



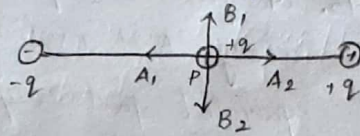
Padalsalai's Telegram Groups!

(தலைப்பிற்கு கீழே உள்ள லிங்கை கிளிக் செய்து குழுவில் இணையவும்!)

- Padalsalai's NEWS - Group
https://t.me/joinchat/NIfCqVRBNj9hhV4wu6_NqA
- Padalsalai's Channel - Group
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- 12th Standard - Group
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- 11th Standard - Group
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- 9th Standard - Group
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1. Two identical point charges of magnitude $-q$ are fixed as shown in figure below. A 3rd charge $+q$ is placed midway between the two charges at the point P. Suppose this charge $+q$ is placed small distance from the point P in the direction indicated by the arrows, in which direction will $+q$ be stable with respect to displacement?

Ans: (b) B_1 and B_2

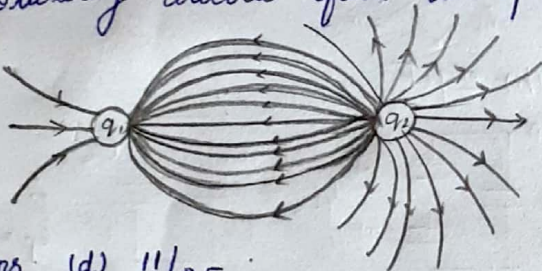


When $+q$ is moved along B_1 and B_2 , $+q$ will be stable.

2. Which charge configuration produces an uniform electric field?

Ans: (c) uniformly charged infinite plane

3. What is the ratio of charge $\left| \frac{q_1}{q_2} \right|$ for following electric field line pattern.



Ans: (d) $11/25$

q_1 - negative charge, q_2 - positive charge. The number of line from q_2 to q_1 is 11 and number of lines in q_2 is 25. $\Rightarrow \left| \frac{q_1}{q_2} \right| = 11/25$

4. An electric dipole is placed at an alignment angle of 30° with an electric field of $2 \times 10^5 \text{ NC}^{-1}$. It experiences a torque

equal to 8 Nm . The charge on the dipole if the dipole length is 1 cm is

Ans: (b) 8 mC

$$\tau = Eqd \sin \theta$$

$$q = \frac{\tau}{E \cdot d \sin \theta} \Rightarrow q = \frac{8}{2 \times 10^5 \times 10^{-2} \times \sin 30^\circ}$$

$$q = \frac{8}{2 \times 10^5 \times 10^{-2} \times 1/2} \Rightarrow q = 8 \times 10^{-3} \text{ C}$$

5. Four Gaussian surfaces are given below with charges inside each gaussian surface. Rank the electric flux through each Gaussian surface in increasing order.

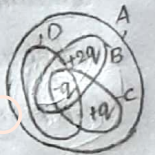
Ans: (a) $D < C < B < A$

Electric flux at A = $2q/\epsilon_0$

Electric flux at B = q/ϵ_0

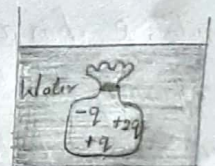
Electric flux at C = $0/\epsilon_0 = 0$

Electric flux at D = $-q/\epsilon_0$



6. The total electric flux for the following closed surface which is kept inside water

Ans: (b) $\frac{q}{40\epsilon_0}$



$$\phi = \frac{q}{\epsilon_r \epsilon_0} \Rightarrow \phi = \frac{2q}{80\epsilon_0} \Rightarrow \frac{q}{40\epsilon_0}$$

$\therefore$ here $q = 2q$, ϵ_r of Water = 80.

7. Two identical conducting balls having positive charge q_1 and q_2 are separated by a center to center distance r . If they are made to touch each other and then separated to the same distance, the force between them will be

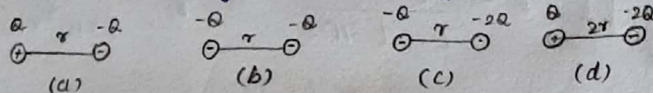
Ans: (c) more than before.

$$F \propto q_1 q_2, \text{ After touching } F' \propto q^2$$

Naturally, $q^2 > q_1 q_2$

$$\therefore F' > F$$

8. Rank the electrostatic potential energies for the following in increasing order



Ans: (a) $1 = 4 < 2 < 3$

$$U_1 \propto -\frac{Q^2}{r}; U_2 \propto \frac{Q^2}{r}; U_3 \propto \frac{2Q^2}{r};$$

$$U_4 \propto -\frac{2Q^2}{2r} \propto -\frac{Q^2}{r}$$

9. An electric field $\vec{E} = 10x\hat{i}$ exists in a certain region of space. Then the potential difference $V = V_0 - V_A$, when V_0 is the potential at the origin and V_A is potential at $x = 2\text{m}$ is

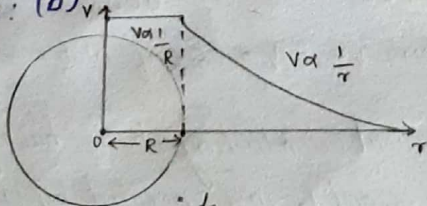
Ans: (c) $+20\text{J}$

$$V = V_0 - V_A = \int_{V_A}^{V_0} \vec{E} \cdot d\vec{x} = - \int_0^2 10x \cdot dx$$

$$V = -10 \left[\frac{x^2}{2} \right]_0^2 = -5 [0 - 4] = +20\text{V}$$

10. A thin conducting spherical shell of radius R has a charge Q which is uniformly distributed on its surface. The correct plot for electrostatic potential due to spherical shell is

Ans: (b)



11. Two potential points A and B are maintained at potential of 7V and -4V respectively. The work done in moving 50 electrons from A to B is

Ans: $8.80 \times 10^{-17}\text{J}$

$$q = ne = -50 \times 1.6 \times 10^{-19}$$

$$\Delta V = V_B - V_A = -4 - 7 = -11\text{V}$$

$$W = q\Delta V = -50 \times 1.6 \times 10^{-19} \times -11 = 880 \times 10^{-19}\text{J}$$

12. If voltage applied on a capacitance is increased from V to $2V$, choose the correct conclusion.

Ans: (c) C remains same, Q doubled

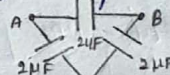
If V is doubled then Q also doubled but $C = Q/V = 2Q/2V = Q/V$, C remains same.

13. A parallel plate capacitor stores a charge Q at a voltage V . Suppose the area of parallel plate capacitor and the distance between the plates are each doubled then which is the quantity that will change?

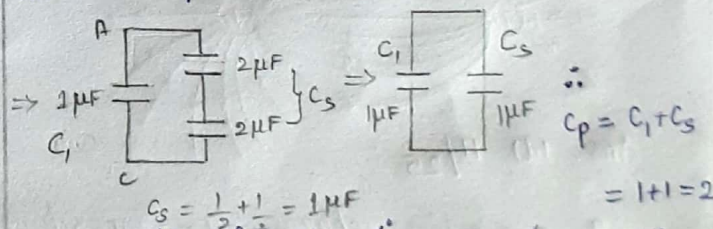
Ans: (d) Energy density.

If A and d are doubled then C, V remains same but energy density varies.

14. Three capacitors are connected in triangle as shown in figure. The equivalent capacitance between the point A and C is



Ans: (b) $2\mu\text{F}$



$$C_3 = \frac{1}{\frac{1}{2} + \frac{1}{2}} = 1\mu\text{F}$$

$$= 1 + 1 = 2$$

15. Two metallic spheres of radius 1cm and 3cm are given charges of $-1 \times 10^{-2}\text{C}$ and $5 \times 10^{-2}\text{C}$ respectively. If these are connected by a conducting wire, the final charge on the bigger sphere is

Ans: (a) $3 \times 10^{-2}\text{C}$

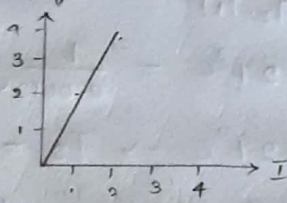
$$\text{here, } V_1 = V_2 \therefore \frac{q_1}{r_1} = \frac{q_2}{r_2} = \frac{Q}{r_1 + r_2} = \frac{q_1 + q_2}{r_1 + r_2}$$

$$\Rightarrow q_2 = \left(\frac{q_1 + q_2}{r_1 + r_2} \right) r_2 = \left(\frac{3 \times 10^{-2}}{4 \times 10^{-2}} \right) \times 4 \times 10^{-2}$$

$$\Rightarrow q_2 = 3 \times 10^{-2}\text{C}$$

UNIT - 2

1. The following graph shows current versus voltage value of some unknown conductor. What is the resistance of this conductor?

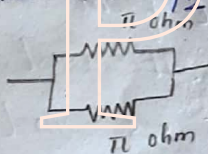


Ans: (a) 2 ohm.

$$R = \Delta V / \Delta I = 4/2 = 2 \text{ ohm.}$$

2. A wire of resistance 2 ohms per meter is bent to form a circle of radius 1m. The equivalent resistance between its two diametrically opposite point A and B as shown in figure is

Ans: (b) $\pi/2$ ohm.



$$\Rightarrow R_p = \pi/2 \text{ ohm.}$$

3. A heater operating at 240V has a resistance of 120 ohm. The power is

Ans: (c) 480 W

$$P = V^2 / R = \frac{240 \times 240}{120} = 480 \text{ W}$$

4. A carbon resistor of $(47 \pm 4.7) \text{ k ohm}$ to be marked with rings of different colours for its identification. The colour code sequence will be

Ans: (b) yellow - violet - Orange - Silver

$$R = 47 \times 10^3 \pm 10\% \rightarrow \text{Silver.}$$

$\downarrow \quad \downarrow \quad \downarrow$
 yellow violet Orange

5. What is the value of resistance of the following resistor?

Ans: (a) 100 k ohm

brown black yellow
 $\downarrow$ $\downarrow$ $\downarrow$
 1 0 10^4

$$\Rightarrow 10 \times 10^4 \Omega = 100 \text{ k ohm.}$$

6. Two wires A and B with circular cross section made up of same material with equal lengths. Suppose $R_A = 3R_B$, then what is the ratio of radius of wire A to that of B?

Ans: (c) $\frac{1}{\sqrt{3}}$

$$R \propto \frac{L}{A} \propto \frac{1}{r^2} \Rightarrow \frac{R_A}{R_B} = \frac{r_B^2}{r_A^2} \Rightarrow \frac{r_B^2}{r_A^2} = \frac{3R_B}{R_B}$$

$$\Rightarrow \frac{r_B^2}{r_A^2} = 3 \Rightarrow \frac{r_A^2}{r_B^2} = \frac{1}{3} \Rightarrow \frac{r_A}{r_B} = \frac{1}{\sqrt{3}}$$

7. A wire connected to a power supply of 230V has power dissipation P_1 . Suppose the wire is cut into two equal pieces and connected parallel to same power supply. In this case power dissipation is P_2 . The ratio $\frac{P_2}{P_1}$ is

Ans: (d) 4.

$$P_1 \propto \frac{1}{R}, \quad \text{---} \left[\begin{array}{c} R/2 \\ R/2 \end{array} \right] \quad R/4 = R'$$

$$\Rightarrow P_2 \propto \frac{1}{R'} \quad \therefore \frac{P_2}{P_1} = \frac{R}{R'} = \frac{R}{(R/4)} = 4$$

8. In India electricity supplied for domestic use at 220V. It is supplied at 110V in USA. If the resistance of a 60W bulb for use in India is R, the resistance of a 60W bulb for use in USA will be

Ans: (c) $R/4$

$$\frac{V_1^2}{R_1} = \frac{V_2^2}{R_2} \Rightarrow R_2 = \left(\frac{V_1^2}{V_2^2} \right) R_1$$

$$\Rightarrow R_2 = \left(\frac{110 \times 110}{220 \times 220} \right) R_1 \Rightarrow R_2 = R_1 / 4$$

9. In a large building, there are 15 bulbs of 40 W, 5 bulbs of 100 W, 5 fans of 80 W and 1 heater of 1 kW are connected. The voltage of electric mains is 220 V. The minimum capacity of the main fuse of building will be

Ans: (d) 12 A.

$$P_{\text{tot}} = (15 \times 40) + (5 \times 100) + (5 \times 80) + (1 \times 1000) \Rightarrow P = 600 + 500 + 400 + 1000$$

$$\Rightarrow P = 2500 \text{ W} \therefore I = P/V = 2500/220$$

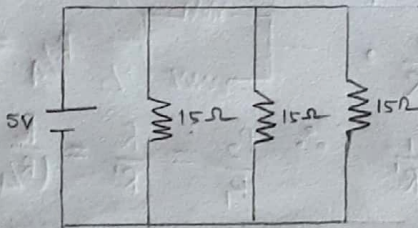
$$\Rightarrow I = 11.36 \approx 12 \text{ A}$$

10. There is a current of 1.0 A in the circuit shown below. What is the resistance of P?

Ans: (c) 3.5 Ω

$$9 = P + 2.5 + 3 \Rightarrow P = 3.5 \Omega$$

11. What is the current out of battery?



Ans: 1 A

$$I = \frac{V}{R_{\text{eff}}} \quad \therefore R_{\text{eff}} = \frac{R}{n} = \frac{15}{3} = 5 \Omega$$

$$I = 5/5 = 1 \text{ A}$$

12. The temperature coefficient of resistance of wire is 0.00125 per $^{\circ}\text{C}$. At 300 K, its resistance is 1 Ω . The resistance

of a wire will be 2 Ω at

Ans: (d) 1127 K.

$$\alpha = \frac{R_2 - R_1}{R_1 (T_2 - T_1)}$$

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

$$\Rightarrow T_2 - 27^{\circ}\text{C} = \frac{1}{0.00125} \Rightarrow T_2 - 27 = 800$$

$$\Rightarrow T_2 = 827^{\circ}\text{C} \Rightarrow T_2 = 1100 \text{ K}$$

13. The internal resistance of a 2.1 V cell which gives current of 0.2 A through a resistance of 10 Ω is

Ans: (b) 0.5 Ω

$$r = \frac{E - V}{I} \quad \therefore V = IR \Rightarrow V = 0.2 \times 10 = 2 \text{ V}$$

$$r = \frac{2.1 - 2}{0.2} \Rightarrow r = \frac{0.1}{0.2} = 0.5 \Omega$$

14. A piece of copper and another of germanium are cooled from room temperature to 80 K. The resistance of

Ans: (d) copper decreases and germanium increases.

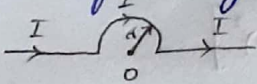
$\therefore$ If temperature decreases, the resistance of conductor decreases while the resistance of semi-conductor increases.

15. In Joule's law of heating, when I and t are constant, if the H is taken along y axis and I^2 along x axis, the graph is

Ans: (a) straight line.

$$H \propto I^2$$

1. The magnetic field at a centre O of the following current loop is



Ans: (a) $\frac{\mu_0 I}{4r} \otimes$

$$B = \int dB = \int_0^{\pi r} \frac{\mu_0 I}{4\pi} \cdot \frac{I dl}{r^2}$$

$$\Rightarrow B = \frac{\mu_0 I}{4\pi r^2} \cdot [\ell]_0^{\pi r} = \frac{\mu_0 I}{4r} \otimes$$

2. An electron moves straight inside a charged parallel plates capacitor of uniform charge density σ . The time taken by the electron to cross the parallel plate capacitor when the plates of the capacitor are kept under constant magnetic field of induction $\vec{B}$ is

Ans: (d) $\epsilon_0 \frac{LB}{\sigma}$

$$V = E/B$$

$$E = \sigma/\epsilon_0$$

$$L/t = \frac{\sigma}{\epsilon_0 B} \Rightarrow t = \epsilon_0 \frac{LB}{\sigma}$$

3. The force experienced by a particle having mass m and charge q accelerated through a potential difference V when it is kept under perpendicular magnetic field $\vec{B}$ is:

Ans: (c) $\sqrt{\frac{2q^3 B^2 V}{m}}$

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

$$v = \sqrt{\frac{2qV}{m}}$$

$$F = Bqv = Bq \sqrt{\frac{2qV}{m}}$$

$$F = \sqrt{\frac{2q^3 B^2 V}{m}}$$

4. A circular coil of radius 5 cm and has 50 turns carries a current of 3 ampere. The magnetic dipole moment of coil is:

Ans: (b) 1.2 amp-m²

$$A = \pi r^2$$

$$M = NIA = 50 \times 3 \times 3.14 \times (5 \times 10^{-2})^2$$

$$M = 1.17 \approx 1.2 \text{ A-m}^2$$

5. A thin insulated wire forms a plane spiral of $N = 100$ tight turns carrying a current $I = 8$ mA. The radii of inside and outside turns are equal to $a = 50$ mm and $b = 100$ mm respectively. The magnetic induction at the centre of spiral is:

Ans: (b) 7 μ T

$$B = \frac{\mu_0 N I}{2(b-a)} \ln\left(\frac{b}{a}\right) = \frac{4\pi \times 10^{-7} \times 8 \times 10^{-3} \times 100^2}{2(100-50) \times 10^{-3}} \ln\left(\frac{100}{50}\right)$$

$$B = 4 \times 3.14 \times 10^{-7} \times 8 \times 2.303 \log 2$$

$$B = 69.65 \times 10^{-7} \approx 7 \mu\text{T} \quad \log 2 = 0.3010$$

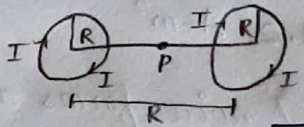
6. Three wires of equal length are bent in the form of loops. One of the loops is circle, another is a semicircle and the third one is a square. They are placed in a uniform magnetic field and same electric current is passed through them. Which will experience greater torque.

Ans: (a) Circle

$$A_{\text{circle}} > A_{\text{square}} > A_{\text{semi-circle}}$$

$$\tau_{\text{circle}} > \tau_{\text{square}} > \tau_{\text{semi-circle}}$$

7. Two identical coils, each with N turns and radius R are placed coaxially at a distance R as shown in figure. If I is the current passing through the loops of in the same direction, then magnetic field at a point P which is at a distance $R/2$ between two coil is:



Ans: (b) $\frac{8N\mu_0 I}{5^{3/2}R}$

$$B_1 = \frac{4N\mu_0 I}{5^{3/2}R} \quad \frac{n\mu_0 I R^2}{2(R^2 + x^2)^{3/2}} \quad x = R/2$$

$$B_1 = \frac{n\mu_0 I R^2}{2(R^2 + R^2/4)^{3/2}} = \frac{n\mu_0 I R^2}{2(5R^2/4)^{3/2}}$$

$$B_1 = \frac{n\mu_0 I R^2}{\frac{5^{3/2}}{4}(R^3)} = \frac{4N\mu_0 I}{5^{3/2}R} = B_2$$

$$B_T = B_1 + B_2 = \frac{8N\mu_0 I}{5^{3/2}R}$$

8. A wire of length l carries a current I along the y direction and magnetic field is given by $\vec{B} = \frac{B}{\sqrt{3}}(\hat{i} + \hat{j} + \hat{k})$ T. The magnitude of Lorentz force acting on wire is:

Ans: (a) $\sqrt{\frac{2}{3}} BIl$

$$\vec{F} = I \vec{l} \times \vec{B}$$

$$\vec{F} = I l \hat{j} \times \frac{B}{\sqrt{3}}(\hat{i} + \hat{j} + \hat{k})$$

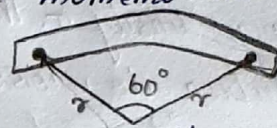
$$\vec{F} = \frac{I l B}{\sqrt{3}} [(\hat{j} \times \hat{i}) + (\hat{j} \times \hat{j}) + (\hat{j} \times \hat{k})]$$

$$\vec{F} = \frac{I l B}{\sqrt{3}} [\hat{k} + 0 + (-\hat{i})]$$

$$\vec{F} = \frac{I l B}{\sqrt{3}} [1^2 + (-1)^2]$$

$$\vec{F} = \frac{I l B}{\sqrt{3}} \sqrt{2} = \sqrt{\frac{2}{3}} I l B$$

9. A bar magnet of length l and magnetic moment M is bent in the form of an arc as shown in figure. The new magnetic dipole moment will be:



Ans: (b) $3/\pi M$

$$M = q_m \times P$$

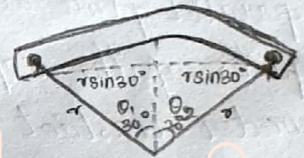
After bent

$$M' = q_m \times l'$$

$$l' = 2r \sin 30^\circ = \frac{1}{2} \times 2r = r$$

$$l/r = \pi/6 \quad \therefore r = 3l/\pi$$

$$M' = q_m \times \frac{3l}{\pi} = \frac{3}{\pi} M$$



10. A non conducting charged ring of charge q , mass m and radius r is rotated with constant angular speed ω . Find the ratio of its magnetic moment with angular velocity momentum is:

Ans: $q/2m$

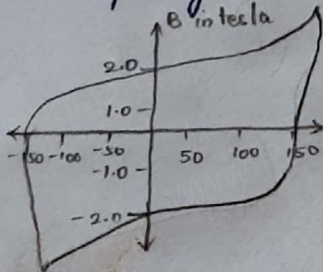
$$L = m\omega r^2$$

$$\mu_L = i \cdot A = \frac{q}{T} \cdot \pi r^2 \quad \therefore T = \frac{2\pi}{\omega}$$

$$\mu_L = \frac{q \omega \pi r^2}{2\pi} = \frac{1}{2} q r^2 \omega$$

$$\frac{\mu_L}{L} = \frac{\frac{1}{2} q r^2 \omega}{m \omega r^2} = \frac{1}{2} \frac{q}{m} = \frac{q}{2m}$$

11. The BH curve for a ferromagnetic material is shown in figure. The material is placed inside a long solenoid which contain 1000 turns/cm. The current that should be passed in the solenoid to demagnetize the ferromagnet completely:



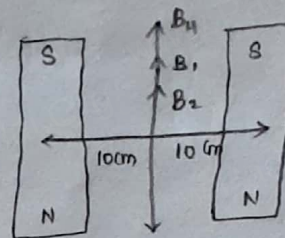
Ans: (C) 1.5 mA

$$\mu = nI \Rightarrow I = \mu/n = \frac{150}{1000 \times 10^{-2}}$$

$$\mu = \frac{150}{100} \times 10^{-3} = 1.5 \text{ mA}$$

12. Two short bar magnets have magnetic moment 1.20 Am^2 and 1.00 Am^2 respectively. They are kept on a horizontal table parallel to each other with their north poles pointing towards the south. They have a common magnetic equator and are separated by a distance of 20.0 cm. The value of resultant horizontal magnetic induction at mid-point O of line joining their centre is (Horizontal magnetic induction is $3.6 \times 10^{-5} \text{ Wb m}^{-2}$)

Ans: (C) $2.56 \times 10^{-4} \text{ T}$



$$B = B_1 + B_2 + B_H$$

$$B = \frac{\mu_0}{4\pi} \cdot \frac{M_1}{r^3} + \frac{\mu_0}{4\pi} \cdot \frac{M_2}{r^3} + B_H$$

$$B = \frac{\mu_0}{4\pi r^3} [M_1 + M_2] + B_H$$

$$B = \frac{10^{-7}}{(10^{-1})^3} [1.2 + 1] + 3.6 \times 10^{-5}$$

$$B = 2.2 \times 10^{-4} + 3.6 \times 10^{-5}$$

$$B = 2.56 \times 10^{-4} \text{ T}$$

13. The vertical component of Earth's magnetic field at a point is equal to horizontal component. What is the value of angle of dip at this point?

Ans: (b) 45°

$$B_V = B_H \quad \therefore \tan \theta = \frac{B_V}{B_H} = 1 \Rightarrow \theta = 45^\circ$$

14. A flat dielectric disc of radius R carries an excess charge on its surface. The surface charge density is σ . The disc rotates about an axis perpendicular to its plane ^{passing} through centre with angular velocity ω . Find the magnitude of torque on disc if it is placed in a uniform magnetic field whose strength is B which is directed perpendicular to the axis of rotation:

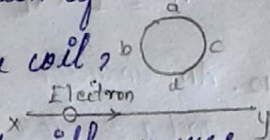
Ans: (d) $\frac{1}{4} \sigma \omega \pi B R^4$

$$M = \frac{q}{4} \omega R^2 = \frac{\sigma A}{4} \omega R^2 = \frac{\sigma \pi R^2 \omega R^2}{4}$$

$$M = \frac{1}{4} \sigma \omega \pi R^4 \Rightarrow \tau = \frac{1}{4} \sigma \omega \pi B R^4$$

UNIT - 4

1. An electron moves on a straight line path xy as shown in figure. The coil $abcd$ is adjacent to path of electron. What will be the direction of current, if any, induced in the coil?



Ans: (a) & The current will reverse its direction as the electron goes past the coil.

Electron moves towards the path, magnetic flux increases. The current flows in the direction $abcd$.

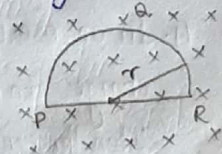
When electron moves away, magnetic flux decreases. The current flow in direction $adcb$.

2. A thin semi-circular conducting ring (PQR) of radius r is falling with its plane vertical in a horizontal magnetic field B , as shown in figure. The potential difference developed across the ring when its speed v is

Ans: (d) $2rBv$ and R is at higher potential.

$$\mathcal{E} = Blv = B2rv$$

R at higher potential.



3. The flux linked with a coil at any instant t is given by $\Phi_B = 10t^2 - 50t + 250$. The induced emf at $t = 3$ is

Ans: (b) $-10V$

$$\mathcal{E} = -\frac{d\Phi_B}{dt} = -[20t - 50] \quad t = 3$$

$$\mathcal{E} = -10V$$

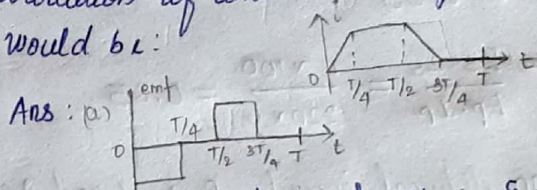
4. When the current changes from $+2A$ to $-2A$ in $0.05s$, an emf of $8V$ is induced in a coil. The coefficient of self-induction of the coil is:

Ans: (d) $0.1 H$

$$\mathcal{E} = -L \left(\frac{di}{dt} \right) \Rightarrow L = -\mathcal{E} / (di/dt)$$

$$L = \frac{8}{(4/0.05)} = 0.1 H$$

5. The current i flowing in a coil varies with time as shown in figure. The variation of induced emf with time would be:



Ans: (a)

(1) $0 \rightarrow T/4$; $\frac{di}{dt} = \text{changes}$; $\mathcal{E} = \text{negative}$ (true)

(2) $T/4 \rightarrow T/2$; $\frac{di}{dt} = 0$; $\mathcal{E} = 0$

(3) $T/2 \rightarrow 3T/4$; $\frac{di}{dt} = \text{changes}$; $\mathcal{E} = \text{positive}$ (true)

(4) $3T/4 \rightarrow T$; $\frac{di}{dt} = 0$; $\mathcal{E} = 0$

6. A circular coil with a cross-sectional area of 4 cm^2 has 10 turns. It is placed at the centre of a long solenoid that has 15 turns/cm and a cross-sectional area 10 cm^2 . The axis of the coil coincides with the axis of the solenoid. What is their mutual inductance?

Ans: (a) $7.54 \mu H$

$$M = \frac{\mu_0 N_1 N_2 A_2}{2l} = \mu_0 N_1 N_2 A_2$$

$$M = 4\pi \times 10^{-7} \times \frac{15}{10^{-2}} \times 10 \times 4 \times 10^{-4}$$

$$M = 7.54 \times 10^{-6} = 7.54 \mu H$$

7. In a transformer, the number of turns in the primary and secondary are 410

and 1230 respectively. If the current in primary is 6A, then that in the secondary coil is:

Ans: (a) 2A

$$\frac{I_s}{I_p} = \frac{N_p}{N_s} \Rightarrow I_s = \frac{N_p}{N_s} (I_p)$$

$$\Rightarrow I_s = \frac{410}{1230} \times 6 \Rightarrow I_s = 2A$$

8. A step down transformer reduces the supply voltage from 220V to 11V and increases the current from 6A to 100A. Then its efficiency is:

Ans: (b) 0.83

$$\eta = \frac{E_s \cdot I_s}{E_p \cdot I_p} = \frac{11 \times 100}{220 \times 6} = 0.83$$

9. In an electrical circuit, R, L, C and AC voltage source are all connected in series. When L is removed from the circuit, the phase difference between the voltage and current in the circuit is $\pi/3$. Instead, if C is removed from the circuit, the phase difference is again $\pi/3$. The power factor of the circuit is:

Ans: (c) 1

$$\text{here, } X_L = X_C \Rightarrow Z = R$$

$$\cos \phi = R/Z = 1$$

10. In a series RL circuit, the resistance and inductive reactant are same. Then the phase difference between the voltage and current in the circuit is:

Ans: (a) $\pi/4$

$$R = X_L \therefore \tan \phi = \frac{X_L}{R} = 1$$

$$\Rightarrow \phi = \tan^{-1}(1) \Rightarrow \phi = \pi/4$$

11. In a series resonant RLC circuit, the voltage across 100Ω resistor is 40V.

The resonant frequency ω is 250 rad/s. If the value of C is $4\mu F$, then voltage across L is:

Ans: 400V

$$X_L = X_C = \frac{1}{C\omega} = \frac{1}{4 \times 10^{-6} \times 250} = 10^3 \Omega$$

$$I = V/R = 40/100 = 0.4A$$

$$V_L = I \times X_L = 0.4 \times 10^3 = 400V$$

12. An inductor 20mH, a capacitor $50\mu F$ and a resistor 40Ω are connected in series across a source of emf $V = 10 \sin 340t$. The power loss in AC circuit is:

Ans: (c) 0.46W

$$X_L = \omega L = 20 \times 10^{-3} \times 340 = 6.8 \Omega$$

$$X_C = \frac{1}{C\omega} = \frac{1}{50 \times 10^{-6} \times 340} = 58.8 \Omega$$

$$X_L - X_C = 52 \Omega \therefore Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$Z = \sqrt{40^2 + 52^2} \Rightarrow Z = 65.6 \Omega$$

$$P = I_{rms}^2 \cdot R = \left[\frac{E_{rms}}{Z} \right]^2 \cdot R = \left[\frac{10}{65.6} \right]^2 \times 40$$

$$P = 0.46W$$

13. The instantaneous value of alternating current and voltage in a circuit are:

$$i = \frac{1}{\sqrt{2}} \sin(100\pi t) A \text{ and } v = \frac{1}{\sqrt{2}} \sin(100\pi t + \pi/3) V$$

The average power is:

Ans: (d) $1/8$

$$P_{av} = \frac{I_0 E_0}{2} \times \cos \phi = \frac{1}{2} \times \frac{1}{\sqrt{2}} \times \frac{1}{\sqrt{2}} \times \cos \pi/3 = 1/8$$

14. In an oscillating LC circuit, the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic field is

Ans: (c) $Q/\sqrt{2}$

$$U' = 1/2 \therefore \frac{Q'^2}{2C} = 1/2 \cdot \frac{Q^2}{2C} \Rightarrow Q' = Q/\sqrt{2}$$

$$\Rightarrow Q' = Q/\sqrt{2}$$

15. $\frac{20}{\pi^2}$ H inductor is connected to a capacitor of capacitance C. The value of C in order to impart maximum power at 50 Hz is: Ans: (d) $5\mu F$

$$X_L = X_C \Rightarrow C = \frac{1}{L\omega} = \frac{1}{20 \times 4\pi^2 \times 2500} = 5\mu F$$

UNIT - 5

1. The dimension of $\frac{1}{\mu_0 \epsilon_0}$ is:

Ans: (b) $[L^2 T^{-2}]$

μ_0 dimension $[M L T^{-2} A^{-2}]$

ϵ_0 dimension $[M^{-1} L^{-3} T^4 A^2]$

$$\therefore \frac{1}{\mu_0 \epsilon_0} = \frac{1}{[L^{-2} T^2]} = [L^2 T^{-2}]$$

2. If the amplitude of magnetic field is $3 \times 10^{-6} T$, then amplitude of electric field for a electromagnetic waves:

Ans: (d) $900 Vm^{-1}$

$$C = E_0 / B_0 \Rightarrow E_0 = C B_0$$

$$E = 3 \times 10^8 \times 3 \times 10^{-6} = 9 \times 10^2 Vm^{-1}$$

3. Which of the following electromagnetic radiation is used for viewing object through fog?
(d) infrared rays.

4. Which of the following are false for electromagnetic waves?
Ans: (c) longitudinal.

5. Consider an oscillator which has a charged particle and oscillates about its mean position with a frequency of 300 MHz. The wave length of electromagnetic waves produced by this oscillator is:

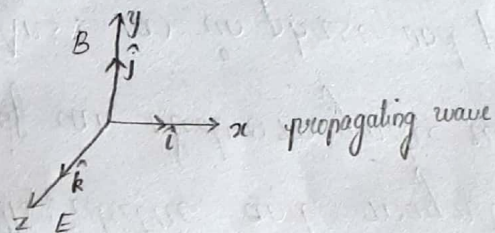
Ans: (a) 1 m

$$C = \lambda \nu \Rightarrow \lambda = C / \nu = \frac{3 \times 10^8}{300 \times 10^6}$$

$$\Rightarrow \lambda = 1 m$$

6. The electric and the magnetic field, associated with an electromagnetic wave, propagating along x axis can be represented by:

Ans: (b) $\vec{E} = E_0 \hat{k}$ and $\vec{B} = B_0 \hat{j}$



7. In an electromagnetic wave in free space the rms value of the electric field is $3 Vm^{-1}$. The peak value of magnetic field is:

Ans: (a) $1.414 \times 10^{-8} T$

$$C = E_{rms} / B_{rms} \Rightarrow B_{rms} = E_{rms} / C$$

$$B_0 = \sqrt{2} \cdot B_{rms} \Rightarrow B_0 = \sqrt{2} \cdot \frac{E_{rms}}{C}$$

$$\Rightarrow B_0 = 1.414 \cdot \left(\frac{3}{3 \times 10^8} \right) = 1.414 \times 10^{-8} T$$

8. During the propagation of electromagnetic waves in a medium.
Ans: (c) electric energy density is equal to magnetic energy density

9. If the magnetic monopole exists, then which of Maxwell's equation to be modified?

Ans: (b) $\oint \vec{E} \cdot d\vec{A} = 0$

10. A radiation of energy to be E modified falls normally on a perfectly reflecting surface. The momentum transferred to the surface is:

Ans: (b) $2E/c$

$$E = h\nu = h \cdot c/\lambda = P \cdot c$$

$$\Rightarrow P = E/c$$

Initial momentum $P_i = E/c$

Final momentum $P_f = -E/c$

$$\Delta P = -2E/c$$

The momentum transferred to surface $= |\Delta P| = 2E/c$

11. Which of the following is an electromagnetic wave?

Ans: (c) γ -rays.

12. Which of them is used to produce a propagating electromagnetic waves?

Ans: (a) an accelerating charge.

13. Let $E = E_0 \sin(10^6 x - \omega t)$ be the electric field of plane electromagnetic wave, the value of ω is:

Ans: $3 \times 10^{14} \text{ rad s}^{-1}$

$$E = E_0 \sin(10^6 x - \omega t)$$

$$E = E_0 \sin(kx - \omega t)$$

$$k = 10^6 \quad \therefore k = \omega/c$$

$$\Rightarrow kc = \omega \Rightarrow \omega = 10^6 \times 3 \times 10^8$$

$$= 3 \times 10^{14} \text{ rad s}^{-1}$$

14. Which of the following is not true for electromagnetic waves?

Ans: (d) In Vacuum, it travels with different speeds which depends on their frequency.

$\therefore$ In vacuum, speed remains constant.

15. The electric and magnetic field of an electromagnetic wave are:

Ans: (a) in phase and perpendicular to each others.