PHYSICS TEST PAPER WITH ANSWER & SOLUTIONS
FINAL NEET(UG)–2023 (EXAMINATION)
Held On Sunday 7th MAY, 2023
CODE – F6

Physics : Section-A (Q. No. 001 to 035)

1. In a series LCR circuit, the inductance L is 10 mH, capacitance C is 1μF and resistance R is 100 Ω. The frequency at which resonance occurs is :-

(1) 15.9 kHz (2) 1.59 rad/s
(3) 1. 59 kHz (4) 15.9 rad/s

Ans. (3)

Sol. $L = 10 \times 10^{-3} H$

$C = 1 \times 10^{-6} F$

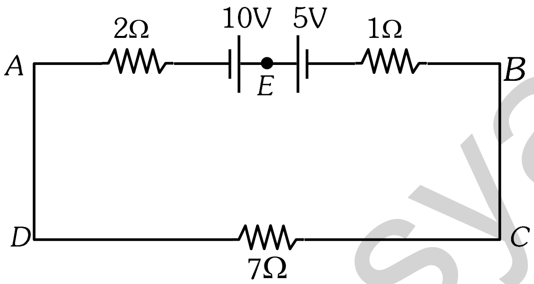
$R = 100\ \Omega$

At resonance $X_L = X_C$

$$\omega L = \frac{1}{\omega C}$$

$$f = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{10\times10^{-3}\times10^{-6}}} = 1.59 \text{ KHz}$$

2. The magnitude and direction of the current in the following circuit is :-



(1) 0.5 A from A to B through E

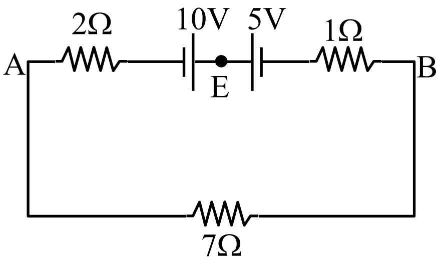
(2) $\frac{5}{9}$ A from A to B through E

(3) 1.5 A from B to A through E

(4) 0.2 A from B to A through E

Ans. (1)

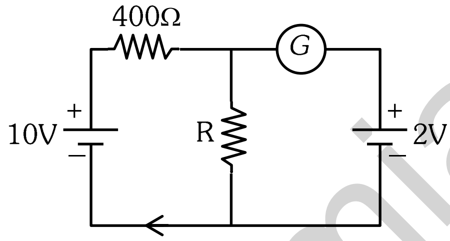
Sol. $i = \frac{10-5}{10} = \frac{5}{10} A$



= 0.5 A

from A to B through E.

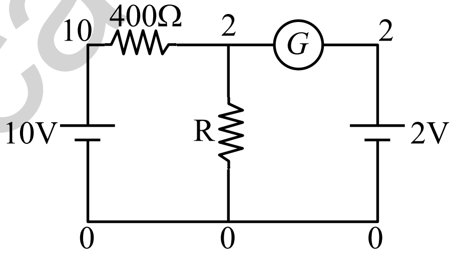
3. If the galvanometer G does not show any deflection in the circuit shown, the value of R is given by :



(1) 50 Ω (2) 100Ω
(3) 400 Ω (4) 200 Ω

Ans. (2)

Sol. For no reading galvanometer. Potential across it is same.



$$i_{400\Omega} \Rightarrow \frac{10-2}{400} = \frac{8}{400} = \frac{1}{50} = i_R$$

$$i_R \Rightarrow \frac{V_R}{R} \Rightarrow \frac{2}{R} = \frac{1}{50} \Rightarrow R = 100\Omega$$

4. The temperature of a gas is –50°C. To what temperature the gas should be heated so that the rms speed is increased by 3 times ?

(1) 3295°C (2) 3097 K
(3) 223 K (4) 669°C

Ans. (1)

Sol. $v_{rms} \propto \sqrt{T}$

$$\frac{v_1}{v_2} = \sqrt{\frac{T_1}{T_2}}$$

= let initial speed is v

As speed is increased by 3 times so final speed become 4v

$$\Rightarrow \frac{v}{4v} = \sqrt{\frac{223}{T}}$$

T = 3568 K

So temp. in °C = 3568 – 273 = 3295°C

5. The ratio of radius of gyration of a solid sphere of mass M and radius R about its own axis to the radius of gyration of the thin hollow sphere of same mass and radius about its axis is :-

(1) 5 : 3 (2) 2 : 5 (3) 5 : 2 (4) 3 : 5

Ans. (4/BONUS)

Sol. Radius of gyration : $K = \sqrt{\frac{I}{m}}$

$$\frac{k_{\text{solid sphere}}}{k_{\text{hollow sphere}}} = \sqrt{\frac{2mR^2/5m}{2mR^2/3m}} = \sqrt{3} : \sqrt{5}$$

6. A Carnot engine has an efficiency of 50% when its source is at a temperature 327° C. The temperature of the sink is :-

(1) 15°C (2) 100°C

(3) 200°C (4) 27°C

Ans. (4)

Sol. Efficiency of carnot engine

$$\%\eta = \left(1 - \frac{T_{sink}}{T_{source}}\right) \times 100$$

T_{source} = 327°C = 600 K

$$50 = \left(1 - \frac{T_{sink}}{600}\right) \times 100$$

$$\frac{1}{2} = 1 - \frac{T_{sink}}{600}$$

$$T_{Sink} = 300K$$

So temp. of sink is °C = 300 – 2763 = 27°C

7. A bullet is fired from a gun at the speed of 280 ms^{-1} in the direction 30° above the horizontal. The maximum height attained by the bullet is $\left(g = 9.8ms^{-2}, \sin 30° = 0.5\right)$:-

(1) 2000 m (2) 1000 m

(3) 3000 m (4) 2800 m

Ans. (2)

Sol. $H_{max} = \frac{u^2 \sin^2 \theta}{2g}$

$$= \frac{(280)^2 (\sin 30°)^2}{2(9.8)}$$

= 1000 m

8. An electric dipole is placed at an angle of 30° with an electric field of intensity 2 × 10^5 NC^{-1}. It experiences a torque equal to 4 N m. Calculate the magnitude of charge on the dipole, if the dipole length is 2 cm.

(1) 6 mC (2) 4 mC (3) 2 mC (4) 8 mC

Ans. (3)

Sol. τ on a dipole = $\vec{p} \times \vec{E}$

$\tau = pE\sin\theta$

$4 = q \times \ell \times E \times \sin 30°$

$$4 = q \times 2 \times 10^{-2} \times 2 \times 10^{5} \times \frac{1}{2}$$

$q = 2 \times 10^{-3}$

q = 2 mC

9. Given below are two statements:

Statement I : Photovoltaic devices can convert optical radiation into electricity.

Statement II : Zener diode is designed to operate under reverse bias in breakdown region.

In the light of the above statements, choose the ***most appropriate*** answer from the options given below :

(1) Both **Statement I** and **Statement II** are incorrect.

(2) **Statement I** is correct but **Statement II** is incorrect.

(3) **Statement I** is incorrect but **Statement II** is correct.

(4) Both **Statement I** and **Statement II** are correct

Ans. (4)

Sol. Statement I : Photocell/solar cell convert light energy into electric energy/current.

Statement II : We use zener diode in reverse biased condition, when reverse biased voltage more than break down voltage than it act as stablizer.

10. The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are :

(1) Personal errors

(2) Least count errors

(3) Random errors

(4) Instrumental errors

Ans. (3)

Sol. Error arise due to unpredictable fluctuation in temperature and voltage supply are → random errors.

11. The ratio of frequencies of fundamental harmonic produced by an open pipe to that of closed pipe having the same length is :

(1) 2 : 1 (2) 1 : 3 (3) 3 : 1 (4) 1 : 2

Ans. (1)

Sol. $$\frac{n_{oop}}{n_{cop}} = \frac{\frac{V}{2L}}{\frac{V}{4L}}$$

$$\Rightarrow \frac{n_{oop}}{n_{cop}} = \frac{2}{1}$$

12. The net magnetic flux through any closed surface is :

(1) Positive

(2) Infinity

(3) Negative

(4) Zero

Ans. (4)

Sol. Magnetic field exist in

Closed Loops (Monopoles do not exist)

$\boxed{\oint \vec{B}.d\vec{A} = 0}$

(Gauss law for magnetism)

13. The work functions of Caesium (Cs), potassium (K) and Sodium (Na) are 2.14 eV, 2.30 eV and 2.75 eV respectively. If incident electromagnetic radiation has an incident energy of 2.20 eV, which of these photosensitive surfaces may emit photoelectrons ?

(1) Both Na and K

(2) K only

(3) Na only

(4) Cs only

Ans. (4)

Sol. Given energy of photon E = 2.20 eV

Work function of Cs ϕ_0 = 2.14 eV, K ϕ_0 = 2.30 eV , Na ϕ_0 = 2.75 eV

We know that e^- emitts when $h\nu > \phi_0$

here it is clear that energy of photon is more than the work function of Cs [Caesium] only so Ans. only (Cs).

14. The minimum wavelength of *X*-rays produced by an electron accelerated through a potential difference of *V* volts is proportional to :

(1) $\frac{1}{V}$ (2) $\frac{1}{\sqrt{V}}$

(3) V^2 (4) $\sqrt{V}$

Ans. (1)

Sol. Minimum wavelength of X-Rays is

$$\lambda_{min} = \frac{hC}{eV}$$

hence $\lambda_{min} \propto \frac{1}{V}$

So Ans. $\left(\frac{1}{V}\right)$

15. A 12 V, 60 W lamp is connected to the secondary of a step down transformer, whose primary is connected to ac mains of 220 V. Assuming the transformer to be ideal, what is the current in the primary winding ?

(1) 2.7 A (2) 3.7 A

(3) 0.37 A (4) 0.27 A

Ans. (4)

Sol. $V_S I_S = V_P I_P$ (ideal Transformer)

$\Rightarrow P_{out} = P_{in}$

$\Rightarrow 60 = 220 \times I_P$

$$I_P = \frac{60}{220} = 0.27A$$

16. Light travels a distance *x* in time t_1 in air and 10x in time t_2 in another denser medium. What is the critical angle for this medium ?

(1) $\sin^{-1}\left(\frac{10t_2}{t_1}\right)$ (2) $\sin^{-1}\left(\frac{t_1}{10t_2}\right)$

(3) $\sin^{-1}\left(\frac{10t_1}{t_2}\right)$ (4) $\sin^{-1}\left(\frac{t_2}{t_1}\right)$

Ans. (3)

Sol. Speed of light is air $V_1 = \frac{x}{t_1}$

speed of light is a medium $V_2 = \frac{10x}{t_2}$

$$\sin\theta_c = \frac{V_2}{V_1} = \frac{10x}{t_2}\frac{t_1}{x}$$

$$\theta_c = \sin^{-1}\left(\frac{10t_1}{t_2}\right)$$

17. A metal wire has mass (0.4 ± 0.002) g, radius (0.3 ± 0.001) mm and length (5 ± 0.02) cm. The maximum possible percentage error in the measurement of density will nearly be :

(1) 1.3% (2) 1.6% (3) 1.4% (4) 1.2%

Ans. (2)

Sol. $\rho = \frac{M}{V}$

$$\rho = \frac{M}{\pi r^2 \ell}$$

$$\frac{\Delta\rho}{\rho} = \frac{\Delta M}{M} + \frac{2\Delta r}{r} + \frac{\Delta\ell}{\ell}$$

$$\frac{\Delta\rho}{\rho}\% = \left[\frac{0.002}{0.4} + \frac{2(0.001)}{(0.3)} + \frac{0.02}{5}\right] \times 100\%$$

$$= \frac{1}{2}\% + \frac{2}{3}\% + \frac{2}{5}\%$$

$= 1.6\%$

18. For Young's double slit experiment, two statements are given below :

Statement I : If screen is moved away from the plane of slits, angular separation of the fringes remains constant.

Statement II : If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.

In the light of the above statements, choose the *correct* answer from the options given below :

(1) Both **Statement I** and **Statement II** are false

(2) **Statement I** is true but **Statement II** is false

(3) **Statement I** is false but **Statement II** is true

(4) Both **Statement I** and **Statement II** are true

Ans. (2)

Sol. Angular width, $\theta_w = \frac{\lambda}{d}$

θ_w independent of D but depends on λ

19. The half life of a radioactive substance is 20 minutes. In how much time, the activity of substance drops to $\left(\frac{1}{16}\right)^{th}$ of its initial value ?

(1) 40 minutes

(2) 60 minutes

(3) 80 minutes

(4) 20 minutes

Ans. (3)

Sol. Half life T = 20 min

Left fraction of activity $\frac{1}{16}$

$\because \frac{R}{R_0} = \left(\frac{1}{2}\right)^{t/T}$

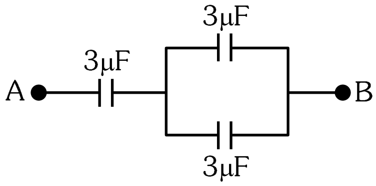
$\frac{1}{16} = \left(\frac{1}{2}\right)^{t/20}$

$\left(\frac{1}{2}\right)^{4} = \left(\frac{1}{2}\right)^{t/20}$

$4 = \frac{t}{20}$

t = 80 min

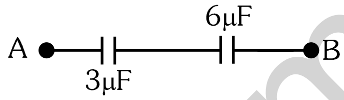
20. The equivalent capacitance of the system shown in the following circuit is :



(1) 3μF (2) 6μF (3) 9μF (4) 2μF

Ans. (4)

Sol. $C_{AB} = \frac{3\times 6}{3+6} = 2\mu F$



21. Resistance of a carbon resistor determined from colour codes is (22000 ± 5%) Ω. The colour of third band must be :

(1) Green (2) Orange (3) Yellow (4) Red

Ans. (2)

Sol. $R = [22\times 10^3 \pm 5\%]\Omega$

Acc. to color code

Third Band → Orange

(color code for digit 3 is orange)

22. An ac source is connected to a capacitor C. Due to decrease in its operating frequency :

(1) displacement current increases.

(2) displacement current decreases.

(3) capacitive reactance remains constant.

(4) capacitive reactance decreases.

Ans. (2)

Sol. $i_C = i_D = \frac{V_O}{X_C}\sin\omega t$

$i_C = i_D = (V_O\omega C)\sin\omega t$

On decreasing frequency $i_C \downarrow$

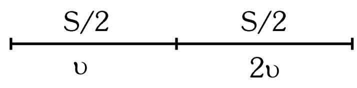
23. A vehicle travels half the distance with speed υ and the remaining distance with speed 2υ. Its average speed is :

(1) $\frac{2\upsilon}{3}$ (2) $\frac{4\upsilon}{3}$

(3) $\frac{3\upsilon}{4}$ (4) $\frac{\upsilon}{3}$

Ans. (2)

Sol.



$V_{avg} = \frac{2\upsilon_1\upsilon_2}{\upsilon_1+\upsilon_2} = \frac{2(\upsilon)(2\upsilon)}{\upsilon+2\upsilon} = \frac{4\upsilon^2}{3\upsilon} = \frac{4\upsilon}{3}$

24. The amount of energy required to form a soap bubble of radius 2 cm from a soap solution is nearly: (surface tension of soap solution = 0.03 N m^{-1})

(1) 5.06×10^{-4} J (2) 3.01×10^{-4} J

(3) 50.1×10^{-4} J (4) 30.16×10^{-4} J

Ans. (2)

Sol. $E = 2T(4\pi R^2)$

$= 2\,(0.03)\,(4)\,(3.14)\,(2 \times 10^{-2})^2$

$= 3.01 \times 10^{-4} J$

25. The venturi-meter works on :

(1) Bernoulli's principle

(2) The principle of parallel axes

(3) The principle of perpendicular axes

(4) Huygen's principle

Ans. (1)

Sol. Venturimeter works an Bernoulli's principle

26. In hydrogen spectrum, the shortest wavelength in the Balmer series is λ. The shortest wavelength in the Bracket series is :

(1) 4 λ (2) 9 λ (3) 16 λ (4) 2 λ

Ans. (1)

Sol. Shortest wavelength in Balmer series when transition of e^- from ∞ to n = 2

$$\because \frac{1}{\lambda} = Rz^2\left[\frac{1}{2^2} - \frac{1}{\infty^2}\right]$$

$$\frac{1}{\lambda} = \frac{R}{4} \quad ..(1)$$

Shortest wavelength is Bracket series when transition of e^- from ∞ to n = 4

$$\frac{1}{\lambda'} = R(1)^2\left[\frac{1}{4^2} - \frac{1}{\infty^2}\right] \Rightarrow \frac{1}{\lambda'} = \frac{R}{16} \quad ..(2)$$

Eq. (1)/Eq. (2)

$$\frac{\lambda'}{\lambda} = \frac{R}{4} \times \frac{16}{R} \Rightarrow \lambda' = 4\lambda$$

27. The potential energy of a long spring when stretched by 2 cm is U. If the spring is stretched by 8 cm, potential energy stored in it will be :

(1) 4U (2) 8U (3) 16U (4) 2U

Ans. (3)

Sol. $U = \frac{1}{2}kx^2$

for x = 2

$$U = \frac{1}{2}k(2)^2 \quad .(1)$$

$$U' = \frac{1}{2}k(8)^2 \quad .(2)$$

Eq. (2)/eq. (1)

$$\Rightarrow \frac{U'}{U} = \left(\frac{8}{2}\right)^2$$

$$\Rightarrow \boxed{U' = 16U}$$

28. A full wave rectifier circuit consists of two p-n junction diodes, a centre-tapped transformer, capacitor and a load resistance. Which of these components remove the ac ripple from the rectified output ?

(1) p-n junction diodes

(2) Capacitor

(3) Load resistance

(4) A centre-tapped transformer

Ans. (2)

Sol. Capacitor used to remove AC ripples from Rectifier output.

29. The magnetic energy stored in an inductor of inductance 4 μH carrying a current of 2 A is :

(1) 4 mJ (2) 8 mJ (3) 8 μJ (4) 4 μJ

Ans. (3)

Sol. Energy = $\frac{1}{2}Li^2$

$= \frac{1}{2} 4 \times 10^{-6} \times 2^2$

$= 8 \times 10^{-6}$ J

energy = 8 μJ

30. If $\oint_s \vec{E}.\vec{dS} = 0$ over a surface, then:

(1) the magnitude of electric field on the surface is constant.

(2) all the charges must necessarily be inside the surface.

(3) the electric field inside the surface is necessarily uniform.

(4) the number of flux lines entering the surface must be equal to the number of flux lines leaving it.

Ans. (4)

Sol. $\phi_{closed} = 0$

So $\phi_{in} = \phi_{out}$

Number of field lines entering is equal number of field lines leaving.

31. A football player is moving southward and suddenly turns eastward with the same speed to avoid an opponent. The force that acts on the player while turning is :

(1) along northward

(2) along north-east

(3) along south-west

(4) along eastward

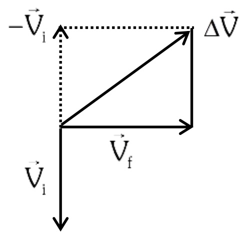
Ans. (2)

Sol. $\vec{V}_i = (V)$ southward

$\vec{V}_F = (V)$ Eastward

$\overrightarrow{\Delta V} = \vec{V}_F - \vec{V}_i$

= Along North – East



32. Let a wire be suspended from the ceiling (rigid support) and stretched by a weight *W* attached at its free end. The longitudinal stress at any point of cross-sectional area *A* of the wire is :

(1) *W/A* (2) *W/2A*

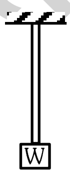
(3) Zero (4) 2*W/A*

Ans. (1)

Sol. Stress = $\frac{IRF}{A}$

Stress = $\frac{W}{A}$

(Here A Cross-sectional Area)



33. The angular acceleration of a body, moving along the circumference of a circle, is :

(1) along the radius towards the centre

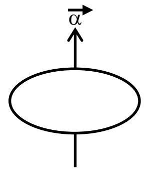
(2) along the tangent to its position

(3) along the axis of rotation

(4) along the radius, away from centre

Ans. (3)

Sol.



Along the axis of rotation

34. In a plane electromagnetic wave travelling in free space, the electric field component oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 Vm^{-1}. Then the amplitude of oscillating magnetic field is : (Speed of light in free space = 3×10^8 m s^{-1})

(1) 1.6×10^{-8} T (2) 1.6×10^{-7} T

(3) 1.6×10^{-6} T (4) 1.6×10^{-9} T

Ans. (2)

Sol. $C = \frac{E_0}{B_0}$

$B_0 = \frac{E_0}{C}$

$= \frac{48}{3 \times 10^8}$

$= 1.6 \times 10^{-7}$ T

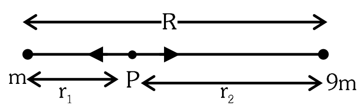
35. Two bodies of mass *m* and 9*m* are placed at a distance *R*. The gravitational potential on the line joining the bodies where the gravitational field equals zero, will be (*G* = gravitational constant) :

(1) $-\frac{12Gm}{R}$ (2) $-\frac{16Gm}{R}$

(3) $-\frac{20Gm}{R}$ (4) $-\frac{8Gm}{R}$

Ans. (2)

Sol.



Position of Neutral point (Zero Gravitational Field)

$$r_1 = \frac{\sqrt{m_1}R}{\sqrt{m_1}+\sqrt{m_2}} = \frac{\sqrt{m}R}{\sqrt{m}+\sqrt{9m}} = \frac{R}{4}$$

$r_2 = R - R/4 = 3R/4$

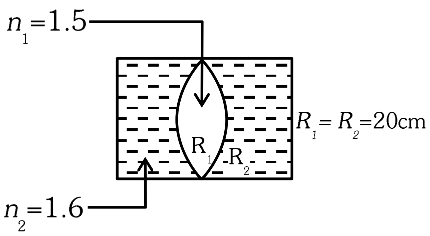
Now Gravitational potential at point P

$$V_P = -\frac{GM}{R/4} - \frac{9(GM)}{3R/4}$$

$$= \frac{-16GM}{R}$$

Physics : Section-B (Q. No. 036 to 050)

36. In the figure shown here, what is the equivalent focal length of the combination of lenses (Assume that all layers are thin) ?

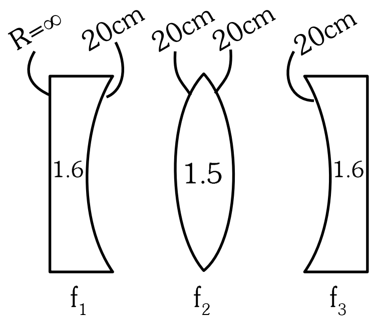


(1) – 40 cm (2) –100 cm

(3) –50 cm (4) 40 cm

Ans. **(2)**

Sol.



Use $\frac{1}{f} = [\mu - 1]\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

$$\frac{1}{f_1} = [1.6 - 1]\left[\frac{1}{\infty} - \frac{1}{20}\right] = \frac{-3}{100}$$

$$\frac{1}{f_2} = [1.5 - 1]\left[\frac{1}{20} + \frac{1}{20}\right] = \frac{1}{20}$$

$$\frac{1}{f_3} = \frac{-3}{100}$$

$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$

$$\frac{1}{f_{eq}} = -\frac{3}{100} + \frac{1}{20} - \frac{3}{100} = \frac{-1}{100}$$

37. Calculate the maximum acceleration of a moving car so that a body lying on the floor of the car remains stationary. The coefficient of static friction between the body and the floor is 0.15 ($g = 10\ m\ s^{-2}$).

(1) 150 $m\ s^{-2}$

(2) 1.5 $m\ s^{-2}$

(3) 50 $m\ s^{-2}$

(4) 1.2 $m\ s^{-2}$

Ans. **(2)**

Sol. $F_S = ma$

$f_L = ma_{max}$

$\mu\ mg = ma_{max}$

$a_{max} = \mu g$

$= 0.15(10)$

$= 1.5\ m/s^2$

38. A satellite is orbiting just above the surface of the earth with period *T*. If *d* is the density of the earth and *G* is the universal constant of gravitation, the quantity $\frac{3\pi}{Gd}$ represents :

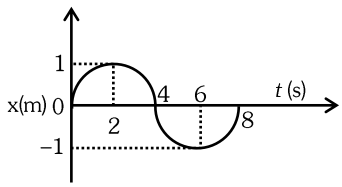
(1) T^2 (2) T^3 (3) $\sqrt{T}$ (4) T

Ans. **(1)**

Sol. $T = \frac{2\pi}{\sqrt{GM}} r^{3/2} \Rightarrow T^2 = \frac{4\pi^2 R^3}{G\left(\frac{4}{3}\pi R^3 d\right)}$ (r = R)

$$T^2 = \frac{3\pi}{Gd}$$

39. The *x* - *t* graph of a particle performing simple harmonic motion is shown in the figure. The acceleration of the particle at *t* = 2 s is :



(1) $-\frac{\pi^2}{8} m s^{-2}$ (2) $\frac{\pi^2}{16} m s^{-2}$

(3) $-\frac{\pi^2}{16} m s^{-2}$ (4) $\frac{\pi^2}{8} m s^{-2}$

Ans. **(3)**

Sol.

$x = A \sin(\omega t)$

$$\frac{dx}{dt} = v = A\omega\cos(\omega t)$$

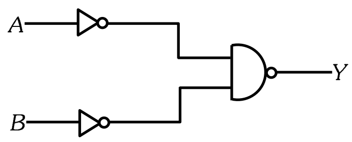
$$\frac{dv}{dt} = a = -\omega^2 A\sin(\omega t)$$

$$a = -\left(\frac{2\pi}{8}\right)^2 \times 1\sin\left(\frac{2\pi}{8} \times 2\right)$$

$$\Rightarrow a = -\frac{\pi^2}{16} \times \sin\left(\frac{\pi}{2}\right)$$

$$\therefore \boxed{a = \frac{-\pi^2}{16} m/s^2}$$

40. For the following logic circuit, the truth table is :



(1)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(2)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

(3)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(4)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

Ans. (1)

Sol. $y = \overline{\overline{A}.\overline{B}} = \overline{\overline{A}} + \overline{\overline{B}}$

= (A + B) OR Gate

A	B	y
0	0	0
0	1	1
1	0	1
1	1	1

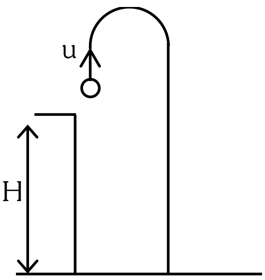
41. A horizontal bridge is built across a river. A student standing on the bridge throws a small ball vertically upwards with a velocity 4 m s^{-1}. The ball strikes the water surface after 4 s . The height of bridge above water surface is (Take g = 10 m s^{-2})

(1) 60 m (2) 64 m

(3) 68 m (4) 56 m

Ans. (2)

Sol. $S = ut + \frac{1}{2}at^2$



$-H = 4 \times 4 - \frac{1}{2} \times 10 \times 4^2$

$-H = 16 - 80$

$-H = -64$

H = 64 m

42. Two thin lenses are of same focal lengths (*f*), but one is convex and the other one is concave. When they are placed in contact with each other, the equivalent focal length of the combination will be :

(1) *f*/4 (2) *f*/2

(3) Infinite (4) Zero

Ans. (3)

Sol. $\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{f_{eq}} = \frac{1}{f} - \frac{1}{f}$

$f_{eq} = \infty$

43. A wire carrying a current *I* along the positive x-axis has length *L*. It is kept in a magnetic field $\vec{B} = (2\hat{i} + 3\hat{j} - 4\hat{k})T$. The magnitude of the magnetic force acting on the wire is :

(1) $\sqrt{5}\ IL$ (2) 5 *IL*

(3) $\sqrt{3}\ IL$ (4) 3 *IL*

Ans. (2)

Sol. $\vec{F} = I(\vec{\ell} \times \vec{B})$

$= I\left[(L\hat{i}) \times (2\hat{i} + 3\hat{j} - 4\hat{k})\right]$

$= I(4L\,\hat{j} + 3L\,\hat{k})$

$|\vec{F}| = 5\ IL$

44. A bullet from a gun is fired on a rectangular wooden block with velocity *u*. When bullet travels 24 cm through the block along its length horizontally, velocity of bullet becomes $\frac{u}{3}$. Then it further penetrates into the block in the same direction before coming to rest exactly at the other end of the block. The total length of the block is :

(1) 24 cm (2) 28 cm (3) 30 cm (4) 27 cm

Ans. (4)

Sol. By $v^2 = u^2 + 2as$

$$\left(\frac{u}{3}\right)^2 = u^2 - 2ax$$

$$2ax = u^2 - \frac{u^2}{9}$$

$$\boxed{2ax = \frac{8u^2}{9}} \quad \ldots(1)$$

Similarly from starting

$v^2 = u^2 + 2ax$

$0 = u^2 - 2ax_2$

$$\boxed{2ax_2 = u^2} \quad \ldots(2)$$

By (1) / (2)

$$\frac{x}{x_2} = \frac{8}{9}$$

$$\frac{24}{x_2} = \frac{8}{9}$$

$x_2 = 27$ cm

45. The resistance of platinum wire at 0°C is 2Ω and 6.8 Ω at 80°C. The temperature coefficient of resistance of the wire is :

(1) 3×10^{-3} °C^{-1}

(2) 3×10^{-2} °C^{-1}

(3) 3×10^{-1} °C^{-1}

(4) 3×10^{-4} °C^{-1}

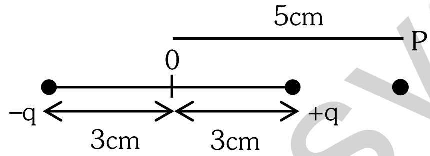
Ans. **(2)**

Sol. $R_T = R_0\left[1+\alpha(T-T_0)\right]$

$$6.8 = 2[1+\alpha(80-\alpha)]$$

$$\alpha = \frac{2.4}{80} = 0.03/°C = 3 \times 10^{-2}/°C$$

46. An electric dipole is placed as shown in the figure.



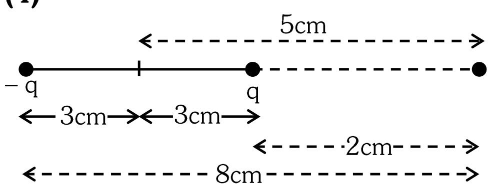
The electric potential (in 10^2 V) at point P due to the dipole is (ϵ_0 = permittivity of free space and $\frac{1}{4\pi\epsilon_0} = K$):

(1) $\left(\frac{5}{8}\right)qK$ (2) $\left(\frac{8}{5}\right)qK$

(3) $\left(\frac{8}{3}\right)qK$ (4) $\left(\frac{3}{8}\right)qK$

Ans. **(4)**

Sol.



$$v = \frac{Kq}{2\times10^{-2}} - \frac{Kq}{8\times10^{-2}}$$

$$= Kq\left[\frac{3}{8}\right]\times 10^2$$

47. 10 resistors, each of resistance R are connected in series to a battery of emf *E* and negligible internal resistance. Then those are connected in parallel to the same battery, the current is increased *n* times. The value of *n* is :

(1) 100 (2) 1 (3) 1000 (4) 10

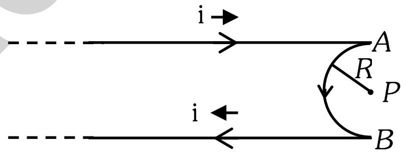
Ans. **(1)**

Sol. $I_S = \frac{E}{10R}$ … (1)

$$I_P = \frac{E}{R/10} = \frac{10E}{R} \quad \ldots (2)$$

$$n = \frac{I_P}{I_S} = 100 \Rightarrow n = 100$$

48. A very long conducting wire is bent in a semi-circular shape from *A* to *B* as shown in figure. The magnetic field at point *P* for steady current configuration is given by :



(1) $\frac{\mu_0 i}{4R}$ pointed away from the page

(2) $\frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$ pointed away from page

(3) $\frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$ pointed into the page

(4) $\frac{\mu_0 i}{4R}$ pointed into the page

Ans. **(2)**

Sol. $B = \frac{\mu_0}{4\pi}\frac{I}{R}(\pi) - \frac{\mu_0}{4\pi}\frac{2I}{R}$

$= \frac{\mu_0 I}{4R}\left[1-\frac{2}{\pi}\right]$ outward i.e away from page.

49. The radius of inner most orbit of hydrogen atom is 5.3×10^{-11} m. What is the radius of third allowed orbit of hydrogen atom ?

(1) 1.06 Å (2) 1.59 Å

(3) 4.77 Å (4) 0.53 Å

Ans. **(3)**

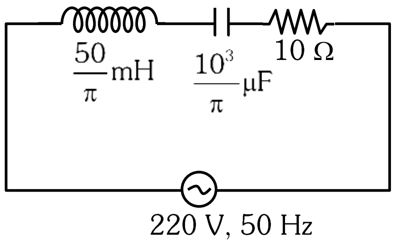
Sol. Radius of n^{th} orbit in Hydrogen Atom

$$r_n = 0.53 \times \frac{n^2}{Z} Å$$

So, radius of third orbit

$$r_3 = 0.53 \times \frac{(3)^2}{(1)} Å = 4.77Å$$

50. The net impedance of circuit (as shown in figure) will be :



(1) 15 Ω (2) $5\sqrt{5}\,\Omega$

(3) 25 Ω (4) $10\sqrt{2}\,\Omega$

Ans. (2)

Sol. $X_L = \frac{50}{L} \times 10^{-3} \times 2\pi \times 50 = 5\Omega$

$$X_C = \frac{1}{2\pi \times 50 \times \frac{10^3}{\pi} \times 10^{-6}} = 10\Omega$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$= \sqrt{(10)^2 + (5)^2}$$

$$= 5\sqrt{5}\,\Omega$$