Be Ahead with Sustained Excellence

CET - 2011

Question paper with Solution

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CET - 2011

Physics

(Version – C2)

60 Questions
60 Marks
Duration: 70 Minutes

1. Wavefront is the locus of all points, where the particles of a medium vibrate with the same

(1) frequency (2) period
(3) phase (4) amplitude

Ans (3)

Phase

2. Two monochromatic light waves of amplitudes 3A and 2A interfering at a point have a phase difference of 60°. The intensity at that point will be proportional to

(1) 7 A^2 (2) $19A^2$ (3) $5A^2$ (4) 13 A^2

Ans (2)

$$I_\theta = a_1^2 + a_2^2 + 2a_1a_2\cos\theta$$

$$= (3A)^2 + (2A)^2 + 2(3A)(2A)\cos 60°$$

$$= 9A^2 + 4A^2 + 12A^2\left(\frac{1}{2}\right) = 13A^2 + 6A^2$$

$$I_\theta = 19A^2$$

3. Consider the following statements in case of Young's double slit experiment.

(a) A slit S is necessary if we use an ordinary extended source of light.
(b) A slit S is not needed if we use an ordinary but well collimated beam of light.
(c) A slit S is not needed if we use a spatially coherent source of light.

Which of the above statements are correct?

(1) (b) and (c) (2) (a) and (c)
(3) (a), (b) and (c) (4) (a) and (b)

Ans (3)

All the three statements are correct.

(The question is not clearly stated.)

4. A parallel beam of light of wavelength 6000 Å gets diffracted by a single slit of width 0.3 mm. The angular position of the first minimum of diffracted light, is

(1) 1.8×10^{-3} rad (2) 6×10^{-3} rad (3) 2×10^{-3} rad (4) 3×10^{-3} rad

Ans (3)

$a \sin\theta = \lambda$

$$\sin\theta = \frac{\lambda}{a} = \frac{6\times10^{-7}}{3\times10^{-4}} = 2\times10^{-3}$$

θ is usually very small

$\therefore \sin\theta \approx \theta \quad \Rightarrow \theta = 2 \times 10^{-3}$ rad

5. The critical angle of a certain medium is $\sin^{-1}\left(\frac{3}{5}\right)$. The polarizing angle of the medium is

(1) $\tan^{-1}\left(\frac{3}{4}\right)$ (2) $\tan^{-1}\left(\frac{4}{3}\right)$ (3) $\sin^{-1}\left(\frac{4}{5}\right)$ (4) $\tan^{-1}\left(\frac{5}{3}\right)$

Ans (4)

$$n = \tan\theta = \frac{1}{\sin C} = \frac{5}{3}$$

$$\theta = \tan^{-1}\left(\frac{5}{3}\right)$$

6. A particle executing a simple harmonic motion has a period of 6 sec. The time taken by the particle to move from the mean position to half the amplitude, starting from the mean position is

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

Ans (4)

$$y = A\sin\left(\frac{2\pi t}{T}\right) \ ; \quad \text{Here } y = \frac{A}{2} \qquad \therefore \frac{A}{2} = A\sin\left(\frac{2\pi t}{T}\right) \Rightarrow \sin\left(\frac{2\pi t}{T}\right) = \frac{1}{2}$$

$$\Rightarrow \frac{2\pi t}{T} = \frac{\pi}{6} \quad \Rightarrow \frac{2\pi t}{6} = \frac{\pi}{6} \quad \Rightarrow t = \frac{1}{2} \text{ s}$$

7. The equation of a wave is given by $y = 10\sin\left(\frac{2\pi}{45}t + \alpha\right)$. If the displacement is 5 cm at t = 0, then the total phase at t = 7.5 sec. is

(1) $\frac{\pi}{6}$ (2) π (3) $\frac{\pi}{3}$ (4) $\frac{\pi}{2}$

Ans (4)

At t = 0, $\sin\alpha = \frac{1}{2} \Rightarrow \alpha = 30°$

$$\theta = \frac{2\pi t}{T} + \alpha = \frac{2\pi \times 7.5}{45} + \frac{\pi}{6}$$

$$\theta = \frac{2\pi}{6} + \frac{\pi}{6} = \frac{\pi}{2}$$

8. Two tuning forks, A and B, produce notes of frequencies 258 Hz and 262 Hz. An unknown note sounded with A produces certain number of beats. When the same note is sounded with B, the beat frequency gets doubled. The unknown frequency is

(1) 254 Hz (2) 256 Hz (3) 250 Hz (4) 252 hz

Ans (1)

$\nu_A \sim \nu = \nu_b \Rightarrow 258 \sim \nu = \nu_b$

$\nu_B \sim \nu = 2\,\nu_b \Rightarrow 262 \sim \nu = 2\nu_b$

$262 \sim \nu = 2\,(258 \sim \nu)$

$262 - \nu = 516 \sim 2\nu$

$\nu = 516 - 262 \Rightarrow \nu = 254$ Hz

9. A wire under tension vibrates with a fundamental frequency of 600 Hz. If the length of the wire is doubled, the radius is halved and the wire is made to vibrate under one-ninth the tension. Then the fundamental frequency will become

(1) 600 Hz (2) 400 Hz (3) 200 Hz (4) 300 Hz

Ans (3)

If another wire of same material of $l' = 2l,\ r' = \dfrac{r}{2}$ is used

$$\frac{f'}{f} = \frac{\left(\dfrac{\sqrt{T'}}{l'd'}\right)}{\left(\dfrac{\sqrt{T}}{ld}\right)} = \left(\frac{l\,d}{l'\,d'}\right)\sqrt{\frac{T'}{T}} = \frac{1}{2}\times 2\times\sqrt{\frac{1}{9}} = 3$$

$$\therefore\ f' = \frac{f}{3} = \frac{600}{3} = 200\ \text{Hz}$$

(When the length of a wire is doubled by stretching it, its area of cross-section is halved as its volume).

10. Faintest stars are called

(1) sixth magnitude stars (2) dwarfs

(3) zero magnitude stars (4) second magnitude stars

Ans (1)

Sixth magnitude stars

11. If C be the capacitance and V be the electric potential, then the dimensional formula of CV^2 is

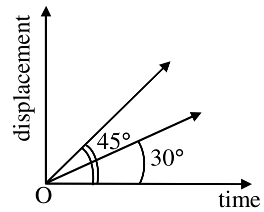
(1) $M^0L^1T^{-2}A^0$ (2) $M^1L^{-3}T^1A^1$

(3) $M^1L^2T^{-2}A^0$ (4) $M^1L^1T^{-2}A^{-1}$

Ans (3)

CV^2 is energy. Hence, its dimensional formula is $ML^2T^{-2}A°$.

12. The displacement-time graphs of two moving particles make angles of 30° and 45° with the X-axis. The ratio of their velocities is



(1) 1 : 2 (2) $1:\sqrt{3}$

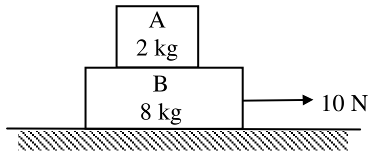
(3) $\sqrt{3}:2$ (4) 1 : 1

Ans (2)

Velocity is given by the slope of the displacement time graph.

$$\therefore \frac{v_1}{v_2}=\frac{\tan 30°}{\tan 45°}=\frac{\frac{1}{\sqrt{3}}}{1}=\frac{1}{\sqrt{3}}$$

13. A Block A of mass 2 kg is placed over a block B of mass 8 kg. The combination is placed over a rough horizontal surface. Coefficient of friction between B and the floor is 0.5. Coefficient of friction between A and B is 0.4. A horizontal force of 10 N is applied on the block B. The force of friction between A and B is ($g = 10\ ms^{-2}$).



(1) 50N (2) zero (3) 100 N (4) 40 N

Ans (2)

When the force of 10 N is applied on block B, the block A also moves along with A. Since there is no relative motion between A and B, the frictional force between A and B is zero.

14. The height y and the distance x along the horizontal plane of a projectile on a certain planet (with no surrounding atmosphere) are given by $y = 8t - 5t^2$ meter and $x = 6t$ meter, where t is in seconds. The velocity with which the projectile is projected is

(1) 10 ms^{-1} (2) 14 ms^{-1} (3) 6 ms^{-1} (4) 8 ms^{-1}

Ans (1)

$x = 6t \quad \therefore u_x = 6\ m\ s^{-1}$

$8t - 5t^2 \quad \therefore u_y = 8 - 10t$

$u_y(0) = 8\ m\ s^{-1}$

$$u=\sqrt{u_x^2+u_y^2}=\sqrt{6^2+8^2}=10\,m\ s^{-1}$$

15. A body of mass 5 kg is thrown vertically up with a kinetic energy of 490 J. The height at which the kinetic energy of the body becomes half of the original value is (acceleration due to gravity = 9.8 ms^{-2}).

(1) 10m (2) 12.5m (3) 5m (4) 2.5m

Ans (3)

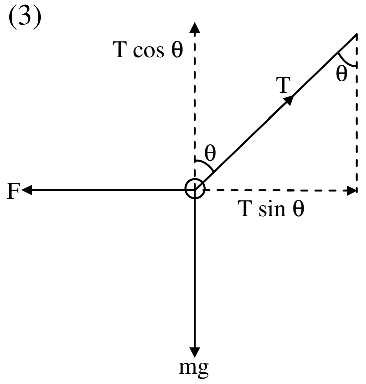
$$v_0=\sqrt{\frac{2E_k}{m}}=\sqrt{\frac{2\times 490}{5}}=\sqrt{\frac{980}{5}}=\sqrt{196}=14\ m\ s^{-1}$$

$$h=\frac{v_0^2-v^2}{2g}=\frac{v_0^2\left(\frac{1}{2}\right)}{2g}=\frac{14\times 14}{2\times 2\times 9.8}=\frac{196}{4\times 9.8}=5\ m$$

16. Two identical charged spheres of material density ρ, suspended from the same point by inextensible strings of equal length make an angle θ between the strings. When suspended in a liquid of density σ, the angle θ remains the same. The dielectric constant K of the liquid is

(1) $\dfrac{\rho}{\rho+\sigma}$ (2) $\dfrac{\rho+\sigma}{\rho}$ (3) $\dfrac{\rho}{\rho-\sigma}$ (4) $\dfrac{\rho-\sigma}{\rho}$

Ans (3)



From the diagram $T\cos\theta = mg$

$T\sin\theta = F$

$$\Rightarrow \tan\theta = \frac{F}{mg} = \frac{F}{\rho Vg} = \frac{\left(\frac{F}{K}\right)}{(\rho-\sigma)\,Vg}$$

$$\Rightarrow \frac{1}{\rho Vg} = \frac{1}{K(\rho-\sigma)\,Vg}$$

$$\Rightarrow \rho = K\,(\rho-\sigma)$$

$$K = \frac{\rho}{\rho-\sigma}$$

17. The electric field at a point due to an electric dipole, on an axis inclined at an angle θ ($< 90°$) to the dipole axis, is perpendicular to the dipole axis, if the angle θ is

(1) $\tan^{-1}(\sqrt{2})$ (2) $\tan^{-1}\left(\dfrac{1}{\sqrt{2}}\right)$

(3) $\tan^{-1}(2)$ (4) $\tan^{-1}\left(\dfrac{1}{2}\right)$

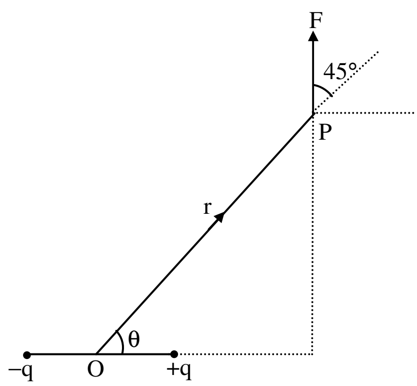
Ans (3)

$$\tan\phi = \frac{\tan\theta}{2}$$

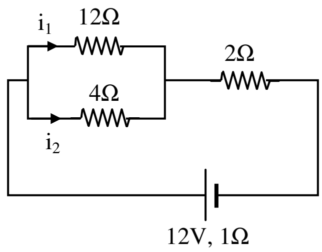
$$\phi = 45°$$

$$\therefore\ \tan\theta = 2$$

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



18. In the circuit shown, the currents i_1 and i_2 are



(1) $i_1 = 1$ A, $i_2 = 3$ A (2) $i_1 = 3$A, $i_2 = 1$A

(3) $i_1 = 1.5$ A, $i_2 = 0.5$ A (4) $i_1 = 0.5$ A, $i_2 = 1.5$ A

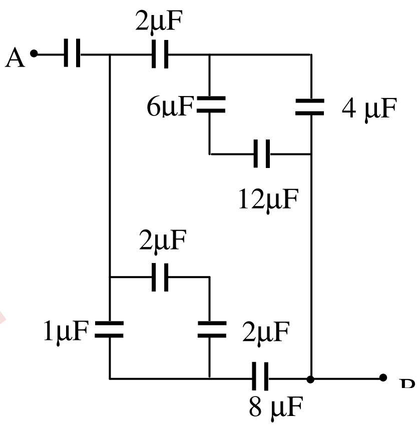
Ans (4)

$$I = i_1 + i_2 = \frac{E}{R+r} = \frac{12}{6} = 2A$$

$$i_1 = \frac{IR_2}{R_1+R_2} = \frac{2\times 4}{16} = \frac{8}{16} \qquad i_2 = \frac{IR_1}{R_1+R_2} = \frac{2\times 12}{16} = \frac{24}{16}$$

$i_1 = 0.5$ A $\qquad i_2 = 1.5$ A

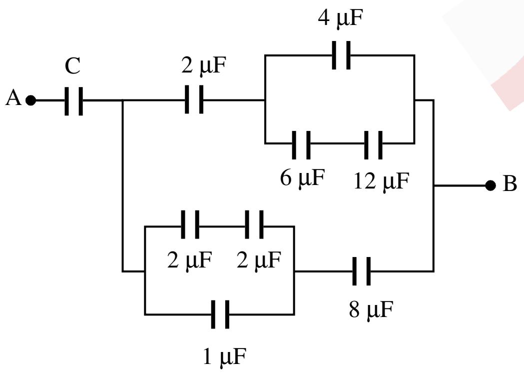
19. In the given network, the value of C, so that an equivalent, capacitance between A and B is 3μF, is



(1) 48 μF (2) 36 μF

(3) $\frac{1}{5}$μF (4) $\frac{31}{5}$μF

Ans (1)



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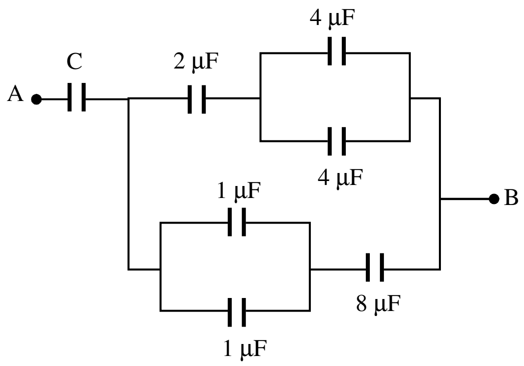

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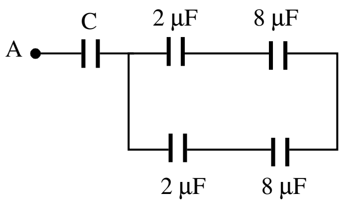

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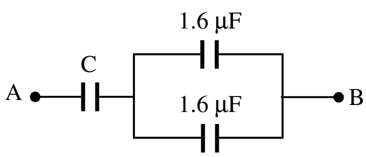


C series 3.2 μF

$$C_{AB} = \frac{C\times 3.2}{C+3.2}$$

$$3 = \frac{C \times 3.2}{C+3.2}$$

Solving, C = 48 μF

20. A conductor wire having 10^{29} free electrons/m^3 carries a current of 20A. If the cross-section of the wire is $1mm^2$, then the drift velocity of electrons will be $(e = 1.6 \times 10^{-19}\ C)$

(1) $1.25 \times 10^{-5}\ ms^{-1}$
(2) $6.25 \times 10^{-3}\ ms^{-1}$
(3) $1.25 \times 10^{-4}\ ms^{-1}$
(4) $1.25 \times 10^{-3}\ ms^{-1}$

Ans (4)

$I = nAev_d$

$$v_d = \frac{I}{nAe} = \frac{20}{10^{29} \times 10^{-6} \times 1.6 \times 10^{-19}} = 1.25 \times 10^{-3}\ m\ s^{-1}$$

21. Wavelength of given light waves in air and in a medium are $6000\ \mathring{A}$ and $4000\ \mathring{A}$ respectively. The critical angle is

(1) $\sin^{-1}\left(\frac{2}{3}\right)$
(2) $\sin^{-1}\left(\frac{3}{2}\right)$
(3) $\tan^{-1}\left(\frac{2}{3}\right)$
(4) $\tan^{-1}\left(\frac{3}{2}\right)$

Ans (1)

$\lambda_A = 6000\ \mathring{A}, \quad \lambda_m = 4000\ \mathring{A}$

$$\sin C = \frac{1}{n_m} = \frac{\lambda_m}{\lambda_a} = \frac{4000}{6000} = \frac{2}{3}$$

$$C = \sin^{-1}\left(\frac{2}{3}\right)$$

22. The time required for a light ray to pass through a glass slab (refractive index = 1.5) of thickness 4 mm is $(c = 3 \times 10^8\ ms^{-1}$, speed of light in free space).

(1) $2 \times 10^{+11}$ sec
(2) 2×10^{-5} sec
(3) 10^{-11} sec
(4) 2×10^{-11} sec

Ans (4)

$$v_g = \frac{c}{n_g} = \frac{3 \times 10^8}{1.5} = 2 \times 10^8\ m\ s^{-1}$$

Time taken, $t = \frac{s}{v_g} = \frac{4 \times 10^{-3}}{2 \times 10^8} = 2 \times 10^{-11}\ s$

23. A prism having refractive index 1.414 and refracting angle 30°, has one of the refracting surfaces silvered. A beam of light incident on the other refracting surface will retrace its path, if the angle of incidence is

(1) 60°
(2) 45°
(3) 0°
(4) 30°

Ans (2)

$r_2 = 0, \ r_1 = A = 30°$

$n_a \sin i_1 = n_g \sin r_1$

$$1 \sin i_1 = \sqrt{2} \sin 30° = \frac{1}{\sqrt{2}}$$

$i_1 = 45°$

24. A planoconvex lens has a maximum thickness of 6 cm. When placed on a horizontal table with the curved surface in contact with the table surface, the apparent depth of the bottommost point of the lens is found to be 4 cm. If the lens is inverted such that the plane face of the lens is in contact with the surface of the table, the apparent depth of the center of the plane face is found to be $\left(\frac{17}{4}\right)$ cm. The radius of curvature of the lens is

(1) 128 cm (2) 34 cm (3) 68 cm (4) 75 cm

Ans (2)

Case 1 : When the curved surface of the lens is in contact with the table surface,

$$n = \frac{RD}{AD} = \frac{6}{4} = \frac{3}{2}$$

Case 2 : When the plane surface of the lens is in contact with the table surface,

$$\frac{n_0}{u} + \frac{n_i}{v} = \frac{n_0 \sim n_i}{R}$$

$$\Rightarrow \frac{(3/2)}{6} + \frac{1}{-(17/4)} = \frac{(3/2)-1}{R}$$

$$\Rightarrow \frac{1}{4} - \frac{4}{17} = \frac{1}{2R}$$

$$\Rightarrow \frac{1}{68} = \frac{1}{2R}$$

$$\Rightarrow R = 34 \text{ cm}$$

25. Two thin lenses have a combined power of +9D. When they are separated by a distance of 20 cm, their equivalent power becomes $+\frac{27}{5}$ D. Their individual powers (in diopters) are

(1) 3, 6 (2) 4, 5 (3) 1, 8 (4) 2, 7

Ans (1)

$P_{eff} = +9D$ $\quad P_1 + P_2 = 9 \quad \ldots (1)$

$P'_{eff} = \frac{27}{5} D$ $\quad P_1 + P_2 - \frac{20}{100} P_1 P_2 = \frac{27}{5}$

$$9 - \frac{20}{100} P_1 P_2 = \frac{27}{5}$$

$$9 - \frac{27}{5} = \frac{20}{100} P_1 P_2$$

$$\frac{18}{5} = \frac{20}{100} P_1 P_2$$

$P_1 P_2 = 18 \quad \ldots (2)$

Solving (1) and (2), we get $P_1 = 3$ D and $P_2 = 6$ D

26. Two capillary tubes of different diameters are dipped in water. The rise of water is

(1) greater in the tube of smaller diameter

(2) independent of the diameter of the tube

(3) the same in both tubes

(4) greater in the tube of larger diameter

Ans (1)

$h \propto \frac{1}{d}$ where h is the capillary rise and d is the diameter of the tube.

27. A perfect gas at 27°C is heated at constant pressure so as to double its volume. The increase in temperature of the gas will be ________

(1) 54°C (2) 300°C (3) 600°C (4) 327°C

Ans (2)

Volume changes from V to 2 V and $V \propto T$

$\therefore$ T also changes from T to 2 T

$\therefore 2\ T = 2 \times 300\ K = 600\ K \Rightarrow 327\ °C$

$\therefore \Delta T = (600 - 300)\ K = 300\ K$

$\Delta t = 300°C$

28. Three identical rods A, B and C are placed end to end. A temperature difference is maintained between the free ends of A and C. The thermal conductivity of B is THRICE that of C and HALF of that of A. The effective thermal conductivity of the system will be (K_A is the thermal conductivity of rod A).

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

Ans (3)

$$\frac{3}{K_s} = \frac{1}{K_A} + \frac{2}{K_A} + \frac{6}{K_A} = \frac{9}{K_A}$$

$$\frac{1}{K_s} = \frac{3}{K_A}$$

$$\therefore K_s = \frac{1}{3}K_A$$

29. The quantities of heat required to raise the temperatures of two copper spheres of radii r_1 and r_2 ($r_1 = 1.5\ r_2$) through 1 K are in the ratio of

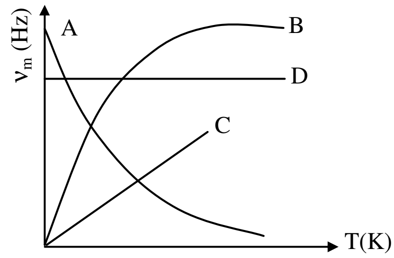
(1) $\frac{3}{2}$ (2) 1 (3) $\frac{27}{8}$ (4) $\frac{9}{4}$

Ans (3)

$$\frac{Q_1}{Q_2} = \frac{m_1}{m_2} = \frac{\rho \times (\text{volume})_1}{\rho \times (\text{volume})_2} = \left(\frac{r_1}{r_2}\right)^3 = \left(\frac{1.5r_2}{r_2}\right)^3$$

$$= 1.5^3 = \left(\frac{3}{2}\right)^3 = \frac{27}{8}$$

30. Which one of the following is $\nu_m - T$ graph for a perfectly black body? ν_m is the frequency of radiation with maximum intensity. T is the absolute temperature.



(1) C (2) D

(3) A (4) B

Ans (1)

$\nu_m \propto T$, from Wein's displacement law

$\therefore$ graph C represents $\nu_m - T$ graph

31. A resistor has a colour code of green, blue, brown and silver. What is its resistance?

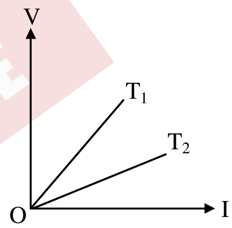
(1) $560\ \Omega \pm 5\ \%$ (2) $5600\ \Omega \pm 10\ \%$

(3) $56\ \Omega \pm 5\ \%$ (4) $560\ \Omega \pm 10\ \%$

Ans (4)

$560\ \Omega \pm 10\ \%$

32. The voltage V and current I graphs for a conductor at two different temperatures T_1 and T_2 are shown in the figure. The relation between T_1 and T_2 is



(1) $T_1 = T_2$ (2) $T_1 = \frac{1}{T_2}$

(3) $T_1 > T_2$ (4) $T_1 < T_2$

Ans (3)

Slope of the graph $= \frac{\Delta V}{\Delta I} = R$ and $R\ \alpha\ T$

Slope of T_1 > Slope of T_2

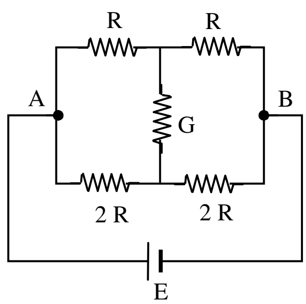
$\therefore\ T_1 > T_2$

33. Consider the following statements regarding the network shown in the figure.

(a) The equivalent resistance of the network between points A and B is independent of value of G.

(b) The equivalent resistance of the network between points A and B is $\frac{4}{3}$ R

(c) The current through G is zero.



Which of the above statements is/are TRUE?

(1) (b) and (c) (2) (a), (b) and (c)

(3) (a) alone (4) (b) alone

Ans (2)

It is a balanced wheatstone network. Therefore a and c are true.

Also, the equivalent resistance between A and B is equal to $\frac{4}{3}$ R.

$\therefore$ b is also true.

$\therefore$ a, b and c, all are true.

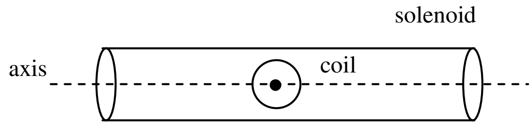
34. The torque required to hold a small circular coil of 10 turns, area 1 mm^2 and carrying a current of $\left(\frac{21}{44}\right)$A in the middle of a long solenoid of 10^3 turns/m carrying a current of 2.5 A, with its axis perpendicular to the axis of the solenoid is

(1) $1.5 \times 10^{+6}$ N-m

(2) $1.5 \times 10^{+8}$ N-m

(3) 1.5×10^{-6} N-m

(4) 1.5×10^{-8} N-m



Ans (4)

$\tau = nIAB$ and $B = \mu_0 nI$

$$= 10 \times \left(\frac{21}{44}\right) \times 10^{-6} \times 4 \times \frac{22}{7} \times 10^{-7} \times 10^3 \times 2.5$$

$\tau = 1.5 \times 10^{-8}$ N – m

35. A particle of charge e and mass m moves with a velocity v in a magnetic field B, applied perpendicular to the motion of the particle. The radius r of its path in the field is

(1) $\frac{ev}{Bm}$ (2) $\frac{Bv}{em}$ (3) $\frac{mv}{Be}$ (4) $\frac{Be}{mv}$

Ans (3)

$$Bev = \frac{mv^2}{r}$$

$$r = \frac{mv}{Be}$$

36. A solid sphere, of mass m rolls down an inclined plane without slipping, starting from rest at the top of an inclined plane. The linear speed of the sphere at the bottom of the inclined plane is v. The kinetic energy of the sphere at the bottom is

(1) $\frac{2}{5}mv^2$ (2) $\frac{7}{10}mv^2$ (3) $\frac{1}{2}mv^2$ (4) $\frac{5}{3}mv^2$

Ans (2)

Total kinetic energy = (Translational kinetic energy) + (Rotational kinetic energy)

$$= \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

$$= \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{2}{5}\right)mr^2\left(\frac{v}{r}\right)^2$$

$$= \frac{1}{2}mv^2 + \frac{1}{5}mv^2$$

$$= \frac{7}{10}mv^2$$

37. Two satellites of mass m and 9 m are orbiting a planet in orbits of radius R. Their periods of revolution will be in the ratio of

(1) 1 : 1 (2) 1 : 3 (3) 9 : 1 (4) 3 : 1

Ans (1)

Orbital time period of a satellite is independent of mass of a satellite. Therefore both the satellites have the same time period.

$\therefore$ Ratio of time periods of revolution is 1 : 1

38. The following four wires of length L and radius rare made of the same material. Which of these will have the largest extension, when the same tension is applied?

(1) L = 300 cm, r = 0.6 mm (2) L = 400 cm, r = 0.8 mm

(3) L = 100 cm, r = 0.2 mm (4) L = 200 cm, r = 0.4 mm

Ans (3)

$$Y = \frac{\frac{F}{A}}{\frac{\Delta L}{L}} \Rightarrow \Delta L = \frac{FL}{YA} = \frac{FL}{Y\pi r^2}$$

$$\therefore \ \Delta L \ \alpha \left(\frac{L}{r^2}\right)$$

For option, (1) $\left(\frac{300}{(0.6)^2}\right) \times 10^4 \ -833 \times 10^4 \ = \frac{L}{r^2}$

(2) $\frac{400}{(0.8)^2} \times 10^4 \ = 625 \times 10^4 \ = \frac{L}{r^2}$

(3) $\frac{100}{(0.2)^2} \times 10^4 \ = 2500 \times 10^4 \ = \frac{L}{r^2}$

(4) $\frac{200}{(0.4)^2} \times 10^4 \ = 1250 \times 10^4 \ = \frac{L}{r^2}$

39. The resultant of two forces acting at an angle of 120° is 10 kg wt and is perpendicular to one of the forces. That force is

(1) 10 kg wt (2) $\frac{10}{\sqrt{3}}$ kg wt (3) $10\sqrt{3}$ kg wt (4) $20\sqrt{3}$ kg wt

Ans (2)

$$\sqrt{P^2 + Q^2 + 2PQ\cos 120°} = 10$$

$$P^2 + Q^2 - PQ = 100 \qquad \ldots(1)$$

Also $\tan\alpha = \frac{Q\sin\theta}{P + Q\cos\theta} \quad \Rightarrow P + Q\cos\theta = 0$

$$P + Q\cos 120° = 0$$

$$P + Q\left(-\frac{1}{2}\right) = 0$$

$$P - \frac{Q}{2} = 0 \ \Rightarrow P = \frac{Q}{2}$$

Or $Q = 2P$ $\qquad \ldots(2)$

$\therefore$ (1) becomes

$$P^2 + (2P)^2 - P(2P) = 100$$

$$P^2 + 4P^2 - 2P^2 = 100$$

$$3P^2 = 100$$

$$P^2 = \frac{100}{3} \quad \Rightarrow P = \frac{10}{\sqrt{3}} \text{ kg wt.}$$

40. Eight equal drops of water are falling through air with a steady velocity of 10 cm s^{-1}. If the drops combine to form a single drop bigger in size, then the terminal velocity of the big drop is

(1) 30 cm s^{-1} (2) 80 cm s^{-1} (3) 40 cm s^{-1} (4) 10 cm s^{-1}

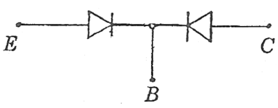
Ans (3)

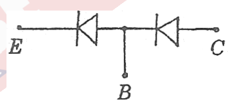
Terminal velocity of big drop formed by n drops each of steady velocity V is $= n^{\frac{2}{3}}$ V

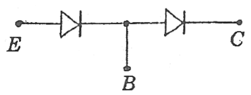
$$= 8^{\frac{2}{3}} \times 10 \text{ cm s}^{-1}$$

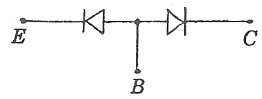
$$= 4 \times 10 \text{ cm s}^{-1} = 40 \text{ cm s}^{-1}$$

41. An n–p–n transistor can be considered to be equivalent to two diodes, connected. Which of the following figures is the CORRECT ONE?

(1) 

(2) 

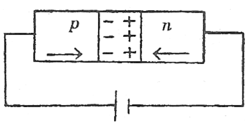
(3) 

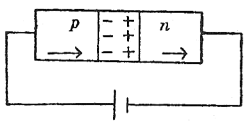
(4) 

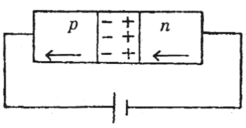
Ans (4)

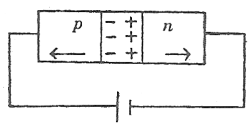
Figure (4) is an arrangement of np and pn connected to each other.

42. In the case of forward biasing of a p–n junction diode, which one of the following figures correctly depicts the direction of conventional current (indicated by an arrow mark)?

(1) 

(2) 

(3) 

(4) 

Ans (2)

Holes move from p to n region → direction of conventional current.

Electrons move from n to p region → opposite to the direction of conventional current.

43. An electron of mass m_e and a proton of mass m_p are moving with the same speed. The ratio of their de-Broglie's wavelengths $\frac{\lambda_e}{\lambda_p}$ is

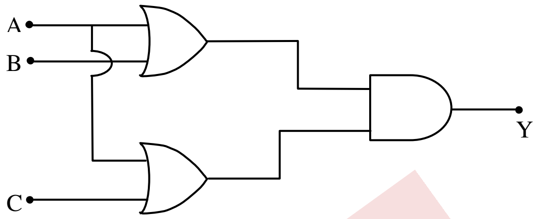
(1) $\frac{1}{1836}$ (2) 918 (3) 1 (4) 1836

Ans (4)

$\lambda = \frac{h}{mv} \Rightarrow \lambda \propto \frac{1}{m}$

$\therefore \frac{\lambda_e}{\lambda_p} = \frac{m_p}{m_e} = 1836$

44. The output of given logic circuit is



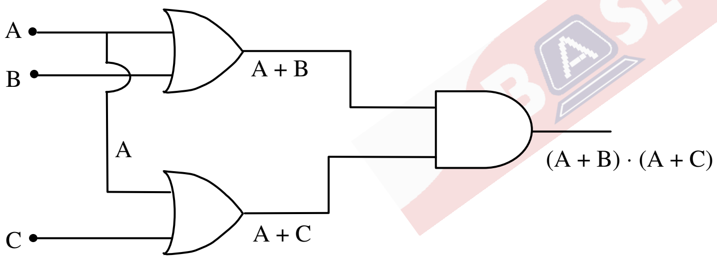
(1) (A + B) · (A + C)

(2) A + B + C

(3) A · (B + C)

(4) A · (B · C)

Ans (1)



45. If the scattering intensity of a liquid is 8 units at a wavelength of 500 nm, then the scattering intensity at a wavelength of 400 mm will be approximately

(1) 20 units (2) 24 units (3) 13 units (4) 16 units

Ans (1)

$\frac{I_2}{I_1} = \left(\frac{\lambda_1}{\lambda_2}\right)^4$

$\frac{I_2}{8} = \left(\frac{5}{4}\right)^4$

$I_2 = \frac{8 \times 625}{64 \times 4} \approx 20$ units

46. The energy V stored in an inductor of self inductance L henry carrying a current of I ampere is

(1) LI^2 (2) L^2I (3) $\frac{1}{2}L^2I$ (4) $\frac{1}{2}LI^2$

Ans (4)

$U = \frac{1}{2}LI^2$

47. A transformer works on the principle of

(1) mutual induction (2) magnetic effect of the electric current

(3) self induction (4) electrical inertia

Ans (1)

Mutual induction.

48. Flash spectrum confirms a/an

(1) earthquake (2) magnetic storm

(3) total solar eclipse (4) lunar eclipse

Ans (3)

Total solar eclipse.

49. The photoelectric threshold wavelength for silver is λ_0. The energy of the electron ejected from the surface of silver by an incident wavelength $\lambda(\lambda < \lambda_0)$ will be

(1) $\frac{h}{c}\left(\frac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$ (2) $hc\left(\frac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$ (3) $hc(\lambda_0 - \lambda)$ (4) $\frac{hc}{\lambda_0 - \lambda}$

Ans (2)

$$KE = hc\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$$

$$= hc\left(\frac{\lambda_0 - \lambda}{\lambda_0\lambda}\right)$$

50. Rutherford's atom model could account for

(1) the positively charged central core of an atom

(2) concept of stationary orbits

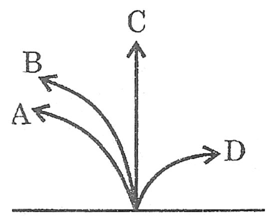
(3) stability of an atom

(4) origin of spectra

Ans (1)

. . . the positively charged central core of an atom

51. A neutron, a proton, an electron and an. α-particle enter a region of uniform magnetic field with the same velocity. The magnetic field is perpendicular and directed into the plane of the paper. The tracks of the particles are labelled in the figure. The electron follows the track



(1) C (2) D

(3) A (4) B

Ans (2)

Electron follows the track D (by Flemming's Left hand rule).

52. The deflection in a moving coil galvanometer is reduced to half when it is shunted with a 40 Ω coil. The resistance of the galvanometer is

(1) 20 Ω (2) 15 Ω (3) 80 Ω (4) 40 Ω

Ans (4)

$$ig = i\frac{S}{G+S}, \quad \frac{i_g}{i} = \frac{1}{2} = \frac{S}{G+S}$$

$$\Rightarrow 2S = G+S \quad \Rightarrow G = S = 40\ \Omega$$

53. A current of $\left(\frac{2}{\sqrt{3}}\right)$A produces a deflection of 60° in a tangent galvanometer. The reduction factor is

(1) 2 A (2) $\left(\frac{3}{2}\right)$ A (3) $\left(\frac{2}{\sqrt{3}}\right)$ A (4) $\left(\frac{2}{3}\right)$A

Ans (4)

$$K = \frac{I}{\tan\theta} = \frac{\frac{2}{\sqrt{3}}}{\tan 60^\circ} = \frac{\frac{2}{\sqrt{3}}}{\sqrt{3}} = \frac{2}{3}\ \text{A}$$

54. In an A.C. circuit, V and I are given by V = 150 sin(150t) volt and I = 150 in $\left(150t + \frac{\pi}{3}\right)$ ampere. The power dissipated in the circuit is

(1) 5625 W (2) zero (3) 106 W (4) 150 W

Ans (1)

$$P = V_{rms}\ I_{rms}\ \cos\phi$$

$$= \frac{150}{\sqrt{2}} \times \frac{150}{\sqrt{2}} \times \cos\frac{\pi}{3}$$

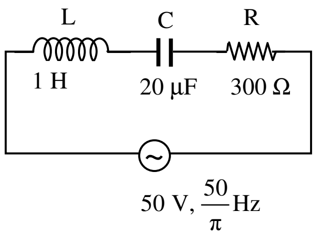
$$= \frac{22500}{2} \times \frac{1}{2} = \frac{22500}{4}$$

$$P = 5625\ \text{W}$$

55. In the series L–C–R circuit shown, the impedance is

(1) 300 Ω (2) 500 Ω

(3) 200 Ω (4) 100 Ω



Ans (2)

$$X_L = 2\pi fL = 2\times\pi\times\frac{50}{\pi}\times 1 = 100\ \Omega$$

$$X_C = \frac{1}{2\pi fC} = \frac{1}{2\times\pi\times\frac{50}{\pi}\times 20\times 10^{-6}} = \frac{10^6}{2000} = 500\ \Omega$$

$$X_L - X_C = 400\,\Omega$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{300^2 + 400^2} = 500\ \Omega$$

56. When an electron jumps from the orbit n = 2 to n = 4, then wavelength of the radiations absorbed will be (R is Rydberg's constant)

(1) $\frac{5R}{16}$ (2) $\frac{3R}{16}$ (3) $\frac{16}{3R}$ (4) $\frac{16}{5R}$

Ans (3)

$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{4^2}\right) = R\left(\frac{4-1}{16}\right) = \frac{3R}{16}$$

$$\therefore \lambda = \frac{16}{3R}$$

57. Thermonuclear reactions involving hydrogen inside the stars, are taking place by a cycle of operations. The particular element which acts as a catalyst is

(1) helium (2) carbon (3) nitrogen (4) oxygen

Ans (2)

Carbon

58. The ratio of minimum wavelengths of Lyman series and Balmer series will be

(1) 5 (2) 10 (3) 1.25 (4) 0.25

Ans (4)

$$\frac{1}{\lambda_{min}} = R\left(\frac{1}{n^2}\right)$$

$$\therefore \frac{1}{\lambda} \alpha \frac{R}{n^2} \qquad \frac{\lambda_L}{\lambda_B} = \frac{1}{4} = 0.25$$

59. The fraction of the initial number of radioactive nuclei which remain undecayed after half of a half-life of the radioactive sample is

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

Ans (2)

60. 1 curie represents

(1) 10^6 disintegrations per second

(2) 1 disintegration per second

(3) 3.7×10^7 disintegrations per second

(4) 3.7×10^{10} disintegrations per second

Ans (4)

1 curie = 3.7×10^{10} disintegrations per second.

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