86. $P=VI\Rightarrow\frac{E}{t}=VI\Rightarrow E=VI\times t=2.2\times0.25\times1=0.55J$

$Q=It=0.25\times1=0.25C$

87. $V=\frac{kq}{r}=\frac{(9\times10^9)(2\times10^{-6})}{1^2}=1.8\times10^4V$

88. For discharging $= q=q_oe^{-t/RC}$ (Dividing by C) so: $q/C=q_o/C(e^{-t/RC})$, $V=V_oe^{-t/RC}$

89. Electrostatic force is mutual force

90. $E=Kq/r^2$

91. $F=\frac{kq_1q_2}{r^2}$

92. $E\propto\frac{1}{r^2}$ for $r'=2r\Rightarrow E'=\frac{E}{4}$

$V\propto\frac{1}{r}\Rightarrow V'\propto\frac{1}{2r}\Rightarrow V'=\frac{V}{2}$

93. Energy $=qV=5e\times25=125eV=125\times1.6\times10^{-19}J$

94. $E=-\frac{\Delta V}{\Delta r}\Rightarrow E\propto\frac{1}{\Delta r}$

95. $V\propto\frac{1}{r}\rightarrow\frac{V_1}{V_2}=\frac{r_2}{r_1}$

$\frac{1}{V_2}=2\rightarrow V_2=\frac{1}{2}=0.5$ Volt

96. $E=\frac{q}{4\pi \in_o \in_r r^2}\rightarrow E\propto\frac{1}{\in_r}$

97. In capacitor electrical energy is stored in the form of electric intensity

$E_d=\frac{1}{2}\in_o E^2$

98. $RC=t\Rightarrow(\text{ohm})(\text{farad})=\text{time}$

99. $C=\frac{A\varepsilon_o}{d}$

100. $F\propto\frac{1}{r^2}$

101. $\hat{E}=\hat{F}$

102. At equilibrium $\Sigma F=0$

103. For two capacitor of series $C_s=\frac{Product}{Sum}=\frac{C_1C_2}{C_1+C_2}$

104. $V=\frac{W}{q}$

105. On equipotential surface $\Delta V=0$

$W=q\Delta V=0$

106. $C=4\pi\varepsilon_o\left(\frac{ba}{b-a}\right)$

107. $\frac{C_{max}}{C_{min}}=\frac{nc}{\frac{c}{n}}=n^2$

108. $U=\frac{Q^2}{2C}$

109. $V=\frac{W}{q}$

$V=\frac{600}{2}=300V$

110. $\Phi_e=\frac{1}{\varepsilon_o}Q, E=\frac{\sigma}{\varepsilon_o}$

So, we cannot find permittivity by using Gauss's law.

111. Information.

112. Information.

113. a = F/m = qE/m

$E\neq0$ so $a\neq0$

114. $W=U=\frac{Q^2}{2C}$

$Q'=2Q$

$W'=4W$

115. Application of Gauss's law.

116. $C=\dfrac{A\varepsilon_o}{d}$

Capacitance is independent of thickness of plate.

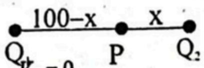
117. Unit of potential difference is volt.

118. $V=\dfrac{W}{q}$

119. $1\text{eV}=1.602\times10^{-19}\text{J}$

120. Book formula.

121.



$V_p=0$

$V_{Q1}+V_{Q2}=0$

$\dfrac{k\times3\times10^{-6}}{100-x}-\dfrac{k\times1\times10^{-6}}{x}=0\Rightarrow x=25cm$

122.

$E\propto\dfrac{1}{r^2}$

$r'=\dfrac{r}{2}$

$E'=4E=4\times200=800NC^{-1}$

123. Information.

124.

$F\propto\dfrac{1}{r^2}$

$r'=\dfrac{r}{2}$

$F'=4F$

125. Information.

126. Book formula.

127. $C_{eq}=\dfrac{C_1C_2}{C_1+C_2}=\dfrac{8}{6}=1.33\,\mu F$

128. $K.E=q\Delta V=1.6\times10^{-19}\times20=32\times10^{-19}J$

129. $F=\dfrac{kq_1q_2}{r^2}=\dfrac{9\times10^9\times1\times1}{1^2}=9\times10^9N$

130. $C_{med}=\varepsilon_rC_{vac}=2\times20\times10^{-6}=40\mu F$

$C_{med}=2C_{vac}$

131. Mathematical formula.

132. $E=\dfrac{F}{q}$

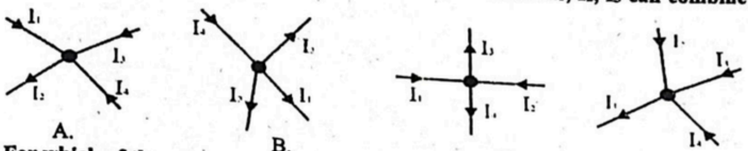
133. Information.

TOPIC 7

CURRENT ELECTRICITY

PRACTICE EXERCISE

Q.1 The diagrams show five different ways in which currents I_1, I_2, I_3 can combine at a junction.



A. B. C. D.

For which of these junctions, is the following equation correct? $I_1 + I_2 = I_3 + I_4$

A. A
B. B
C. C
D. D

Q.2 Kabir bought 5 new light bulbs of 50 W each in addition to the 7 bulbs he already had in his house which were also 50 W each. Calculate his electricity bill, if he keeps the new bulbs on for 5 hours and the older bulbs on only for 3 hours, and the cost of one unit of electricity is Rs. 60.

A. Rs.136
B. Rs.137
C. Rs.138
D. Rs.139

Q.3 In potentiometer, the ratio of emf of cells is equal to the corresponding ratio of their:

A. Balancing lengths
B. Balancing currents
C. Both 'A' and 'B'
D. None of these

Q.4 An engine uses 30 A of current. The resistance offered is 15 ohms. Calculate the power consumed by the engine in horse power.

A. 18 hp
B. 19 hp
C. 17 hp
D. 13500 hp

Q.5 A current of 3 A passes through an electric circuit for 5 minutes and does a work of 900J. What is the emf of the source?

A. 3V
B. 1V
C. 5V
D. 10V

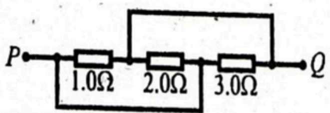
Q.6 A cooler of 1500 W, 200 volt and a fan of 500 W, 200 volts are to be used from a household supply. The rating of fuse to be used is

A. 2.5 A
B. 5.0 A
C. 7.5 A
D. 10 A

Q.7 An electric current is passed through a circuit containing two wires of the same material, connected in parallel. If the lengths and radii of the wires are in the ratio of 4/3 and 2/3, then the ratio of the currents passing through the wire will be

A. 3
B. 8/9
C. 1/3
D. 2

Q.8 Three resistors are connected as shown in the diagram using connecting wires of negligible resistance.



What is the approximate resistance between point P and Q?

A. 0.5Ω
B. 2.0Ω
C. 0.8Ω
D. 2.2Ω

Q.9 The current in a resistor is 8.0 mA. What charge flows through the resistor in 0.020 s?
A. 0.16 mC
B. 4.0 mC
C. 1.6 mC
D. 0.40 mC

Q.10 Which of the following statements is not true?
A. Conductance is the reciprocal of resistance and is measured in siemens
B. Semiconductors diode are ohmic devices
C. Ohm's law is not applicable at very low and very high temperatures
D. Ohm's law is not applicable to electron tubes, discharge tubes

Q.11 Ohm's law establishes a relation between
A. Current and voltage
B. Resistance and voltage
C. Charge and voltage
D. Current and resistance

Q.12 For an ohmic conductor, doubling the voltage without changing the resistance will cause the current to
A. Decrease by a factor of 4
B. Decrease by a factor of 2
C. Remain unchanged
D. Increase by a factor of 2

Q.13 Which equation is used to define resistance?
A. Energy = $(\text{current})^2$ × resistance × time
B. Power = $(\text{current})^2$ × resistance
C. Potential difference = current × resistance
D. Resistivity = resistance × area ÷ length

Q.14 The charge of an electron is 1.6×10^{-19} (C) How many electrons strike the screen of a cathode ray tube each second when the beam current is 16 mA
A. 10^{19}
B. 10^{-19}
C. 10^{17}
D. 10^{-17}

Q.15 The following four wires are made of the same material and are at the same temperature. Which one of them has highest electrical resistance
A. length = 100 cm, diameter = 1 mm
B. length = 200 cm, diameter = 2 mm
C. length = 50 cm, diameter = 0.5 mm
D. length = 300 cm, diameter = 3 mm

Q.16 The resistance of a wire of uniform diameter d and length l is R. The resistance of another wire of the same material but diameter 2d and length $4l$ will be
A. 2R
B. $\frac{R}{2}$
C. R
D. $\frac{R}{2}$

Q.17 When the length and area of cross-section both are doubled, then its resistance
A. Will become half
B. Will remain the same
C. Will be doubled
D. Will become four times

Q.18 The example for non-ohmic resistance is
A. Copper wire
B. Diode
C. Carbon resistance
D. Tungston wire

Q.19 A wire 100cm long and 2.0 mm diameter has a resistance of 0.7 ohm, the electrical resistivity of the material is
A. 4.4×10^{-6} ohm m
B. 1.1×10^{-6} ohm m
C. 2.2×10^{-6} ohm m
D. 0.22×10^{-6} ohm m

Q.20 Which of the following have the same temperature coefficient of resistivity?
A. Iron and silver
B. Platinum and silver
C. Iron and platinum
D. Silver and gold

Q.21 When a wire is stretched double of is length, then its resistance will be
A. 16 R
B. 4 R
C. 2 R
D. 8 R

Q.22 **A wire of resistance R is cut into two equal parts, its resistance becomes R/2, what happens to resistivity:**
A. Double
B. Same
C. Half
D. One fourth

Q.23 **A wire of resistance R is stretched four times its length uniformly. Its new resistance will be**
A. 16 R
B. 4 R
C. $\frac{R}{4}$
D. $\frac{R}{16}$

Q.24 **The resistance of a wire is 1 Ω. Which of the following is new resistance if length of wire is doubled?**
A. 2 Ω
B. 4 Ω
C. $\frac{1}{2}\Omega$
D. $\frac{1}{4}\Omega$

Q.25 **When Cu and Ge are cooled to – 150 °C Then resistance of Cu ___ and that of Ge _____**
A. Increases, increases
B. Decreases, decreases
C. Increases, decreases
D. Decreases, increases

Q.26 **If a wire conductor of 0.2 ohm resistance is doubled in length, its resistance becomes**
A. 0.4 ohm
B. 0.8 ohm
C. 0.6 ohm
D. 1.0 ohm

Q.27 **If $r = 0$, $R = \infty$, ($V = \varepsilon - Ir$) then**
A. $V > \varepsilon$
B. $V = \varepsilon$
C. $V < \varepsilon$
D. $V = 0$

Q.28 **An 8Ω resistance connected to a battery with internal resistance draws 1.6 A and if a 30Ω resistance is connected to the same battery if draws 0.5 (A. What is the current drawn by a 6Ω resistance from this battery?**
A. 2A
B. 2.5 A
C. 2.2 A
D. None of these

Q.29 **Internal resistance of ideal current source is**
A. Infinite
B. Very low
C. Zero
D. Very high

Q.30 **Internal resistance is the resistance offered by ________________**
A. Source of e.m.f
B. Resistor
C. Conductor
D. Capacitor

Q.31 **An electric current source is actually source of**
A. Current
B. Energy
C. Charge
D. Power

Q.32 **A new flashlight cell of emf 1.5 volts gives a current of 15 A, when connected directly to an ammeter of resistance 0.04 Ω. The internal resistance of cell is**
A. 0.04 Ω
B. 0.10 Ω
C. 0.06 Ω
D. 10 Ω

Q.33 **If the current in electric bulb decreases by 0.5%, then the power in the bulb decreases by approximately**
A. 1%
B. 0.5%
C. 2%
D. 0.25%

Q.34 **What will be energy used by the battery if the battery has to drive 6.28×10^{18} electrons with potential difference of 20 V across the terminal?**
A. 5 joules
B. 15 joules
C. 10 joules
D. 20 joules

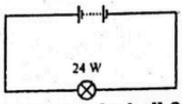
Q.35 **1 horse power = ______**
A. 746 kW
B. 746 W
C. 746mW
D. 746MW

Q.36 **If R_1 and R_2 are respectively the filament resistances of a 200-watt bulb and 100-watt bulb designed to operate on the same voltage, then**
A. R_1 is two times R_2
B. R_2 is four times R_1
C. R_2 is two times R_1
D. R_1 is four times R_2

Q.37 **Two electric bulbs, one of 200 volt 40 watt and the other 200 volt 100 watt are connected in a house wiring circuit**
A. They have equal currents through them
B. The resistance of the filaments in both the bulbs is same
C. The resistance of the filament in 40-watt bulb is more than the resistance in 100-watt bulb
D. The resistance of the filament in 100-watt bulb is more than the resistance in 40-watt bulb

Q.38 **A heater coil is cut into two equal parts and only one part is now used in the heater. The heat generated will now be**
A. Halved
B. Four times
C. One-fourth
D. Doubled

Q.39 **A battery is used to light a 24 W electric lamp. The battery provides a charge of 120 C in 60 s.**



What is the potential difference across the bulb?
A. 5 V
B. 12 V
C. 24 V
D. 120 V

Q.40 **A 100 W, 200V bulb is connected to a 160 V supply. The actual power consumption would be**
A. 64 W
B. 100 W
C. 72 W
D. 90 W

Q.41 **Electrical energy is converted to heat at the rate of ______**
A. IRt
B. I^2Rt
C. I^2R
D. VIt

Q.42 **A 40 W lamp turns half the electrical energy to give light. How much light energy does it give out in 10 s?**
A. 200 J
B. 800 J
C. 400 J
D. 40 J

Q.43 **An electrical bulb marked 100 W, 200 V would mean the resistance is**
A. 200-ohm
B. 50 ohm
C. 400 ohm
D. 50 ohm

Q.44 **You are given four bulbs of 25 W, 40 W, 50 W and 60 W. Which bulb has the lowest resistance?**
A. 25 W
B. 60 W
C. 50 W
D. 40 W

Q.45 **SI unit of resistivity is______**
A. $\Omega\text{-m}^2$
B. $(\Omega\text{-m})^{-2}$
C. Ω-m
D. $(\Omega\text{-m})^{-1}$

Q.46 **The following four wires are made of the same material and are at the same temperature. Which one of them has highest electrical resistance**
A. length = 100 cm, diameter = 1 mm
B. length = 50 cm, diameter = 0.5 mm
C. length = 200 cm, diameter = 2 mm
D. length = 300 cm, diameter = 3 mm

7 Topic

CURRENT ELECTRICITY

PAST PAPER MCQ'S

.47 A wire has resistance 100 Ohm at 0 °C and 200 Ohm at 100 °C. What is its temperature coefficient in K^{-1}? **(MCAT 2008)**

A. –0.01 B. 0.01
C. –1/273 D. 1/273

.48 The heat produced by a current I in the wire of resistance R during time interval t is **(MCAT 2008)**

A. I^2/Rt B. $I^2/R/t$
C. I^2Rt D. IR^2t

49 The fractional change in resistance per Kelvin is known as: **(MCAT 2009)**

A. Temperature coefficient of resistance B. Linear coefficient of expansion
C. Thermal coefficient D. Volumetric coefficient of expansion

50 The energy supplied by the cell to the charge carriers is derived from the conversion of: **(MCAT 2009)**

A. Heat energy into Electrical energy B. Solar energy into Electrical energy
C. Chemical energy into Electrical energy D. Mechanical energy into Electrical energy

51 The deviation of I-V graph from the straight line is due to: **(MCAT 2009)**

A. Decrease in temperature and decrease in resistance
B. Decrease in temperature and increase in resistance
C. Increase in temperature and increase in resistance
D. Increase in temperature and decrease in resistance

.52 The equivalent current which passes from a point at higher potential to a point at a lower potential as if it represented a movement of positive charges is **(MCAT 2010)**

A. Electronic current B. Magnetic lines
C. Electric current D. Conventional current

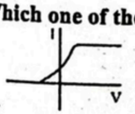
.53 The substances like germanium and silicon have **(MCAT 2010)**

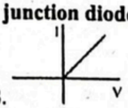
A. Negative temperature coefficient B. Positive temperature coefficients
C. Both A and B D. None of the above

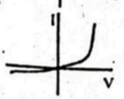
.54 If 2 A current passes through a resistor when connected to a certain battery. If the resistance is replaced by the double resistance, then the current will become **(MCAT 2011)**

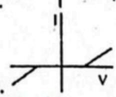
A. 2A B. 6A
C. 4A D. 1A

Q.55 Which one of the following is I-V curve of a junction diode? **(MCAT 2012)**

A. 

B. 

C. 

D. 

Q.56 Electric charge on an object is measured as 5 micro coulombs. How the value of this charge can be expressed in terms of base unit: **(MCAT 2012)**

A. 5×10^{-3} ampere second B. 5×10^{-6} ampere second
C. 5×10 ampere second D. 5×10^{-2} ampere second

Q.57 12-volt battery is applied across 6Ω resistance to have a steady flow of current. What must be the required potential difference across the same resistance to have a steady current of one ampere? (MCAT 2013)

A. 12V B. 1V
C. 3.V D. 6.V

Q.58 Resistance between two opposite faces of square thin film of area $1mm^2$ having thickness of 1μm if resistivity of material is $10^{-6}\Omega m$ will be: (MCAT 2016)

A. 1000 Ω B. 1Ω
C. 100 Ω D. 10 Ω

Q.59 If the potential difference across a resistor is doubled: (ETEA 2016)

A. Only the current is doubled B. Only the current is halved
C. Only the resistance is doubled D. Only the resistance is halved

Q.60 A total charge of 100 C flows through a 12W bulb in a time of 50 second. What is the potential difference across the bulb during this time? (ETEA 2016)

A. 0.12V B. 2.0V
C. 6.0V D. 24V

Q.61 The temperature coefficient of resistance of a semiconductor is: (ETEA 2016)

A. Positive B. Negative
C. Imaginary D. Zero

Q.62 2×10^6 electrons passing through a conductor in 1 ms. Find electric current flowing through conductor: (MDCAT 2017)

A. 32×10^{-9} A B. 3.2×10^{-10} A
C. 320×10^{-10} A D. 0.32×10^{-10} A

Q.63 A carbon resistor is connected to a battery of 50 volt and 2 ampere current is passing through it. If voltage is increased to 75 volt, current will become: (MDCAT 2017)

A. 3Amp B. 4.5Amp
C. 1.5Amp D. 6Amp

Q.64 When the current is neither drawn from a source nor given to it then: (MDCAT 2017)

A. $E = V_t$ B. $E > V_t$
C. $V_t > E$ D. Both "B" & "C"

Q.65 When potential difference is applied across the ends of uniform wire of length *l* and radius r, a current *I* flow in the wire. If same potential difference is applied to the ends of another wire of the same material but of length 2*l* and radius 2r, the current in the wire is (MDCAT 2018)

A. I/4 B. I
C. 2I D. I/2

Q.66 The reciprocal of the conductance is called (ETEA 2018)

A. conductivity B. Resistivity
C. Resistance D. Inductance

Q.67 A typical mobile phone of 5.0 V and an internal resistance of 200 m Ω. What is the terminal P.D of the battery when it supports a current of 500 mA? (ETEA 2018)

A. 4.8V B. 4.9V
C. 5.0 V D. 5.1V

Q.68 A metal cube with sides of length "a" has electrical resistance R between opposite faces. What is the resistance between the opposite faces of a cube of the same metal with sides of length 3a? (ETEA 2018)

A. 9R B. 3R
C. R/3 D. R/9

Q.69 A filament lamp has a resistance of 180Ω when the current in it is 500mA. What is the power dissipated in the lamp? (ETEA 2018)

A. 45W
B. 90 W
C. 290 W
D. 360 W

Q.70 A cell of internal resistance 2.0Ω and electromotive force (e.m.f) 1.5V is connected to a resistor of resistance 3.0 Ω what is the potential difference across 3Ω resistor. (ETEA 2018)

A. 5V
B. 1.2V
C. 0.9 V
D. 0.6V

Q.71 Calculate the rate at which energy is transferred by 220 V mains supply which provides a current of 0.1 A to a LED? (MDCAT 2019)

A. 22 kW
B. 22 W
C. 2.2 kW
D. 2.2 W

Q.72 A copper wire has length L and cross-sectional area A. Its resistance is R. If we halved the length and halved the diameter of wire, then what will be the resistance of this wire? (MDCAT 2019)

A. R
B. 2R
C. 3R
D. 4R

Q.73 A car battery has EMF of 12 Volts and internal resistance 5×10^{-2} ohm. If it draws 60 ampere current, then terminal voltage of the battery will be (ETEA 2019)

A. 5 volts
B. 3 volts
C. 15 volts
D. 9 volts

Q.74 One kilowatt-hour is commonly termed as one commercial unit of electric energy which is equal to (NMDCAT 2020)

A. 3.6×10^5 j
B. 3.6×10^6 j
C. 3.6×10^4 j
D. 3.6×10^3 j

Q.75 When a wire is compressed and its radius becomes 2R then its resistance will be: (NMDCAT 2020)

A. 16R
B. 4R
C. 1/16 R
D. 1/4 R

Q.76 One of the following is an ohmic device (NMDCAT 2020)

A. Filament bulb
B. Semiconductor diode
C. Transistor
D. Copper wire

Q.77 The change in a resistance of metallic conductor below 0°C? (NMDCAT 2020)

A. Nonlinear
B. Curve
C. Linear
D. Curvilinear

Q.78 The power of an electric bulb is 100W. It is connected to 110V power is supply. The resistance of electric bulb will be? (NUMS 2020)

A. 11 Ω
B. 121 Ω
C. 20 Ω
D. 200 Ω

Q.79 If length of the wire becomes two time to the original value and area becomes one half to its original value, then resistance of the wire becomes: (NUMS 2020)

A. Double
B. Four times
C. One half
D. One fourth

Q.80 Conductivity depends on (NMDCAT 2021)

A. Temperature and nature of material
B. Length
C. Area
D. All

Q.81 A load of resistance 0.04 Ω is attached to the cell having E.M.F 1.5 V and 15 A is drawn in the circuit. The internal resistance of cell will be (NMDCAT 2021)

A. 0.6 Ω
B. 0.06 Ω
C. 6 Ω
D. 0.3 Ω

Q.82 Bulb Having Current 200A, and Voltage 220 find Power (NMDCAT 2021)

A. 22kw
B. 44kw
C. 44watt
D. 40 kw

Q.83 A heater of 400 Watt was on for 5 hours what is electrical Consumption (NMDCAT 2021)

A. 20KwH
B. 12 KWH
C. 2KWH
D. None

Q.84 Which of the following bulb has least resistance? (NMDCAT 2021)

A. 50 W
B. 100 W
C. 200 W
D. 300 W

Q.85 How much potential drop exist across closed switch? (UHS 2022)

A. 0 V
B. 1 V
C. 2 V
D. 3 V

Q.86 A 3 V battery is connected in series with ammeter and 2 ohm resistance after short circuiting. What will be reading of ammeter? (UHS 2022)

A. 1 A
B. 1.5 A
C. 5 A
D. 6 A

Q.87 The resistance of a conductor does not depend on which of the following? (UHS 2022)

A. Area
B. Resistivity
C. Length
D. Mass

Q.88 Which of the following statement is NOT CORRECT Kirchhoff's rule? (UHS 2022)

A. Kirchhoff's current rule based upon the law of conservation of charge
B. Wheatstone bridge is an application of Kirchhoff's rule
C. Kirchhoff's rules are more suitable in AC circuits
D. Kirchhoff's voltage rule based upon the law of conservation of energy

Q.89 What do the substances whose resistance decreases with increase in temperature have? (UHS 2022)

A. High temperature coefficient
B. Negative temperature coefficient
C. Positive temperature coefficient
D. Zero temperature coefficient

Q.90 A low voltage supply with an e.m.f of 20 V and an internal resistance of 1.5 ohms is used to supply power to a heater of resistance 6.5 ohms in a fish tan. What is the power supplied to the water in the fish tank? (UHS 2022)

A. 41 W
B. 50 W
C. 53 W
D. 62 W

Q.91 Ohm meter is the unit of: (SZABMU 2022)

A. Resistance
B. Resistivity
C. Conductance
D. Conductivity

Q.92 The total resistance of wire is inversely proportional to: (SZABMU 2022)
A. Length
B. Area
C. Temperature
D. Time

Q.93 Potential divider circuit is made when: (ETEA 2022)
A. Current is divided
B. Emf source is divided
C. Resistance is divided
D. Number of electrons are divided

Q.94 A conductor has resistance R. If its length is stretched to twice the actual value and its radius is reduced to one third of its original values, the new resistance will be: (ETEA 2022)
A. 3R
B. 9R
C. 18R
D. 27R

Q.95 Two electric bulbs "A" and "B" of powers 500W and 2000W respectively are connected to 240V supply. The ratio of current passing through bulb "A" to the current passing through bulb "B" is: (ETEA 2022)
A. 1:2
B. 1:4
C. 1:3
D. 1:16

Q.96 A conductor has length equal to π meters and radius r meters. Its resistance will be equal to: (ETEA 2022)
A. $R = \rho r^{-1}$
B. $R = \rho r^{-2}$
C. $R = \rho r^{-3}$
D. $R = \rho r^{-4}$

Q.97 When two conductors each of resistance R are attached in series to external circuit, their net resistance is: (ETEA 2022)
A. R
B. 2R
C. 3R
D. 4R

Q.98 In a conducting electric wire, the electric current flows due to: (ETEA 2022)
A. Protons
B. Ions
C. Holes
D. Electrons

Q.99 Which of the following is Ohmic device? (BMU 2022)
A. Filament bulb
B. Transistor
C. Semi-conductor diode
D. Copper wire

Q.100 The internal resistance of a battery is due to which of the following reasons? (BMU 2022)
A. Electrolytes
B. Ions moving charges
C. Moving charges
D. Static charges

Q.101 When different resistors are connected across the terminal of a battery: (DUHS 2022)
A. Both emf and terminal potential difference becomes zero
B. Both emf and terminal potential difference changes
C. Its emf changes but terminal potential difference remains the same
D. Both emf and terminal potential difference remains the same
E. Its emf remains same but terminal potential difference changes

Q.102 A battery of emf 'E' has an internal resistance 'r'. If current 'I' is drawn then terminal potential V_t is given by: (DUHS 2022)
A. $V_t = E + Ir$
B. $V_t = E - Ir$
C. $V_t = \frac{E}{I - r}$
D. $V_t = Er$
E. $V_t = \frac{E}{I + r}$

Q.103 The electrical energy dissipated as heat in a resistor is: (DUHS 2022)

A. V^2R
B. V^2Rt
C. I^2R
D. I^2Rt
E. IR

Q.104 Resistance of 5 Ω and 10 Ω are connected in parallel. If the P.D across 5 Ω resistor is 20V then current through 10 Ω resistor will be: (DUHS 2022)

A. 0.5 A
B. 20 A
C. 4 A
D. 10 A
E. 2 A

Q.105 A conducting wire of resistivity 'ρ' is cut into two equal parts. The resistivity of each part will be: (DUHS 2022)

A. The same
B. One fourth
C. $\sqrt{2}$ times
D. Halved
E. Doubled

Q.106 Four cells of emf 3 volt are connected in series to form a battery. Net emf of the combination is: (DUHS 2022)

A. 12 volt
B. 1.33 volt
C. 9 volt
D. 7 volt
E. 3 volt

Q.107 The magnitude of current in metals is proportional to the applied voltage as long as temperature of conductor is kept constant. It is statement of: (NUMS 2022)

A. Joule's law
B. Gauss's law
C. Ohm's law
D. Ampere's law

Q.108 The resistance of pure metal increases with: (NUMS 2022)

A. Increase in temperature
B. Increase in pressure
C. Decrease in temperature
D. Decrease in pressure

ANSWER KEY

PRACTICE EXERCISE

1	C	11	A	21	B	31	B	41	B
2	C	12	D	22	B	32	C	42	A
3	A	13	C	23	A	33	A	43	C
4	A	14	C	24	A	34	D	44	B
5	B	15	C	25	D	35	B	45	C
6	D	16	C	26	A	36	C	46	B
7	C	17	B	27	B	37	C		
8	A	18	B	28	A	38	D		
9	A	19	C	29	C	39	B		
10	B	20	C	30	A	40	A		

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47	B	57	D	67	B	77	C	87	D	97	B	107	C
48	C	58	B	68	C	78	B	88	C	98	D	108	A
49	A	59	A	69	A	79	B	89	B	99	D		
50	C	60	C	70	C	80	A	90	B	100	A		
51	C	61	B	71	B	81	B	91	B	101	E		
52	D	62	B	72	B	82	B	92	B	102	B		
53	A	63	A	73	D	83	C	93	C	103	D		
54	D	64	A	74	B	84	D	94	C	104	E		
55	C	65	C	75	C	85	A	95	B	105	A		
56	B	66	C	76	D	86	B	96	B	106	A		

EXPLANATORY NOTES

PRACTICE EXERCISE

1. According to Kirchhoff's current rule.
Current flowing towards a point = current flowing away from point.
2. New bulbs = 5; Old bulbs = 7; Total wattage of new bulbs = 5 × 50;
Total wattage of old bulbs = 7 × 50; Time the new bulbs are kept on = 5 hours;
Time the old bulbs are kept on = 3 hours
The number of units of electricity consumed by new bulbs (n_1) = (total wattage × time in hours) / 1000 = 50×5×5 / 1000 = 1.25
The number of units of electricity consumed by old bulbs (n_2) = 50×7×3 / 1000 = 1.05
Total bill of electricity = number of units of electricity consumed × amount for one unit of electricity
= (n_1 + n_2) × 60 = (1.25 + 1.05) × 60 = 138
Therefore, his electricity bill will be Rs. 138.
3. $\frac{E_1}{E_2}=\frac{l_1}{l_2}$
4. Current used = 30 A; Resistance = 15 ohms
The required equation is: Power = current^2 × resistance = 30 × 30 × 15 = 13,500 Watts
We know that, 1 Watt = 746 horse power (hp). So, 13,500 Watts = 18.096 hp, which can approximately be equal to 18 hp.
Therefore, the engine consumes 18 hp power.
5. Current = 3 A; Time taken = 5 minutes = 300 seconds
Work done = 900 J; Power = Work done / Time taken = 900/300 = 3 W
Power = Voltage (emf) x Current → Emf = Power/Current=3/3 = 1V
Therefore, the emf of the source is 1 volt.
6. Total power used, P = P_1 + P_1 = 1500 + 500 = 2000 W.
Current drawn from the supply,
$I=\frac{P}{V}=\frac{2000}{200}10A$
7. $\frac{i_1}{i_2}=\frac{R_2}{R_1}=\frac{\ell_2}{\ell_1}\times\left(\frac{r_1}{r_2}\right)^2=\frac{3}{4}\left(\frac{2}{3}\right)^2=\frac{1}{3}$
8. Current divide in each case
So all resistance are parallel so $\frac{1}{R_{eq}}=\frac{1}{1}+\frac{1}{2}+\frac{1}{3}$
$R_{eq}=0.5\Omega$
9. $Q=It=8\times10^{-3}\times0.020=0.16mC$
10. Semiconductor diode is non-ohmic device.
11. $I\propto V\Rightarrow I=\frac{V}{R}$
12. $I=\frac{V}{R}\Rightarrow I\propto V \quad (\because R=\text{constant})$
13. V = IR

14. $I=\frac{Q}{t}=\frac{ne}{t}\Rightarrow 16\times10^{-3}=\frac{n\times1.6\times10^{-19}}{1}\Rightarrow n=10^{17}$

15. $R=\rho\frac{\ell}{A}\propto\frac{\ell}{d^2}$. For highest resistance $\frac{\ell}{d^2}$ should be maximum, which is correct for option.

16. $R=\frac{4\rho L}{\pi d^2}\Rightarrow R'=\frac{4\rho(4L)}{\pi 4d^2}=\frac{4\rho L}{\pi d^2}\Rightarrow R'=R$

17. $R_1\propto\frac{l}{A}\Rightarrow R_2\propto\frac{2l}{2A}$ i.e. $R_2\propto\frac{l}{A}$ $\quad\therefore R_1=R_2$

18. Because V-i graph of diode is non-linear.

19. $\rho=\frac{RA}{L}=\frac{R\pi r^2}{L}\Rightarrow\rho=\frac{R\pi d^2}{4L}=\frac{0.7\times3.14\times4\times10^{-6}}{4\times1}=2.2\times10^{-6}\,\Omega m$

20. Iron and platinum (information from text book).

21. $R'=\frac{\rho L'}{A'}=\frac{\rho(2L)}{A/2}=\frac{4\times\rho L}{A}\Rightarrow R'=4R$

22. Resistivity does not depend upon dimension (L,W) of wire. It only depends upon nature & temperature of wire.

23. $R=\frac{\rho L}{A}$

$L'=4L\Rightarrow A'=\frac{A}{4}\Rightarrow\boxed{R'=16R}$

24. $R=\frac{\rho L}{A}\Rightarrow\boxed{R\propto L}$

25. Temperature coefficient of resistance $=\alpha^{+ve\ for\ Cu}_{-ve\ for\ Ge}$

$\Rightarrow\alpha=+ve$ for $Cu\Rightarrow T\uparrow\Rightarrow R\uparrow$ or $T\downarrow\Rightarrow R\downarrow$

& $\alpha=-ve$ for $Ge\Rightarrow T\uparrow\Rightarrow R\downarrow$ or $T\downarrow\Rightarrow R\uparrow$

So resistance of Cu decreases & that of Ge increases by cooling or decreasing temperature.

26. $R\propto L$

27. $v_t=\varepsilon-Ir$

28. $v=\varepsilon-I_1r\Rightarrow I_1R_1=\varepsilon-I_1r$

$(1.6)(8)=\varepsilon-1.6r\Rightarrow\boxed{12.8=\varepsilon-1.6r}\rightarrow$ (i)

$(15-12.8)=(\varepsilon-1.6r)-(\varepsilon-0.5r)$

$2.2=-1.1r\Rightarrow\boxed{r=2}$

$\varepsilon=16V$

$I_2R_2=\varepsilon-I_2r\Rightarrow\boxed{15=\varepsilon-0.5r}\rightarrow$ (ii)

$\varepsilon=I(R+r)\Rightarrow16=I(6+2)\Rightarrow\boxed{I=2A}$

29. Internal resistance of ideal current source is zero.

30. Internal resistance is the resistance offered by source of e.m.f.

31. Source of emf provides energy.

32. $V_t = \varepsilon - Ir \Rightarrow IR = \varepsilon - Ir$

$(15)(0.04) = 1.5 - (15)(r)$

$0.6 = 1.5 - 15r \Rightarrow 15r = \frac{0.9}{15} = 0.06\Omega$

33. %age increase in $P = 2$(%age increase in I) $\Rightarrow$ %age increase in $P = 2(0.5\%) = 1\%$

34. $Q = ne = 6.28 \times 10^{18} \times 1.6 \times 10^{-19} = 10 \times 10^{-1} = 1C \Rightarrow \Delta V = \frac{W}{Q} \Rightarrow W = Q\Delta V = 1 \times 20 = 20J$

35. 1hp = 746 Watt

36. $P \propto \frac{1}{R} \Rightarrow \frac{P_1}{P_2} = \frac{R_2}{R_1} \Rightarrow \frac{200}{100} = \frac{R_2}{R_1} \Rightarrow R_2 = 2R_1$

37. $P = \frac{V^2}{R} \Rightarrow R_1 = \frac{V_1^2}{P_1} = \frac{(200)^2}{40} = 1000\Omega$ and $R_2 = \frac{V_2^2}{P_2} = \frac{(200)^2}{100} = 400\Omega$

So, $R_1 > R_2$

38. $H = I^2Rt \Rightarrow H' = (2I)^2\left(\frac{R}{2}\right)t \Rightarrow H' = 2H$

39. $P = VI = V\frac{Q}{t}$

$V = \frac{Pt}{Q} = \frac{24 \times 60}{120} = 12V$

40. $R = \frac{V^2}{P} = \frac{(200)^2}{100} = 400\ \Omega \Rightarrow P = \frac{V^2}{R} = \frac{(160)^2}{400} = 64$ Watt

41. $H = I^2Rt$

42. $E = P \times t = (20)(10) = 200J$

43. $P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P} = \frac{200^2}{100} = 400\Omega$

44. The resistance of high power devices is smaller than the low power ones. The resistance of 60 watt bulb is smaller than 40 watt bulb and so on $P = \frac{V^2}{R}$ For a given voltage, $P \propto \frac{1}{R}$. So, 60 W bulb has the lowest resistance.

45. $\rho = \frac{RA}{L} = \frac{\Omega m^2}{m} = \Omega m$

46. $R \propto \frac{l}{r^2}$. For highest resistance $\frac{l}{r^2}$ should be maximum, which is correct for option.

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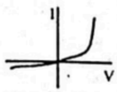
47. $\alpha = \frac{R_t - R_o}{R_o t} = \frac{200-100}{100\times100} = \frac{100}{100\times100} = 0.01$
48. According to Joule's Law $H = I^2Rt$
49. Definition of temperature co-efficient of resistance.
50. The energy supplied by the cell to the charge carrier is derived from conversion of chemical energy into electrical energy.
51. The deviation of I-V graph means, Temperature is not constant. So $\Delta R \propto \Delta t$
52. Conventional current.
53. The substances like germanium and silicon have negative temperature co-efficient o resistance.
54.

$V = \text{same}$

$I \propto \frac{1}{R} \quad \therefore I = 2A \quad \text{if } R' = 2R \qquad I' = \frac{I}{2} = \frac{2}{2} = 1A$

55.



56. $Q = 5\mu C \Rightarrow Q = 5\times10^{-6}\,As$
57. $\frac{V_2}{V_1} = \frac{I_2R_2}{I_1R_1} \qquad \therefore \qquad I_1 = \frac{V}{R} = \frac{12}{6} = 2A$

$V_2 = \frac{I_2R_2}{I_1R_1}\times V_1 \Rightarrow V_2 = \frac{1\times6}{2\times6}\times12 = 6V$

58. $R = \rho\frac{L}{A} \Rightarrow \frac{\rho L}{Lt} = \frac{\rho}{t} = \frac{10^{-6}}{10^{-6}} = 1\Omega$
59. Ohm law $V \propto I$
60. $V = \frac{P}{I} = \frac{P}{\frac{Q}{t}} = \frac{P\times t}{Q}$
61. $\alpha = \frac{\Delta R}{R_o \Delta T}$
62. $I = \frac{Q}{t} = \frac{ne}{t} = \frac{2\times10^6\times1.6\times10^{-19}}{10^{-3}} = 3.2\times10^{-10}A$
63. $V \propto I,\ \frac{V_2}{V_1} = \frac{I_2}{I_1} \Rightarrow I_2 = \frac{V_2}{V_1}\times I_1 = \frac{75}{50}\times2 \Rightarrow I_2 = 3A$
64. $vt = \varepsilon - Ir \Rightarrow I = 0 \Rightarrow vt = \varepsilon$
65.

$I = \frac{V}{R},\ R = \frac{\rho L}{A} = \frac{\rho L}{\pi r^2}$

$R' = \frac{\rho(2L)}{\pi(2r)^2} = \frac{2\rho L}{4A} = \frac{R}{2} \Rightarrow I' = \frac{V}{R/2} = 2\frac{V}{R} = 2I$

66. $G=\frac{1}{R}$

67. $E = I(R+r)$

68. $R=\frac{\rho L}{A}=\frac{\rho a}{a^2}=\frac{\rho}{a}$

$R_1=\frac{\rho 3a}{9a^2}=\frac{\rho}{3a}$

$R_1=\frac{R}{3}$

69. $P = I^2R$

70. $I = 1.5/3+2 = 1.5/5$ now $V= IR = 1.5/5 \times 3 = 0.9V$

71. $R=\frac{V}{I}=\frac{220}{0.1}=2200\Omega \Rightarrow P=\frac{V^2}{R}=\frac{(220)^2}{2200}=22W$

72. $R=\frac{\rho L}{A}=\frac{\rho L}{\pi r^2}=\frac{\rho L}{\pi D^2/4}\Rightarrow R=\frac{4\rho L}{\pi D^2}$

$R'=\frac{4\rho L/2}{\pi\left(D/2\right)^2}=\frac{4\rho L}{2\pi D^2/4}=\frac{2(4\rho L)}{\pi D^2}=2R$

73. $E=V+Ir$

74. $P=\frac{E}{t}\Rightarrow E=P\times t.=1000\times 3600\Rightarrow P=3.6\times 10^6 J$

75. $R=\rho\frac{\ell}{A}=\frac{\rho\times \ell\times A}{A^2}=\rho\frac{V}{A^2}$

$R=\rho\frac{V}{\pi^2R^4}\Rightarrow R\propto\frac{1}{R^4}$

76. For copper wire there is straight line graph of I-V

77. The is linear behavior between change in resistance w.r.t temperature below 0°C

78. $P=\frac{V^2}{R}$

79. $R=\frac{\rho L}{A}$

80. Conductivity depends on temperature and nature of material.

81. $r=\frac{\varepsilon - vt}{I}=\frac{1.5-15\times 0.04}{15}=0.06\Omega$

82. $P = IV = 200\times 220 = 44\,kW$

83. Electrical consumption $=\frac{P(W)\times t(hours)}{1000}=\frac{400\times 5}{1000}=2\,kWh$

84.

$P=\frac{V^2}{R}$

$P\propto\frac{1}{R}$

Voltage across the close circuit is zero.

85. $I = \frac{V}{R} = \frac{3}{2} = 1.5A$

86. $R = \frac{\rho L}{A}$ (R is independent of mass).

87. Information.

88. Definition.

89. $I = \frac{\varepsilon}{R+r} = \frac{20}{6.5+1.5} = 2.5A$

90. $P = VI = 20 \times 2.5 = 50W$

91. Unit of resistivity is Ωm.

92. $R = \frac{\rho L}{A}$

$R \propto \frac{1}{A}$

93. $V = \frac{r}{R} \times E$

94. $R = \frac{\rho L}{A} = \frac{\rho L}{\pi r^2}$

$R' = \frac{2\rho L}{\pi r^2/9} = 18R$

95. $I = \frac{P}{V}$

$V = \text{constant} \Rightarrow I \propto P$

$\frac{I_A}{I_B} = \frac{P_A}{P_B} = \frac{500}{2000} = \frac{1}{4}$

96. $R = \frac{\rho L}{A} = \frac{\rho L}{\pi r^2} = \frac{\rho \pi}{\pi r^2} = \rho r^{-2}$

97. When two conductors are connected in series $\quad R_{eq} = R + R = 2R$

98. Information.

99. Examples of Ohmic devices.

100. Information.

101. Emf is the cause it always remains constant. According to $V_t = E - Ir$, when different resistors are connected R_{eq} changes, so V_t changes.

102. Book formula.

103. Book formula.

104. $I = \frac{V}{R} = \frac{20}{10} = 2A$

105. Resistivity 'ρ' depends upon temperature and nature of material and independent of length of wire.

106. In series $E_{net} = E_1 + E_2 + E_3 + E_4 = 3 + 3 + 3 + 3 = 12$ V

107. Statement of Ohm's law.

108. Metals have positive temperature coefficient. $\quad T \propto R$

8 TOPIC

ELECTROMAGNETISM

PRACTICE EXERCISE

Q.1 Which of the following will experience a maximum force, when projected with the same velocity perpendicular to the magnetic field: (i) α-particle, and (ii) β-particle?

A. Both α-particle and β-particle
B. None
C. β-particle
D. α-particle

Q.2 Two parallel wires carrying currents in the opposite directions

A. Repel each other
B. Attract each other
C. Have no effect upon each other
D. They cancel out their individual magnetic fields

Q.3 The direction of the magnetic lines of force depends upon:

A. Nature of the material of the conducting wire
B. Amount of the current
C. Area of the conducting wire
D. Direction of the current

Q.4 The direction of magnetic field at a point on the magnetic lines of force can be taken along:

A. Normal at that point
B. Axis of the magnetic line of force at that point
C. The tangent at that point
D. Can't be taken

Q.5 The direction of the magnetic lines of force can be found by using:

A. Right hand rule
B. Left hand rule
C. Henry's law
D. Faraday's law

Q.6 A uniform magnetic field is represented by a set of lines of force which are

A. Parallel
B. Convergent
C. Divergent
D. None of these

Q.7 When a current carrying conductor is placed in a magnetic field. It moves from a region of

A. Stronger to weak field
B. Weak to strong field
C. Strong to weak if current is large
D. Weak to strong if current is large

Q.8 Magnetic lines of force

A. Always intersects
B. Tend to crowd far away from the poles of a magnet
C. Are always in closed shape
D. Do not pass through vacuum

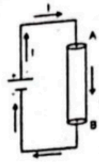
Q.9 A magnetic needle is kept in a non-uniform magnetic field. It experiences

A. Neither a force on a torque
B. A force but not a torque
C. A torque but not a force
D. A force and a torque

Q.10 Which of the following quantity is not affected by a magnetic field?

A. Stationary charge
B. Change in magnetic flux
C. Moving charge
D. Current flowing in a conductor

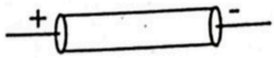
Q.11 **A straight current carrying conductor is shown in the figure. A person observes it from below at paint "B". What must be direction of magnetic field observed?**



A. Clock-wise
B. Out of paper
C. Anti-clock wise
D. Into the paper

Q.12 **Magnetic field has its application in ______**
A. Motors
B. Current detector
C. Generators
D. All

Q.13 **A conductor is shown in the figure connected with the terminals of a source as shown. What is true about this?**



A. $\vec{B}$ is present inside conductor
B. $\vec{B}$ and $\vec{E}$ both are present inside conductor
C. $\vec{B}$ is present outside conductor
D. $\vec{B}$ is outside while $\vec{E}$ is inside conductor

Q.14 **A square coil $10^{-2}m^2$ area is placed perpendicular to a uniform magnetic field of strength 10^3 web/m². The magnetic flux through the coil.**
A. 10 weber
B. 10^5 weber
C. 10^{-5} weber
D. 10^0 weber

Q.15 **A magnetic field of 2.5 T passes perpendicular to a disc of radius 2cm. Find the magnetic flux associated with the disc.**
A. 3.14×10^{-3} Wb
B. 3.14×10^{-4} Wb
C. 3.14×10^{-2} Wb
D. 3.14×10^{-5} Wb

Q.16 **A coil of area of cross section $10^{-2}m^2$ and 100 turns is placed in a magnetic field of 1T, with its axis making an angle 60° with the field. Find the total flux associated with the field.**
A. 0.5 Wb
B. 0.3 Wb
C. 0.4 Wb
D. 0.2 Wb

Q.17 **When the coil is rotated between the pole pieces of a magnet, during one complete rotation of the coil, how aften will the magnetic flux linked with coil be maximum and minimum?**
A. Maximum and minimum once each
B. Maximum once minimum twice
C. Maximum and minimum twice each
D. Maximum twice, minimum once

Q.18 **When area is placed perpendicular to external magnetic field the magnetic flux will be?**
A. Minimum
B. In between maximum and minimum
C. Maximum
D. None

Q.19 **Direction of magnetic flux is**
A. Normal to the surface
B. At any angle
C. Parallel to the surface
D. No direction

Q.20 **If 0.5 T magnetic field is perpendicular to the 0.5 m² area then the magnetic flux would be**
A. 0.25 Wb
B. 1.25 Wb
C. 6.25 Wb
D. Zero

Q.21 20 Wb magnetic flux passes through the 5m² area of certain sheet, the magnetic flux density would be

A. 2 Wb m^{-2} B. 6Wb m^{-2}
C. 4 Wb m^{-2} D. 8Wb m^{-2}

Q.22 The Relationship between tesla(T) and smaller unit gauss(G) of magnetic induction is given by

A. $1T = 10^3 G$ B. $1T = 10^{-4} G$
C. $1T = 10^{-2} G$ D. $1T = 10^4 G$

Q.23 Weber ampere per metre is equal to

A. Joule B. Newton
C. Watt D. Henry

Q.24 The unit of magnetic flux density is

A. Wbm^{-2} B. $NA^{-1}m^{-1}$
C. Tesla D. All of these

Q.25 The magnetic induction B is also called the

A. Flux B. Flux density
C. Density D. Tesla

Q.26 A 2 MeV proton is moving perpendicular to a uniform magnetic field of 2.5 T. The force on the proton is:

A. 2.5×10^{-10} N B. 2.5×10^{-11} N
C. 8×10^{-11} N D. 8×10^{-12} N

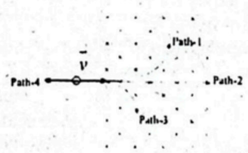
Q.27 The magnitude of the force on a moving charge is maximum when angle between the velocity of the charge and the magnetic field is,

A. 0° B. 90°
C. 180° D. 45°

Q.28 If a charge particle enters a uniform magnetic field, there is a change in its

A. Kinetic energy B. Direction of velocity
C. Magnitude of velocity D. All of these

Q.29 The fig shows a uniform magnetic field $\vec{B}$ directed into the plane of paper. A particle with negative charge moves in the plane, which of four paths 1, 2, 3 or 4 does the particle follow

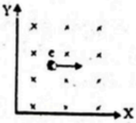


A. Path 1 B. Path 3
C. Path 2 D. Path 4

Q.30 Which of the following Statements is false?

A. A stationary charge produces a constant electric field
B. An accelerated charge produces combination of varying electric and magnetic field
C. A moving charge with uniform speed produces a constant magnetic field.
D. A conductor carrying steady current has no electric field in it

Q.31 In the given figure the electron enters into the magnetic field. It deflects in.......direction

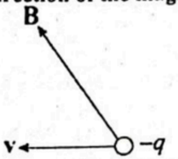


A. +ve X direction
B. –ve X direction
C. + ve Y direction
D. – ve Y direction

Q.32 In the formula F = q (v × B).

A. F must be perpendicular to v but not necessarily to B
B. v must be perpendicular to B but not necessarily to F
C. F must be perpendicular to both v and B
D. All three vectors must be mutually perpendicular

Q.33 In the figure below, what is the direction of the magnetic force F_B?

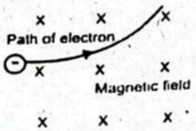


A. To the right
B. Downward, in the plane of the page
C. Upward, in the plane of the page
D. Out of the plane of the page

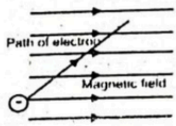
Q.34 Which of the following cannot be deflected by a magnetic field?

A. Alpha rays
B. Gamma rays
C. Beta rays
D. Cosmic rays

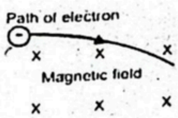
Q.35 The following diagrams shows an electron passing through a magnetic field. Which diagram shows the possible path of the electrons as they pass through the field?



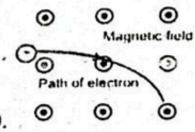
A.



B.



C.



D.

Q.36 Work done by magnetic force on a moving charge particle is

A. Positive
B. Zero
C. Negative
D. Infinite

Q.37 A positively charged particle moving due east enters a region of uniform magnetic field directed vertically upwards. The particle will

A. Continue to move due east
B. Move in a circular orbit with its speed increases
C. Move in a circular orbit with its speed unchanged
D. Get deflected vertically upwards

Q.38 **A strong magnetic field is applied to a stationary electron, then**
A. Electron move in the direction of field
B. Electron start spinning
C. Electron move opposite to field
D. Electron remain stationary

Q.39 **The magnitude of force on a moving charge is zero then angle between the velocity of the charge carrier and magnetic field is**
A. 0°
B. 45°
C. 90°
D. 120°

Q.40 **An electron enters in a uniform magnetic field making an angle 60° with field. The shape of its trajectory in magnetic field is**
A. Circle
B. Straight line
C. Parabola
D. Helix

Q.41 **Which of the following in motion cannot be deflected by magnetic field?**
A. Electron
B. Proton
C. Neutron
D. Sodium ion

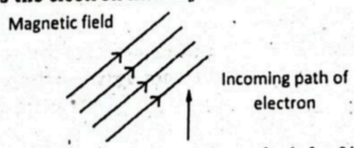
Q.42 **When a charged particle is projected perpendicularly in a magnetic field its trajectory is**
A. Hyperbola
B. Parabola
C. Helix
D. Circular

Q.43 **When a charged particle moves through a magnetic field, it suffers a change in**
A. Direction
B. Energy
C. Speed
D. No change

Q.44 **Magnetic field is caused by**
A. Stationary charge
B. A moving negative charge only
C. A moving positive charge only
D. Moving positive and negative charges both

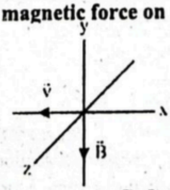
Q.45 **A charged particle moves through a magnetic field in a direction perpendicular to it. Which of the following remain unchanged for the particle?**
A. Velocity
B. Speed
C. Acceleration
D. Direction

Q.46 **The diagram shows an electron as it enters magnetic field. The path of the electron and the magnetic field are in the plane of the paper.**
In which direction is the electron initially deflected?



A. into the plane of the paper
B. to the left of its incoming path
C. out of the plane of the paper
D. to the right of its incoming path

Q.47 **An electron moves in the negative x direction, through a uniform magnetic field in the negative y direction. The magnetic force on the electron is**



A. In the negative z direction
B. In the negative y direction
C. In the positive z direction
D. In the positive y direction

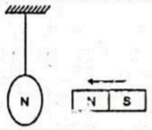
EXPLANATORY NOTES

PRACTICE EXERCISE

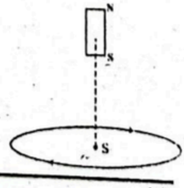
1. Primary power = 220 × 6 = 1320 W
Secondary power = 11 × 100 = 1100 W
$$\text{Efficiency} = \frac{\text{secondary power}}{\text{Primary power}} = \frac{1100}{1320} = 0.833$$

2. $$\frac{N_s}{N_p} = \frac{I_p}{I_s}$$
$$\frac{1230}{410} = \frac{6}{I_s}$$
$$I_s = \frac{6\times 410}{1230} = 2A$$

3. Holding a magnet inside solenoid will not change magnetic flux. Hence no emf is generated.
4. Resistance of coil has no effect on emf.
5. Induce current will produce when there is relative motion between magnet and coil.
6. (i) A magnet falls with S-pole along the axis of ring. So according to Lenz's law S-pole form along the face of magnet. As shown in Fig. the current clock wise.
(ii) The ring is open. So, no current induced in the ring i.e I = 0
7. It is the statement of Lenz's law.
8. According to Lenz's law, the current induced in the ring oppose the cause that produce it



9. All options are correct by using Lenz's law.
10. $$\varepsilon = -N\frac{\Delta\phi}{\Delta t} \Rightarrow \varepsilon \propto \frac{\Delta\phi}{\Delta t}$$
11. $$\varepsilon = N\left(\frac{\Delta B}{\Delta t}\right).A\cos\theta = 500\times1\times(10\times10^{-2})^2\cos0^\circ = 5\text{V}$$
12. $$\varepsilon = \frac{\Delta\phi}{\Delta t} \Rightarrow IR = \frac{\Delta\phi}{\Delta t} \Rightarrow \frac{Q}{\Delta t} = \frac{\Delta\phi}{R\Delta t}$$
$$\Rightarrow Q = \frac{\Delta\phi}{R} = \frac{10-2}{2} = 4C$$
13.
(i) A magnet falls with S-pole along the axis of ring. So according to lenz's law S-pole form along the face of magnet. As shown in Fig. the current clock wise.
(ii) Due to repulsion between magnet and ring, the acceleration of magnet is less than "g".



14. Lenz's law is a manifestation of the conservation of energy.

15. As, $\varepsilon = N\omega AB\sin\theta$

For maximum induced emf $\theta = 90°$

$\varepsilon = N\omega AB$

16. $I = I_o \sin\omega t = I_o \sin(2\pi f t)$

From the graph, the period T is 2.5 ms.

$\therefore$ Frequency, $f = \dfrac{1}{2.5\times10^{-3}} = 400\,\text{Hz}$

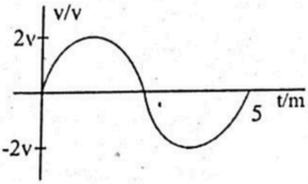
$\therefore$ $I = I_o \sin(2\pi(400)t) = I_o \sin(800\pi t)$

17. From graph

$V_o = 2\,V$

$T = 5\,ms$

$= 5\times10^{-3}$ sec



As

$$f = \frac{1}{T} = \frac{1}{5\times10^{-3}}$$

$$= \frac{10^3}{5} = \frac{1000}{5}$$

$= 200$ Hz

18. Generator is a device that converts mechanical energy into electrical energy.

19. Output of A.C generator is a sine wave.

20. Electric generator work on the principal of Faraday's law

21. $\varepsilon = N\omega AB$

$$\varepsilon_{max} = N\omega AB \Rightarrow \omega = \frac{\varepsilon}{NAB} = \frac{1.6}{(200)\left(\frac{4\times4}{100\times100}\right)(0.75)} = \frac{20}{3}\,rad/s$$

22. $V = V_0 \sin(\frac{2\pi}{T}t) = 0.5\sin\left(\frac{2\pi}{0.2}t\right) = 0.5\sin(10\pi t)$

23. Transformer is a device which is use to increase or decrease the alternating voltage.

$P = VI \Rightarrow P = \text{same} \Rightarrow V \propto \frac{1}{I}$

24. As, $\dfrac{N_S}{N_P} = \dfrac{V_S}{V_P} = \dfrac{I_P}{I_S}$

From relation current and voltage changes. Only for ideal transformer power remain same otherwise power also changes. But frequency in transformer does not change.

25. As, $\dfrac{V_S}{V_P} = \dfrac{I_P}{I_S}$

$$\frac{4\times10^3}{200} = \frac{1}{I_S}$$

$$I_S = \frac{200}{4\times10^3} = 50\times10^{-3}\,A = 50\,mA$$

26. As, $\frac{N_S}{N_P} = \frac{I_P}{I_S}$

$\frac{2}{3} = \frac{3}{I_S} \Rightarrow I_S = \frac{9}{2} = 4.5\,A$

27. Because transformer only works with alternating voltage and it is used increase or decrease the alternating voltages.

28. efficiency $= \frac{P_{output}}{P_{input}} \times 100$

$= \frac{100}{V_P I_P} \times 100 = \frac{100}{220 \times 0.5} \times 100$

$= \frac{100}{110} \times 100 = 90\%$

29. As, $\frac{N_S}{N_P} = \frac{V_S}{V_P} = \frac{I_P}{I_S}$

30. As, $\frac{V_S}{V_P} = \frac{I_P}{I_S} \Rightarrow \frac{V_P}{V_S} = \frac{I_S}{I_P}$

31. In an ideal transformer power remain same.

32. The magnetic flux changes through solid conductor (core material), induce current (i.e eddy current) are setup in closed path in the body of conductor. It results in power dissipation and heating of core material.

33. Hysteresis loss

34. $\varepsilon = vBL\sin\theta$

Where $\theta = 90°$

$\varepsilon = vBL$

35. (i) The eddy current results in power dissipation and heating of the core material.

(ii) Hysteresis loss (magnetic hysteresis) is the energy spent to magnetize and demagnetize the core material

(iii) The power also loss in transformer due to resistance of coil.

36. $\eta = \frac{P_{output}}{P_{input}} \times 100\% = \frac{V_s I_s}{V_p I_p} = \frac{11(90)}{220(5)} = \frac{990}{1100} = 0.9$

$\%\eta = 0.9 \times 100\% = 90\%$

37. $P_o = P_i = I_i V_i = 120 \times 3 = 360$ W

38. Flux coupling between primary and secondary coils must be maximum.

39. Voltage by a battery is D.C but transformer operates on A.C

40. Transformer is a device use to step up or down alternating current and voltage keeping power constant ideally.

41. A machine having moving parts reduce its efficiency due to frictional losses but in transformer there is no moving parts.

42. $\eta = \frac{P_o}{P_i} = \frac{I_s V_s}{I_p V_p} = 0.8$

$I_p = \frac{I_s V_s}{V_p (0.8)} = \frac{(20)(120)}{(1000)(0.8)} = 3A$

43. Step-up transformer increase voltage level hence current level decreases.

44. Power input = power output for an ideal transformer

For current $\frac{I_s}{I_p} = \frac{N_p}{N_s}$

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45. $\frac{Vs}{Vp} = \frac{Ns}{Np} \Rightarrow Np = \frac{Ns}{Vs} \times Vp$

46. Principle of transformer.

47. Principle of ac generator.

48. The function of main transformer is to convert one alternating voltage to another alternating voltage of different magnitude.

49. P = VI

If I decrease and voltage increase

So, $P = I^2Rt$

Power losses will be minimum.

50. Frequency is used in Pakistan is 50 Hz.

51. Basically, transformer is used to step up or step-down voltage.

52. Induced emf and induced current flows if there is rate of change of magnetic flux.

$EMF = -N\frac{\Delta\phi}{\Delta t}$

53. $\frac{N_s}{N_p} = \frac{V_s}{V_p}$

54. In step up transformer voltage increases and current decreases but power remains same.

55. $\frac{N_s}{N_p} = \frac{V_s}{V_p} = \frac{1}{1}$

56. Information.

57. $\varepsilon = VBL = 20 \times 0.6 \times 1 = 12V$

58. $\frac{\Delta\Phi}{\Delta t} = \frac{Wb}{s} = \frac{Nm}{As}$

59. Fact.

60. Conceptual information.

61. Information.

62. Fleming's right-hand rule indicates

Index finger → magnetic field

Middle finger → induced current

Thumb → force

63. Working principle of transformer is mutual induction.
64. Information.
65. Information.
66. Fact.
67. Input = Output
    So, heat dissipation = 0
68. Information.
69. $\varepsilon = N\dfrac{\Delta\phi}{\Delta t} \Rightarrow \varepsilon \propto \dfrac{\Delta\phi}{\Delta t}$
    So, emf is independent of resistance of coil.
70. $\varepsilon = N\dfrac{\Delta\phi}{\Delta t} \Rightarrow \varepsilon \propto \dfrac{\Delta\phi}{\Delta t}$
71. Faraday's law of electromagnetic induction.
72. Book formula
73. $H = I^2Rt$
    For long distance transmission current must be low and voltage high to reduce losses and improve efficiency of system.
74. Information
75. In Fleming's right-hand rule
    F → Force → Thumb
    B → Magnetic field → Index finger
    I → Induced current → Middle finger
76. Working principle of transformer.

10 TOPIC — ELECTRONICS

PRACTICE EXERCISE

Q.1 The applied input a.c. power to a half-wave rectifier is 100 watts. The d.c. output power obtained is 40 watts. What is the rectification efficiency?

A. 50% B. 80%
C. 40% D. 95%

Q.2 The ripple factor indicates the number of ripples in the

A. A.C output B. D.C output
C. A.C input D. None of these

Q.3 For a half wave or full wave rectifier the Peak Inverse Voltage of the rectifier is always

A. Greater than the input voltage
B. Smaller than the input voltage
C. Equal to the input voltage
D. Greater than the input voltage for full wave rectifier and smaller for the half wave rectifier

Q.4 The device which coverts A.C into D.C is called

A. Oscillator B. Transducer
C. Rectifier D. Diode

Q.5 The types of rectifications are

A. 3 B. 4
C. 5 D. 2

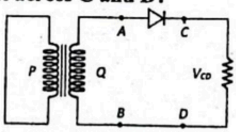
Q.6 Rectification is possible by

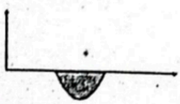
A. Transistor B. Diode
C. Amplifier D. Capacitor

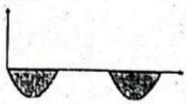
Q.7 The semiconductor diode can be used as a rectifier because __________

A. It has low resistance to the current flow when forward biased & high resistance when reverse biased
B. It has low resistance to the current flow when forward biased
C. It has high resistance to the current flow when reverse biased
D. Its conductivity increases with rise of temperature

Q.8 In the half-wave rectifier circuit shown. Which one of the following wave forms is true for diode, the output across C and D?



A.


C.


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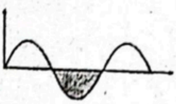

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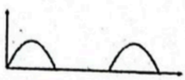
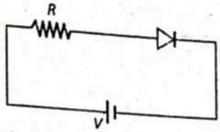


Q.9 **For the given circuit of PN-junction diode, which of the following statement is correct**



A. In forward biasing the voltage across R is 2V
B. In reverse biasing the voltage across R is V
C. In forward biasing the voltage across R is V
D. In reverse biasing the voltage across R is 2V

Q.10 **The simplest type of rectification known as half wave rectification is obtained by ________**
A. Using a transistor
B. Suppressing half wave of A.C supply by using diode
C. Suppressing the harmonics in A.C voltage
D. Using a Coolidge tube

Q.11 **Output of half wave rectifier is suitable only**
A. To operate radio
B. Charging batteries
C. For running a D.C motor
D. All of these

Q.12 **During the interval $0 \rightarrow \frac{T}{2}$ the forward biased diode offers**
A. Very small resistance
B. Very high resistance
C. Very small current flow through it
D. Zero resistance

Q.13 **In a half wave rectifier, the frequency of the input is N, the frequency and form of the output will be**
A. N/2 and Pulsating
B. 2 N and steady
C. N and Pulsating
D. N and continuous

Q.14 **The most common device used as filter is**
A. Capacitor
B. Transformer
C. Resistor
D. Transistor

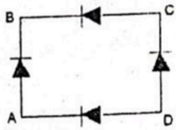
Q.15 **The method by which only one half of A.C cycle is converted into direct current is called**
A. Half wave amplification
B. Full wave rectification
C. Half wave rectification.
D. Full-wave amplification

Q.16 **If time period of input T in the full wave bridge rectifier circuit, then time period of the pulsating output of the circuit will be**
A. T
B. T/2
C. 2T
D. T/4

Q.17 **In a bridge rectifier how, many diodes conduct during each half cycle of input A.C**
A. 2
B. 1
C. 3
D. All

Q.18 **If a full wave rectifier circuit is operating from 50 Hz mains, the fundamental frequency in the ripple will be**
A. 50 Hz
B. 70.7 Hz
C. 100 Hz
D. 25 Hz

Q.19 In figure the input is across the terminals A and C and the output is across B and D. Then the output is



A. Half wave rectified
B. Full wave rectified
C. Zero
D. Same as input

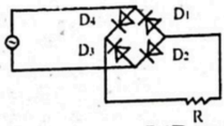
Q.20 To reduce ripples in the output of bridge rectifier we should use

A. Diodes having low forward resistance
B. Low frequency A.C
C. Diodes having high forward resistance
D. A filter circuit

Q.21 In full wave rectification, the output D.C. voltage across the load is obtained for

A. The positive half cycle of input A.C
B. The complete cycle of input A.C
C. The negative half cycle of input A.C
D. All of the above

Q.22 In the following figure

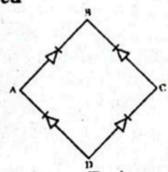


A. D_1 and D_3 conducts simultaneously
B. D_1 and D_2 conducts alternatively
C. D_1 and D_2 conducts simultaneously
D. Both A and C

Q.23 Output voltage of rectifier is not smooth. It can be made smooth by using a circuit known as:

A. Wheat stone circuit
B. Ripple circuit
C. Bridge circuit
D. Filter circuit

Q.24 In the diagram, diodes are arranged for the full wave rectification where input alternating voltage must be applied



A. Across A and B
B. Across B and D
C. Across A and C
D. Across B and C

Q.25 The basic reason why a full wave rectifier has a twice the efficiency of a half wave rectifier is that?

A. It make use of transformer
B. It utilizes both half cycle of the input
C. Its ripple factor is much less
D. Its output frequency is double the frequency

Q.26 If an A.C voltage of rms value of 10V is applied as input of half wave rectifier, then the rms voltage value of D.C output will be

A. 10 V
B. 10.3 V
C. 10.7 V
D. 9.3 V

Q.27 If a half-wave rectifier is used to convert 50Hz A.C into D.C then the number of pulses present in rectifier voltage is:

A. 25
B. 100
C. 50
D. 75

Q.28 The output from a full wave rectifier is

A. An ac voltage
B. Uni-directional
C. Pulsating dc
D. Both B and C

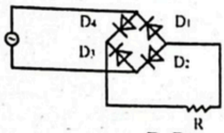
Q.29 Conversion of alternating current into direct current is called **(ETEA 2012)**

A. Rectification
B. Amplification
C. Regeneration
D. Oscillation

Q.30 Output voltage of rectifier is not smooth. It can be made smooth by using a circuit known as: **(MDCAT 2017)**

A. Wheat stone circuit
B. Ripple circuit
C. Bridge circuit
D. Filter circuit

Q.31 In the following figure what happens for the positive half cycle of the input? **(MDCAT 2017)**



A. D_1 and D_3 conducts
B. D_4 and D_2 conducts
C. D_1 and D_2 conducts
D. D_4 and D_3 conducts

Q.32 In case of half wave rectification, resistance of diode during negative half of A.C is: **(MDCAT 2018)**

A. Very high
B. A few ohms
C. Very low
D. Negligible

Q.33 The direction of current through the load resistance of a full-wave rectification circuit: **(MDCAT 2018)**

A. Inverts for negative cycle
B. Inverts for positive cycle
C. Changes for every cycle
D. Remains constant

Q.34 In full wave rectification, the diodes are used **(NMDCAT 2020)**

A. 1
B. 2
C. 3
D. 4

Q.35 Which has less ripple factor? **(NMDCAT 2021)**

A. Half wave rectifier
B. Full wave rectifier
C. Both
D. None

Q.36 Ripple factor of full wave rectifier? **(NMDCAT 2021)**

A. 0.482
B. 1.21
C. 0.21
D. 0.84

Q.37 If f = 50Hz then in half wave no of pulses are **(NMDCAT 2021)**

A. 50
B. 60
C. 100
D. 150

Q.38 When the temperature of semiconductor suddenly drops to zero kelvin, then a semiconductor acts as: **(UHS 2022)**

A. Conductor
B. Semi-conductor
C. Super conductor
D. Insulator

Q.39 A process in which only one half of alternating current is converted into direct current, such process is called: **(UHS 2022)**

A. Full wave rectification
B. Amplification
C. Half wave rectification
D. Magnification

Q.40 Efficiency of full wave rectifier circuit is almost _______ than half wave rectifier circuit: **(SZABMU 2022)**

A. Four times
B. Same as
C. Sixteen times
D. Double

Q.41 **The conversion of A.C into D.C is called rectification and circuit is called rectifier. Which component of electronics acts as a rectifier?** **(SZABMU 2022)**

A. Diode
B. Transistor
C. Transformer
D. Inductor

Q.42 **Output current of a half wave rectifier is:** **(ETEA 2022)**

A. AC current
B. Unidirectional current
C. Zero always
D. Straight line parallel to vertical axis

Q.43 **The resistance of full wave rectifier is:** **(ETEA 2022)**

A. Less than the resistance of half wave rectifier
B. More than the resistance of half wave rectifier
C. Equal to the resistance of half wave rectifier
D. Negligible in comparison to the resistance of half wave rectifier

Q.44 **When AC is converted to DC, the process is called:** **(ETEA 2022)**

A. Magnification
B. Amplification
C. Rectification
D. Resolution

Q.45 **A circuit that converts pulsating voltage of the rectifier to smooth voltage is known as:** **(BMU 2022)**

A. Conductor
B. Transformer
C. Filter
D. Choke

Q.46 **The potential difference applied across a diode to reduce depletion layer is:** **(DUHS 2022)**

A. Reverse biasing
B. Forward biasing
C. Biasing voltage
D. Junction potential
E. Potential barrier

Q.47 **A device that converts AC into DC is called:** **(NUMS 2022)**

A. Diode
B. Transistor
C. Capacitor
D. Inductor

Q.48 **The conversion of alternating current into direct current is called:** **(NUMS 2022)**

A. Amplification
B. Rectification
C. Magnification
D. Resolution

ANSWER KEY

PRACTICE EXERCISE

1	C	6	B	11	B	16	B	21	B	26	D
2	B	7	A	12	A	17	A	22	D	27	C
3	B	8	D	13	C	18	C	23	D	28	D
4	C	9	C	14	A	19	B	24	C		
5	D	10	B	15	C	20	D	25	B		

PAST PAPER MCQ'S

29	A	34	D	39	C	44	C
30	D	35	B	40	D	45	C
31	B	36	A	41	A	46	B
32	A	37	A	42	B	47	A
33	D	38	D	43	B	48	B

EXPLANATORY NOTES

PRACTICE EXERCISE

1. Rectification efficiency $= \dfrac{\text{d.c.output power}}{\text{a.c.input power}} = \dfrac{40}{100} = 0.4 = 40\%$
2. The ripple factor indicates the number of ripples in the D.C output.
3. The peak input voltage is smaller than the input voltage due to the presence of diode(s). A single diode reduces the output voltage by approximately 0.7V.
4. Definition of rectifier.
5. Two types of rectification
   i) Half wave rectification   ii) Full wave rectification
6. Diode is used as rectifier.
7. Its reverse biased resistance is very high in order of M Ω and forward biased resistance is very low in order of few ohms.
8. Half wave rectifier, rectifies only the half cycle of input ac signal and it blocks the other half
9. In forward biasing, resistance of PN junction diode is zero, so whole voltage appears across the resistance.
10. PN junction has low resistance in one direction of potential difference +V, so a large current flows (forward biasing). It has a high resistance in the opposite potential difference direction V, so a very small current flows (Reverse biasing)
11. Output voltage of half wave rectifier is pulsating, when it made smooth by filter, voltage level is decrease this low voltage suitable for charging batteries.
12. Forward biased diodes has low resistance.
13. In half wave rectifier
    - Input frequency = output frequency
    - Output wave is pulsating
14. Filters made output smooth.
15. In half wave rectification only one half of AC is converted into DC.
16. As in the full wave rectification $f_o = 2f_{in} \Rightarrow T_o = \dfrac{T}{2}$
17. In a bridge rectifier two diodes in forward biased and conduct in each half cycle of input A.C
18. In full wave rectifier, frequency of output wave is double of input wave.
19. It is the diagram of full wave bridge rectifier circuit.
20. We use capacitor as filter circuit.
21. Direction of current flow through the load resistance R is the same in both halves cycles of input wave.
22. Full wave rectifier circuit opposite diodes work simultaneously
23. Output voltage of rectifier is not smooth. It can be made smooth by using a circuit known as filter circuit.

24. In full wave bridge rectification circuit, input must be applied at the terminals where opposite ends of two diodes are joined
25. It allows both half cycles so its efficiency is twice.
26. In general, potential barrier of Si is 0.7V
    So, D.C output = 10 – 0.7 = 9.3 V
27. For half wave rectifier. $f' = f \Rightarrow f' = 50Hz$
28. Rectification is process in which A.C converts into pulsative D.C.

PAST PAPER MCQ'S

29. Definition of rectification.
30. Output voltage of rectifier is not smooth. It can be made smooth by using a circuit known as filter circuit.
31. During the positive half cycle the diodes D_2 and D_4 are forward biased and diodes D_1 and D_3 are reversed biased.
32. In case of half rectification, resistance of diode during negative half of A.C is very high.
33. In full wave rectification circuit, direction of current through load resistance remains same during +ve & -ve half cycles.
34. Four diodes are used in FWR
35. Ripple factor of H.W.R = 1.21
    Ripple factor of F.W.R = 0.48
36. Form factor $= \dfrac{I_{rms}}{I_{D.C}} = \dfrac{I_o/\sqrt{2}}{2I_o} = \dfrac{\pi}{2\sqrt{2}} = 1.11$
    $$R.F = \sqrt{(F.F)^2 - 1} = \sqrt{(1.1)^2 - 1} = 0.48$$
37. In half wave rectification $f_{output} = f_{input}$
38. Information.
39. Definition.
40. η of H.W.R = 40.6% $\Rightarrow \eta$ of F.W.R = 81.2% (which is double of half wave rectifier)
41. Information.
42. Information.
43. Information.
44. Definition.
45. Definition.
46. In forward biasing, width of depletion layer decreases.
47. Information.
48. Definition.

11 TOPIC

DAWN OF MODERN PHYSICS

PRACTICE EXERCISE

Q.1 Threshold wavelength for a metal having work function W_o is X. What is the threshold wavelength for the metal having work function $2W_o$?

A. 4λ
B. 2λ
C. $\lambda/2$
D. $\lambda/4$

Q.2 An electric bulb of 100 W converts 3 % of electrical energy into light energy. If the wavelength of light emitted is 6625 Å, the number of photons emitted in 1 s is _____.
($h=6.625\times10^{-34}$ J.sec)

A. 10^{17}
B. 10^{19}
C. 10^{21}
D. 10^{15}

Q.3 The wavelength of a photon needed to remove a proton from a nucleus which is bound to the nucleus with 1 MeV energy is nearly

A. 1.2 nm
B. 1.2×10^{-3} nm
C. 1.2×10^{-6} nm
D. 1.2×10^{1} nm

Q.4 If K.E. of free electron is doubled, its de Broglie wavelength become.

A. $\frac{1}{\sqrt{8}}$
B. $\sqrt{2}$
C. $\frac{1}{\sqrt{2}}$
D. 2

Q.5 Compton shift is Maximum when θ is

A. 40°
B. 0°
C. 180°
D. 45°

Q.6 The momentum of a photon is 2×10^{-16} gm-cm/sec. Its energy is

A. 0.61×10^{-26} erg
B. 2.0×10^{-26} erg
C. 6×10^{-6} erg
D. 6×10^{-8} erg

Q.7 Ratio of momentum of photons having wavelength 4000 angstrom and 8000 angstroms is

A. 2 : 1
B. 1 : 2
C. 20 : 1
D. 1 : 20

Q.8 A radio station emits 10 kW power of 90.8 MHz. Find the number of photons emitted per second?

A. 1.6×10^{28}
B. 1.6×10^{29}
C. 1.6×10^{30}
D. 1.6×10^{32}

Q.9 The energy of a photon is 3×10^{-19} J. Its momentum is

A. 10^{-27} kg ms^{-1}
B. 9×10^{-11} kg ms^{-1}
C. 10^{-11} kg ms^{-1}
D. 3×10^{-7} kg ms^{-1}

Q.10 Condition for pair production is that

A. $hf < 2m_oc^2$
B. $hf > 2m_oc^2$
C. $hf = m_oc^2$
D. $hf > m_oc^2$

Q.11 The momentum of a photon is p. The frequency associated with it is given by

A. pc/h
B. hc/p
C. ph/c
D. h/pc

Q.12 Photon A has twice the energy of photon B. What is the ratio of the momentum of A to that of B?

A. 2 : 1
B. 1 : 2
C. 1 : 1
D. None of these

Q.13 The value and units of the Plank's constant 'h' can be expressed as:

A. $6.63 \times 10^{-34}\ Js^{-1}$ B. 6.63×10^{-34} Js

C. 6.63×10^{-43} Js D. 3.63×10^{-34} Js

Q.14 Let n_r and n_b be respectively the number of photons emitted by a red bulb and a blue bulb of equal power in a given time. Then

A. $n_r = n_b$

B. $n_r < n_b$

C. $n_r > n_b$

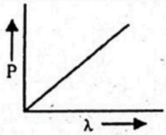
D. The information is insufficient to get a relation between n_r and n_b

Q.15 λ is proportional to

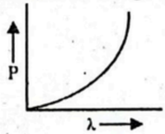
A. $\frac{1}{E}$ for both photons and particles B. $\frac{1}{\sqrt{E}}$ for both photons and particles

C. $\frac{1}{E}$ for photons and $\frac{1}{\sqrt{E}}$ for particles D. $\frac{1}{\sqrt{E}}$ for photons and $\frac{1}{E}$ for particles

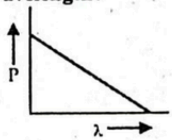
Q.16 Which of the following graphs correctly represents the variation of particle momentum with associated de-Broglie wavelength?



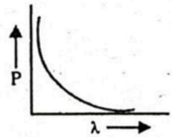
A.



B.



C.



D.

Q.17 A material particle with a rest mass m_o is moving with speed of light c. The associated de-Broglie wavelength is given by

A. $\frac{h}{m_o c}$ B. $\frac{m_o c}{h}$

C. 0 D. ∞

Q.18. As the temperature of black body is raised, the wavelength corresponding to maximum intensity

A. Shifts towards longer wavelength

B. Shifts towards shorter wavelength

C. Remain the same

D. Shifts towards longer as well as shorter wavelengths

Q.19 If electron and proton have same De-Broglie wavelength, which have greater speed

A. Electron B. Proton

C. Both have same D. Electron and Proton can't have wavelength

Q.20 The wavelength of a moving particle is inversely proportional to

A. Mass B. Velocity

C. Energy D. Momentum

Q.21 A photon of energy 3.4eV is incident on a metal having work function 2eV. The maximum K.E of photo-electron is equal to

A. 1.4 eV B. 1.7eV

C. 5.4 eV D. 6.8 eV

Q.22 Davisson determine the wavelength of scattered electron from the relation:

A. $\lambda=\frac{h}{2mVe}$
B. $\lambda=\frac{2h}{\sqrt{mVe}}$
C. $\lambda=\frac{h}{2\sqrt{2mVe}}$
D. $\lambda=\frac{h}{\sqrt{2mVe}}$

Q.23 If an electron is accelerated through a potential difference of 54 volts, its de-Broglie wavelength will be:

A. 1.66×10^{-8}m
B. 1.66×10^{-10}m
C. 1.66×10^{-9}m
D. 1.66×10^{-12}m

Q.24 Light of frequency 1.5 times the threshold frequency is incident on a photo sensitive material. If the frequency is halved and intensity is doubled the photo electric current becomes

A. Four times
B. Double
C. Half
D. Zero

Q.25 A body of mass 200 g moves at the speed of 5 m/hr. So de-Broglie wavelength related to it is of the order (h=6.26 x 10^{-34} Js)

A. 10^{-10}m
B. 10^{-20} m
C. 10^{-30} m
D. 10^{-40} m

Q.26 In Davisson-Germer experiment, the diffracted electron beam from crystal shows

A. Particle property
B. Light property
C. Wave property
D. Quantum property

Q.27 The electron, accelerated by a potential difference V has de-Broglie wavelength λ. If the electron is accelerated by a p.d 4V, its de-Broglie wavelength will be

A. 2λ
B. $\frac{\lambda}{2}$
C. 4λ
D. $\frac{\lambda}{4}$

Q.28 A proton and an $\alpha-$particle are accelerated through the same potential difference. The ratio of their de-Broglie wavelengths $(\lambda_p/\lambda_\alpha)$ is

A. 1
B. $2\sqrt{2}$
C. 2
D. $1\sqrt{2}$

Q.29 The ratio of momenta of an electron and an α-particle which are accelerated from rest by a potential difference of 100 V is

A. 1
B. $\sqrt{\frac{m_e}{m_\alpha}}$
C. $\sqrt{\frac{2m_e}{m_\alpha}}$
D. $\sqrt{\frac{m_e}{2m_\alpha}}$

Q.30 What is the de Broglie wavelength of a proton whose linear momentum has a magnitude of 3.3×10^{-23} kg m/s?

A. 0.0002 nm
B. 0.002 nm
C. 0.02 nm
D. 0.2 nm

Q.31 The velocity of a particle of mass m of de-Broglie wavelength λ is ______

A. $\frac{2h}{m\lambda}$
B. $\frac{m\lambda c^2}{h}$
C. $2\,m\lambda c^2$
D. $h/m\lambda$

Q.32 If E_1, E_2 and E_3 are the respective kinetic energies of an electron, an alpha particle and a proton, each having the same de-Broglie wavelength, then

A. $E_1 > E_3 > E_2$
B. $E_1 > E_2 > E_3$
C. $E_2 > E_3 > E_1$
D. $E_1 = E_2 = E_3$

Q.33 If the K.E of a free electron doubles then its de-Broglie wavelength changes by a factor

A. $\frac{1}{2}$
B. 2
C. $\frac{1}{\sqrt{2}}$
D. $\sqrt{2}$

Q.34 The magnitude of de-Broglie wavelength (λ) of electrons (e), proton (p), neutron (n), and α particles all have the same energy 1 MeV, in increasing order will follow the sequence.

A. $\lambda_e, \lambda_p, \lambda_n, \lambda_\alpha$
B. $\lambda_e, \lambda_p, \lambda_n, \lambda_\beta$
C. $\lambda_\alpha, \lambda_n, \lambda_p, \lambda_e$
D. $\lambda_\alpha, \lambda_p, \lambda_n, \lambda_e$

Q.35 The wavelength of matter waves is independent of:

A. Mass
B. Velocity
C. Momentum
D. Charge

Q.36 A particle of mass M at rest decays into two masses m_1 and m_2 with non-zero velocities. The ratio of de-Broglie wave lengths of the particles $\frac{\lambda_1}{\lambda_2}$ is

A. $\sqrt{\frac{m_2}{m_1}}$
B. $\frac{m_1}{m_2}$
C. $\frac{\sqrt{m_1}}{\sqrt{m_2}}$
D. 1 : 1

Q.37 The Davisson and Garmer experiment indicate

A. Interference
B. Electron diffraction
C. Polarization
D. Refraction

Q.38 Select the correct relation between wave and particle nature of radiation? (ETEA 2014)

A. $E=\frac{hc}{\lambda}$
B. $E=\frac{hc}{c}$
C. $E=\frac{\lambda c}{h}$
D. $E=h\lambda c$

Q.39 Which one of the following has the largest energy content? (MCAT 2015)

A. $\gamma-rays$
B. Infrared rays
C. X-rays
D. Ultra violet radiations

Q.40 Choose the correct relationship, when E= energy, h = plank's constant, c = velocity of light, f = frequency, λ = wavelength: (ETEA 2015)

A. E = hfc
B. $E=\frac{c}{\lambda}$
C. E = hf
D. $E=\frac{n\lambda}{c}$

Q.41 Which of the following is the best evidence for the wave nature of matter? (ETEA 2015)

A. The photoelectric effect
B. The Compton effect
C. The spectral radiation form cavity radiation
D. The reflection of electrons by crystal

Q.42 The momentum of wave of wavelength 1.32×10^{-9} is: (MDCAT 2017)

A. 5×10^{-26} Ns
B. 5×10^{-43} Ns
C. 5×10^{-25} Ns
D. 5×10^{-44} Ns

Q.43 Calculate the frequency of a photon having a momentum of 4.42×10^{-26} Ns: (MDCAT 2017)

A. 2×10^{14} Hz
B. 5×10^{16} Hz
C. 2×10^{16} Hz
D. 2×10^{18} Hz

Q.44 The De-Broglie wavelength of particle of mass "m" moving with the kinetic energy "E" can be written as:

A. $\sqrt{\frac{h}{2mE}}$
B. $\frac{h}{2mE}$
C. $\frac{h}{\sqrt{2mE}}$
D. $\frac{\sqrt{h}}{2mE}$

Q.45 The de Broglie wave length of an electron travelling with a speed of 1.0×10^{7} m/s equal to, ($h=6.6\times10^{-34}$Js and $m_e=9.1\times10^{-31}$kg): (MDCAT 2018)

A. 7.3×10^{11}m
B. 7.3×10^{-11}m
C. 7.3×10^{8}m
D. 7.3×10^{-13}m

Q.46 A 5-watt LED bulb converts 80% of the power into light photons of wavelength 660 nm. What is the number of photons emitted from the bulb in one second? (MDCAT 2018)

A. 5.8×10^{34}
B. 7.5×10^{18}
C. 6.6×10^{7}
D. 1.3×10^{19}

Q.47 The value and units of the Plank constant 'h' can be expressed as: (MDCAT 2019)

A. $6.63 \times 10^{-34}\ Js^{-1}$ B. $6.63 \times 10^{-34}\ Js$

C. $6.63 \times 10^{-43}\ Js$ D. $3.63 \times 10^{-34}\ Js$

Q.48 Calculate the energy of a photon of frequency 3.0×10^{18} Hz. ($h = 6.63 \times 10^{-34} Js$) (MDCAT 2019)

A. 19.89×10^{-18} J B. 11.89×10^{-16} J

C. 1.89×10^{-16} J D. 19.89×10^{-16} J

Q.49 The wavelength associated with an electron is of the order of: (NMDCAT 2020)

A. Visible light B. X-Rays

C. Radio waves D. Infrared

Q.50 Which photon carries the most energy? (NMDCAT 2020)

A. Blue B. Violet

C. Red D. Green

Q.51 Photon is made up___________quarks (NMDCAT 2021)

A. Basons B. No quark

C. Quarks in hadrons D. Masons

Q.52 If clouds were black body _____ what would happen? (NMDCAT 2021)

A. Will receive no light on surface B. Some light would reach surface

C. Reflects back D. Absorbs light

Q.53 By Wein's constant the wavelength______and temperature Are related. (NMDCAT 2021)

A. Inversely B. Directly

C. Equal D. None

Q.54 If wavelength = 500 nm of a photon, then its frequency is: (NMDCAT 2021)

A. 5×10^{14} Hz B. 6×10^{14} Hz

C. 7×10^{14} Hz D. 8×10^{14} Hz

Q.55 Find E in ev "'Photon Wavelength was given 1440nm"? (NMDCAT 2021)

A. 0.867 eV B. 18.67 eV

C. 9.32 eV D. 0.932 eV

Q.56 If velocity Becomes 5 times, what happened to De Broglie Wavelength (NMDCAT 2021)

A. Decrease by 5 times B. Increase by 5 times

C. Both D. None

Q.57 If electron, proton, neutron, and alpha particle have same velocity, which of them has the shortest wavelength? (UHS 2022)

A. Electron B. Proton

C. Neutron D. Alpha particle

Q.58 The process of ejection of loosely bound electrons from a certain photo sensitive surface by absorption of photon is called: (UHS 2022)

A. Compton effect B. Photoelectric effect

C. Pair production D. Black body radiation

Q.59 In a photoelectric effect experiment, the stopping potential is: (UHS 2022)

A. The kinetic energy of the most energies electron ejected

B. The potential energy of the most energetic electron ejected

C. The photon energy

D. The electric potential that causes the electron current to vanish

Q.60 **Red light is used in photographic dark room because of:** **(SZABMU 2022)**
A. More frequency, less wavelength
B. Less frequency, less wavelength
C. Less frequency, more wavelength
D. More frequency, more wavelength

Q.61 **Which photons carriers the most energy?** **(SZABMU 2022)**
A. Blue
B. Violet
C. Red
D. Green

Q.62 **An electron will have maximum kinetic energy when it has:** **(ETEA 2022)**
A. Long wavelength
B. Short wavelength
C. Low frequency
D. Circular motion

Q.63 **In pair annihilation two gamma ray's photons created, travel in opposite direction not in the same direction, because:** **(ETEA 2022)**
A. This proves law of conservation of energy
B. This proves law of conservation of momentum
C. This proves law of conservation of charge
D. This proves law of conservation of mass-energy

Q.64 **Which photon is travelling with largest speed in vacuum?** **(ETEA 2022)**
A. Gamma photon
B. Visible light photon
C. Infrared
D. All photons move with the speed of light

Q.65 **In physics it is observed that when matter and anti-matter combine, they form:** **(ETEA 2022)**
A. Particles with zero charge
B. Particles with positive charge
C. Particles with negative charge
D. Particles with dual mass

Q.66 **Positron and electron annihilate into:** **(BMU 2022)**
A. α-rays
B. One γ ray photon
C. Two γ ray photons
D. X-rays

Q.67 **The units of the equation of Compton scattering** $\Delta\lambda = \frac{h}{m_o c}(1-\cos\theta)$ **are of:** **(BMU 2022)**
A. Length
B. Time
C. Mass
D. Frequency

Q.68 **The minimum energy of photon for pair production is** **(DUHS 2022)**
A. 1.02 J
B. 1.02 eV
C. 1.02 MeV
D. 1.02 GeV
E. 1.02 keV

Q.69 **The experimental proof of particle nature of light is:** **(DUHS 2022)**
A. Pair-production
B. Photoelectric effect
C. Davison-Germer experiment
D. de-Broglie concept
E. Compton's effect

ANSWER KEY

PRACTICE EXERCISE

1	C	11	A	21	A	31	D
2	B	12	A	22	D	32	A
3	B	13	B	23	B	33	C
4	C	14	C	24	D	34	C
5	C	15	C	25	C	35	D
6	D	16	D	26	C	36	A
7	A	17	C	27	B	37	B
8	B	18	B	28	B		
9	A	19	A	29	D		
10	B	20	D	30	C		

PAST PAPER MCQ'S

38	A	48	D	58	B	68	C
39	A	49	B	59	D	69	B
40	C	50	B	60	C		
41	B	51	B	61	B		
42	C	52	D	62	B		
43	C	53	A	63	B		
44	C	54	B	64	D		
45	B	55	A	65	A		
46	D	56	A	66	C		
47	C	57	D	67	A		

EXPLANATORY NOTES

PRACTICE EXERCISE

1. Since $W_o = h\frac{c}{\lambda}$

$$2W_o = h\frac{c}{\lambda_1} \Rightarrow 2 = \frac{\lambda}{\lambda_1} \quad or \quad \lambda_1 = \frac{\lambda}{2}$$

2. $P = 100 \times \frac{3}{100} = 3\,Watt,\ t = 1\sec,\ N = ?$

$\lambda = 6625\,A^o = 6625 \times 10^{-10}\,m$

$P = \frac{Nhc}{\lambda t}$

$N = \frac{P\lambda t}{hc} = \frac{3 \times 6625 \times 10^{-10} \times 1}{6.625 \times 10^{-34} \times 3 \times 10^8}$

$N = 10^{19}$

3.

$E = \frac{hc}{\lambda},\ \lambda = \frac{hc}{E} = \frac{1240}{10^6}\,nm$

$= 1.24 \times 10^{-3}\,nm$

4. Since $\lambda = \frac{h}{\sqrt{2m\,K.E}} \Rightarrow \lambda \propto \frac{1}{\sqrt{K.E}}$

5. $\Delta\lambda = \frac{h}{m_o c}(1 - \cos\theta)$

6. $E = mc.c = pc = (2 \times 10^{-16})(3 \times 10^8) = 6 \times 10^{-8}\,erg$

7. $P = \frac{h}{\lambda} \Rightarrow \frac{P_1}{P_2} = \frac{\lambda_2}{\lambda_1} = \frac{8000\,\mathring{A}}{4000\,\mathring{A}} = 2:1$

8. $E = nhf \Rightarrow \frac{E}{t} = \frac{n}{t}hf \Rightarrow \frac{n}{t} = \frac{P}{hf} = 1.6 \times 10^{29}$

9. $E = Pc \Rightarrow P = \frac{E}{c} = \frac{3 \times 10^{-19}}{3 \times 10^8} = 10^{-27}\,kg\,ms^{-1}$

10. Condition for pair production

11. De-Broglie wavelength $= \lambda = \frac{h}{P} \Rightarrow \frac{c}{f} = \frac{h}{P} \Rightarrow f = \frac{pc}{h}$.

12. $E = Pc \Rightarrow P \propto E\ ,\ \frac{P_A}{P_B} = \frac{E_A}{E_B} = \frac{2E_B}{E_B} = \frac{2}{1}$

13. Plank's constant = h = 6.63×10^{-34} Js

14. $E = nhf \Rightarrow n = \frac{E}{hf} = \frac{E\lambda}{hc} \Rightarrow n \propto \lambda$

15. For photon $\Rightarrow E = hf = \frac{hc}{\lambda} \Rightarrow E \propto \frac{1}{\lambda}$

For particle $\Rightarrow \lambda = \frac{h}{\sqrt{2mE}} \Rightarrow \lambda \propto \frac{1}{\sqrt{E}}$

16. $P = \frac{h}{\lambda} \Rightarrow P \propto \frac{1}{\lambda}$

17. $m = \frac{m_o}{\sqrt{1-\frac{c^2}{c^2}}} = \infty \quad \lambda = \frac{h}{mv} \Rightarrow \boxed{\lambda = 0}$

18. $\lambda_{max} \propto \frac{1}{T}$

19. $\lambda = \frac{h}{P} \Rightarrow \lambda = \frac{h}{mv} \Rightarrow v = \frac{h}{m\lambda} \Rightarrow v \propto \frac{1}{m}$

20. $\lambda = \frac{h}{P} \Rightarrow \lambda \propto \frac{1}{P}$

21. $K.E_{max} = E - \phi_o = (3.4-2)eV = 1.4eV$

22. $\lambda = \frac{h}{P}$, $P = \sqrt{2meV}$

So, $\lambda = \frac{h}{\sqrt{2meV}}$

23. $\lambda = \frac{h}{\sqrt{2meV}} = \frac{6.63\times10^{-34}}{\sqrt{2(9.1\times10^{-31})(1.6\times10^{-19})(54)}} = 1.66\times10^{-10}m$

24. When the frequency of light is less than threshold frequency then no photo electron will be emitted hence photo electric current will be zero

25. $m = 200g = 0.2kg,\ v = 5\frac{m}{hr} = \frac{5}{3600}\frac{m}{s}$

$p = \frac{h}{\lambda} = mv$

$\therefore \lambda = \frac{h}{mv} = \frac{6.626\times10^{-34}\times3600}{0.2\times5}$

$= 23.85\times10^{-31}$

$= 2.385\times10^{-30} = 10^{-30}m$

26. Diffracted electron beam from crystal shows wave nature.

27. $\lambda = \frac{h}{\sqrt{2meV}} \Rightarrow \lambda = \frac{1}{\sqrt{V}}$

28. $\lambda = \frac{h}{\sqrt{2mqV}} \propto \frac{1}{\sqrt{mq}} \Rightarrow \frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{m_\alpha q_\alpha}{m_p q_p}} = \sqrt{\frac{4m_p\times2e}{mp\times e}} = \sqrt{8} = 2\sqrt{2}$

29. $\lambda = \frac{h}{\sqrt{2meV}}$

$P = \sqrt{2meV}$

$\frac{p_e}{p_\alpha} = \sqrt{\frac{2m_e eV}{2m_\alpha (2e)V}} \Rightarrow \frac{p_e}{p_\alpha} = \sqrt{\frac{m_e}{2m_\alpha}}$

30. $\lambda = \frac{h}{P} \Rightarrow \lambda = \frac{6.63\times10^{-34}}{3.3\times10^{-23}} = 2\times10^{-11}m = 0.02\times10^{-9}m = 0.02nm$

31. $\lambda = \frac{h}{P} = \frac{h}{mv} \Rightarrow v = \frac{h}{m\lambda}$

32. $\lambda = \frac{h}{\sqrt{2mE}} \Rightarrow E = \frac{h^2}{2m\lambda^2} \Rightarrow E \propto \frac{1}{m}$

33. $\lambda = \frac{h}{\sqrt{2m\,k.E}} \Rightarrow \lambda = \frac{1}{\sqrt{K.E}}$

34. $\lambda = \frac{h}{\sqrt{2mE}} \Rightarrow \lambda \propto \frac{1}{\sqrt{m}}$

35. Wavelength of matter wave is independent of charge.

36. $\lambda = \frac{h}{\sqrt{2meV}} \Rightarrow \lambda = \frac{1}{\sqrt{m}} \Rightarrow \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{m_2}{m_1}}$

37. Davission and Germer shows diffraction of electron through metal crystal.

PAST PAPER MCQ'S

38. $E = hf = \frac{hc}{\lambda}$

39. Gamma rays have more energy.

40. Energy of photon = E = hf

41. Compton effect shows wave nature of matter.

42. $\rho = \frac{h}{\lambda} = \frac{6.63\times10^{-34}}{1.32\times10^{-9}} = 5\times10^{-25}\,Ns$

43. $\lambda = \frac{h}{p} \Rightarrow \frac{c}{f} = \frac{h}{p} \qquad \because c = f\lambda$

$\Rightarrow f = \frac{pc}{h} = \frac{4.42\times10^{-26}\times3\times10^{8}}{6.63\times10^{-34}} = 2\times10^{16}\,Hz$

44. $\lambda = \frac{h}{\sqrt{2mVe}}$

$Ve = K.E = E$

$\lambda = \frac{h}{\sqrt{2mE}}$

45. $\lambda = \frac{h}{mc} = \frac{6.63\times10^{-34}}{9.1\times10^{-31}\times1\times10^{7}} = 7.3\times10^{-11}m$

46. $P = \frac{W}{t} = \frac{nhf}{t} \quad \because W = E = nhf$

$n = \frac{Pt}{hf} = \frac{Pt\lambda}{hc}$

$= \frac{80\%(5)\times 1\times 660\times 10^{-9}}{6.63\times 10^{-34}\times 3\times 10^{8}} = 1.3\times 10^{19}$

47. Value and units of plank's constant is $h = 6.63\times 10^{-34}$ Js.

48. $E = hf = 6.63 \times 10^{-34} \times 3 \times 10^{18} = 1.989 \times 10^{-15}J = 19.89 \times 10^{-16}J$

49. $\lambda = \frac{h}{mv} = \frac{6.63\times 10^{-34}}{9.1\times 10^{-31}\times 10^{6}} = 10^{-10}$

50. $f_v > f_b > f_r$

$E = hf$

E_{voilet} is greater

51. Photon is made of no quarks

52. Clouds absorb all right.

53.

$\lambda T = \text{constant}$

$\lambda = \frac{1}{T}$

54. $f = \frac{3\times 10^{8}}{500\times 10^{-9}} = \frac{3}{500}\times 10^{17} = 0.006\times 10^{17}$

$f = 6\times 10^{14}\ Hz$

55. $E = \frac{(6.63\times 10^{-34})(3\times 10^{8})}{1440\times 10^{-9}} J$

$= 0.014\times 10^{-34+8+9} J = \frac{1.4\times 10^{-19}}{1.6\times 10^{-19}} eV = 0.87\, eV$

56. $\lambda = \frac{h}{mv}$

57. $\lambda = \frac{h}{mv}$

$v = \text{same}$

$\lambda \propto \frac{1}{m}$

58. Definition.

59. Definition.

60. Red light has less frequency, less energy and more wavelength so it will not ruin the pictures during the developing process in photographic room.

61. $E = hf = \frac{hc}{\lambda} \Rightarrow E \propto \frac{1}{\lambda}$

Violet colour has small wavelength so it has most energy.

62. $\lambda = \frac{h}{\sqrt{2m K.E}}$

$\lambda \propto \frac{1}{\sqrt{K.E}}$

63. Conceptual information.

64. $c = f\lambda$

65. When $\overset{-}{e} + \overset{+}{e} \rightarrow \gamma - rays + \gamma - rays$ are chargeless.

66. $e^{+} + e^{-} \rightarrow \gamma + \gamma$

67. $\frac{h}{m_o c} = 2.43 \times 10^{-12} m$

Meter is unit of length.

68. The minimum energy of photon for pair production is 1.02 MeV.

69. Photoelectric effect is experimental proof of particle nature of light.

12 TOPIC

ATOMIC SPECTRA

PRACTICE EXERCISE

Q.1 When a hydrogen atom is in its first excited level, what is the relation of radius and Bohr radius?
A. Twice
B. 4 times
C. Same
D. Half

Q.2 What is the energy required to ionize an H-atom from the third excited state, if ground state ionization energy of H-atom is 13.6 eV?
A. 0.85 eV
B. 3.4 eV
C. 13.6 eV
D. 12.1 eV

Q.3 $\frac{1}{\lambda_n} = R\left(\frac{1}{P^2} - \frac{1}{n^2}\right)$ in this relation P = 1,2,3...... and n will be
A. P, P+1, P+2....
B. P+1, P+2....
C. P, P −1, P−2....
D. P−1, P−2....

Q.4 Lyman series of H-atoms lie in the ______ region of electromagnetic spectrum
A. visible
B. ultraviolet
C. infrared
D. red

Q.5 The Balmer series for hydrogen atom corresponds to electronic transitions that terminate in the state of quantum number n = 2. The longest wavelength of photon emitted is
A. $\frac{5R}{36}$
B. $\frac{36}{5}$
C. $\frac{36}{5R}$
D. $\frac{5}{36}$

Q.6 The hydrogen atoms are excited to the stationary state designated by the principal quantum number n = 4. The number of maximum spectral lines are observing
A. 2
B. 4
C. 3
D. 6

Q.7 Bracket series is obtained when all the transition of electron terminate at
A. First orbit
B. Third orbit
C. Second orbit
D. Fourth orbit

Q.8 Number of the emission spectra are
A. One
B. Three
C. Two
D. Four

Q.9 When electron jumps from n^{th} to the p^{th} orbit in an hydrogen atom then the wavelength of the emitted radiation is given by
A. $\frac{1}{\lambda} = R_H\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$
B. $\frac{1}{\lambda} = \frac{1}{R_H}\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$
C. $\frac{1}{\lambda} = R_H\left[\frac{1}{n^2} - \frac{1}{p^2}\right]$
D. $\frac{1}{\lambda} = \frac{1}{R_H}\left[\frac{1}{4^2} - \frac{1}{n^2}\right]$

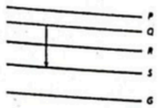
Q.10 Photon of highest frequency emitted in Lyman series is given as:
A. $f = \frac{c}{R_H}$
B. $f = \frac{R_H}{c}$
C. $f = R_H c$
D. $f = \frac{1}{R_H c}$

Q.11 Which of the following is true for number of spectral lines in going from Lyman series to P-fund series?
A. Increases
B. Decreases
C. Unchanged
D. May decreases or increases

Q.12 **Number of spectral lines in hydrogen atom is**

A. 3
B. 6
C. 15
D. infinite

Q.13 **Figure shows the energy levels P, Q, R, S and G of an atom where G is the ground state. A red line in the emission spectrum of the atom can be obtained by an energy level change from Q to S. A blue line can be obtained by following energy level change**



A. R to S
B. Q to R
C. R to G
D. P to Q

Q.14 **The maximum wavelength of Lyman series is......**

A. $\frac{4}{3R}$
B. $\frac{1}{R^2}$
C. $\frac{C}{R}$
D. $\frac{1}{RC}$

Q.15 **An atom is excited to an energy level E_1 from its ground state energy level E_0. The wavelength of the radiation emitted is**

A. $(E_0 - E_1)/hc$
B. $\frac{E_1}{hc} - \frac{E_0}{hc}$
C. $(E_1 - E_0)/h$
D. $\frac{hc}{(E_1 - E_0)}$

Q.16 **Which of the transitions in hydrogen atom emits a photon of lowest frequency (n = quantum number)**

A. n = 2 to n = 1
B. n = 4 to n = 3
C. n = 3 to n = 1
D. n = 4 to n = 2

Q.17 **During the transition of Electron of Hydrogen atom from higher orbit to a third orbit, a photon of:**

A. Paschen series is emitted
B. Lyman series is emitted
C. Balmer series is emitted
D. Brakett series is emitted

Q.18 **The radiations emitted from hydrogen filled discharge tube shows:**

A. Continuous spectrum
B. Band spectrum
C. Line spectrum
D. None of these

Q.19 **An electron jumps from the 4th orbit to the 2nd orbit of hydrogen atom. Given the Rydberg's constant $R = 10^5 cm^{-1}$. The frequency in Hz of the emitted radiation will be**

A. $\frac{3}{16} \times 10^5$
B. $\frac{3}{16} \times 10^{15}$
C. $\frac{9}{16} \times 10^{15}$
D. $\frac{3}{4} \times 10^{15}$

Q.20 **If an electron jumps from 1st orbital to 3rd orbital, then it will.**

A. Absorb energy
B. Release energy
C. No gain of energy
D. None of these

Q.21 **The ratio of the frequencies of the long wavelength limits of Lyman and Balmer series of hydrogen spectrum is**

A. 27 : 5
B. 5 : 27
C. 4 : 1
D. 1 : 4

Q.22 The electron in the hydrogen atom makes a transition from n = 2 energy state to the ground state n = 1. The wavelength of emitted photon is

A. $\frac{3R}{4}$ B. $\frac{3}{4}$

C. $\frac{4}{3R}$ D. $\frac{4}{3}$

Q.23 Shortest wavelength photon in the Balmer series is

A. $\frac{4}{R}$ B. $\frac{R}{4}$

C. $\frac{1}{4}$ D. 4

Q.24 To find longest wavelength radiation in Balmer series, the value of n used is

A. 2 B. 4

C. 3 D. ∞

Q.25 Photon of highest frequency will be absorbed when transition takes place from:

A. 1^{st} to 5^{th} orbit B. 5^{th} to 1^{st} orbit

C. 3^{rd} to 5^{th} orbit D. 4^{th} to 5^{th} orbit

Q.26 Balmer series lies in that region of electromagnetic wave spectrum, which is known as:

A. Visible region B. Ultraviolet region

C. Invisible region D. Infra-red region

Q.27 The relation for Paschen series is given as

A. $\frac{1}{\lambda}=R_H\left(\frac{1}{2^2}-\frac{1}{n^2}\right)$ B. $\frac{1}{\lambda}=R_H\left(\frac{1}{4^2}-\frac{1}{n^2}\right)$

C. $\frac{1}{\lambda}=R_H\left(\frac{1}{3^2}-\frac{1}{n^2}\right)$ D. $\frac{1}{\lambda}=R_H\left(\frac{1}{5^2}-\frac{1}{n^2}\right)$

Q.28 In Bohr model of hydrogen atom, let PE represent potential energy and TE the total energy. In going to a higher level:

A. PE decreases, TE increases B. PE increases, TE decreases

C. PE decreases, TE decreases D. PE increases, TE increases

Q.29 The ratio of the energies of the hydrogen atom in the first and the second excited states is

A. 1 : 4 B. 4 : 1

C. 4 : 9 D. 9 : 4

Q.30 In the nth orbit, the energy of an electron $E_n = -13.6/n^2$ eV for hydrogen atom. The energy required to take the electron from first orbit to second orbit will be

A. 10.2 eV B. 12.1 eV

C. 13.6 eV D. 3.4 eV

Q.31 Ionization potential of hydrogen atom is 13.6 V. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. The spectral lines emitted by hydrogen atoms according to Bohr's theory will be

A. Four B. Two

C. Three D. One

12 Topic

ATOMIC SPECTRA

PAST PAPER MCQ'S

Q.32 Which of the following series lies in ultraviolet region? **(NMDCAT 2021)**

A. Balmer series
B. Pascher series
C. Lyman series
D. Bracket series

Q.33 The line spectrum of hydrogen atom contains the spectral lines in the region of: **(UHS 2022)**

A. Ultraviolet
B. Infrared
C. Visible
D. All of these

Q.34 The speed of electron in the first Bohr orbit is: **(UHS 2022)**

A. $2.19\times10^{6}\ ms^{-1}$
B. $2.19\times10^{-6}\ ms^{-1}$
C. $2.19\times10^{4}\ ms^{-1}$
D. $2.19\times10^{-4}\ ms^{-1}$

Q.35 Which one of the following series lies in the ultraviolet region? **(SZABMU 2022)**

A. Balmer series
B. Pascher series
C. Lyman series
D. Bracket series

Q.36 Which x-ray photon will have longest wavelength? **(SZABMU 2022)**

A. K_{α}
B. K_{β}
C. K_{γ}
D. M_{α}

Q.37 The radiation emitted by warm blooded animals lies the region of: **(ETEA 2022)**

A. Visible
B. Ultraviolet
C. Infrared
D. X-rays

Q.38 The shortest possible wavelength is associated with: **(ETEA 2022)**

A. Lyman series
B. Balmer series
C. Paschen series
D. Brackett series

Q.39 The longest wavelength observed in Balmer series is: **(ETEA 2022)**

A. 36R/5
B. 36R/7
C. 36R/11
D. 36R/13

Q.40 The shortest wavelength of Lyman series is (R_H = Rydberg constant) **(ETEA 2022)**

A. R_H
B. $1/R_H$
C. $3R_H$
D. $5/R_H$

Q.41 If Rydberg constant for hydrogen is R_H then wave length 'λ' of first line in Lyman series is **(DUHS 2022)**

A. $\frac{4R_H}{3}$
B. $\frac{R_H}{3}$
C. $\frac{4}{R_H}$
D. $\frac{4}{3R_H}$
E. $\frac{R_H}{2}$

Q.42 The kinetic energy of an electron in first Bohr radius of H – atom is: **(DUHS 2022)**

A. 13.6 J
B. 13.6 eV
C. –13.6 eV
D. 13.6 keV
E. 13.6 KJ

ANSWER KEY

PRACTICE EXERCISE

1	B	11	B	21	A	31	C
2	A	12	D	22	C		
3	B	13	C	23	A		
4	B	14	A	24	C		
5	C	15	D	25	A		
6	D	16	B	26	A		
7	D	17	A	27	C		
8	B	18	C	28	D		
9	A	19	C	29	D		
10	C	20	A	30	A		

PAST PAPER MCQ'S

32	C	42	B
33	D		
34	A		
35	C		
36	D		
37	C		
38	A		
39	A		
40	B		
41	D		

EXPLANATORY NOTES

PRACTICE EXERCISE

1. For the first excited level, n = 2.
$r_2 = (2)^2 r_0 = 4r_0$.
So, when a hydrogen atom is in its first excited level, its radius is 4 times of the Bohr radius.

2. Third excited state means fourth energy states so electron have energy
$$E_n = \frac{-E_o}{n^2} = -\frac{13.6\,\text{eV}}{4^2} = -0.85\,\text{eV}$$
Hence ionization energy = $-E_4 = -(-0.85\text{ eV}) = +0.85$ eV

3. We know $\frac{1}{\lambda_n} = R\left(\frac{1}{P^2} - \frac{1}{n^2}\right)$ where p is lower state and n is higher state. So, n = p+1

4. In Hydrogen spectrum Lyman series is strongest and lies in the ultraviolet region.

5. $\frac{1}{\lambda_n} = R\left(\frac{1}{P^2} - \frac{1}{n^2}\right)$ For longest wavelength in Balmer series p=2 & n=3
$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = R\left(\frac{1}{4} - \frac{1}{9}\right) = \frac{5R}{36} \Rightarrow \lambda = \frac{36}{5R}$$

6. No of spectral lines $= \frac{n(n-1)}{2}$ Here n = 4, So $\frac{4(4-1)}{2} = 6$

7. Braket series is obtained when all transitions of electron terminate at p=4

8. There are three emission spectra: Line Spectrum, Band Spectrum and Continuous Spectrum

9. We know $\frac{1}{\lambda} = R_H\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$ where n=p+1(n is higher state and p is lower state)

10. Highest frequency in Lyman series when n=α $\frac{1}{\lambda} = R_H\left[\frac{1}{1} - 0\right] = R_H \Rightarrow R_H\lambda = 1 \; Also \; f\lambda = c$

11. For Lyman series electron can transit from infinity to p=1 and for P-fund series electron can transit from infinity to p=5

12. In hydrogen atom only one electron but infinite energy states so there are infinite spectral lines.

13. If E is the energy radiated in transition, then $E_{R\to G} > E_{Q\to S} > E_{Q\to R} > E_{P\to Q}$ For getting blue line energy radiated should be maximum $\left(E \propto \frac{1}{\lambda}\right)$

14. We know $\frac{1}{\lambda} = R_H\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$ For maximum wavelength of Lyman series p=1 & n=2
$$\frac{1}{\lambda} = R_H\left[\frac{1}{p^2} - \frac{1}{n^2}\right] \Rightarrow \frac{1}{\lambda} = R_H\left[\frac{1}{1} - \frac{1}{4}\right] = R_H\frac{3}{4} \Rightarrow \lambda = \frac{4}{3R_H}$$

15. $$\Delta E = E_1 - E_0 = hf = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E_1 - E_0}$$

16. As we go to higher states the energy difference between the consecutive states decreases so photon of lowest frequency is obtained when it transits from n = 4 to n = 3

17. For Paschen series p=3 and n=4,5,6.....

18. Hydrogen gas gives the line spectrum.

19. $\frac{1}{\lambda}=R\left(\frac{1}{2^2}-\frac{1}{4^2}\right)=\frac{3R}{16}\Rightarrow\lambda=\frac{16}{3R}=\frac{16}{3}\times10^{-5}cm\Rightarrow f=\frac{c}{\lambda}=\frac{3\times10^{10}}{\frac{16}{3}\times10^{-5}}=\frac{9}{16}\times10^{15}Hz$

20. When electron jumps from lower to higher state it will absorb the energy because higher states have higher energies.

21. For Lyman series $\nu_{\text{Lymen}}=\frac{c}{\lambda_{\max}}=Rc\left[\frac{1}{(1)^2}-\frac{1}{(2)^2}\right]=\frac{3RC}{4}$

For Balmer series $\nu_{\text{Balmer}}=\frac{c}{\lambda_{\max}}=Rc\left[\frac{1}{(2)^2}-\frac{1}{(3)^2}\right]=\frac{5RC}{36}$ So, $\therefore\ \frac{\nu_{\text{Lymen}}}{\nu_{\text{Balmer}}}=\frac{27}{5}$

22. $\frac{1}{\lambda}=R\left(\frac{1}{1}-\frac{1}{4}\right)\Rightarrow\frac{1}{\lambda}=R\left(\frac{3}{4}\right)\Rightarrow\lambda=\frac{4}{3R}$

23. $\frac{1}{\lambda}=R\left(\frac{1}{2^2}-\frac{1}{\infty}\right)\Rightarrow\frac{1}{\lambda}=\frac{R}{4}\Rightarrow\lambda=\frac{4}{R}$

24. $\frac{1}{\lambda}=R\left(\frac{1}{2^2}-\frac{1}{n^2}\right)$, For longest wavelength = n =3

25. $\Delta E=hf\Rightarrow\Delta E\propto f$

26. Balmer series lies in visible region of electromagnetic wave spectrum.

27. $\frac{1}{\lambda}=R\left(\frac{1}{2^2}-\frac{1}{n^2}\right)$

28. $P.E=\frac{-ke^2}{r_n}$

when r increase $P.E$ becomes less negative i.e increases

$TE=\frac{-ke^2}{2r_n}$

when r increases TE becomes less negative i.e increases

29. $E_n=\frac{-E_o}{n^2}\Rightarrow E_n\propto\frac{1}{n^2}$

$\frac{E_1}{E_2}=\left(\frac{n_2}{n_1}\right)^2=\left(\frac{3}{2}\right)^2=\frac{9}{4}$

30. $E_{1\to2}$=-3.4-(13.6)=+10.2eV

31. Final energy of electron = –13.6 + 12.1 = –1.51 eV. Which is corresponds to third level i.e.

n = 3. Hence number of spectral lines emitted $=\frac{n(n-1)}{2}=\frac{3(3-1)}{2}=3$

PAST PAPER MCQ'S

32. Lyman series lies in ultraviolet region of electromagnetic wave spectrum.
33. Information.
34. $v_n = \frac{2\pi ke^2}{nh}$ where $n=1$

    $v_1 = 2.19\times10^6 ms^{-1}$
35. Information
36. Among these M_α has smallest energy and longest wavelength.
37. Information.
38. Information.
39. For longest wavelength P = 2, n = 3,

    $\frac{1}{\lambda} = R\left[\frac{1}{P^2} - \frac{1}{n^2}\right] \Rightarrow \lambda = \frac{36}{5R}$.
40. For shortest wavelength P = 1, n = infinity,

    $\frac{1}{\lambda} = R_H\left[\frac{1}{P^2} - \frac{1}{n^2}\right] \Rightarrow \lambda = \frac{1}{R_H}$
41.

    $\frac{1}{\lambda} = R_H\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$

    $p=1,\ n=2$

    $\frac{1}{\lambda} = R_H\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = R_H\left[\frac{4-1}{4}\right]$

    $\lambda = \frac{4}{3R_H}$
42. $K.E = \frac{Ke^2}{2r} = 13.6eV$,

13 TOPIC NUCLEAR PHYSICS

PRACTICE EXERCISE

Q.1 What is the half-time of a radioactive sample (in minutes), if its mean life is 200 s?

A. 0.69 min
B. 2 min
C. 2.57 min
D. 2.31 min

Q.2 What will happen in a time of 7 hours, if a radioactive substance has an average life of 7 hours?

A. Half of the active nuclei decay
B. Less than half of the active nuclei decay
C. More than half of the active nuclei decay
D. All active nuclei decay

Q.3 The difference between U^{235} and U^{238} atom is that

A. U^{238} contains 3 more protons
C. U^{238} contains 3 more protons and 3 more electrons.
B. U^{238} contains 3 more neutrons and 3 more electrons.
D. U^{238} contains 3 more neutrons

Q.4 Which two nuclei contain the same number of neutrons?

A. $^{12}_{6}C$ and $^{14}_{6}C$
B. $^{23}_{11}Na$ and $^{24}_{12}Mg$
C. $^{16}_{7}N$ and $^{15}_{8}O$
D. $^{32}_{14}Si$ and $^{32}_{15}P$

Q.5 What is the ratio of the nuclear densities of two nuclei having mass numbers in the ratio 1:4?

A. 1:1
B. 1:2
C. 1:4
D. 1:3

Q.6 The radius for an atom is -------- times the radius of the nucleus.

A. 10^5
B. 10^{10}
C. 10^{15}
D. 10^{20}

Q.7 α, β and γ are emitted from a radioactive substance

A. Spontaneously
B. When it is heated
C. When it interacts with the other particles
D. When it is exposed to light

Q.8 The order of penetration power of α and β and γ -rays is

A. $\alpha > \beta > \gamma$
B. $\alpha < \beta > \gamma$
C. $\alpha > \beta < \gamma$
D. $\alpha < \beta < \gamma$

Q.9 In a given reaction $^{A}_{Z}X \longrightarrow {}^{A}_{Z+1}Y \longrightarrow {}^{A-4}_{Z-1}B \longrightarrow {}^{A-4}_{Z-1}B$

Radioactive radiations are emitted in the sequence

A. γ, β, γ
B. β, α, γ
C. γ, α, β
D. α, γ, β

Q.10 When boron $^{10}_{5}B$ is bombarded by neutrons, α-particles are emitted. The resulting nucleus has the mass number

A. 11
B. 6
C. 7
D. 15

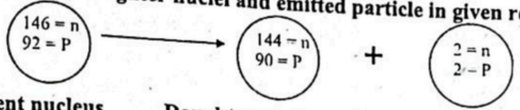
Q.11 In which radioactive disintegration neutron dissociates into proton and electron?

A. α–emission
B. β–emission
C. γ–emission
D. None of these

Q.12 $_{92}U^{238}$ nucleus emits two α-particles and two β-particles and transforms into a thorium nucleus. Which of the following is the mass number and atomic number of the thorium nucleus so produced?

A. 230, 90
B. 230, 88
C. 234, 90
D. 234, 88

Q.13 Specify the parent, daughter nuclei and emitted particle in given reaction



	Parent nucleus	Daughter nucleus	Emitted particle
A.	Thorium	Uranium	neutron
B.	Uranium	Thorium	neutron
C.	Thorium	Uranium	Alpha
D.	Uranium	Thorium	Alpha

Q.14 The decay of a nucleus is accompanied by the emission of two β-particles and α-radiation. What effect (if any) does this decay have on the proton number and the nucleon number of the nucleus?

	Proton number	Nucleon number
A	Increases	decreases
B	decreases	Increases
C	unchanged	decreases
D	decreases	unchanged

Q.15 α-particle is bombarded on ^{14}N as a result ^{17}O is formed. The particle emitted is

A. Neutron
B. Electron
C. Proton
D. Positron

Q.16 If $_{92}U^{233}$ decays twice by α-emission, the resulting isotopes will be

A. $^{225}Ra_{88}$
B. $^{234}Pa_{88}$
C. $^{225}Rn_{86}$
D. $^{229}Th_{90}$

Q.17 The following represents a sequence of radioactive decays involving two α-particles and one β-particles. $^{217}_{85}At \xrightarrow{\alpha} V \xrightarrow{\alpha} W \xrightarrow{\beta} X$

What is the nuclide X?

A. $^{213}_{85}At$
B. $^{209}_{82}Pb$
C. $^{215}_{77}Ir$
D. $^{217}_{81}Tl$

Q.18 Radon-220 is radioactive and decays to Polonium-216 with the emission of an α-particle. The equation for the radioactive decay is shown. $^{220}_{86}Rn \rightarrow ^{216}_{84}Po + ^{4}_{2}He$ How many neutrons are in the radon and polonium nuclei?

	Rn	Po
A.	86	84
B.	134	132
C.	220	212
D.	220	216

Q.19 In alpha decay, the ratio of decrease in proton number to the decrease in neutron number is

A. 2 : 1 B. 1 : 1

C. 1 : 2 D. 4 : 1

Q.20 Radon $^{222}_{86}Rn$ decays by α-and β-emission to bismuth $^{214}_{83}Bi$ For the decay of each nucleus of radon. How many α-and β-particles are emitted?

	α-particles	β-particles
A.	1	1
B.	2	1
C.	1	2
D.	2	2

Q.21 A radioactive nucleus undergoes a series of decay according to the scheme $A \xrightarrow{\alpha} A_1 \xrightarrow{\beta} A_2 \xrightarrow{\alpha} A_3 \xrightarrow{\gamma} A_4$. If the mass number and atomic number of A are 180 and 72 respectively, then what are these number for A4.

A. 172 and 69 B. 176 and 69

C. 174 and 70 D. 176 and 70

Q.22 Neutron decay in the free space is given as follows

$$_0n^1 \rightarrow {}_1H^1 + {}_{-1}e^0 + [\ ]$$

Then the parenthesis represents an

A. Photon B. Neutrino

C. Graviton D. Antineutrino

Q.23 The ratio of the rate of decay of a parent atom to the number of radioactive nuclei present at that time is equal to:

A. Half-life B. Mean life

C. Decay constant D. Activity

Q.24 The masses of two radioactive substances are same and their half-lives are 1 year and 2 years respectively. The ratio of their activities after six years will be:

A. 1:4 B. 4:1

C. 1:8 D. 8:1

Q.25 Let T be the mean life of a radioactive sample. 75% of the active nuclei present in the sample initially will decay in time.

A. 2T B. 4T

C. $\frac{1}{2}(\ln 2)T$ D. $2(\ln 2)T$

Q.26 In a sample of radioactive material, what fraction of the inertial number of active nuclei will remain undisintegrated after half of a half-life of the sample?

A. 1/4 B. $\frac{1}{\sqrt{2}}$

C. $\frac{1}{2\sqrt{2}}$ D. $\sqrt{2}-1$

Q.27 If the decay constant of an element is smaller then

A. More of its atoms will decay in a particular interval

B. Its infinite atoms will decay in a particular interval

C. Less of its atoms will decay in a particular interval

D. Both A. and C. are possible depending upon the half-life of element

Q.28 Three-fourths of the radioactive nuclei present in a radioactive sample decay in $\frac{3}{4}s$. The half-life of the sample is:

A. $\frac{3}{4}s$ B. $\frac{3}{8}s$

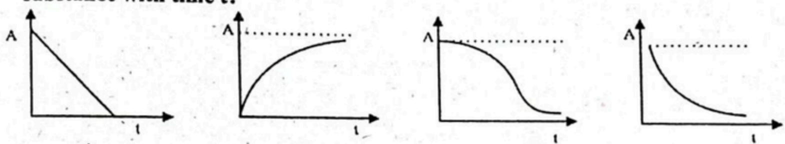
C. $1\ s$ D. $\frac{1}{2}s$

Q.29 The decay constant of radium is 4.28×10^{-4} per year. Its half-life will be

A. 1240 years B. 1620 years

C. 2000 years D. 63 years

Q.30 Which of the following graph represents the variation of activity A of a radioactive substance with time t?



A. B. C. D.

Q.31 The activity of a radioactive sample is 1.6 curie and its half-life is 2.5 days. Its activity after 10 days will be

A. 0.8 curie B. 0.1 curie

C. 0.4 curie D. 0.16 curie

Q.32 A radioactive element emits 200 particles per second. After three hours 25 particles per second are emitted. The half-life period of element will be

A. 50 minutes B. 70 minutes

C. 60 minutes D. 80 minutes

Q.33 The half-life of Bi^{210} is 5 days. If we start with 50000 atoms of this isotope, then which of the following will be the number of atoms left over after ten days?

A. 5000 B. 12500

C. 20000 D. 25000

Q.34 The sample of radioactive element decayed after 5 – half lives

A. $\frac{1}{32}N_o$ B. $\frac{N_o}{31}-\frac{N_o}{32}$

C. $\frac{31}{32}N_o$ D. $\frac{N_o}{32}-\frac{N_o}{31}$

Q.35 Relation for half-life of any radioactive element is

A. $T_{½}=\lambda\ln2$ B. $\lambda=T_{½}\ln2$

C. $T_{½}=\frac{\ln2}{\lambda}$ D. $T_{½}=\frac{\lambda}{\ln2}$

Q.36 The half-life period of radium is 1600 years. Its average life time will be

A. 3200 years
B. 2319 years
C. 4800 years
D. 4217 years

Q.37 The decay constant of a radioactive element is 0.01 per second. Its half-life period is

A. 0.693 sec
B. 6.93 sec
C. 69.3 sec
D. 693 sec

Q.38 What is the ratio of un-decayed and decayed nuclei of a radioactive element after 3 half -lives have elapsed?

A. 1/7
B. 7/8
C. 7
D. 8/7

Q.39 Which of the following is the percentage of the original quantity of a radioactive material left after five half–lives approximately?

A. 3%
B. 5%
C. 10%
D. 20%

Q.40 Which one of the following can be preferred for the treatment of skin?

A. β-particles
B. x-rays
C. γ-radiations
D. α-rays

Q.41 For skin cancer which of following can be used:

A. Iodine 131
B. Carbon 14
C. Phosphorous 32
D. Carbon 12

Q.42 Radio isotope cobalt which emit high energy γ-rays is used for the treatment of

A. Temperature
B. Liver
C. Bones
D. Cancer

Q.43 Cancerous tissue in a thyroid gland can be detected by the intake of

A. Radio iodine
B. Radio carbon
C. Radio sodium
D. Radio phosphors

Q.44 Circulation of blood can be studied by:

A. Sodium – 24
B. Carbon 14
C. Strontium 90
D. Iodine 131

Q.45 Which one of the following is the most useful tracer?

A. Strontium – 90
B. Carbon – 14
C. Iodine – 131
D. Cobalt – 60

13 Topic

NUCLEAR PHYSICS

PAST PAPER MCQ'S

Q.46 A certain radioactive mass decays from 64 gm to 2 gm in 20 days. What is its half-life? **(MCAT 2008)**

A. 5 days B. 10 days
C. 4 days D. 6 days

Q.47 When a helium atom loses an electron, it becomes: **(MCAT 2008)**

A. An alpha particle B. A positive helium ion
C. Proton D. A negative helium ion

Q.48 Beta ray emitted by a radioactive substance is: **(MCAT 2008)**

A. An electron which was existing outside the nucleus.
B. An electron emitted by the nucleus as a result of the decay of neutron inside the nucleus.
C. An electron which was existing inside the nucleus.
D. A pulse of electromagnetic wave.

Q.49 The emission of γ-radiations from the nucleus is generally represented by the equation: **(MCAT 2009)**

A. ${}_zX^A \to {}_zX^{\dot{A}} + \gamma -$ radiations B. ${}_zX^A \to {}_zX^A + \beta -$ particles
C. ${}_zX^{\dot{A}} \to {}_{ZA}X^A + \gamma -$ radiations D. ${}_zX^{\dot{A}} \to {}_zX^A + \gamma -$ radiations

Q.50 In the half-life of an element, the equation for the number of decaying atoms is given by: **(MCAT 2010)**

A. $\Delta N = N\Delta t$ B. $\Delta N \propto -n\Delta t$
C. $\Delta N = KN\Delta t$ D. $\Delta N = -\Delta N\Delta t$

Q.51 Decay constant 'λ' is given a: **(MCAT 2010)**

A. $-\frac{\Delta N / N}{\Delta t}$ B. $-\frac{N}{\Delta t}$
C. $-\frac{\Delta N}{\Delta t}$ D. $\frac{\Delta N / N}{\Delta t}$

Q.52 Ionizing capability of gamma rays is: **(MCAT 2011)**

A. Equal to alpha and beta particle
B. Less than both alpha and beta particles
C. Less than alpha but greater than beta particles
D. Less than beta but greater than alpha particles

Q.53 Half-life of a radioactive element is: **(MCAT 2011)**

A. Inversely proportional to square of decay constant
B. Directly proportional to decay constant
C. Directly proportional to square of decay constant
D. Inversely proportional to decay constant

Q.54 The transformation of a neutron into proton in the nucleus gives rise to emission of: **(MCAT 2011)**

A. Beta particles B. Gamma particles
C. Alpha particles D. X-rays

Q.55 The ratio of the rate of decay of a parent atom to the number of radioactive nuclei present at that time is equal to: **(MCAT 2011)**

A. Half-life of radioactive element
B. Decay constant of radioactive element
C. Mean life
D. Activity if radioactive element

Q.56 What is the charge on alpha particles emitted during the phenomenon of radioactivity? (MCAT 2012)

A. +e B. –2e
C. –e D. +2e

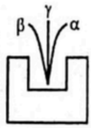
Q.57 A radioactive nuclide decays by emitting an α-particle and a γ-ray photon, the change in the nucleon number will be: (MCAT 2012)

A. –4 B. –2
C. –2 D. –3

Q.58 A half-life of sodium-24 is __________ which is used to estimate the volume of blood in a patient: (MCAT 2012)

A. 6 hours B. 8 hours
C. 15 hours D. 15 days

Q.59 In a radioacuve phenomenon, observation shown in figure where α deviates lesser than β in same electric or magnetic field (not shown in the figure). What is the reason of less deviation of α? (MCAT 2012)



A. α is a lighter particle B. α is heavier particle
C. α is very fasting moving particle D. None of these

Q.60 Which of the following effect is observed due to emission of β during the phenomenon of radioactivity? (MCAT 2012)

A. A increases by 1 and Z remains same B. Z decreases by 1 and A remains same
C. Z increases by 1 and A remains same D. A decreases by 1 and Z remains same

Q.61 Isotopes are those nuclei of an element that have: (MCAT 2013)

A. Same mass number but different atomic number
B. Different mass number as well as atomic number
C. Same mass number as well as atomic number
D. Same atomic number but different mass number

Q.62 Emission of alpha decay from a radioactive substance cause: (MCAT 2013)

A. Decrease in 'Z' by 4 and decrease in 'A' by
B. Decrease in 'Z' by 1 and "A" remains same
C. Decreases in 'A' by 1 and 'Z' remains same
D. Decrease in 'A' by 4 and decrease in 'Z' by 2

Q.63 Which one of the following emissions takes place in a nuclear reaction? (MCAT 2013)

$_{90}Th^{234} \rightarrow {}_{91}Pa^{234} +$ ________

A. Alpha B. Beta
C. Gamma D. Photons

Q.64 Among the three types of radioactive radiation, which have strongest penetration power? (MCAT 2013)

A. Alpha B. Beta
C. Gamma D. α, β and γ have same penetration

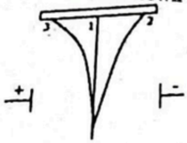
Q.65 Emission of radiation from radioactive substance is (MCAT 2013)

A. Dependent on both temperature and pressure
B. Independent of both temperature and pressure
C. Independent of temperature but dependent on pressure
D. Independent of pressure but dependent on temperature

Q.66 In the nuclear reaction $_{11}Na^{24} \rightarrow {}_{12}Mg^{24} + X$ the particle X is: (ETEA 2013)

A. Electron
B. Positron
C. Proton
D. Neutron

Q.67 Three points of radioactive radiation are observed as shown in the figure presence of electric field, which type of radiation is shown in the path '1'? (MCAT 2014)



A. Alpha
B. Beta
C. Gamma
D. Cathode ray

Q.68 A beta particle is a fast-moving electron, During a β decay how the atomic number and mass number of a nucleus change? (MCAT 2014)

	Atomic number	Mass number
A.	Remains the same	Increases by one
B.	Increases by one	Remains the same
C.	Increases by one	Decreases by two
D.	Decreases by two	Decreases by four

Q.69 A uranium isotope $^{234}_{92}U$ undergoes one α-decay and one $^{0}_{-1}\beta$-decay. What is the atomic number of the final product? (MCAT 2014)

A. 90
B. 89
C. 91
D. 88

Q.70 A naturally occurring radioactive element decays two alpha particles. Which one of the following represents the status of daughter element with respect to mass number A and charge number Z? (MCAT 2014)

A. Z decreases by 4 and A decreases by 2
B. Z decreases by 4 and A decreases by 8
C. Z decreases by 2 and A decreases by 4
D. Z decreases by 8 and A decreases by 4

Q.71 A radioactive isotope W decay to x which decay to Y and Y decays to Z as represented by the figure below. (MCAT 2014)

$$W \xrightarrow[\beta]{} X \xrightarrow[\alpha]{} Y \xrightarrow[\alpha]{} Z$$

What is the change in the atomic number from W to Z?

A. Increases by 3
B. Increases by 5
C. Decreases by 3
D. Decreases by 5

Q.72 In the reaction $^{234}_{90}Th \rightarrow {}^{234}_{91}Pa + {}^{0}_{-1}e$ the electron $^{0}_{-1}e$ emits from the (MCAT 2015)

A. 1st orbit
B. Nucleus
C. 2nd orbit
D. Valence shell

Q.73 According to the equation $^{A}_{Z}X \rightarrow Y + 3\alpha$ particles, what are the atomic and mass numbers of 'Y'? (MCAT 2015)

A. Z–6, A–12
B. Z+1, A
C. Z–2, A–4
D. Z+3, A

Q.74 **A certain radioactive nuclide of mass number 'x' decay by β–emission and α–emission to a second nuclide of mass number 't', which of the following correctly relates 'x' and 't'?** **(MCAT 2015)**

A. $x = t - 4$ B. $x + 3 = t$
C. $x = t + 4$ D. $x - 1 = t$

Q.75 **During the decay of radioactive isotopes $^{232}_{90}X$ to a stable isotope, six α-particles and four β-particles are emitted, what is the atomic number 'Z' and mass number 'A' of the stable isotopes:** **(MCAT 2015)**

A. Z = 70, A = 220 B. Z = 82, A = 212
C. Z = 78, A = 212 D. Z = 82, A = 208

Q.76 **Wavelength of γ-rays is:** **(MCAT 2016)**

A. Equal to the X-rays B. Shorter than X-rays
C. Longer than X-rays D. Broader than X-rays

Q.77 **Thorium is transformed after the emission of β-particle into:** **(MCAT 2016)**

A. Bismuth B. Polonium
C. Protactinium D. Palladium

Q.78 **Emission of γ-rays from radioactive element result into:** **(MCAT 2016)**

A. Increase of charge number 1 B. No change in the charge number
C. Decrease of mass number by 1 D. Decrease charge number by 1

Q.79 **The relation between decay constant 'λ' and half-life '$T_{1/2}$' of radioactive substance is:** **(MCAT 2016)**

A. $\lambda = \dfrac{1}{T_{1/2}}$ B. $\lambda = T_{1/2}$

C. $\lambda = 0.693\ T_{1/2}$ D. $\lambda = \dfrac{0.693}{T_{1/2}}$

Q.80 **Radiation damages living organism is primarily due to:** **(ETEA 2016)**

A. Excitation phenomena B. Ionization
C. Photo electric effect D. Heating

Q.81 **Complete the radioactive equation** $^{?}_{?}Z \longrightarrow {}^{a}_{b}Y + \gamma$ **(MDCAT 2017)**

A. $^{a}_{b+1}Z$ B. $^{a+1}_{b+1}Z$
C. $^{a+1}_{b-1}Z$ D. $^{a}_{b}Z$

Q.82 **The quantity of uranium is 400g. After 3rd half-life, how much uranium will be left?** **(MDCAT 2017)**

A. 50g B. 100g
C. 25g D. 200g

Q.83 **The half-life of radium is about 1600 years. If 100 g radium existing now, 25 g will remain un-decayed after:** **(MDCAT 2017)**

A. 4800 years B. 2400 years
C. 6400 years D. 3200 years

Q.84 **Which of the following has maximum ionizing power?** **(MDCAT 2017)**

A. α B. γ
C. β D. Neutron

Q.85 **A radioactive nucleus X undergoes a series of decay according to the same:**

$$X \xrightarrow{\alpha} X_1 \xrightarrow{\beta} X_2 \xrightarrow{\alpha} X_3 \xrightarrow{\gamma} X_4$$

If the mass number and atomic number of X are 180 and 72 respectively, the corresponding number of x4 are: **(MDCAT 2017)**

A. 176, 69 B. 172, 69
C. 176, 7 D. 172, 71

Q.86 **Calculate the activity (decaying atom per unit time) of radioactive strontium-90 having 6.7×10^{21} atoms at t=0 decay constant of strontium-90 is $8.3\times10^{-10}\ s^{-1}$?** **(MDCAT 2018)**

A. 8.01×10^{10}Bq
B. 5.6×10^{12}Bq
C. $5.6\times10^{11}s^{-1}$
D. 12×10^{11}Bq

Q.87 **Calculate the half-life of bismuth-214 which has a decay constant of $4.3\times10^{3}\ s^{-1}$?** **(MDCAT 2018)**

A. 2.9×10^{-4} s
B. 3.9×10^{3} s
C. 1.6×10^{-4} s
D. 2.9×10^{3} s

Q.88 **Two radioactive samples, S_1 and S_2 have half-live 3 hours and 7 hours respectively. If they have the same activity at certain instant t, what is the ratio of the number of atoms of S_1 to S_2 at instant t?** **(ETEA 2018)**

A. 9:49
B. 49:9
C. 3:7
D. 7:3

Q.89 **In relation $\lambda\ T_{1/2} = 0.693$, which quantity is represented by λ.** **(MDCAT 2019)**

A. Half-life
B. Activity
C. Wavelength
D. Decay constant

Q.90 **The main difference between X-Rays and γ-Rays is:** **(ETEA 2019)**

A. Frequency
B. Wave length
C. Energy
D. Origin

Q.91 **There are initially 400 atoms in a radioactive sample. What would be the number of atoms after 3 half-lives?** **(ETEA 2019)**

A. 400
B. 200
C. 50
D. 25

Q.92 **While using radiation therapy, cancerous thyroid is treated with _____ radioisotope:** **(ETEA 2019)**

A. Carbon
B. ^{235} uranium
C. Thorium
D. Iodine – 131

Q.93 **Half-life of iodine-131 is 8 days. If 20mg is present initially, how much iodine is left behind after 2 half-lives?** **(NUMS 2020)**

A. 10 mg
B. 5 mg
C. 2.5 mg
D. 1.25 mg

Q.94 **4.5×10^{9} year is the half-life of:** **(NUMS 2020)**

A. U^{238}
B. U^{235}
C. U^{236}
D. U^{14}

Q.95 **Number of Quarks in hydrogen atom** **(MDCAT 2021)**

A. 1
B. 2
C. 3
D. 4

Q.96 **Which radiations more ionization** **(MDCAT 2021)**

A. Alpha
B. Beta
C. Gamma
D. None

Q.97 **High speed beta rays are** **(MDCAT 2021)**

A. Electron
B. Positron
C. Electron and positron
D. Proton

Q.98 A low energy neutron has RBE of 10. How much energy is absorbed by a man of mass 80 kg if the value of equivalent dose is 400 rem? (UHS 2022)

A. 16 J
B. 32 J
C. 48 J
D. 64 J

Q.99 It has been observed that Thorium ($^{234}_{90}Th$) is transformed into Protactinium ($^{234}_{91}Pa$) after the emission of ________ particle: (UHS 2022)

A. Alpha
B. Beta
C. Gamma
D. Alpha, Beta, Gamma

Q.100 The half-life of Strontium (Sr) is 8.70 hours. Its decay constant is: (UHS 2022)

A. 0.000022 s
B. 45000/s
C. 0.000022/s
D. 0.000032/s

Q.101 The half-life of Iodine – 31 is: (SZABMU 2022)

A. 10 days
B. 8 days
C. 45 days
D. 60 days

Q.102 The half-life of carbon is 5730 years. How much carbon will left after 22920 years? (SZABMU 2022)

A. $1/32^{th}$
B. $1/16^{th}$
C. $1/64^{th}$
D. $1/4^{th}$

Q.103 Skin burns, loss of hair, drop in the white blood cells etc are examples of: (SZABMU 2022)

A. Somatic effect
B. Genetic effect
C. Metabolism effect
D. Mutation effect

Q.104 The half-life of a radio-active sample predicts about: (ETEA 2022)

A. Whole life of sample
B. Disintegration time of half number of atoms
C. Decay only
D. Total time for stable atoms

Q.105 Which radiation cannot be generated under electron transitions in different orbits? (ETEA 2022)

A. Infrared
B. Ultraviolet
C. X-rays
D. γ-rays

Q.106 Radioactivity does not depend upon: (ETEA 2022)

A. Initial number of atoms
B. Temperature
C. Nature of material
D. Time

Q.107 Which one is not the unit of radio-activity? (ETEA 2022)

A. Bq
B. Ci
C. Decay/second
D. Tesla/m^2

Q.108 Curie is the unit of: (ETEA 2022)

A. Radioactivity
B. Temperature
C. Half-life
D. Transition of magnetism

Q.109 Which one is stable element in the followings? **(ETEA 2022)**

A. Lead
B. Plutonium
C. Radium
D. Protactinium

Q.110 For the treatment of cancer, the source of gamma rays used, is: **(ETEA 2022)**

A. Co-60
B. Iodine 126
C. Na-15
D. Pb-207

Q.111 Radio isotopes can be formed by bombardment with ______ particles **(BMU 2022)**

A. Neutron
B. Photons
C. Electrons
D. Positron

Q.112 When a radioactive nucleus emits a gamma radiation than the mass number of atom is **(BMU 2022)**

A. Remain same
B. Increased by a factor 2
C. Decreased by a factor 1
D. Increased by a factor 1

Q.113 Half-life of a radioactive sample is given by: **(DUHS 2022)**

A. $T_{\frac{1}{2}} = \frac{(0.693)}{\sqrt{\lambda}}$

B. $T_{\frac{1}{2}} = \sqrt{\frac{(0.693)}{\sqrt{\lambda}}}$

C. $T_{\frac{1}{2}} = (0.693)\lambda$

D. $T_{\frac{1}{2}} = \sqrt{0.693}$

E. $T_{\frac{1}{2}} = \frac{0.693}{\lambda}$

Q.114 In nuclear reaction $_7N^{14} + {}_2He^4 \rightarrow {}_8O^{17} +$ ______, the missing particle is. **(DUHS 2022)**

A. Proton
B. α- particle
C. Electron
D. Position
E. Neutron

Q.115 1 Gy is equal to: **(NUMS 2022)**

A. 1 Jkg
B. 1 Jkg^{-1}
C. 1 $J^{-1}Kg$
D. $J^{-1}kg^{-1}$

Q.116 A 32g radioactive element decays and remains 2g after 60 days. What is the half-life of radioactive element: **(NUMS 2022)**

A. 2 days
B. 6 days
C. 10 days
D. 15 days

ANSWER KEY

PRACTICE EXERCISE

1	D	16	A	31	B
2	C	17	B	32	C
3	D	18	B	33	B
4	B	19	B	34	C
5	A	20	B	35	C
6	A	21	A	36	B
7	A	22	D	37	C
8	D	23	C	38	A
9	B	24	C	39	A
10	C	25	D	40	C
11	B	26	B	41	C
12	A	27	C	42	B
13	D	28	B	43	A
14	C	29	B	44	A
15	C	30	D	45	B

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46	C	61	D	76	B	91	C	106	B
47	B	62	D	77	C	92	D	107	D
48	C	63	B	78	B	93	B	108	A
49	D	64	C	79	D	94	A	109	A
50	A	65	B	80	B	95	C	110	A
51	A	66	A	81	D	96	C	111	A
52	B	67	C	82	A	97	A	112	A
53	D	68	B	83	D	98	B	113	E
54	A	69	C	84	A	99	B	114	A
55	B	70	B	85	B	100	C	115	B
56	D	71	C	86	B	101	B	116	D
57	A	72	B	87	C	102	B		
58	C	73	A	88	C	103	A		
59	B	74	C	89	D	104	B		
60	C	75	D	90	D	105	D		

EXPLANATORY NOTES

PRACTICE EXERCISE

1. $T_{1/2} = 0.693t = 0.693 \times 200s = 138.6/60 \text{ min} = 2.31$ minutes
2. In one average life, i.e. at 7 hours, 63.2 % of the active nuclei will decay. Therefore, in a time of 7 hours, it can be considered that more than half of the active nuclei will decay.
3. Isotopes are the atoms of an element having same atomic number Z but different mass number A. So U^{238} contains 3 more neutrons.
4. Number of neutrons in $Na_{11}^{23} = 23-11=12$ and $Mg_{12}^{24} = 24-12=12$
5. As the nuclear density is independent of mass number, so the ratio of nuclear densities of the two given nuclei is 1:1. Its value d=2.3 x10^{17} Kgm^{-3}
6. $R_{atom} = 10^{-10}$ m & $R_{nucleus} = 10^{-15}$ m
7. Emission of α, β and γ-radiations is spontaneous and random process.
8. The penetrating power of α is least and that of γ-radiations is the most.
9. ${}_{Z}^{A}X \xrightarrow{-1\beta} {}_{Z+1}^{A}Y \xrightarrow{{}_{2}^{4}\alpha} {}_{Z-1}^{A-4}B \xrightarrow{\gamma} {}_{Z-1}^{A-4}B$
   - When β is emitted then charge will increase by one.
   - When α is emitted then mass will reduce by 4 and charge will reduce by 2.
10. ${}_{5}^{10}B + {}_{0}^{1}n \to {}_{3}^{7}X + {}_{2}^{4}He$ Resultant nucleus has mass number "7".
11. In β-emission ${}_{0}^{1}n \to {}_{-1}^{0}\beta + {}_{1}^{1}H$
12. ${}_{92}^{238}U \xrightarrow{2\alpha} {}_{88}^{230}X \xrightarrow{2\beta} {}_{90}^{230}Th$
13. Here parent nucleus is "${}_{92}^{238}U$" uranium (146+92=238), thorium is "${}_{90}^{234}Th$" (144+90=234) and emitted radiation is He (Alpha).
14. $X_{z}^{A} \xrightarrow{2\beta} X_{z+2}^{A} \xrightarrow{\alpha} X_{z}^{A-4}$
15. ${}_{7}^{14}N + {}_{2}^{4}He \to {}_{8}^{17}O + {}_{1}^{1}P$
16. ${}_{85}^{217}At \xrightarrow{\alpha} {}_{83}^{213}V \xrightarrow{\alpha} {}_{81}^{209}W \xrightarrow{\beta} {}_{82}^{209}X$
17. Number of neutrons in radon = 220 – 86 = 134
    Number of neutrons in polonium = 216 – 84 = 132
18. By emission of alpha two protons and two neutrons are decreased.
19. ${}_{86}^{222}Rn \xrightarrow{\alpha} {}_{84}^{218}X \xrightarrow{\alpha} {}_{82}^{214}Y \xrightarrow{\beta} {}_{83}^{214}Bi$ (2-α particles & 1-β particle)
20. ${}_{72}A^{180} \xrightarrow{\alpha} {}_{70}A_{1}^{176} \xrightarrow{\beta} {}_{71}A_{2}^{176} \xrightarrow{\alpha} {}_{69}A_{3}^{172} \xrightarrow{\gamma} {}_{69}A_{4}^{172}$
21. The reaction for neutron decay is ${}_{0}^{1}n \longrightarrow {}_{1}^{1}H + {}_{-1}^{o}e + \bar{\upsilon}$ Here $\bar{\upsilon}$ = anti – neutrino
22. By definition of decay constant: $\dfrac{\Delta N}{\Delta t} = N\lambda \Rightarrow \lambda = \dfrac{\Delta N/\Delta t}{N}$
23. We know $\dfrac{A}{A_0} = \dfrac{N}{N_0} = \dfrac{1}{2^n}$, So $\dfrac{A_1}{A_2} = \dfrac{2^3}{2^6} = \dfrac{1}{8}$
24. When 75% decays, 25% is left un-decayed. This requires a time $t = 2T_{1/2}$, where
    $T_{1/2}$ = half life $= \dfrac{\ln 2}{\lambda}$. Also $T = \dfrac{1}{\lambda}$. $\therefore t = 2\left(\dfrac{\ln 2}{\lambda}\right) = 2(\ln 2)T$

25. As $n = \frac{t}{T_{1/2}} = \frac{\frac{1}{2}T_{1/2}}{T_{1/2}} = \frac{1}{2}$. Fractional un-decay $= \frac{1}{2^n} = \frac{1}{2^{1/2}} = \frac{1}{\sqrt{2}}$

26. $T_{1/2} = \frac{0.693}{\lambda} \Rightarrow \lambda T_{1/2} = 0.693$ It means for smaller λ half-life will be longer.

27. $\frac{3}{4}N_o = \frac{3}{2^2}N_o \Rightarrow n = 2$ As $t = nT_{1/2} \Rightarrow T_{1/2} = \frac{t}{n} = \frac{3/4}{2} = \frac{3}{8}$ sec

28. As $T_{1/2} = \frac{0.693}{\lambda} = \frac{0.693}{4.28\times10^{-4}} \approx 1620$ year

29. Activity of a radioactive element decays exponentially.

30. Number of half lives $n = \frac{10}{2.5} = 4 \Rightarrow \frac{A}{A_o} = \frac{N}{N_o} = \left(\frac{1}{2}\right)^n \Rightarrow A = 1.6\times\left(\frac{1}{2}\right)^4 = 0.1$ curie

31. $n = 3 \Rightarrow T_{\frac{1}{2}} = \frac{t}{n} = \frac{60\times3}{3} = 60$ minutes

32. Number of half-lives (n= 2) We know $N_R = N_o\left(\frac{1}{2}\right)^n \Rightarrow \frac{50000}{4} = 12500$

33. $N_D = N_o\frac{2^n - 1}{2^n} \Rightarrow \frac{N_D}{N_o} = \frac{2^5 - 1}{2^5} = \frac{31}{32}$

34. $T_{1/2} = \frac{\ell n2}{\lambda} \Rightarrow \lambda T_{1/2} = \ell n2$

35. Average life $= \frac{1}{\lambda} = \frac{T_{1/2}}{0.693} = \frac{1600}{0.693} = 2308 \approx 2319$ years

36. $T_{1/2} = \frac{0.693}{\lambda} = \frac{0.693}{0.01} = 69.3$ sec

37. $N_R = N_0(\frac{1}{2^n})$ & $N_D = N_0(\frac{2^n - 1}{2^n}) \Rightarrow \frac{N_R}{N_D} = \frac{1}{8}\times\frac{8}{7} = \frac{1}{7}$

38. After 5 half-lives remaining amount $= \frac{1}{2^5} = \frac{1}{32}$

Percentage of remaining amount $= \frac{1}{32}\times100 \approx 3\%$

39. γ-radiations can be preferred for the treatment of skin
40. For skin cancer phosphorus-32 or strontium-90 may be used.
41. Radiotherapy with γ-rays from cobalt-60 is often used in the treatment of cancer of liver.
42. Radio-iodine is absorbed mostly by the thyroid gland.
43. Study the circulation of blood using radioactive isotope sodium-24.
44. The most useful tracer is Carbon – 14.

PAST PAPER MCQ'S

45. $m = 64g$

$1T_{1/2} = 32g$ $\quad 2T_{1/2} = 16g$ $\quad 3T_{1/2} = 8g$ $\quad 4T_{1/2} = 4g$ $\quad 5T_{1/2} = 2g$

$n = 5$

$T_{1/2} = \frac{t}{n} = \frac{20}{5} = 4$days.

46. When a helium atom loses an electron, it gets positive charge and becomes a positive helium ion.
47. Beta ray emitted by a radioactive substance is an electron which was existing inside the nucleus ${}_{Z}X^{A} \longrightarrow {}_{Z+1}Y^{A} + \beta^{o}_{-1} + \bar{\nu}$
Emission of $\beta-$particles is a nuclear phenomenon.
48. ${}_{Z}X^{A} \longrightarrow {}_{Z}X^{A} + \gamma$ - radiation
49. $\Delta N = -N\Delta t$
50. $\lambda = -\frac{\Delta N / N}{\Delta t}$
51. $\gamma-\text{rays}_{I.E} < \beta-\text{rays}_{I.E} < \gamma$ particles$_{I.E}$
52. $T_{1/2} = \frac{0.693}{\lambda} \Rightarrow T_{1/2} \propto \frac{1}{\lambda}$
53. ${}_{0}n^{1} \longrightarrow {}_{1}H^{1} + \beta^{o}_{-1} + \bar{\nu}$
54. $\frac{\Delta N}{N\Delta t}$
55. Alpha particle is also known as Helium nuclide, and Helium nuclide have charge 2e.
56. $X^{A}_{Z} \xrightarrow{\alpha} Y^{A-4}_{Z-2} \xrightarrow{\gamma} Y^{A-4}_{Z-2}$
57. Half-life of sodium-24 is 15 hours.
58. α= particle has more momentum So, it will less deviate.
59. $X^{A}_{Z} \xrightarrow{\beta^{o}_{-1}} Y^{A}_{Z+1}$
60. Definition
61. $X^{A}_{Z} \xrightarrow{\alpha} Y^{A-4}_{Z-2}$
62. ${}_{90}Th^{234} \longrightarrow {}_{91}Pa^{234} + \beta^{o}_{-1}$
63. $\alpha < \beta < \gamma$
64. Emission of radiation from radioactive substance is a natural phenomenon. So, it is independent of both temperature and pressure.
65. β-decay $X^{A}_{z} \longrightarrow Y^{A}_{z+1} + \beta_{-1}$
66. The electric field does not disturb γ-radiation because gamma radiation no charge.
67. During beta decay, atomic number increases by 1 and mass number remains same.
68. ${}_{92}U^{234} \xrightarrow{\alpha} {}_{90}V^{230} \xrightarrow{\beta} {}_{91}Y^{230}$ So, z=91
69. ${}_{Z}X^{A} \xrightarrow{2\alpha} {}_{Z-4}Y^{A-8}$
70.

$$W \xrightarrow{\beta} {}_{+1}X \xrightarrow{\alpha} {}_{-1}Y \xrightarrow{\alpha} {}_{-3}Z$$

71. $\beta-$particles emit from nucleus.

72. $X_Z^A \xrightarrow{3\alpha} Y_{Z-6}^{A-12}$

73. $X_Z^A \longrightarrow Y_{Z+1}^{X} \xrightarrow{\alpha} Y_{Z-1}^{X-4=t}$

$X-4=t$

$X=t+4$

74. $X_{90}^{232} \xrightarrow{6\alpha} X_{78}^{208} \xrightarrow{4\beta} X_{82}^{208}$

75. $E=\frac{hc}{\lambda} \Rightarrow E \propto \frac{1}{\lambda} \Rightarrow \lambda_{\gamma-rays} < \lambda_{x-rays}$

76. ${}_{90}Th^{234} \longrightarrow {}_{91}Pa^{234} + \beta_{-1}^{0}$

77. $X_z^{a^*} \longrightarrow X_z^a + \gamma - rays$

78. $T_{1/2}\lambda = 0.693 \Rightarrow \lambda = \frac{0.693}{T_{1/2}}$

79. Radiation produced ionization

80. ${}_b^aZ^* \longrightarrow {}_b^aZ + \gamma$

81. $N=\frac{N_{\circ}}{2^n}=\frac{400}{2^3}=50g$

82. $N=N_o\left(\frac{1}{2}\right)^n \Rightarrow 25=100\frac{1}{2^n} \Rightarrow \frac{1}{4}=\frac{1}{2^2}=\frac{1}{2^n} \Rightarrow n=2$

$T=nT_{\frac{1}{2}}=2\times1600=3200\,\text{years}$

83. α-particle has maximum ionizing power.

84. ${}_{72}^{180}X \xrightarrow{\alpha} {}_{70}^{176}X_1 \xrightarrow{\beta} {}_{71}^{176}X_2 \xrightarrow{\alpha} {}_{69}^{172}X_3 \xrightarrow{\gamma} {}_{69}^{172}X_4$

85. $A=\lambda N=8.3\times10^{-10}\times6.7\times10^{21}=55.61\times10^{11}=5.6\times10^{12}\,Bq.$

86. $T_{1/2}=\frac{0.693}{\lambda}=\frac{0.693}{4.3\times10^{+3}}=0.16\times10^{-3}=1.6\times10^{-4}\,s$

87. $R=\frac{\Delta N}{\Delta t}=\lambda N=\frac{0.693N}{T} \Rightarrow N \propto T$

88. In relation $\lambda T_{1/2}=0.693$, λ is decay constant.

89. Both are E.M waves. X-Rays produced by Coolidge tube while γ-Rays produced by decelerated of nucleus

90. $N_R=N_o.\left(\frac{1}{2}\right)^3=\frac{400}{8}=50$

91. Cancerous thyroid is treated with iodine -131

92. $Left = \frac{1}{2^n} N_o$
93. Information of book.
94. Two up quarks and one down quark.
95. $I.E\ of \propto > I.E\ of\ B > I.E\ of\ \gamma$
96. High speed β-rays are electrons.
97. $D_e = 400 rem = 400 \times 0.01 Sv = 4Sv$

$$D = \frac{D_e}{RBE} = \frac{4}{10} = 0.4\,Gy$$

$$E = mD = 80 \times 0.4 = 32J$$

98. $Th_{90}^{234} \rightarrow Pa_{91}^{234} + e_{-1}^{0}$
99. $\lambda = \frac{0.693}{T_{\frac{1}{2}}} = \frac{0.693}{8.70 \times 3600} = 0.000022/s$
100. Information
101. $n = \frac{t}{T_{1/2}} = \frac{22920}{5730} = 4$

Remaining carbon $= = \frac{1}{2^4} = \frac{1}{2^4} = \frac{1}{16}$

102. Examples of somatic effect
103. Definition.
104. Because γ-rays are nuclear radiation.
105. It is the natural phenomena so its independent of temperature and pressure.
106. Bq, Ci, Decay/second are unit of radioactivity. T/m^2 is not unit of radioactivity.
107. Curie is the unit of radioactivity.
108. Information.
109. Information.
110. Definition of artificial radio-active elements.
111. In gamma decay neither 'A' changes nor 'Z'.
112. Book formula
113. ${}_7N^{14} + {}_2He^4 \rightarrow {}_8O^{17} + H_1^1$
114. $D = \frac{E}{m}$
115. $N = \frac{N_o}{2^n}$

$$2 = \frac{32}{2^n} \Rightarrow \frac{1}{16} = \frac{1}{2^4} = \frac{1}{2^n} \Rightarrow n = 4$$

$$T_{1/2} = \frac{T}{n} = \frac{60}{4} = 15\,\text{days}$$

1 UNIT — FORCE AND MOTION

SELF ASSESSMENT TEST

Q.1 A truck requires 3 Hrs to complete a journey of 150 km, what is the average speed?
A. 50 km/hr
B. 25 km/hr
C. 15 km/h
D. 10 km/hr

Q.2 A balloon is going upwards with a velocity 12 m/s. It releases a packet when it is at a height of 65m from ground. How much time the packet will take to reach the ground if $g = 10\ m/s^2$?
A. 5s
B. 6s
C. 7s
D. 8s

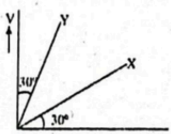
Q.3 A man covers half of his journey at 6km/hr and the remaining half at 3km/hr. His average speed is
A. 4 km/hr
B. 3 km/hr
C. 9 km/hr
D. 4.5 km/h

Q.4 The relative velocity of a particle moving with a velocity v w.r.t. itself is
A. v
B. –v
C. Zero
D. None of the above

Q.5 A ball is dropped from a height 10m. The ball is embedded in sand 1m and stops, then
A. Only momentum remains conserved
B. Only kinetic energy remains conserved
C. Both momentum and K.E are conserved
D. Neither K.E nor momentum is conserved

Q.6 A ball is thrown horizontally from the top of a tower. What happens to the horizontal component of its acceleration?
A. First increases and then decreases
B. Increase
C. Decrease
D. Zero

Q.7 Velocity time graph of body X and Y is shown in fig. The ratio of the acceleration of Y to acceleration of X is



A. 3:1
B. $1:\sqrt{3}$
C. 1 :3
D. $\sqrt{3}:1$

Q.8 Four projectiles are fired with the same velocity at angle, 25°, 40°, 55° and 70° with the horizontal. The range of projectile will be largest for the one projected at angle
A. 70°
B. 40°
C. 55°
D. 25°

Q.9 A fighter plane drops a bomb when it is at the top of enemies target. Bomb misses the target due to
A. Horizontal component of velocity
B. Action of gravity
C. Vertical component of velocity
D. Bad weather

Q.10 A projectile is projected with kinetic energy (K.E). If it has the maximum possible horizontal range, then its kinetic energy at the highest point will be:
A. K.E
B. 0.75 K.E
C. 0.5 K.E
D. 0.25 K.E

Q.11 A car travels equal distance in the same direction with velocities 60 km h^{-1}, 20 km h^{-1} and 10 km h^{-1} respectively. The average velocity of the car over the whole journey of motion is

A. 8 ms^{-1}
B. 6 ms^{-1}
C. 7 ms^{-1}
D. 5 ms^{-1}

Q.12 A particle is moving eastwards with a velocity 5 ms^{-1}. In 10 s, the velocity changes to 5 ms^{-1} northward. The average acceleration in this time is

A. $\frac{1}{\sqrt{2}} ms^{-2}$NE
B. $\frac{1}{2} ms^{-2}$N
C. Zero
D. $\frac{1}{\sqrt{2}} ms^{-2}$NW

Q.13 A force of 5 Newton acts on a body of weight 9.8 Newton. What is the acceleration produced in ms^{-2}?

A. 0.51
B. 1.46
C. 49.00
D. 5.00

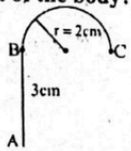
Q.14 Time of flight of projectile is

A. $\frac{v_i \sin\theta}{g}$
B. $\frac{2v_i \sin\theta}{g}$
C. $\frac{v_i \sin 2\theta}{g}$
D. $\frac{v_i^2}{g}$

Q.15 A cyclist riding at a speed of 5m/sec braked with uniform deceleration and stopped in 3m. The acceleration is

A. 2.16m/sec^2
B. – 2.16m/sec^2
C. 4.16m/sec^2
D. – 4.16m/sec^2

Q.16 A body moves from A to B in a straight line then in semi-circle of radius as shown in fig. What is the displacement of the body?



A. 7 cm
B. 9 cm
C. 5 cm
D. 12 cm

Q.17 Angle between action and reaction forces is

A. 0°
B. $\frac{\pi}{2}$rad
C. πrad
D. 2πrad

Q.18 The P.E gained by projectile when it reaches at maximum height is expressed by equation

A. $K.E_i \cos^2\theta$
B. $K.E_i \tan\theta$
C. $K.E_i \sin^2\theta$
D. $K.E_i \cot\theta$

Q.19 A 1 kg ball moving in some direction at 8 m/sec hits a 4 kg ball moving at 6 m/sec in the same direction. Assume that the 1 kg ball stops after collision. What will be the velocity, after collision, of the 4 kg ball if the 1 kg ball stops?

A. 10 m/sec
B. 0 m/sec
C. 8 m/sec
D. 12 m/sec

Q.20 **A runner runs 100m in 10s, then turns around and jogs 50m back toward the starting point in 30s. What is his average speed and average velocity in m/s.**

A. 3, 1.25
B. 3.75, 1.25
C. 4.25, 1.25
D. 3, 1

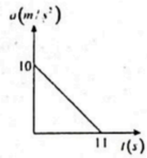
Q.21 **A car of mass 1000 kg moving with 25 ms^{-1} collide straight with stationary truck of mass 1500 kg, and start moving together. Find the common velocity?**

A. 15 ms^{-1}.
B. 25 ms^{-1}
C. 10 ms^{-1}
D. 6 ms^{-1}

Q.22 **A body moves from point P (3, 4) to Q (5, 7). Its displacement vector would be**

A. $8\hat{i}+10\hat{j}$
B. $8\hat{i}+2\hat{j}$
C. $2\hat{i}-2\hat{j}$
D. $2\hat{i}+3\hat{j}$

Q.23 **A particle starting from rest undergoes a rectilinear motion with acceleration a. The variation of a' with time t is shown in graph. Maximum velocity attained by the particle during the motion is:**



A. 55 m/s
B. 110 m/s
C. 550 m/s
D. 650 m/s

Q.24 **A missile is fired for maximum range with an initial velocity of 20 m/s. If g=10m/s², the range of the missile is**

A. 30 m
B. 20 m
C. 40 m
D. 60 m

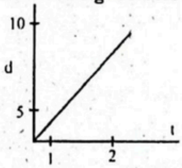
Q.25 **A ball is projected horizontally from the top of a cliff on the surface of the earth with a speed of 40ms^{-1}. Assuming that there is no air resistance, what will its speed be 3 s later?**

A. 30ms^{-1}
B. 40ms^{-1}
C. 50ms^{-1}
D. 60ms^{-1}

Q.26 **The rate of change of momentum of a body falling freely under gravity is equal to its**

A. Impulse
B. Kinetic energy
C. Power
D. Weight

Q.27 **Displacement time graph is shown in figure below acceleration will be**



A. 5 ms^{-2}
B. 10 ms^{-2}
C. 2.5 ms^{-2}
D. 0

Q.28 **At which point for a projectile its kinetic energy is completely converted into potential energy?**

A. At point of projection
B. At the highest point
C. Point to hit the ground
D. Not possible

Q.29 A 10 kg object collides with stationary 5 kg object and after collision they stick together and move forward with velocity $4ms^{-1}$. What is the velocity with which the 10 kg object hit the second one?

A. $6ms^{-1}$

B. $8ms^{-1}$

C. $12ms^{-1}$

D. $10ms^{-1}$

Q.30 A force of 10 N acts on a body of mass 20 kg for 10 seconds. The change in its momentum is

A. 50 kg-m/s

B. 100 kg-m/s

C. 300 kg-m/s

D. 1000 kg-m/s

Q.31 An aircraft is moving with a velocity of $300ms^{-1}$. If all the forces acting on it are balanced, then

A. It still moves with the same velocity

B. It will explode

C. It will lose its velocity gradually

D. It will fall down instantaneously

Q.32 If a car covers 2/5th of the total distance with v_1 speed and 3/5th distance with v_2 then average speed is

A. $\frac{v_1+v_2}{2}$

B. $\frac{2v_1v_2}{v_1+v_2}$

C. $\frac{5v_1v_2}{3v_1+2v_2}$

D. $\frac{1}{2}\sqrt{v_1v_2}$

Q.33 If initial velocity of projectile is doubled then which is correct

	Time of flight	Max. height	Horizontal range
A.	Same	Doubled	4 times
B.	Same	4 times	4 times
C.	Doubled	4 times	Doubled
D.	Doubled	4 times	4 times

Q.34 Which one of the following is true in the case of inelastic collision?

Total energy	Kinetic Energy	Momentum
A. Conserved	Conserved	Conserved
B. Conserved	Not conserved	Conserved
C. Conserved	Conserved	Not conserved
D. Not conserved	Not conserved	Conserved

Q.35 A body is thrown with a velocity of 9.8 m/s making an angle of $30°$ with the horizontal. It will hit the ground after a time

A. 1 sec

B. 2 sec

C. 3 sec

D. 1.5 sec

Q.36 If $R = \frac{R\max}{2}$ then angle of projection is

A. 30°

B. 60°

C. 15°

D. 45°

Q.37 A body is thrown horizontally from the top of a tower of height 5 m. It touches the ground at a distance of 10 m from the foot of the tower. The initial velocity of the body is ($g = 10\ ms^{-2}$)

A. $2.5ms^{-1}$

B. $5ms^{1}$

C. $10ms^{1}$

D. $20ms^{1}$

Q.38 A cricket ball is hit so that it travels straight up in air and it acquires 3 seconds to reach the maximum height. Its initial velocity is

A. $10ms^{-1}$ B. $15ms^{-1}$

C. $29.4ms^{-1}$ D. $12.2ms^{-1}$

Q.39 The distance travelled by a body is proportional to the square of time. The body is moving with

A. Uniform acceleration B. Uniform velocity

C. Variable acceleration D. All of the above

Q.40 Two balls projected at 30° and 60° with same initial velocities. The ratio of their maximum heights is

A. 1:2 B. 1:3

C. 1:4 D. $1:\sqrt{2}$

Q.41 A 7.0 kg bowling ball experiences a net force of 5.0 N what will be its acceleration?

A. $7.1\ ms^{-2}$ B. $5.0\ ms^{-2}$

C. $0.71\ ms^{-2}$ D. $35.0\ ms^{-2}$

Q.42 Two projectiles are fired at different angles with the same magnitude of velocity such that they have the same range. At what angles they might have been projected?

A. 35° and 75° B. 10° and 50°

C. 25° and 65° D. None of the above

Q.43 A train takes 1 hour to go from one station to the other. It travels at a speed of 30 kmh^{-1} for first half hour and at a speed of 50 kmh^{-1} for the next half hour. The average speed of the train is:

A. $45\ kmh^{-1}$ B. $40\ kmh^{-1}$

C. $35\ kmh^{-1}$ D. $30\ kmh^{-1}$

Q.44 If a projectile is thrown with 19.6m/s velocity at 30° with x-axis, time taken to reach highest point?

A. 1 sec B. 3 sec

C. 2 sec D. 4 sec

Q.45 The distance travelled is given by

A. Area under speed-time graph B. Area under distance-time graph

C. Slope of velocity-time graph D. Slope of distance-time graph

Q.46 If a body starts from a point, and returns back to the same point, then its

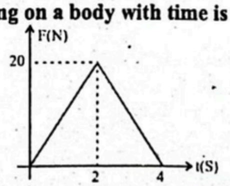
A. Average velocity is zero but not average speed

B. Average speed is zero but not average velocity

C. Both average velocity and average speed are not zero

D. Both average speed and average velocity are zero

Q.47 The variation of force acting on a body with time is shown



What is the change in momentum of body after 4s?

A. 10Ns B. 40Ns

C. 20Ns D. 80Ns

Q.48 **Velocity and acceleration are in the same direction when**
A. Velocity of a car is increasing on a straight road
B. Car is turning round a corner
C. Velocity of a car is decreasing on a straight road
D. None of these

Q.49 **When the average velocity of a moving body is equal to its instantaneous velocity then it is moving with**
A. Uniform velocity
B. Uniform acceleration
C. Variable velocity
D. Variable acceleration

Q.50 **If the initial speed of a projectile is doubled.**
A. Its range will double
B. Its range will quadruple
C. Its range will be decreased by a factor of two
D. Its range will decrease by a factor of four

Q.51 **In straight line motion the**
A. Acceleration is parallel (or antiparallel) to the velocity
B. Acceleration is vertical, while the velocity can be in any direction
C. Acceleration is perpendicular to the velocity
D. Acceleration is vertical and the velocity is horizontal

Q.52 **In projectile motion the**
A. Acceleration is parallel (or antiparallel) to the velocity
B. Acceleration is vertical, while the velocity can be in any direction
C. Acceleration is perpendicular to the velocity
D. Acceleration is vertical and the velocity is horizontal

Q.53 **A baseball is thrown vertically into the air. The acceleration of the ball at its highest point is:**
A. Zero
B. g, down
C. g, up
D. 2g, down

Q.54 **A racing car traveling with constant acceleration increases its speed from 10 m/s to 50 m/s over a distance of 60 m. How long does this take?**
A. 2.0 s
B. 5.0 s
C. 4.0 s
D. 8.0 s

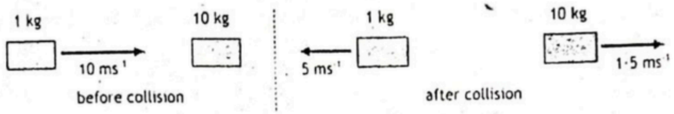
Q.55 **An aeroplane is flying horizontally at a velocity v. It drops a packet from a height h. the time taken by the packet to reach the ground will be**
A.. $\sqrt{\frac{2h}{g}}$
B. $\sqrt{\frac{2v}{g}}$
C. $\sqrt{\frac{h}{2g}}$
D. $\sqrt{\frac{v}{h}}$

Q.56 **A particle is moving with a constant speed along straight-line path. A force is not required to**
A. Change its direction
B. Increase its speed
C. Decrease its momentum
D. Keep it moving with uniform velocity

Q.57 **Two particles are moving with velocities v_1 and v_2. Their relative velocity is maximum when the angle between their velocities**
A. zero
B. $\pi/2$
C. π
D. $\pi/4$

Q.58 **Horizontal distance travelled by a ball if it's thrown with initial velocity of 20 m s^{-1} at an angle of 30° is**
A. 24 m
B. 56 m
C. 35.3 m
D. 36.3 m

Q.59 **A block of mass 1 kg slides along a frictionless surface at 10 ms^{-1} and it collides with a stationary block of mass 10 kg. After the collision, the first block rebounds at 5 ms^{-1} and the other one moves off at 1.5 ms^{-1}.**



Identify which row in the table that correctly describes the collision.

	Momentum	Kinetic Energy	Type of Collision
A.	Conserved	Conserved	Elastic
B.	Conserved	Not conserved	Inelastic
C.	Conserved	Not conserved	Elastic
D.	Not conserved	Not conserved	Inelastic

Q.60 **A body is thrown with the velocity $(4\hat{i} + 3\hat{j})$ m/s. Its maximum height is (g=10m/s²)**

A. 2.5m
B. 0.8m
C. 0.9m
D. 0.45m

ANSWER KEY

1	A	11	D	21	C	31	A	41	C	51	A
2	A	12	D	22	D	32	C	42	C	52	B
3	A	13	D	23	A	33	D	43	B	53	B
4	C	14	B	24	C	34	B	44	A	54	A
5	A	15	D	25	C	35	A	45	A	55	A
6	D	16	C	26	D	36	C	46	A	56	D
7	A	17	C	27	D	37	C	47	B	57	C
8	B	18	C	28	D	38	C	48	A	58	C
9	A	19	C	29	A	39	A	49	A	59	B
10	C	20	B	30	B	40	B	50	B	60	D

2 UNIT

WORK AND ENERGY

SELF ASSESSMENT TEST

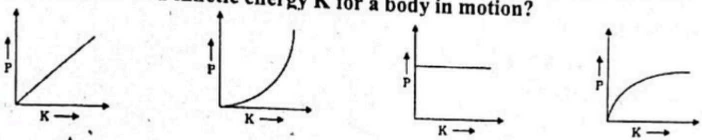
Q.1 Proton, electron and neutron particles have the same momentum. Which of them have highest K.E?

A. Proton
B. Electron
C. Neutron
D. alpha-particle

Q.2 What is the Average Power Required to Lift a Mass of 100kg to a Height of 50m in 50 Seconds?

A. 100
B. 980
C. 50
D. 5000

Q.3 Which of the following graphs best represents graphical relation between momentum P and kinetic energy K for a body in motion?



A. B. C. D.

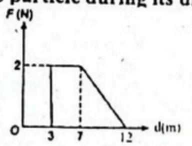
Q.4 A motorbike engine can develop a power of 90000 W in order to keep a constant velocity of 30 m/s. What is the pushing force?

A. 3000 N
B. 30000 N
C. 300000 N
D. 300 N

Q.5 If a stone of mass 500 g strikes the ground with velocity of 20 ms^{-1} then kinetic energy at that point is

A. 10 J
B. 40 J
C. 75 J
D. 100 J

Q.6 Force F on a particle moving in a straight line varies with distance d as shown in the figure. The work done on the particle during its displacement from 3m to 12m



A. 13 J
B. 26 J
C. 18 J
D. 21 J

Q.7 Two bodies with kinetic energies in the ratio 4 : 1 are moving with equal linear momentum. The ratio of their masses is:

A. 1 : 2
B. 1 : 4
C. 1 : 1
D. 4 : 1

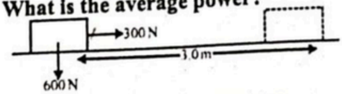
Q.8 How much work must be done by a force on 50 kg body in order to accelerate it from rest to 20 m/s in 10 s?

A. 2×10^3J
B. 10^3J
C. 10^4J
D. 4×10^4J

Q.9 A force applied by an engine of a train of mass 2.05×10^6kg changes its velocity from 5m/s to 25m/s in 5 minutes. The power of the engine is

A. 6 MW
B. 1.025 MW
C. 5 MW
D. 2.05 MW

Q.10 **When a 300 N force is applied to a box weighing 600 N, the box moves 3.0 m horizontally in 20 s. What is the average power?**



A. 45 W
B. 90 W
C. 900 W
D. 1800 W

Q.11 **An engine pumps out 50 kg of water. If the water comes out vertically upwards with a velocity of 20 m/s. The power of engine is (take g= 10 m s^{-2})**

A. 10 KW
B. 20 kW
C. 1000 W
D. 10 MW

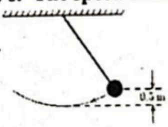
Q.12 **A body, constrained to move in the y – direction, is subjected to a force F = $-2\hat{i}+15\hat{j}+6k$ Newton's. The work done by this force in moving the body a distance of 10m along the y-axis is**

A. 190 J
B. 160 J
C. 150 J
D. 20 J

Q.13 **Two particles of masses m and 4m have linear momenta in the ratio of 2 : 1. What is the ratio of their kinetic energies?**

A. $\sqrt{2}$
B. 2
C. 4
D. 16

Q.14 **The long pendulum shown is drawn aside until the ball has risen 0.50 m. It is then given an initial speed of 3.0 m/s. The speed of the ball at its lowest position is:**



A. Zero
B. 0.89 m/s
C. 3.1 m/s
D. 4.3 m/s

Q.15 **Two men with weights in the ratio 5 : 3 run up a staircase (of same height) in times in the ratio 11 : 9. The ratio of power of first to that of second is**

A. 11/15
B. 11/9
C. 15/11
D. 9/11

Q.16 **A body of mass m is dropped from a height h above the ground. The velocity v of the body when it has lost half its initial potential energy is given by**

A. $v=\sqrt{gh}$
B. $v=\sqrt{2gh}$
C. $v=\sqrt{\frac{gh}{2}}$
D. $v=2\sqrt{gh}$

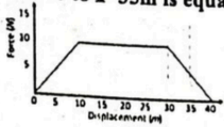
Q.17 **A moving body need not have**

A. Velocity
B. Momentum
C. Potential energy
D. Kinetic energy

Q.18 According to work energy principle work done on body will equal to change its

A. K.E only
B. P.E only
C. K.E and P.E both
D. All may correct

Q.19 Adjacent figure shows the force-displacement graph of a moving body, the work done in displacing body from x=0 to x=35m is equal to



A. 25 J
B. 200 J
C. 287.5 J
D. 50 J

Q.20 A body of mass 2 kg is projected vertically upwards with a velocity of $2msec^{-1}$. The K.E. of the body just before striking the ground is

A. 2J
B. 4J
C. 1J
D. 8J

Q.21 A particle of mass m at rest is acted upon by a force F for a time t. Its K.E after an interval t is

A. $\frac{F^2t^2}{m}$
B. $\frac{F^2t^2}{3m}$
C. $\frac{F^2t^2}{2m}$
D. $\frac{Ft}{2m}$

Q.22 An electric motor exerts a force of 40 N on a cable and pulls it by a distance of 30 m in one minute. The power supplied by the motor (in Watts) is

A. 200
B. 20
C. 10
D. 2

Q.23 A weight lifter lifts 300 kg from the ground to a height of 2 meter in 3 second. The average power generated by him is

A. 5880 watt
B. 4410 watt
C. 2205 watt
D. 1960 Watt

Q.24 Power of a water pump is 2 kW. If $g=10m/sec^2$, the amount of water it can raise in one minute to a height of 10 m is

A. 2000 litre
B. 1000 litre
C. 1200 litre
D. 100 litre

Q.25 A car of mass 1000 kg accelerates uniformly from rest to a velocity of 54 km/hour in 5s. The average power of the engine during this period in watts is

A. 2000 W
B. 22500 W
C. 5000 W
D. 2250 W

Q.26 A boy holds a 400 N weight at arm's length for 10s. His arm is 1.5m above the ground. The work done by the force of the boy on the weight while he is holding it is:

A. 0
B. 900J
C. 600J
D. 400J

Q.27 A man does a given amount of work in 10 sec. Another man does the same amount of work in 20 sec. The ratio of the output power of first man to the second man is

A. 2/1 B. 1/2
C. 1 D. 4/1

Q.28 A man of weight 500 newtons walks up to the top of a building of height of 20 m above the street level. The increase in the potential energy of man is

A. 5×9.8 J B. 500×20 J
C. 500×9.8 J. D. $\frac{500\times20}{9.8} J$

Q.29 Kinetic energy of a body moving with speed of 10 ms^{-1} is 30 J. If its speed becomes 30 ms^{-1} then its K.E becomes:

A. 10 J B. 90 J
C. 270 J D. 180 J

Q.30 A car is driven along a level road. The total energy input from the petrol is 60kJ and the car wastes 45kJ of energy, what is the efficiency of car

A. 25% B. 15%
C. 45% D. 75%

Q.31 A 50kg man with 20kg load on his head climbs up 20 steps of 0.25m height each. The work done in climbing is?

A. 100 J B. 350 J
C. 3430 J D. 5 J

Q.32 If force and displacement of particle in direction of force are doubled. Work would be

A. Double B. 1/4 times
C. Half D. 4 times

Q.33 A person walks 2m with an acceleration of $5ms^{-2}$, holding an object of mass 2kg. The work done on the object is

A. 20 J B. 10 J
C. 5 J D. 0 J

Q.34 The work done on an object does not depend upon the

A. Displacement B. Angle between force and displacement
C. Force applied D. Initial velocity of the object

Q.35 Which of the following is correct order?

A. $1kwh > 1erg > 1J$ B. $1J > 1erg > 1kwh$
C. $1kwh > 1J > 1erg$ D. $1kwh = 1J = 1erg$

Q.36 You lift a suit case from the floor and keep it on a table. The work done by you on the suitcase does not depend upon

A. The path taken by the suitcase B. The time taken by you in doing work
C. Weight of the suitcase D. A and B

Q.37 A particle moves with velocity $6\hat{i}-4\hat{j}+3\hat{k}$ ms^{-1} under the influence of constant force $\vec{F}=20\hat{i}+15\hat{j}-5k$ N. The instantaneous power applied to particle is

A. 45 Js^{-1} B. 35 Js^{-1}
C. 25 Js^{-1} D. 195 Js^{-1}

Q.38 A ball is dropped from a height of 10 m.

A. Its potential energy increases and kinetic energy decreases during the falls
B. Its potential energy is equal to the kinetic energy during the fall.
C. The potential energy decreases and the kinetic energy increases during the fall.
D. The potential energy and kinetic energy is maximum while it is falling.

Q.39 **How much time will be required to perform 520 J of work at the rate of 20 W?**
A. 24s
B. 16s
C. 20 s
D. 26 s

Q.40 **Output of a truck is 4500 J and its efficiency is 50%, input energy provided to truck is**
A. 5000 J
B. 9000 J
C. 900 J
D. 500 J

Q.41 **Due to application of 5 N force an object moves 10 meter along perpendicular direction of the force. What amount work is done?**
A. 50 J
B. 5 J
C. 15 J
D. 0 J

Q.42 **Work is independent of:**
A. Force
B. Time
C. Displacement
D. All of these

Q.43 **When the speed of object is halved and the mass is quadrupled then the kinetic energy is:**
A. Quartered
B. One Third
C. Twice
D. Remain same

Q.44 **For a body moving in a circular path, the work done by the centripetal force is**
A. Negative
B. Constant
C. Positive
D. Zero

Q.45 **If a pump can lift 200 kg of water through a height of 6 m in 10 seconds, then its power is**
A. 1100 watts
B. 1300 watts
C. 1000 watts
D. 1200 watts

Q.46 **A light and a heavy body have equal momenta. Which one has greater K.E**
A. The light body
B. The K.E. are equal
C. The heavy body
D. Data is incomplete

Q.47 **Two bodies of masses 2m and 1m have their K.E. in the ratio 8 : 1, then their ratio of momenta is**
A. 1 : 1
B. 4 : 1
C. 2 : 1
D. 8 : 1

Q.48 **The decrease in the potential energy of a ball of mass 20 kg which falls from a height of 50 cm is**
A. 968 J
B. 1980 J
C. 98 J
D. None of these

Q.49 **A body moves a distance of 10 m along a straight line under the action of a force of 5 N. If the work done is 25 joules, the angle which the force makes with the direction of motion of the body**
A. 0°
B. 60°
C. 30°
D. 90°

Q.50 **A force F=$(5\hat{i}+3\hat{j})$ newton is applied over a particle which displaces it from its origin to the point r=$(2\hat{i}-1\hat{j})$ metres. The work done on the particle is**
A. –7 joules
B. + 7 joules
C. + 13 joules
D. + 11 joules

Q.51 **What happens to the kinetic energy of a moving object if the net work done is positive?**
A. The kinetic energy increases
B. The kinetic energy remains the same
C. The kinetic energy decreases
D. The kinetic energy is zero

Q.52 **If momentum is increased by two times K.E increases by**
A. Two times
B. 3 times
C. four times
D. Remains

Q.53 **A particle moves with $\vec{v} = -3\hat{j} + 5\hat{i} + 6\hat{k}$ ms^{-1} under $\vec{F} = 10\hat{i} + 10\hat{j} + 20\hat{k}$ N. The power applied**
A. 200 Js^{-1}
B. 170 Js^{-1}
C. 40 Js^{-1}
D. 140 Js^{-1}

Q.54 **Effort × distance through which effort acts =**
A. Output of machine
B. Input of machine
C. Efficiency
D. Work

Q.55 **Load × distance covered by the load =**
A. Output of machine
B. Intput of machine
C. Efficiency
D. Work

Q.56 **An object is thrown straight up. Which of the following is true about the sign of work done by the gravitational force while the object moves up and then down?**
A. Work is positive on the way up, work is positive on the way down
B. Work is negative on the way up, work is negative on the way down
C. Work is negative on the way up, work is positive on the way down
D. Work is positive on the way up, work is negative on the way down

Q.57 **The burning of coal, wood or natural gas and releasing of heat and light energy in the air is a**
A. Nuclear reaction
B. Kinetic reaction
C. Chemical reaction
D. Potential reaction

Q.58 **When five times momentum of a body is equal to the kinetic energy of the same body then its velocity is equal to:**
A. 5 m/s
B. 10 m/s
C. 15 m/s
D. 20 m/s

Q.59 **If the linear momentum of the object is increased by 0.1%, then the kinetic energy is increased by**
A. 0.1 %
B. 0.2%
C. 0.4%
D. 0.01%

Q.60 **A machine which has an efficiency of 80% raises a load of 50 N through a vertical height of 10 m. The work input to the machine is:**
A. 400 J
B. 500 J
C. 800 J
D. 625 J

ANSWER KEY

1	B	11	A	21	C	31	C	41	D	51	A
2	B	12	C	22	B	32	D	42	B	52	C
3	D	13	D	23	D	33	A	43	D	53	D
4	A	14	D	24	C	34	D	44	D	54	B
5	D	15	C	25	B	35	C	45	D	55	A
6	A	16	A	26	A	36	D	46	A	56	C
7	B	17	C	27	A	37	A	47	B	57	C
8	C	18	D	28	B	38	C	48	C	58	B
9	D	19	C	29	C	39	D	49	B	59	B
10	A	20	B	30	A	40	B	50	B	60	D

3 UNIT ROTATIONAL AND CIRCULAR MOTION

SELF ASSESSMENT TEST

Q. 1 **When a body is whirled in a horizontal circle by means of a string the centripetal force is supplied by**

A. Mass of a body
B. Velocity of body
C. The tension in the string
D. Centripetal acceleration

Q. 2 **If a wheel of radius r turns through an angle of 30° then the distance through which any point on its rim moves is**

A. $\pi/3 \times r$
B. $\pi/6 \times r$
C. $\pi/30 \times r$
D. $\pi/180 \times r$

Q. 3 **The ratio of the angular speed of the minute hand of a clock to that of its hour hand is**

A. 3600 : 1
B. 60 : 1
C. 24 : 1
D. 12 : 1

Q. 4 **A body of mass 10 kg, is moving with a velocity of 5 m/s in a circle of radius 5 m, what is the centripetal acceleration of the body?**

A. $5 m/s^2$
B. $25 m/s^2$
C. $0.5 m/s^2$
D. $50 m/s^2$

Q. 5 **A particle moves on a circular path with decreasing speed. Choose the correct statement.**

A. Angular momentum remains constant
B. Acceleration is towards the center
C. Particle moves on a spiral path with decreasing radius
D. The direction of angular momentum remains constant

Q. 6 **A disc is rotating about an axis through its centre and perpendicular to its plane. A point P on the disc is twice as far from the axis as a point Q. At a given instant, what is the value of the** $\frac{\text{the linear velocity of P}}{\text{the linear velocity of Q}}$?

A. 4
B. 2
C. $\frac{1}{2}$
D. $\frac{1}{4}$

Q. 7 **An angular ring with inner and outer radii R_1 and R_2 is rolling without slipping with a uniform angular speed. The ratio of the forces experienced by the two particles situated on the inner and outer parts of the ring, F_1 / F_2 is**

A. 1
B. $\frac{R_1}{R_2}$
C. $\frac{R_2}{R_1}$
D. $\left(\frac{R_2}{R_1}\right)^2$

Q. 8 **If a body of mass m is rotating in a circle of radius r with frequency of rotation "f" then centripetal force acting on it is**

A. $2\pi mrf$
B. $4\pi^2 mrf$
C. $4\pi^2 mrf^2$
D. $\pi^2 mrf^2$

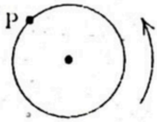
Q. 9 **A body is rotating clockwise with decreasing angular velocity. Its angular acceleration is directed**

A. Into the plane of paper
B. Along the radius
C. Out of the plane of paper
D. Along the tangent to the circle.

Q. 10 $r\omega^2$ has unit of

A. N
B. ms^{-1}
C. ms^{-2}
D. s^{-1}

Q. 11 The figure shows a cylinder of radius 0.7m rotating about its axis at 10rad/s. The speed of the point P is:



A. 7.0m/s
B. 14π rad/s
C. 7.0π rad/s
D. 0.70m/s

Q. 12 Centripetal acceleration can be expressed as

A. $\frac{v^2}{r}$
B. $r\omega^2$
C. $v\omega$
D. All of these

Q. 13 In equation $\vec{v} = \vec{\omega} \times \vec{r}$ 90° is angle between

A. $\vec{v}$ and $\vec{r}$
B. $\vec{r}$ and $\vec{\omega}$
C. $\vec{v}$ and $\vec{\omega}$
D. All are correct

Q. 14 What is the speed of the tip of second's hand of a clock if its length is 10 cm

A. 1.05 cms^{-1}
B. 2.05 cms^{-1}
C. 1.05 m/s
D. 3.05 cms^{-1}

Q. 15 A particle of rigid body is at a distance 0.1 m from axis of rotation to rotate with linear speed 3 m/s. What is angular speed of the rigid body

A. 0.3 rad/s
B. 30 $rads^{-1}$
C. 3 rad s^{-1}
D. 1.5 rad/s

Q. 16 If E is the K.E of body moving in circle of radius r then the centripetal force may be written as

A. $F_c = \frac{K.E}{2r}$
B. $F_c = \frac{K.E}{2r^2}$
C. $F_c = K.E \cdot 2r$
D. $\frac{2K.E}{r}$

Q. 17 The ratio of displacement along diameter and total distance along circle is:

A. $\pi : 1$
B. $\pi : 2$
C. $2 : \pi$
D. $1 : \pi$

Q. 18 A ball of mass 0.25 kg attached to the end of a string of length 1.96 m is moving in a horizontal circle. The string will break if the tension is more than 25 N. What is the maximum speed with which the ball can be moved?

A. 14 m/s
B. 3 m/s
C. 3.92 m/s
D. 5 m/s

Q. 19 An elevator accelerates at $4.9ms^{-2}$ first upward and then downward. Ratio of the apparent weights will be

A. 1 : 2
B. 2 : 1
C. 3 : 1
D. 2 : 3

Q. 20 A wheel is at rest. Its angular velocity increases uniformly and becomes 60 rad/sec after 5 sec. The total angular displacement is

A. 600 rad
B. 300 rad
C. 75 rad
D. 150 rad

Q.21 A car of mass 1000 kg is moving with speed 72 km/h in a circular track of radius 100 m. The centripetal force acting on it is

A. 4 N
B. 400 N
C. 40 N
D. 4000 N

Q.22 A circle of radius 1m rolls through some distance making an angle 180° at the centre; find the distance:

A. 3.14 m
B. 3.14 rad
C. 5m
D. 2.8 m

Q.23 A particle comes round a circle of radius 1 *m* once. The time taken by it is 10 *sec*. The average velocity of motion is

A. 0.2 πm/s
B. 2 πm/s
C. 2 m/s
D. Zero

Q.24 The acceleration of a train travelling with speed of 400 *m/s* as it goes round a curve of radius 160 *m*, is

A. 1 km/s^2
B. 100 m/s^2
C. 10 m/s^2
D. 1 m/s^2

Q.25 An aircraft executes a horizontal loop of radius 1 km with steady speed of 900 km/h. What is its centripetal acceleration?

A. 250km/s^2
B. 75m/s^2
C. 62.5m/s^2
D. 60m/s^2

Q.26 If the body is moving in a circle of radius r with a constant speed v, its angular velocity is

A. v^2/r
B. vr
C. v/r
D. r/v

Q.27 Centripetal force may be equal to

A. $\frac{mv^2}{r}$
B. $\frac{pv}{r}$
C. $\frac{p^2}{mr}$
D. All of these

Q.28 What is outward force acting on a mass of 10 kg when rotating at one end on an inelastic string 10m long at speed of 1m/s?

A. 1 N
B. 2 N
C. 10 N
D. 100N

Q.29 The angle subtended by an arc equal to radius is

A. 1 rad
B. One degree
C. 1 Revolution
D. All of these

Q.30 If a particle moves in a circle describing equal angles in equal times, its velocity vector

A. Remains constant
B. Changes in magnitude
C. Changes in direction
D. Changes both in magnitude and direction

Q.31 A motor cyclist going round in a circular track at constant speed has

A. Constant linear velocity
B. Constant acceleration
C. Constant angular velocity
D. Constant force

Q.32 Which of the following statements is false for a particle moving in a circle with a constant angular speed?

A. The velocity vector is tangent to the circle
B. The acceleration vector is tangent to the circle
C. The acceleration vector points to the centre of the circle
D. The velocity and acceleration vectors are perpendicular to each other

Q. 33 The number of revolutions in 3π radians

A. 2 B. 3

C. 3/2 D. 1/2

Q. 34 A Wheel of radius 50 cm having an angular speed of 5 rad s^{-1} have linear speed

A. $1.5ms^{-1}$ B. $3.5ms^{-1}$

C. $4.5ms^{-1}$ D. $2.5ms^{-1}$

Q. 35 In circular motion, if the angular velocity and angular acceleration becomes parallel, then the motion becomes:

A. Slower B. Faster

C. Constant D. Both 'A' and 'C'

Q. 36 An object is moving in a circle of radius 100 m with a constant speed of 31.4 m/s. What is its average speed for one complete revolution?

A. Zero B. 3.14 m/s

C. 31.4 m/s D. $\sqrt{2}\times 31.4m/s$

Q. 37 $1\frac{rev}{min}$ is equal to:

A. $\frac{\pi}{6} rad\ s^{-1}$ B. $\frac{\pi}{15} rad\ s^{-1}$

C. $\frac{\pi}{20} rad\ s^{-1}$ D. $\frac{\pi}{30} rad\ s^{-1}$

Q. 38 A wheel rotates about an axis passing through the center and perpendicular to the plane with slowly increasing angular speed. Then it has

A. Radial velocity and radial acceleration

B. Tangential velocity and radial acceleration

C. Tangential velocity and tangential acceleration

D. Tangential velocity but acceleration having both components

Q. 39 A body moves in a circle of radius 4 m with constant speed 8 m/s experiences centripetal force 128 N. What is the mass of body?

A. 2 Kg B. 8 Kg

C. 4 Kg D. 16 Kg

Q. 40 85.95° degree in terms of radian is

A. $\frac{1}{2}$ radian B. 1 radian

C. $1\frac{1}{2}$ radian D. 2 radian

Q. 41 Two bodies of mass 10 kg and 5 kg moving in concentric orbits of radii R and r such that their periods are the same. Then the ratio between their centripetal acceleration is

A. R/r B. R^2/r^2

C. r/R D. r^2/R^2

Q. 42 The force which can do no work on the body on which it acts:

A. Frictional force B. Elastic force

C. Gravitational force D. Centripetal force

Q. 43 A string breaks if its tension exceeds 10 newtons. A stone of mass 250 gm tied to this string of length 10 cm is rotated in a horizontal circle. The maximum angular velocity of rotation can be

A. 20 rad/s B. 40 rad/s

C. 100 rad/s D. 200 rad/s

Q. 44 An electric fan has blades of length 30 cm as measured from the axis of rotation. If the fan is rotating at 1200 r.p.m. The acceleration of a point on the tip of the blade is about

A. 1600 m/sec^2
B. 4740 m/sec^2
C. 2370 m/sec^2
D. 5055 m/sec^2

Q. 45 The expression for centripetal force is given by:

A. $mr\omega^2$
B. $\frac{m^2v^2}{r^2}$
C. $\frac{m^2v^2}{r}$
D. $\frac{mv^2}{r^2}$

Q. 46 The period of circular motion is

A. $T=\frac{2\pi}{\omega}$
B. $T=2\pi\omega$
C. $T=\frac{\omega}{2\pi}$
D. $T=\frac{\pi\omega}{2}$

Q. 47 The curved flight of fighter planes at high speed requires a large

A. Gravitational force
B. Frictional force
C. Centripetal force
D. Centrifugal acceleration

Q. 48 Two particle of equal masses are revolving in circular paths of radius r_1 and r_2, respectively with the same speed. The ratio of their centripetal force is

A. $\left(\frac{r_2}{r_1}\right)$
B. $\sqrt{\left(\frac{r_2}{r_1}\right)}$
C. $\left(\frac{r_2}{r_1}\right)^2$
D. $\left(\frac{r_1}{r_2}\right)^2$

Q. 49 In uniform circular motion, the factor that remains constant is

A. Linear velocity
B. Centripetal force
C. Acceleration
D. Speed

Q. 50 A particle moves in a circle of radius 25cm at two revolutions per second. The radial acceleration of the particle is

A. π^2
B. $8\pi^2$
C. $4\pi^2$
D. Zero

Q. 51 A fly wheel rotates at a constant speed of 3000rpm. The angle described by the shaft in radian in one second is:

A. 3000π
B. 50π
C. 100π
D. 2π

Q.52 A stone is whirled in a vertical plane. The stone has

A. Radial acceleration only
B. Tangential acceleration only
C. Both radial and tangential accelerations
D. Neither radial nor tangential acceleration

Q. 53 A body is rotating in circle of radius r. Keeping period of rotation constant but radius is doubled (2r) then centripetal force become

A. Half
B. Same
C. Double
D. Four times

Q. 54 A particle is moving in a circle of radius 'r'. In one period of revolution its displacement and distance covered are

A. $2\pi r$, $2\pi r$ B. π, $2\pi r$
C. 2π, $2\pi r$ D. zero , $2\pi r$

Q. 55 A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle. The motion takes place in a plane. It follows that

A. Its velocity is constant B. Its acceleration is constant
C. Its motion is linear D. Its motion is circular

Q. 56 A particle describes a circular path of diameter 20 m every 2s. the average angular speed of the particle during 4s is

A. 20 / π rad s B. 10 / π rad s
C. 5 / π rad s D. π rad s

Q. 57 A point on the wheel of 400cm diameter has a velocity of 1600cm/s. The angular velocity of the wheel is

A. 8 rad/s B. 4 rad/s
C. 12 rad/s D. 2 rad/s

Q. 58 Four particles have the following masses (in terms of m), speeds (in terms of v), and radii (in terms of r). Which particle have the same centripetal force as particle-1?

Particle	Mass	Speed	Radius
1	m	v	r
2	m/2	2v	2r
3	2m	v/2	r
4	1m	2v	3r

A. Particle 1 B. Particle 2
C. Particle 3 D. Particle 4

Q. 59 Which of the following changes when a body performs uniform circular motion?

A. Speed B. Mass
C. Direction D. Kinetic energy

Q. 60 A body is moving in a circular path with acceleration 'a'. If the speed of the body in increased to four times the initial value, the acceleration will become:

A. 4a B. 8 a
C. 16a D. a

ANSWER KEY

1	C	11	A	21	D	31	C	41	A	51	C
2	B	12	D	22	A	32	B	42	D	52	C
3	D	13	D	23	D	33	C	43	A	53	C
4	A	14	A	24	A	34	D	44	B	54	D
5	D	15	B	25	C	35	B	45	A	55	D
6	B	16	D	26	C	36	C	46	A	56	D
7	B	17	D	27	D	37	D	47	C	57	A
8	C	18	A	28	A	38	D	48	A	58	B
9	C	19	C	29	A	39	B	49	D	59	C
10	C	20	D	30	C	40	C	50	C	60	C

UNIT 4

WAVES

SELF ASSESSMENT TEST

Q. 1 The velocity of sound is greatest in

A. Water
B. Air
C. Copper
D. Ammonia

Q. 2 Silence zone takes place due to

A. Constructive interference
B. Destructive interference
C. Beats
D. Resonance

Q. 3 If the length of a simple pendulum is increased by 2%, then the time period

A. Increases by 1%
B. Decreases by 1%
C. Increases by 2%
D. Decreases by 2%

Q. 4 The phase difference between the acceleration of a particle executing simple harmonic motion and the instantaneous velocity is?

A. π
B. 0.707π
C. Zero
D. 0.5π

Q. 5 Velocity of sound in air is

A. Faster in dry air than in moist air
B. Directly proportional to temperature
C. Directly proportional to pressure
D. Slower in dry air than in moist air

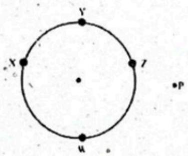
Q. 6 The length of a string is 1m, tension in it is 40N and mass of the string is 0.1 kg. Then the velocity of transverse waves produced in the string will be:

A. 400 ms^{-1}
B. 80 ms^{-1}
C. 180 ms^{-1}
D. 20 ms^{-1}

Q. 7 In strings, the position of antinodes is obtained at

A. $\lambda, 2\lambda, 3\lambda$
B. $2\lambda, 4, 6\lambda$
C. $0, \lambda/2, \lambda$
D. $\lambda/4, \frac{3\lambda}{4}, \frac{5\lambda}{4}$

Q. 8 A sound source rotates anti-clock wise with an angular velocity w. Radius of the circle is R. A person is at P. The maximum frequency is heared when position of the source is at.



A. Y
B. Z
C. X
D. W

Q. 9 The wavelength of the sound produced by a source is 0.8m. If the source moves towards the stationary listener at 32 ms^{-1}, what will be apparent wavelength of the sound? The velocity of sound is 320 ms^{-1}.

A. 0.80 m
B. 0.40 m
C. 0.72 m
D. 0.32 m

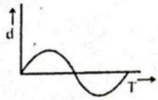
Q. 10 A source of sound is moving towards a stationary observer with $\frac{1}{10}$ of the speed of sound. The ratio of apparent to actual frequency of sound is:

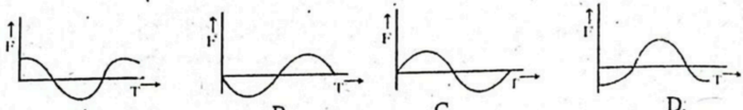
A. $\frac{10}{9}$
B. $\frac{11}{9}$
C. $\frac{11}{10}$
D. $\frac{9}{11}$

Q. 11 When a wave moves through 10m, a point changes from crest to trough and time taken is 1s then wavelength of wave and its frequency are

A. 20 m, 0.5 Hz
B. 0.5 Hz, 20 m
C. 10 m, 1 Hz
D. 1 m, 10 Hz

Q. 12 Displacement time graph of particle executing SHM is shown. The corresponding force-time graph of particle is





A. B. C. D.

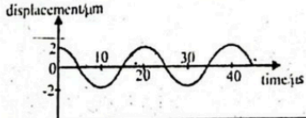
Q. 13 At which temperature will the velocity of sound at 27°C become double?

A. 54 °C
B. 327 °C
C. 927 °C
D. – 123 °C

Q. 14 An observer moves towards a stationary source of sound, with a velocity one fifth of the velocity of sound. What is the percentage increase in the apparent frequency?

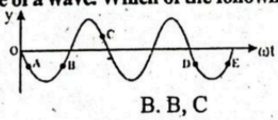
A. zero
B. 0.5%
C. 5%
D. 20%

Q. 15 The graph shown below the variation of displacement with time for a particle moving with simple harmonic motion. Which one of the following correctly gives the value of the frequency and the amplitude of the motion?



	Frequency / kHz	Amplitude / μm
A.	5	2
B.	25	2
C.	25	4
D.	50	2

Q. 16 The diagram shows the profile of a wave. Which of the following pairs of points are in phase?



A. A, B
B. B, C
C. B, D
D. B, E

Q. 17 A sound source moving with 8 ms^{-1} cross a stationary observer. The ratio of apparent frequency before and after crossing the observer (speed of sound = 332 ms^{-1})

A. $\frac{85}{81}$
B. $\frac{65}{61}$
C. $\frac{81}{85}$
D. $\frac{61}{65}$

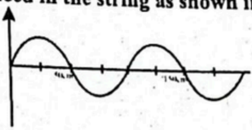
Q. 18 In a sinusoidal wave, the time required for a particular point to move from maximum displacement to zero displacement is 0.5 sec. The frequency of the wave is

A. 0.2 Hz
B. 0.5 Hz
C. 5 Hz
D. 10 Hz

Q. 19 A stretched string resonates with fundamental frequency of 50 Hz. The wavelength for its 3rd overtone is if speed of transverse wave in the string is 100 ms^{-1}

A. 66 cm
B. 33 cm
C. 50 cm
D. 100 cm

Q. 20 The string is attached to one end of vibrator having frequency 800 Hz. What will be the speed of the waves produced in the string as shown in figure.



A. 200 ms^{-1}
B. 400 ms^{-1}
C. 800 ms^{-1}
D. 600 ms^{-1}

Q. 21 A standing wave is established in a stretched string which is 100 cm long with fundamental frequency f. If tension in the string is increased to double its fundamental frequency would become

A. 2 f
B. $\frac{f}{2}$
C. $\sqrt{2}f$
D. $\frac{f}{\sqrt{2}}$

Q. 22 The sonometer wire is vibrating in its first overtone. There are

A. Two nodes and two antinodes
B. Four nodes and three antinodes
C. Three nodes and two antinodes
D. Three nodes and three antinodes

Q. 23 In case of a moving source of sound which is moving away from an observer

A. The wavelength of sound appears to be less
B. The wavelength of sound appears same
C. The wavelength of sound appears to be more
D. Frequency and wavelength of sound appears to be same

Q. 24 Distance and displacement traveled by a vibrating body in a time equal to $\frac{3}{4}T$; where T is the period of the vibration

A. $3x_o, 3x_o$
B. $3x_o, 0$
C. $3x_o, x_o$
D. $2x_o, 0$

Q. 25 The ratio of fundamental wavelengths of one end close pipe to the both end open pipe having same lengths

A. 1 : 2
B. 1 : 4
C. 2 : 1
D. 4 : 1

Q. 26 An organ pipe P_1 closed at one end vibrating in its first overtone and another pipe P_2 open at both ends vibrating in its third overtone are in resonance with a given tuning fork. The ratio of lengths of P_1 and P_2 is

A. 8 : 3
B. 3 : 8
C. 4 : 3
D. 3 : 4

Q. 27 **Two stretched strings have lengths ℓ and 2ℓ while tensions are T and 4T respectively. If they are made of same material the ratio of their frequencies is**

A. 1 : 1
B. 1 : 2
C. 2 : 1
D. 1 : 4

Q. 28 **If the source of sound is moving away from the stationary observer with a speed half the speed of sound then the apparent wavelength for the observer would be if speed of sound is v and its original frequency is f.**

A. $\frac{v}{2f}$
B. $\frac{5v}{2f}$
C. $\frac{3v}{2f}$
D. $\frac{v}{3f}$

Q. 29 **With what speed an observer should move towards a stationary source such that apparent frequency is double the actual frequency (v is speed of sound waves)**

A. v
B. $\frac{v}{2}$
C. 2 v
D. 4 v

Q. 30 **For a closed organ pipe resonance is occurred when air columns of lengths are equal to**

A. $\frac{\lambda}{1},\frac{\lambda}{2},\lambda$
B. $\frac{\lambda}{2},\frac{3\lambda}{2},\frac{5\lambda}{2}$
C. $\frac{\lambda}{2},\lambda,3\lambda$
D. $\frac{\lambda}{4},\frac{3\lambda}{4},\frac{5\lambda}{4}$

Q. 31 **The waves propagating on water surface are**

A. Ultrasonic
B. Unaudible
C. Longitudinal
D. Transverse

Q. 32 **The wavelength of sound in air is 10 cm. Its frequency is (Take velocity of sound = 330 ms^{-1})**

A. 3.3 kHz
B. 330 Hz
C. 330 mHz
D. 3×10^9 Hz

Q. 33 **A wave generator produces 500 pulses in 10 seconds. Find period of pulses it produces**

A. 50s
B. $\frac{1}{50}s$
C. $\frac{1}{5}s$
D. $\frac{10}{50}s$

Q. 34 **The speed of a wave on a particular string is 24 ms^{-1}. If string is 6m long. Find its fundamental frequency?**

A. 2 Hz
B. 6 Hz
C. 4 Hz
D. 8 Hz

Q. 35 **The restoring force of SHM is maximum when particle:**

A. Displacement is maximum
B. Half way between them
C. Crossing mean position
D. At rest

Q. 36 **The essential properties of a medium for the propagation of mechanical waves are**

A. Inertia and mass
B. Inertia and elasticity
C. Elasticity only
D. Inertia only

Q. 37 **The nature of sound waves in gases is**

A. Transverse
B. Longitudinal
C. Stationary
D. Electromagnetic

Q. 38 The frequency of a rod is 200 Hz. If the velocity of sound in air is $340\,ms^{-1}$, the wavelength of the sound produced is

A. 1.7 cm
B. 6.8 cm
C. 1.7 m
D. 6.8 m

Q. 39 Standing waves are produced in 10m long stretched string. If string vibrates in 5 segments and wave velocity is 20m/s, what is the frequency?

A. 10Hz
B. 5Hz
C. 20Hz
D. 4Hz

Q. 40 When two identical traveling waves are superimposed, velocity of resultant wave

A. Decreases
B. Increases
C. Remains same
D. Becomes zero

Q. 41 The distance between 1st node and 4th antinode is:

A. $\frac{7}{4}\lambda$
B. $5\frac{\lambda}{4}$
C. $13\frac{\lambda}{4}$
D. $11\frac{\lambda}{4}$

Q. 42 If V is the speed of sound at pressure P then speed of sound at 2P, keeping temperature constant, will be

A. 1 : 2
B. 1 : 1
C. 2 : 1
D. $\sqrt{2}:1$

Q. 43 Which of the following has maximum value of $\gamma = \frac{C_P}{C_v}$?

A. Monoatomic gas
B. Polyatomic gas
C. Diatomic gas
D. All have same value

Q. 44 Velocity of sound in air

A. Decreases with increase in temperature
B. Increase with decrease in temperature
C. Decreases with decrease of temperature
D. Does not depend on temperature

Q. 45 At what temperature, the velocity of sound will be double its value at 273 K?

A. 2×273 K
B. 8×273 K
C. 4×273 K
D. 16×273 K

Q. 46 For all gases

A. $v_t = v_o\sqrt{1-\frac{t}{273}}$
B. $v_t = v_o\sqrt{1+\frac{t}{273}}$
C. $v_t = v_o\sqrt{1+273t}$
D. $v_t = v_o\sqrt{1+\frac{273}{t}}$

Q. 47 Sound travels faster in moist air at STP because

A. Moist air is heavier than dry air
B. The pressure of moist air is greater than that of dry air
C. The value of γ of moist air is greater than that for dry air
D. The density of moist air is less than that of dry air

Q. 48 Newton assumed that sound propagation in a gas takes place under

A. Isothermal conditions
B. Isobaric condition
C. Adiabatic conditions
D. Isochoric condition

Q. 49 **If v_a, v_h and v_m are the speeds of sound in air, hydrogen and a metal at the same temperature, then**

A. $v_h > v_a > v_m$
B. $v_m > v_h > v_a$
C. $v_h > v_m > v_a$
D. $v_a > v_h > v_m$

Q. 50 **A rope of length 5 m is stretched to a tension of 80 N. If its mass is 1 kg, at what speed would a 10 Hz transverse wave travel down the string?**

A. 2 m/s
B. 5 m/s
C. 20 m/s
D. 50 m/s

Q. 51 **At which temperature the speed of sound in hydrogen will be same as that of speed of sound in oxygen at 100°C**

A. – 148°C
B. – 317.5°C
C. – 212.5°C
D. – 249.7°C

Q. 52 **A stationary wave is set up in the air column of a closed pipe. At the closed end of the pipe:**

A. Always a node is formed
B. Neither node nor antinode is formed
C. Always an antinode is formed
D. Sometimes a node and sometimes an antinode is formed

Q. 53 **A string, clamped at its ends, vibrates in three segments. The string is 100cm long. The wavelength is:**

A. 33.3cm
B. 66.7cm
C. 150cm
D. 300cm

Q. 54 **In stationary wave**

A. Strain is maximum at nodes
B. Strain is minimum at nodes
C. Strain is maximum at antinodes
D. None of these

Q. 55 **A property of the progressive wave that does not depend upon other characteristics mentioned below is**

A. Wavelength
B. Frequency
C. Amplitude
D. Wave velocity

Q. 56 **If the frequency of oscillation of a particle doing simple harmonic motion is n, the frequency of kinetic energy is?**

A. 2n
B. n
C. n/2
D. 2/n

Q. 57 **A spring (spring constant = k) is cut into 4 equal parts and two parts are connected in parallel. What is the effective spring constant?**

A. 4k
B. 16k
C. 8k
D. 6k

Q. 58 **If a simple harmonic oscillator has got a displacement of 0.02m and acceleration equal to 2m/s² at any time, the angular frequency of the oscillator is equal to**

A. 10 rad/s
B. 0.1 rad/s
C. 100 rad/s
D. 1 rad/s

Q. 59 **Water waves refract at a boundary between deep water and shallow water. What is the effect on the frequency, wavelength and speed of the waves at the boundary?**

	Frequency	Wavelength	Speed
A.	Changes	Changes	Stays the same
B.	Changes	Stays the same	Stays the same
C.	Stays the same	Changes	Changes
D.	Stays the same	Stays the same	Changes

Q. 60 **When a particle performing uniform circular motion of radius 10 cm undergoes the SHM, what will be its amplitude?**

A. 10 cm
B. 5 cm
C. 2.5 cm
D. 20 cm

ANSWER KEY

1	C	11	A	21	C	31	D	41	A	51	D
2	B	12	B	22	C	32	A	42	B	52	A
3	A	13	C	23	C	33	B	43	A	53	B
4	D	14	D	24	C	34	A	44	C	54	A
5	D	15	D	25	C	35	A	45	C	55	C
6	D	16	D	26	B	36	B	46	B	56	A
7	D	17	A	27	A	37	B	47	D	57	C
8	D	18	B	28	C	38	C	48	A	58	A
9	C	19	C	29	A	39	B	49	B	59	C
10	A	20	C	30	D	40	C	50	C	60	A

5
UNIT

THERMODYNAMICS

SELF ASSESSMENT TEST

Q. 1 A system which can neither exchange matter nor energy with the surroundings is called

A. Open system
B. Isolated system
C. Closed system
D. Ideal system

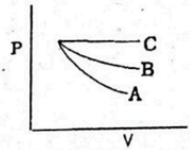
Q. 2 A system absorb 10 kJ of heat at constant volume and its temperature rises from 270 C to 370 C. The value of Δ U is

A. 100 kJ
B. 10 kJ
C. 0 kJ
D. 1 kJ

Q. 3 Metabolism is the name of a process in which energy transformation takes place within

A. Heat engine
B. Human body
C. Atmosphere
D. Laboratory

Q. 4 It is known that curves A, B, C are Isobaric, Isothermal, Adiabatic process then when one is correct



A. A - Adiabatic, B - Isothermal, C - Isobaric
B. A- Isothermal, B - Adiabatic, C - Isobaric
C. A - Isobaric, B - Isothermal C - Adiabatic
D. None of these

Q. 5 If for a gas $\left(\frac{R}{C_v}\right) = 0.67$ this gas is made up of molecules which are

A. Diatomic
B. Mixture of diatomic and polyatomic
C. Mono atomic
D. Polyatomic

Q. 6 Specific heat capacity at constant volume of gases in an adiabatic process is

A. ∞
B. Zero
C. Finite but not zero
D. $0 < C_v < \infty$

Q. 7 The molar specific heat at constant volume Cv for a diatomic gas is

A. 3/2R
B. 7/2R
C. 5/2R
D. 9/2R

Q. 8 Which of following process provide us maximum work done by system?

A. Isothermal
B. Adiabatic
C. Isochoric
D. Isobaric

Q. 9 For an adiabatic compression W = 100J, what will be ΔU?

A. – 100 J
B. 0 J
C. + 100 J
D. None

Q. 10 For an adiabatic expansion:

A. T decreases
B. Mechanical energy goes out of the system
C. Q = constant
D. All of these

Q. 11 For adiabatic contraction:

A. T increases
B. Mechanical energy comes into system
C. ΔQ = zero
D. All of these

Q. 12 Unit of molar specific heat is same as that of

A. Entropy
B. General gas constant
C. Internal energy
D. Pressure

Q. 13 For mono-atomic gas $C_v = \frac{3R}{2}$, therefore γ for this gas is

A. $\frac{3}{2}$
B. $\frac{5}{3}$
C. $\frac{3}{5}$
D. $\frac{3}{4}$

Q. 14 If 1 mole of an idea gas is heated at constant volume, then

A. $\Delta U = nC_v\Delta Q$
B. $\Delta U = C_v\Delta T$
C. $\Delta T = C_v\Delta U$
D. $\Delta U = C_p\Delta T$

Q. 15 Compressed air coming out of punctured football becomes cooler because of

A. Isothermal expansion
B. Energy dissipation
C. Adiabatic expansion
D. Adiabatic compression

Q. 16 The amount of heat required to raise the temperature of one mole of substance through 1 Kelvin at constant pressure is called

A. Specific heat
B. Molar specific heat capacity at constant pressure
C. Molar heat capacity at constant pressure
D. Heat capacity at constant pressure

Q. 17 Mathematically molar specific heat at constant pressure can be expressed as

A. $C_p = \frac{Q_p}{\Delta T}$
B. $C_p = \frac{T}{\Delta Q_p}$
C. $C_p = \frac{\Delta T}{Q_p}$
D. $C_p = \Delta Q_p \times T$

Q. 18 The motion possess by mono-atomic gas molecules is

A. Translatory
B. Rotatory
C. Vibratory
D. None of these

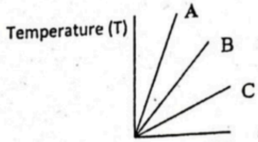
Q. 19 Sound passes through air under the following process

A. Isobaric
B. Isothermal
C. Adiabatic
D. Both B and C

Q. 20 The specific heat of a gas in an isothermal process is

A. Infinity
B. Negative
C. Zero
D. Remain constant

Q. 21 Which of the substances A, B or C has the highest specific heat? The temperature vs heat graph is?



A. A
B. B
C. C
D. All have equal specific heats

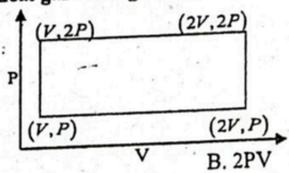
Q. 22 The curve represents isothermal process is called

A. Isotherm
B. Both "A" and "C"
C. Adiabatic
D. Either "A" or "C"

Q. 23 Which one is not adiabatic process

A. Escape of air from burst tyre
B. Cloud formation
C. Slow expansion
D. None

Q. 24 The work done on ideal gas during the cycle is



A. 1PV
B. 2PV
C. $\frac{PV}{2}$
D. 0

Q. 25 Heat energy added to a system under isothermal conditions appears as

A. Work done by the system
B. Work done on the system
C. Increase in internal energy
D. Increase in temperature

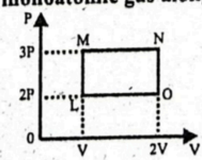
Q. 26 The change in internal energy can be defined as

A. $\Delta U-W$
B. $Q-W$
C. $P\Delta V$
D. $Q+W$

Q. 27 A gas expands 0.25 m^3 at constant pressure 10^3 N/m^2. The work done is

A. 2.5 ergs
B. 250J
C. 300J
D. 150J

Q. 28 The work done by an ideal monoatomic gas along path LMNO is



A. PV
B. 3PV
C. 2PV
D. 4PV

Q. 29 During adiabatic expansion the change in internal energy of 2 moles of a gas is 100J. the work done during this expansion is

A. Zero
B. –100J
C. 200J
D. 100J

Q. 30 Which of the following is necessarily zero when the system is an ideal gas that undergoes a change at constant temperature?

A. Work
B. Pressure
C. Change in Internal Energy
D. None of these

Q. 31 In which process, the change in internal energy of the system is zero

A. Isochoric process
B. Isobaric process
C. Adiabatic process
D. Isothermal process

Q. 32 In an equation PV^{γ}= constant

A. $\gamma = \frac{C_P}{C_V}$
B. $\gamma = \frac{C_V}{C_P}$
C. $\gamma = C_P - C_V$
D. $\gamma = C_p C_v$

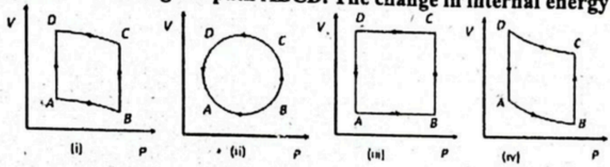
Q. 33 The temperature of the system decreases in the process of

A. Free expansion
B. Adiabatic expansion
C. Isothermal expansion
D. Isothermal compression

Q. 34 If both temperature and volume of an ideal gas are doubled, the pressure

A. Remains constant
B. Increases by a factor of 4
C. Is also doubled
D. Is diminished by a factor $\frac{1}{4}$

Q. 35 In the diagrams (i) to (iv) of variation of volume with changing pressure is shown. A gas is taken along the path ABCD. The change in internal energy of the gas will be



A. Positive in all cases (i) to (iv)
B. Negative in cases (i), (ii) and (iii) but zero in (iv) case
C. Positive in cases (i), (ii) and (iii) but zero in (iv) case
D. Zero in all four cases

Q. 36 We can express the work in terms of

A. $P\Delta U$
B. $P\Delta A$
C. $P\Delta V$
D. All are correct

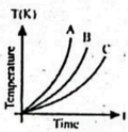
Q. 37 Internal energy is a function of state because change in internal energy

A. Does not depend on path
B. Corresponds to isothermal process
C. Depends on path
D. Corresponds to adiabatic process

Q. 38 The internal energy of ideal gas is

A. Totally K.E
B. Partly K.E and partly P.E
C. Totally P.E
D. Neither K.E nor P.E

Q. 39 Which of the substances A, B or C has the highest specific heat? The temperature vs time graph is shown.



A. A
B. C
C. B
D. All have equal specific heat

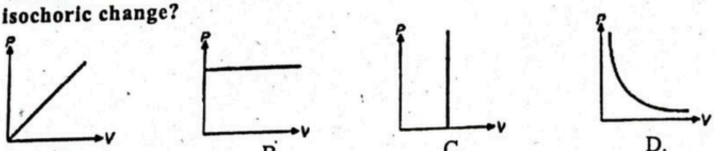
Q. 40 The value of γ of triatomic gas (linear arrangement) molecules is

A. $\frac{5}{3}$ B. $\frac{8}{6}$
C. $\frac{7}{5}$ D. $\frac{9}{7}$

Q. 41 Two different samples have the same mass and temperature. Equal quantities of energy are absorbed as heat by each. Their final temperatures may be different because the samples have different:

A. Thermal conductivities B. Coefficients of expansion
C. Densities D. Heat capacities

Q. 42 Which of the following graphs between pressure and volume correctly shows isochoric change?

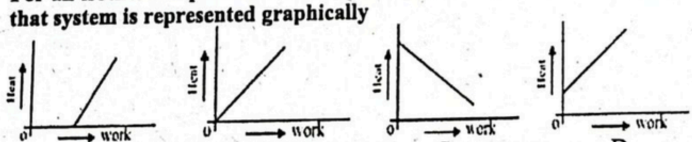


A. B. C. D.

Q. 43 In a given process of an ideal gas, $\Delta W = 0$ and $\Delta Q = -ve$. Then for the gas

A. The temperature will decrease B. The volume will increase
B. The pressure will remain constant D. The temperature will increase

Q. 44 For an isothermal process heat added to an ideal system versus work performed by that system is represented graphically



A. B. C. D.

Q. 45 System A is in thermal equilibrium with B and B is separately in thermal equilibrium with C. Then A and C are in thermal equilibrium, from which law of thermodynamics it follows?

A. Zeroth B. First
C. Second D. Third

Q. 46 A monoatomic gas (γ=5/3) is suddenly compressed to 1/8 of its original volume adiabatically, then the pressure of the gas will change to

A. 24/5 B. 40/3
C. 8 D. 32 times its initial pressure

Q. 47 Heat neither enters nor leave a system then its temperature:

A. Must remain same B. May fall
C. May rise D. Both B & C

Q. 48 The amount of heat required to raise the temperature of one mole of substance through 1 Kelvin is called

A. Specific heat B. Specific heat at constant volume
C. Molar specific heat D. Heat capacity

Q. 49 If 1 mole of an ideal gas is heated at constant pressure, then:

A. $Q_p = C_v\Delta T$ B. $Q_v = C_v\Delta T$
C. $Q_p = C_p\Delta T$ D. $Q_v = C_p\Delta T$

Q. 50 The amount of heat energy required to raise the temperature of a body of mass 1 kg through 1 k is called:

A. Specific heat
B. Molar specific heat
C. Heat capacity
D. Heat of vaporization

Q. 51 The molar specific heat constant pressure of an ideal gas is 7R/2. The ratio of specific heat at constant pressure to that at constant volume is?

A. 9/7
B. 7/5
C. 8/7
D. 5/7

Q. 52 $C_P - C_V$ and $\frac{C_v}{C_p}$ are respectively equal to

A. $\left(\frac{1}{R}, \gamma^{-1}\right)$
B. $\left(\frac{1}{R}, \gamma\right)$
C. (R, g)
D. (R, γ^{-1})

Q. 53 Which one is correct relation?

A. $C_p + C_v = \gamma$
B. $\gamma = \frac{C_p}{C_v}$
C. $C_p = 1 + \frac{R}{C_v}$
D. $C_p = 1 - \frac{R}{C_v}$

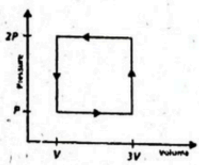
Q. 54 Four students found set of C_P and C_V (in cal/deg mole) as given below. Which of the following set is correct?

A. $C_V = 4$, $C_P = 2$
B. $C_V = 3$, $C_P = 3$
C. $C_V = 2$, $C_P = 1$
D. $C_P = 5$, $C_V = 3$

Q. 55 When the temperature of the gas system is changed by 30K and the internal energy of the system is changed by 48J, the molar specific heat of system at constant volume will be:

A. 0.6J/mol.K
B. 1.0J/mol.K
C. 1.6J/mol.K
D. 2.1J/mol.K

Q. 56 A thermodynamic system is explained with the help of the graph ABCD. What is the heat rejected by the system during the cycle?



A. pV
B. 2pV
C. 4pV
D. 1/2pV

Q. 57 If Cp = 34.4 J /mol K and value of R is 8.314 then

A. Cv = 26.1 J/ mol K
B. Cv = 20.1 J/ mol K
C. Cv = 10.1 J/ mol K
D. Cv = 120.1 J/ mol K

Q. 58 Which of the statement is true?

A. $R = (\gamma - 1)\, C_V$
B. $R = (\gamma + 1)\, C_V$
C. $C_V = R\,(\gamma + 1)$
D. $C_p = \frac{R}{(\gamma - 1)}$

Q. 59 100 g of water is heated from 30 °C to 50 °C. Ignoring the slight expansion of the water, the change in its internal energy is (specific heat of water is 4184 J kg^{-1} K^{-1})

A. 4.2 kJ B. 8.4 kJ
C. 84 kJ D. 2.1 kJ

Q. 60 When an ideal diatomic gas is heated at constant pressure, the fraction of the heat energy supplied which increases the internal energy of the gas is

A. 2/5 B. 3/5
C. 3/7 D. 5/7

ANSWER KEY

1	B	11	D	21	C	31	D	41	D	51	B
2	B	12	B	22	A	32	A	42	C	52	D
3	B	13	B	23	C	33	B	43	A	53	B
4	A	14	B	24	A	34	A	44	B	54	D
5	C	15	C	25	A	35	D	45	A	55	C
6	B	16	B	26	B	36	C	46	D	56	B
7	C	17	A	27	B	37	A	47	D	57	A
8	D	18	A	28	A	38	A	48	C	58	A
9	C	19	C	29	D	39	B	49	C	59	B
10	D	20	A	30	C	40	D	50	A	60	D

6 UNIT

ELECTROSTATICS

SELF ASSESSMENT TEST

Q.1 A parallel plate air capacitor has a capacity of 2 pF. If the separation between its plates is doubled and a mica sheet is introduced between its plates, its capacity becomes 6 pF. What is the dielectric constant of mica?

A. 6
B. 5
C. 4
D. 3

Q.2 An electric charge at rest produces

A. Only a magnetic field
B. Only an electric field
C. Neither electric field nor magnetic field
D. Both electric and magnetic fields

Q.3 Two similar charges each of one coulomb placed in the air one meter apart repel each other with a force

A. 9×10^9N
B. 9.2×10^4N
C. 9×10^8N
D. 9×10^7N

Q.4 3 capacitors with capacitances 5μ F, 6μ F and 7μ F are arranged in series combination with a battery of 5V, then which capacitor has more potential difference across a plates

A. 5μ F capacitor
B. 6μ F capacitor
C. 7μ F capacitor
D. Same potential difference across all

Q.5 A test charge is moved from lower potential point to a higher potential point. The potential energy of test charge will

A. Remain the same
B. Increase
C. Decrease
D. Become zero

Q.6 The force per unit charge is known as ____________

A. Electric flux
B. Electric intensity
C. Electric potential
D. All of above are same

Q.7 Uncharged capacitor is connected in a series with resistor, switch and a battery. When switch is closed the potential drop across resistor

A. Remain same
B. Initially maximum then decreases to zero
C. Become zero then increase maximum
D. Remain zero

Q.8 Two charges placed in air repel each other by a force of 10^{-4}N. When oil is introduced between the charges, the force becomes 2.5×10^{-5}N. The dielectric constant of oil is

A. 3
B. 4
C. 2
D. 0.25

Q.9 Two charges each equal to 2μC are 0.5m apart. If both of them exist inside vacuum, then the force between them is

A. 2.44 N
B. 0.144 N
C. 1.89 N
D. 3.144 N

Q.10 The electric lines of force are ____________

A. Imaginary
B. Physically existing every where
C. Physically existing near the charges
D. Depends upon case

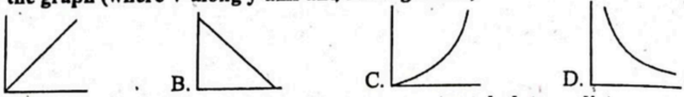
Q.11 A capacitor of capacitance C has charge Q and stored energy is W. If the charge is increase to 2Q. The stored energy will be

A. W/4
B. W/2
C. 2W
D. 4W

Q.12 **A hollow metal sphere of radius 5 cm is charged so that the potential on its surface is 10 V. The potential at the center of the sphere is**

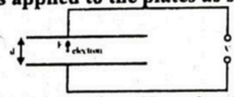
A. 10 V
B. Same as at point 5 cm away from the surface
C. 0 V
D. Same as at point 25 cm away from the surface

Q.13 **The variation of electric potential due to a point charge with distance is represented by the graph (where V along y-axis and r along x-axis)**



A. B. C. D.

Q.14 **An electron of charge e is introduced between two metal plates a distance d apart. A potential difference V is applied to the plates as shown in the diagram.**



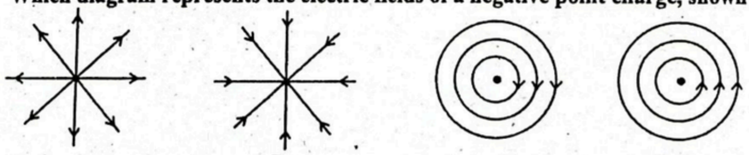
Which expression gives the electric force F on the electron?

A. $\frac{eV}{d}$
B. eVd
C. $\frac{V}{ed}$
D. $\frac{dV}{e}$

Q.15 **The energy stored per unit volume in an electric field of strength E volt/meter in a medium of dielectric constant K (in Joule/metre^3) is:**

A. $\frac{1}{2}\varepsilon_0 E^2$
B. $\frac{1}{2}K\varepsilon_0 E^2$
C. $\frac{1}{2}.\frac{\varepsilon_0 E^2}{K}$
D. $\frac{1}{2}K^2\varepsilon_0^2 E$

Q.16 **Which diagram represents the electric fields of a negative point charge, shown by.**



A. B. C. D.

Q.17 **A charge of 2C experiences a force 2000N in a uniform electric field. In this field the potential difference between two points separated by a distance 1cm is**

A. 2V
B. 5V
C. 10 V
D. 20V

Q.18 **A 5 μF capacitor has a potential difference across its plates is 200 volts. The charge on the capacitor is**

A. 2.5×10^{-8} C
B. 10^{-3} C
C. 10^3 C
D. 4×10^3 C

Q.19 **If the distance between the plates of parallel plates condenser is increased, its potential will**

A. Remain same
B. Increase
C. Decrease
D. Decreases exponentially

Q.20 The number of electrons in one coulomb charge is equal to

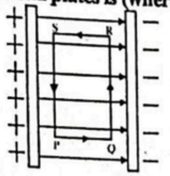
A. 6.2×10^{18}

B. 1.6×10^{-19}

C. 6.2×10^{21}

D. 1.6×10^{-27}

Q.21 The amount of work done in joule in carrying a charge +q along the closed path PQRSP between the oppositely charged metal plates is (where E is electric field between the plates)



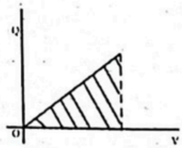
A. Zero

B. q

C. $qE(PQ+QR+SR+SP)$

D. $\frac{q}{\varepsilon_0}$

Q.22 The graph shows the growth of charge with potential difference between plates. The area under the graph shows



A. Capacitance

B. Separation of plates

C. Energy stored

D. Electric intensity

Q.23 Value of ε_r for various dielectrics is always

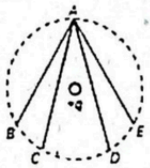
A. Less than unity

B. Equal to unity

C. Larger than unity

D. No hard and fast rule

Q.24 In the electric field of a point charge q, a certain charge is carried from point to B, C, D and E. Then the work done



A. Is least along the path AB

B. Is zero along all the paths AB, AC, AD and AE

C. Is least along AE

D. Is least along the path AD

Q.25 A charge particle is free to move in an electric field. It will travel

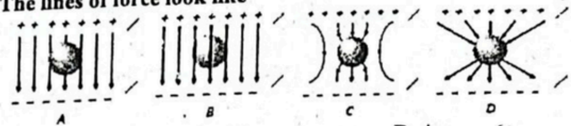
A. Along a line of force, if it has some initial velocity in the direction of an acute angle with the line of force

B. Always along a line of force

C. Along a line of force, if its initial velocity is zero

D. None of these

Q.26 **An uncharged sphere of metal is placed in between two charged plates as shown. The lines of force look like**



A. C
B. A
C. D
D. B

Q.27 **The intensity of electric field required to balance a proton of mass 1.7×10^{-27}kg and charge1.6×10^{-19} C is nearly**

A. 1×10^{-7} V/m
B. 1×10^{-5} V/m
C. 1×10^{7} V/m
D. 1×10^{5} V/m

Q.28 **Two plates are 2cm apart, a potential difference of 10 volt is applied between them, the electric field between the plates is**

A. 20 N/C
B. 500N/C
C. 5N/C
D. 250 N/C

Q.29 **A particle A has charge +q and a particle B has charge +4q with each of them having the same mass m. When allowed to fall from rest through the same electric potential difference, the ratio of their speed v_A/v_B will become**

A. 1:2
B. 1:4
C. 2:1
D. 4:1

Q.30 **What would happen to the electrostatic force between a pair of charged particles if both charges were doubled and the distance between them were also doubled?**

A. It would decrease by a factor of 4
B. It would decrease by a factor of 2
C. It would remain unchanged
D. It would increase by a factor of 2.

Q.31 **Two charges 1 μC and 5 μC separated by 20 cm, the ratio of electric forces acting on them will be:**

A. 1 : 2
B. 1:1
C. 1:5
D. 5:1

Q.32 **In bringing an electron towards the second electron the electrostatic potential of the system**

A. Increases
B. Remains the same
C. Decreases
D. Becomes zero

Q.33 **A capacitor is charged by using a battery which is then disconnected. A dielectric slab is then slipped between the plates, which results in**

A. Reduction of charge on the plates and increase of potential difference across the plates
B. Increase in the potential difference across the plate, reduction in stored energy, but no change in the charge on the plates
C. Decrease in the potential difference across the plates, reduction in the stored energy, but no change in the charge on the plates
D. None of the above

Q.34 **Unit of energy density of electric field is:**

A. JC^{-1}
B. Jm^{-3}
C. JV^{-1}
D. JF^{-3}

Q.35 **Coulomb's law applicable for______**

A. Any two charges
B. Point charges
C. Both
D. None

Q.36 Three charges 2q,-q,-q are located at the vertices of an equilateral triangle. At the center of the triangle.

A. The field is zero but potential is non-zero
B. The field is non-zero but potential is zero
C. Both field and potential are zero
D. Both field and potential are non-zero

Q.37 An external agency carries '–5 C' of charge from infinity to a point in an electrostatic field and performs 100 joule of work. The potential at the given point is

A. 10 V
B. 20 V
C. –10 V
D. –20 V

Q.38 A tin nucleus has charge + 50e. If the proton is at a distance 10^{-12} m from the nucleus, then the potential V at this position is [charge on the proton = 1.6×10^{-19}C]

A. 14.4×10^4 volt
B. 7.2×10^8 volt
C. 7.2×10^4 volt
D. 14.4×10^8 volt

Q.39 Four charges 2C, –3C, –4C and 5C respectively are placed at all the corners of a square. Which of the following statements is true for the point of intersection of the diagonals?

A. Electric field is zero but electric potential is non-zero
B. Electric field non-zero but electric potential is zero
C. Both electric field and electric potential are zero
D. Neither electric field nor electric potential is zero

Q.40 Two charges are placed at a certain distance. If the magnitude of each charge is doubled the force will become

A. $\frac{1}{4}$ th of its original value
B. $\frac{1}{8}th$ of its original value
C. 4 times of original value
D. 8 times of its original value

Q.41 Force between the plates of a charged parallel plate capacitor is attractive and its magnitude is

A. $\frac{Q^2}{A\varepsilon_0}$
B. $\frac{Q^2}{2A\varepsilon_0}$
C. $Q^2A\varepsilon_0$
D. Q A ε_0

Q.42 The electric intensity at infinite distance from the point charge is

A. Zero
B. Infinite
C. 1-volt m^{-1}
D. Negative

Q.43 Value of ε_r for air is;

A. 1.6
B. 1.96
C. 1.986
D. 1.0006

Q.44 What will be the electric potential energy of a 7 nC charge that is 2cm from a 20 nC charge?

A. 6.3×10^{-1}J
B. 6.3×10^{-5}J
C. 6.3×10^{-5}V
D. 1.3×10^{-5}J

Q.45 The potential at a point, due to a positive charge of $100\mu C$ at a distance of $9m$, is

A. 10^4 V
B. 10^5 V
C. 10^6 V
D. 10^7 V

Q.46 The quantity $\frac{\Delta V}{\Delta r}$ is known as:

A. Potential Difference
B. Potential Energy
C. Potential Gradient
D. All of these

Q.47 **A unit positive charge + q_o placed anywhere in the vicinity of a positive point charge, experiences a repulsive force directed.**

A. Radially inward
B. Radially out ward
C. Radially zero
D. None of these

Q.48 **If E be the electric intensity of an electrostatic field, then the electrostatic energy density is proportional to**

A. E
B. E^2
C. $1/E^2$
D. E^3

Q.49 **The coulombs force between two point charges is F. If magnitude of each charge is doubled and distance between charges is halved, the forces between them becomes**

A. F
B. 8F
C. 4F
D. 16F

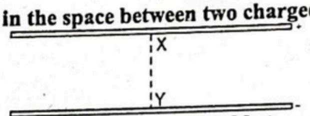
Q.50 **Relative permittivity ε_r is defined by the following relation?**

A. $\frac{C_{med}}{C_{vac}}$
B. $\frac{C_{vac}}{C_{med}}$
C. $C_{med} \times C_{vac}$
D. $C_{med} + C_{vac}$

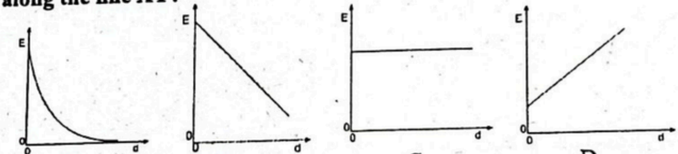
Q.51 **Two-point charges are separated by a distance of 4 m. The force between them is 4 N. What is the force between the charges, when the distance between them is 1 m?**

A. 16 N
B. 64 N
C. 1 N
D. 32 N

Q.52 **An electric field exists in the space between two charged metal plates.**



Which graph shows the variation of electric field strength *E* with distance *d* from X along the line XY?



A. B. C. D.

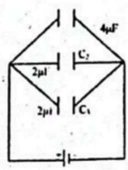
Q.53 **Gaussian surface is**

A. An imaginary surface
B. A curved surface
C. An open surface
D. A plane surface

Q.54 **12 J of work is to be done against an existing electric field to take a charge of 0.01 C from A to B. Find the potential difference between B and A.**

A. 120 V
B. 1.2 V
C. 1200 V
D. 12 V

Q.55 **Three capacitors C_1, C_2 and C_3 are connected in parallel as in the Fig. The equivalent capacitance will be**



A. 8μF
B. 0.8μF
C. 1μF
D. 16μF .

Q.56 **Three capacitors of capacitance 12 μF each are available. The minimum and maximum capacitances which may be obtained from these are**

A. 12 μF, 36 μF
B. 4 μF, 12 μF
C. 4 μF, 36 μF
D. 0 μF, ∞ μF

Q.57 **Electric potential is________**

A. A scalar quantity
B. A vector quantity
C. A dimensionless quantity
D. Always a positive quantity

Q.58 **The work done in placing a charge of 8 uC on a condenser of capacity 100 nF is________**

A. 16×10^{-5} J
B. 32×10^{-6} J
C. 3.2×10^{-4} J
D. 16×10^{-4} J

Q.59 **The metallic spheres A and B of radii 2m and 4m respectively carry the same charge 4×10^{8} C. If the spheres are connected by a copper wire**

A. The charge will flow from A to B
B. The charge will flow from B to A
C. No flow of charge will occur
D. Both A and B are possible

Q.60 **Let Q denote charge, V denote potential difference, and U denote stored energy. Of these quantities, capacitors in parallel must have the same:**

A. Q only
B. V only
C. U only
D. Q and U only

ANSWER KEY

1	A	11	D	21	A	31	B	41	A	51	B
2	B	12	A	22	C	32	A	42	A	52	C
3	A	13	D	23	C	33	C	43	D	53	A
4	A	14	A	24	B	34	B	44	B	54	C
5	B	15	B	25	C	35	B	45	B	55	A
6	B	16	B	26	A	36	B	46	C	56	C
7	B	17	C	27	A	37	D	47	B	57	A
8	B	18	B	28	B	38	C	48	B	58	C
9	B	19	B	29	A	39	B	49	D	59	A
10	A	20	A	30	C	40	C	50	A	60	B

UNIT 7 CURRENT ELECTRICITY

SELF ASSESSMENT TEST

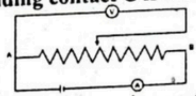
Q.1 **When a piece of aluminium wire of finite length is drawn through a series of dies to reduce its diameter to half its original value, its resistance will become**

A. Two times
B. Four times
C. Eight times
D. Sixteen times

Q.2 **An electric wire is connected across a cell of e.m.f. E. The current I is measured by an ammeter of resistance R. According to ohm's law**

A. $E=I^2R$
B. $E=IR$
C. $E=R/I$
D. $E=I/R$

Q.3 **In the given circuit as the sliding contact C is moved from A to B the readings of**



A. Both the ammeter and the voltmeter remain constant
B. Both the ammeter and the voltmeter increase
C. The ammeter remains constant but that of the voltmeter increases
D. The ammeter remains constant but that of the voltmeter decreases

Q.4 **A bulb has a power of 200W. What is the energy dissipated by it in 5 minutes?**

A. 60J
B. 1000J
C. 60kJ
D. 1kJ

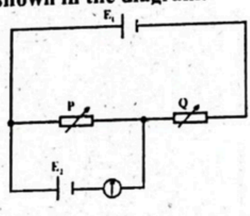
Q.5 **A wire of uniform area of cross section is cut into two parts of equal lengths. The resistivity of any part**

A. Remain same
B. Is doubled
C. Is halved
D. One fourth

Q.6 **The resistance of a coil is 4.2 ohm at 100° C and the temperature coefficient of resistance of its material is 0.004/°C. Its resistance at 0°C**

A. 6.5 ohm
B. 5 ohm
C. 3 ohm
D. 4 ohm

Q.7 **Two cells of e.m.f E_1 and E_2 and of negligible internal resistance are connected with two variable resistors as shown in the diagram.**



Galvanometer

When the galvanometer deflection is zero, the values of both resistances are P and Q. what is the value of the ratio $\frac{E_2}{E_1}$?

A. $\frac{P}{Q}$
B. $\frac{Q}{(P+Q)}$
C. $\frac{P}{(P+Q)}$
D. $\frac{(P+Q)}{P}$

Q.8 **10,000 alpha particles per minute, are passing through a straight tube of radius r. The resulting electric current in approximately**

A. 0.5×10^{-16} amp
B. 0.5×10^{12} amp
C. 2×10^{12} amp
D. 2×10^{-12} amp

Q.9 **An electric current source is actually source of**

A. Current
B. Charge
C. Energy
D. Power

Q.10 **What can be used as the unit of energy**

A. watt × second
B. volt × meter
C. volt per coulomb
D. newton per meter

Q.11 **A nichrome wire 50 cm long and one square millimetre cross-section carries a current of 4A when connected to a 2V battery. The resistivity of nichrome wire in ohm metre is**

A. 1×10^{-6}
B. 4×10^{-7}
C. 3×10^{-7}
D. 2×10^{-7}

Q.12 **Calculate the amount of charge flowing in 2 minutes in a wire of resistance 10 Ohm when a potential difference of 20 V is applied between its ends**

A. 4 C
B. 20 C
C. 240 C
D. 120 C

Q.13 **An electric iron is marked 20 volts 500W. The units consumed by it in using it for 24 hours will be**

A. 12
B. 24
C. 5
D. 1100

Q.14 **The electric resistance of a certain wire of iron is R. If its length and radius are both doubled, then**

A. The resistance will be halved and the specific resistance will remain unchanged
B. The resistance will be doubled and the specific resistance will be halved
C. The resistance will be halved and the specific resistance will be doubled
D. The resistance and the specific resistance, will both remain unchanged

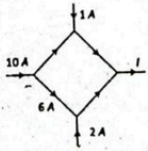
Q.15 **The graphical representation of Ohm's law is ___________**

A. Hyperbola
B. Ellipse
C. Parabola
D. Straight line

Q.16 **SI unit of resistivity is___________**

A. Ω-m^2
B. (Ω-m)-^{1}
C. Ω-m
D. $(\Omega\text{-m})^{-1}$

Q.17 **The figure shows a network of currents. The magnitude of currents is shown here. The current *I* will be**



A. 3 A
B. 9 A
C. 13 A
D. 19 A

Q.18 **Electric current is generated by;**

A. Diode
B. Transistor
C. Generator
D. Motor

Q.19 A flow of 10^7 electron per second in a conductor constitutes a current of
A. 1.6×10^{-26} A
B. 1.6×10^{12} A
C. 1.6×10^{-12} A
D. 10^7 A

Q.20 A 25 W, 220 V bulb and a 100 W, 220 V bulb are joined in series and connected to mains which bulb will glow brighter
A. 25 W
B. 100 watt bulb
C. First 20W and then 100 W bulb
D. Neither bulb will glow

Q.21 A typical value of drift velocity is
A. 1 mm s^{-1}
B. 1 ms^{-1}
C. 10 ms^{-1}
D. 1000 km s^{-1}

Q.22 The specific resistance of wire is $50\times10^{-8}\,\Omega$ m. The resistance of a cube of length 50 cm will be
A. $10^{-6}\,\Omega$
B. $2.5\times10^{-5}\,\Omega$
C. $10^{-8}\,\Omega$
D. $5\times10^{-4}\,\Omega$

Q.23 5A of current is passed through a metallic conductor. The charge flowing in one minute in coulomb, will be
A. 5
B. 12
C. $\frac{1}{12}$
D. 300

Q.24 The length of the wire is doubled. Its conductance will be
A. Uncharged
B. Halved
C. Halved
D. $\frac{1}{4}$ of the original value

Q.25 1.6 mA current is flowing in conducting wire then the number of electrons flowing per second
A. 10^{11}
B. 10^{16}
C. 10^{19}
D. 10^{15}

Q.26 A primary cell has an emf of 1.5V, when short circuited it gives a current of 3A. The internal resistance of the cell is:
A. 4.5Ω
B. 2Ω
C. 0.5Ω
D. $\frac{1}{4.5}\Omega$

Q.27 For which of the following the resistance decreases on increasing the temperature
A. Copper
B. Tungsten
C. Germanium
D. Aluminium

Q.28 For a metallic wire, the ratio V/i (V = the applied potential difference, i = current flowing) is
A. Independent of temperature
B. Increases as the temperature rises
C. Decreases as the temperature rises
D. Increases or decreases as temperature rises, depending upon the metal

Q.29 The resistances of a wire at temperatures $t°C$ and $0°C$ are related by
A. $R_t = R_0(1+\alpha t)$.
B. $R_t = R_0(1-\alpha t)$
C. $R_t = R_0^2(1+\alpha t)$
D. $R_t = R_0^2(1-\alpha t)$

Q.30 Total number of electrons present in 4 ampers current flowing for 1 sec is:
A. 2.5×10^{19}
B. 1.25×10^{13}
C. 2.5×10^{20}
D. 6×10^{8}

Q.31 **If a source of emf is traversed from positive to negative the potential change will be**
A. Positive
B. Zero
C. Negative
D. Constant

Q.32 **Resistivity at a given temperature depends upon:**
A. Area of cross-section
B. Length
C. Nature of material of conductor
D. Both length and area

Q.33 **A cell of emf E Volt and internal resistance r ohm is being charged with a current of *i* amp. Then the terminal potential difference is**
A. E
B. E + ir
C. E − *i*r
D. E − *i*R

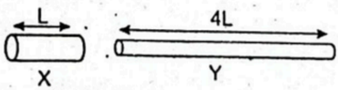
Q.34 **The temperature of a metal wire rises when an electric current passes through it because**
A. Collision of metal atoms with each other releases heat energy
B. Collision of conduction electrons with each other releases heat energy
C. Collision of conduction electrons with the atoms of metal give them energy which appears as heat
D. all of these

Q.35 **If a bulb has a 20W power. If it is working at 60% efficiency, then its output power is**
A. 12W
B. 15W
C. 20W
D. 18W

Q.36 **The substances which have a large number of free electrons and offer a low resistance are called**
A. Insulators
B. semi-conductors
C. Inductors
D. Conductors

Q.37 **A light bulb draws 300 mA when the voltage across it is 240 V. The resistance of the light bulb is**
A. 400 Q
B. 800 Q
C. 600 Q
D. 1000 Q

Q.38 **Two copper wires X and Y have the same volume. Wire Y is four times as long as wire X.**



What is the ratio $\dfrac{\textbf{resistance of wire Y}}{\textbf{resistance of wire X}}$**?**
A. 4
B. 16
C. 8
D. 64

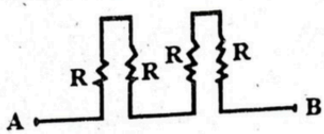
Q.39 **Which of the following materials has a negative temperature co-efficient of resistance?**
A. Copper
B. Carbon
C. Aluminum
D. Brass

Q.40 **The terminal potential difference of a cell when short-circuited is (E = E.M.F. of the cell)**
A. E
B. E/2
C. Zero
D. E/3

Q.41 By a cell a current of 0.9 A flows through 2 *ohm* resistor and 0.3 A through 7 *ohm* resistor. The internal resistance of the cell is

A. 0.5Ω B. 1.0Ω
C. 1.2Ω D. 2.0Ω

Q.42 Four identical wires each having resistance R are connected as shown in the figure. Equivalent resistance between A and B is:



A. $\frac{R}{4}$ B. $\frac{R}{2}$
C. 4R D. R

Q.43 Two bulbs having the ratings 40 W, 220 V and 20 W, 110 V. The ratio of their resistance is

A. 1: 2 B. 1 :1
C. 2 :1 D. 1 : 4

Q.44 A total charge of 100 C flows through a 12 W light bulb in a time of 50s. What is the potential difference across the bulb during this time?

A. 0.12 V B. 6.0 V
C. 2.0 V D. 24 V

Q.45 Two bulbs of 500 W and 200 W rated at 250 V will have resistance ratio as

A. 4 : 25 B. 2 : 5
C. 25 : 4 D. 5 : 2

Q.46 The resistance of a metallic wire becomes 8 times when;

A. Length is doubled B. Lengths is trippled
C. Length is doubled and radius is halved D. Length is halved and radius is doubled

Q.47 The internal resistance of a cell is the resistance of

A. Electrodes of the cell B. Vessel of the cell
C. Electrode used in the cell D. Material used in the cell

Q.48 An electron is circulating in a circular path with a frequency of 50 Hz. What is the associated current?

A. 0.8×10^{-17} A B. 8×10^{-17}A
C. 0.4×10^{-17}A D. 80×10^{-17}A

Q.49 How many electrons per second constitute a current of one micro ampere?

A. One electron B. 10^{-6} electrons
C. 10^{6} electrons D. 6.25×10^{12} electrons

Q.50 A steady current is flowing in a conductor of non-uniform cross-section. The charge passing through any cross-section per unit time is

A. Directly proportional to the area of cross-section
B. Proportional to square of the area of cross-section
C. Inversely proportional to the area of cross-section
D. Independent of the area of cross-section

Q.51 In the case of gases, the charge carries are

A. Positive and negative ions B. Negative ions and electrons
C. Electrons and holes D. Positive ions and electron

Q.52 What is meant by 5 A?

A. A charge of 5 C flows through a point in 1 second
B. 5V electricity is causing 1 C of charge to flow
C. 5 V electricity flows across 1Ω of resistance
D. A charge of 5 C flows through a point in 5 seconds.

Q.53 Slope of the graph between "V" On X-axis and "I" on the Y-axis is

A. Resistance
B. Conductance
C. Emf
D. Capacitance

Q.54 When we double the voltage in a simple electric circuits we double the

A. Current
B. Power
C. Resistance
D. Both 'A' and 'B'

Q.55 The 40 watt, 100 watt and 150 watt bulbs are connected in series across 220-volt supply. Which bulb will be brightest?

A. 150 watt
B. 100 watt
C. 40 watt
D. All have same brightness

Q.56 At what temperature will the resistance of a copper wire become three times its value at 0°C (Temperature coefficient of resistance for copper = 4×10^{-3} per °C)

A. 400°C
B. 450°C
C. 500°C
D. 550°C

Q.57 Two electric bulbs, one of 200volt 40 watt and the other 200volt 100 watt are connected in a house wiring circuit

A. They have equal currents through them
B. The resistance of the filaments in both the bulbs is same
C. The resistance of the filament in 40watt bulb is more than the resistance in 100watt bulb
D. The resistance of the filament in 100watt bulb is more than the resistance in 40watt bulb

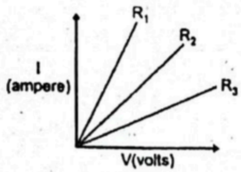
Q.58 Two electric bulbs have 40W and 60W rating at 220V, then the ratio of their resistances will be

A. 3 : 2
B. 2 : 3
C. 3 : 4
D. 4 : 3

Q.59 If there are two bulbs connected in series and one blows out, what happens to the other bulb?

A. The other bulb continues to glow with the same brightness
B. The other bulb stops glowing
C. The other bulb glows with increased brightness
D. The other bulb also burns out

Q.60 A student carries out an experiment and plots the V-I graph of three samples of nichrome wire with resistances R_1 R_2 and R_3 respectively. Which of the following is true?



A. $R_1 = R_2 = R_3$
B. $R_1 > R_2 > R_3$
C. $R_3 > R_2 > R_1$
D. $R_2 > R_3 > R_1$

ANSWER KEY

1	D	11	A	21	A	31	C	41	A	51	D
2	B	12	C	22	A	32	C	42	C	52	A
3	C	13	A	23	D	33	B	43	C	53	B
4	C	14	A	24	B	34	C	44	B	54	A
5	A	15	D	25	B	35	A	45	B	55	C
6	C	16	C	26	C	36	D	46	C	56	C
7	C	17	C	27	C	37	B	47	D	57	C
8	A	18	C	28	B	38	B	48	A	58	A
9	C	19	C	29	A	39	B	49	D	59	B
10	A	20	A	30	A	40	C	50	A	60	C

8 UNIT

ELECTROMAGNETISM AND ELECTROMAGNETIC INDUCTION

SELF ASSESSMENT TEST

Q.1 **A conducting rod of length L is falling with velocity V in a uniform horizontal magnetic field B normal to the rod. The induced emf between the ends of the rod will be**

A. 2 Bvl
B. Zero
C. Blv
D. $\frac{Bvl}{2}$

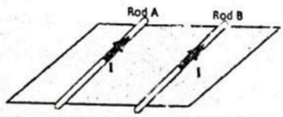
Q.2 **The total flux in the core of an electrical machine is 20 mWb and its flux density is 1 T. The cross-sectional area of the core is:**

A. 0.05 m^2
B. 0.02 m^2
C. 20 m^2
D. 50 m^2

Q.3 **A positive charge enters in a magnetic field and travels parallel to the field. Its speed experiences is**

A. Increases
B. Decreases
C. Remain same
D. None of these

Q.4 **In the given figure, force on rod A and rod B are in direction respectively:**



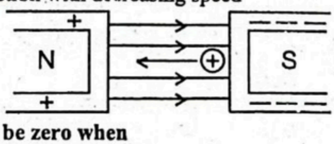
A. Rightward direction, leftward direction
B. Rightward direction, Rightward direction
C. Leftward direction, Leftward direction
D. Leftward direction, Rightward direction

Q.5 **In velocity selector arrangement electric and magnetic field will be**

A. Parallel each other
B. Anti-parallel each other
C. Perpendicular to each other
D. Inclined at 45° to each other

Q.6 **A proton is projected in a region containing both electric and magnetic field pointing in opposite direction to the motion of proton. The proton may**

A. Move in same direction with increasing speed
B. Deflect downward with decreasing speed
C. Deflect upward with same speed
D. Move in same direction with decreasing speed



Q.7 **Magnetic flux would be zero when**

A. $\vec{B}$ is parallel to $\vec{A}$
B. $\vec{B}$ is along to $\vec{A}$
C. $\vec{B}$ is perpendicular to $\vec{A}$
D. None of these

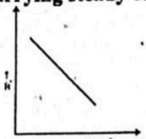
Q.8 **If an electron projected in a magnetic field with a velocity v, it will experience a force given by**

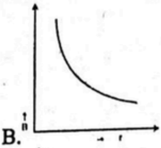
A. $\vec{F} = -e\,\vec{v}\times\vec{B}$
B. $\vec{F} = +e\,\vec{v}\times\vec{B}$
C. $\vec{F} = -e\,\vec{v}.\vec{B}$
D. $\vec{F} = +e\,\vec{v}.\vec{B}$

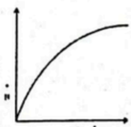
Q.9 A proton charge (+e coulomb B. enters in a magnetic field of strength B(Tesla) making an angle 30° with the direction of magnetic field with speed v. The magnetic force on the proton is

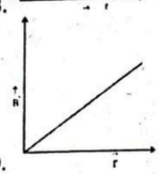
A. evB
B. Zero
C. ∞
D. $\frac{evB}{2}$

Q.10 The magnetic field intensity c at a distance 'r' from a long straigth conductor carrying steady current I varies with 'r' as shown in the figure:

A.


B.


C.


D.


Q.11 Magnetic field is produced by the flow of current in a straight wire. This phenomenon was discovered by

A. Faraday
B. Coulomb
C. Maxwell
D. Oersted

Q.12 Protons are shot perpendicular to a magnetic field

A. The magnetic field will have no influence on the motion of the protons
B. The protons will continue to move in the opposite direction but will gain momentum
C. The protons will continue to move in the same direction but will gain momentum
D. They will bend in an arc of a circle

Q.13 The magnetic induction at a point P which is distant 4 cm from a long current carrying wire is 10^{-3} tesla. The field of induction at a distance 12 cm from the same current would be;

A. 3.33×10^{-4}T
B. 3×10^{-3}T
C. 1.11×10^{-4}T
D. 9×10^{-3}T

Q.14 A proton and an alpha-particle enter a uniform magnetic field with the same velocity. The period of rotation of the alpha-particle will be

A. Four times that of the proton
B. Three times that of the proton
C. Two times that of the proton
D. Same as that of the protons

Q.15 An electron moves at $2x10^2$m/sec perpendicular to magnetic field of 2T. What is the magnitude of magnetic force?

A. 1×10^{-6}N
B. 6.4×10^{-17}N
C. 3.6×10^{-24}N
D. 4×10^{6}N

Q.16 When a charged particle moves through a magnetic field, the effect of the field changes the particles

A. Speed
B. Mass
C. Energy
D. Direction

Q.17 An electron is injected into a uniform magnetic field with components of velocity parallel to and normal to the field direction. The path of the electron is a

A. Helix
B. Parabola
C. Circle
D. Straight line

Q.18 If the current flowing through the conductor is made two times. Magnetic field strength due to it will increase;

A. Two times
B. Remain same
C. Three times
D. Four times

Q.19 Which of the following does not affect the motion of a moving electron?

A. Electric field applied in the direction of motion
B. Electric field applied perpendicular to the direction of motion
C. Magnetic field applied in the direction of motion
D. Magnetic field applied perpendicular to the direction of motion

Q.20 An electron is moving north in a region where the magnetic field is south. The magnetic force exerted on the electron is:

A. Zero
B. Down
C. Up
D. East west

Q.21 A charged particle travelling in a uniform field could have a circular trajectory if the field is

A. Gravitational
B. Electrical
C. Magnetic
D. Gravitational or electrical

Q.22 A uniform magnetic field will cause a charge to move in a circle if the charge is moving

A. Perpendicular to the field lines and the field strength is constant
B. Perpendicular to the field and the field is increasing
C. Parallel to the field and the field is constant
D. Parallel to the field and the field is increasing

Q.23 The magnetic flux through a wire loop in a magnetic field does not depend on

A. The area of the loop
B. The shape of the loop
C. The magnitude of the field
D. The angle between the plane of the loop and the direction

Q.24 A proton (or charged particle) moving with velocity v is acted upon by electric field E and magnetic field B. The proton will move undeflected if

A. E is perpendicular to B
B. E, B and v are mutually perpendicular and v=E/B
C. E is parallel to v and perpendicular to B
D. E and B both are parallel to v

Q.25 The direction of magnetic lines of force produced by passing a direct current in a conductor is

A. Perpendicular to the conductor and coming outward
B. Parallel to conductor
C. Perpendicular to the conductor and going inward
D. Surrounding the conductor and of circular nature

Q.26 A charge q is moving with a velocity parallel to a magnetic field. Force on the charge due to magnetic field is

A. qvB
B. 0
C. qB/v
D. Bv/q

Q.27 A straight wire of diameter 0.5 mm carrying current of 1A is replaced by another wire of 1 mm diameter carrying the same current. The strength of magnetic field far away is:

A. Twice the earlier value
B. One quarter of the earlier value
C. One half of the earlier value
D. No change

Q.28 An electron accelerated through a potential difference V, passes through a uniform transverse magnetic field and experiences a force F. If the accelerating potential increased to 2V, the electron in the same magnetic field will experience a force:

A. F
B. $\sqrt{2}F$
C. F/2
D. 2F

Q.29 The magnetic lines of force inside a bar magnet

A. Are from north pole to south pole of the magnet
B. Depend upon the area of cross-pole of the magnet
C. Does not exist
D. Are from south pole to north pole of the magnet

Q.30 A charged particle moves in a uniform magnetic field. The velocity of the particle at some instant makes an acute angle with the magnetic field. The path of the particle will be

A. A straight line
B. A helix with uniform speed
C. A circle
D. A helix with non-uniform speed

Q.31 If F_1 and F_2 are forces acting on α-particle and electron respectively when moving perpendicular to the magnetic field then:

A. $F_1 = F_2$
B. $F_1 > F_2$
C. $F_1 < F_2$
D. $F_1 = 4F_2$

Q.32 A uniform magnetic field of 3 G, exists in a + x direction. A proton shoots through the field in the + y-direction with a speed of 5×10^6 m/s. The magnitude of the force on the proton is

A. 2.4×10^{-16} N
B. 2.4×10^{-6} N
C. 4×10^{-16} N
D. 4 N

Q.33 20 Wb magnetic flux passes through the $5m^2$ area of certain sheet, the magnetic flux density would be

A. 2 Wb m^{-2}
B. 4 Wb m^{-2}
C. 6Wb m^{-2}
D. 8 Wb m^{-2}

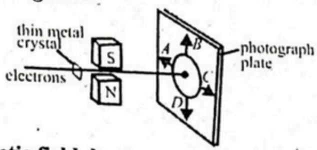
Q.34 The magnetic field in a certain region is $5Wbm^{-2}$. How much flux passes through an area of $18m^2$, if a loop is placed at right angle to the field

A. 3.6Wb
B. 90Wb
C. 9.0 Wb
D. 36Wb

Q.35 When electrons are directed at right angle to a magnetic field directed into the plane of paper they will experience

A. A variable force
B. A constant force
C. Force along the direction of velocity
D. No force

Q.36 **G.P Thomson's early experiments on the diffraction of the electrons by crystals were criticized on the ground that the beams affecting the photographic plate might be X-rays. He proved that this was not so by placing bar magnets on each side of the beam as shown in the diagram.**



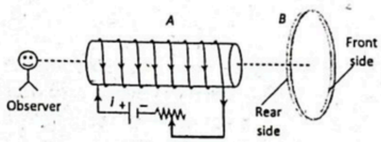
How would the magnetic field due to magnetic affect the diffraction rings?

A. The rings would be deflected in the direction A
B. The rings would be deflected in the direction C
C. The rings would be deflected in the direction B
D. The rings would be deflected in the direction D

Q.37 **In a circuit with a coil of resistance 2 ohms, the magnetic flux changes from 2.0 Wb to 10.0 Wb in 0.2 second. The charge that flows in the coil during this time is**

A. 5.0 coulomb
B. 4.0 coulomb
C. 1.0 coulomb
D. 0.8 coulomb

Q.38 **An aluminium ring *B* faces an electromagnet *A*. The current *I* through *A* can be altered**



A. Whether I increases or decreases, B will not experience any force
B. If I decrease, A will repel B
C. If I increases, A will attract B.
D. If I increases, A will repel B

Q.39 **A coil having an area 2 m^2 is placed in a magnetic field which changes from 1 Wb/m^2 to 4 Wb/m^2 in a interval of 2 second. The e.m.f. induced in the coil will be**

A. 4 V
B. 1.5 V
C. 3 V
D. 2 V

Q.40 **If the core of transformer is of substance whose hysteresis loop area is decreased, then the efficiency of transformer is**

A. Increased
B. Decreased
C. Same as original
D. None of these is possible

Q.41 **A coil of wire is arranged with its plane perpendicular to a uniform magnetic field of flux density B. when the radius of the coil increases from r_1 to r_2 in time Δt, then what is the emf induced in the coil?**

A. $\dfrac{\pi B\left(r_2^2 - r_1^2\right)}{\Delta t}$
B. $\dfrac{\pi B\left(r_2 - r_1\right)^2}{\Delta t}$
C. $\dfrac{B\left(r_2^2 - r_1^2\right)}{\Delta t}$
D. $\dfrac{\pi B\left(r_2^2 + r_1^2\right)}{\Delta t}$

Q.42 The coils of a step-down transformer have 500 and 5000 turns. In the primary coil an AC of 4 A at 2200 volts in sent. The value of the current and potential difference in the secondary will be.

A. 20 A, 22 V
B. 0.4 A, 22000 A
C. 40 A, 220 V
D. 40 A, 22000V

Q.43 An alternating current or voltage ______________

A. Fluctuates off and on
B. Varies in magnitude alone
C. Changes its direction again and again
D. Changes its magnitude continuously and reverses its direction of flow after regularly recurring intervals.

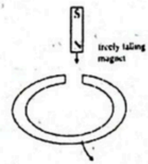
Q.44 Lenz's law

A. Is the same as the right hand palm rule
B. Bears no relation to the law of conservation of energy
C. Determines the magnitude of an induced emf
D. Is useful in deciding the direction of an induced emf

Q.45 A metal ring is held horizontally and a bar magnet is dropped through the ring, with its length along the axis of the ring. The acceleration of the falling magnet is:

A. Equal to g
B. More than g
C. Less than g
D. Depends on the diameter of the ring and length of magnet

Q.46 A magnet is allowed to fall freely above a ring shaped metal which is having a cut in it as shown in the figure. When magnet fall towards ring then

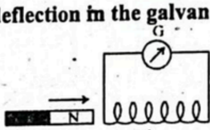


A. No emf will be induce in the ring
B. No current but some emf will be induced in ring
C. No current will be induce in the ring
D. No emf but some current will be induce in the ring

Q.47 A.C voltage source changes its polarity_____ in one period

A. Once
B. Thrice
C. Twice
D. None

Q.48 Refer to the figure maximum deflection in the galvanometer occurs when



A. The magnet is pushed toward the coil
B. The magnet is rotated in the coil
C. The magnet is stationary at the centre of coil
D. The number of turns in the coil is reduced

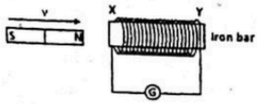
Q.49 The emf induced in AC Generator is ε. If the angular speed of the coil is tripod, then the emf induced is

A. ε
B. 3 ε
C. 2 ε
D. 4 ε

Q.50 A transformer has 200 turns in primary and 400 turns in secondary, if 50-watt power is given to input, what is output power?

A. 25 W
B. 50 W
C. 100 W
D. 200 W

Q.51 **A permanent magnet approaches a solenoid with a constant speed v. What is the magnetic pole induced at the portion Y of the solenoid and the direction of the induced current into the galvanometer?**



A.

Polarity at Y	Direction of the current
N-pole	From the left

B.

Polarity at Y	Direction of the current
N-pole	From the right

C.

Polarity at Y	Direction of the current
S-pole	From the left

D.

Polarity at Y	Direction of the current
S-pole	From the right

Q.52 **In a transformer 220 ac voltage is increased to 2200 volts. If the number of turns in the secondary are 2000, then the number of turns in the primary will be**

A. 200
B. 50
C. 100
D. 20

Q.53 **A step-down transformer is connected to 2400 volts' line and 80 amperes of current is found to flow in output load. The ratio of the turns in primary and secondary coil is 20:1. If transformer efficiency is 100%, then the current flowing in primary coil will be**

A. 1600 A
B. 4 A
C. 20 A
D. 1.5 A

Q.54 **The magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in time Δt. Then the total quantity of electric charge q which passing during this time through any point of the circuit is given by**

A. $q = \frac{\Delta\phi}{\Delta t}$
B. $q = -\frac{\Delta\phi}{\Delta t} + R$
C. $q = \frac{\Delta\phi}{\Delta t} \times R$
D. $q = \frac{\Delta\phi}{R}$

Q.55 **Primary secondary coils of a transformer have 50 and 200 turns respectively. When primary is connected to 9-volt battery secondary voltage is**

A. 90
B. 18
C. 36
D. Zero

Q.56 **An electron is projected along the axis of a circular conductor carrying the same current. Electron will experience**

A. A force along the axis
B. A force perpendicular to the axis
C. A force at an angle of 4° with axis
D. No force experienced

Q.57 **A coil having 500 sq. loops of side 10 cm is placed normal to magnetic flux which increases at a rate of 1 T/s. The induced emf is**

A. 0.1 V
B. 0.5 V
C. 1 V
D. 5 V

Q.58 **North pole induces**

A. Clockwise current
B. Anti-clockwise current
C. Zero current
D. Infinite current

Q.59 Transformer ratings are given in

A. kVA B. HP

C. kVAR D. kW

Q.60 Calculate the emf when a coil of 100 turns is subjected to a flux rate of 0.3 tesla/sec.

A. 3 B. 30

C. –30 D. –300

ANSWER KEY

1	C	11	D	21	C	31	B	41	A	51	C
2	B	12	D	22	A	32	A	42	C	52	A
3	C	13	A	23	B	33	B	43	D	53	B
4	A	14	C	24	B	34	B	44	D	54	D
5	C	15	B	25	D	35	B	45	C	55	D
6	D	16	D	26	B	36	A	46	B	56	D
7	C	17	A	27	D	37	B	47	A	57	D
8	A	18	A	28	B	38	D	48	A	58	B
9	D	19	C	29	D	39	C	49	B	59	A
10	B	20	A	30	B	40	A	50	B	60	B

9 UNIT
ELECTRONICS AND DAWN OF MODERN PHYSICS
SELF ASSESSMENT TEST

Q.1 In Compton scattering, the change in wavelength is maximum if

A. The angle of scattering is 90°
B. The angle of scattering is 60°
C. The angle of scattering is 180°
D. The angle of scattering is 0

Q.2 Calculate the energy of a photon of wavelength 6600 angstroms.

A. 0.3×10^{-19} J
B. 3×10^{-19} J
C. 30×10^{-19} J
D. 300×10^{-19} J

Q.3 If the frequency of the incident radiation is equal to the threshold frequency, what will be the value of the stopping potential?

A. 0
B. Infinite
C. 180 V
D. 1220 V

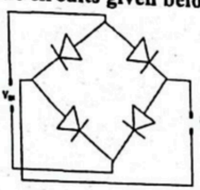
Q.4 Which theory is confirmed by the Davisson – Germer experiment?

A. de – Broglie theory
B. Newton's theory
C. Einstein's theory,
D. Planck's theory

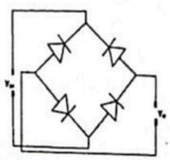
Q.5 The photoelectric effect can be understood on the basis of

A. Wave theory of light only
B. Electromagnetic theory of light only
C. Quantum theory of light only
D. None of these

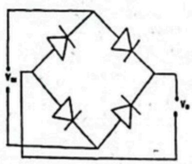
Q.6 In the circuits given below, the correct full wave rectifier is ________



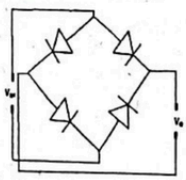
A.



B.



C.



D.

Q.7 The momentum of a photon is p. The frequency associated with it is given by

A. pc/h
B. hc/p
C. ph/c
D. h/pc

Q.8 There are n_1 photons of frequency f_1 in beam of light. In an equally energetic beam, there are n_2 photons of frequency f_2 then the correct relation is

A. $\frac{n_1}{n_2} = 1$
B. $\frac{n_1}{n_2} = \frac{f_2}{f_1}$
C. $\frac{n_1}{n_2} = \frac{f_1}{f_2}$
D. $\frac{n_1}{n_2} = \frac{f_1^2}{f_2^2}$

Q.9 If we use two diodes and a centre tapped transformer, we will get

A. Half wave rectification
B. A.C current
C. Full wave rectification
D. All of these

Q.10 Stopping potential for a metal surface in case of photoelectric emission depends on
A. The threshold frequency for the metal surface
B. The intensity of incident light
C. The frequency of incident light and the work function of the metal surface
D. All of the above

Q.11 If an electron and a photon propagate in the form of waves having the same wavelength, it implies that they have the same
A. Velocity B. Energy
C. Angular momentum D. Momentum

Q.12 The kinetic energy of electron and proton is 10^{-32}J. Then the relation between their de-Broglie wavelengths is
A. $\lambda_p = \lambda_e$ B. $\lambda_p > \lambda_e$
C. $\lambda_p < \lambda_e$ D. $\lambda_p = 2\lambda_e$

Q.13 If the energy of the photon is increased by a factor of 4, then its momentum
A. Does not change B. Increases by a factor of 4
C. Decreases by a factor of 4 D. Decreases by a factor of 2

Q.14 Which light photon has the least momentum?
A. Red B. Blue
C. Yellow D. Green

Q.15 De Broglie wave length associated with an electron at a speed of 1×10^6 ms^{-1}
A. 7×10^{-10}m B. 6×10^{-10}m
C. 5×10^{-10} m D. 4×10^{-10}m

Q.16 Davisson and Germer indicates _______ in their experiment.
A. Electron reflection B. Electron refraction
C. Electron polarization D. Electron diffraction

Q.17 The electrons behave as waves because they can be:
A. Deflected by electric filed B. Deflected by magnetic field
C. Ionize as gas D. Diffracted by crystals

Q.18 If the momentum of particle is doubled, then its de-Broglie wavelength:
A. Doubles B. Remain unchanged
C. Halves D. None of these

Q.19 In Davison and Germer experiment, nickel crystal acts as a:
A. Perfect reflector B. Two-dimensional grating
C. Perfect absorber D. Three-dimensional grating

Q.20 In Davison and Germer experiment, the angle which the incident beam makes with the normal to the nicked crystal is:
A. 69° B. 90°
C. 65° D. 180°

Q.21 In a full wave rectifier input AC current has a frequency f, the output frequency of current is
A. 2f B. f/2
C. f D. 1.5 f

Q.22 Of the following moving with same momentum, the one which has largest wavelength is?
A. An electron B. An α-particle
C. A proton D. All have same de-Broglie wavelength

Q.23 **A particle of mass M at rest decays into two masses m_1 and m_2 with equal speed in opposite direction. The ratio of de-Broglie wave lengths of the particles $\frac{\lambda_1}{\lambda_2}$ is**

A. $\frac{m_2}{m_1}$
B. $\frac{\sqrt{m_1}}{\sqrt{m_2}}$
C. $\frac{m_1}{m_2}$
D. 1 : 1

Q.24 **A transmitter radiates 30 μW at 6.63 mm wavelength. The number of photons emitted per second are:**

A. 6.63×10^{-34}
B. 6.63×10^{34}
C. 10^{18}
D. 10^{11}

Q.25 **Wave is associated with matter**

A. When it is stationary
B. When it is in motion with the velocity of light only
C. When it is in motion with any velocity
D. None of these

Q.26 **The frequency of a photon, having energy 100 *eV* is (h=6.610^{-34}*J-sec*)**

A. $2.42 \times 10^{26} Hz$
B. $2.42 \times 10^{12} Hz$
C. $2.42 \times 10^{16} Hz$
D. $2.42 \times 10^{9} Hz$

Q.27 **Which one is the correct expression of de Broglie equation for the wave length of atoms of mass m at temperature? T (k = Boltzmann's constant)**

A. $\lambda = \frac{h}{3mk}$
B. $\frac{h}{\sqrt{3kTm}}$
C. $\frac{h}{3kTm}$
D. $\lambda = \frac{h}{\sqrt{3kT}}$

Q.28 **The ratio of momenta of an electron and an α-particle which are accelerated from rest by a potential difference of 100 V is**

A. 1
B. $\sqrt{\frac{2m_e}{m_\alpha}}$
C. $\sqrt{\frac{m_e}{m_\alpha}}$
D. $\sqrt{\frac{m_e}{2m_\alpha}}$

Q.29 **The energy radiated is directly proportional to the fourth power of Kelvins temperature is**

A. Karl-Weins law
B. Rayleigh-Jeans law
C. Stephens law
D. Planck's

Q.30 **The PN junction diode is used as**

A. A rectifier
B. An oscillator
C. An amplifier
D. A modulator

Q.31 **If n number of photon are striking on a metal surface, then total momentum exerted is __________**

A. nh/λ
B. 2nhλ
C. Zero
D. n f × t

Q.32 The frequency of light beam A is twice that of light beam B. The ratio E_A/E_B of photon energies is

A. 1
B. 4
C. 1/2
D. 2

Q.33 Which one of the following radiations has the strongest photon?

A. T.V waves
B. Micro waves
C. X-rays
D. γ-rays

Q.34 In the electron positron pair production, the speed of electron is

A. Zero
B. Less than speed of positron
C. Equal to speed of positron
D. Greater than speed of positron

Q.35 In full wave rectification, the output D.C. voltage across the load is obtained for__________

A. The positive half cycle of input A.C.
B. The negative half cycle of input A.C.
C. The complete cycle of input A.C.
D. All of the above.

Q.36 The output of a half wave rectifier is suitable only for

A. Running car radius
B. Charging batteries
C. Running AC motors
D. Running tape recorders

Q.37 The primary function of a rectifier filter is to

A. Minimize a.c input variation
B. Stabilize d.c level of the output voltage
C. Suppose add harmonics in the rectifier output
D. Remove ripples, from the rectified output

Q.38 The value of planck's constant can be determine by equation (E =

A. $h = \dfrac{E}{\lambda}$
B. $h = \dfrac{Ec}{\lambda}$
C. $h = \dfrac{E\lambda}{c}$
D. $h = \dfrac{\lambda c}{E}$

Q.39 An atomic particle of mass m moving at speed v is found to have wavelength λ. What is the wavelength of second particle with three times the speed and twice the mass?

A. $\dfrac{3\lambda}{2}$
B. 6λ
C. $\dfrac{2\lambda}{3}$
D. $\dfrac{\lambda}{6}$

Q.40 A proton, accelerated through a p.d V has a certain de Broglie wavelength. In order to have the same de Broglie wavelength, an α - particle must be accelerated through a potential difference

A. 4V
B. V/4
C. 8V
D. V/8

Q.41 The de-Broglie wavelength of the particle of mass m and energy E is

A. $\lambda = \dfrac{h}{\sqrt{2mE}}$
B. $\lambda = h\sqrt{2mE}$
C. $\lambda = \dfrac{\sqrt{2mE}}{h}$
D. $\lambda = \dfrac{1}{h\sqrt{2mE}}$

Q.42 **A proton and an α-particle are accelerated through same voltage, the ratio of their de-Broglie wavelength will be**
A. 1:2
B. $2\sqrt{2}:1$
C. $\sqrt{2}:1$
D. 2:1

Q.43 **If particles are moving with same velocity, then maximum de-Broglie wavelength will be for**
A. Neutron
B. Proton
C. β-particle
D. α-particle

Q.44 **An electron of mass m when accelerated through a potential difference V has de-Broglie wavelength λ. The de-Broglie wavelength associated with a proton of mass M accelerated through the same potential difference will be**
A. $\lambda\frac{m}{M}$
B. $\lambda\frac{M}{m}$
C. $\lambda\sqrt{\frac{m}{M}}$
D. $\lambda\sqrt{\frac{M}{m}}$

Q.45 **Frequency of photon having energy 66 eV is**
A. 8×10^{-15}Hz
B. 16×10^{15}Hz
C. 12×10^{-15}Hz
D. None of these

Q.46 **The antiparticle of electron is**
A. Neutron
B. Proton
C. Photon
D. Positron

Q.47 **The energy of photon of radio waves is only**
A. 10^{-10} eV
B. 100 eV
C. 10^{-5} eV
D. 1 MeV

Q.48 **If an electron is accelerated through a potential difference of 54 volts, its de-Broglie wavelength will be:**
A. 1.66×10^{-8}m
B. 1.66×10^{-9}m
C. 1.66×10^{-10}m
D. 1.66×10^{-12}m

Q.49 **A particle which has zero rest mass and non-zero energy and momentum must travel with a speed**
A. Equal to c, the speed of light in vacuum
B. Less than c
C. Greater than c
D. Tending to infinity

Q.50 **Wavelength of a 1 keV photon is $1.24\times10^{-9}m$. What is the frequency of 1 MeV photon?**
A. $1.24\times10^{15}Hz$
B. $1.24\times10^{18}Hz$
C. $2.4\times10^{20}Hz$
D. $2.4\times10^{23}Hz$

Q.51 **The frequency of a photon, having energy 100 eV is (h=6.610^{-34}J-sec)**
A. $2.42\times10^{26}Hz$
B. $2.42\times10^{12}Hz$
C. $2.42\times10^{16}Hz$
D. $2.42\times10^{9}Hz$

Q.52 **Energy of photon whose frequency is 10^{12}MHz, will be**
A. 4.14×10^{3}keV
B. 4.14×10^{3}MeV
C. 4.14×10^{2}Ev
D. 4.14×10^{3}eV

Q.53 **The momentum of photon is**
A. $\frac{h}{c}$
B. $\frac{hc}{\lambda}$
C. $\frac{h}{\lambda}$
D. Both 'B' and 'C'

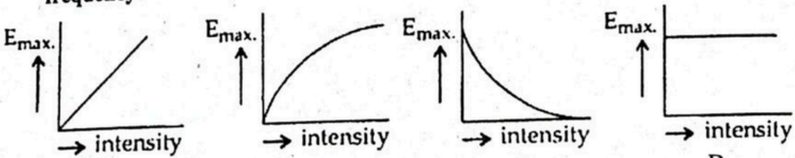
Q.54 **Stopping potential is the negative voltage on the collector plate at which the photoelectric current just becomes ________.**
A. > V   B. < V
C. Zero   D. None of these

Q.55 **Which photon have the maximum momentum?**
A. Green   B. Red
C. Blue   D. Have same momentum

Q.56 **Photons of energy 10.25 eV fall on the surface of the metal emitting photoelectrons of maximum kinetic energy 5.0 eV. What is the stopping voltage required for these electrons?**
A. 10 V   B. 4 V   C. 8 V   D. 5 V

Q.57 **If the intensity of incident radiation in a photo-cell is increased, how does the stopping potential vary?**
A. Increases   B. Remains the same
C. Decreases   D. Infinite

Q.58 **Which one of the following graphs represent correctly the variation of maximum kinetic energy E_{max} with the intensity of incident radiations having a constant frequency?**



A.   B.   C.   D.

Q.59 **Half Wave diode rectifier circuit consists of ________.**
A. Single diode in Series with R_L B. Two diodes in Series with R_L
C. Single diode in Parallel with R_L D. Two diodes in Parallel with R_L

Q.60 **A simple diode rectifier has 'ripples' in the output wave which makes it unsuitable as a DC source. To overcome this one can use.**
A. A capacitor in series with the load resistance
B. A capacitor in parallel to the load resistance
C. Both of the mentioned situations will work
D. None of the mentioned situations will work

ANSWER KEY

1	C	11	D	21	A	31	A	41	A	51	C
2	B	12	C	22	D	32	D	42	B	52	D
3	A	13	B	23	D	33	D	43	C	53	C
4	A	14	A	24	C	34	C	44	C	54	C
5	C	15	A	25	C	35	C	45	B	55	C
6	C	16	D	26	C	36	B	46	D	56	D
7	A	17	D	27	B	37	D	47	A	57	B
8	B	18	C	28	D	38	C	48	C	58	D
9	C	19	D	29	C	39	D	49	A	59	A
10	C	20	C	30	A	40	D	50	C	60	B

UNIT 10

ATOMIC SPECTRA AND NUCLEAR PHYSICS

SELF ASSESSMENT TEST

Q.1 Gamma (γ) radiation are fast moving
A. Electrons
B. Protons
C. Photons
D. Neutrons

Q.2 If a radioactive element has a half-life of 40 minutes. The initial count rate was 1000 per minute, then how long will it take for the count rate to drop to 125 per minutes
A. 120 minutes
B. 90 minutes
C. 30 minutes
D. 60 minutes

Q.3 The half-life of Carbon-14 is
A. 23 years
B. 1000 years
C. 1200 years
D. 5730 years

Q.4 The activity of a sample of radioactive bismuth decreases to one-eighth of the original in 15 days. Its half-life is
A. 10 days
B. 15 days
C. 3 days
D. 5 days

Q.5 The half-life of N is 6.5 s. A sample of this nuclide of hydrogen is observed for 32.5 s. The fraction of the original radioactive isotope remaining after this time is
A. 1/32
B. 1/16
C. 1/8
D. 1/4

Q.6 If an electron jumps from 1st orbital to 3rd orbital, then it will
A. No gain of energy
B. Release energy
C. Absorb energy
D. None of these

Q.7 An example of an absorption spectrum is the spectrum of:
A. Sodium vapour
B. Atomic hydrogen
C. Molten iron
D. Mercury vapour lamp

Q.8 The spectral series that contains transitions terminating on the ground level of hydrogen is called:
A. Paschen series
B. Balmer series
C. Pfund series
D. Lyman series

Q.9 Paschen series is obtained when all the transitions of electron terminate on.
A. 2nd orbit
B. 4th orbit
C. 3rd orbit
D. 5th orbit

Q.10 The relation for paschen series is given as
A. $\frac{1}{\lambda} = R_H\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$
B. $\frac{1}{\lambda} = R_H\left(\frac{1}{4^2} - \frac{1}{n^2}\right)$
C. $\frac{1}{\lambda} = R_H\left(\frac{1}{3^2} - \frac{1}{n^2}\right)$
D. $\frac{1}{\lambda} = R_H\left(\frac{1}{5^2} - \frac{1}{n^2}\right)$

Q.11 Isotopes are the atoms of the same element which contain equal number of
A. Nucleons
B. Neutrons
C. Protons
D. Neutrons and protons

Q.12 What are the number of neutrons, protons and electrons in a neutral atom of $^{235}_{92}U$?

	Number of neutrons	Number of protons	Number of electrons
A.	92	143	143
B.	143	92	92
C.	92	235	235
D.	235	92	92

Q.13 Nucleus of an atom whose atomic mass is 24 consists of

A. 11 electrons, 11 protons and 13 neutrons B. 11 protons and 13 neutrons

C. 11 electrons, 13 protons and 11 neutrons D. 11 protons and 13 electrons

Q.14 As compared ^{12}C atom, ^{14}C atom has

A. Two extra protons and two extra electrons

B. Two extra neutrons and no extra electrons

C. Two extra protons but no extra electrons

D. Two extra neutrons and two extra electron

Q.15 Which one of the following pair is of isobars?

A. $^{12}_{6}C$ and $^{14}_{6}C$. B. $^{14}_{6}C$ and $^{14}_{7}N$

C. $^{4}_{2}He$ and $^{3}_{1}H$ D. Both A and C

Q.16 Diameter of nucleus is approximately__________

A. 10^{-12}m B. 10^{-10}m

C. 10^{-11}m D. 10^{-14}m

Q.17 A radioactive isotope 'W' decays to 'X' which decays to 'Y' and 'Y' decays to 'Z' as represented by the figure below

$$W \xrightarrow{\beta} X \xrightarrow{\alpha} Y \xrightarrow{\alpha} Z$$

What is the change in the atomic number from 'W' to 'Z'?

A. Increase by 3 B. Increase by 5

C. Decrease by 3 D. Decrease by 5

Q.18 Consider a radioactive material of half-life 1 minute. If one of the nuclei decays now, the next one will decay

A. After one-minute B. After any time

C. After two minutes D. After $\frac{1}{2}$ minute

Q.19 During a negative β-decay

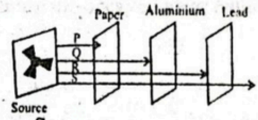
A. An atomic electron is ejected

B. An electron which already present with in the nucleaus is ejected

C. A neutron in the nucleus decays emitting an electron

D. A part of binding energy of nuclei is converted into electron

Q.20 Which of the arrangement about the particle is in accordance with the diagram?



	P	Q	R	S
A.	α	β	γ	n
B.	α	β	n	γ
C.	α	β	n	γ
D.	γ	n	β	α

Q.21 When a radioactive nucleus emits a beta particle, the proton neutron ratio:
A. Decreases
B. Increases.
C. Remains the same
D. None of the above

Q.22 Which statement concerning α-particles, is correct?
A. An α-particle has charge +4e
B. When α particle travel through air, they cause ionization
C. An α-particle is a helium atom
D. When α-particle travel through a sheet of gold foil, they make the gold radioactive

Q.23 The decay of a nucleus of neptunium is accompanied by the emission of a β-particle and γ-radiation. What effect (if any) does this decay have on the proton number and the nucleon number of the nucleus?

	proton number	nucleon number
A.	increases	decreases
B.	unchanged	decreases
C.	decreases	increases
D.	increases	unchanged

Q.24 The transformation of a neutron into proton in the nucleus gives rise to emission of:
A. Beta particles
B. Gamma particles
C. Alpha particles
D. X-rays

Q.25 In the reaction $^{234}_{92}Th \rightarrow ^{234}_{93}Y + ^{0}_{-1}e$, the electron emits from the
A. 1st orbit
B. Nucleus
C. 2nd orbit
D. Valence Shell

Q.26 According to the equation $^{A}_{Z}X \rightarrow Y + 3$ α-particles, what are the atomic and mass numbers of 'Y'?
A. Z – 6, A – 12
B. Z + 1, A
C. Z – 2, A – 4
D. Z + 3, A

Q.27 The value of A in the following reaction is

$$_4Be^9 + _2He^4 = _6C^A + _0n^1$$

A. 14
B. 10
C. 12
D. 16

Q.28 In a radioactive series, $^{238}_{92}U$ changes to $^{206}_{82}Pb$ through n_1 α-decay processes and n_2 β-decay processes.
A. $n_1 = 8, n_2 = 8$
B. $n_1 = 8, n_2 = 6$
C. $n_1 = 6, n_2 = 6$
D. $n_1 = 6, n_2 = 8$

Q.29 The most penetrating radiations out of the following is that of
A. γ-rays
B. α-particles
C. β-rays
D. X-rays

Q.30 Two radioactive elements X and Y have half- lives of 25 minutes and 75 minutes respectively. Sample of X and Y initially contain equal numbers of atoms. After 150 minutes what is the value of the following fraction? $\dfrac{\text{No. of nuclei of X unchanged}}{\text{No. of nuclei of Y unchanged}}$
A. 1 : 16
B. 16 : 1
C. 1 : 8
D. 8 : 1

Q.31 **In a radioactive substance at $t=0$, the number of atoms is 8×10^4. Its half-life period is 3 years. The number of atoms 1×10^4 will remain after interval**

A. 9 years
B. 8 years
C. 6 years
D. 24 years

Q.32 **If the decay or disintegration constant of a radioactive substance is λ, then its half-life and mean life are respectively**

A. $\frac{1}{\lambda}$ and $\frac{\log_e 2}{\lambda}$
B. $\frac{\log_e 2}{\lambda}$ and $\frac{1}{\lambda}$
C. $\lambda \log_e 2$ and $\frac{1}{\lambda}$
D. $\frac{\lambda}{\log_e 2}$ and $\frac{1}{\lambda}$

Q.33 **In a sample of radioactive material, what fraction of the material will decay after half of its half-life?**

A. $\frac{1}{\sqrt{2}}$
B. $\sqrt{2}-1$
C. $\frac{\sqrt{2}-1}{\sqrt{2}}$
D. $\sqrt{2}$

Q.34 **The decay constant λ of a radioactive sample**

A. Decrease as the age of atoms increase
B. Increase as the age of atoms increase
C. Is independent of the age
D. Depends on the nature of activity

Q.35 **A radioactive decay rate of radioactive elements is found to be 10^3 disintegrations per sec at a certain time. If the half-life of the element is 1 second, the decay rate after one second is __________ and after 3 second is__________**

A. 500, 125
B. 125, 500
C. 10^3, 10^3
D. 100, 10

Q.36 **If the radioactive decay constant of radium is 1.07×10^{-4} per year, then its half-life period is approximately equal to**

A. 8,900 years
B. 6,476 years
C. 7,000 years
D. 2,520 years

Q.37 **Half-life of radioactive element depends upon**

A. Amount of element present
B. Temperature
C. Pressure
D. None

Q.38 **A radioactive substance has a half-life of 60 minutes. After 3 hours, the fraction of atom that have decayed would be**

A. 12.5%
B. 8.5%
C. 87.5%
D. 25.1%

Q.39 **Half-life of radium is 1600 years. Which of the following is the fraction of a sample of radium that would remain un-decayed after 6400 years?**

A. $\frac{1}{2}$
B. $\frac{1}{4}$
C. $\frac{1}{8}$
D. $\frac{1}{16}$

Q.40 **A given radioactive sample is reduced from 20 g to 1.25 g in 40 days. Its half-life would be**

A. 10 days
B. 8 days
C. 5 days
D. 6 days

Q.41 **A radioactive substance has a half-life of four months, three-fourths of the substance will decay in:**

A. 3 months B. 4 months
C. 8 months D. 12 months

Q.42 **Calculate the half-life of bismuth-214 which has a decay constant of $4.3 \times 10^{3}\ s^{-1}$?**

A. 3.9×10^{3} s B. 2.9×10^{-3} s
C. 2.9×10^{3} s D. 1.6×10^{-4} s

Q.43 **The radioactivity of a certain radioactive element drops to $\frac{1}{64}$ of its initial value in 30 second. Its half-life is:**

A. 2 second B. 5 second
C. 4 second D. 6 second

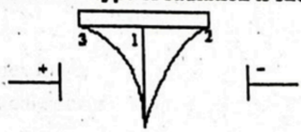
Q.44 **Cobalt-57 is radioactive, emitting β particles. The half-life for this is 270 days. If 100 mg of this is kept in an open container, the mass of Cobalt-57 after 540 days will be:**

A. 50 mg B. $\frac{50}{\sqrt{2}}$ mg
C. 25 mg D. Zero

Q.45 **When thorium ($_{90}Th^{234}$) emits a β-particle its proton to neutron ratio would become**

A. 90/144 B. 91/144
C. 91/143 D. 90/143

Q.46 **Three paths of radioactive radiations are observed as shown in the figure in the presence of electric field. Which type of radiation is shown in path 1?**



A. Alpha B. Gamma
C. Beta D. Cathode rays

Q.47 **In radiotherapy X-rays are used to:**

A. Detect bone fractures B. Detect heart diseases
C. Treat cancer by controlled exposure D. Detect fault in radio receiving circuits

Q.48 **Radioactive iodine can be used to check person's ______ is working properly**

A. Cancer B. Lungs
C. Skin cancer D. Thyroid gland

Q.49 **Phosphorus is used as tracer in**

A. Industries B. Electrical machinery
C. Agriculture D. All of these

Q.50 **Cobalt-60 is used for treatment of**

A. Cancer B. Kidneys
C. Lungs D. Thyroid

Q.51 **The γ – rays radiographs are used in:**

A. Agriculture industry B. Medical industry
C. Support Industry D. All of above

Q.52 **In heavy elements (Z = No. of protons, N = No. of neutrons)**

A. Z = N B. Z < N
C. Z > N D. Z + N = A

Q.53 A nucleus emits a radiation neither its mass no. nor charge no. change the radiation is

A. α B. γ
C. β D. Neutron

Q.54 An atom emits some radiation such that daughter nucleus is isotope of parent nucleus, the emitted radiation is

A. α B. γ
C. β D. 1α and 2β

Q.55 In radioactivity β particles originate from

A. K-shell electron B. The decay of neutron
C. Preexisting electron in nucleus D. The decay of proton

Q.56 CFC is used in

A. Refrigeration B. Aerosol spray
C. Plastic foam industry D. All of above

Q.57 The age of fossil when C-14: C-12 in bone is one fourth of ratio in bone of living animal and half-life of C-14 is 5732 years is

A. 100 years B. 11460 years
C. 1000 years D. 1200 years

Q.58 Technimum-99 has a half-life of 6 hours. If there is 300 mg of it, how much will be left in 48 hours?

A. 1.58 mg B. 1.25 mg
C. 1.17 mg D. 2.56 mg

Q.59 What is the ratio of minimum to maximum wavelength in the Balmer series?

A. 5:9 B. 5:36
C. 1:4 D. 3:4

Q.60 When a hydrogen atom is in its first excited level, what is the relation of radius and Bohr radius?

A. Twice B. 4 times
C. Same D. Half

ANSWER KEY

1	C	11	C	21	B	31	A	41	C	51	B
2	A	12	B	22	B	32	B	42	D	52	B
3	D	13	B	23	D	33	C	43	B	53	B
4	D	14	B	24	A	34	C	44	C	54	D
5	A	15	B	25	B	35	A	45	C	55	B
6	C	16	D	26	A	36	B	46	B	56	A
7	B	17	C	27	C	37	D	47	C	57	B
8	D	18	B	28	B	38	C	48	D	58	C
9	C	19	C	29	A	39	D	49	C	59	A
10	C	20	A	30	A	40	A	50	A	60	B

POST-PREP ASSESSMENT

Note: Physics paper of MDCAT contains 54 questions.

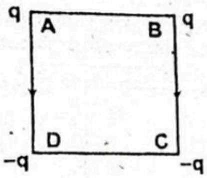
Q.1 A battery is used to charge a parallel plate capacitor till the potential difference between the plates becomes equal to the electromotive force of the battery. The ratio of the energy stored in the capacitor and the work done by the battery will be

A. 1
B. 2
C. $\frac{1}{4}$
D. $\frac{1}{2}$

Q.2 In gamma ray emission from a nucleus

A. Both the neutron number and the proton number change
B. There is no change in the proton number and the neutron number
C. Only the neutron number changes
D. Only the proton number changes

Q.3 Charges are placed on the vertices of a square as shown. Let E be the electric field and V the potential at the centre. If the charges on A and B are interchanged with those on D and C respectively, then



A. $\overline{E}$ remain unchanged, V changes
B. Both $\overline{E}$ and V change
C. $\overline{E}$ and V remains unchanged
D. $\overline{E}$ changes, V remains unchanged

Q.4 A block of mass 'm' is connected to another block of mass 'M' by a spring (massless) of spring constant 'k'. The blocks are kept on a smooth horizontal plane. Initially the block are at rest and the spring is unstretched. Then a constant force 'F' starts acting on the block of mass 'M' to pull it. Find the force on the block of mass 'm'

A. $\frac{mF}{M}$
B. $\frac{(M+m)F}{M}$
C. $\frac{mF}{(m+M)}$
D. $\frac{MF}{(m+M)}$

Q.5 A charged particle moves through a magnetic field perpendicular to its direction. Then

A. The momentum changes but the kinetic energy is constant
B. Both momentum and kinetic energy of the particle are not constant
C. Both, momentum and kinetic energy of the particle are constant
D. Kinetic energy changes but the momentum is constant

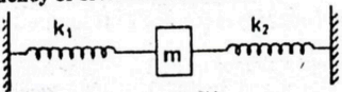
Q.6 The resistance of a wire is 5 ohm at 50°C and 6 ohm at 100°C. The resistance of the wire at 0°C will be

A. 2 ohm
B. 1 ohm
C. 4 ohm
D. 3 ohm

Q.7 A particle is projected at 60° to the horizontal with a kinetic energy K. The kinetic energy at the highest point is

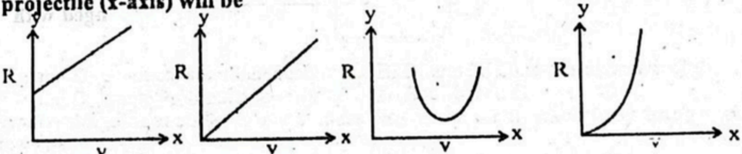
A. K
B. Zero
C. K/2
D. K/4

Q.8 Two springs, of force constants k_1 and k_2 are connected to a mass m as shown. The frequency of oscillation of the mass is f. If both k_1 and k_2 are made four times their original values, the frequency of oscillation becomes



A. f/2
B. f/4
C. 4f
D. 2f

Q.9 The graph of range of projectile (on y-axis) as plotted against velocity, of projectile (x-axis) will be



A. B. C. D.

Q.10 A body is moving in a circle with period of 20π. What is angular frequency of body

A. 0.1 Hz
B. 100 Hz
C. 2 Hz
D. 10π Hz

Q.11 A body is revolving with a constant speed along a circle. If its direction of motion is reversed but the speed remains the same, then which of the following statement is true

A. The centripetal force will not suffer any change in magnitude
B. The centripetal force will have its direction reversed
C. The centripetal force will not suffer any change in direction
D. The centripetal force would be doubled

Q.12 The angular velocity of the minute hand of a clock is

A. $\frac{2\pi}{60} rads^{-1}$
B. $\frac{\pi}{24} rads^{-1}$
C. $\frac{2\pi}{3600} rads^{-1}$
D. $\frac{\pi}{3600} rads^{-1}$

Q.13 A simple harmonic oscillator has a time period of 10 seconds. Which equation relates its acceleration a and displacement x?

A. $a = -10x$
B. $a = -(20\pi)^2 x$
C. $a = -(20\pi)x$
D. $a = -(2\pi/10)^2 x$

Q.14 In stationary wave of wavelength 0.4 m the distance between node and antinodes is

A. 0.1 m
B. 0.4 m
C. 0.2 m
D. 0.5 m

Q.15 **The minimum length of tube open at both ends that resonates with frequency of 350 Hz if $v = 350\ m\ s^{-1}$.**

A. 1 m
B. $\frac{1}{2}$m
C. 2 m
D. $\frac{1}{14}$m

Q.16 **The ratio of angular frequency and linear frequency is**

A. 2π
B. π
C. $\frac{1}{2\pi}$
D. $\frac{\pi}{2}$

Q.17 **How many electrons per second constitute a current of one micro ampere?**

A. One electron
B. 10^6 electrons
C. 10^{-6} electrons
D. 6.25×10^{12} electrons

Q.18 **A sound source is moving towards a stationary observer with $\frac{1}{10}$ of the speed of sound. The ratio of apparent to real frequency is ______**

A. $\frac{10}{9}$
B. $\frac{11}{10}$
C. $\left(\frac{11}{10}\right)^2$
D. $\left(\frac{9}{10}\right)^2$

Q.19 **When we double the voltage in a simple electric circuit, we double the**

A. Current
B. Resistance
C. Power
D. Both 'A' and 'C'

Q.20 **Which relation exactly described the isothermal process?**

A. $Q = W$
B. $W = -\Delta U$
C. $Q = -\Delta U$
D. $Q = \Delta U + W$

Q.21 **The work done in moving a unit positive charge from one point to another against the electric field is a measure of**

A. Capacitance
B. Potential difference between two points
C. Intensity of electric field
D. Resistance between two points

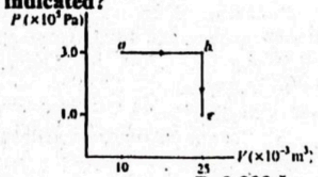
Q.22 **Energy density in case of a capacitor is always proportional to**

A. E^2
B. ε_o
C. V^2
D. C

Q.23 **The capacitance of a parallel plate capacitor is given by**

A. $C=\frac{A}{\varepsilon_o d}$
B. $C=\frac{\varepsilon_o d}{A}$
C. $C=\frac{A\varepsilon_o}{d}$
D. $C=\frac{d}{\varepsilon_o A}$

Q.24 **What's the total work performed on the gas as it's transformed from state *a* to state *c*, along the path indicated?**



A. 1,500 J
B. 3,000 J
C. 4,500 J
D. 5,000 J

Q.25 The charge of an electron is 1.6×10^{-19} C. How many electrons strike the screen of a cathode ray tube each second when the beam current is 16 mA

A. 10^{19}
B. 10^{17}
C. 10^{-19}
D. 10^{-17}

Q.26 The following four wires are made of the same material and are at the same temperature. Which one of them has highest electrical resistance

A. length = 100 cm, diameter = 1 mm
B. length = 50 cm, diameter = 0.5 mm
C. length = 200 cm, diameter = 2 mm
D. length = 300 cm, diameter = 3 mm

Q.27 In a circuit with a coil of resistance 2 ohms, the magnetic flux changes from 2.0 Wb to 10.0 Wb in 0.2 second. The charge that flows in the coil during this time is

A. 5.0 coulomb
B. 1.0 coulomb
C. 4.0 coulomb
D. 0.8 coulomb

Q.28 The radiations emitted from hydrogen filled discharge tube show_______

A. band spectrum
B. line spectrum
C. continuous spectrum
D. none

Q.29 A radio station emits 10 kW power of 90.8 MHz. Find the number of photon emitted per second

A. 1.6×10^{28}
B. 1.6×10[illegible]
C. 1.6×10^{29}
D. 1.6×10[illegible]

Q.30 The number of turns in the primary and secondary coils of a transformer are 100 and 300 respectively. If the input power is 60 W. The output power will be

A. 100 W
B. 3×10^{3} W
C. 60 W
D. 90 W

Q.31 In Davisson-Germer experiment, the diffracted electron beam from crystal shows

A. Particle property
B. Wave property
C. Light property
D. Quantum property

Q.32 The Lenz's law refers to induce

A. emf
B. Resistance
C. Current
D. Capacitance

Q.33 When a current carrying conductor is placed in a magnetic field. It moves from a region of

A. Stronger to weak field
B. Weak to strong field
C. Strong to weak if current is large
D. Weak to strong if current is large

Q.34 In electromagnetic induction, the induced e.m.f. in a coil is independent of

A. Resistance of the circuit
B. Time
C. Change in the flux
D. None

Q.35 In full wave rectifier with input frequency 50Hz the ripple in the output is mainly of frequency:

A. 25 Hz
B. 50 Hz
C. 100 Hz
D. zero

Q.36 What percentage of original radioactive atoms is left after five half lives

A. 0.3%
B. 1%
C. 31%
D. 3.125%

Q.37 A 2 MeV proton is moving perpendicular to a uniform magnetic field of 2.5 T. The force on the proton is:

A. 2.5×10^{-10} N
B. 2.5×10^{-11} N
C. 8×10^{-11} N
D. 8×10^{-12} N

Q.38 Unit of decay constant is

A. s
B. m^{-1}
C. m
D. s^{-1}

Q.39 A certain radioactive mass decays from 64 gm to 2 gm in 20 days. What is its half-life?

A. 5 days
B. 4 days
C. 3 days
D. 5 days

Q.40 An electron makes transition from n = 4 to n = 1 state in a hydrogen atom. The maximum possible number of photons emitted will be

A. 1
B. 3
C. 2
D. 6

Q.41 A 60 kg man pushes a 40 kg man by a force of 60 N. The 40 kg man has pushed the other man with a force of:

A. 40 N
B. 0
C. 60 N
D. 20 N

Q.42 The speed of a vehicle of mass 500kg increases from $30ms^{-1}$ to $70ms^{-1}$. Calculate the work?

A. 10^2
B. 10^3
C. 10^6
D. 10^9

Q.43 Work done by the gravitational force on a body of mass "m" moving on a smooth horizontal surface through a distance "s" is: (Given acceleration due to gravity = g):

A. mgs
B. –mgs
C. 0
D. 2mgs

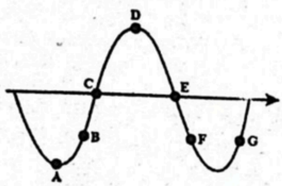
Q.44 A plane is revolving around the earth with a speed if 100 km/hr at a constant height from the surface of earth. The change in the velocity as it travels half circle is

A. 200 km/hr
B. 150 km/hr
C. 100 km/hr
D. 0

Q.45 Doppler effect is independent of ________.

A. Velocity of source
B. Velocity of listener
C. distance between source and observer
D. None of the above

Q.46 The following figure depicts a wave travelling in a medium. Which pairs of particles are in phase?



A. B & F
B. C & E
C. A & D
D. B & G

Q.47 First law of thermodynamics states that:

A. System can do work
B. System has temperature
C. System has pressure
D. Heat is a form of energy

Q.48 A hollow metal sphere of radius 5 cm is charged so that the potential on its surface is 10 V. The potential at the center of the sphere is

A. 10 V
B. Same as at point 5 cm away from the surface
C. 0 V
D. Same as at point 25 cm away from the surface

Q.49 A conducting resistance is connected to the battery and temperature of conductor decreases by the process of cooling then the value of current will be

A. Increased
B. Decreased
C. Remain constant
D. Zero

Q.50 When a bar magnet is broken into two pieces

A. We will have a single pole on each piece
B. Each piece will have two unlike poles
C. Each piece will have two like poles
D. None of these

Q.51 Whenever there is a change in the magnetic flux linked with a closed circuit, an emf and a current are induced in the circuit. This statement is referred to as;

A. Lenz's law
B. Faraday's second law of electromagnetic induction
C. Fraday's first law of electromagnetic induction
D. Laplace's law

Q.52 A transformer:

A. Transforms energy
B. Transforms frequency
C. Transforms voltage
D. None

Q.53 The wavelengths of a proton and a photon are same. Then:

A. Their velocities are same
B. Their momenta are equal
C. Their energies are same
D. Their speeds are same.

Q.54 Bohr's model can explain:

A. The spectrum of hydrogen atom only
B. Spectrum of an atom or ion containing one electron only
C. The spectrum of hydrogen molecule
D. The solar spectrum

ANSWER KEY

1	D	11	A	21	B	31	B	41	C	51	C
2	B	12	C	22	A	32	C	42	C	52	C
3	D	13	D	23	C	33	A	43	C	53	B
4	C	14	A	24	C	34	A	44	A	54	B
5	A	15	B	25	B	35	C	45	C		
6	C	16	A	26	B	36	D	46	D		
7	C	17	D	27	C	37	D	47	A		
8	D	18	A	28	B	38	D	48	A		
9	D	19	A	29	C	39	B	49	A		
10	A	20	A	30	C	40	D	50	B		

EXPLANATORY NOTES

Q.1 $\dfrac{\frac{1}{2}qv}{qv}=\dfrac{1}{2}$

Q.2 In gamma ray emission from a nucleus there is no change in the proton number and the neutron number

Q.3 As $\vec{E}$ is a vector quantity.

Q.4 $Kx = ma = \dfrac{mF}{m+M}$

Q.5 A charged particle moves through a magnetic field perpendicular to its direction. Then the momentum changes but the kinetic energy is constant

Q.6

$$\frac{5}{6}=\left(\frac{1+50\alpha}{1+100\alpha}\right)$$

$$\alpha=\frac{1}{200}$$

$$5=R_o(1+50\alpha)$$

$$R_o=4$$

Q.7

$$K' = K\cos^2\theta$$

$$=K\cos^2 60°$$

$$=K\left(\frac{1}{2}\right)$$

Q.8

$$f=\frac{1}{2\pi}\sqrt{\frac{k_1+K_2}{m}}$$

$$f'=\frac{1}{2\pi}2\sqrt{\frac{k_1+K_2}{m}}=2f$$

Q.9 $R=\dfrac{v_i^2\sin 2\theta}{g}\rightarrow R\propto v_i^2$ (Parabola along y-axis)

Q.10 $\omega=\dfrac{2\pi}{T}=\dfrac{2\pi}{20\pi}=0.1$

Q.11 $\vec{F}_c = m\omega^2(-\vec{r})$ the magnitude of the centripetal force remains constant but its direction is continuously changing.

Q.12 $\theta = \omega t$

$$\omega = \frac{\theta}{t} = \frac{2\pi}{3600} = \text{rads}^{-1}$$

Q.13 $a = -x\omega^2$

$$a = -x\left(\frac{2\pi}{T}\right)^2 = -x\left(\frac{2\pi}{10}\right)^2$$

Q.14 Distance between node and antinode is $= \frac{\lambda}{4} = \frac{0.4}{4} = 0.1$

Q.15 $v = f\lambda \rightarrow \lambda = \frac{v}{f} = \frac{350}{350} = 1$

For open pipe $\lambda_1 = 2\ell \rightarrow \ell = \frac{1}{2}\text{m}$

Q.16 $\frac{\omega}{f} = \frac{2\pi f}{f} = 2\pi$

Q.17 $\frac{n}{t} = \frac{I}{e} \Rightarrow$ Number of free electrons per second $= \frac{10^{-6}}{1.6\times10^{-19}} = 6.25\times10^{12}$ electrons / sec

Q.18 $f' = \left(\frac{v}{v-u_s}\right)f \Rightarrow f' = \left(\frac{v}{v-\frac{v}{10}}\right)f$

$$\frac{f'}{f} = \frac{v}{\frac{9}{10}v} = \frac{10}{9}$$

Q.19 According to Ohm's law $I \propto V$

If voltage is doubled then current will also be doubled, so power will be four times as $P \propto V^2$ also $P \propto I^2$

Q.20 In isothermal process $\Delta U = 0$

$Q = \Delta U + W$

$Q = W$

Q.21 $V = \frac{W}{q}$

Q.22 $U = \frac{1}{2}\varepsilon_0\varepsilon,\ E^2 \Rightarrow U \propto E^2$

Q.23 $C = \frac{A\varepsilon_o}{d}$

Q.24

$W = P\Delta V = P(V_2 - V_1)$

$W = (3\times10^5)(25-10)\times10^{-3} = 4500\,J$

Q.25 $I = \frac{ne}{t} \Rightarrow 16\times10^{-3} = \frac{n\times1.6\times10^{-19}}{1} \Rightarrow n = 10^{17}$

Q.26 $R \propto \frac{l}{r^2}$. For highest resistance $\frac{l}{r^2}$ should be maximum, which is correct for option

Q.27 $\varepsilon = \frac{\Delta\phi}{\Delta t} \Rightarrow IR = \frac{\Delta\phi}{\Delta t} \Rightarrow \frac{Q}{\Delta t} = \frac{\Delta\phi}{R\Delta t}$

$\Rightarrow Q = \frac{\Delta\phi}{R} = \frac{10-2}{2} = 4C$

Q.28 Gas or vapor state of elements shows line spectrum

Q.29 $E = nhf \Rightarrow \frac{E}{t} = \frac{n}{t}hf \Rightarrow \frac{n}{t} = \frac{P}{hf} = 1.6\times10^{29}$

Q.30 $P_{in} = P_{out}$ [Ideal transformer] $V_pI_p = V_sI_s$

Q.31 Diffracted electron beam from crystal shows wave nature.

Q.32 Lenz's law refers to induce current.

Q.33 Current carrying conductor will move from stronger to weaker magnetic field.

Q.34 $\varepsilon = N\frac{\Delta\phi}{\Delta t}$

Q.35 In full wave frequency of the output is 2f

Q.36 Percentage fractional undecay $= \frac{1}{2^n}\times100 = \frac{1}{2^5}\times100 = \frac{1}{32}\times100 = 3.125\%$

Q.37 $K.E = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{2K.E}{m}}$; $F = qvB$

Q.38 $\lambda = \frac{\Delta N/No}{\Delta t}$ $\therefore$ unit $= s^{-1}$

Q.39 Remaining atoms $= \frac{\text{Orignal atoms}}{2^n}$

$2^n = \frac{64}{2} = 32$

$n = 5$

5 half-lives in 20 days

So, half-life $= \frac{20}{5} = 4$ days

Q.40 Number of spectral lines $= \frac{n(n-1)}{2} = \frac{4(4-1)}{2} = 6$

Q.41 To every action, there is an equal and opposite reaction. So when 60 kg man exerts a force of 60 N on 40 kg man, 40 kg man also exerts the same force of 60 N on the 60 kg man.

Q.42 $K.E_i = 1/2 \times 500 \times 30^2 = 250 \times 900 = 225000$ J

$K.E_f = 1/2 \times 500 \times 70^2 = 250 \times 4900 = 1225000$ J

Work = Change in Kinetic energy, $= K.E_f - K.E_i = 1225000 - 225000 = 1000000 = 10^6$ J

Q.43 As the gravitational force is perpendicular to the distance moved by body, the work done by gravity will be zero.

Q.44 As we know,

$\Delta v = 2v\sin(\theta/2) = 2 \times v \times \sin 90°$

$= 2 \times 100 = 200$ km/hr

Q.45 Doppler effect is independent of distance between source and observer

Q.46 Path difference between B and G is λ so they are in the same phase.

Q.47 $\Delta Q = \Delta U + \Delta W$

Q.48 Since potential inside the hollow sphere is same as that on the surface.

Q.49 The resistance of the conducting wire will decrease according to equation $R_t = R_o(1 \pm \alpha\Delta t)$ due to which current will increase according to ohm's law

Q.50 When we break a magnet into two, both act as magnets, that is both have a north and south pole each. In both these pieces the corresponding north and south poles remain on the sides as in the original magnet. This means that the two broken sides must get oppositely polarized.

Q.51 Faraday's first law of electromagnetic induction state that whenever a conductor are placed in a varying magnetic field emf are induced which is called induced emf, if the conductor circuit are closed current are also induced which is called induced current.

Q.52 Transformers are capable of either increasing or decreasing the voltage and current levels of their supply, without modifying its frequency, or the amount of Electrical Power being transferred from one winding to another via the magnetic circuit.

Q.53 For Proton, $\lambda = \frac{h}{mv} \rightarrow \lambda_1 = \frac{h}{p}$

for photon, $E = \frac{hc}{\lambda}, \lambda_2 = \frac{h}{E/c}$

$\lambda_1 = \lambda_2 \Rightarrow P = \frac{E}{c}$

Q.54 Bohr's model is valid to atom or ion having only one electron such as H, He^+, Li^{++}, Be^{+++}, etc