NEET(UG)
07/05/2023

MATRIX

Paper Code
F6

Question Paper with Solutions & Answer Keys

for

Time : 3 hrs. 20 Min.

M.M. : 720

NEET (UG)-2023

Read carefully the Instructions on the Cover of this Test Booklet.

Important Instructions :

1. The test is of 3 hours 20 minutes duration and the Test Booklet contains 200 multiple choice questions (Four options with a single correct answer). There are two sections in each subject, i.e. Section-A & Section-B. You have to attempt all 35 questions from Section-A & only 10 questions from Section-B out of 15. (Candidates are advised to read all 15 questions in each subject of Section-B before they start attempting the question paper. In the event of a candidate attempting more than ten questions, the first ten questions answered by the candidate shall be evaluated.)
2. Each question carries 4 marks. For each correct response, the candidate will get 4 marks. For every wrong response 1 mark shall be deducted from the total scores. The maximum marks are 720.
3. Use Blue / Black Ball point Pen only for writing particulars on this page / marking responses on Answer Sheet.
4. Rough work is to be done in the space provided for this purpose in the Test Booklet only.
5. On completion of the test, the candidate must handover the Answer Sheet to the Invigilator before leaving the Room / Hall. The candidates are allowed to take away this Test Booklet with them.
6. The CODE for this Booklet is F6.
7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet. Use of white fluid for correction is NOT permissible on the Answer Sheet.
8. Each candidate must show on-demand his/her Admission Card to the Invigilator.
9. No candidate, without special permission of the Centre Superintendent or Invigilator, would leave his/her seat.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination.
12. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.
13. The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.

SUBJECT : PHYSICS

SECTION - A

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

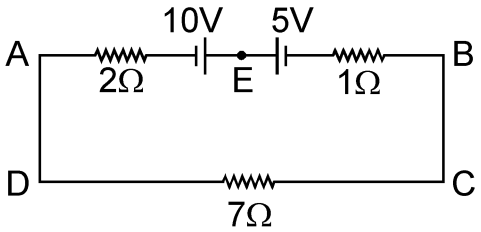
(1) 15.9 kHz (2) 1.59 rad/s (3) 1.59 kHz (4) 15.9 rad/s

Ans. (3)

Sol. Resonant frequency $(f_0) = \frac{1}{2\pi\sqrt{LC}}$

$$f_0 = \frac{1}{2\pi\sqrt{10\times10^{-3}\times10^{-6}}} = \frac{10^4}{2\pi} = \frac{10\times10^3}{2\pi} = 1.59 \text{ kHz}$$

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



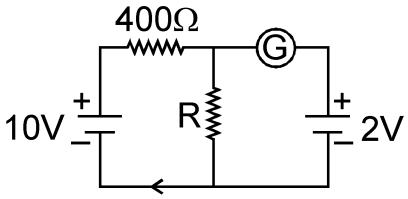
(1) 0.5 A from A to B through E (2) $\frac{5}{9}$ A from A to B through E

(3) 1.5 A from B to A through E (4) 0.2 A from B to A through E

Ans. (1)

Sol. $I = \frac{E_{net}}{R_{eq}} = \frac{(10-5)}{(2+1+7)} = 0.5$ A from A to B through E

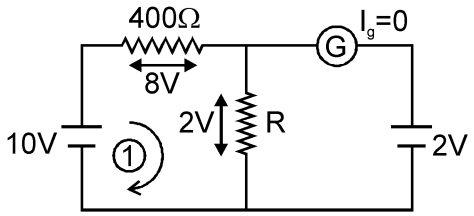
3. If the galvenometer G does not show any deflection in the circuit shown, the value of R is given by -



(1) 50 Ω (2) 100 Ω (3) 400 Ω (4) 200 Ω

Ans. (2)

Sol.



400Ω and R in series in loop (1)

$$\frac{V_1}{V_2} = \frac{R_1}{R_2} \quad \Rightarrow \quad \frac{8}{2} = \frac{400}{R}$$

$R = 100\Omega$

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. $T_1 = -50^0C = 223K$, $v_1 = v$ and $v_2 = 4v$

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

$$\frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} ; \frac{4v}{v} = \sqrt{\frac{T_2}{223}} ; 16 = \frac{T_2}{223}$$

$T_2 = 16 \times 223 = 3568$ k

$T_2 = 3568 - 273 = 3295\ ^0C$

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. (Bonus)

Sol. Hollow sphere $K_H = \sqrt{\frac{2}{3}}R$

Solid sphere $K_S = \sqrt{\frac{2}{5}}R$

$$\frac{K_S}{K_H} = \sqrt{\frac{3}{5}}$$

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. $\eta = 50\% = 0.5, T_1 = 327^0C = 600k$

$$\eta = 1 - \frac{T_2}{T_1} \Rightarrow \qquad 0.5 = 1 - \frac{T_2}{600}$$

$$\frac{T_2}{600} = 1 - 0.5 = 0.5$$

$T_2 = 600 \times 0.5 = 300k$

$T_2 = 300 - 273 = 27^0C$

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 - ($g = 9.8\ ms^{-2}$, $\sin 30° = 0.5$)

(1) 2000 m (2) 1000 m (3) 3000 m (4) 2800 m

Ans. (2)

Sol. $$H_{max.} = \frac{u^2 \sin^2\theta}{2g} = \frac{(280)^2 \sin^2 30^0}{2 \times 9.8} = 1000m$$

8. An electric dipole is placed at an angle 30° with an electric field of intensity $2 \times 10^5\ NC^{-1}$. It experiences a torque equal to 4 Nm. 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. $\tau = PE \sin 30°$

$\tau = (q/) E \sin 30° \Rightarrow 4 = q\ (2 \times 10^{-2}) \times 2 \times 10^5 \times \frac{1}{2}$

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

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 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)

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. unpredictable error belongs to random error

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. $f_{open} = \frac{v}{2\ell}$; $f_{closed} = \frac{v}{4\ell}$

$$\frac{f_{open}}{f_{closed}} = \frac{v/2\ell}{v/4\ell} = \frac{2}{1}$$

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

(1) Positive (2) Infinity (3) Negative (4) Zero

Ans. (4)

Sol. $\oint \vec{B}.\overrightarrow{ds} = \mu_0 \sum m = 0$

so magnetic flux through any closed surface in zero

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. W_{cs} = 2.14 ev

W_k = 2.30 ev

W_{Na} = 2.75 ev

Energy of incident photon

E = 2.20 ev

$W_{cs} < E$ and $W_{Na} > E$, $W_k > E$

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. $eV = \frac{hc}{\lambda_{min}} \Rightarrow \lambda_{min} = \frac{hc}{eV}$

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

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. Transformer is ideal

input power in primary = output power in secondary

$\varepsilon_P I_P = 60 \quad \Rightarrow \quad 220\ (I_P) = 60$

$I_P = \frac{3}{11} = 0.27\ A$

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. In air, $V_1 = \frac{x}{t_1}$

In medium, $V_2 = \frac{10x}{t_2} \Rightarrow \sin i_c = \frac{V_2}{V_1} = \frac{10x / t_2}{x / t_1} = \frac{10t_1}{t_2}$

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. $\text{density} = \frac{\text{mass}}{\text{volume of wire}} \Rightarrow D = \frac{m}{\pi r^2 l}$

$\%\ \text{error in}\ m = \frac{\Delta m}{m_0} = \frac{0.002}{0.4} \times 100 = 0.5\%$

% error in r = $\frac{\Delta r}{r_0} = \frac{0.001}{0.3} \times 100 = 0.33\%$

% error in L = $\frac{\Delta L}{L_0} = \frac{0.02}{5} \times 100 = 0.4\%$

% error in density = (% error in m) + 2(% error in r) + (% error in L) = 1.56% $\approx$ 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. $\beta_\theta = \frac{\lambda}{d}$

Statement I : β_θ remains same if D is changed.

Statement II : If λ is increased β_θ will increase

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

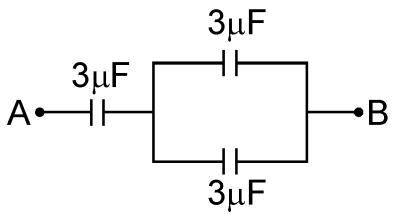
(3) 80 minutes

(4) 20 minutes

Ans. (3)

Sol. $1 \xrightarrow{\frac{T_1}{2}} \frac{1}{2} \xrightarrow{\frac{T_1}{2}} \frac{1}{4} \xrightarrow{\frac{T_1}{2}} \frac{1}{8} \xrightarrow{\frac{T_1}{2}} \frac{1}{16}$

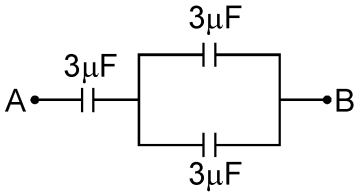
20. The equivalent capacitance of the system shown in the following circuit is -



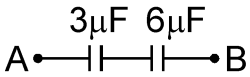
(1) 3 μF (2) 6 μF (3) 9 μF (4) 2 μF

Ans. (4)

Sol.



$\Rightarrow$



$$C_{AB} = \frac{3 \times 6}{(3+6)}\mu F = 2\mu F$$

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 (22000 ± 5%)Ω = (22 × 10^3 ± 5%)Ω

R = AB × 10^C ± D%

C = 3 $\Rightarrow$ orange (B B R<u>O</u>Y Great Britain Very Good Watch)

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. Current through capacitor in A. C. circuit.

$$I_d = \frac{dq}{dt} = \frac{d(CV)}{dt} = \frac{CdV}{dt} = \frac{Cd(V_0 \sin\omega t)}{dt}$$

$$I_d = \frac{V_0}{1/\omega C}\sin(\omega t + \pi/2)$$

$$I_d = \frac{V_0}{1/\omega C} = \frac{V_0}{X_C}$$

If $\omega\downarrow \Rightarrow X_C\uparrow \Rightarrow I_d\downarrow$

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. $V_{av} = \frac{2v_1v_2}{v_1+v_2} = \frac{2\times v\times 2v}{3v} = \frac{4v}{3}$

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 Nm^{-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. $W = 8\pi Tr^2 = 8\pi \times 0.03 \times (2 \times 10^{-2})^2 = 3.01 \times 10^{-4}$ 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)

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. $\lambda_{min} \propto \frac{n^2}{z}$

$$\frac{\lambda_{Bracket}}{\lambda_{Balmer}} = \left(\frac{n_{Bracket}}{n_{Balmer}}\right)^2 \Rightarrow \frac{\lambda_{Bracket}}{\lambda} = \left(\frac{4}{2}\right)^2 = 4$$

$\lambda_{Bracket} = 4\lambda$

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. $U = \frac{1}{2}kx^2 \Rightarrow \frac{U_f}{U_i} = \left(\frac{x_f}{x_i}\right)^2 = \left(\frac{8}{2}\right)^2$

$U_f = 16U$

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)

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. $E = \frac{1}{2} Li^2 = \frac{1}{2} \times 4 \times 10^{-6} \times (2)^2 = 8\ \mu J$

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 lines leaving it.

Ans. (4)

Sol. $\oint_s \vec{E}.\vec{dS} = 0$ i.e. total electric flux = zero

i.e. The number of flux lines entering the surface must be equal to the number of flux lines leaving it.

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. $V_i = V(-\hat{j}) \Rightarrow V_f = V(\hat{i})$

$\vec{F}$ is along $\Delta\vec{P} = m(\vec{v}_f - \vec{v}_i)$

$= mv(\hat{i} + \hat{j}) \Rightarrow$ North-East direction

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) 2W/A

Ans. (1)

Sol. Stress = $\frac{F}{A} = \frac{W}{A}$

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. angular acceleration is along 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. $E_0 = 48$ V/m

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

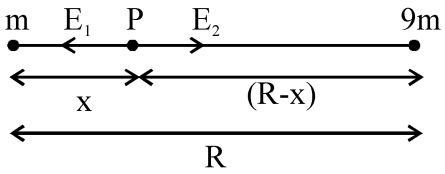
$$B_0 = \frac{E_0}{C} = \frac{48}{3\times10^{8}} = 1.6 \times 10^{-7}\,T$$

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.



At neutral point net gravitational field is zero, so

$E_1 = E_2$

$$\frac{Gm}{x^2} = \frac{G(9m)}{(R-x)^2} \Rightarrow \frac{1}{x} = \frac{3}{(R-x)}$$

$(R–x) = 3x$

$$4x = R \Rightarrow x = \frac{R}{4}$$

Gravitational potential at neutral point

$$V_P = -\frac{Gm}{x} - \frac{9Gm}{(R-x)}$$

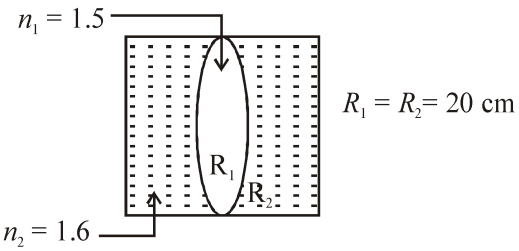
$$V_P = -\frac{Gm}{R/4} - \frac{9Gm}{3R/4}$$

$$V_P = -\frac{4Gm}{R} - \frac{12Gm}{R}$$

$$V_P = -\frac{16Gm}{R}$$

SECTION - B

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. $\frac{1}{f_1}=\left(\frac{1.6}{1}-1\right)\left(\frac{1}{\infty}-\frac{1}{20}\right)=\frac{-0.6}{20}=-\frac{3}{100}$

$\frac{1}{f_2}=\left(\frac{1.5}{1}-1\right)\left(\frac{1}{20}-\frac{1}{-20}\right)=\frac{1}{2}\times\frac{2}{20}=\frac{1}{20}$

$\frac{1}{f_3}=\left(\frac{1.6}{1}-1\right)\left(\frac{1}{-20}-\frac{1}{\infty}\right)=\frac{-0.6}{20}=-\frac{3}{100}$

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

f_{net} = –100 cm

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. $a_{max}=\mu g=0.15\times10=1.5\ m/s^2$

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. $T = 2\pi\sqrt{\frac{R}{g}}\left(1+\frac{h}{R}\right)^{3/2}$

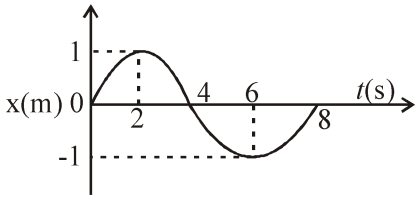
for nearby satellite $\Rightarrow h \simeq 0$

$$T = 2\pi\sqrt{\frac{R}{g}}$$

$$T = 2\pi\sqrt{\frac{R}{\frac{4}{3}\pi GRd}} = \sqrt{\frac{4\pi^2 R}{\frac{4\pi GRd}{3}}} = \sqrt{\frac{3\pi}{Gd}}$$

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

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)**

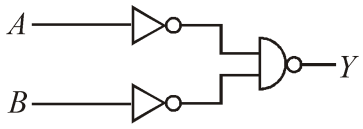
Sol. at t = 2, x = 1 m

time period = T = 8 sec

so, $\omega = \frac{2\pi}{T} = \frac{2\pi}{8} = \frac{\pi}{4}$

$\therefore$ acceleration = a = $-\omega^2 x = -\frac{\pi^2}{16}\times 1 = -\frac{\pi^2}{16}$ ms^{-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. $y = \overline{\overline{A}.\overline{B}} = \overline{\overline{A+B}} = A+B$ **OR GATE**

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. Using second equation of motion

$s = ut + \frac{1}{2}at^2$, $a = -10 m/s^2$, $u = 4$ m/sec.

$s = 4 \times 4 - \frac{1}{2} \times 10 \times 4^2 = -64$ 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. $\frac{1}{f_{net}} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{f} + \frac{1}{-f} = 0;\ f_{net} = \infty$

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

$\vec{F} = I\left[3L\hat{k} + 4L\hat{j}\right]$

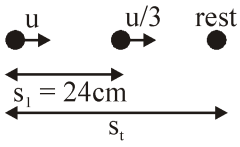
F = 5 IL

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.



using third equation of motion

$v^2 = u^2 - 2as$

$\left(\frac{u}{3}\right)^2 = u^2 - 2as_1 \Rightarrow 2as_1 = \frac{8}{9}u^2$

$0^2 = u^2 - 2as_t \Rightarrow 2\ as_t = u^2$

$2as_1 = \frac{8}{9}(2as_t)$

$s_t = \frac{9}{8}s_1 = \frac{9}{8} \times 24cm = 27cm$

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

(1) $3\times10^{-3}\,{}^oC^{-1}$ (2) $3\times10^{-2}\,{}^oC^{-1}$ (3) $3\times10^{-1}\,{}^oC^{-1}$ (4) $3\times10^{-4}\,{}^oC^{-1}$

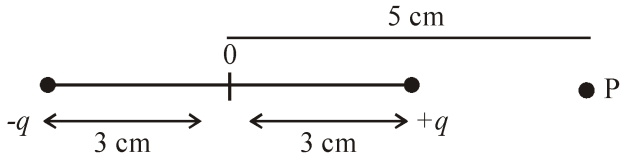
Ans. (2)

Sol. $R_\theta = R_0(1+\alpha\theta) \Rightarrow 6.8 = 2(1+80\alpha)$

$(3.4-1) = 80\alpha$

$$\alpha = \frac{2.4}{80} = \frac{24}{8}\times10^{-2} = 3\times10^{-2}\ {}^0C^{-1}$$

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

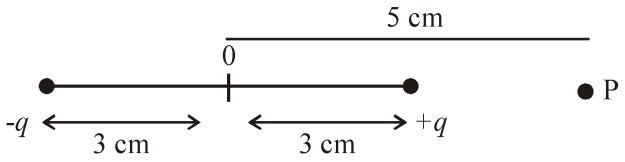


The electric potential (in 10^2 V) at point P due to the dipole is ($\in_0$ = permittivity of free space and $\frac{1}{4\pi\in_0} = K$) :

(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.



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

$$V_{total} = 10^2Kq\left[\frac{1}{2}-\frac{1}{8}\right]$$

$$V_{total} = \frac{3}{8}Kq\times10^2 \text{ volt} \Rightarrow \frac{3}{8}Kq$$

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)

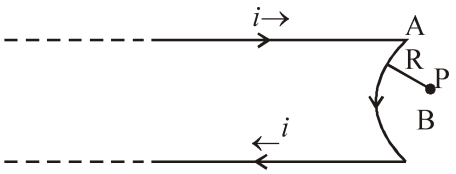
Sol. $I_{series} = \frac{E}{10R}$

$I_{parallel} = \frac{E}{R/10} = \frac{10E}{R} = 100 I_{series}$

$I_{parallel} = nI_{series}$

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. Due to wire $B_{wire} = \frac{\mu_0 I}{4\pi R}\otimes + \frac{\mu_0 I}{4\pi R}\otimes = \frac{\mu_0 I}{2\pi R}\otimes$

Due to arc $B_{arc} = \frac{\mu_0 I}{4R}\odot$

$B_{total} = (B_{arc} - B_{wire})\odot$

$B_{total} = \left(\frac{\mu_0 I}{4R} - \frac{\mu_0 I}{2\pi R}\right)\odot$

$B_{total} = \frac{\mu_0 I}{4R}\left(1 - \frac{2}{\pi}\right)\odot$

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. $r_1 = 5.3\times10^{-11}\,m = 0.53$ Å

$r \propto n^2$

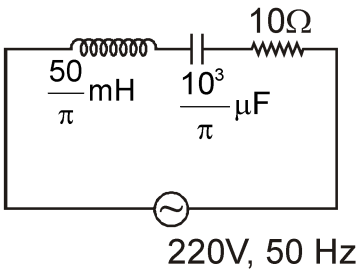
$\frac{r_2}{r_1} = \left(\frac{n_2}{n_1}\right)^2$

$\frac{r_2}{0.53Å} = \left(\frac{3}{1}\right)^2$

$r_2 = 9 \times 0.53Å$

$r_2 = 4.77Å$

50. The net impendance 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. $X_L = \omega L = 2\pi fL = 2\pi \times 50 \times \frac{50}{\pi} \times 10^{-3}\Omega = 5\Omega$

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

$$z = \sqrt{R^2 + (X_C - X_L)^2} = \sqrt{10^2 + 5^2}$$

$$z = \sqrt{125} = 5\sqrt{5}\Omega$$