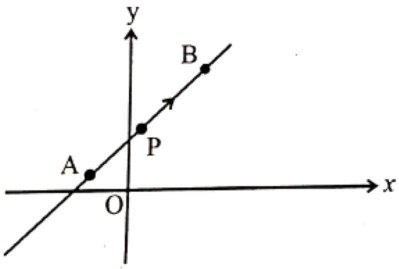
1. Two particles which are initially at rest move towards each other under the action of their mutual attraction. If their speeds are v and 2v at any instant, then the speed of centre of mass of the system is

(a) 2v (b) zero (c) 1.5 v (d) v

Ans: (b)

Sol: Since, there is no external force acting on the system Δp_{CM} = constant $\Rightarrow v_{CM} = 0$

2. A particle is moving uniformly along a straight line as shown in the figure. During the motion of the particle from A to B, the angular momentum of the particle about 'O'



(a) increases (b) decreases

(c) remains constant (d) first increases then decreases

Ans: (c)

Sol: $\vec{L} = \vec{r} \times \vec{p}$

$= rp\sin\theta$

$= (r\sin\theta)\,p$

$r\sin\theta$ remains constant during the motion of the particle from A to B.

3. A satellite is orbiting close to the earth and has a kinetic energy K. The minimum extra kinetic energy required by it to just overcome the gravitation pull of the earth is

(a) K (b) $2K$ (c) $\sqrt{3}K$ (d) $2\sqrt{2}K$

Ans: (a)

Sol: $E_{orbital} = K.E._{orbital} + U_{orbital}$

$$= \frac{GMm}{2r} - \frac{GMm}{r}$$

$E_{orb} = -K$

$E_{\infty} = 0$

$\Delta E = 0 - (-K) = K$

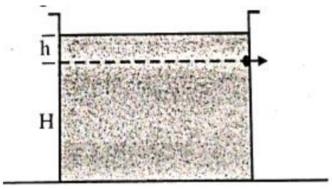
4. A wire is stretched such that its volume remains constant. The Poission's ratio of the material of the wire is

(a) 0.50 (b) – 0.50 (c) 0.25 (d) - 0.25

Ans: (a)

Sol: When volume remains constant $\sigma = 0.5$

5. A cylindrical container containing water has a small hole at height of $H = 8cm$ from the bottom and at a depth of $2cm$ from the top surface of the liquid. The maximum horizontal distance travelled by the water before it hits the ground (x) is



(a) $8\,\text{cm}$ (b) $4\sqrt{2}\,\text{cm}$ (c) $4\,\text{cm}$ (d) $6\,\text{cm}$

Ans: (a)

Sol: $v_{efflux} = \sqrt{2gh}$

$$R = v\sqrt{\frac{2H}{g}}$$

$$= \sqrt{2gh \times \frac{2H}{g}}$$

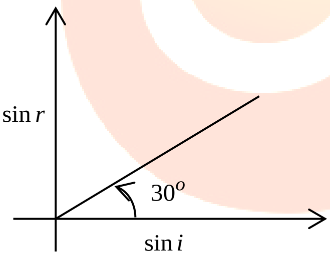
$$= 2\sqrt{hH}$$

$$= 2\sqrt{2 \times 8}$$

$$= 2 \times 4$$

$$R = 8 \text{ cm}$$

6. A transparent medium shows relation between i and r as shown. If the speed of light in vacuum is c the Brewster angle for the medium is



(a) 30^o (b) 45^o (c) 60^o (d) 90^o

Ans: (c)

Sol: $n = \frac{\sin i}{\sin r} = \cot 30°$

$n = \tan 60°$; $n = \tan i_p$

$\Rightarrow i_p = 60°$

7. In Young's double slit experiment, using monochromatic light of wavelength λ, the intensity of light at a point on the screen where path difference is λ is K units. The intensity of light at a point where path difference is $\frac{\lambda}{3}$ is

(a) K (b) $\frac{K}{4}$ (c) $4K$ (d) $2K$

Ans: (b)

Sol: $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos d$

When path difference $= \lambda$, phase difference $= 2\pi$

$I_\lambda = 4I_o = K$

$\Rightarrow \quad I_o = \frac{K}{4}$

When path difference $= \frac{\lambda}{3}$ phase difference $= \frac{2\pi}{3}$

8. Due to Doppler's effect the shift in wavelength observed is 0.1Å for a star producing wavelength $6000\,\overset{o}{\text{A}}$ Velocity of recession of the star will be

(a) 25 km/s (b) 10 km/s (c) 5 km/s (d) 20 km/s

Ans: (c)

Sol: $V = \frac{\Delta\lambda}{\lambda} \times C \quad = \frac{0.1}{6000} \times 3 \times 10^8$

V = 5 km / s

9. An electron is moving with an initial velocity $\vec{V} = V_0\hat{i}$ and is in a uniform magnetic field $\vec{B} = B_0\hat{j}$. Then its de Broglie wavelength

(a) remain constant (b) increases with time

(c) decreases with time (d) increase and decreases periodically

Ans: (a)

Sol: Since, the electron is moving in a uniform $\vec{B}$, its velocity remains constant. Hence, de-Brogile wavelength remains constant.

10. Light of certain frequency and intensity on a photosensitive material causes photoelectric effect. If both the frequency and intensity are doubled, the photoelectric saturation current becomes

(a) quadrupled (b) doubled (c) halved (d) unchanged

Ans: (b)

Sol: Saturation current doubles since the intensity is getting double & its independent of frequency

11. In a cyclotron a charged particle

(a) undergoes acceleration all the time

(b) speeds up between the does because of the magnetic field.

(c) speeds up in dee

(d) slows down within a dee and speeds up between dees

Ans: (a)

Sol: Undergoes acceleration all the time

12. The number of turns in a coil of Galvanometer is tripled, then

(a) Voltage sensitivity increases 3 times and current sensitivity remains constant

(b) Voltage sensitivity remains constant and current sensitivity increases 3 times

(c) Bothe voltage and current sensitivity remains constant

(d) Both voltage and current sensitivity decreases by 33%

Ans: (b)

Sol: Resistance increases by 3 times when number of turns is tripled.

13. A circular current loop of magnetic moment M is in a arbitrary orientation in an external uniform magnetic field $\vec{B}$. The work done to rotate the loop by 30^o about an axis perpendicular to its plane is

(a) MB (b) $\sqrt{3}\frac{MB}{2}$ (c) $\frac{MB}{2}$ (d) Zero

Ans: (c)

Sol: $W = MB\sin\theta = MB\sin 30° = \frac{MB}{2}$

14. In a permanent magnet at room temperature

(a) magnetic moment of each molecule is zero

(b) the individual molecules have non zero magnetic moment which are all perfectly aligned

(c) domains are partially aligned

(d) domains are all perfectly aligned

Ans: (c)

Sol: Domains are partially aligned

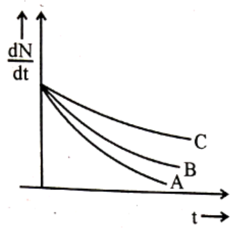
15. Coersivity of a moment where the ferromagnet gets completely demagnetized is $3\times10^3\,\text{Am}^{-1}$. The minimum current required to be passed in a solenoid having 100 turns per metre, so that the magnet gets completely demagnetized when speed inside the solenoid is

(a) 30 mA (b) 60 mA (c) 3 A (d) 6 A

Ans: (c)

Sol: $Coersivity = I \times (N/l)$ $I = \frac{Coersivity}{\left(n/l\right)} = \frac{3\times10^3}{1000}$ $I = 3A$

16. Which one of the following nuclei has shorter mean life?



(a) A (b) B (c) c (d) Same for all

Ans: (a)

Sol: Activity of 'A' ceases to zero faster than B & C. Hence, it has a shorter mean life.

17. The conductivity of semiconductor increases with increase in temperature because.
    (a) number density of charge carriers increases
    (b) relaxation time increases
    (c) both number density of charge carriers and relaxation time increase
    (d) number density of current carriers increases, relaxation time decreases but effect of decrease in relaxation time is much less than increase in number density

Ans: (d)

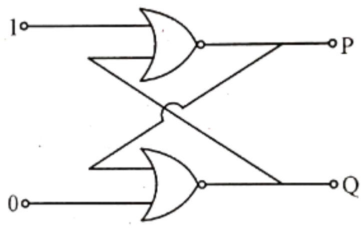
Sol: Number density of current carriers increases, relaxation time decreases but effect of decrease in relaxation time is much less than increase in number density

18. For a transistor amplifier, the voltage gain
    (a) remains constant for all frequencies
    (b) is high at temperature and constant in the middle frequency range
    (c) is low at high and low frequencies and constant at mid frequencies
    (d) constant at high frequencies and low at low frequencies

Ans: (c)

Sol: Low at high and low frequencies and constant at mid frequencies

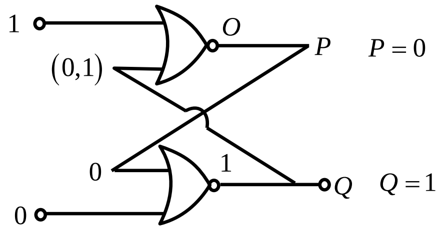
19. In the following circuit, what are P and Q?



(a) P = 0, Q = 0 (b) P = 1, Q = 0 (c) P = 0, Q = 1 (d) P = 1, Q = 1

Ans: (c)

Sol:



20. An antenna uses electromagnetic waves of frequency 5 MHz. For proper working, the size of the antenna should be

(a) 15 m (b) 300 m (c) 15 km (d) 3 km

Ans: (a)

Sol: $h = \lambda/4 \quad = \frac{c/v}{4}$

$= \frac{3\times10^8}{5\times10^6\times4} = \frac{3}{20}\times10^2$

$= \frac{300}{20} \qquad h = 15m$

21. A magnetic needle has a magnetic moment of $5\times10^{-2}\,\text{Am}^2$ and moment of inertia $8\times10^{-6}\,\text{kgm}^2$. It has a period of oscillation of 2s in a magnetic field $\vec{B}$. The magnitude of magnetic field is approximately

(a) $1.6\times10^{-4}\,\text{T}$ (b) $0.4\times10^{-4}\,\text{T}$ (c) $3.2\times10^{-4}\,\text{T}$ (d) $0.8\times10^{-4}\,\text{T}$

Ans: () **[Option does not match]**

Sol: $T = 2\pi\sqrt{\frac{I}{MB}}$

$2 = 2\pi\sqrt{\frac{8\times10^{-6}}{5\times10^{-2}\times B}}$

$1 = \pi\sqrt{\frac{8\times10^{-6}}{5\times10^{-2}\times B}}, \quad \frac{1}{10} = \frac{8\times10^{-4}}{5B}$

$B = 1.6\times10^{-3}T$

22. A torpid has 500 turns per metre length. If it carries a current of 2A, the magnetic energy density inside the toroid is

(a) $0.628\ \text{J/m}^3$ (b) $0.314\ \text{J/m}^3$ (c) $6.28\ \text{J/m}^3$ (d) $3.14\ \text{J/m}^3$

Ans: (a)

Sol: $u_B = \frac{B^2}{2\mu_0}$

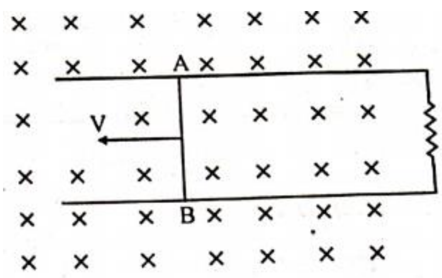
$= \frac{(\mu_0 n I)^2}{2\mu_0}$

$= \frac{\mu_0 (nI)^2}{2}$

$= \frac{4\pi \times 10^{-7} \times 10^6}{2}$

$= 0.628 \ \text{J/m}^3$

23. Consider the situation given in figure. The wire AB is slid on the fixed rails with a constant velocity. If the wire AB is replaced by a semi-circular wire, the magnitude of the induced current will



(a) increase (b) remain same

(c) decrease

(d) increase or decrease depending on whether the semicircle bulges towards the resistance or away from it

Ans: (b)

Sol: The induced current will remain same. (if there is no change in the resistance of the wire)

24. The frequency of an alternating current is 50 Hz. What is the minimum time taken by current to reach its peak value from rms value?

(a) $5 \times 10^{-3}\text{s}$ (b) $2.5 \times 10^{-3}\text{s}$ (c) 0.02s (d) $10 \times 10^{-3}\text{s}$

Ans: (b)

Sol: $I = I_o \sin \omega t$

When $I = \frac{I_o}{\sqrt{2}}$

$\Rightarrow \frac{I_o}{\sqrt{2}} = I_o \sin \omega t_1$

$\sin \omega t_1 = \frac{1}{\sqrt{2}} \quad \omega t_1 = \frac{\pi}{4}$

$2\pi v t_1 = \frac{\pi}{4}$

$t_1 = \frac{1}{8v} = \frac{1}{400}\text{s}$

When $I = I_o$

$$\Rightarrow I_o = I_o \sin wt_2$$

$$\sin wt_2 = 1$$

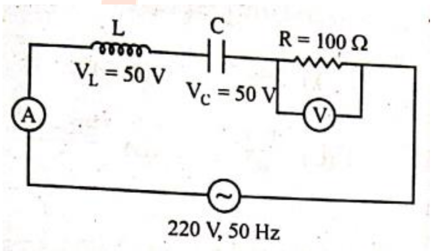
$$wt_2 = \frac{\pi}{2}$$

$$2\pi v t_2 = \frac{\pi}{2}$$

$$t_2 = \frac{1}{4v} = \frac{1}{200}s$$

$$\Delta t = t_2 - t_1 = \frac{1}{200} - \frac{1}{400} = 2.5\times10^{-3}s$$

25. The readings of ammeter and voltmeter in the following circuit are respectively



(a) 1.2 A, 120 V (b) 1.5 A, 100 V (c) 2.7 A, 220 V (d) 2.2 A, 220 V

Ans: (d)

Sol: $V_e = \sqrt{(V_L - V_o)^2 + V_R^2}$

$$220 = V_R \Rightarrow V_R = 220\text{ V}$$

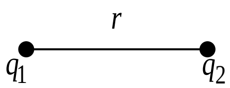
$$I = \frac{V_R}{R} = \frac{220}{100} = 2.2\text{ A}$$

26. A certain charge 2Q is divided at first into two parts q_1 and q_2. Later the charges are placed at a certain distance. If the force of interaction between two charges is maximum then $\frac{Q}{q_1} =$ ________

(a) 4 (b) 2 (c) 1 (d) 0.5

Ans: (c)

Sol:



$$F = \frac{1}{4\pi\varepsilon_o}\frac{q_1 q_2}{r^2}$$

$$q_1 + q_2 = 2Q$$

$$F = \frac{1}{4\pi\varepsilon_o}\frac{q_1(2Q-q_1)}{r^2}$$

$\frac{dF}{dq_1} = 0$ for F to be maximum

$$\frac{dF}{dq_1} = \frac{1}{4\pi\varepsilon_o r^2}(2Q-2q_1)$$

$$\Rightarrow 2Q - 2q_1 = 0$$

$$Q = q_1$$

$$\frac{Q}{q_1} = 1$$

27. A particle of mass m and charge q is placed at rest in uniform electric field E and then released. The kinetic energy attained by the particle after moving distance y is

(a) qEy^2 (b) qE^2y (c) qEy (d) q^2Ey

Ans: (c)

Sol: KE $= \frac{1}{2}mv^2$

$$v^2 + u^2 + 2as$$

$$\Rightarrow v^2 = 2ay$$

$$\therefore KE = \frac{1}{2}m.2ay$$

$$= may$$

Now, $qE = Ma$

Hence, $KE = qEy$

28. An electric dipole is kept in non-uniform electric field. It generally experiences

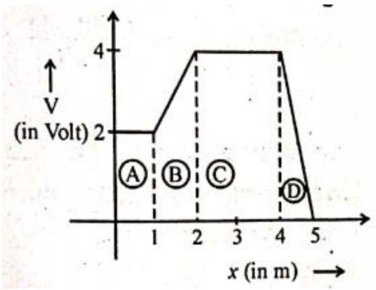
(a) A force and torque (b) A force but not a torque

(c) A torque but not a force (d) Neither a force nor a torque

Ans: (a)

Sol: A force and torque

29. The figure gives the electric potential V as a function of distance through four regions on $x-$axis. Which of the following is true for the magnitude of the electric field E in these regions?



(a) $E_A > E_B > E_C > E_D$

(b) $E_A = E_C$ and $E_B < E_D$

(c) $E_B = E_D$ and $E_A < E_C$

(d) $E_A < E_B < E_C < E_D$

Ans: (b)

Sol: $E = -\frac{dv}{dr}$

$E_A = E_C = 0$

$\frac{dV}{dr} = 0$

$\left(\frac{dV}{dr}\right)_D > \left(\frac{dV}{dr}\right)_B$

$\Rightarrow E_W > E_B$

30. A system of two charges separated by a certain distance apart stores electrical potential energy. If the distance between them is increased, the potential energy of the system

(a) increases in any case
(b) decreases in any case
(c) may increase or decrease
(d) remains the same

Ans: (b)

Sol: $V = \frac{1}{4\pi\varepsilon_o}\frac{q_1q_2}{r}$

$V \alpha \frac{1}{r}$

V decreases when r increases

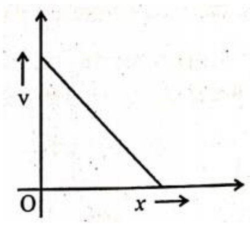
31. If P, Q and R are physical quantities having different dimensions, which of the following combinations can never be a meaningful quantity?

(a) $\frac{P-Q}{R}$
(b) $PQ-R$
(c) $\frac{PQ}{R}$
(d) $\frac{PR-Q^2}{R}$

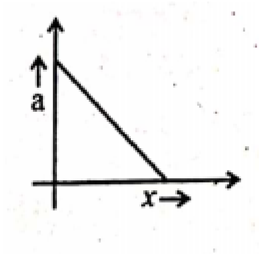
Ans: (a)

Sol: Physical quantities with different dimensions cannot be subtracted

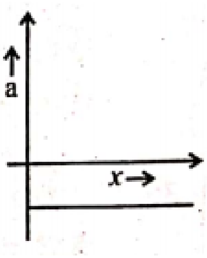
32. The given graph shows the variation of velocity (v) with position (x) for a particle moving along a straight line. Which of the following graph shows the variation of acceleration (a) with position (x)?



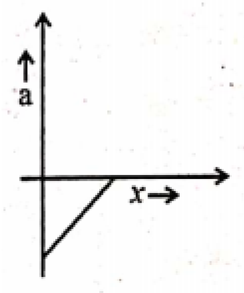
(a)



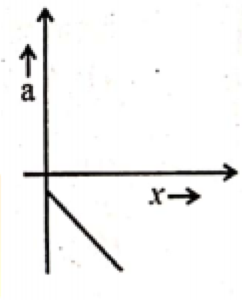
(b)



(c)



(d)



Ans: (c)

Sol: The particle is decelerating & coming to rest

33. The trajectory of a projectile projected from origin is given by the equation $y = x - \frac{2x^2}{5}$. The initial velocity of the projectile is

(a) $\frac{2}{5}\,\text{ms}^{-1}$ (b) $5\,\text{ms}^{-1}$ (c) $25\,\text{ms}^{-1}$ (d) $\frac{5}{2}\,\text{ms}^{-1}$

Ans: (b)

Sol: $y = (\tan\theta)x - \left(\frac{g}{2u^2\cos^2\theta}\right)x^2$

$\tan\theta = 1 \frac{g}{2u^2\cos^2\theta} = \frac{2}{5}$

$\theta = 45^o$

$\Rightarrow \frac{10}{2u^2 \times \frac{1}{2}} = \frac{2}{5}$ $\quad u^2 = 25$

$u = 5m/s$

34. An object with mass 5 kg is acted upon by a force, $\vec{F} = \left(-3\hat{i} + 4j\right)N$. If its initial velocity at $t = 0$ is $\vec{v} = \left(6\hat{i} - 12j\right)\text{ms}^{-1}$, the time at which it will just have a velocity $y-$ axis is

(a) 5 s (b) 10 s (c) 2 s (d) 15 s

Ans: (b)

Sol: $a = \frac{F}{m} = \frac{(-3i + 4j)}{5}$

$a = \frac{-3}{5}i + \frac{4}{5}j$

Now, $a_x = \frac{-3}{5}, u_x = 6, v_x = 0, t = ?$

$V = u + at$

$V_x = u_x + a_x t$

$\Rightarrow 0 = 6 + \left(\frac{-3}{5}\right)t$

$\frac{3t}{5} = 6$

$t = 10s$

35. During inelastic collision between two objects, which of the following quantity always remains conserved?

(a) Total kinetic energy (b) Total mechanical energy

(c) Total linear momentum (d) Speed of each body

Ans: (c)

Sol: Total linear momentum

36. In Rutherford experiment, for head-on collision of $\alpha-$particles with a gold nucleus, the impact parameter is

(a) zero (b) of the order of 10^{-14} m

(c) of the order of 10^{-10} m (d) of the order of 10^{-6} m

Ans: (a)

Sol: zero

37. Frequency of revolution of an electron revolving in n^{th} orbit of $H-$atom is proportional to

(a) $\frac{1}{n^2}$ (b) n

(c) n independent of n (d) $\frac{1}{n^3}$

Ans: (d)

Sol: $f_n \propto \frac{V_n}{r_n}$ $V_n \propto \frac{1}{n}, r_n \propto \frac{1}{n2}$

$\therefore$ $f_n \propto \frac{1}{n^3}$

38. A hydrogen atom in ground state absorbs 10.2 eV of energy. The orbital angular momentum of the electron is increased by

(a) 1.05×10^{-34} Js (b) 2.11×10^{-34} Js (c) 3.16×10^{-34} Js (d) 4.22×10^{-34} Js

Ans: (a)

Sol: $E_n = -13.6 + 10.2 = -3.4eV$

Now, $E_n = \frac{-13.6}{n^2}$ $-3.4 = \frac{13.6}{n^2}$

$\Rightarrow n^2 = 4$ $n = 2$

$L_n = \frac{n\lambda}{2\pi}$

$\Delta L = L_2 - L_1 = \frac{2h}{2\pi} - \frac{h}{2\pi} = 1.05\times10^{-34}$ Js

39. The end product of decay of $_{90}Th^{232}$ is $_{82}Pb^{208}$. The number of α and β particles emitted are respectively

(a) 3, 3 (b) 6, 4 (c) 6, 0 (d) 4, 6

Ans: (b)

Sol: $A_1 = 232, A_2 = 208$

$Z_1 = 90, \ Z_2 = 82$

No. of α particles, $n = \frac{A_1 - A_2}{4}$

$= \frac{232-208}{4}$ $= 6$

No. of β particles emitted $= Z_2 - Z_1 + 2n$

$= 82 - 90 + 12 = 4$

40. Two protons are kept at a separation of 10 nm. Let F_n and F_e be the nuclear force and the electromagnetic force between them

(a) $F_e = F_n$ (b) $F_e >> F_n$

(c) $F_e << F_n$ (d) F_e and F_n differ only slightly

Ans: (b)

Sol: $F_e >> F_n$

41. Two metal plates are separated by 2 cm. The potentials of the plates are -10 V and $+30$ V. The electric field between the two plates is

(a) 500 V/m (b) 1000 V/m (c) 2000 V/m (d) 3000 V/m

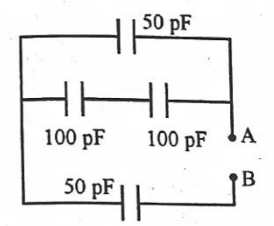
Ans: (c)

Sol: $E = \frac{dV}{dx}$ $dV = 30-(-10) = 40$

$dx = 2cm = 2\times10^{-2} M$

$\therefore E = \frac{40}{2\times10^{-2}} = 20\times10^{2} = 2000\,\text{V/m}$

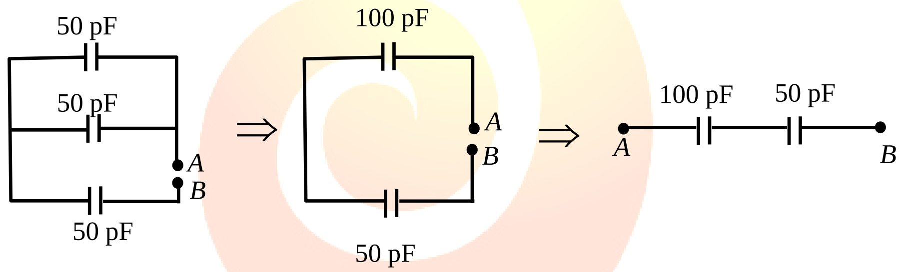
42. The equivalent capacitance between A and B is,



(a) 50 pF (b) $\frac{100}{3}$ pF (c) 150 pF (d) 300 pF

Ans: (b)

Sol:



$\frac{1}{C} = \frac{1}{100} + \frac{1}{50}$

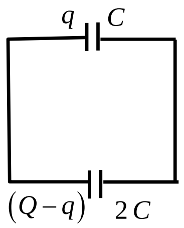
$\therefore C = \frac{5000}{150} = \frac{100}{3}\,pF$

43. A capacitor of capacitance C charged by an amount Q is connected in parallel with an uncharged capacitor of capacitance $2C$. The final charges on the capacitance are

(a) $\frac{Q}{2}, \frac{Q}{2}$ (b) $\frac{Q}{4}, \frac{3Q}{4}$ (c) $\frac{Q}{3}, \frac{2Q}{3}$ (d) $\frac{Q}{5}, \frac{4Q}{5}$

Ans: (c)

Sol:



V is same across both the capacitor

$$\Rightarrow \frac{q}{c} = \frac{Q-q}{2C}$$

$$2q = a - q$$

$$\therefore q = \frac{Q}{3}$$

$$Q - q = \frac{2Q}{3}$$

44. Though the electron drift velocity is small and electron charge is very small, a conductor can carry an appreciably large current because

(a) electron number density is very large

(b) drift velocity of electron is very large

(c) electron number density depends on temperature

(d) relaxation time is small

Ans: (a)

Sol: electron number density is very large

45. Masses of three wires of copper are in the ratio $1:3:5$ and their lengths are in the ratio $5:3:1$. The ratio of their electrical resistance are

(a) $1:3:5$ (b) $5:3:1$ (c) $1:15:125$ (d) $125:15:1$

Ans: (d)

Sol: $R = \frac{\rho L}{A}$

$$m = A.L\sigma$$

$$A \propto \frac{m}{L} \quad \therefore R \propto \frac{L^2}{m}$$

$$R_1 : R_2 : R_3 = \frac{25}{1} : \frac{9}{3} : \frac{1}{5}$$

$$= 125 : 15 : 1$$

46. An aluminium sphere is dipped into water. Which of the following is true?

(a) Buoyancy will be less in water at $0°C$ than that in water at $4°C$

(b) Buoyancy will be more in water at $0°C$ than that in water at $4°C$

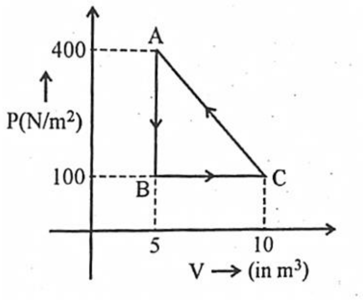
(c) Buoyancy in water at $0°C$ will be same as that in water at $4°C$

(d) Buoyancy may be more or less in water at $4°C$ depending on the radius of the sphere

Ans: (d)

Sol: $B = \rho V g$

47. A thermodynamic system undergoes a cyclic process ABC as shown in the diagram. The work done by the system per cycle is



(a) 750 J (b) −1250 J (c) −750 J (d) 1250 J

Ans: (c)

Sol: $W = \frac{1}{2}(10-5)(400-100) = \frac{1}{2}\times 5\times 300$

$W = -750J$ [anti clock wise]

48. One mole of O_2 gas is heated at constant pressure starting at $27\ °C$. How much energy must be added to the gas as heat to double its volume?

(a) Zero (b) 450 R (c) 750 R (d) 1050 R

Ans: (d)

Sol: $T_1 = 27^o C = 300K \quad T_2 = ?$

$V_1 = V \qquad V_2 = 2V$

$PV = nRT \qquad$ Now, $Q = nC_p dt$

$\Rightarrow \frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad = \left(\frac{7R}{2}\right)\times 300\left[C_p = \frac{7R}{2} \text{ for } O_2\right]$

$\frac{V}{300} = \frac{2V}{T_2} \qquad \therefore Q = \frac{2100R}{2}$

$T_2 = 600K \qquad = 1050R$

49. A piston is performing S.H.M. in the vertical direction with a frequency of 0.5 Hz. A block of 10 kg is placed on the piston. The maximum amplitude of the system such that the block remains in contact with the piston is

(a) 1 m (b) 0.5 m (c) 1.5 m (d) 0.1 m

Ans: (a)

Sol: $mg = m\omega^2 x$

$$x = \frac{g}{\omega^2} = \frac{g}{(2\pi v)^2} = \frac{10}{(2\pi \times 0.5)^2} = \frac{10}{\pi^2} = 1m$$

50. The equation of a stationary wave is $y = 2\sin\left(\frac{\pi x}{15}\right)\cos(48\pi t)$. The distance between a node and its next antinode is

(a) 7.5 units (b) 1.5 units (c) 22.5 units (d) 30 units

Ans: (a)

Sol: Comparing given equation with $y = 2A\sin Kx\cos wt$

We get $K = \frac{\pi}{15}$

But $K = \frac{2\pi}{\lambda}$

$\Rightarrow \frac{2\pi}{\lambda} = \frac{\pi}{15}$

$\therefore \lambda = 30$ units

Distance between node & anti node $= \lambda/4$

$= 7.5$ units

51. An insulator of inductance L and resistor R are joined together in series and connected by a source of frequency ω. The power dissipated in the circuit is

(a) $\frac{R^2+\omega^2L^2}{V}$ (b) $\frac{V^2R}{R^2+\omega^2L^2}$ (c) $\frac{V}{R^2+\omega^2L^2}$ (d) $\frac{V^2R}{\sqrt{R^2+\omega^2L^2}}$

Ans: (b)

Sol: Energy is dissipated by resistor in the form of heat

$\therefore P = I^2R = \frac{V^2R}{Z^2}$ $\quad \because [V = IZ)$

$$P = \frac{V^2R}{R^2+\omega^2L^2}$$

52. An electromagnetic wave is travelling in x-direction with electric field vector given by, $\vec{E}_y = E_0 \sin(kx - \omega t)\hat{j}$. The correct expression for magnetic field vector is

(a) $\vec{B}_y = E_0 C \sin(kx - \omega t)\hat{j}$
(b) $\vec{B}_z = E_0 C \sin(kx - \omega t)\hat{k}$
(c) $\vec{B}_y = \frac{E_0}{C} \sin(kx - \omega t)\hat{j}$
(d) $\vec{B}_z = \frac{E_0}{C} \sin(kx - \omega t)\hat{k}$

Ans: (d)

Sol: $\overrightarrow{B_z}$ and $\overrightarrow{E_y}$ are perpendicular to each other

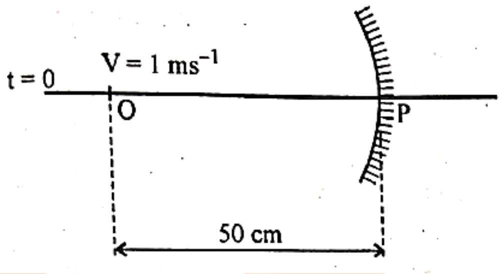
53. The phenomenon involved in the reflection of radio-waves by ionosphere is similar to

(a) reflection of light by plane mirror
(b) total internal reflection of light in air during a mirage
(c) dispersion of light by water molecules during the formation of a rainbow
(d) scattering of light by air particles

Ans: (b)

Sol: total internal reflection of light in air during a mirage

54. A point object is moving uniformly towards the pole of a concave mirror of focal length 25 cm along its axis as shown below. The speed of the object is $1\ \text{m s}^{-1}$. At $t = 0$, the distance of the object from the mirror is 50 cm. The average velocity of the image formed by the mirror between time $t = 0$ and $t = 0.25$ s is



(a) $40\ \text{cm s}^{-1}$
(b) $20\ \text{cm s}^{-1}$
(c) Zero
(d) Infinity

Ans: (d)

Sol: At $t = 0.25s$, the point object is at the focal length of the mirror. Hence its image will be formed at infinity. Therefore, average velocity of the image is infinity.

55. A certain prism is found to produce a minimum deviation of $38°$. It produces a deviation of $44°$ when the angle of incidence is either $42°$ or $62°$. What is the angle of incidence when it is undergoing minimum deviation?

(a) $30°$
(b) $40°$
(c) $49°$
(d) $60°$

Ans: (c)

Sol: When $i_1 = 42^o$ and $i_2 = 62^o$, $\delta = 44^o$

Now, $\delta = i_1 + i_2 - A$

$\Rightarrow 44 = 42 + 62 - A$

$\therefore A = 60^o$

For minimum deviation $i_1 = i_2 = i$ & $\delta = 38^o$

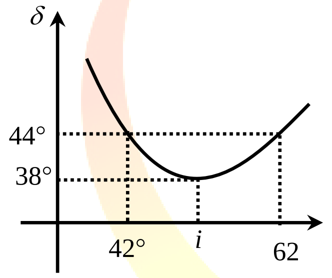
$\Rightarrow 38^o = i + i - 60^o$

$38^o = 2i - 60^o$

$2i = 98^o$

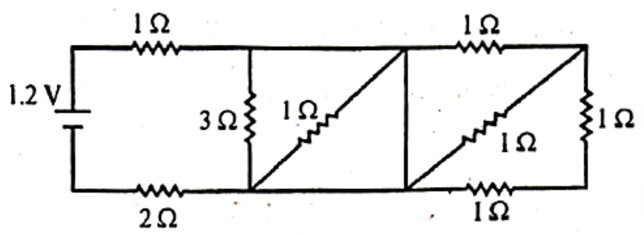
$i = 49^o$

Alternate method



Should be between 42^o & 62^o and closer to 42^o

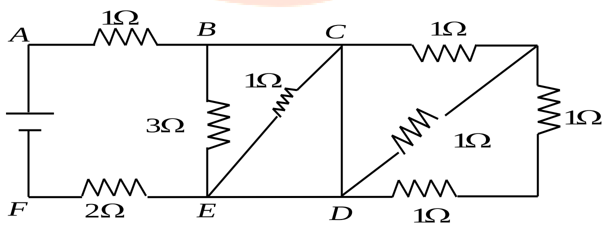
56. In the given circuit, the current through $2\ \Omega$ resistor is



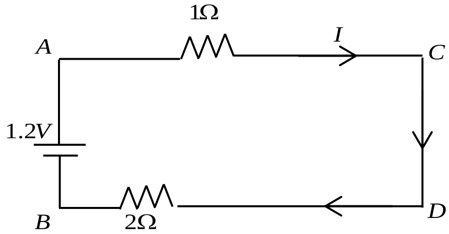
(a) 0.2 A (b) 0.3 A (c) 0.4 A (d) 0.1 A

Ans: (c)

Sol:



Since, the points B & E are directly connected 6y a wire the circuit can be redrawn as below



$$I = \frac{V}{R} = \frac{1.2}{1+2} = 0.4A$$

57. Kirchhoff's junction rule is a reflection of

(a) Conservation of current density vector

(b) Conservation of energy

(c) Conservation of momentum

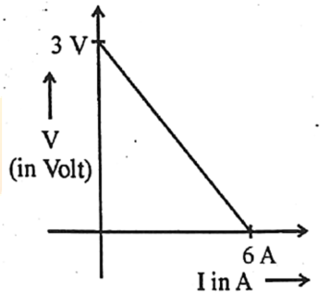
(d) Conservation of charges

Ans: (d)

Sol: Conservation of charges

58. The variation of terminal potential difference (V) with current flowing through a cell is as shown

The emf and internal resistance of the cell are



(a) 3 V, 2 Ω (b) 3 V, 0.5 Ω (c) 6 V, 2 Ω (d) 6 V, 0.5 Ω

Ans: (b)

Sol: $V = E - Ir$

When $I = 0A, V = 3V$

$\Rightarrow 3 = E - 0$

$\therefore E = 3V$

When $I = 6A, V = 0V$

$\Rightarrow 0 = 3 - 6r$

$\therefore r = 0.5\Omega$

59. In a potentiometer experiment, the balancing point with a cell is at a length 240 cm. On shunting the cell with a resistance of 2 Ω, the balancing length becomes 120 cm. The internal resistance of the cell is

(a) 4 Ω (b) 2 Ω (c) 1 Ω (d) 0.5 Ω

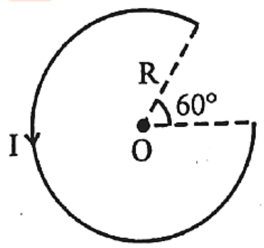
Ans: (b)

Sol: $r = R\left[\frac{l_1}{l_2} - 1\right]$

$= 2\left[\frac{240}{120} - 1\right]$

$r = 2\Omega$

60. The magnetic field at the centre 'O' in the given figure is



(a) $\frac{7}{14}\frac{\mu_o I}{R}$ (b) $\frac{5}{12}\frac{\mu_o I}{R}$ (c) $\frac{3}{10}\frac{\mu_o I}{R}$ (d) $\frac{\mu_o I}{12R}$

Ans: (b)

Sol: $B = \frac{\mu_0}{2R}$

Since $n = \frac{5}{6}$

$\therefore B = \frac{\mu_0}{12R}$

Key Answers:

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

Q21: Grace