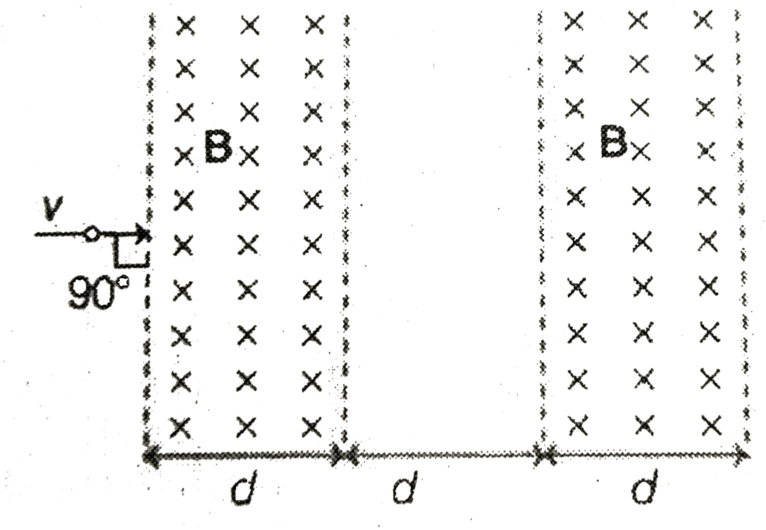
PHYSICS

BOOKS - CENGAGE PHYSICS (ENGLISH)

MISCELLANEOUS VOLUME 5

Single Correct

1. A positive charged particle of mass m and charge q is projected with velocity v as shown in the figure. If radius of curvature of charged particle in magnetic field is $R(2d < R < 3d)$, then time lapse by charged particle in magnetic field regions is :



A. $\frac{2m}{qB}\sin^{-1}\left(\frac{dqB}{mv}\right)$

B. $\frac{2m}{qB}\sin^{-1}\left(\frac{mv}{dqB}\right)$

C. $\frac{m}{qB}\sin^{-1}\left(\frac{dqB}{mv}\right)$

D. $\frac{m}{qB}\sin^{-1}\left(\frac{mv}{dqB}\right)$

Answer: C

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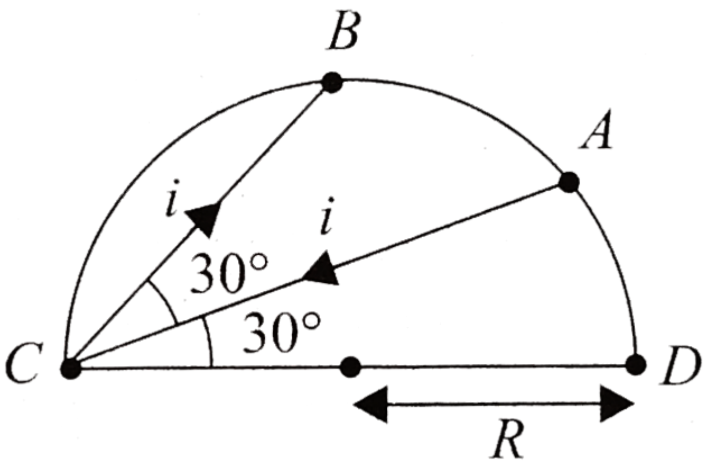
2. A current carrying wire is placed in the grooves of an insulating semicircular disc of radius 'R', as shown in Fig. The current enters at point A and leaves from point B. Determine the magnetic field at Point D.



A. $\dfrac{\mu_0 i}{8\pi R\sqrt{3}}$

B. $\dfrac{\mu_0 i}{4\pi R\sqrt{3}}$

C. $\dfrac{\sqrt{3}\mu_0 i}{8\pi R}$

D. None of these

Answer: B

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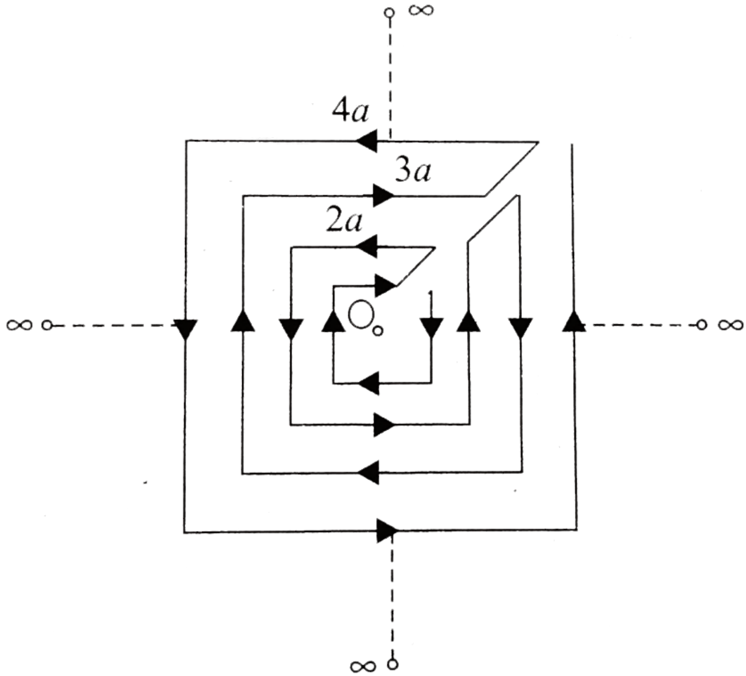
3. Determine the magnetic field at the centre of the current carrying wire arrangement shown in Fig. The arrangement extends to infinity. (The wires joining the successive squares are along the line passing through the centre).



A. $\frac{\mu_0 i}{\sqrt{2}\pi a}$

B. 0

C. $\frac{2\sqrt{2}\mu_0 i}{\pi a} 1n2$

D. None of these

Answer: C

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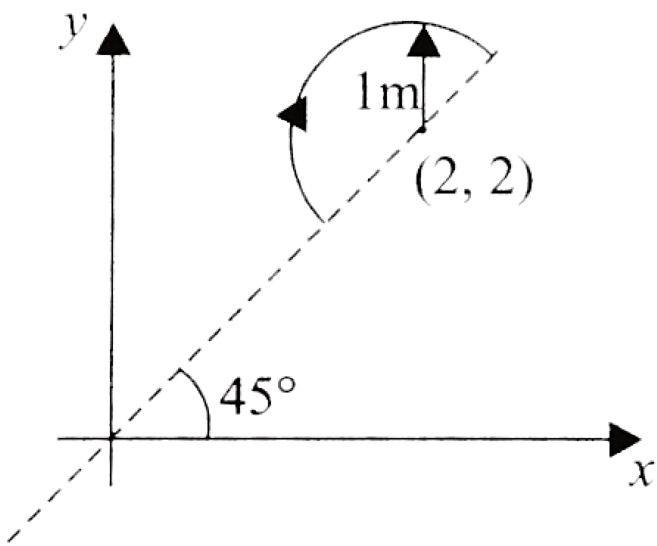
4. A uniform magnetic field $\vec{B} = 3\hat{i} + 4\hat{j} + \hat{k}$ exists in region of space. A semicircular wire of radius of 1 m carrying current 1 A having its centre at (2, 2, 0) is placed in x-y plane as shown in Fig. The force on semicircular wire will be



A. $\sqrt{2}\left(\hat{i}+\hat{j}+\hat{k}\right)$

B. $\sqrt{2}\left(\hat{i}-\hat{j}+\hat{k}\right)$

C. $\sqrt{2}\left(\hat{i}+\hat{j}-\hat{k}\right)$

D. $\sqrt{2}\left(-\hat{i}+\hat{j}+\hat{k}\right)$

Answer: B

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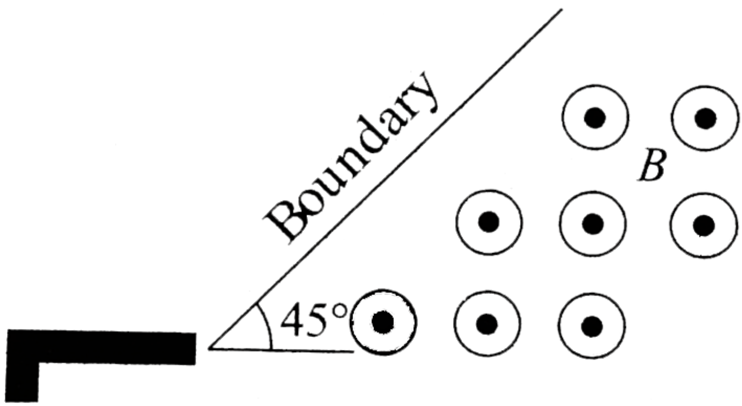
5. An electron gun ejects electrons at an angle of 45° with magnetic field boundary as shown in Fig. Find the angular deviation of electrons as it comes out of field.



A. 45°

B. 90°

C. 60°

D. None of these

Answer: B

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6. In a certain region of space, there exists a uniform and constant electric field of strength E along x-axis and uniform constant magnetic field of induction B along z-axis. A charge particle having charge q and mass m is projected with speed v parallel to x-axis from a point (a, b, 0). When the particle reaches a point(2a, $b/2$, 0) its speed becomes 2v. Find the value of electric field strength in term of m, v and co-ordinates.

A. $\frac{3}{2}\frac{mv^2}{qa}$

B. $\frac{mv^2}{qa}$

C. $\frac{2mv^2}{qBa}$

D. $\frac{3}{2}vB$

Answer: A

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7. A particle of specific charge $q/m=(\pi)C/kg$ is projected from the origin towards positive x-axis with a velocity of $10m/s$ in a uniform magnetic field $\overrightarrow{B}=-2\widehat{K}$ Tesla. The velocity $\overrightarrow{V}$ of the particle after time $t=1/6$ s will be

A. $\left(5\hat{i}+5\sqrt{3}\hat{j}\right)m/s$

B. $10\hat{j}m/s$

C. $\left(5\sqrt{3}\hat{i}+5\hat{j}\right)m/s$

D. $-10\hat{j}m/s$

Answer: A

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8. An (α)-particle and a proton are both simultaneously projected in opposite direction into a region of constant magnetic field perpendicular to the direction of the field. After some time it is found that the velocity of the (α)-particle has changed in a direction by 45°. Then at this time, the angle between velocity vectors of (α)-particle and proton is

A. 90°

B. 45°

C. 135°

D. none

Answer: C

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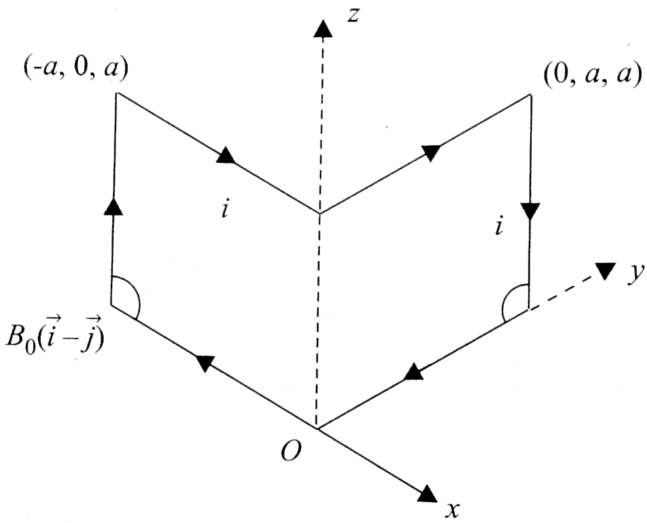
9. The torque experienced by a given current carrying loop in a uniform magnetic field $\vec{B}$ given by $B_0\left(\hat{i}-\hat{j}\right)$

would have magnitude



A. $\sqrt{2}B_0a^2I$

B. zero

C. $2B_0a^2I$

D. B_0a^2I

Answer: B

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10. A wire is wound on a long rod of material of relative permeability $\mu_r = 4000$ to make a solenoid. If the current through the wire is 5 A and number of turns per unit length is 1000 per metre, then the magnetic field inside the solenoid is

A. $4\pi mT$

B. $8\pi mT$

C. $4\pi T$

D. $8\pi T$

Answer: D

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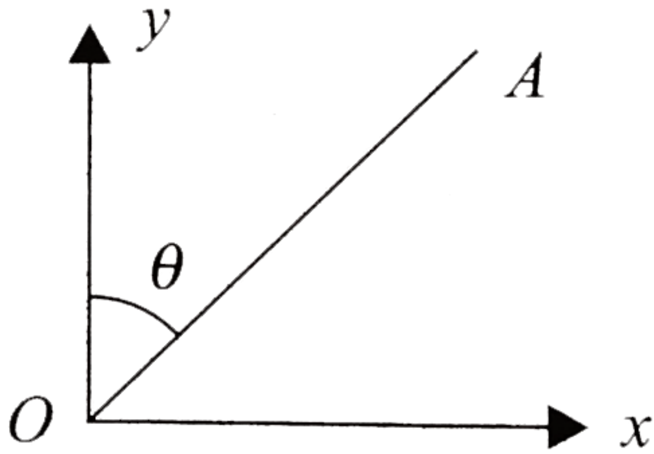
11. A uniform magnetic field B and electric field E exist along y and negative z axis respectively. Under the influence of these field a charge particle moves along OA undeflected. If electric field is switched off, find the pitch of helical trajectory in which the particle will move.



A. $\dfrac{2\pi mE}{qB^2 \cot\theta}$

B. $\dfrac{4\pi mE}{qB^2 \tan\theta}$

C. $\dfrac{4\pi mE}{qB^2 \cot\theta}$

D. $\dfrac{2\pi mE}{qB^2 \tan\theta}$

Answer: D

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12. Axis of a solid cylinder of infinite length and radius R lies along y-axis. It carries a uniformly distributed current I along +y direction. Magnetic field at a point $(R/2, y, R/2)$ is

A. $\dfrac{\mu_0 I}{4\pi R}\left(\hat{i} - \hat{k}\right)$

B. $\dfrac{\mu_0 I}{2\pi R}\left(\hat{j} - \hat{k}\right)$

C. $\dfrac{\mu_0 I}{4\pi R}\hat{j}$

D. $\frac{\mu_0 I}{4\pi R}\left(\hat{i}+\hat{k}\right)$

Answer: A

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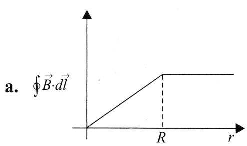
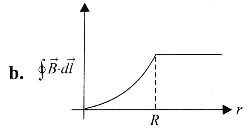
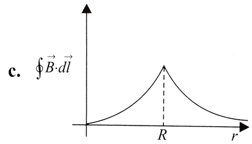
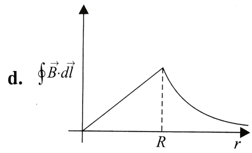
13. A cylinder wire of radius R is carrying uniformly distributed current I over its cross-section. If a circular loop of radius r is taken as amperian loop, then the variation value of $\oint \vec{B} \cdot \vec{dl}$ over this loop with radius 'r' of loop will be best represented by

A. 

B. 

C. 

D. 

Answer: B

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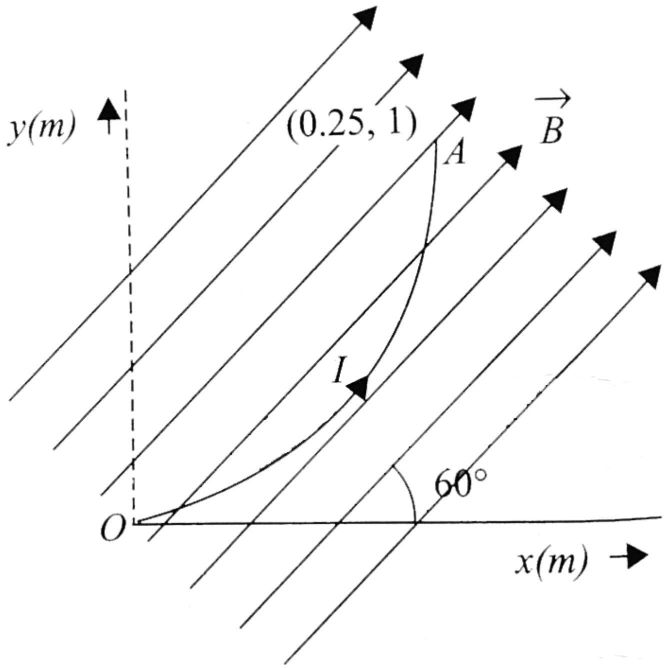
14. A parabolic section of wire OA is located in the x-y plane and carries current $I = 12A$. A uniform magnetic field $B = 4.0T$ making an angle 60° with x axis exists in x-y plane. Calculate the magnetic force on the wire OA.

Coordinates of A are (0.25 m, 1 m)



A. $6\left(\sqrt{3}-4\right)\hat{k}N$

B. $6\left(4-\sqrt{3}\right)\hat{k}N$

C. $3\left(\sqrt{3}-4\right)\hat{k}N$

D. $3\left(4-\sqrt{3}\right)\hat{k}N$

Answer: A

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15. Two coils of self inductance 100 mH and 400 mH are placed very closed to each other. Find maximum mutual inductance between the two when 4 A current passes through them.

A. 200mH

B. 300mH

C. $100\sqrt{2}mH$

D. none of these

Answer: A

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16. In a region at a distance r from z-axis, magnetic field $\vec{B} = B_0 r t \hat{k}$ is present where B_0 is constant and t is time. Then the magnetic of induced electric field at a distance r from z-axis is given by

A. $\frac{r}{2} B_0$

B. $\frac{r^2}{2} B_0$

C. $\frac{r^2}{3} B_0$

D. none

Answer: C

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17. A small square loop of edge a and resistance R is moved with velocity v_0 away from an infinitely long current carrying conductor carrying current I so that the conductor and side of square are always in same plane. Find induced current in loop at a separation of r

A. $\dfrac{\mu_0 i a^2 v}{\pi r^2 R}$

B. $\dfrac{\mu_0 i a^2 v}{4\pi r^2 R}$

C. $\dfrac{\mu_0 i a^2 v}{2\pi r^2 R}$

D. $\dfrac{\mu_0 i a v}{2\pi r R}$

Answer: C

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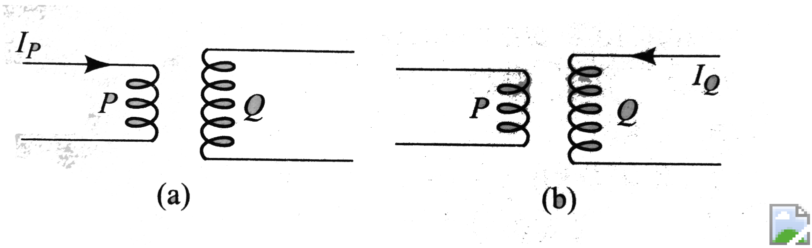
18. In Fig (a) and (b), two air-cored solenoids P and Q have been shows. They are placed near each other. In Fig (a), when I_P, the current in P, changes at the rate of $5As^{-1}$, an emf of $2mV$ is induced in Q. The current in P is then switched off, and the current changing at $2As^{-1}$ is fed through Q as shows in the figure. What emf will be induced in P?



A. $8 \times 10^{-4} V$

B. $2 \times 10^{-3} V$

C. $5 \times 10^{-3} V$

D. $8 \times 10^{-2} V$

Answer: A

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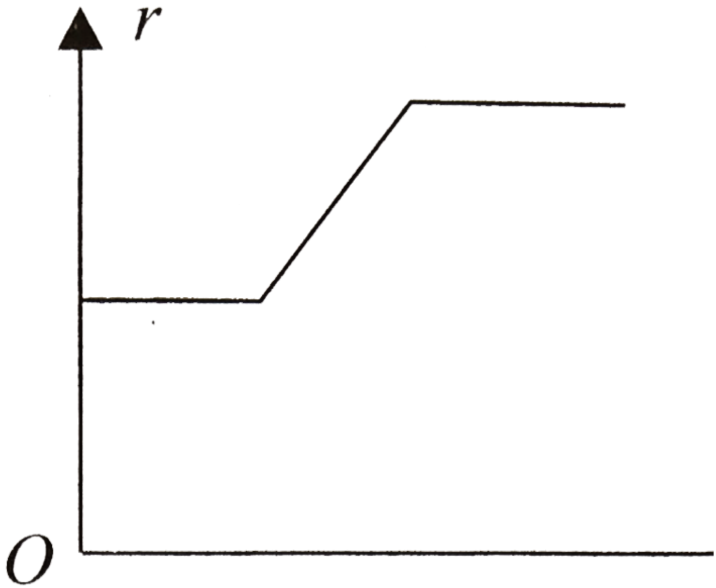
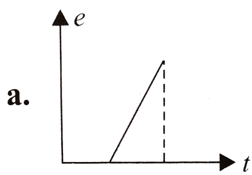
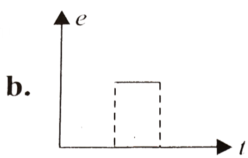
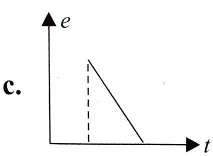
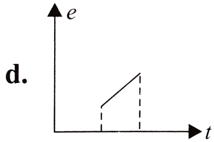
19. Radius of a circular ring is changing with time and the coil is placed in uniform magnetic field perpendicular to its plane. The variation of 'r' with time 't' is shown in Fig. Then induced emf e with time t will be best represented by



A. 

B. 

C. 

D. 

Answer: D

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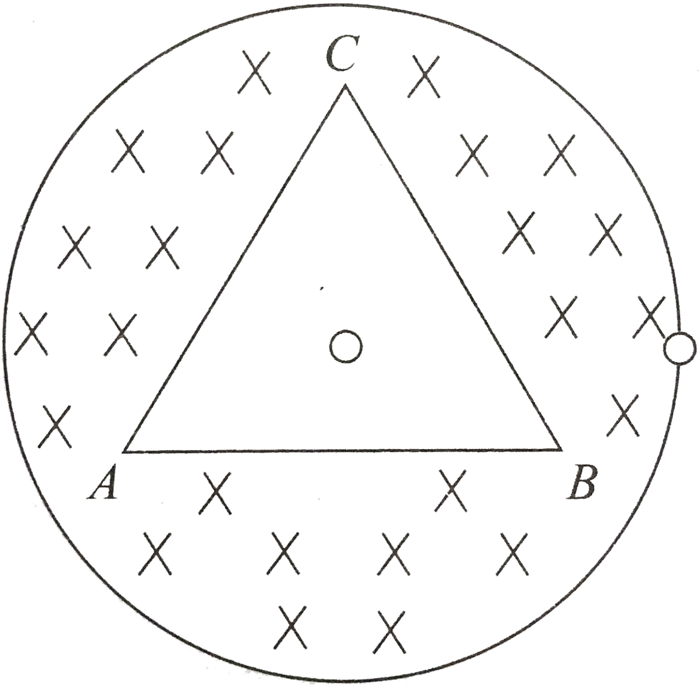
20. A triangular wire frame (each side =2m) is placed in a region of time variant magnetic field $dB/dt = (\sqrt{3})T/s$. The magnetic field is perpendicular to the plane of the triangle and its centre coincides with the centre of triangle. The base of the triangle AB has a resistance $1(\Omega)$ while the other two sides have resistance $2(\Omega)$ each. The magnitude of potential difference between the points A and B will be



A. 0.4 V

B. 0.6 V

C. 1.2V

D. None

Answer: A

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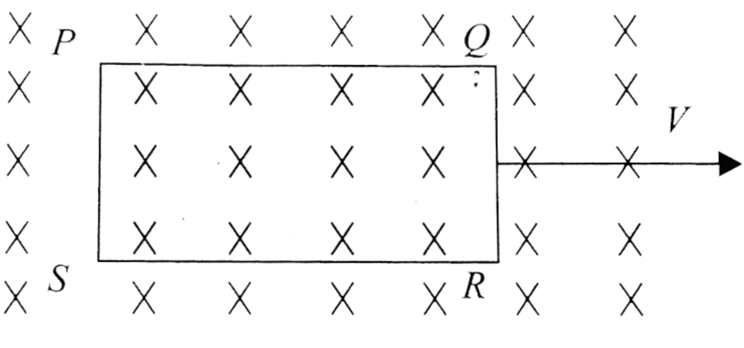
21. A metallic square loop PQRS is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in Fig. If V_P, V_Q, V_R and V_S are the potentials of points P, Q, R and S then which of the following is an incorrect statement?



A. $V_P = V_Q$

B. $V_P > V_S$

C. $V_P > V_R$

D. $V_S = V_R$

Answer: D

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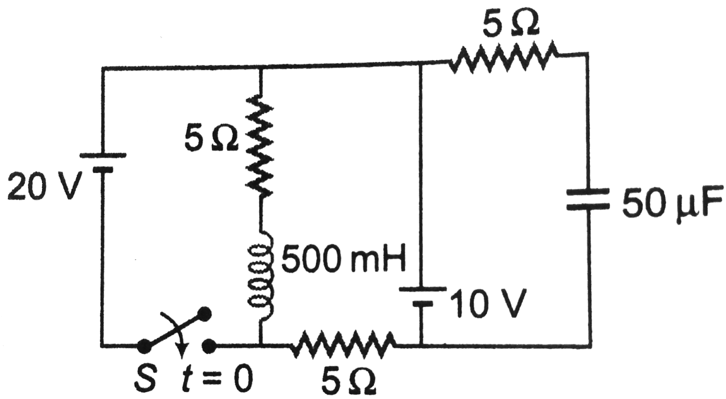
22. Switch S is closed $t = 0$, in the circuit shown. The change in flux in the inductor $(L = 500 mH)$ from $t = 0$

to an instant when it reaches steady state is



A. $2Wb$

B. $1.5Wb$

C. $0Wb$

D. None

Answer: B

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23. An AC source rated $100V(rms)$ supplies a current of $10A(rms)$ to a circuit. The average power delivered by the source

A. must be 1000W

B. may be greater than 100W

C. may be less than 1000W

D. all of the above three are possible

Answer: C

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24. The voltage of an AC source varies with time according to the relation: $E = 120 \sin 100\pi t \cos 100\pi t V$. What is the peak voltage of the source?

A. 60 V

B. 120V

C. 30V

D. $\sqrt{2}V$

Answer: A

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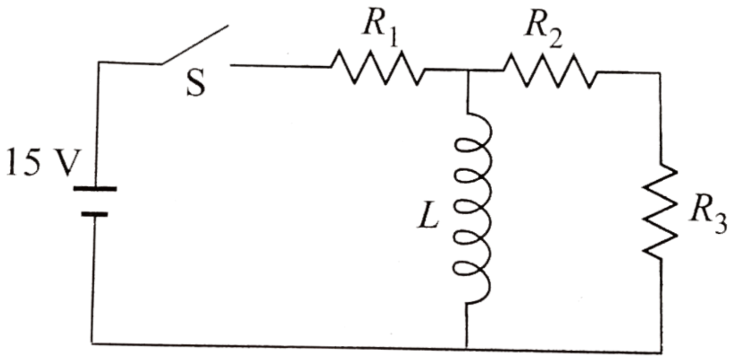
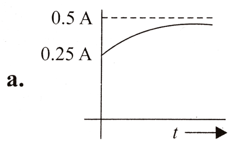
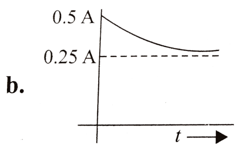
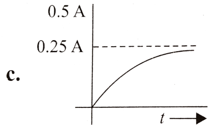
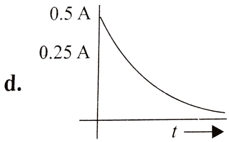
25. The figure below shown a battery with emf 15 V in a circuit with $R_1 = 30(\Omega), R_3 = 20(\Omega$ and $L = 3.0H.$ The switch S is initially in the open position and is then closed at time t = 0. Then the graph which shows the correct variation of current through battery after switch S is closed



A. 

B. 

C. 

D. 

Answer: A

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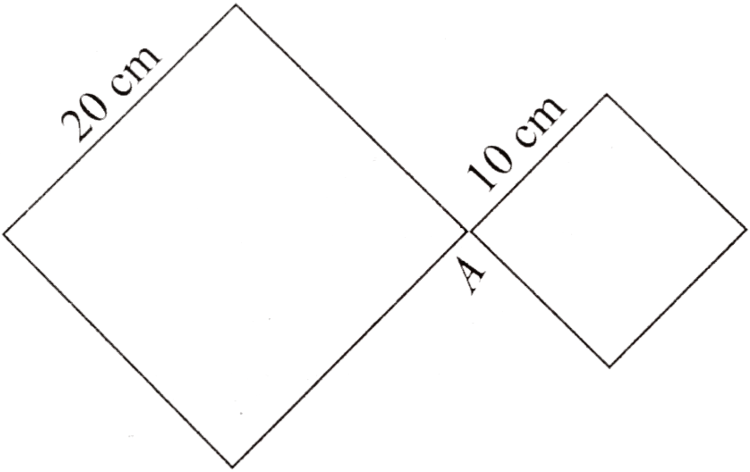
26. A plane loop is shaped as two squares (Fig) and placed in a uniform magnetic field at right angle to the loop's plane. The magnetic induction varies with time as $B = B_0 \sin(\omega)t, where B_0 = 10mT$ and $(\omega) = 100 rads^{-1}$. The wires do not touch at point A. If resistance per unit length of the loop is $50m(\Omega)/m$, then amplitude of current induced in the loop is



A. $1.5A$

B. $1.0A$

C. $0.5A$

D. $2.0A$

Answer: C

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27. Two infinitely long thin , insulated,straight wires lie in the x-y plane along the x and y axes, respectively.Each wire carries a current /respectively, in the positive x direction and positive y - direction.The magntic field will be zero at all points on the straight line with equation

A. $y = x$

B. $y = \; - x$

C. $y = x - 1$

D. $y = \; - x + 1$

Answer: A

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28. Two infinitely long straight parallel wires carry equal currents 'I' in the same direction and are 2 m apart. Magnetic induction at a point which is at same normal distance $(\sqrt{2})m$ from each wire has magnitude

A. $\dfrac{\mu_0 i}{2\pi}\sqrt{2}$

B. $\dfrac{\mu_0 i}{4\pi}\sqrt{2}$

C. $\dfrac{\mu_0 i}{2\sqrt{2}\pi}$

D. $\dfrac{\mu_0 i}{2\pi}$

Answer: D

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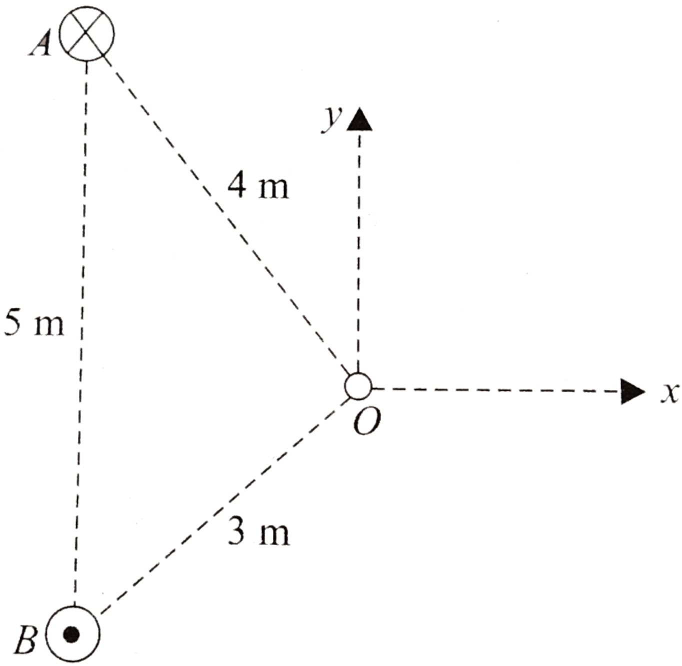
29. Two infinitely long straight parallel wire are 5 m apart, perpendicular to the plane of paper. One of the wires, as it passes perpendicular to the plane of paper, intersects it at A and carries current I in the downward direction. The other wire intersects the plane of paper at point B and carries current k int the outward direction O in the plane of paper as shown in Fig. With x and y axis shown, magnetic induction at O in the component form can be expressed as



A. $\vec{B} = \frac{\mu_0 i}{2\pi}\left[-\hat{\imath} + \frac{3\hat{\jmath}}{5}\right]$

B. $\vec{B} = \frac{\mu_0 i}{5\pi}\left[-\hat{\imath} + \frac{7\hat{\jmath}}{24}\right]$

C. $\vec{B} = \frac{\mu_0 i}{4\pi}\left[-3\hat{\imath} + \frac{7\hat{\jmath}}{18}\right]$

D. $\vec{B} = \frac{\mu_0 i}{7\pi}\left[-2\hat{\imath} + \frac{3\hat{\jmath}}{5}\right]$

Answer: B

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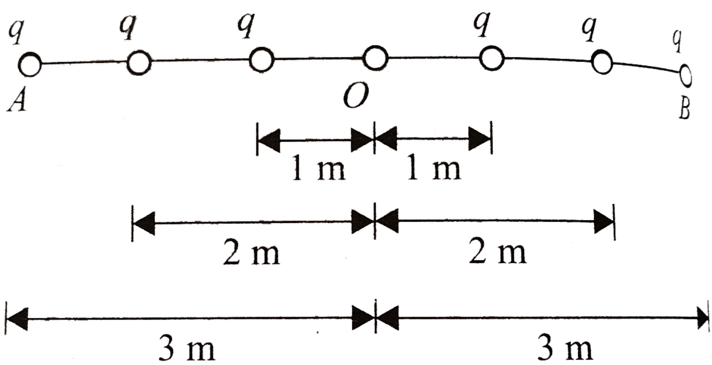
30. In Fig. , AB is a non-conducting rod. Equal charges of magnitude q are fixed at various points on the rod as shown. The rod is rotated uniformly about an axis passing through O and perpendicular to its length such that linear speed at the end A or B of the rod is $3ms^{-1}$.

Magnetic field at O is



A. $\dfrac{11\mu_0 q}{12\pi}$

B. $\dfrac{3\mu_0 q}{7\pi}$

C. $\dfrac{\mu_0 q}{2\pi}$

D. $\dfrac{6\mu_0 q}{13\pi}$

Answer: A

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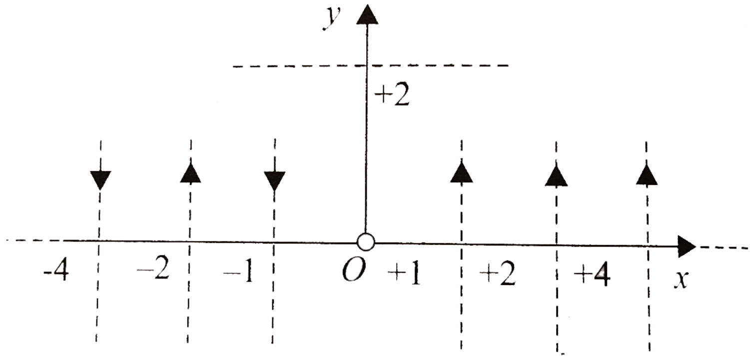
31. Infinite wires, each carrying a current 0.5 A, are kept parallel to y-axis and intersecting x-axis at $x = \pm 1$ m, $+02m, \pm 4m, \pm 8m$ etc. Wires kept at positive values of x carry current in the same direction while wires kept at negative values of x carry current successively in opposite directions as shown in Fig.



A wire is kept parallel to x-axis and intersecting y-axis at y=2 m. It carries a current i. Assuming this wire to be insulated from others then the current i in it such that magnetic induction at O is zero is

(assuming each wire to be infinitely long)

A. $\frac{8}{3}A$ along positive x-axis

B. $\frac{4}{3}A$ along negative x-axis

C. $\frac{5}{3}A$ along negative x-axis

D. $\frac{7}{3}A$ along positive x-axis

Answer: A

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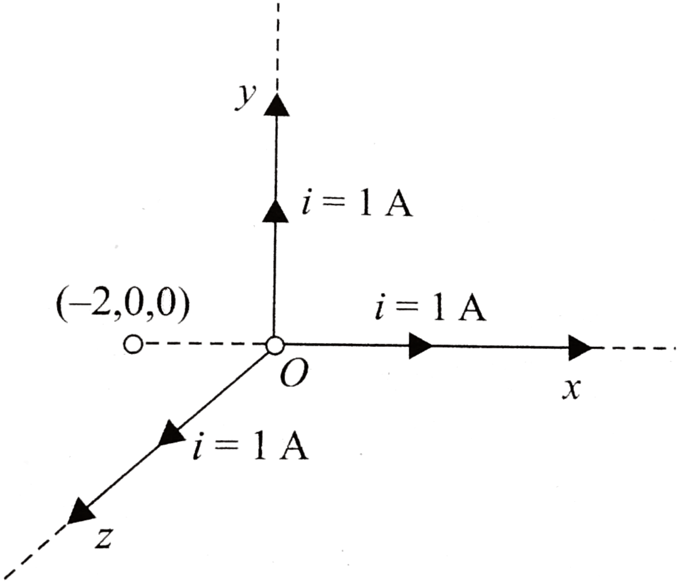
32. Three infinitely long wires, each carrying a current 1A, are placed such that one end of each wire is at the origin, and, one of these wires is along x-axis, the other along y-axis and the third along z-axis. Magnetic induction at point (-2 m, 0, 0) due to the system of these wires can be expressed as



A. $\frac{\mu_0}{4\pi}\left(\hat{j}+\hat{k}\right)$

B. $\frac{\mu_0}{4\pi}\left(\hat{j}-\hat{k}\right)$

C. $\frac{\mu_0}{8\pi}\left(-\hat{j}+\hat{k}\right)$

D. $\frac{\mu_0}{8\pi}\left(\hat{j}+\hat{k}\right)$

Answer: C

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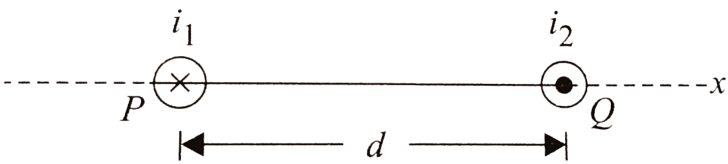
33. Two parallel wires P and Q placed at a separation d =6 cm on x-axis carry electric current $i_1 = 5A$ and $i_2 = 2A$ in opposite directions as shown in Fig. Find the point on the line PQ where the resultant mgnetic field is zero.



A. 4 cm left P

B. 4 cm right of Q

C. middle of PQ

D. At no position

Answer: B

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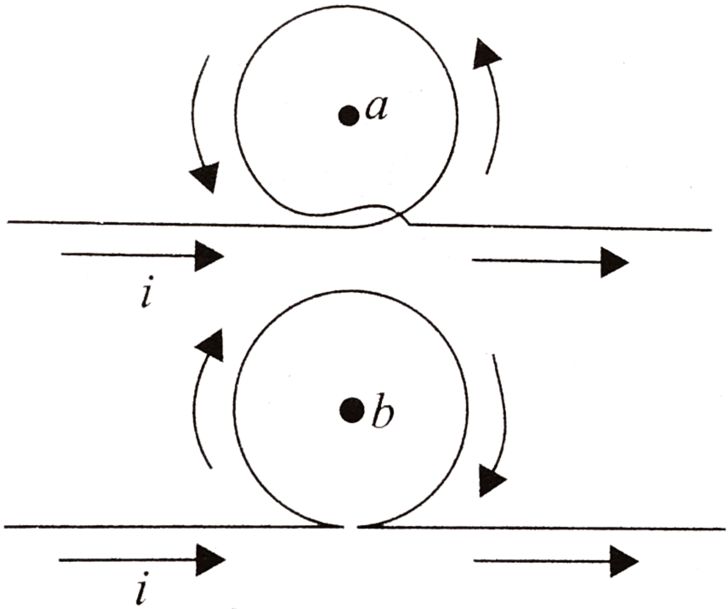
34. In Fig. the conductors carry equal currents i. All straight segments are very long, and the two circular loops have equal radii. However, the currents around the loops have opposite sense. The ratio of the magnetic field at a and b, at the centres of the two loops, is



A. $\dfrac{B_a}{B_b} = \dfrac{\pi + 1}{-\pi + 1}$

B. $\dfrac{B_a}{B_b} = \dfrac{\pi - 1}{\pi + 1}$

C. $\dfrac{B_a}{B_b} = \dfrac{\pi - 2}{\pi + 2}$

D. $\dfrac{B_a}{B_b} = \dfrac{\pi + 2}{\pi - 2}$

Answer: A

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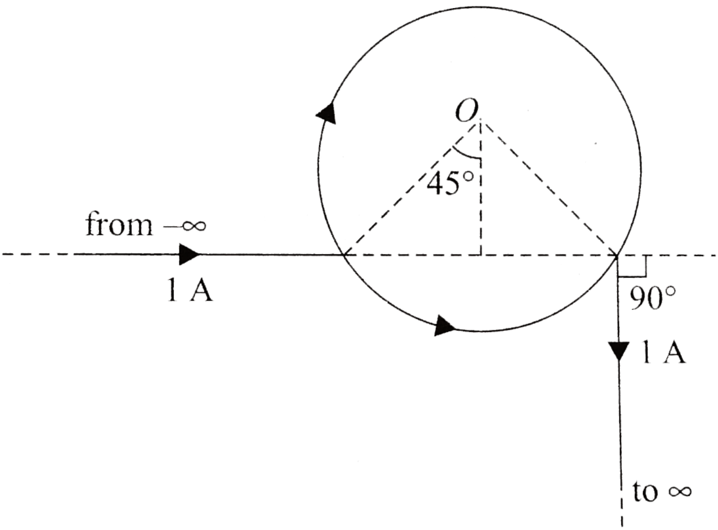
35. What is the magnitude of magnetic field at the centre O of loop of radius $(\sqrt{2})m$ made of uniform wire when a current of 1 A enters in the loop and is taken out of it by two long wires as shown in Fig.



A. $\frac{\mu_0}{\pi}\left[1-\frac{1}{\sqrt{2}}\right]T$

B. $\frac{\mu_0}{\sqrt{2}\pi}\left[1-\frac{1}{\sqrt{2}}\right]T$

C. zero

D. None of these

Answer: C

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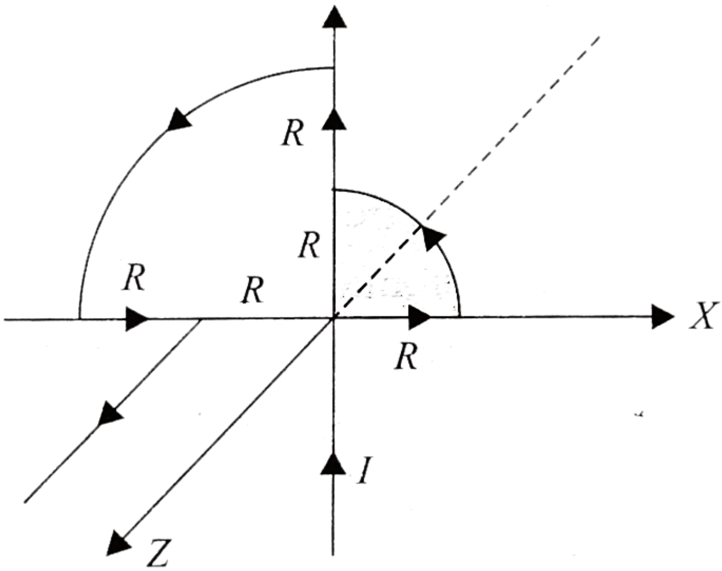
36. Find the magnetic field at the origin in the fig. Shown in fig.



A. $\frac{\mu_0 I}{4R}\left(\frac{3}{4}\hat{k}+\frac{1}{\pi}\hat{j}\right)$

B. $\frac{\mu_0 I}{4R}\left(\frac{3}{2}\hat{k}+\frac{1}{\pi}\hat{j}\right)$

C. $\frac{\mu_0 I}{4R}\left(\frac{3}{4}\hat{k}+\frac{1}{2\pi}\hat{j}\right)$

D. None of these

Answer: A

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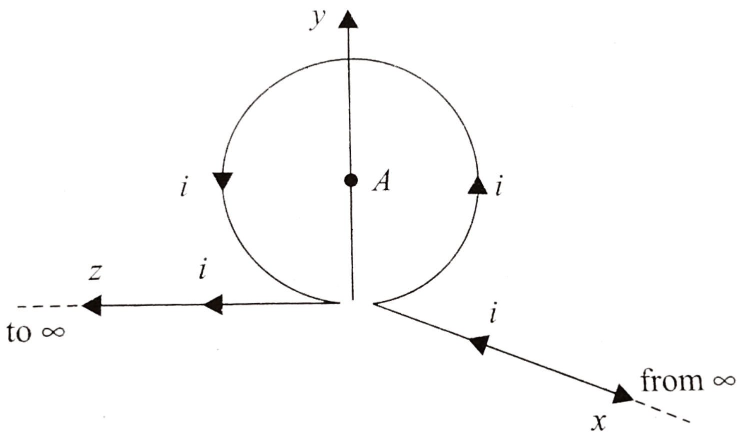
37. Find the magnitude of the magnetic induction B of a magnetic field generated by a system of thin conductors along which a current I is flowing at a point A (O, R, O), that is the centre of a circular conductor of radius R. The ring is in yz plane.



A. $B = \dfrac{\mu_0 i}{4\pi R}\sqrt{(2\pi^2 - 2\pi + 1)}$

B. $B = \dfrac{\mu_0 i}{4\pi R}\sqrt{2(2\pi^2 - 2\pi + 1)}$

C. $B = \dfrac{\mu_0 i}{2\pi R}\sqrt{(2\pi^2 - 2\pi + 1)}$

D. None of these

Answer: B

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38. A charged particle (charge q, mass m) has velocity v_0 at origin in +x direction. In space there is a uniform magnetic field B in -z direction. Find the y coordinate of particle when is crosses y axis.

A. $\frac{mv_0}{qB}$

B. $\frac{2mv_0}{qB}$

C. $\frac{mv_0}{2qB}$

D. None of these

Answer: B

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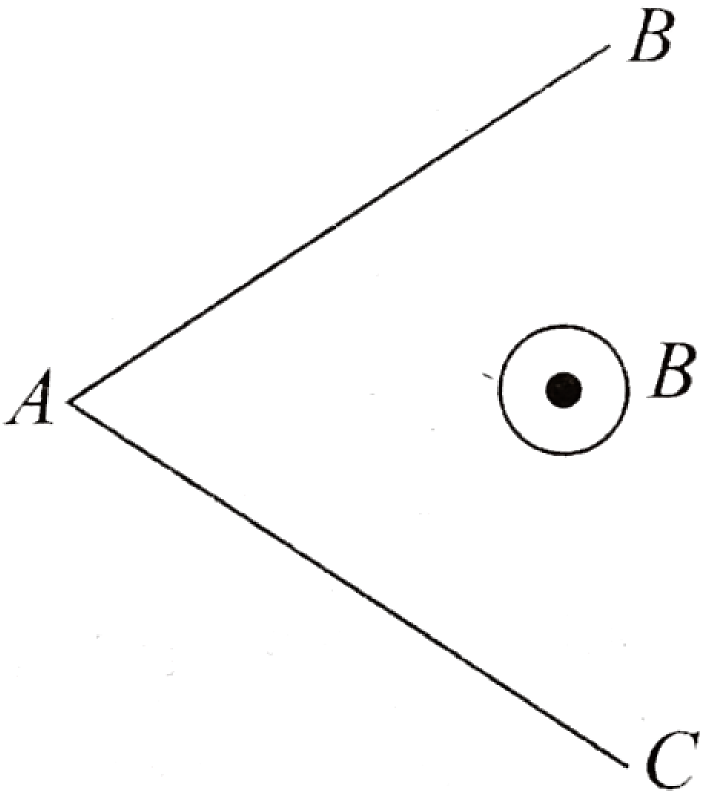
39. AB and AC are boundary lines within which a magnetic field B exists. If the magnetic field is absent, a charged particle of mass m and charge q must have passed through a point P on angle bisector of -BAC, at a distance $r(\sqrt{2})$ from A, if it has fallen on AB normally at a point Q such that QP =r. If the magnetic field is present, how much time the charged particle will take to come out of the magnetic field



A. $\dfrac{m\pi}{Bq}$

B. $\dfrac{2m\pi}{Bq}$

C. $\dfrac{4m\pi}{Bq}$

D. $\dfrac{m\pi}{2Bq}$

Answer: D

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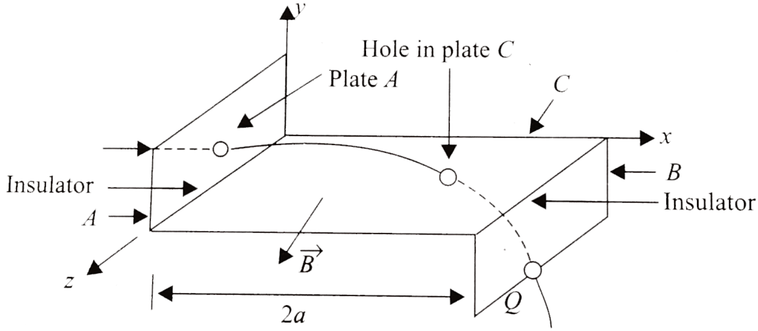
40. Two recangular plates A and B placed at a distance 2a apart, are connected to a battery to produce an electric field. There are insulators between plantes C and other two plates. A magnetic field exists along z-axis. A charged particle of mass m and charge q passes through a hole at the middle of the plate A with velocity v and strikes at Q which is the middle of the bottom edge of plate B after passing through a hole inplate C. If $E = mv^2 / qa$, what will be the speed of the particle at Q?



A. $v\sqrt{2}$

B. $2v$

C. $v\sqrt{5}$

D. $v\sqrt{3}$

Answer: C

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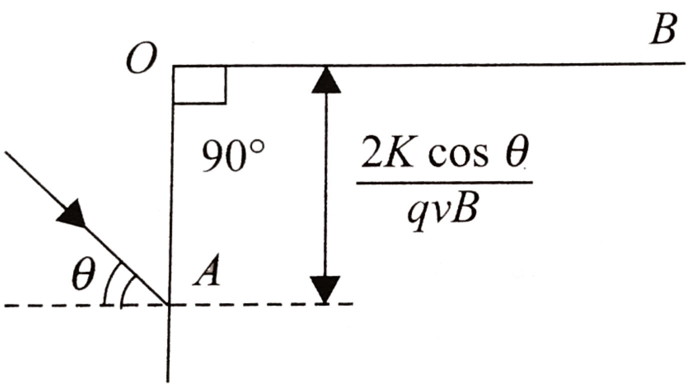
41. A magnetic field B exists between OA and OB. Inclined at an angle (θ), a charged particle strikes at point A on surface OA, at a distance $(2K\cos(\theta))(qvB)$ from O, where K is kinetic energy, q is the charge and v is the velocity of the particle. At what angle with horizontal (measured from end B) will the charged particle emerge from OB?



A. θ

B. $90^\circ - \theta$

C. $90^\circ + \theta$

D. 90°

Answer: D

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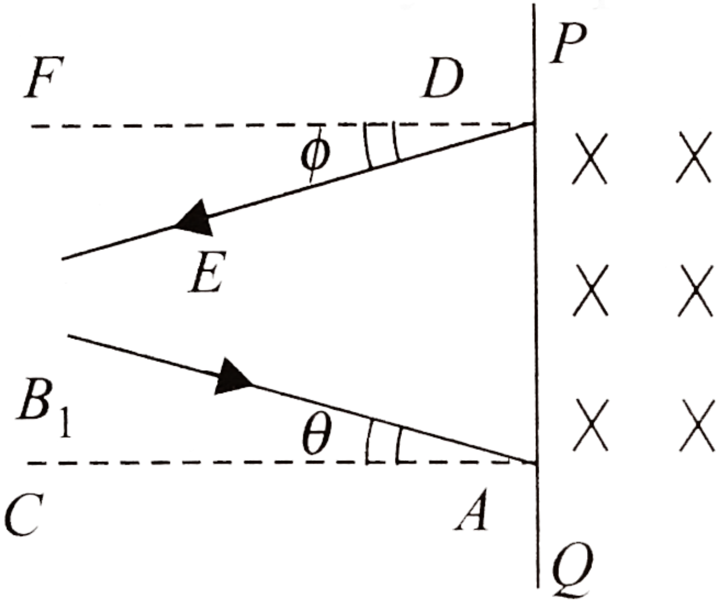
42. To the right of line PQ is a uniform magnetic field $\vec{B}$. B_1A is the line of incidence of a charged particle, which comes out of the field along DE, CA and DF are the normals at A and D. $-B_1AC = (\theta)$. Angle measured from CA in clockwise direction is taken as positive. What will be the value of (θ) so that angle subtended by the part of the circle (along which charged particle moves in the field) at its centre and facing the circle is less than π?



A. θ is positive

B. $\theta - 0$

C. θ is negative

D. θ depands upon $\vec{B}$ and change

Answer: C

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43. In the previous problem, if O is the point on AD and OO_1 is the perpendicular from the centre of the circle, $O_{-1}, then OA / OD$ will be

A. 1

B. > 1

C. < 1

D. depands upon $\overrightarrow{B}$ and charge

Answer: A

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44. In the previous problem, if (ϕ) is the angle between line of emergence DE and normal DF at point D, ratio of $(\phi) / (\theta)$ for positive value of (θ) will be

A. 1

B. > 1

C. < 1

D. depands upon $\overrightarrow{B}$ and charge

Answer: A

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45. In the previous problem, if time period, $T = 2(\pi)\dfrac{m}{BQ}$ where Q is the charge of the particle and m is its mass, the ratio of time spent by the particle in field when (θ) is positive to when (θ) is negative is given by

A. $\left(\dfrac{\pi/2+\theta}{\pi/2-\theta}\right)$

B. $\left(\dfrac{\pi+\theta}{\pi-\theta}\right)$

C. $\left(\dfrac{\pi-\theta}{\pi+\theta}\right)$

D. $\left(\dfrac{\pi/2-\theta}{\pi/2+\theta}\right)$

Answer: A

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46. In the previous problem, the maximum range of movement of the centre of the part of the circle from line AD in which charged particle of charge Q moves with a velocity v when (θ) is positive to when (θ) is negative is given by

A. $\pm\frac{mv}{2QB}$

B. $\pm\frac{mv}{QB}$

C. $\pm\frac{2mv}{QB}$

D. $\pm\frac{2mv}{3QB}$

Answer: B

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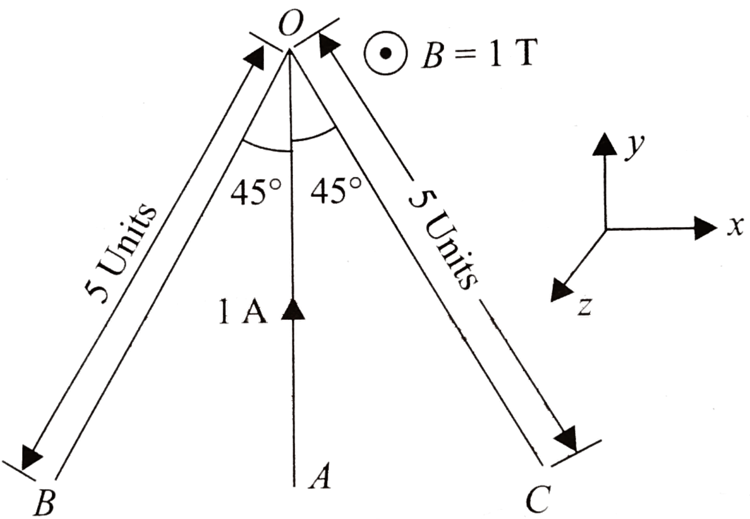
47. A triangular system of mass 100 gm consisting of 3 wires of length, as shown in Fig and length of AO as 4 units, are placed in the magnetic field of 1T. The current of 1 A flows through wire AO. The wires are of same material and cross-sectional area. In which direction will the system move?



A. At $\tan^{-1}(3/4)$ with (-x) axis.

B. along x-axis

C. along y-axis

D. along (-x) axis

Answer: B

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48. In the previous problem, what will be force with which system moves? $\left(Use\left(\sqrt{2}\right) = 1.4\right)$

A. $3.05N$

B. $4.0N$

C. $0.5N$

D. $1.0N$

Answer: C

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49. In the previous problem, instead of being stationary, the system enters the magnetic field with a velocity $0.5m/\sec$ along y-direction. Along which direction the system will move now?

A. along $a\hat{i} + b\hat{j}$

B. along a circular path

C. system will become stationary

D. along a direction in x-y plane

Answer: B

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50. In the previous problem, what will be acceleration of the system (in$m/\sec^2$)?

A. $5\sqrt{2}$

B. $0.5\sqrt{2}$

C. zero

D. 2.5

Answer: C

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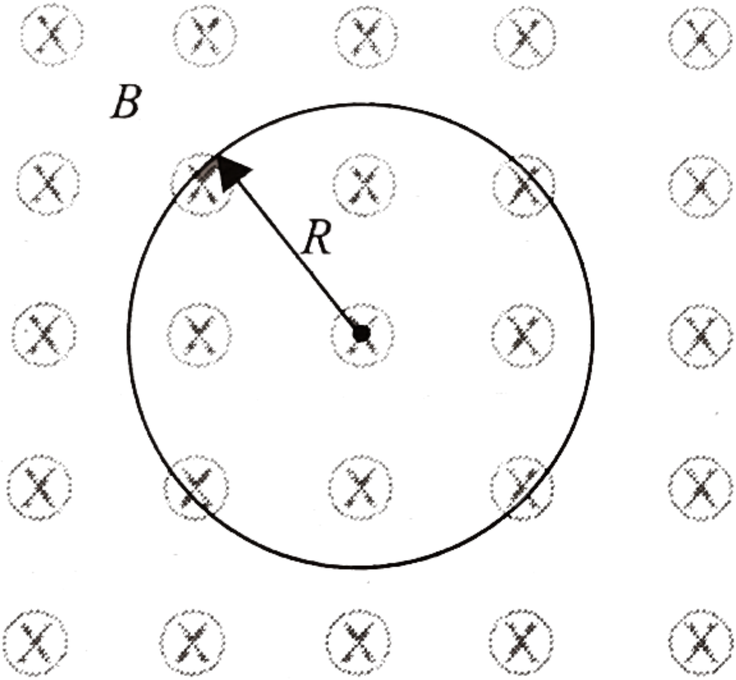
51. A conducting loop of radius R is present in a uniform magnetic field B perpendicular to the plane of the ring. If radius R varies as a function of time t, as $R = R_0 + t$. The emf induced in the loop is



A. $2\pi(R_0 + t)B$ clockwise

B. $\pi(R_0 + t)B$ clockwise

C. $2\pi(R_0 + t)B$ anticlockwise

D. zero

Answer: C

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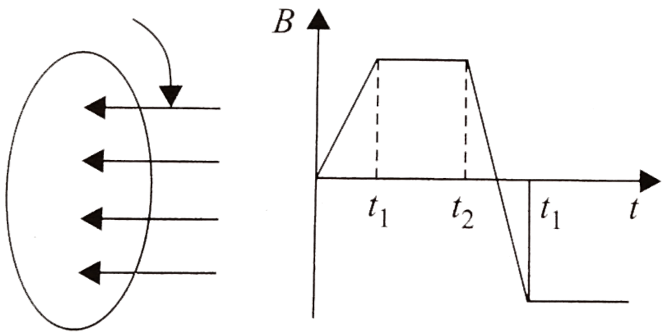
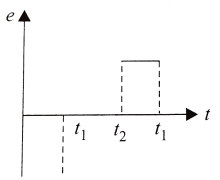
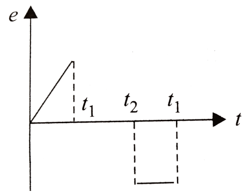
52. A wire loop is placed in a region of time varying magnetic field which is oriented orthogonally to the plane of the loop as shown in Fig. The graph shows the magnetic field variation as the function of time. Assume the positive emf is the one which drives a current in the clockwise direction and seen by the observer in the direction of B. Which of the following graphs best represents the induced emf as a function of time?

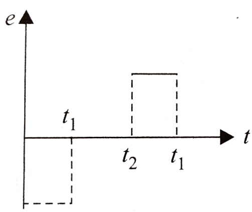


A. 

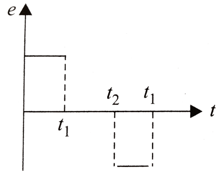
(a)

B. 

(b)

C. 

(c)

D. 

(d)

Answer: C

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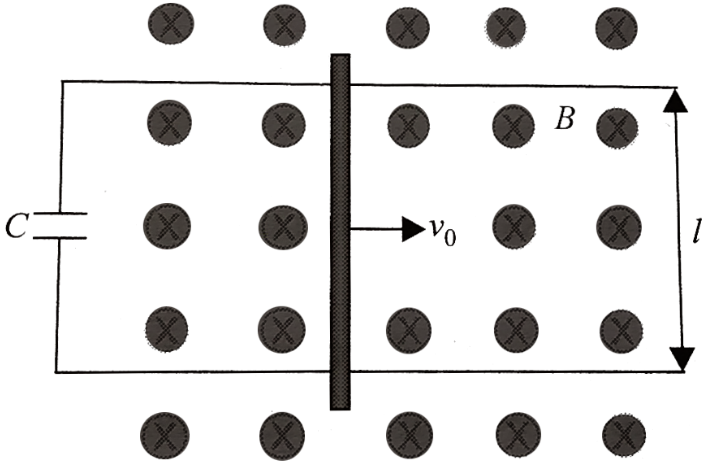
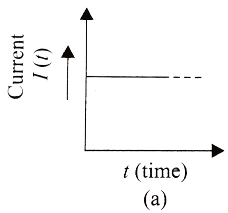
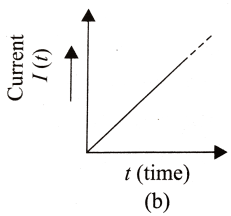
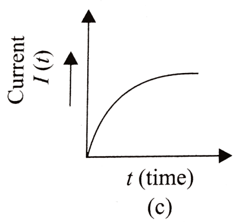
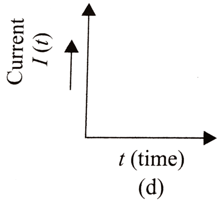
53. Two infinitely long conducting parallel rails are connected through a capacitor C as shown in Fig. A conductor of length l is moved with constant speed v_0. Which of the following graph truly depicts the variation of current through the conductor with time?



A. 

B. 

C. 

D. 

Answer: C

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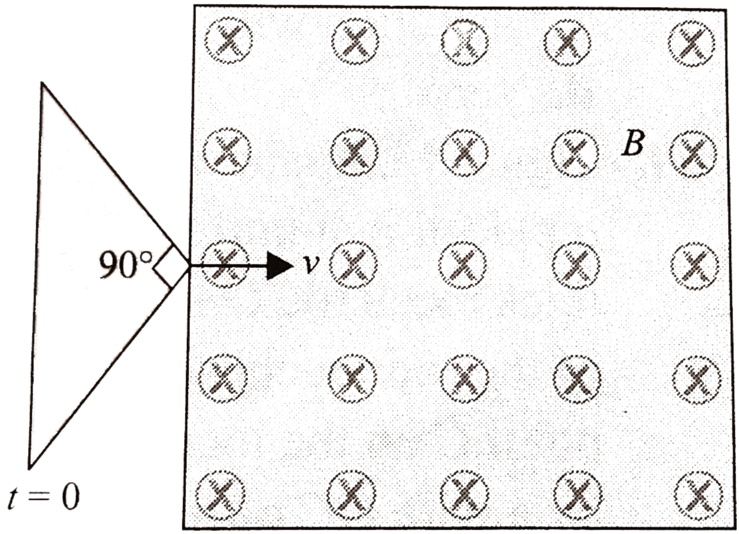
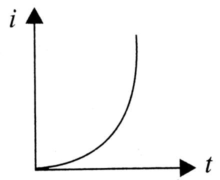
54. Figure shows an isosceles triangle wire frame with apex angle equal to $(\pi)/2$. The frame starts entering into the region of uniform magnetic field B with constant velocity v at t =0. The longest side of the frame is perpendicular to the direction of velocity. If i is the intantaneous current through the frame then choose the alternative showing the correct variation of i with time.

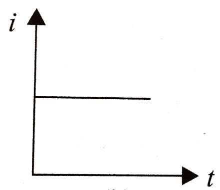


A.

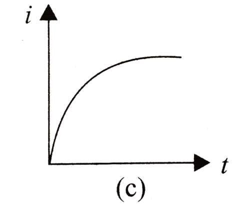


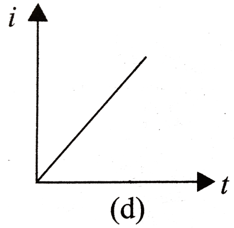
(a)

B.



(b)

C. 

D. 

Answer: D

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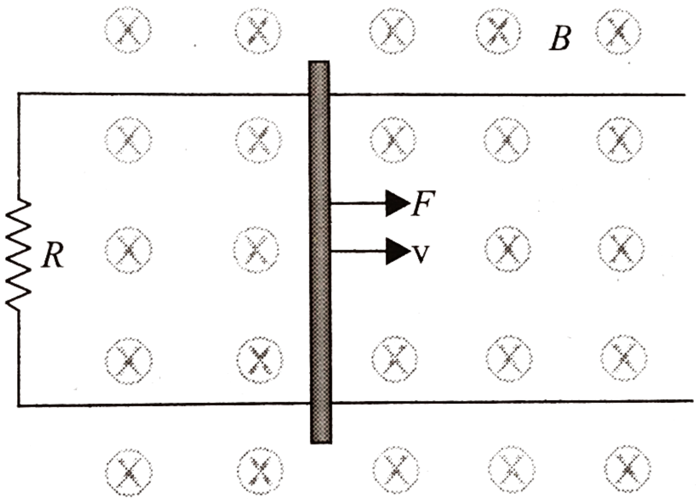
55. A rod closing the circuit shown in Fig moves along a U shaped wire at a constant speed v under the action of the force F. The circuit is in a uniform magnetic field perpendicular to the plane. Calculate F if the rate of heat generation in the circuit is Q.



A. $F = Qv$

B. $F = \frac{Q}{v}$

C. $F = \frac{v}{Q}$

D. $F = \sqrt{Qv}$

Answer: B

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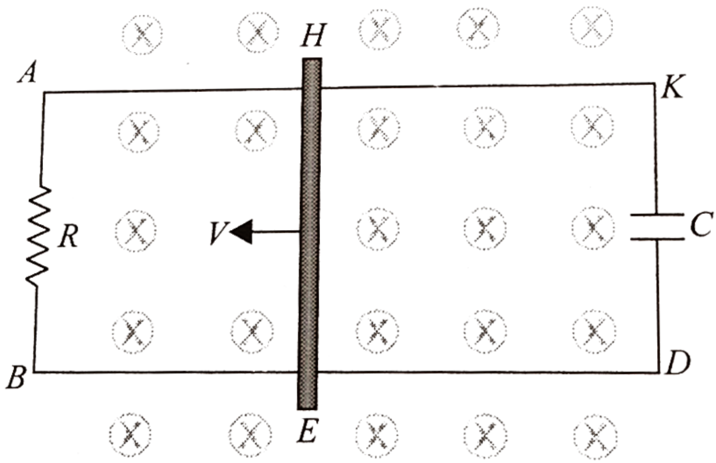
56. In the circuit shown in Fig. A conducting wire HE is moved with a constant speed v towards left. The complete circuit is placed in a uniform magnetic field $\vec{B}$ perpendicular to the plane of circuit inwards. The current in HKDE is



A. clockwise

B. anticlockwise

C. direction will change with time

D. zero

Answer: D

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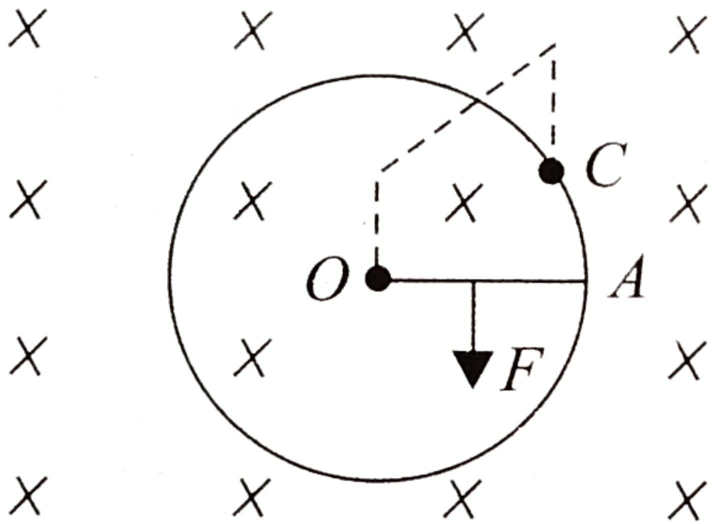
57. Fig. Shows a conducting circular loop of radius a placed in a uniform, perpendicular magnetic field B. A thick metal rod OA is pivoted at the centre O. The other end of the rod touches the loop at A. The centre O and a fixed point C on the loop are connected by a wire OC of resistance R. A force is applied at the middle point of the rod OA perpendicularly, so that the rod rotates clockwise at a uniform angular velocity (ω). Find the force.



A. $\dfrac{\omega a^3 B^2}{R}$ to the right of OA in the figure

B. $\dfrac{\omega a^3 B^2}{2R}$ to the right of OA in the figure

C. $\dfrac{\omega a^3 B^2}{2R}$ to the left of OA in the figure

D. None of these

Answer: B

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58. Consider the situation shown in the figure of the previous problem. Suppose the wire connecting O and C has zero resistance but the circular loop has a resistance R uniformly distributed along its length. The rod OA is made to rotate with a uniform angular speed (ω) as shown in the figure. Find the current in the rod when

$-AOC = 90^{\circ}$

A. $\frac{5}{3}\frac{Ba^2\omega}{R}$

B. $\frac{8}{3}\frac{Ba^2\omega}{R}$

C. $\frac{Ba^2\omega}{3R}$

D. None of these

Answer: B

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59. Consider a variation of the previous problem. Suppose the circular loop lies in a vertical plane. The rod has a mass m. The rod and the loop have negligible resistance but the wire connecting O and C has a resistance R. The rod is made to rotate with a uniform angular velocity (ω) in the clockwise direction by applying a force at the midpoint of OA in a direction perpendicular to it.

Find the magnitude of this force when the rod makes an angle (θ) with the vertical.

A. $\dfrac{B^2a^3\omega}{2R}-mg\sin\theta$

B. $\dfrac{B^2a^3\omega}{2R}+mg\sin\theta$

C. $\dfrac{B^2a^3\omega}{R}-mg\sin\theta$

D. None of these

Answer: A

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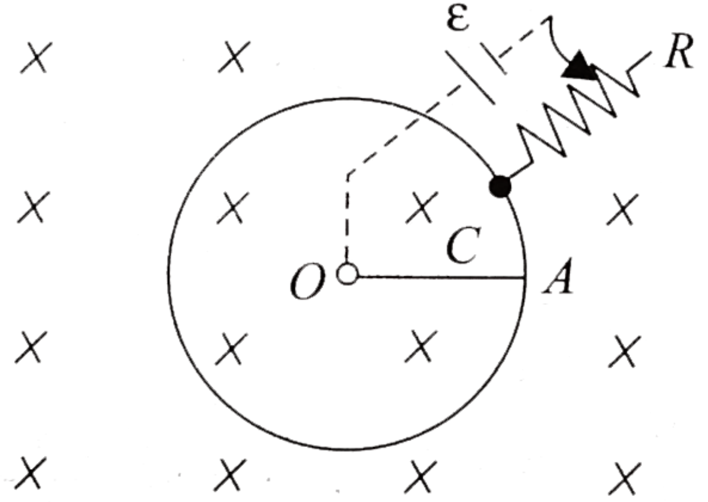
60. Figure shows a situation similar to the previous problem. All parameters are the same except that a battery of emf ε and a variable resistance R are connected between O and C. The connecting wires have zero resistance. No external force is applied on the rod (except gravity, forces by the magnetic field and by the pivot).



In what way should the resistance R be changed so that the rod may rotate with uniform angular velocity in the clockwise direction? Express your answer in terms of the given quantities and the angle (θ) made by the rod OA with the horizontal.

A. $\left(B\omega a^2 - 2\varepsilon\right)\dfrac{aB}{2mg\cos\theta}$

B. $\left(B\omega a^2 + 2\varepsilon\right)\dfrac{aB}{mg\cos\theta}$

C. $\left(B\omega a^2 + 2\varepsilon\right)\dfrac{aB}{2mg\cos\theta}$

D. None of these

Answer: C

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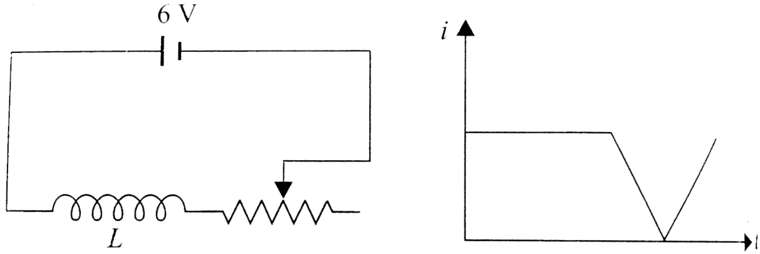
61. In the circuit shown in Fig. Sliding contact is moving with uniform velocity towards right. Its value at some instance is $12(\Omega)$. The current in the circuit at this instant of time will be



A. 0.5 A

B. More than 0.5 A

C. Less than 0.5 A

D. May be less or more than 0.5A depending on the value of L.

Answer: B

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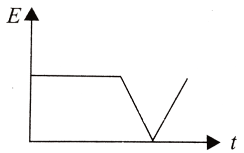
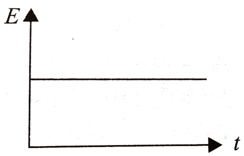
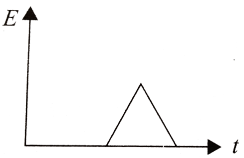
62. The current i in an induction coil varies with time according to the graph shown in figure. Which of the following graph shows induced emf in the coil with time:

A. 

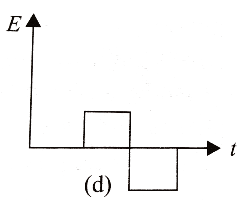
(a)

B. 

(b)

C. 

(c)

D. 

(d)

Answer: D

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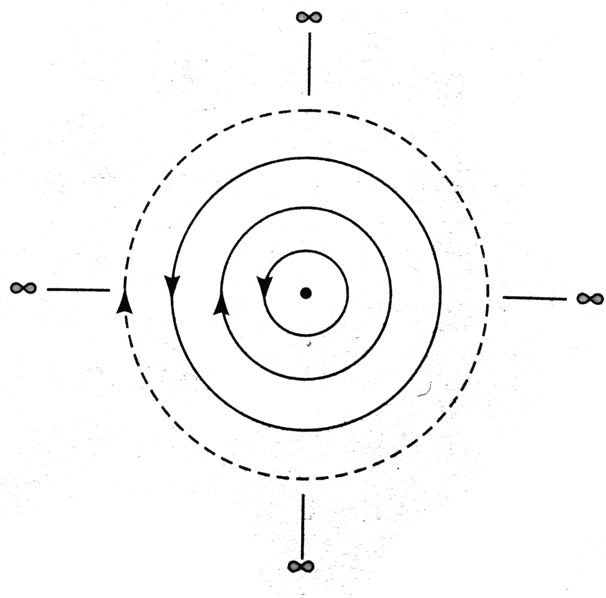
63. In Fig. infinite conducting rings each having current i in the direciton shown are placed concentrically in the same plane as shown in the figure. The radii of rings are $r, 2r, 2^2r, 2^3r, \ldots\ldots, (\infty)$. The magnetic field at the centre of rings will be



A. Zero

B. $\frac{\mu_0 i}{r}$

C. $\frac{\mu_0 i}{2r}$

D. $\frac{\mu_0 i}{3r}$

Answer: D

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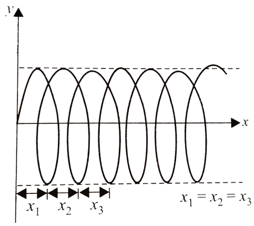
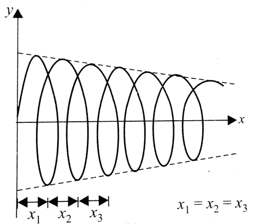
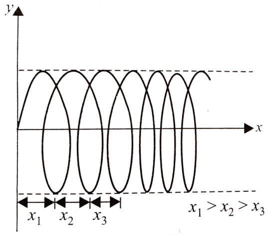
64. The magnetic field exists along negative x-axis and electric field exists along positive x-axis. A charged particle moves with a velocity inclined at an angle (θ) with vertical in (x-y) plane. What will be the correct diagram of the helical path?

A. 

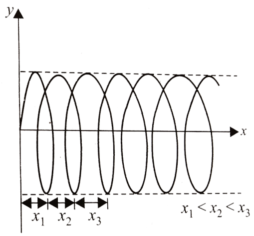
(a)

B. 

(b)

C. 

(c)

D. 

(d)

Answer: D

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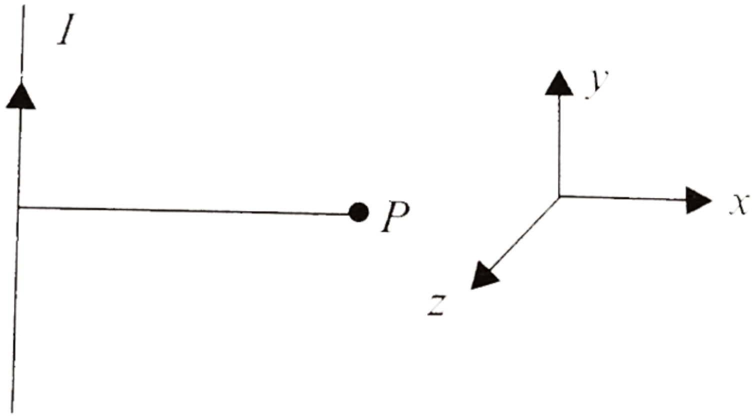
65. One long conductor carries current I along y-axis with charge density λ. An electric field exists along z-axis. In what direction, a charged particle at point P, distance x apart from the wire (along x-axis), be projected with velocity v so that it moves undeflected?



A. Vertically upward

B. vertically downwards

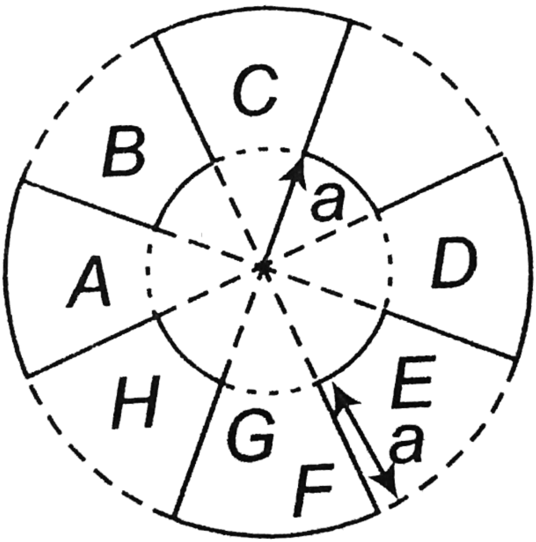
C. horizontally right

D. horizontally left

Answer: A

Watch Video Solution

66. Current I flows through the circuit, as shown. Find the magnetic moment of the figure, if $AB = BC = CD = DE = EF = FG = GH = HA$:



A. $\frac{7}{2} I\pi a^2$

B. $\frac{5}{2} I\pi a^2$

C. $4I\pi a^2$

D. $\frac{5}{3} I\pi a^2$

Answer: B

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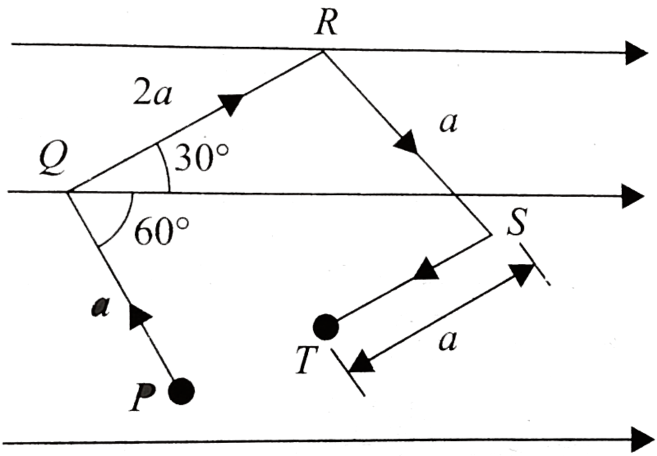
67. Find the force acting on rectangular loop PQRST.



A. $\frac{IaB}{2}$

B. $\frac{IaB}{\sqrt{2}}$

C. $\frac{IaB\sqrt{3}}{2}$

D. $IaB\sqrt{3}$

Answer: A

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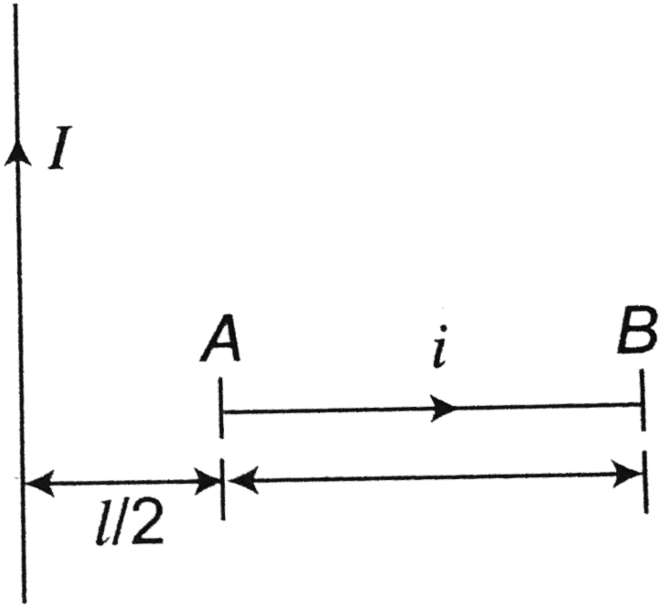
68. A conductor AB of length l carrying current i is placed perpendicular to a long straight conductor carrying a current I as shown. Force on AB will be



A. $\dfrac{3\mu_0 I i}{2\pi}$

B. $\dfrac{\mu_0 I i}{2\pi}\log_e 3$

C. $\dfrac{\mu_0 I i}{2\pi}\log_e 2$

D. $\dfrac{2\mu_0 I i}{3\pi}$

Answer: B

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69. A long straight non-conducting string carriers a charge density of $40\mu C / m$. It is pulled along its length at a speed of $300m / \sec$. What is the magnetic field at a normal distance of $5mm$ from the moving string?

A. $B = 4.8 \times 10^{-7} T$

B. $B = 3.2 \times 10^{-7} T$

C. $B = 2.5 \times 10^{-7} T$

D. $B = 5 \times 10^{-7} T$

Answer: A

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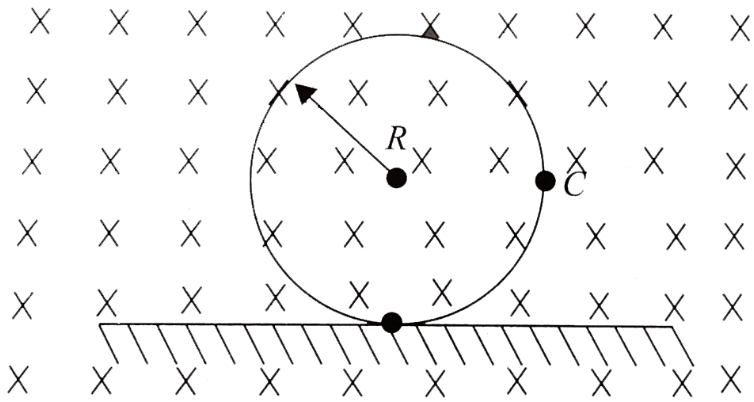
70. A ring of radius R is rolling on a horizontal plane with constant velocity v. There is a constant and uniform magnetic field B which is perpendicular to the plane of the ring. Emf across the lowest point A and right-most point C as shown in the figure will



A. Increase with time

B. decrease with time

C. remains constant and equal to $\sqrt{2}BvR$

D. remains constant and equal to BvR

Answer: D

Watch Video Solution

71. A current $I = 3.36(1 + 2t) \times 10^{-2}$ A increase at a steady state in a long staight wire. A small circular loop of radius 10^{-3} m has its plane parallel to the wire and is placed at a distance of 1 m from the wire. The resistance of loop is $8.4 \times 10^{-4}(\Omega)$. Find the approximate value of induced current in the loop.

A. $5.024 \times 24^{-11} A$

B. $3.8 \times 24^{-11} A$

C. $2.75 \times 24^{-11} A$

D. $1.23 \times 24^{-11} A$

Answer: A

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72. The magnetic field in a region is given by $\overrightarrow{B} = \frac{B_0}{L} y\hat{k}$ where L is a fixed length. A conducting rod of length L lies along the Y - axis between the origin and the point (0,L, 0). If the rod moves with a velocity $v = v_0 \hat{i}$, find the EMF induced between the ends of the rod.

A. $2B_0 v_0 l$

B. $B_0 v_0 l$

C. $\frac{B_0 v_0 l}{2}$

D. None of these

Answer: C

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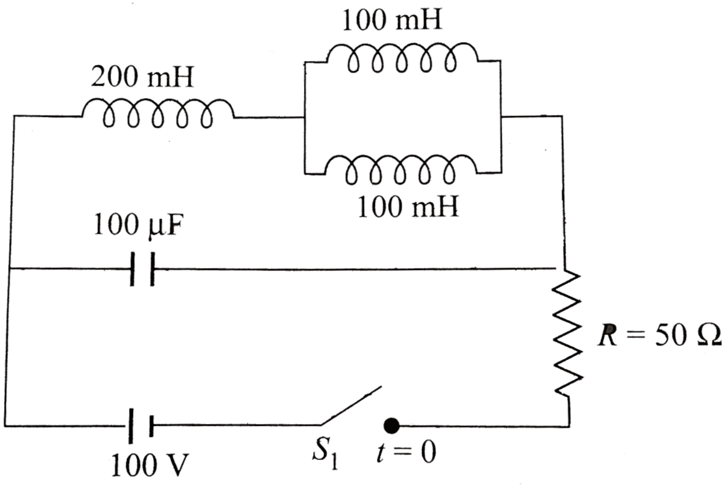
73. In the circuit shown in fig, switch S was closed for long time. At time t-0, the switch is opened again. The maximum potential difference across the plates of the capacitor after the switch is opened is



A. 10V

B. 100V

C. 20V

D. 200V

Answer: B

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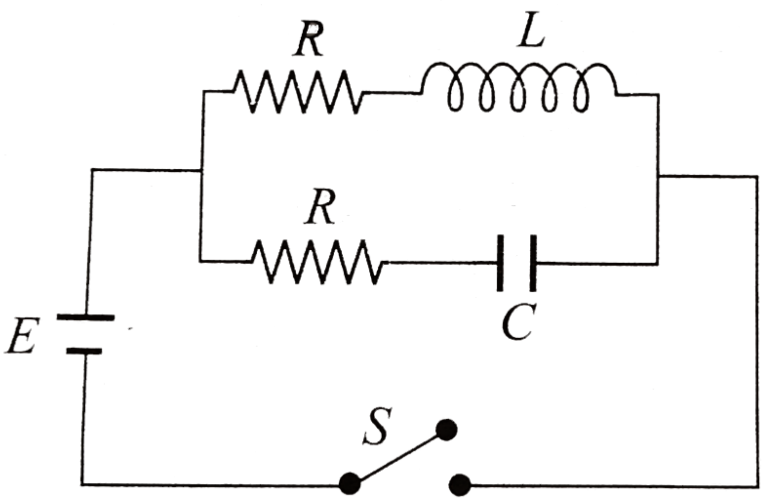
74. In the circuit shown in fig, the time constant of the two braches are equal(=T). Then if the key S is closed at the instant t=0, the time in which the current in the circuit through the battery will rise to its final value of (E/R) will be, (assume that the internal resistance of the battery and of the connecting wire are negligible)



A. Instantly

B. $t = \frac{T}{2}$

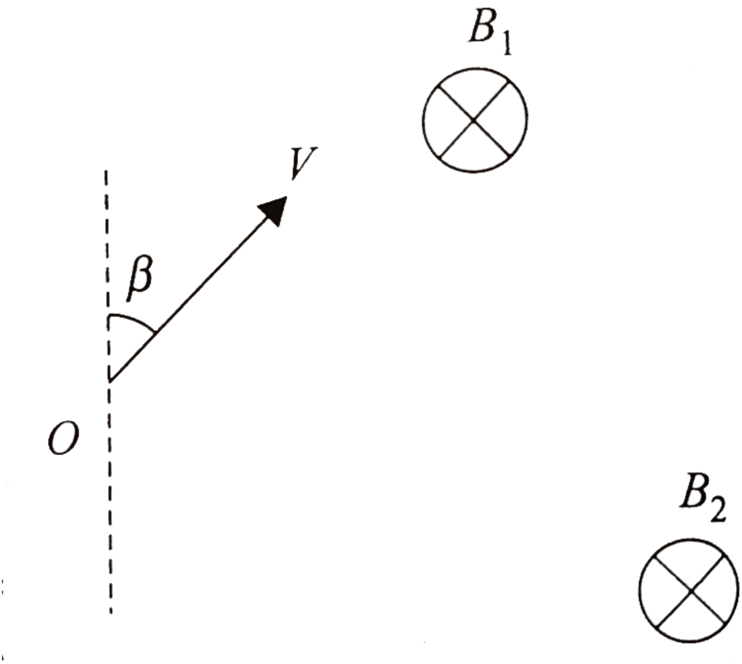
C. $t = 2T$

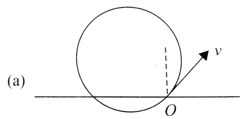
D. $t = \infty$

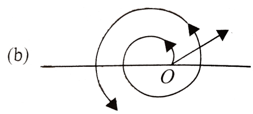
Answer: A

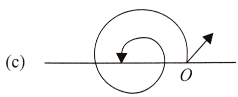
Watch Video Solution

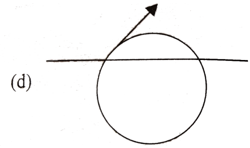
75. A particle of charge +Q and mass M is projected with velocity v in the plane of paper. Above the dark line magnetic field is (B_1) and below it is (B_2) both perpendicular to the plane of paper. Which can be the possible path on which the charge will move? (Consider all possible cases for values of (B_1) and (B_2)`)



A. 

B. 

C. 

D. 

Answer: A

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76. A bulb of 100 W is connected in parallel to an ideal inductance of 1H. This arrangement is connected to a 90 V barrery through a switch. On pressing the switch the

A. blub does not glow

B. bulb glows

C. bulb glows after a short time and then continues to glow.

D. bulb glows for a short time and then stops glowing.

Answer: D

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77. A resistance of 20Ω is connected to a source of an alternating potential $V = 220\sin(100\pi t)$. The time taken by the current to change from the peak value to rms value is

A. $0.2s$

B. $0.25s$

C. $25s$

D. $2.5 \times 10^{-3}s$

Answer: D

Watch Video Solution

78. A uniformly wound solenoid coil of slf inductnace 4 mH and resistance 12Ω is broken int two parts. These two coil are connected in parallel across is $12V$ battery. The steady current through battery is

A. 1A

B. 2A

C. 4A

D. 8A

Answer: C

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79. A current is made up of two components 3 A dc component and ac component given by $I = 4\sin(\omega)tA$. The effective value of current is

A. $\sqrt{17}A$

B. $\sqrt{7}A$

C. $\sqrt{25}A$

D. $\sqrt{7 \times 25}A$

Answer: A

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80. An alternating e.m.f. of 200 V and 50 cycles is connected to a circuit of resistance $3.142\Omega)$ and inductance 0.01 H. The lag in time between the e.m.f. and the current is

A. 1.5 ms

B. 2.5 ms

C. 3.5 ms

D. None of these

Answer: B

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81. In an AC circuit, a resistance of $R ohm$ is connected in series with an inductance L. If phase angle between volage and current be 45°, the value of inductive reactance will be

A. $R/4$

B. $R/2$

C. R

D. cannot be found with the given data

Answer: C

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82. A direct current of 2 A and an alternating current having a maximum value of 2 A flow through two identical resistances . The ratio of heat produced in the two resistances will be

A. $1:1$

B. $1:2$

C. $2:1$

D. $4:1$

Answer: C

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83. In the given circuit, the reading of voltmeter V_1 and V_2 300V each. The reading to the voltmeter V_3 and anmeter A are respectively

A. 800 V, 2 A

B. 300 V, 2 A

C. 220 V, 2.2 V

D. 100 V, 2 A

Answer: C

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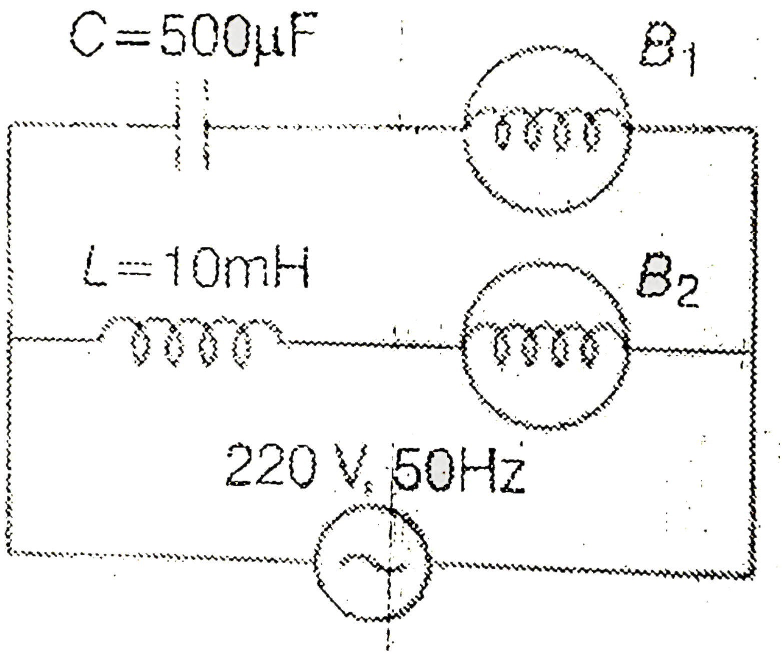
84. In the circuit shown in the figure, if both the bulbs B_1 and B_2 are identical



A. their brightness will be the same

B. B_2 will be brighter than B_1

C. as frequency and that of B_2 will becrease

D. Only B_2 will glow because the capacitor has infinite

impedance

Answer: B

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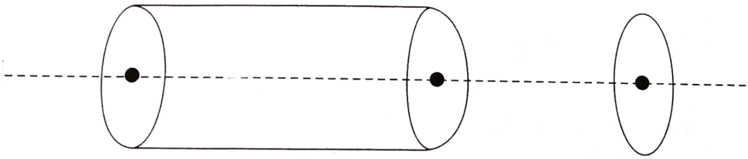
85. The diagram given below shows a solenoid carrying time varying current $l = l_0 t$. On the axis of the solenoid, a ring has been placed. The mutual inductance of the ring and the solenoid is M and the self inductance of the ring is L. If the resistance of the ring is R then maximum current which can flow through the ring is



A. $\frac{(2M+L)I_0}{R}$

B. $\frac{MI_0}{R}$

C. $\frac{(2M-L)I_0}{R}$

D. $\frac{(M+L)I_0}{R}$

Answer: B

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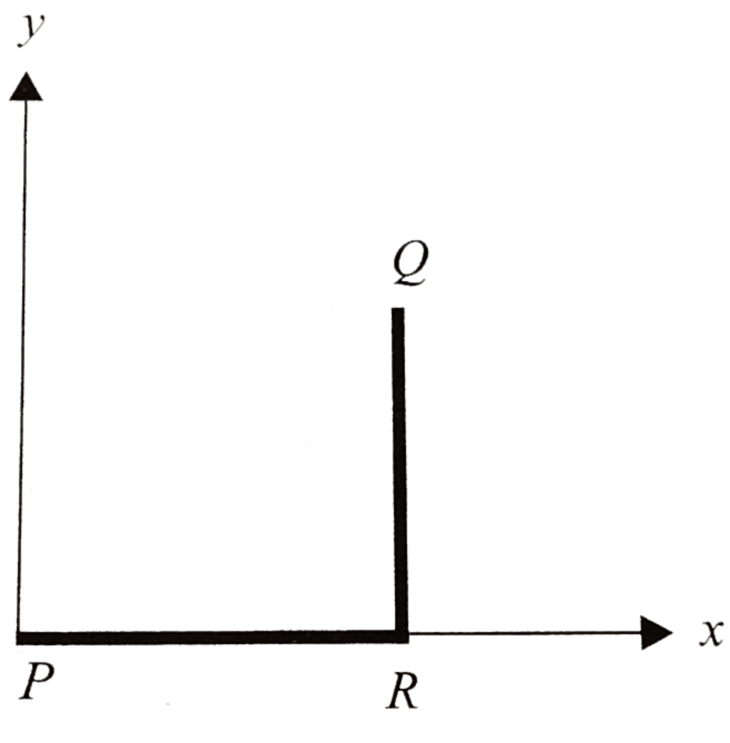
86. An inverted L shaped conductor PRQ is made by joining two perpendicular conducting rods, each of length 1.5 L, at end R. This structure is moving in x-y plane containing variable magnetic field $\overrightarrow{B} = -3x\hat{e}(k)$ with a velocity $v\hat{e}(i) + v\hat{j}$. If potential of P is V_p and that of Q is V_Q, then value of $V_P - V(Q)$ at the instant when P is at origin as shown in Fig. Will be



A. $\frac{9vL^2}{8}$

B. $\frac{27vL^2}{8}$

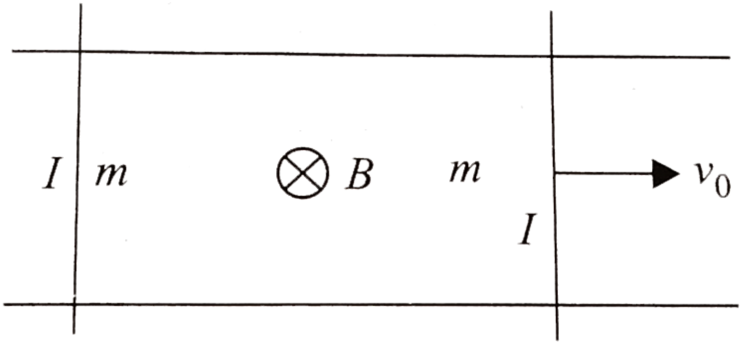
C. $-\frac{9vL^2}{8}$

D. $-\frac{27vL^2}{8}$

Answer: D

Watch Video Solution

87. Consider parallel conducting rails separated by a distance l. There exists a uniform magnetic field B perpendicular to the plane of the rails as shown in Fig. Two conducting wires each of length l are placed so as to slide on parallel conducting rails. One of the wires is given a velocity v_0 parallel to the rails. Till steady state is achieved, loss in kinetic energy of the system is



A. zero

B. $3.4mv_0^2$

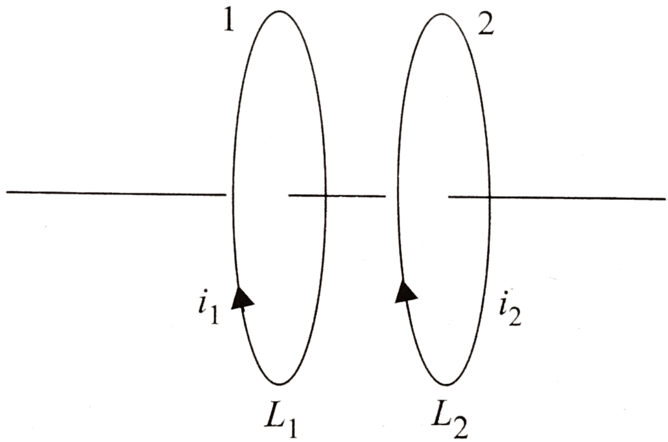
C. $\frac{1}{4}mv_0^2$

D. $\frac{3}{8}mv_0^2$

Answer: C

Watch Video Solution

88. A system consists of two coaxial current carrying circular loops as shown in Fig. The self inductance of loop 1 is L_1 and self inductance of loop 2 is L_2. Magnitude of mutual inductance is M. If at any instant current flowing through loop 1 and loop 2 are i_1 and i_2 respectively, then total magnetic energy of the system is



A. $\frac{1}{2}L_1i_1^2 + \frac{1}{2}L_2i_2^2 - |M|i_1i_2$

B. $\frac{1}{2}L_1i_1^2 + \frac{1}{2}L_2i_2^2 + |M|i_1i_2$

C. $\frac{1}{2}L_1 i_2^2 + \frac{1}{2}L_2 i_2^1 - |M| i_1 i_2$

D. $\frac{1}{2}L_1 i_1^2 + \frac{1}{2}L_2 i_2^2$

Answer: A

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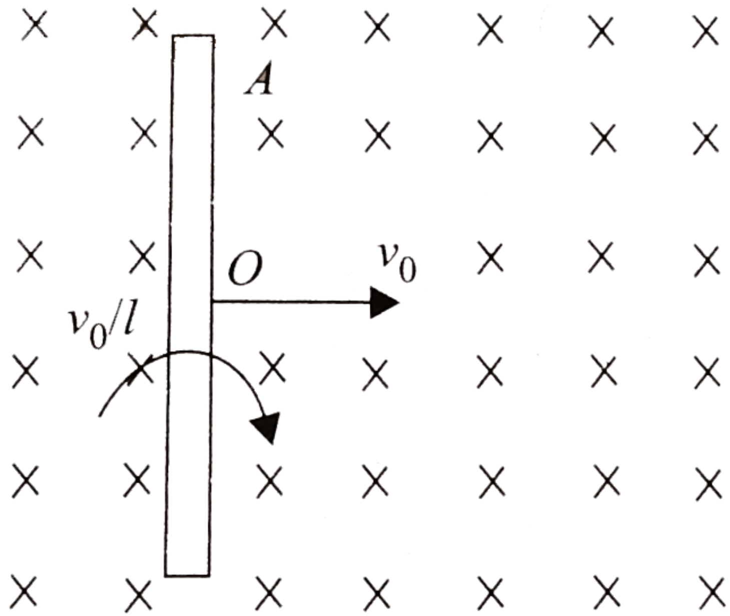
89. A conducting rod of length 1 is moving on a horizontal smooth surface. Magnetic field in the region is vertically downward and magnitude B_0. If centre of mass (COM) of the rod is translating with velocity v_0 and rod rotates about COM with angular velocity v_0 / l, then potential difference between points O and A will be



A. $\frac{5}{8}B_0v_0l$

B. $\frac{3}{8}B_0v_0l$

C. $\frac{1}{8}B_0v_0l$

D. $\frac{1}{2}B_0v_0l$

Answer: A

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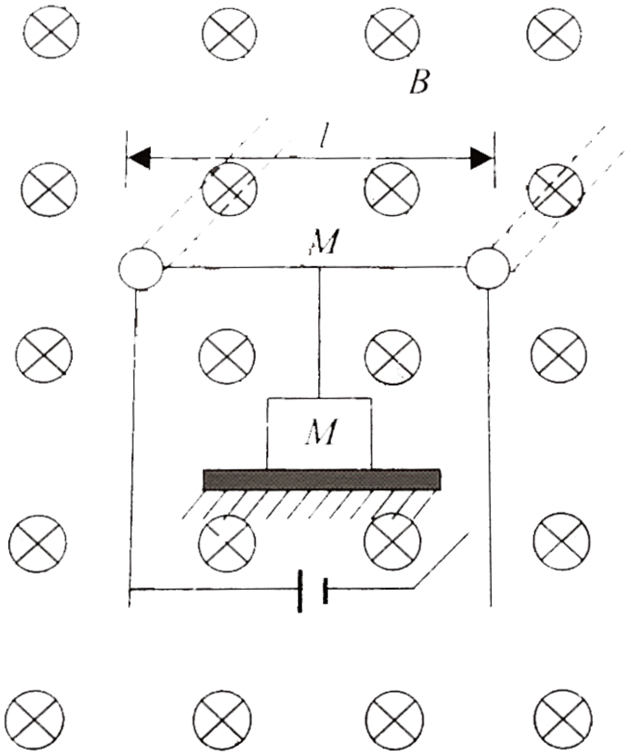
90. There exists a uniform magnetic field in horizontal direction perpendicular to the plane of the paper as shown in Fig. A wire of length 1 and mass m is attached with a block of equal mass with the help of an ideal string. The block is kept on floor and the wire on two conducting support as shown. After closing the switch, a charge q passes though the wire for a small interval of time. To what height the block will rise?

$$\left(take\frac{qBl}{m}=20\right)$$



A. 10 m

B. 5 m

C. 2.5 m

D. 1 m

Answer: B

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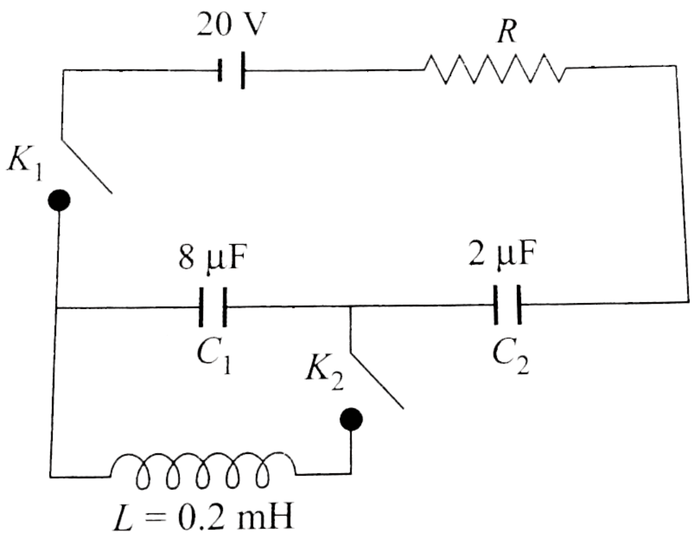
91. A circuit containing capacitors C_1 and C_2 shown in Fig. is in the steady state with key K_1 closed. At the instant t = 0, K_1 is opened and K_2 is closed. The angular frequency of oscillation of the circuit is



A. $25 \times 10^{-3} rads^{-1}$

B. $5 \times 10^{-4} rads^{-1}$

C. $5 \times 10^{4} rads^{-1}$

D. $25 \times 10^{3} rads^{-1}$

Answer: D

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92. An inductor coil stores 32 J of magnetic field energy and dissiopates energy as heat at the rate of 320 W when a current of 4 A is passed through it. Find the time constant of the circuit when this coil is joined across on ideal battery.

A. $t = 0.2s$

B. $t = 0.32s$

C. $t = 0.5s$

D. $t = 1s$

Answer: A

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93. A solenoid of inductance 50 mH and resistance 10Ω is connected to a battery of 6V. Find the time elapsed before the current acquires half of its steady - state value.

A. $3.5ms$

B. $2.5ms$

C. $0.693ms$

D. $2ms$

Answer: A

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94. An inductor-resistance -battery circuit is switched on at t = 0. find the emf of the battery in one time constant .

A. $\frac{E}{R}\cdot\frac{\tau}{e}$

B. $\frac{E}{R}\cdot\frac{\tau}{e-1}$

C. $\frac{E}{R} \cdot \frac{\tau}{e+1}$

D. $\frac{E}{R} \cdot \frac{e-1}{\tau}$

Answer: A

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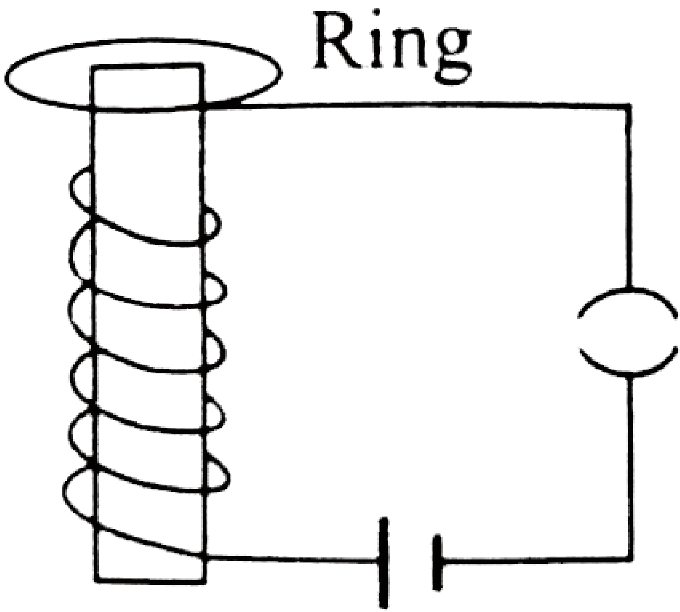
95. Figure shows a powerful electromagnet arrangement. A copper ring, which is free to move, is placed on the projecting part of the core as shown.

When the key is inserted, the ring



A. is thrown up

B. remains stationary

C. sticks to the core

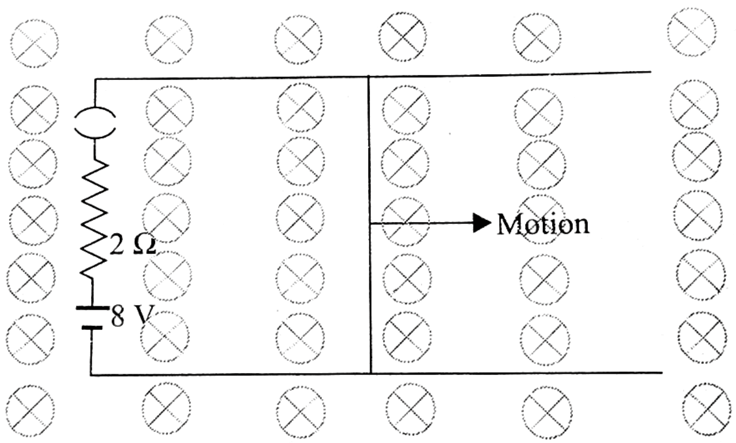
D. slips down along the core

Answer: A

Watch Video Solution

96. Figure shows a conducting frame having battery and a resistance on which a movable conductor of length 0.5 m can slide, The whole arrangement is placed in a uniform magnetic field of B =0.4 T directed perpendicular and into the plane of frame. Initially the circuit is open. When the key is inserted, the conductor begins to move. It is found that a force 0.5 N has to be applied on the conductor to the left to keep it moving at constant speed to the right.

Current flowing in the conductor is:



A. $5A$

B. 2.5 A

C. 1.25 A

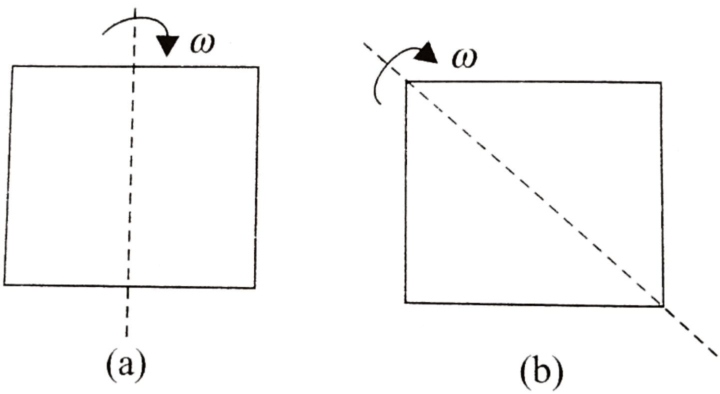
D. $1A$

Answer: B

Watch Video Solution

97. Figures show a squre loop of side a rotating about the given axes in a uniform magnetic field such that the field is perpendicular to the axis in both cases.

Angular speed of rotation is both cases being the same,



A. induced emf is more in (a) than in (b)

B. Induced emf is more in (b) than in (a)

C. Induced emf in the two cases are equal and non-zero

D. induced emf in the two cases are equal and zero

Answer: C

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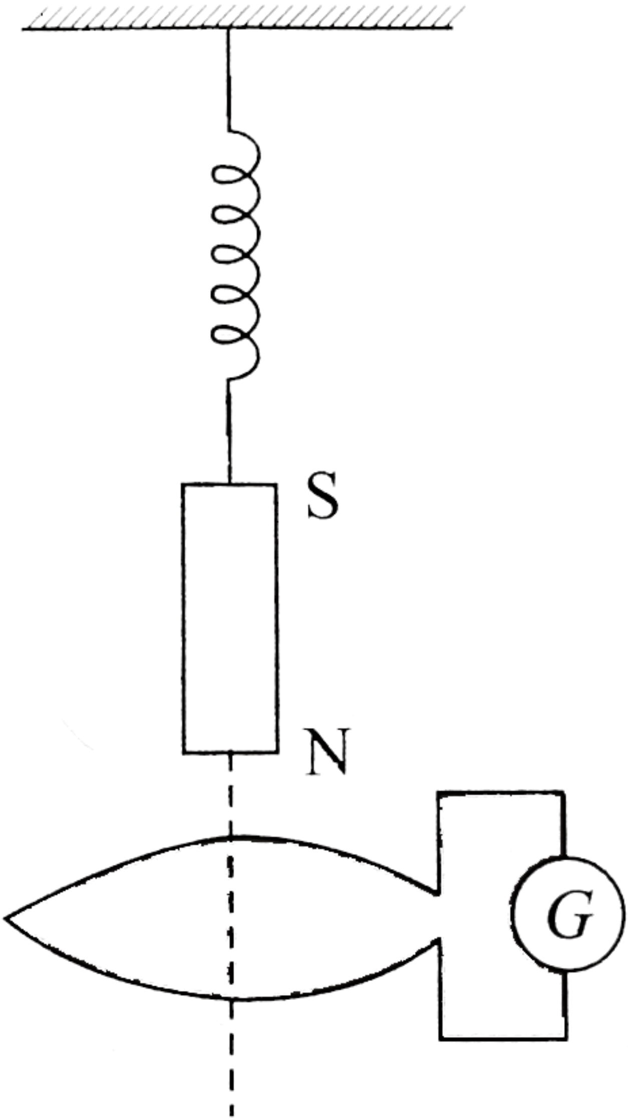
98. Figure shows a magnet suspended at the lower end of a spring while its length lies along the axis of a fixed circular conducting coil. The magnet is made to oscillate, Deflection in the galvanometer is



A. minimum when the magnet is at mean position

B. Maximum when the magnet is at mean position

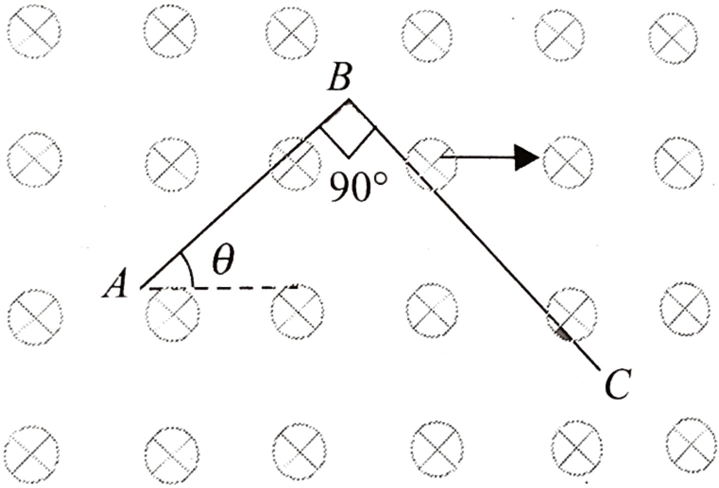
C. zero when the mgnet is at mean position

D. maximum when the magnet is at exteme position

Answer: B

Watch Video Solution

99. A conduting wire ABC (as shown) is moving with a constant velocity along horizontal direction. The magnetic field is perpendicular to the wire and directed into the page. AB =BC. Find the range of angle (θ) made by rod AB with horizontal at A so that value of induced emf at A is greater than at C



A. $\theta > 45^\circ$

B. $\theta < 45^\circ$

C. $\theta > 60^\circ$

D. $\theta < 75^\circ$

Answer: B

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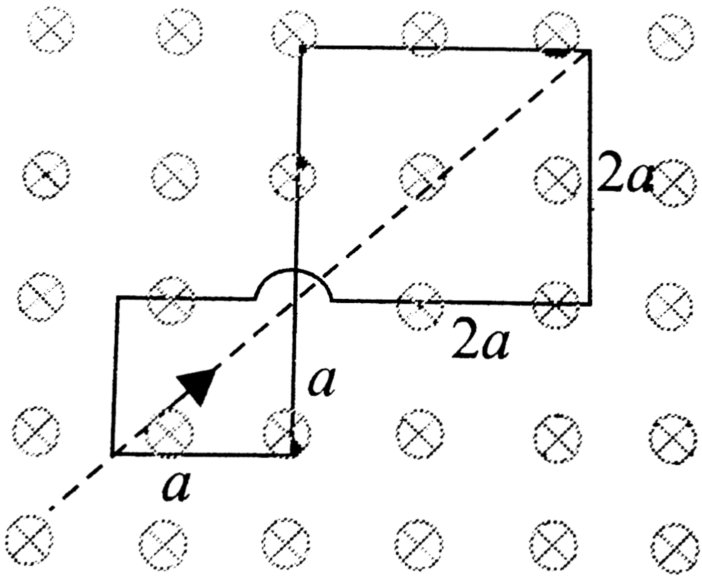
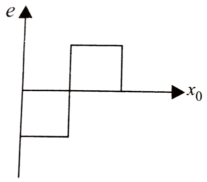
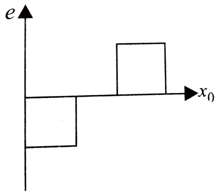
100. A uniform magnetic field exists in a square of side 2a (as shown in Fig). A square loop of side a centers the field along a diagonal and leave it at a constant speed. Draw the curve between induced emf e and distance along the diagonal, say x_0

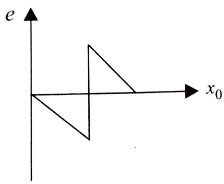


A. 

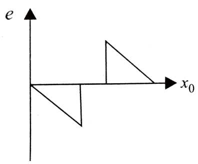
(a)

B. 

(b)

C. 

(c)

D. 

(d)

Answer: D

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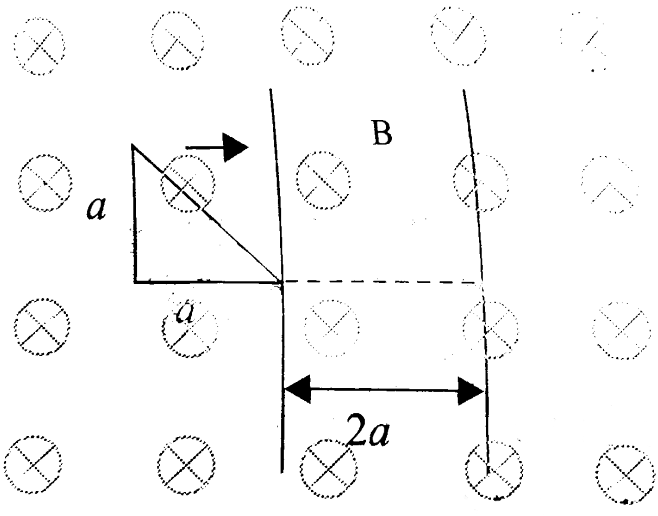
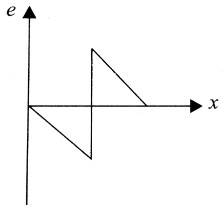
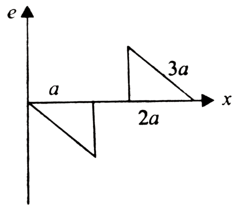
101. A right angled triangular loop as shown below enters uniform magnetic field (at right angle to the boundary of the field) directed into the paper. Draw the graph between induced emf e and the distance along the perpendicular to the boundary of the field, (say x) along which loop moves.

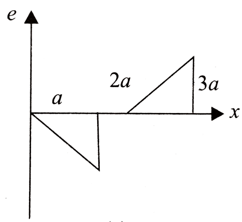


A. 

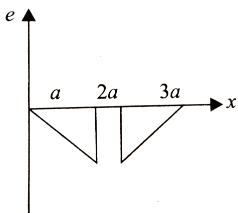
(a)

B. 

(b)

C. 

(c)

D. 

(d)

Answer: C

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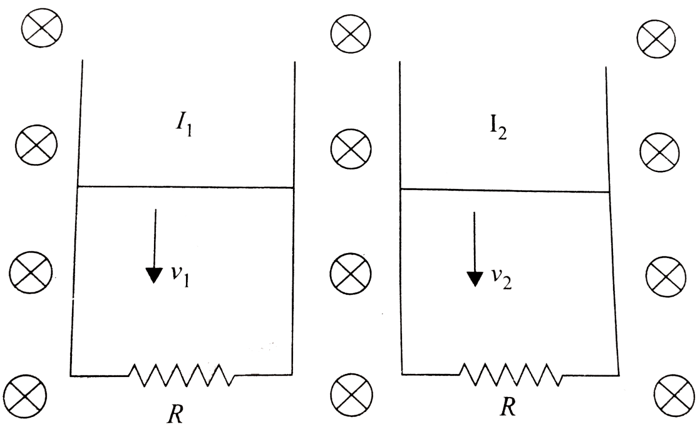
102. In a magnetic field as shown, in Fig. two horizontal wires of same mass and length l_1 and l_2 are free to slide on different vertical rails with velocities v_1 and v_2 respectively. If the resistance of two circuits are same and a_1 and a_2 are acceleration of two horizontal wires respectively, the condition for $a_1 > a_2$ is



A. $\frac{l_1}{l_2} = \frac{v_2}{v_1}$

B. $\frac{l_1}{l_2} < \left(\frac{v_2}{v_1}\right)^{1/2}$

C. $\frac{l_1}{l_2} > \left(\frac{v_1}{v_2}\right)^{1/2}$

D. $\frac{l_1}{l_2} < \frac{v_1}{v_2}$

Answer: B

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103. In the previous problem, if two falling conductors attain velocities v_1 and v_2 respectively after falling through same height h, ratio of energy dissipated as heat to the energy dissipated in resistor per unit time for two conductors is same.

Find which of the following condition will be satisfied

A. $gh + \frac{1}{2}v_1v_2 = 0$

B. $gh + v_1 v_2 = 0$

C. $\frac{1}{2} gh + v_1 v_2 = 0$

D. $gh + \frac{v_1^2 v_2}{v_1 + v_2} = 0$

Answer: A

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Multiple Correct

1. A particle is released from the origin with a velocity $v\hat{e}(i)$. The electric field in the region is $E\hat{e}(i)$ and magnetic field is $B\hat{k}$. Then

A. If $v = 0$ and $E = 0$ then particle will execute a circular path.

B. If $v = 0, E \neq 0$ then particle is positively charged then it executes clockwise

C. If $v = 0$ and $E \neq 0$ then the particle will execute a cycloidal motion in the x-y plane.

D. If $v > 0$ and $E \neq 0$ and the particle is positievely charged and $B > 0$ then the particle wil excute anticlockwise anticlock wise circle as seen from +z direction.

Answer: C::D

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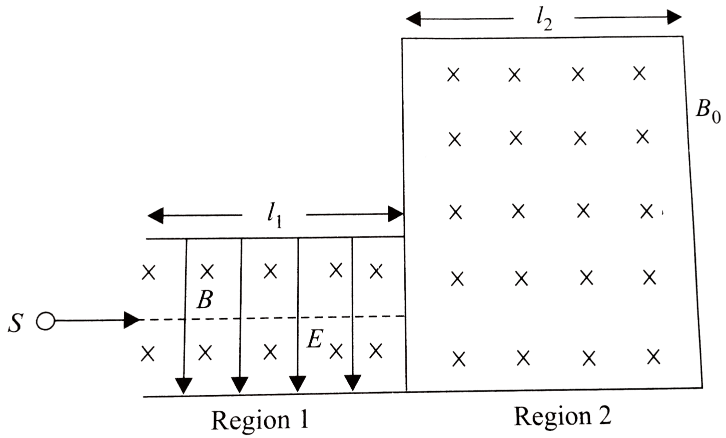
2. A charged particle of specific charge s passes undeviated through region 1 as shown in Fig.



A. Velocity of paticle in rigion 1 is $v = \dfrac{E}{B}$

B. Work done to move the charged particle in region 1 and region 2 is zero.

C. The radius of the trajectory of the charged particle in Region 2 is (E/sBB_0)

D. The particle emerges from region 2 with a velocity

$\vec{v}$ where $\vec{v'}$ = - $\vec{v}$ for $l_2 > \frac{E}{BB_0}$

Answer: A::B::C::D

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3. A proton is fired from origin with velocity $V = v_0\hat{J} + v_0\widehat{K}$ in a uniform magnetic field B=B_(0)hatJ, in the susbsequent motion of the proton

A. its z co-ordinate can never be negative

B. its x co-ordinate can never be positive

C. its x and z co-oridinate cannot be zero at the same time

D. its y co-ordinate will be proportional to its time of flight

Answer: B::D

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4. H^{+}, He^{+} and O^{2+} ions having same kinetic energy pass through a region of space filled with uniform magnetic field B directed perpendicular to the velocity of ions. The masses of the ions

H^{+}, He^{+} and O^{2+} are respectively, in the ratio $1:4:16$.

As a result

A. H^{+} will be deflected the most

B. O^{2+} will be deflected the most

C. He^{+} and O^(2+)` will be deflected equally.

D. All will be deflected equally

Answer: A::C

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5. A beam of electrons moving with a momentum p enters a uniform magnetic field of flux density B perpendicular to its motion. Which of the following statement(s) is (are) true?

A. Energy gained by electrons in megnetic field is $p^2/2m$

B. Centripetal force on the electron is Bem/p.

C. Radius of the electron's path is p/Be

D. Work done on the electrons by the magnetic field is zero

Answer: C::D

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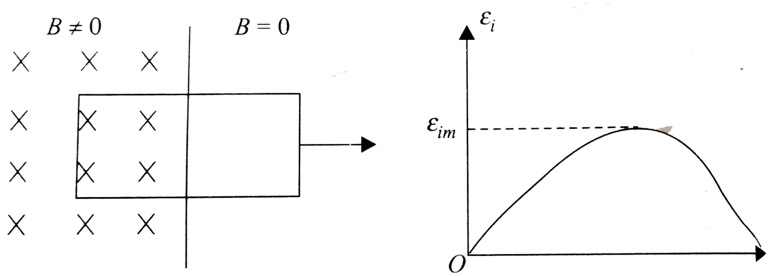
6. A plane rectangular loop is placed in a magnetic field. The emf induced in the loop due to this field is ε_1 whose maximum value is ε_{im}. The loop was pulled out of the magnetic field at a variable velocity. Assume that $\vec{B}$ is uniform and constant ε_1 is plotted against t as shown in the graph.

Which of the following are/is correct statement(s):



A. ε_{im} is independent of rate of removal of coil from the field.

B. The total chage that passes through any point of the loop in the process of complete removal of the loop does not depend on velocity of removal.

C. The total are under the curve $(\varepsilon_i vs t)$ is independent of rate of removal of coilfrom the field.

D. The area under the curve is dependent on the rate of remval of the coil.

Answer: B::C

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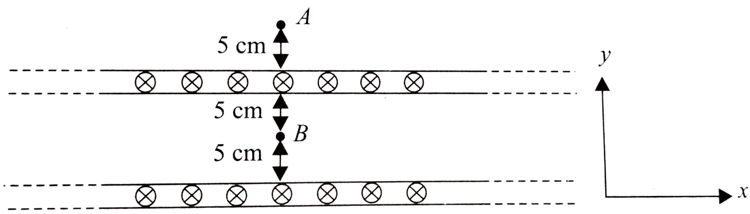
7. Figure shows cross section of two large parallel metal sheets carrying electric currents along their surface. The current in each sheet is $10/\pi A/m$ along the width, Consider two points A and B, as shown in the figure with their positions.



A. Megnetic field at A is $4\mu T$ along x-direction.

B. Magnetic field at A is $4\mu T$ along negative x-direction.

C. Magentic field at B is zero.

D. Magnetic field at B is $2\mu T$ along x-direction.

Answer: A::C

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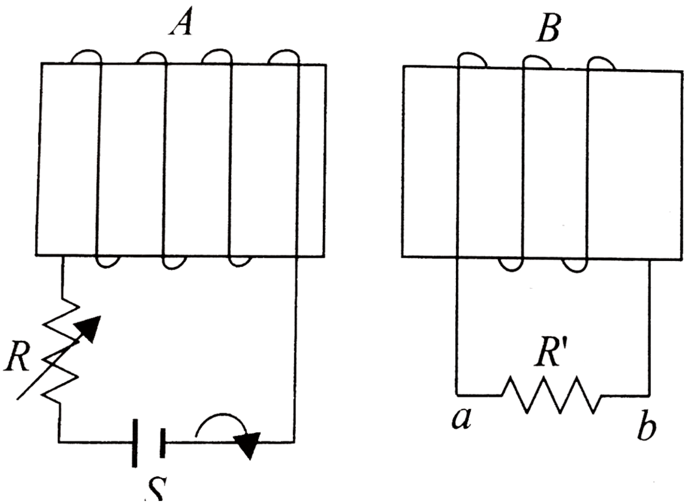
8. For the given electromagnetically coupled circuits: (S is initially in closed state)



A. When switch S is opend, current in R' flows from a to b.

B. When switch S is opend, current in R' flows from b to a.

C. When coil B is brought closer to coil A (with S closed) current in R' flows from b to a

D. When R is decreased (with S closed) then current in R' flows from b to a.

Answer: A::C::D

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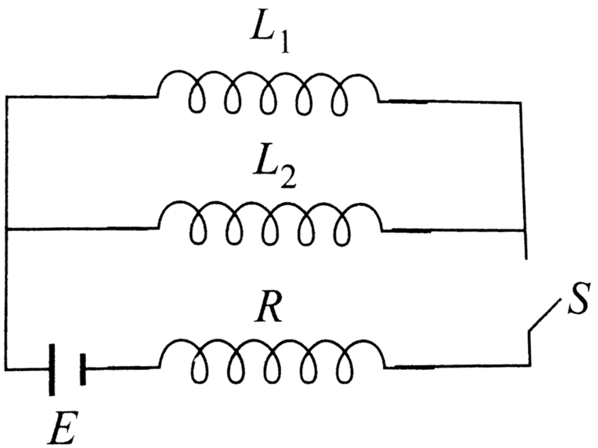
9. In the circuit, a battery of emf E, a resistance R and inductance coil L_1 and L_2 and switch S are connected as shown. In Fig. Initially the switch is open



A. The time constant of the circuit is $\frac{1}{R} \frac{L_1 L_2}{L_1 + L_2}$

B. Steady state current in the inductor $L_1 is$

(EL_(2))/(R(L_(1)+L_(2)))`

C. Steady state current in the inductor L_2 is

$$\frac{EL_1}{R(L_1 + L_2)}$$

D. In steady the total energy stored in the inductor

coils is $\frac{1}{2} \frac{L_1 L_2}{L_1 + L_2} \frac{E^2}{R^2}$

Answer: A::B::C::D

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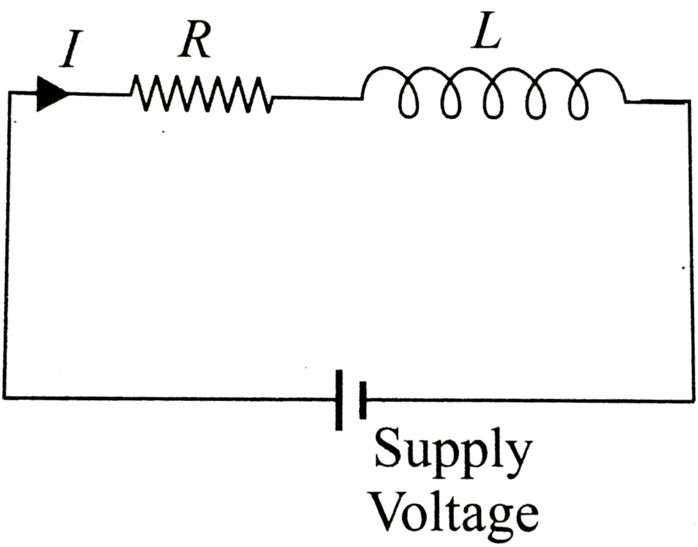
10. When current (I) in R-L series circuit becomes constant, where L is a pure inductor, which of the following given statements is/are correct?



A. voltage across R is RI.

B. Some part (not 100%) of the energy supplied by the battery will be dissipated in R and remaining will continue to store in L.

C. voltage across L is equal to zero.

D. magnetic energy stored is $\frac{1}{2}LI^2$

Answer: A::C::D

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11. A charged particle enters into a space and continues to move undeflected. Considering gravitational force also on the particle, in the space

A. a uniform horizontal electric field and a vertical magnetic field may be present

B. a vertical electric field alone may be present

C. uniform electric field and magnetic field both directed vertically downwards may be present

D. a uniform horizontal magnetic field alone may be present

Answer: B::C::D

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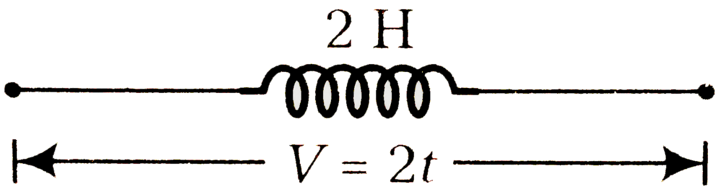
12. A variable voltage V = 2t is applied across an inductor of inductance L = 2H as shown in figure. The,



A. Current versus time graph is a parabola

B. energy stored in magnetic field at $t = 2sis4J.$

C. Potential energy at time $t = 1s$ in magnetic field is increasing at a rate of $1J/s$

D. energy stored in magnetic field is zero all the time.

Answer: A::B::C

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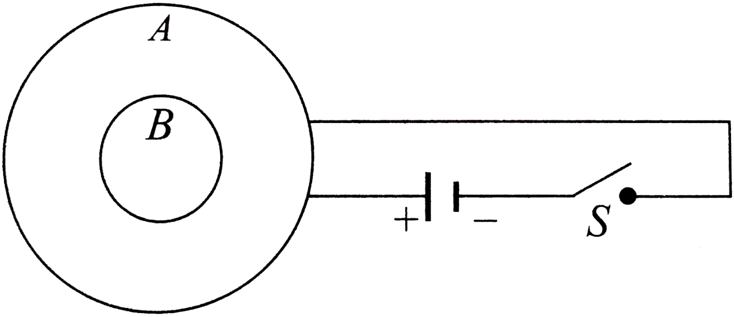
13. There are two coils A and B as shown in Fig.



A. When switch S is closed, the direction of the momentary current induced in coil B will be in anticlockwise direction

B. When switch S is closed, the direction of the momentary current induced in coil B will be in clockwise direction.

C. When switch S is opened, the direction of the momentary induced current in coil B will be in clockwise direction

D. When switch S is opened, the direction of the momentary induced current in coil B will be in anticlockwise direction.

Answer: A::C

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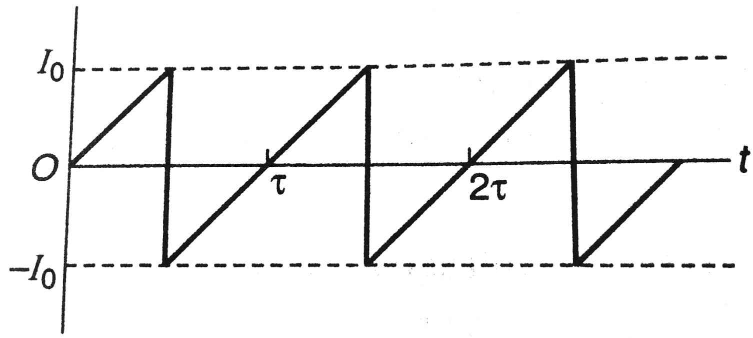
14. The current in a certain circuit varies with time as shown in figure. Find the average current and the rms current in terms of I_0



A. average current is $\frac{I_0}{\sqrt{3}}$

B. average current is zero

C. rms current is $\frac{I_0}{\sqrt{3}}$

D. rms current is $2\frac{I_0}{\sqrt{3}}$

Answer: A::C

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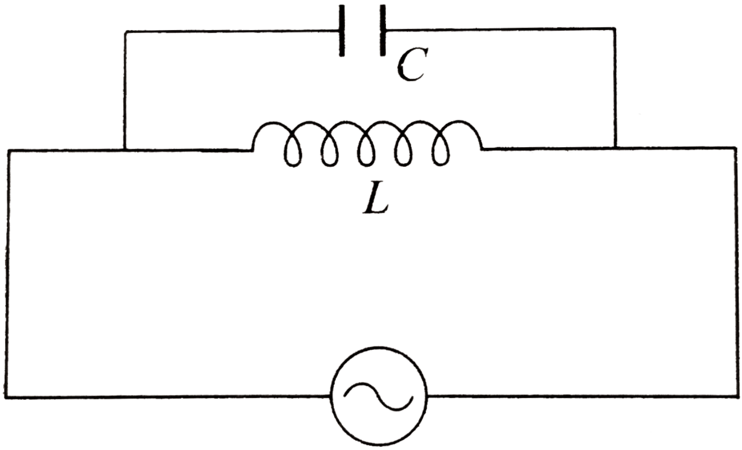
15. For the circuit shown in Fig. the emf of the generator is E. The current through the inductor is 1.6 A. While the current through the condenser is 0.4 A. Then



$E = E_0 \sin \omega t$

A. Current drawn from the generator is $I = 2A$

B. Current drawn from the generator is $I = 1.2A$

C. $\omega = \dfrac{1}{2\sqrt{LC}}$

D. $\omega = \dfrac{1}{4\sqrt{LC}}$

Answer: B::C

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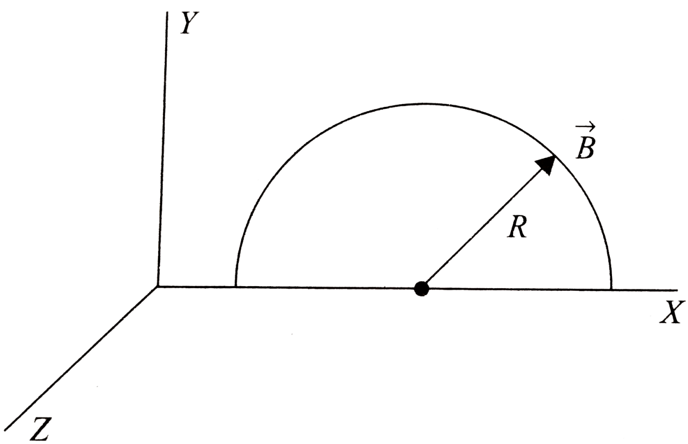
16. A semicircle conducting ring of radius R is placed in the xy plane, as shown in Fig. A uniform magnetic field is set up along the x-axis. No emf, will be induced in the ring if



A. it moves along the x-axis

B. it moves along the y-axis

C. it moves along the z-axis

D. it remains stationary

Answer: A::B::C::D

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17. A bar magnet is moved along the axis of a copper ring placed far away from the magnet. Looking from the side of the magnet, an anticlockwise current is found to be induced in the ring. Which of the following may be true?

A. The south pole faces the ring and the magnet moves towards it.

B. The north pole faces the ring and the magnet moves towards it.

C. The south pole faces the ring and the magnet moves away from it

D. The north pole faces the ring and the magnet moves away from it

Answer: B::C

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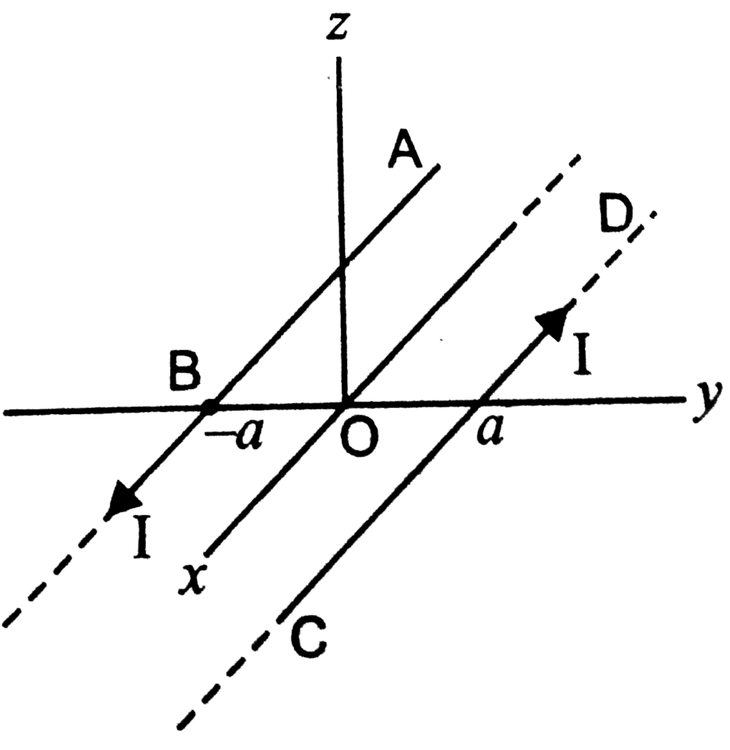
18. Two long parallel wires, AB and CD, carry equal currents in opposite directions. They lie in the x-y plane, parallel to the x-axis, and pass through the points (0,-a,0) and (0,a,0) respectively, Figure. The resultant magnetic field is:



A. zero on the x-axis

B. maximum on the x-axis.

C. direction along the z-axis at the origin, but not at other point on the z-axis.

D. directed along the z-axis at all points on the z-axis.

Answer: B::D

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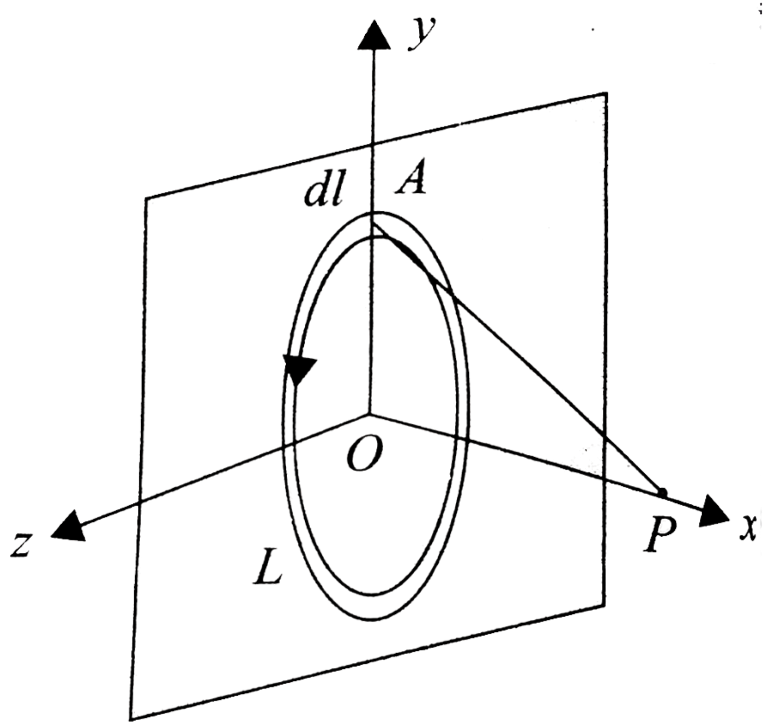
19. L is a circular loop (in y-z plane) carrying an anticlockwise current. P is a point on its axis OX dl is an element of length on the loop at a point A on it. The magnetic field at P



A. due to L is directed along OX.

B. due to kl is directed along OX.

C. due to dl is perpendicular to AP in upwards direction

D. due to dl is perpendicular to AP in downwards direction

Answer: A::D

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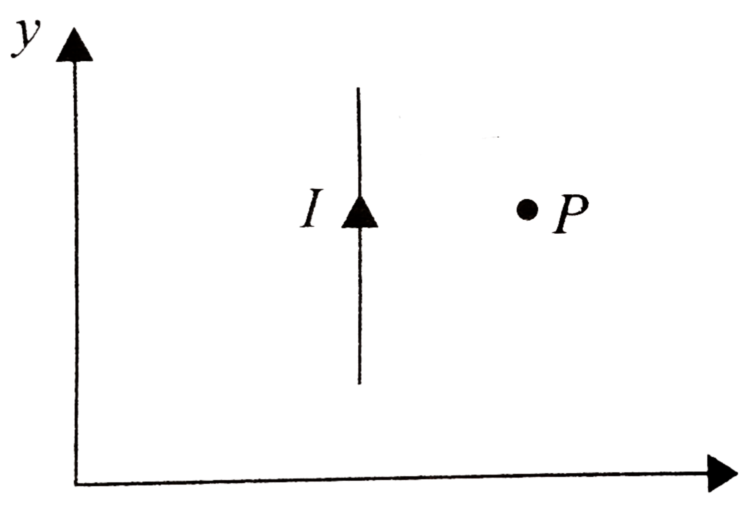
20. A straight wire carrying current is parallel to the y-axis as shown in Fig. The



A. magnetic field at the point P is parallel to the x-axis.

B. magnetic field at P is along z-axis

C. magnetic field are concentric circle with the wire passing through their common centre

D. magnetic fields to the left and right of the wire and oppositely directed.

Answer: B::C::D

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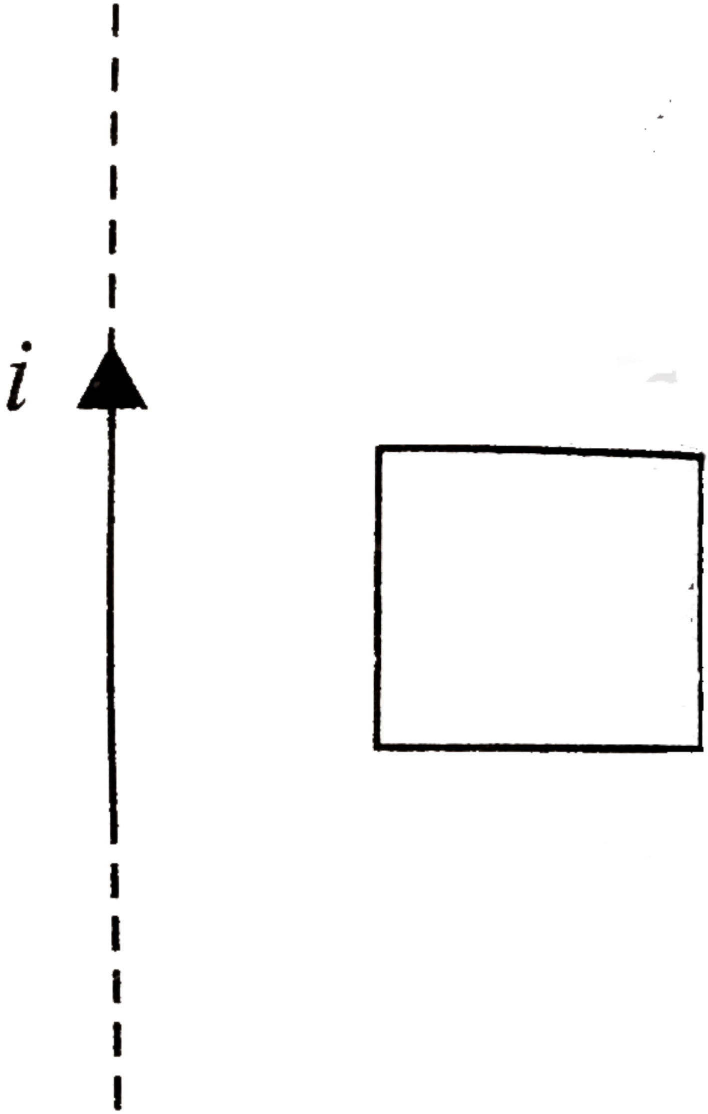
21. A square conducting loop is placed in the neighbourhood of a coplaner long straight wire carrying a current i.



A. if $\frac{di}{dt} = 0$, no current is induced in the loop

B. if $\frac{di}{dt} > 0$, current in the loop is clockwise.

C. if $\frac{di}{dt} < 0$, current in the loop is anticlockwise.

D. if $\frac{di}{dt} > 0$, current in the loop is anticlockwise.

Answer: A::D

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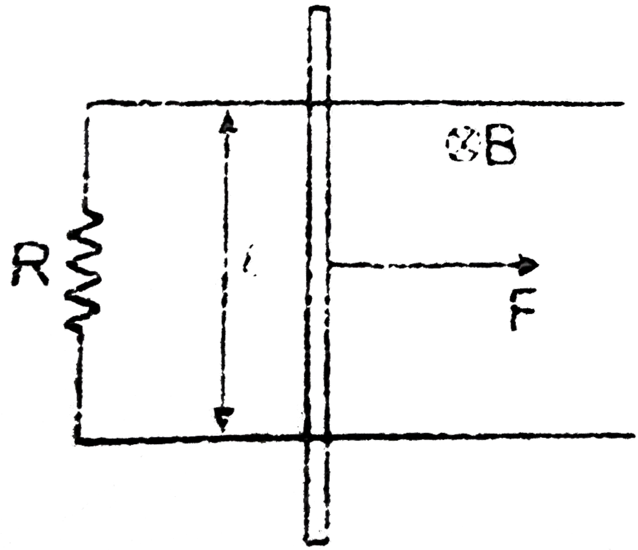
22. A constant force F is being applied on a rod of length t kept at rest on two parallel conducting rails connected at ends by resistance R in uniform magnetic field B as shown.



A. Th thermal power dissipated in the resistor is equal to rate of work done by externl person pulling the rod.

B. If applied external force is doubled then a part of external power increases the velocity of rod.

C. Lenz's Law is not satisfied if the rod is accelerated by external force

D. If resistance R is doubled then power required to maintain the constant velocity v_0 becomes half.

Answer: A::B::D

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23. A rectangular coil $20cm \times 10cm$ having 500 turns rotates in a magnetic field of $5 \times 10^{-3}T$ with a frequency of $1200 rev \min^{-1}$ about an axis perpendicular to the field.

A. The maximum value of the induced emf $2\pi / 5$ volt.

B. The instantaneous emf when the plane of the coil is perpendicular to the field is zero

C. The instantaneous emf when the plane of the coil makes an angle of 60° with the field is $\pi / 5$ volt.

D. The instantaneous emf when the plane of the coil makes an angle of 30° with the field is $\pi / 10$ volt

Answer: A::B::C

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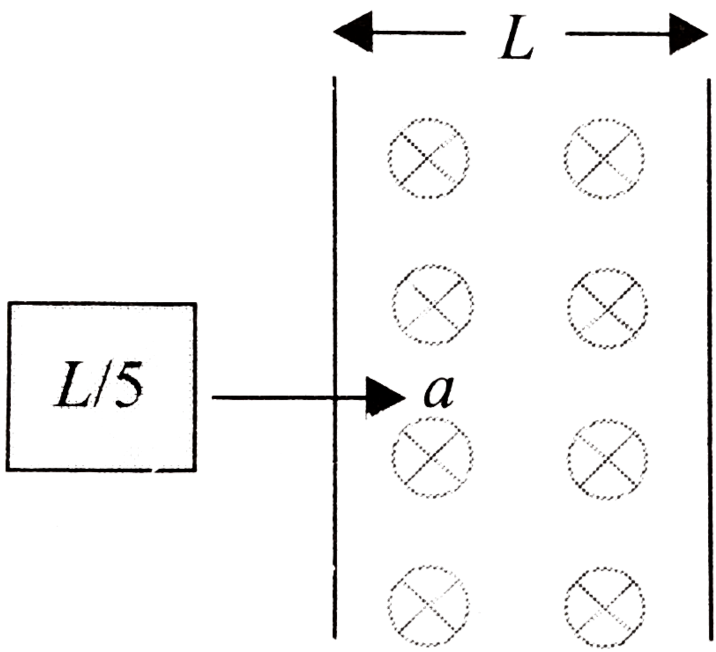
24. Uniform magnetic field B =5 T is acting in the region of length L=5 m as shown in Fig. A square loop of side $L/5$ enters in it with constant acceleration $a = 1ms^{-2}$. Resistance per unit length of the square frame is $1(\Omega)m^{-1}$. At t = 1 s



A. Induced current in the square frame is anti-clockwise.

B. Induced current in the frame is 1.25 A

C. Magnetic force on the frame is 6.25 N.

D. Magnetic torque on the frame is zero

Answer: A::B::C::D

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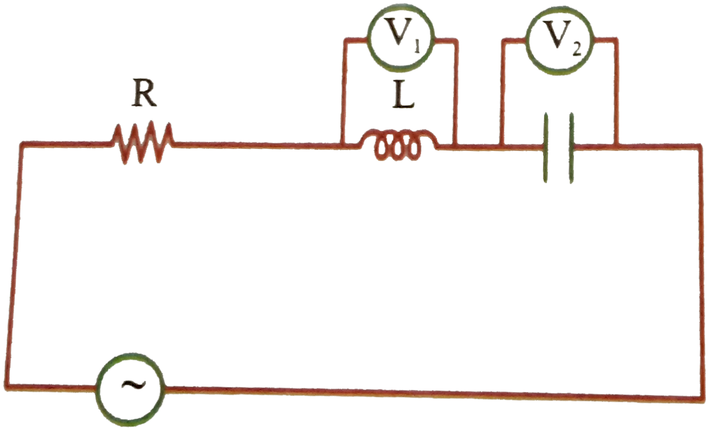
25. In the figure shown $R = 100\Omega L = \frac{2}{\pi}H$ and $C = \frac{8}{\pi}\mu F$ are connected in series with a.c source of 200 volt and frequency $'f'$. V_1 and V_2 are two hot-wire voltmeters. If the readings of V_1 and V_2 are same then:



A. $f = 125 Hz$

B. $f = 250 pHz$

C. current through R is $2A$

D. $V_1 = V_2 = 1000V$

Answer: A::C::D

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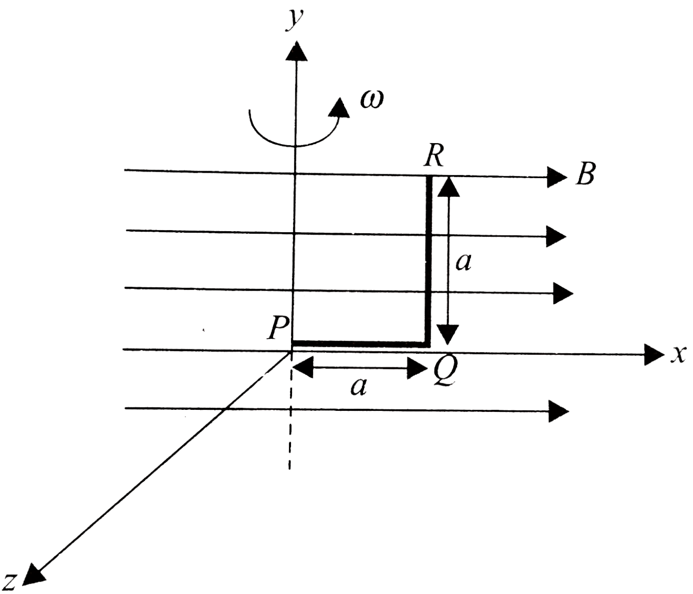
26. In a region there exists a magnetic field B_0 along positive x-axis. A metallic wire of length 2a, one side along x-axis and one side parallel of y-axis is rotates about y-axis with a angular velocity. Then at the instant shown



A. Potential difference across PQ is 0

B. Potential difference across PQ is $\frac{1}{2}B_0\omega a^2$

C. Potential difference across QR is $\frac{1}{2}B_0\omega a^2$.

D. Potential difference across QR is $B_0\omega a^2$.

Answer: A::D

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27. An LR circuit with a battery is connected at t=0. Which of the following quantities is not zero just after the connection?

A. Current in the circuit

B. Magnetic field energy in the inductor

C. Power delivered by battery

D. emf induced in the inductor

Answer: A::B::C

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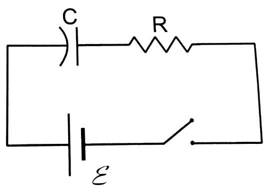
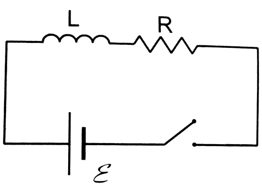
28. The switches in figure and are closed at $= 0$ and reopended after al long time at $t = t_0$.





A. the charge on C just after t =0 is EC

B. the charge on C long after t=0 is EC

C. the current in L just before $t = t_0 is E / R$

D. the current in L long after $t = t_0 is E / R$

Answer: B::C

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29. L,C and R represent the physical quantities inductance, capacitance and resistance respectively. Which of the following combinations have dimensions of frequency?

A. RL^{-1}

B. $R^{-1}L^{-1}$

C. $L^{-1/2}C^{-\frac{1}{2}}$

D. RCL

Answer: A::C

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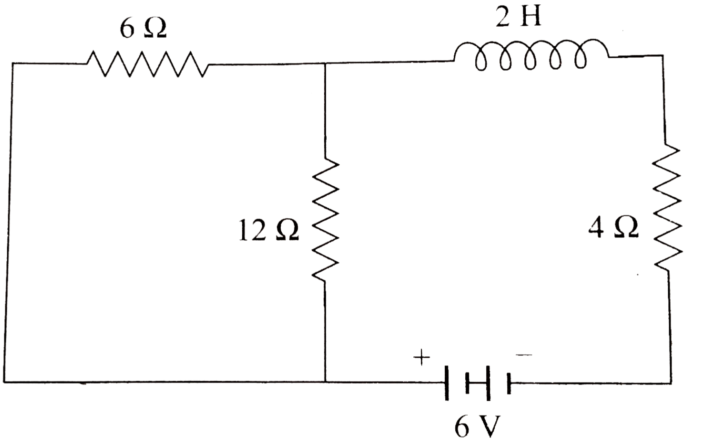
30. For the circuit shown in Fig. Which of the following statements are correct?



A. Its time constant is 0.25 s

B. In steady sate, current through inductance will be

equal to zero

C. In steady state, current through the battery will be

equal to 0.75 A

D. None ot the above.

Answer: A::C

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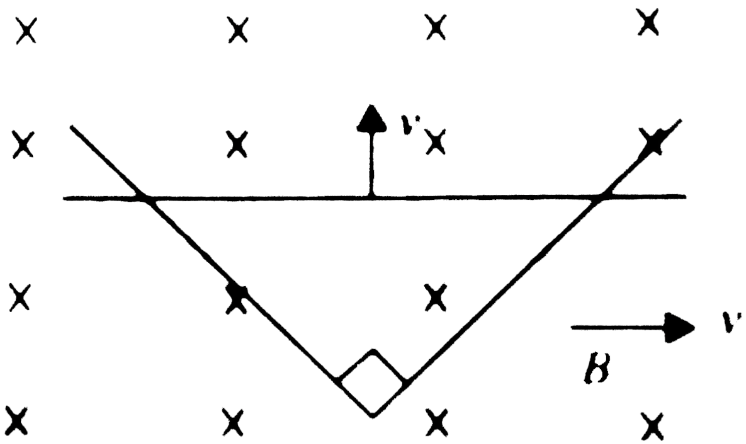
31. Two straight conducting rails form a right angle where their ends are joined. A conducting bar in contact with the rails starts at the vertex at time t = 0 and moves with constant velocity v along them as shown in Fig. A magnetic field $\vec{B}$ is directed into the page. the induced emf in the circuit at any time t is proportional to



A. t°

B. t

C. voltage across L is equal to zero.

D. v^2

Answer: B::D

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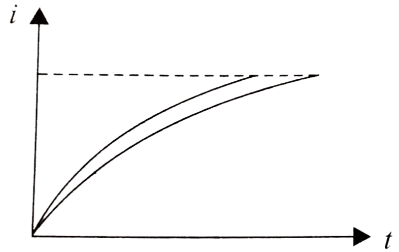
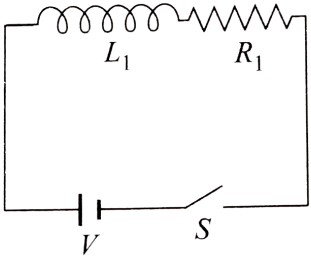
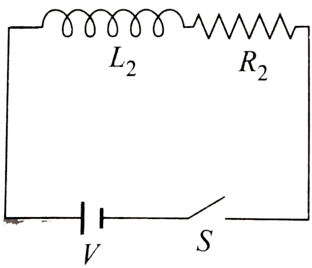
32. The current growth in two L-R circuits (b) and (c) is as shown in Fig. Let L_1, L_2, R_1 and R_2 be the corresponding values in two circuits. Then



(a)



(b)



(c)

A. $R_1 > R_2$

B. $R_1 = R_2$

C. $L_1 > L_2$

D. $L_1 < L_2$

Answer: B::D

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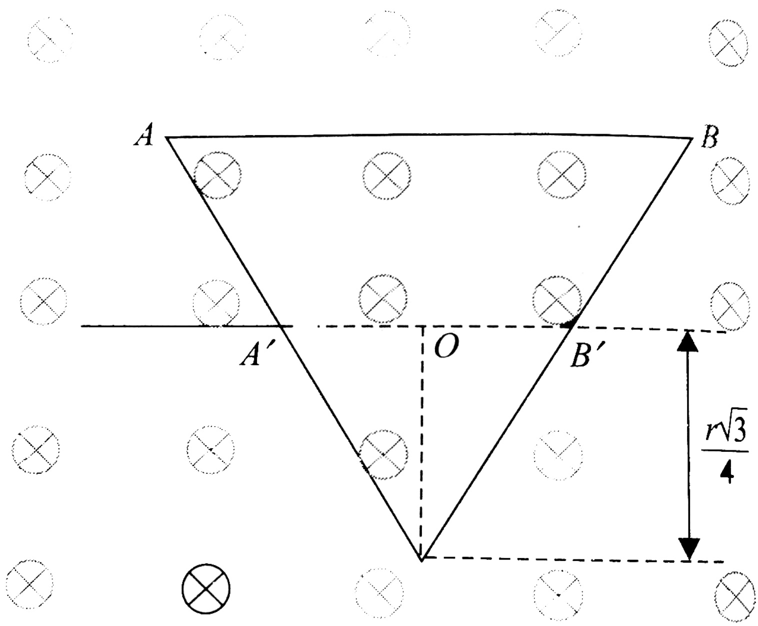
33. ABC is an equilateral triangular frame of mass m and side r. It is at rest under the action of horizontal magnetic field B (as shown) and the gravitational field.



A. The frame remains at rest if the current in the frame is $\frac{2mg}{rB}$

B. The frame remains at rest if the current in the frame is $\frac{2mg}{rB\sqrt{3}}$

C. The frame is in simple harmonic motion when frame is slightly displaced in its plane perpendicular to AB. The period of oscillation is $\pi\left[\frac{r\sqrt{3}}{g}\right]^{-1/2}$

D. For same as in above option, teh period of oscillation is $\pi\left[\frac{3r}{2g}\right]^{1/2}$.

Answer: A::C

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34. An external magnetic field is decreased to zero, due to which a current is induced in a circular wire loop of radius r and resistance R placed in the field. This current will not become zero at the instant when B stops changing

A. At the instant when external magnetic field stops changing (t=0), the current in the loop is i_0. The current in the loop as a function of time for $t > 0$ is given by $i_0 e^{-2Rt/\mu_0 \pi}$.

B. For the same as in option (a), the current in the loop as a function of time $t = 0$ is given by $\frac{\mu_0 i R}{2r}$.

C. The time in which current in loop decreases to $10^{-3}i_0$ (from t=0) for $R = 100\Omega$ and $r = 5cm$ is given by $\frac{3\pi^2 1n10}{10^{10}}s$.

D. Fro the same as in option (c), the time in which current in loop decreases to $10^{-3}i_0$ (from t=0) for $R = 100\Omega$ and $r - 5cm$ is given by $\frac{3\pi^2}{10^6}s$.

Answer: A::C

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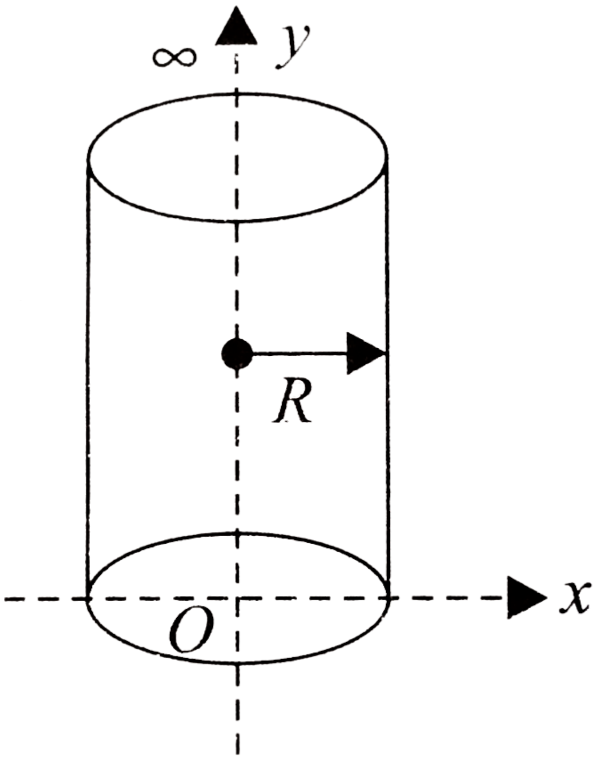
Linked Comprehension

1. An infinite cylindrical wire of radius R and having current density varying with its radius r as, $J = J_0[1 - (r/R)]$. Then answer the following questions.



Graph between the magnetic field and radius is

A. R

B. $3R/4$

C. $r/2$

D. $R/4$

Answer: B

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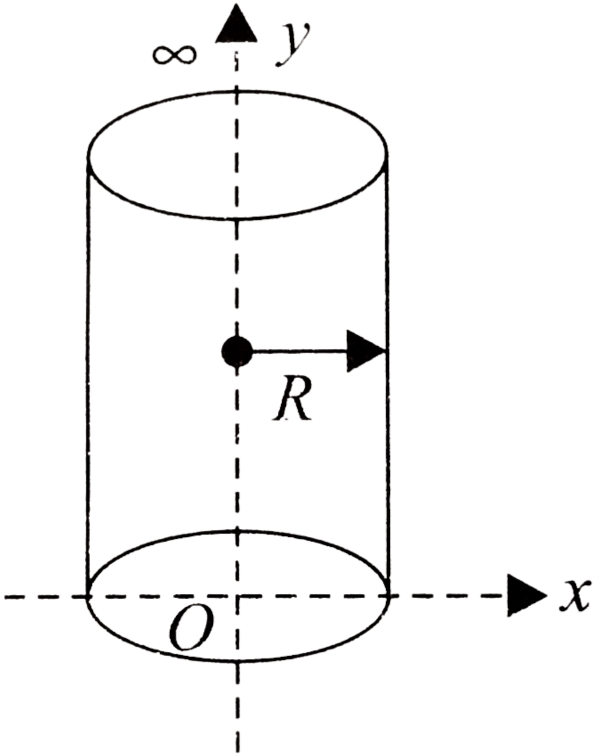
2. An infinite cylindrical wire of radius R and having current density varying with its radius r as, $J = J_0[1 - (r/R)]$. Then answer the following questions.



Graph between the magnetic field and radius is

A. $\frac{J_0 R}{6} \mu_0$

B. $\frac{3}{16} J_0 R \mu_0$

C. $\frac{5}{16} J_0 R \mu_0$

D. $\frac{5}{6} J_0 R \mu_0$

Answer: B

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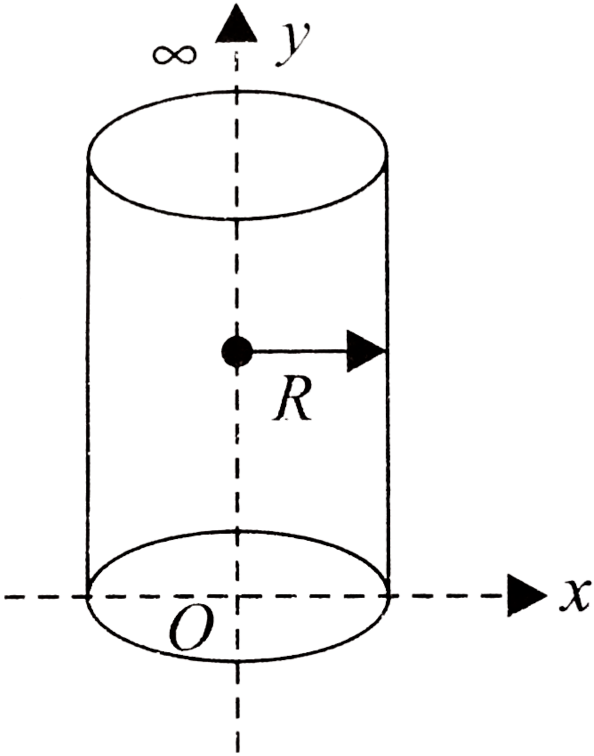
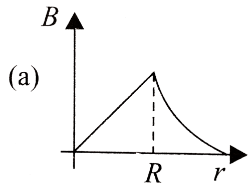
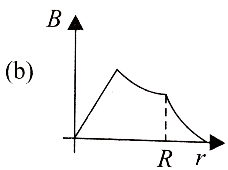
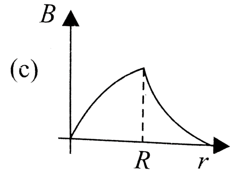
3. An infinite cylindrical wire of radius R and having current density varying with its radius r as, $J = J_0[1 - (r/R)]$. Then answer the following questions.

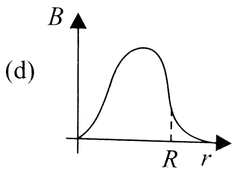


Graph between the magnetic field and radius is

A. 

B. 

C. 

D. 

Answer: D

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4. A closed current-carrying loop having a current I is having area A. Magnetic moment of this loop is defined as $\overrightarrow{\mu} = \overrightarrow{IA}$ where direction of area vector is towards the observer if current is flowing in anticlockwise direction with respect to the observer. If this loop is placed in a uniform magnetic field $\overrightarrow{B}$, then torque acting on the loop is given by $\overrightarrow{\tau} = \overrightarrow{\mu} \times \overrightarrow{B}$. Now answer the following questions:

A uniformly charged insulating ring is rotated in a uniform magnetic field about its own axis, then

A. Ring will experience a magnetic force

B. Ring must experience a magnetic torque

C. Ring may experience a magnetic torque

D. None of the above

Answer: C

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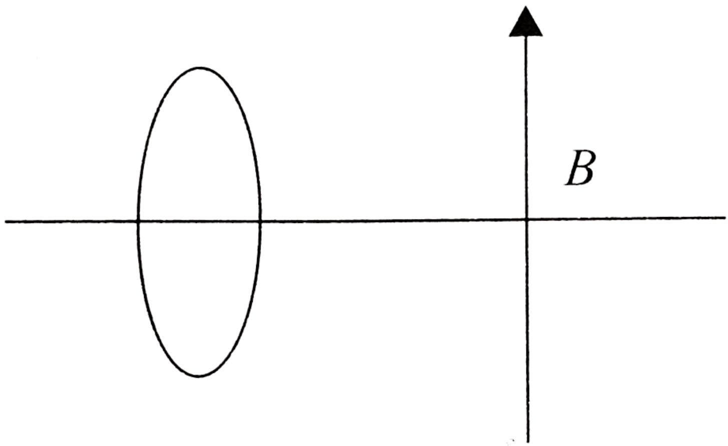
5. A closed current-carrying loop having a current I is having area A. Magnetic moment of this loop is defined as $\overrightarrow{\mu} = \overrightarrow{IA}$ where direction of area vector is towards the observer if current is flowing in anticlockwise direction with respect to the observer. If this loop is placed in a uniform magnetic field $\overrightarrow{B}$, then torque acting on the loop is given by $\overrightarrow{\tau} = \overrightarrow{\mu} \times \overrightarrow{B}$. Now answer the following questions:

Consider the situation shown in Fig., ring is having a uniformly distributed positive charge. Magnetic field is perpendicular to the axis of ring. Now ring is rotated in anticlockwise direction as seen from left hand side direction of magnetic torque acting on the ring is



A. Parallel to $\vec{B}$

B. Parallel to axis of ring

C. Going into plane of paper

D. Coming out of plane of paper

Answer: C

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6. A closed current-carrying loop having a current I is having area A. Magnetic moment of this loop is defined as $\overrightarrow{\mu} = \overrightarrow{IA}$ where direction of area vector is towards the observer if current is flowing in anticlockwise direction with respect to the observer. If this loop is placed in a uniform magnetic field $\overrightarrow{B}$, then torque acting on the loop is given by $\overrightarrow{\tau} = \overrightarrow{\mu} \times \overrightarrow{B}$. Now answer the following questions:

Let ring in the above question is having a radius R and a charge Q is uniformly distributed over it. Ring is rotated with a constant angular velocity (ω) as mentioned above. Torque acting on the ring due to magnetic force is

A. $\dfrac{QR^2\omega B}{2}$

B. $\dfrac{QR^2\omega B}{2\omega}$

C. $\dfrac{\omega R^2 B}{2\pi}$

D. None of the above

Answer: A

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7. A charged particle with charge to mass ratio $\left(\dfrac{q}{m}\right) = \dfrac{(10)^3}{19} Ckg^{-1}$ enters a uniform magnetic field $\overrightarrow{B} = 20\hat{i} + 30\hat{j} + 50\hat{k} T$ at time t = 0 with velocity $\overrightarrow{V} = \left(20\hat{i} + 50\hat{j} + 30\hat{k}\right) m/s$. Assume that magnetic field exists in large space.

During the further motion of the particle in the magnetic field, the angle between the magnetic field and velocity of the particle

A. remains constant

B. increases

C. decreases

D. may increase or decrease

Answer: A

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8. A charged particle with charge to mass ratio $\left(\frac{q}{m}\right) = \frac{(10)^3}{19} Ckg^{-1}$ enters a uniform magnetic field $\vec{B} = 20\hat{i} + 30\hat{j} + 50\hat{k}T$ at time t = 0 with velocity

$\overrightarrow{V} = \left(20\hat{i} + 50\hat{j} + 30\hat{k}\right)m/s$. Assume that magnetic field exists in large space.

The frequency (in Hz) of the revolution of the particle in cycles per second will be

A. $\dfrac{10^3}{\pi\sqrt{38}}$

B. $\dfrac{10^4}{\pi\sqrt{38}}$

C. $\dfrac{10^4}{\pi\sqrt{19}}$

D. $\dfrac{10^4}{2\pi\sqrt{19}}$

Answer: B

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9. A charged particle with charge to mass ratio $\left(\frac{q}{m}\right) = \frac{(10)^3}{19} Ckg^{-1}$ enters a uniform magnetic field $\vec{B} = 20\hat{i} + 30\hat{j} + 50\hat{k} T$ at time t = 0 with velocity $\vec{V} = \left(20\hat{i} + 50\hat{j} + 30\hat{k}\right) m/s$. Assume that magnetic field exists in large space.

The pitch of the helical path of the motion of the particle will be

A. $\pi/100m$

B. $\pi/125m$

C. $\pi/215m$

D. $\pi/250m$

Answer: D

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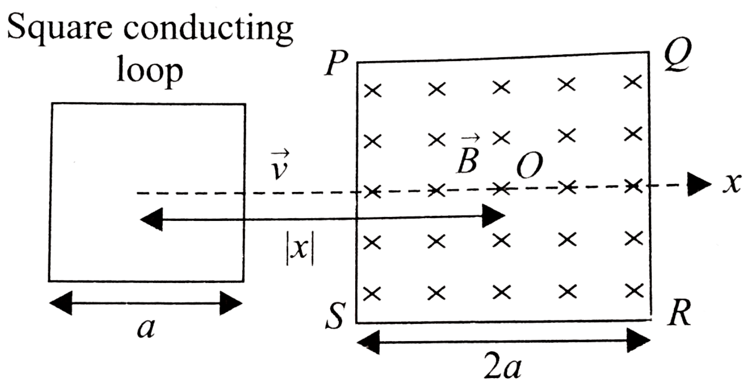
10. PQRS is a square region of side 2a in the plane of paper. A uniform magnetic field B, directed perpendicular to the plane of paper and into its plane is confined within this square region. A square loop of side 'a' and made of a conducting wire of resistance R is moved at a constant velocity $\vec{v}$ from left to right in the plane of paper as shown. Obviously, the square loop will enter the magnetic field at some time and then leave it after some time. During the motion of loop, whenever magnetic flux through it changes, emf will be induced resulting in induced current. Let the motion of the square loop be along x-axis and let us measure x coordinate of the centre of square loop from the centre of the square magnetic field region (taken as origin). Thus, x coordinate will be positive if the centre of square loop is to the right of the origin O (centre of magnetic field) and negative if centre is to the left.



For $x = -9a/5$, magnitude of induced current and its direction as seen from above will be:

A. Bav, clockwise

B. $Ba\frac{v}{R}$, clockwise

C. zero

D. $Ba\frac{v}{R}$, anticlockwise

Answer: C

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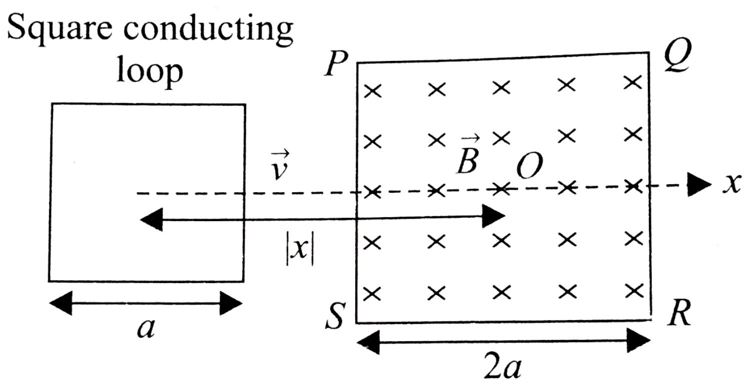
11. PQRS is a square region of side 2a in the plane of paper. A uniform magnetic field B, directed perpendicular to the plane of paper and into its plane is confined within this square region. A square loop of side 'a' and made of a conducting wire of resistance R is moved at a constant velocity $\vec{v}$ from left to right in the plane of paper as shown. Obviously, the square loop will enter the magnetic field at some time and then leave it after some time. During the motion of loop, whenever magnetic flux through it changes, emf will be induced resulting in induced current. Let the motion of the square loop be along x-axis and let us measure x coordinate of the centre of square loop from the centre of the square magnetic field region (taken as origin). Thus, x coordinate will be positive if the centre of square loop is to the right of the origin O (centre of magnetic field) and negative if centre is to the left.



External force required to maintain constant velocity of the loop for $x = -\frac{9}{5}a$ will be

A. $B^2a^2v^2$ to the right

B. $\frac{B^2a^2v^2}{R}$ to the right

C. $\frac{B^2a^2v^2}{R}$ to the left

D. zero

Answer: D

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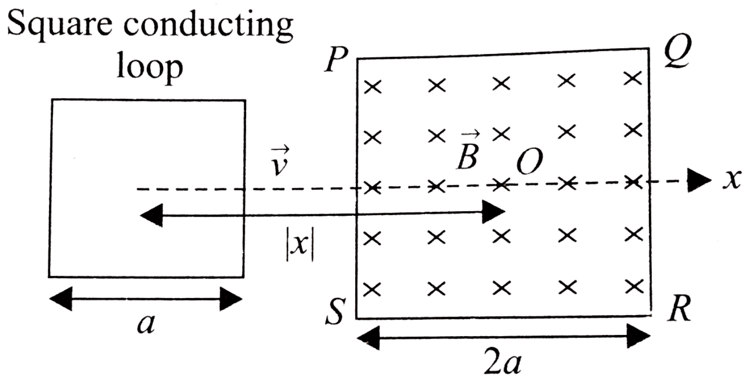
12. PQRS is a square region of side 2a in the plane of paper. A uniform magnetic field B, directed perpendicular to the plane of paper and into its plane is confined within this square region. A square loop of side 'a' and made of a conducting wire of resistance R is moved at a constant velocity $\vec{v}$ from left to right in the plane of paper as shown. Obviously, the square loop will enter the magnetic field at some time and then leave it after some time. During the motion of loop, whenever magnetic flux through it changes, emf will be induced resulting in induced current. Let the motion of the square loop be along x-axis and let us measure x coordinate of the centre of square loop from the centre of the square magnetic field region (taken as origin). Thus, x coordinate will be positive if the centre of square loop is to the right of the origin O (centre of magnetic field) and negative if centre is to the left.



For $x = a/4$

(i) magnetic flux through the loop,

(ii) induced current in the loop and

(iii) external force required to maintain constant velocity

of the loop, will be

A. (i) Ba^2 (ii) $\dfrac{Bav}{2R}$ (iii) $\dfrac{B^2a^2v^2}{4R^2}$

B. (i) Ba^2 (ii) zero (iii) zero

C. (i) Ba^2 (ii) $\dfrac{Bav}{2R}$ (iii) zero

D. (i) zero (ii) zero (iii) zero

Answer: C

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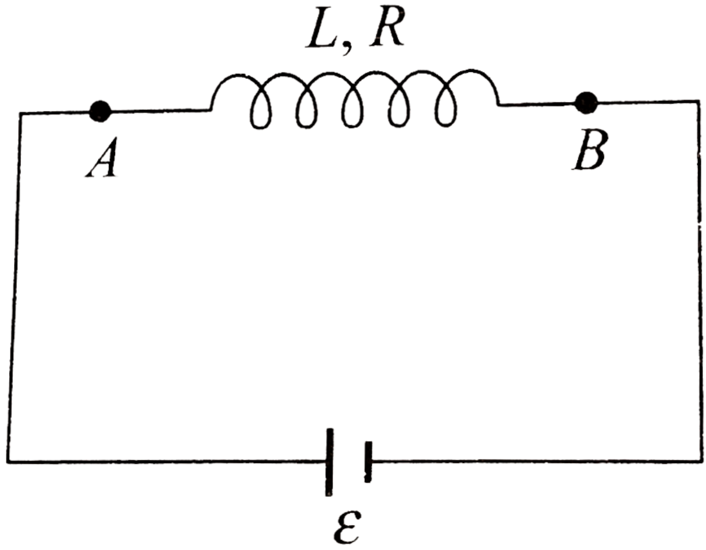
13. An indcutor having self inductance L with its coil resistance R is connected across a battery of emf $elipson$. When the circuit is in steady state t = 0, an iron rod is inserted into the inductor due to which its inductance becomes nL (ngt1).



After insertion of rod which of the following quantities will change with time?

(1) Potential difference across terminals A and B

(2) Inductance

(3) Rate of heat produced in coil

A. only (1)

B. (1) and (3)

C. only (3)

D. (1), (2) and (3)

Answer: C

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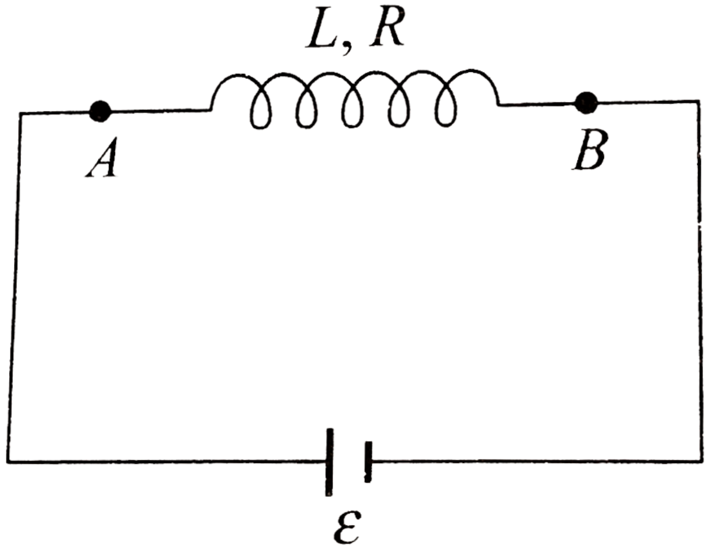
14. An indcutor having self inductance L with its coil resistance R is connected across a battery of emf $elipson$. When the circuit is in steady state t = 0, an iron rod is inserted into the inductor due to which its inductance becomes nL (ngt1).



after insertion of rod, current in the circuit:

A. Increases with time

B. Decreases with time

C. Remains constant with time

D. First decreases with time then becomes constant

Answer: A

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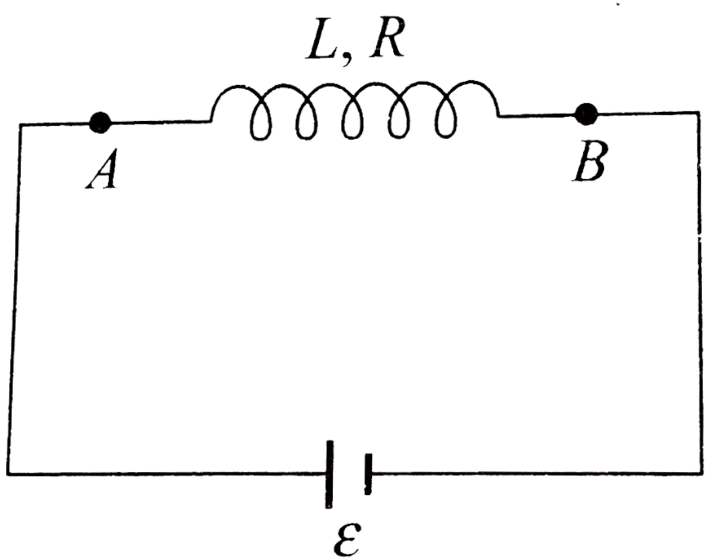
15. An indcutor having self inductance L with its coil resistance R is connected across a battery of emf $elipson$. When the circuit is in steady state t = 0, an iron rod is inserted into the inductor due to which its inductance becomes nL (ngt1).



After insertion of rod which of the following quantities will change with time?

(1) Potential difference across terminals A and B

(2) Inductance

(3) Rate of heat produced in coil

A. $I < \varepsilon / R$

B. $I > \varepsilon / R$

C. $I = \varepsilon / R$

D. None of these

Answer: C

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16. As a charged particle 'q' moving with a velocity $\overrightarrow{v}$ enters a uniform magnetic field $\overrightarrow{B}$, it experience a force

$\vec{F} = q\left(\vec{v} \times \vec{B}\right)$. F or $\theta = 0^\circ$ or 180°, θ being the angle between $\vec{v}$ and $\vec{B}$, force experienced is zero and the particle passes undeflected. For $\theta = 90^\circ$, the particle moves along a circular arc and the magnetic force (qvB) provides the necessary centripetal force $\left(mv^2/r\right)$. For other values of $\theta(\theta \neq 0^\circ, 180^\circ, 90^\circ)$, the charged particle moves along a helical path which is the resultant motion of simultaneous circular and translational motions.

Suppose a particle that carries a charge of magnitude q and has a mass 4×10^{-15} kg is moving in a region containing a uniform magnetic field $\vec{B} = -0.4\hat{k}T$. At some instant, velocity of the particle is $\vec{v} = \left(8\hat{i} - 6\hat{j}4\hat{k}\right) \times 10^6 ms^{-1}$ and force acting on it has a magnitude 1.6 N

Motion of charged particle will be along a helical path with

A. A translational component along x-direction and a circular component in the y-z plane

B. A translational component along y-direction and a circular component in the x-z plane

C. A translational component along z-axis and a circular component in the x-y plane

D. Direction of translational component and plane of circular component are uncertain

Answer: C

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17. As a charged particle 'q' moving with a velocity $\vec{v}$ enters a uniform magnetic field $\vec{B}$, it experience a force $\vec{F} = q\left(\vec{v} \times \vec{B}\right)$. F or $\theta = 0^\circ$ or 180°, θ being the angle between $\vec{v}$ and $\vec{B}$, force experienced is zero and the particle passes undeflected. For $\theta = 90^\circ$, the particle moves along a circular arc and the magnetic force (qvB) provides the necessary centripetal force $\left(mv^2/r\right)$. For other values of $\theta(\theta \neq 0^\circ, 180^\circ, 90^\circ)$, the charged particle moves along a helical path which is the resultant motion of simultaneous circular and translational motions.

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Angular frequency of rotation of particle, also called the `cyclotron frequency' is

A. $8 \times 10^5 rads^{-1}$

B. $12.5 \times 10^4 rads^{-1}$

C. $6.2 \times 10^6 rads^{-1}$

D. $4 \times 10^7 rads^{-1}$

Answer: D

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18. As a charged particle 'q' moving with a velocity $\overrightarrow{v}$ enters a uniform magnetic field $\overrightarrow{B}$, it experience a force $\overrightarrow{F} = q\left(\overrightarrow{v} \times \overrightarrow{B}\right)$. F or $\theta = 0^\circ$ or 180°, θ being the angle between $\overrightarrow{v}$ and $\overrightarrow{B}$, force experienced is zero and the particle passes undeflected. For $\theta = 90^\circ$, the particle moves along a circular arc and the magnetic force (qvB) provides the necessary centripetal force $\left(mv^2/r\right)$. For other values of $\theta(\theta \neq 0^\circ, 180^\circ, 90^\circ)$, the charged particle moves along a helical path which is the resultant motion of simultaneous circular and translational motions.

Suppose a particle that carries a charge of magnitude q and has a mass 4×10^{-15} kg is moving in a region containing a uniform magnetic field $\overrightarrow{B} = -0.4\hat{k}T$. At some instant, velocity of the particle is $\overrightarrow{v}=\left(8\hat{i}-6\hat{j}4\hat{k}\right)\times10^{6}ms^{-1}$ and force acting on it has a magnitude 1.6 N

If the coordinates of the particle at t = 0 are (2 m, 1 m, 0), coordinates at a time t = 3 T, where T is the time period of circular component of motion. will be (take $\pi=3.14$)

A. (2 m, 1 m, 0.942 m)

B. (0.142 m, 130m, 0)

C. (2 m, 1 m, 1.884 m)

D. (142 m, 130 m, 628 m)

Answer: C

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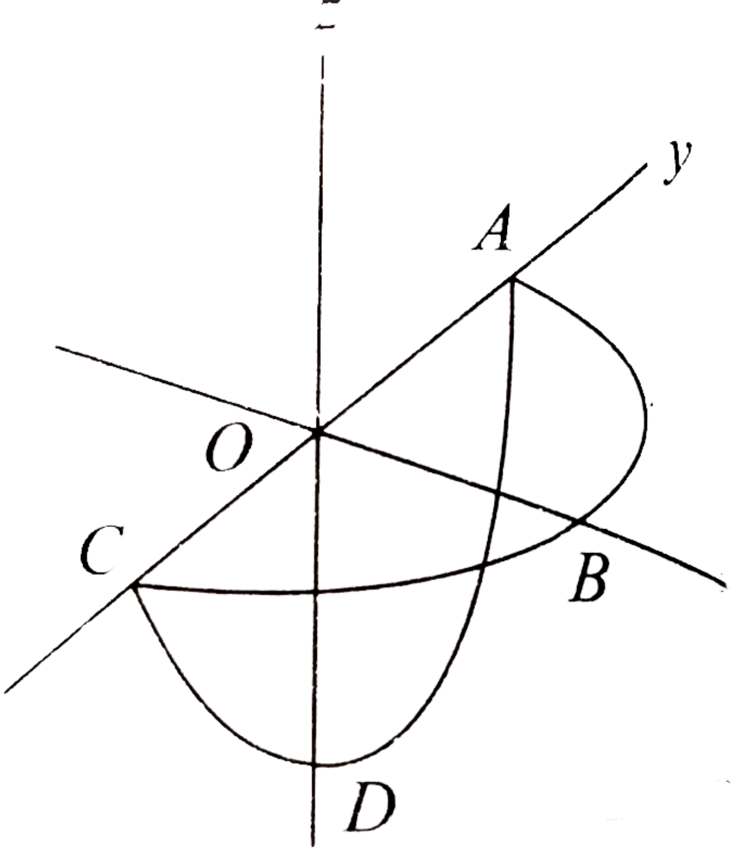
19. ABCDA is a closed loop of conducting wire consisting of two semicircular sections, the part ABCD lying in the XY plane and the part CDA lying in the YZ plane, both the parts having the centre at origin O (see the diagram). This loop is placed in a uniform field $\vec{B}$ which varies with time.

Radius of the semicircular section is 0.5 m



If $\overrightarrow{B}$ be directed along $\left(+\overrightarrow{i}-\overrightarrow{k}\right)$ and decreases at the rate of $10^{-2}Tesla/\sec ond$, the magnitude and the sense of the induced emf in the loop, as seen along the magnetic field direction will be

A. zero

B. $\frac{5\pi}{4\sqrt{2}}$ mV in the counterclockwise sense

C. $\frac{5\pi}{4\sqrt{2}}$ mV in the clockwise sense

D. $\frac{5\pi}{2\sqrt{2}}$ mV in the clockwise sense.

Answer: D

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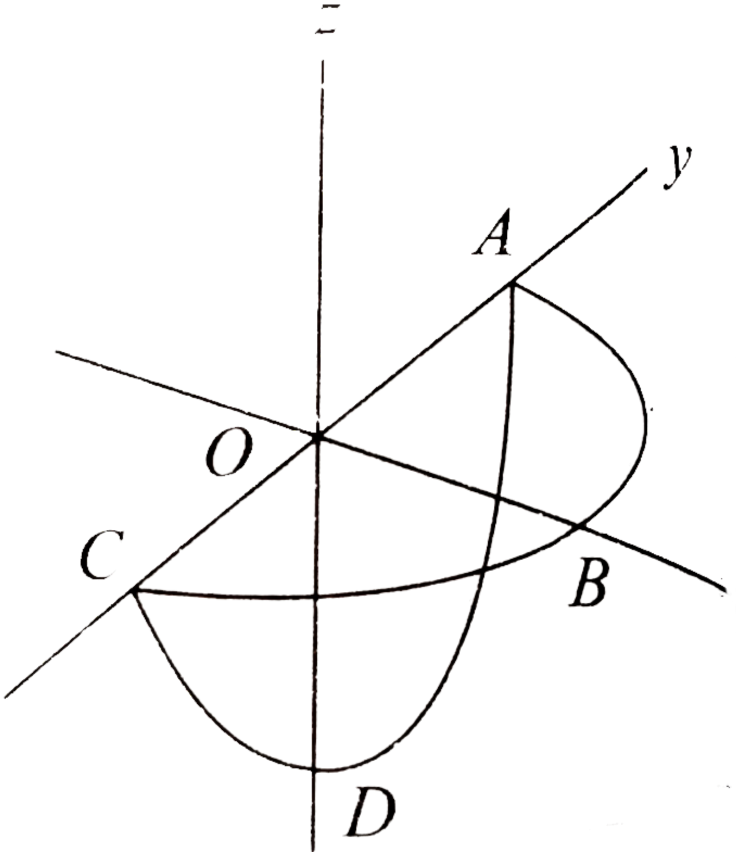
20. ABCDA is a closed loop of conducting wire consisting of two semicircular sections, the part ABCD lying in the XY plane and the part CDA lying in the YZ plane, both the parts having the centre at origin O (see the diagram). This loop is placed in a uniform field $\overrightarrow{B}$ which varies with time.

Radius of the semicircular section is 0.5 m



If $\vec{B}$ be directed along the vector $\left(\vec{i} - \vec{j}\right)$ and decreases at the rate of $10^{-2} Tesl\frac{a}{\sec o}nd.$ The magnitude and sense of the induced emf in the loop as seen along the positive x-axis will be

A. zero

B. $\frac{5\pi}{4\sqrt{2}}$ mV in the counterclockwise sense

C. $\frac{5\pi}{4\sqrt{2}}$ mV in the clockwise sense

D. $\frac{5\pi}{2\sqrt{2}}$ mV in the clockwise sense.

Answer: C

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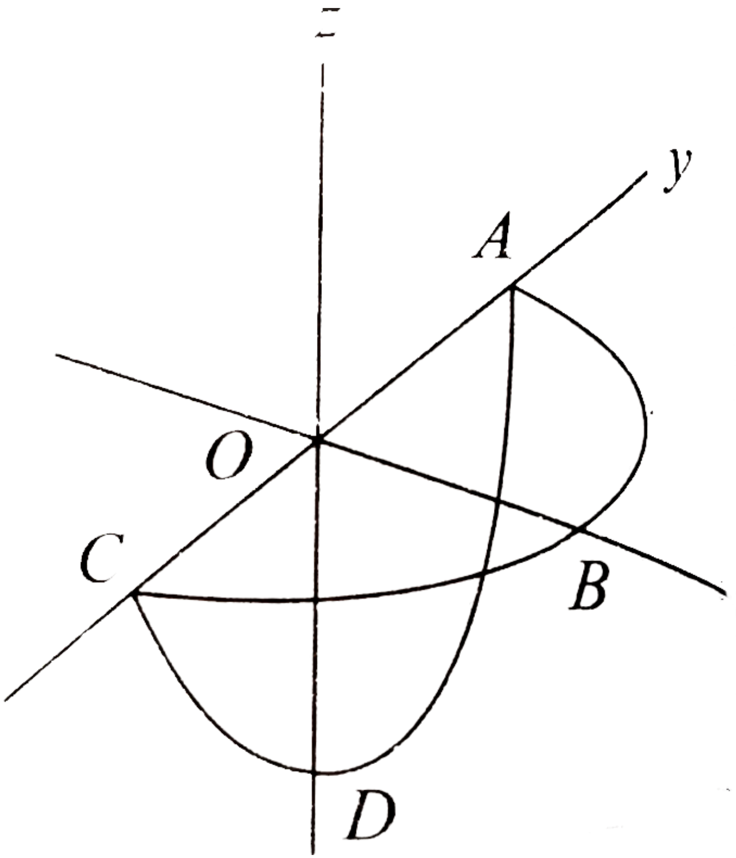
21. ABCDA is a closed loop of conducting wire consisting of two semicircular sections, the part ABCD lying in the XY plane and the part CDA lying in the YZ plane, both the parts having the centre at origin O (see the diagram). This loop is placed in a uniform field $\overrightarrow{B}$ which varies with time.

Radius of the semicircular section is 0.5 m



If $\vec{B}$ be directed along the +z axis and increases at the rate of $10^{-2} \frac{\text{Tesla}}{\text{second}}$. the magnitude and sense of the induced emf in the loop as seen along the field direction will be

A. zero

B. $\frac{5\pi}{4\sqrt{2}}$ mV in the counterclockwise sense

C. $\frac{5\pi}{4\sqrt{2}}$ mV in the clockwise sense

D. $\frac{5\pi}{2\sqrt{2}}$ mV in the clockwise sense.

Answer: B

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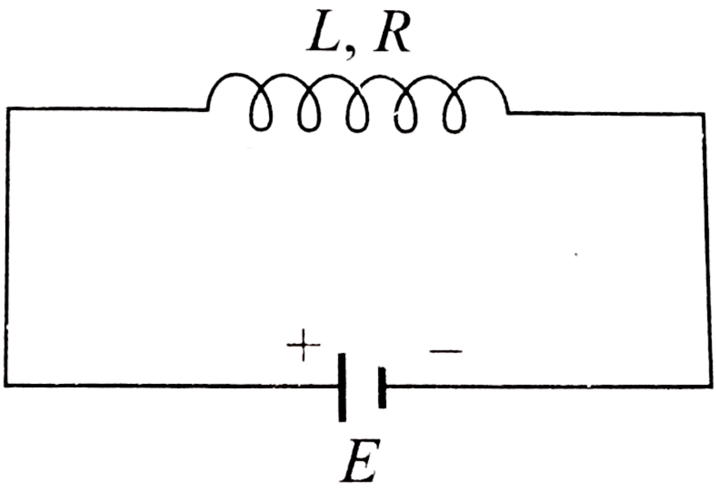
22. A solenoid of resistance R and inductance L has a piece of soft iron inside it. A battery of emf E and of negligible internal resistance is connected across the solenoid as shown in Fig. At any instant, the piece of soft iron is pulled out suddenly so that inductance of the solenoid decrease to $\eta L (\eta < 1)$ with battery remaining connected.



The work done to pull out the soft iron piece is

A. $\frac{\eta L E^2}{2R^2}$

B. $\frac{(1-\eta) L E^2}{2R^2}$

C. $\frac{(1-\eta) L E^2}{\eta R^2}$

D. $\frac{(1-\eta) L E^2}{2\eta R^2}$

Answer: D

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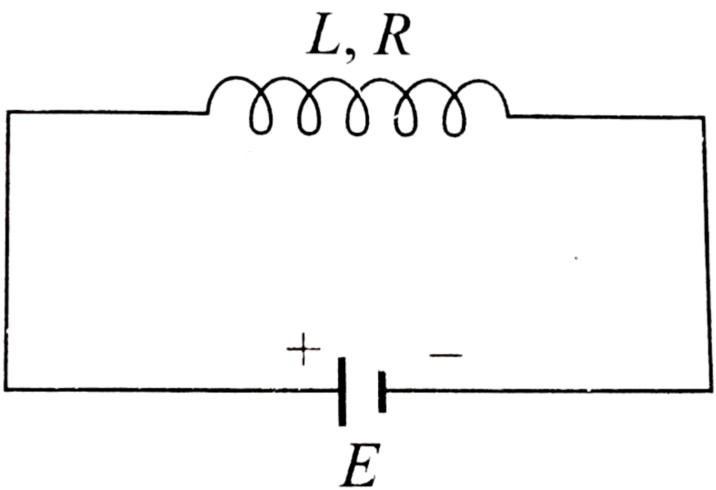
23. A solenoid of resistance R and inductance L has a piece of soft iron inside it. A battery of emf E and of negligible internal resistance is connected across the solenoid as shown in Fig. At any instant, the piece of soft iron is pulled out suddenly so that inductance of the solenoid decrease to $\eta L (\eta < 1)$ with battery remaining connected.



Assume t = 0 is the instant when iron piece has been pulled out, the current as a function of time after this is

A. $i = \frac{E}{R}\left[1 - \left(1 - \frac{1}{\eta}\right)e^{-\frac{t}{\lambda}}\right]$

B. $i = \frac{E}{R}\left[1 + \left(1 + \frac{1}{\eta}\right)e^{-\frac{t}{\lambda}}\right]$

C. $i = \frac{E}{R}\left[1 - \left(1 + \frac{1}{\eta}\right)e^{-\frac{t}{\lambda}}\right]$

D. $i = \frac{E}{R}\left[1 + \left(1 - \frac{1}{\eta}\right)e^{-\frac{t}{\lambda}}\right]$

Answer: A

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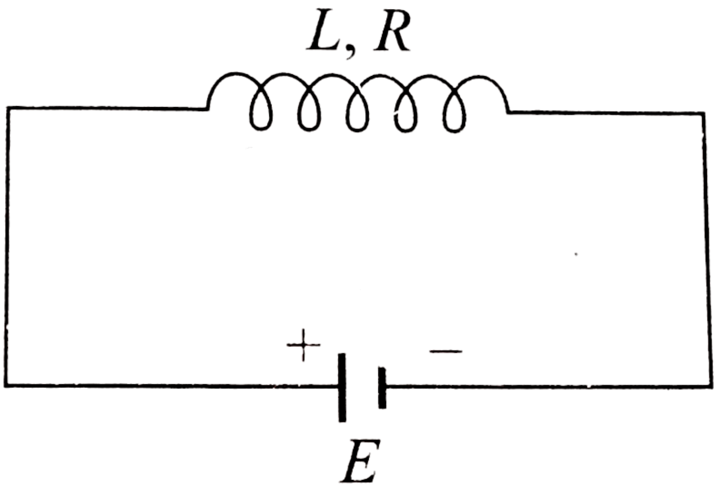
24. A solenoid of resistance R and inductance L has a piece of soft iron inside it. A battery of emf E and of negligible internal resistance is connected across the solenoid as shown in Fig. At any instant, the piece of soft iron is pulled out suddenly so that inductance of the solenoid decrease to $\eta L (\eta < 1)$ with battery remaining connected.



Power supplied by the battery as a function of time

A. $P = \frac{E^2}{R}\left[1 + \left(1 - \frac{1}{\eta}\right)e^{-\frac{t}{\lambda}}\right]$

B. $P = \frac{E^2}{R}\left[1 + \left(1 + \frac{1}{\eta}\right)e^{-\frac{t}{\lambda}}\right]$

C. $P = \frac{E^2}{R}\left[1 - \left(1 + \frac{1}{\eta}\right)e^{-\frac{t}{\lambda}}\right]$

D. $P = \frac{E^2}{R}\left[1 - \left(1 - \frac{1}{\eta}\right)e^{-\frac{t}{\lambda}}\right]$

Answer: D

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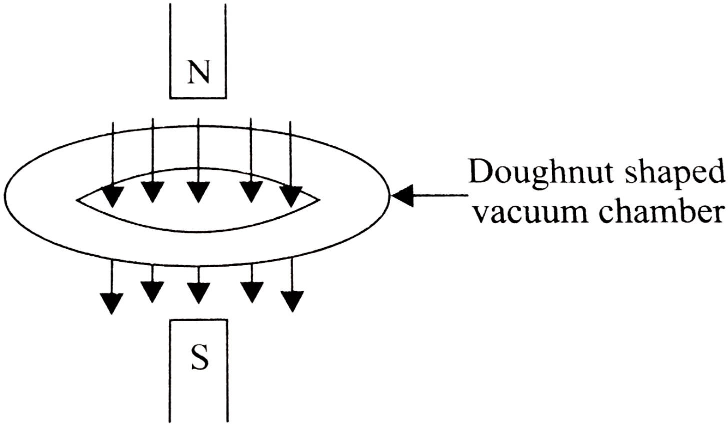
25. The fact tht a changing magnetic flux produces an electric field is basic to the operation of many high energy particle accelerators. Since the principle was first successfully applied to the acceleration of electrons (or beta particles) in a device called the betatron, this method of acceleration is often given that name. The general idea involved is shown in Fig.



An electromagnet is used to produce a changing flux through a circular loop defined by the doughnut shaped vacuum chamber. We see that there will be an electric field E along the circular length of the doughnut, i.e. circling the magnet poles, given by $2\pi aE = d(\phi)\,/\,dt$, where 'a' is the radius of the doughnut. Any charged particle inside the vacuum chamber will experience a force qE and will accelerate. Ordinarily, the charged particle would shoot out the vacuum chamber and becomes lost.

However, if the magnetic field at the position of the doughnut is just proper to satisfy the relation,

Centripetal force = magnetic force or $mv^2 / a = qvB$ then the charge will travel in a circle within the doughnut. By proper shaping of the magnet pole piece, this relation can be satisfied. As a result, the charge will move at high speed along the loop within the doughnut. Each time it goes around the loop, it has, in effect, fallen through a potential difference equal to the induced emf, namely $\varepsilon = (d(\phi) / dt)$. Its energy after 'n' trips around the loop will be $q(n(\varepsilon))$.

Working of betatron is not based upon which of the following theories?

A. changing magnetic flux induces electric field

B. charged particles at rest can be accelerated only by electric fields

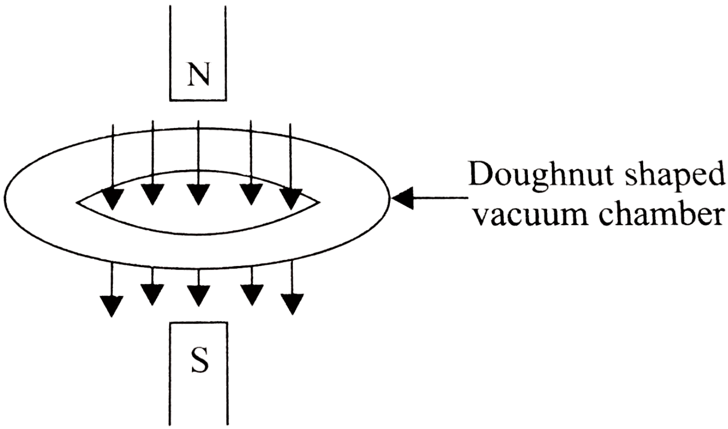
C. magnetic fields can apply a force on moving charges which is perpendicular to both magnetic field and motion of the particle

D. β particles are emitted in radioactive decay process.

Answer: D

Watch Video Solution

26. The fact tht a changing magnetic flux produces an electric field is basic to the operation of many high energy particle accelerators. Since the principle was first successfully applied to the acceleration of electrons (or beta particles) in a device called the betatron, this method of acceleration is often given that name. The general idea involved is shown in Fig.



An electromagnet is used to produce a changing flux through a circular loop defined by the doughnut shaped vacuum chamber. We see that there will be an electric field E along the circular length of the doughnut, i.e. circling the magnet poles, given by $2\pi aE = d(\phi)/dt$, where 'a' is the radius of the doughnut. Any charged particle inside the vacuum chamber will experience a force qE and will accelerate. Ordinarily, the charged particle would shoot out the vacuum chamber and becomes lost.

However, if the magnetic field at the position of the doughnut is just proper to satisfy the relation,

Centripetal force = magnetic force or $mv^2/a = qvB$

then the charge will travel in a circle within the doughnut. By proper shaping of the magnet pole piece, this relation can be satisfied. As a result, the charge will move at high speed along the loop within the doughnut. Each time it goes around the loop, it has, in effect, fallen through a potential difference equal to the induced emf, namely $\varepsilon = (d(\phi) / dt)$. Its energy after 'n' trips around the loop will be $q(n(\varepsilon))$.

Variable magnetic flux

A. can chane sinusoidally

B. should either increase or decrease all the time

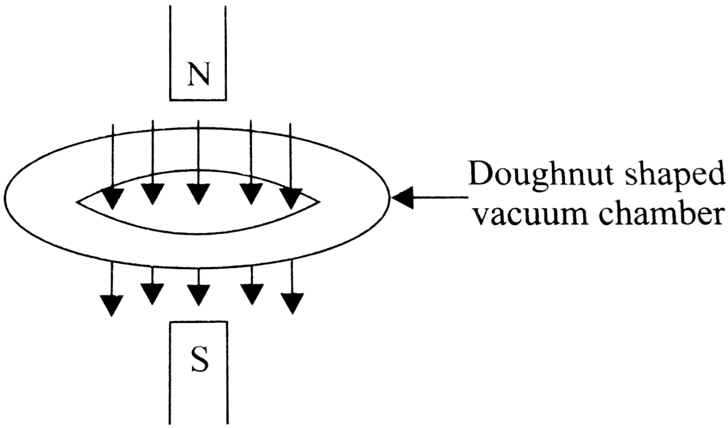
C. must becomes zero when induced field is maximum

D. none of these

Answer: B

Watch Video Solution

27. The fact tht a changing magnetic flux produces an electric field is basic to the operation of many high energy particle accelerators. Since the principle was first successfully applied to the acceleration of electrons (or beta particles) in a device called the betatron, this method of acceleration is often given that name. The general idea involved is shown in Fig.



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Magnetic field which keeps the particles in circular path must

A. remain constant every where

B. increases gradually which is proportional to kinetic energy of the particle

C. increase gradually which is proportional to speed of the particle

D. none of these

Answer: C

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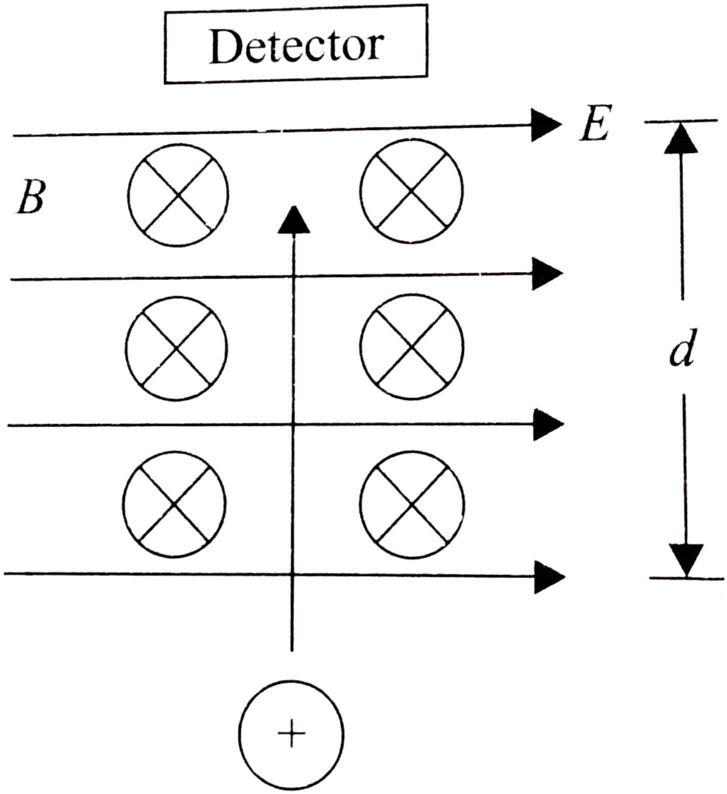
28. A velocity filter uses the properties of electric and magnetic field to select particles that are moving with a specifice velocity. Charged particles with varying speeds are directed into the filter as shown. The filter consistt of an electric field E and a magnetic field B, each of constant magnitude, directed perpendicular to each other as shown, The charge particles will experience a force due to electric field given by F = qE. If positively charged particles are used, this force is towards right.



The moving particle will also experience a force due to magnetic field given by $F = qvB$. When forces due to the two fields are of equal magnitude, the net force on the particle will be zero, the particle will pass through centre with its path unaltered. The electric and magnetic fields can be adjusted t choose the specific velocity to be filtered. The efect of gravity can be neglected.

The electric and magnetic fields are adjusted to detect particles with positive charge q of certain speed v_0. which of the following expressions is equal to this speed?

A. $\frac{B}{q^2 E}$

B. $\left(\frac{E}{q^2 B}\right)$

C. $\left(\frac{B}{E}\right)$

D. $\left(\frac{E}{B}\right)$

Answer: D

Watch Video Solution

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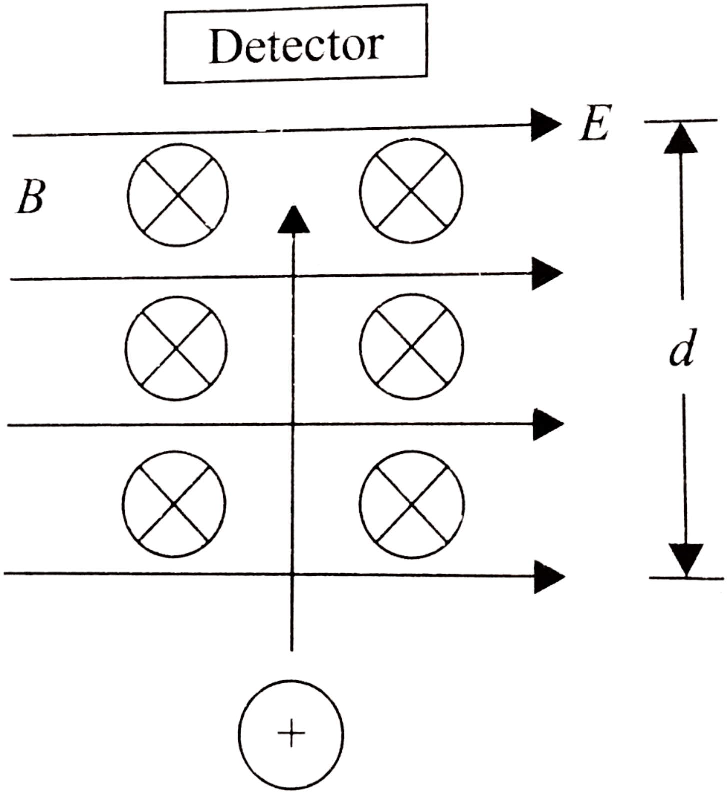

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The electric and magnetic fields are adjusted to detect particles with positive charge q of certain speed v_0. which of the following expressions is equal to this speed?

A. it would not work with negatively charged particles.

B. wider the detector entrance, the narrower the range of speed detected.

C. greater the distance d, the narrower the range of speed detected.

D. The detector may not detect a charged particles with desired filter speed if its charge is too high.

Answer: C

Watch Video Solution

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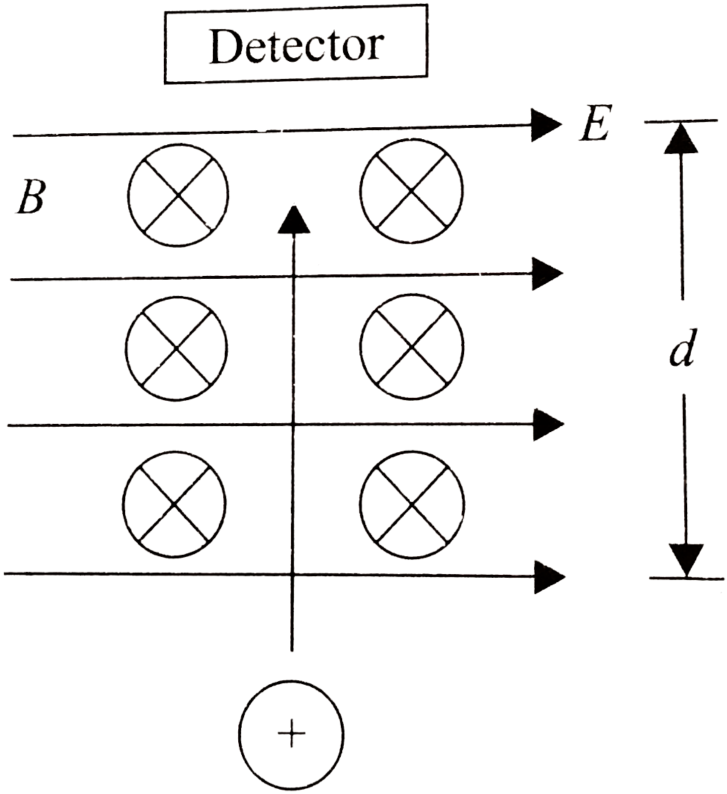

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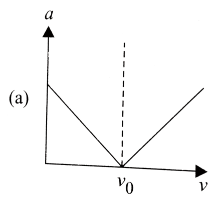
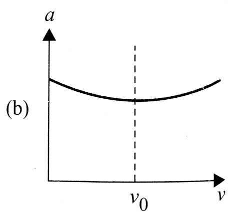
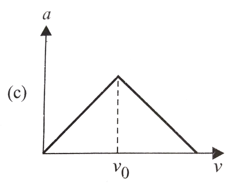
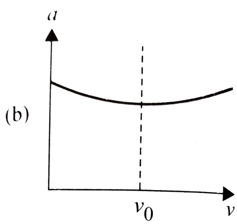
If the filter is set to detect particles of speed v_0, which one of the following diagrams best illustrates how the magnitude of the particle acceleration (a) depends on velocity v?

A. 

B. 

C. 

D. 

Answer: A

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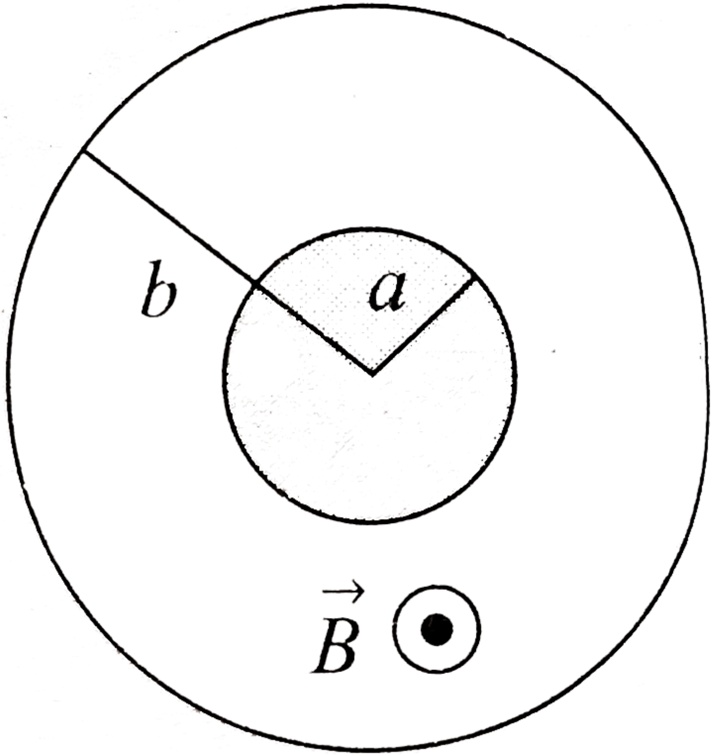
31. In the given arrangement, the space between a pair of co-axial cylindrical conductors is evacuated. The outer cylinder, called anode, may be given a positive potential V relative to the inner cylinder.

A static homogeneous magnetic field $\overrightarrow{B}$ parallel to the cylinder axis, directed out of plane of figure is aslo present. induced charges in the conductors are neglected.

We study the dynamics of electrons with rest mass m and charge e. The electrons are released at the surface of inner cylinder.

Consider the following two cases



Case 1: Firstly the potential V is turned on, but $\vec{B} = 0.$

An electron with negligible velocity is ejected at the surface of inner cylinder. It is found to hit the anode.

Case 2: Now V = 0 but $\vec{B}$ is present. An electron starts out with an initial velocity $\vec{v_0}$ in radial direction. For magnetic field larger than critical value B_c the electron will not reach the anode.

Considering the case 1, the trajectory of electron will be

A. straight line

B. Circular

C. Parabolic

D. Helical

Answer: A

Watch Video Solution

32. In the given arrangement, the space between a pair of co-axial cylindrical conductors is evacuated. The outer cylinder, called anode, may be given a positive potential V relative to the inner cylinder.

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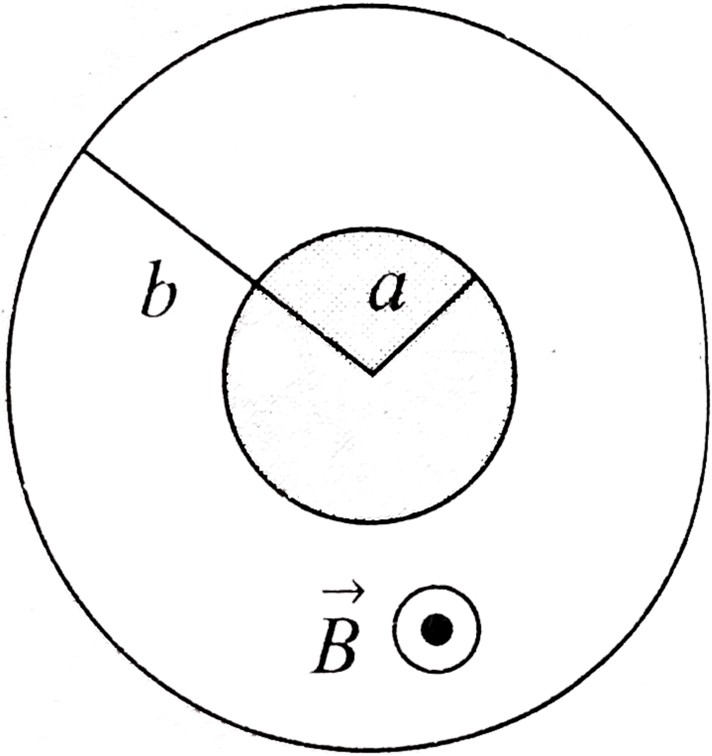

Case 1: Firstly the potential V is turned on, but $\overrightarrow{B} = 0$. An electron with negligible velocity is ejected at the surface of inner cylinder. It is found to hit the anode.

Case 2: Now V = 0 but $\overrightarrow{B}$ is present. An electron starts out with an initial velocity $\overrightarrow{v_0}$ in radial direction. For magnetic field larger than critical value B_c the electron will not reach the anode.

Considering case 2, the trajectory of electron will be

A. straight line

B. Circular

C. Parabolic

D. Helical

Answer: B

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33. In the given arrangement, the space between a pair of co-axial cylindrical conductors is evacuated. The outer cylinder, called anode, may be given a positive potential V relative to the inner cylinder.

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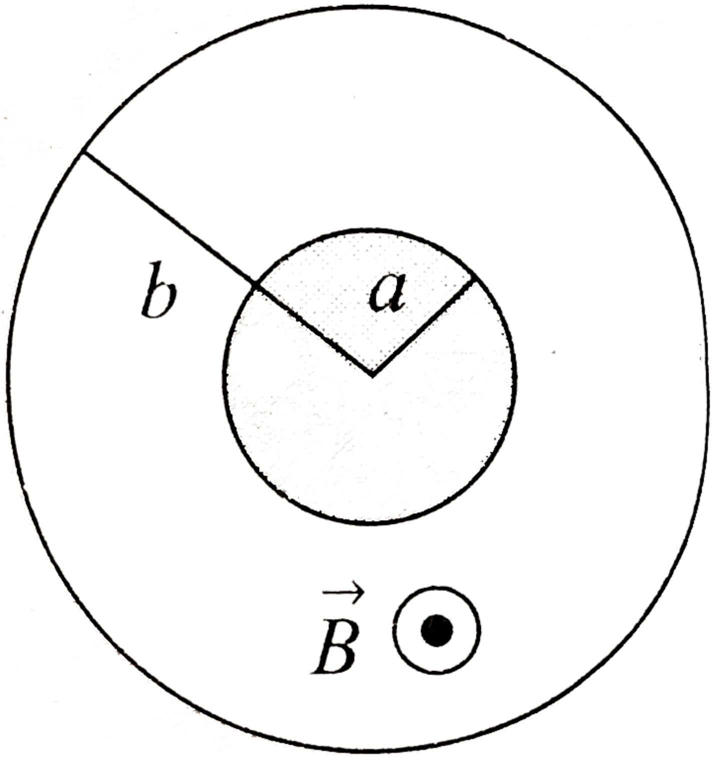

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Case 2: Now V = 0 but $\vec{B}$ is present. An electron starts out with an initial velocity $\vec{v_0}$ in radial direction. For magnetic field larger than critical value B_c the electron will not reach the anode.

The critical magnetic field B_c is given by

A. $\frac{2mv_0}{eb}$

B. $\frac{mv_0}{eb}$

C. $\frac{2bmv_0}{e(b^2 - a^2b)}$

D. $\frac{2amv_0}{e(b^2 - a^2b)}$

Answer: C

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34. The path of a charged particle in a uniform magnetic field depends on the angle θ between velocity vector and magnetic field, When $\theta is 0^\circ$ or 180°, $F_m = 0$ hence path of a charged particle will be linear.

When $\theta = 90^\circ$, the magnetic force is perpendicular to velocity at every instant. Hence path is a circle of radius

$r = \frac{mv}{qB}$.

The time period for circular path will be $T = \frac{2\pi m}{qB}$

When θ is other than $0^\circ, 180^\circ$ and 90°, velocity can be resolved into two components, one along $\vec{B}$ and perpendicular to B.

$v_{|/|} = \cos\theta$

$v_{\hat{}} = v\sin\theta$

The $v_\perp$ component gives circular path and $v_{|/|}$ givestraingt line path. The resultant path is a helical path. The radius of helical path

$r = \frac{mv\sin\theta}{qB}$

ich of helix is defined as $P = v_{|/|}T$

$$P = (2imv\cos\theta)$$

$$p = \frac{2\pi mv\cos\theta}{qB}$$

A charged particle moves in a uniform magnetic field. The velocity of particle at some instant makes acute angle with magnetic field. The path of the particle will be

A. A straliight line

B. A circle

C. A helix with uniform pitch

D. A helix with non-uniform pitch

Answer: C

Watch Video Solution

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$$P = (2imv \cos \theta)$$

$$p = \frac{2\pi mv \cos \theta}{qB}$$

Two ions having masses in the ratio 1:1 and charges 1:2 are projected from same point into a uniform magnetic field with speed in the ratio 2:3 perpendicular to field. The ratio of radii of circle along which the two particles move is :

A. $4:3$

B. $2:3$

C. $3:2$

D. $3:4$

Answer: A

Watch Video Solution

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ich of helix is defined as $P = v_{|/|}T$

$P = (2imv\cos\theta)$

$$p = \frac{2\pi mv\cos\theta}{qB}$$

Which particle will have minimum frequency of revolution when projected with the same velocity perpendicular to a magnetic field.

A. Li^{+}

B. electron

C. Proton

D. He^(+)`

Answer: A

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37. Magnetic force on a charged particle is given by $\vec{F}_m = q\left(\vec{v} \times \vec{B}\right)$ and electrostatic force $\vec{F}_e = q\vec{E}$. A particle having charge q = 1C and mass 1 kg is released from rest at origin. There are electric and magnetic field given by $\vec{E} = \left(10\hat{i}\right)N/Cf$ or $x = 1.8m$ and $\vec{B} = -\left(5\hat{k}\right)T$ for $1.8m \leq x \leq 2.4m$

A screen is placed parallel to y-z plane at $x = 3m$.

Neglect gravity forces.

The speed with which the particle will collide the screen is

A. $3ms^{-1}$

B. $6m / s^{-1}$

C. `9 m//s^(-1)

D. $12m / s^{-1}$

Answer: B

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38. A particle having charge q=1 C and mass m=1kg is released from rest at origin. There are electric and manetic fields given by

$E = \left(10\hat{i}\right)N/C\text{for}x \leq 1.8m$ and

$B = \left(-5\widehat{K}\right)T\text{for}1.8m \leq x \leq 2.4m$ A screen is placed parallel to y-z palane at x=3.0m. Neglect gravity forces.

y-coordinate of particle where it collides with be screen is .....m.

A. $\dfrac{0.6\left(\sqrt{3}-1\right)}{\sqrt{3}}$

B. $\dfrac{0.6\left(\sqrt{3}+1\right)}{\sqrt{3}}$

C. $1.2\left(\sqrt{3}+1\right)$

D. $\dfrac{1.2\left(\sqrt{3}-1\right)}{\sqrt{3}}$

Answer: D

Watch Video Solution

39. Magnetic force on a charged particle is given by $\overrightarrow{F}_m = q\left(\overrightarrow{v} \times \overrightarrow{B}\right)$ and electrostatic force $\overrightarrow{F}_e = q\overrightarrow{E}$. A particle having charge q = 1C and mass 1 kg is released from rest at origin. There are electric and magnetic field given by $\overrightarrow{E} = \left(10\hat{i}\right)N/Cf$ or $x = 1.8m$ and $\overrightarrow{B} = -\left(5\hat{k}\right)T$ for $1.8m \le x \le 2.4m$

A screen is placed parallel to y-z plane at $x = 3m$. Neglect gravity forces.

The speed with which the particle will collide the screen is

A. $\frac{1}{5}\left(3+\frac{\pi}{6}+\frac{1}{\sqrt{3}}\right)$

B. $\frac{1}{5}\left(6+\frac{\pi}{3}+(\sqrt{3})\right)$

C. $\frac{1}{3}\left(5+\frac{\pi}{6}+\frac{1}{\sqrt{3}}\right)$

D. $\frac{1}{5}\left(6+\frac{\pi}{18}+(\sqrt{3})\right)$

Answer: A

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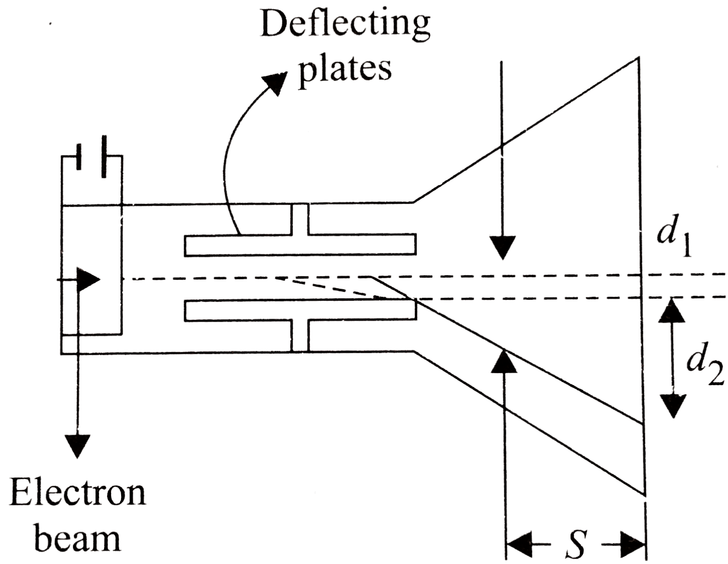
40. Following experiment was performed by J.J. Thomson in order to measure ratio of charge e and mass m of electron.



Electrons emitted from a hot filament are accelerated by a potential difference V. As the electrons pass through deflecting plates, they encounter both electric and magnetic fields. the entire region in which electrons leave the plates they enters a field free region that extends to fluorescent screen. The entire region in which electrons travel is evacuated.

Firstly, electric and magnetic fields were made zero and position of undeflected electron beam on the screen was

noted. The electric field was turned on and resulting deflection was noted. Deflection is given by $d_1 = \frac{eEL^2}{2mV^2}$ where L = length of deflecting plate and v = speed of electron.

In second part of experiment, magnetic field was adjusted so as to exactly cancel the electric force leaving the electron beam undeflected. This gives eE = evB. Using expression for d_1 we can find out $\frac{e}{m} = \frac{2d_1E}{B^2L^2}$

If the electron is deflected downward when only electric field is turned on, in what direction do the electric and magnetic fields point in second part of experiment

A. The electric field point to the top, while the magnetic field point into the page

B. The electric field point to the top, while the magnetic field point out of page

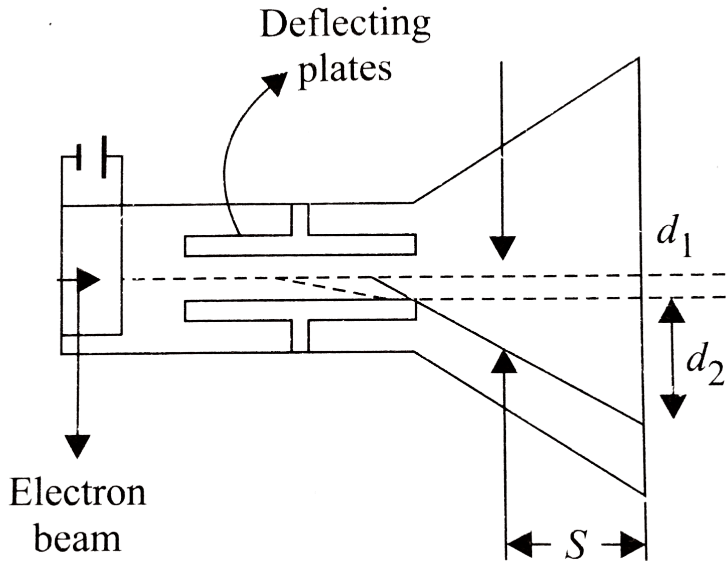
C. Electric field points to the bottom, while the magnetic field point out of pate

D. Electric field points to the bottom, while the magnetic field points into the page

Answer: B

Watch Video Solution

41. Following experiment was performed by J.J. Thomson in order to measure ratio of charge e and mass m of electron.



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In second part of experiment, magnetic field was adjusted so as to exactly cancel the electric force leaving the electron beam undeflected. This gives $eE = evB$. Using expression for d_1 we can find out $\frac{e}{m} = \frac{2d_1E}{B^2L^2}$

A beam of electron with velocity $3 \times 10^7 ms^{-1}$ is deflected 2 mm while passing through 10 cm in an electric field of $1800V/m$ perpendicular to its path. e/m for electron is

A. $1.5 \times 10^{11} Ckg^{-1}$

B. $2 \times 10^{11} Ckg^{-1}$

C. $2.5 \times 10^{11} Ckg^{-1}$

D. $3 \times 10^{11} Ckg^{-1}$

Answer: B

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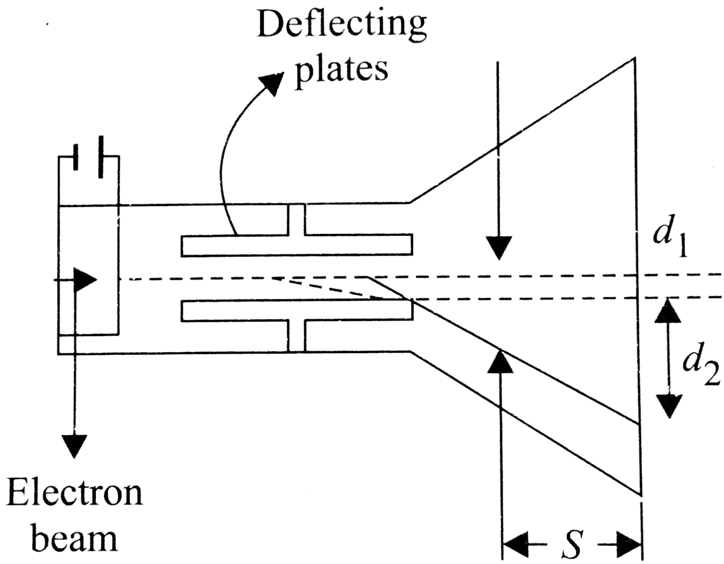
42. Following experiment was performed by J.J. Thomson in order to measure ratio of charge e and mass m of electron.



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In second part of experiment, magnetic field was adjusted so as to exactly cancel the electric force leaving the electron beam undeflected. This gives $eE = evB$. Using expression for d_1 we can find out $\frac{e}{m} = \frac{2d_1E}{B^2L^2}$

If the electron speed were doubled by increasing the potential differece V, which of the following would be true in order to correctly measure e/m

A. Magnetic field would have to be halved

B. Magnetic field would have to be doubled

C. Length L of the plates would have to be doubled

D. Length L of the plates would have to be halved

Answer: A

View Text Solution

43. In uniform magnetic field, if angle between $\vec{v}$ and $\vec{B}\, is 0^\circ < 0 < 90^\circ$, the path of particle is helix. Let v_1 be the component of $\vec{v}\, along \vec{B}$ and v_2 be the component perpendicular to $\vec{B}$. Suppose p is the pitch. T is the time period and r is the radius of helix. Then

$$T = \frac{2\pi m}{qB}, r = \frac{mv_2}{qB}, P = (v_1)T$$

Assume a charged particle of charge q and mass m is released from the origin with velocity $\vec{v} = v_0\hat{i} - v_0\hat{k}$ in a uniform magnetic field $\overrightarrow{B} = -B_0\hat{k}$.

Pitch of helical path described by particle is

A. $\dfrac{2mv_0}{qB_0}$

B. $\dfrac{2\pi mv_0}{qB_0}$

C. $\dfrac{\sqrt{2}\pi mv_0}{qB_0}$

D. $\dfrac{\sqrt{3}\pi mv_0}{qB_0}$

Answer: B

Watch Video Solution

44. In uniform magnetic field, if angle between $\overrightarrow{v}$ and $\overrightarrow{B} is 0^\circ < 0 < 90^\circ$, the path of particle is helix. Let v_1 be the component of $\overrightarrow{v} along \overrightarrow{B}$ and v_2 be the component perpendicular to $\overrightarrow{B}$. Suppose p is the pitch. T is the time period and r is the radius of helix. Then

$$T = \frac{2\pi m}{qB}, r = \frac{mv_2}{qB}, P = (v_1)T$$

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Angle between v and B is

A. 45°

B. 30°

C. 60°

D. 120°

Answer: A

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45. In uniform magnetic field, if angle between $\overrightarrow{v}$ and $\overrightarrow{B} is 0^{\circ} < 0 < 90^{\circ}$, the path of particle is helix. Let v_1 be the component of $\overrightarrow{v} along \overrightarrow{B}$ and v_2 be the component perpendicular to $\overrightarrow{B}$. Suppose p is the pitch. T is the time period and r is the radius of helix. Then

$$T = \frac{2\pi m}{qB}, r = \frac{mv_2}{qB}, P = (v_1)T$$

Assume a charged particle of charge q and mass m is released from the origin with velocity $\overrightarrow{v} = v_0 \hat{i} - v_0 \hat{k}$ in a uniform magnetic field $\overrightarrow{B} = -B_0 \hat{k}$.

Axis of helix is along

A. X-axis

B. Y-axis

C. Negative Y-axis

D. Z-axis

Answer: D

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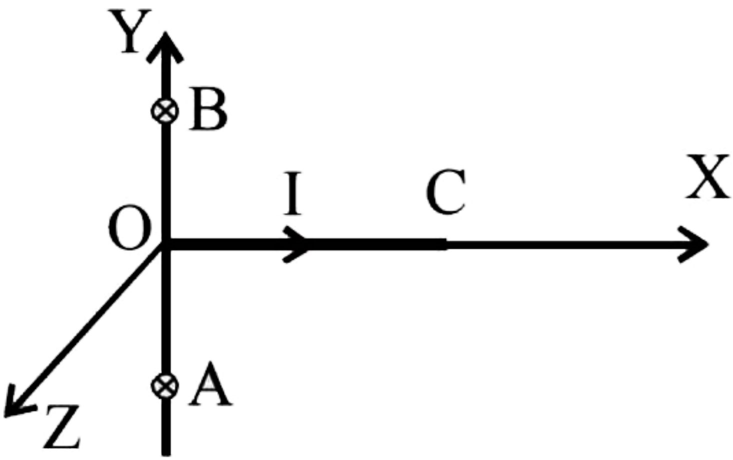
46. A straight segment OC(of length L meter) of a circuit carrying a current $Iamp$ is placed along the x- axis (fig.). Two infinetely long straight wires A and B , each extending from $z = -\infty \rightarrow +\infty$, are fixed at y = -a meter and y = +a meter respectively, as shown in the figure.

If the wires A and B each carry a current $Iamp$ into the plane of the paper, obtain the expression for the force acting on the segment OC. What will be the force on OC if the current in the wire B is reversed?



A. $\left(\dfrac{\mu_0 I^2}{\pi}\right) 1n\left(\dfrac{L^2+a^2}{a^2}\right)(-\hat{k})$

B. $\left(\dfrac{\mu_0 I^2}{2\pi}\right) 1n\left(\dfrac{L^2+a^2}{a^2}\right)(-\hat{k})$

C. zero

D. None of these

Answer: D

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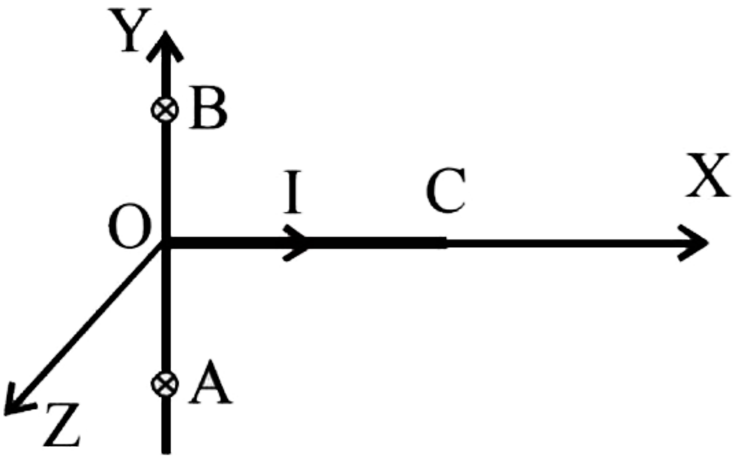
47. A straight segment OC(of length L meter) of a circuit carrying a current $Iamp$ is placed along the x- axis (fig.). Two infinetely long straight wires A and B , each extending from $z = -\infty \to +\infty$, are fixed at y = -a meter and y = +a meter respectively, as shown in the figure.

If the wires A and B each carry a current $Iamp$ into the plane of the paper, obtain the expression for the force acting on the segment OC. What will be the force on

OC if the current in the wire B is reversed?



A. $\left(\frac{\mu_0 I^2}{\pi}\right) 1n\left(\frac{L^2+a^2}{a^2}\right)(-\hat{k})$

B. $\left(\frac{\mu_0 I^2}{2\pi}\right) 1n\left(\frac{L^2+a^2}{a^2}\right)(-\hat{k})$

C. zero

D. None of these

Answer: C

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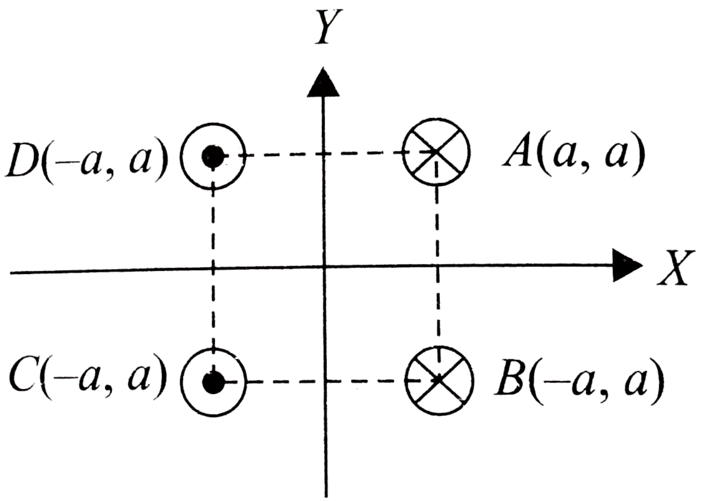
48. Four long wires each carrying current I as shown in Fig. are placed at points A, B, C and D. Find the magnitude and direction of



magnetic field at the centre of the square.

A. $\frac{\mu_0}{4\pi}\left(\frac{I}{a}\right)$ along Y-axis

B. $\frac{\mu_0}{4\pi}\left(\frac{4I}{a}\right)$ along X-axis

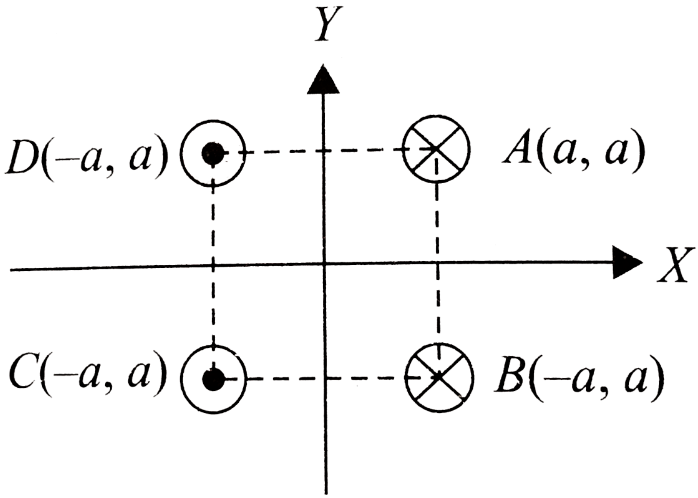
C. $\frac{\mu_0}{4\pi}\left(\frac{4I}{a}\right)$ along Y-axis

D. None of these

Answer: C

Watch Video Solution

49. Four long wires each carrying current I as shown in Fig. are placed at points A, B, C and D. Find the magnitude and direction of



Force per metre acting on wire at point D

A. $\frac{\mu_0}{4\pi}\left(\frac{I^2}{2a}\right)\sqrt{10}, \pi+\tan^{-1}\left(\frac{1}{3}\right)$ with positive x-axis

B. $\frac{\mu_0}{4\pi}\left(\frac{I^2}{2a}\right)\sqrt{10}, \pi+\tan^{-1}\left(\frac{1}{3}\right)$ with negative x-axis

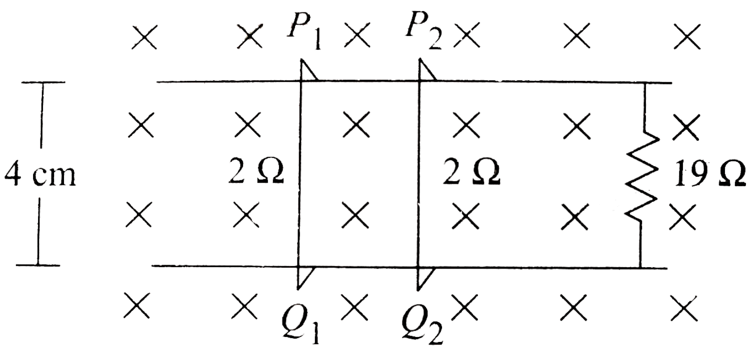
C. $\frac{\mu_0}{4\pi}\left(\frac{I^2}{a}\right)\sqrt{10}, \pi+\tan^{-1}\left(\frac{1}{3}\right)$ with positive x-axis

D. None of these

Answer: A

Watch Video Solution

50. Consider the situation shown Fig. There present a magnetic field B = 1 T which is perpendicular to plane of paper. The wire P_2, Q_2 are made to slide on the rails with the same speed $5cm/s$. Find the electric current in the $19(\Omega)$ resistance if



Both the wires move towards right

A. $0.2mA$

B. $0.3mA$

C. $0.1mA$

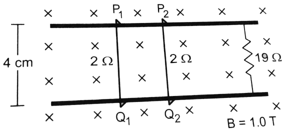
D. None of these

Answer: C

Watch Video Solution

51. Consider the situation shown in . The wires P_1Q_1 and P_2Q_2 are made to slide on the rails with the same speed $5cms^{-1}$. Find the electric current in the 19Ω resistorif (a) both the wires move towards right and (b) if P_1Q_1

moves towards left but P_2Q_2 moves towards right.



A. zero

B. `0.2 mA

C. 0.3 mA

D. None of these

Answer: A

Watch Video Solution

52. Suppose the 19Ω resistor of the previous problem is

disconnected. Find the current through P_2Q_2 in the two situations (a) and (b) of that problem.

A. zero

B. 3 mA

C. 1 mA

D. None of these

Answer: A

Watch Video Solution

53. Suppose the $19(\Omega)$ resistor the previous problem is disconnected. Find the current through P_2Q_2.

Both the wires moves towards right

A. zero

B. 3 mA

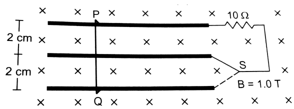
C. 1 mA

D. None of these

Answer: C

Watch Video Solution

54. Consider the situation shown in . The wire PQ has a negligible resistance and is made to slide on the three rails with a constant speed of $5cms^{-1}$. Find the current in the 10Ω resistor when the switch S is thrown to (a) the middle rail (b) the bottom rail.



A. zero

B. 2 mA

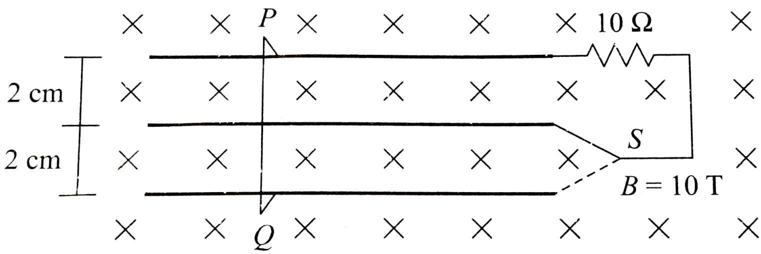
C. 1 mA

D. None of these

Answer: D

Watch Video Solution

55. Consider the situation shown in Fig. The wire PQ has a negligible resistance and is made to slide on the three rails with a constant speed of $5 cm / s$.



Find the current in the $10(\Omega)$ resistor when the switch S

is thrown to

the middle rail

A. zero

B. 2 mA

C. 3 mA

D. None of these

Answer: D

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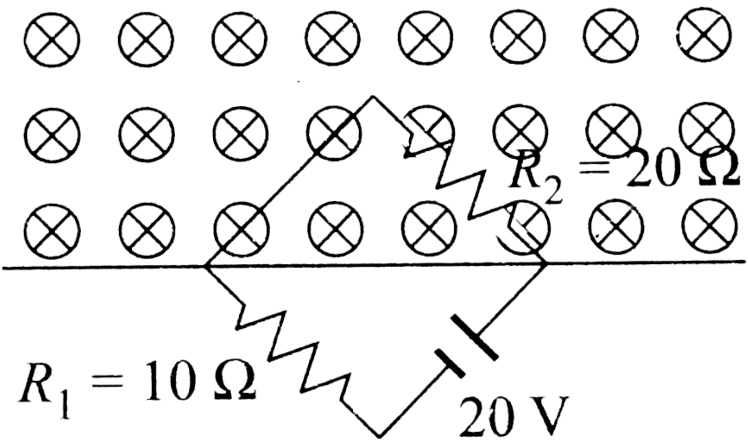
56. A square wire loop with 2 m sides is perpendicular to a uniform magnetic field, with half the area of the loop in the field (see Fig.) The loop contains a 20 V battery with negligible internal resistance. If the magnitude of the field varies with time according to $B = (2 + 5t)$, with B in tesla and t in second.



What is the total emf in the circuit ?

A. 10 V

B. 20 V

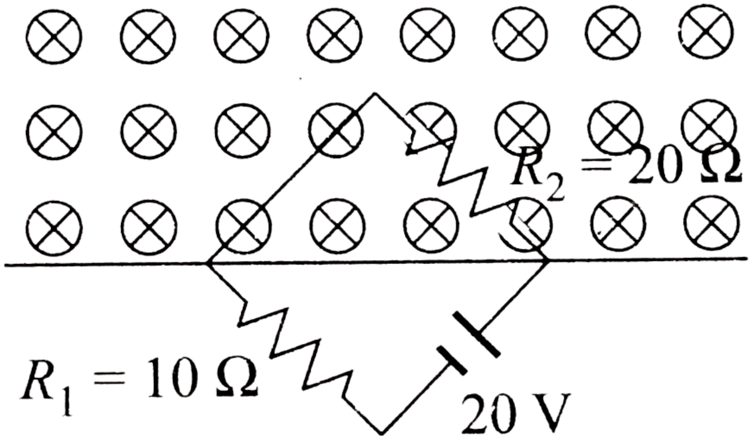
C. 30 V

D. None of these

Answer: C

Watch Video Solution

57. A square wire loop with 2 m sides is perpendicular to a uniform magnetic field, with half the area of the loop in the field (see Fig.) The loop contains a 20 V battery with negligible internal resistance. If the magnitude of the field varies with time according to B = (2 + 5t), with B in tesla and t in second.



What is the current through the battery ?

A. $\frac{1}{3}A$

B. $\frac{1}{2}A$

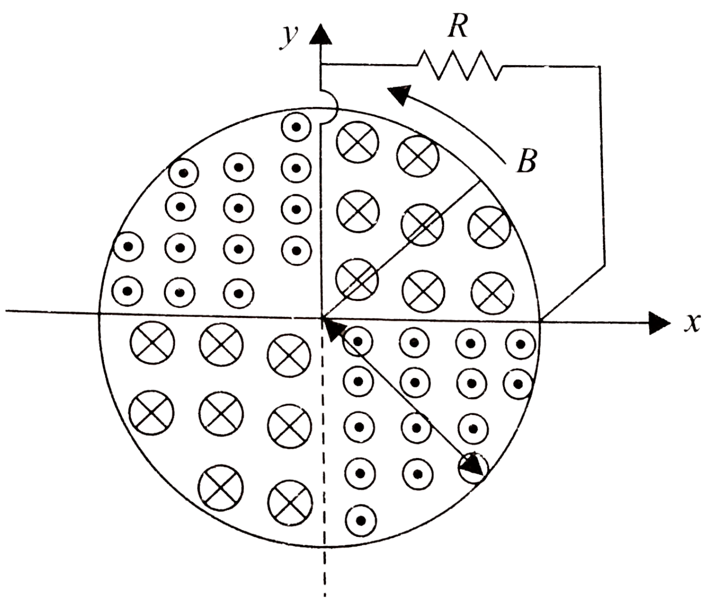
C. $1A$

D. $\frac{3}{2}A$

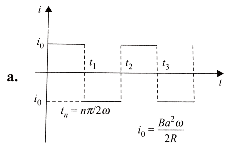
Answer: C

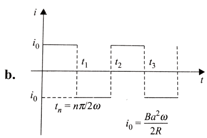
Watch Video Solution

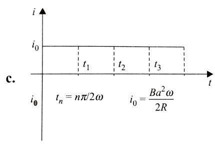
58. In a cylindrical region of radius a, magnetic field exists along its axis but the direction of magnetic field is opposite in the four quadrants of the region as shown in Fig. A or AB rotates with its end A at the centre of magnetic field and other end B slides on a smooth wire at the periphery of the region of magnetic field. At $t = 0$ the rod was situated along the +X direction.

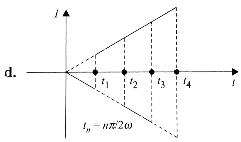


Find and plot the time dependence of the current in the resistance R when rod rotates with a constant angular velocity (ω).

A. 

B. 

C. 

D. 

Answer: A

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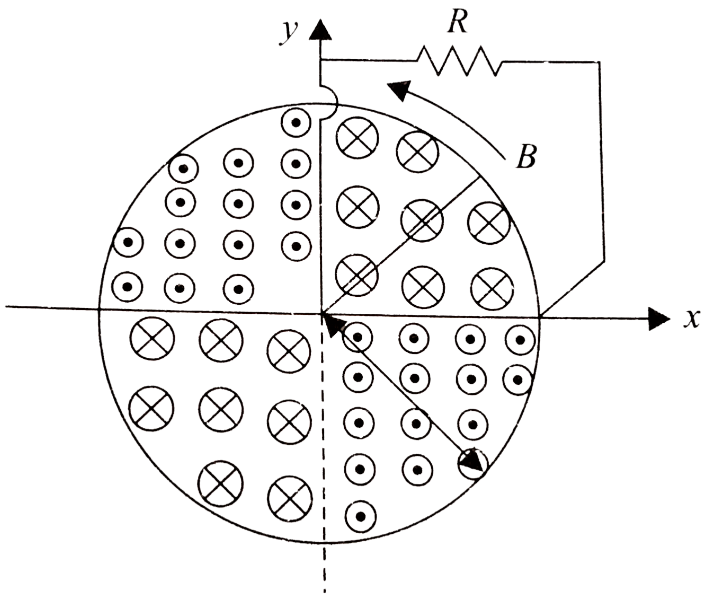
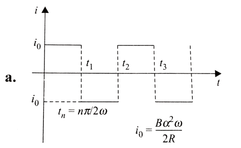
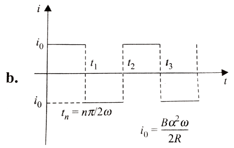
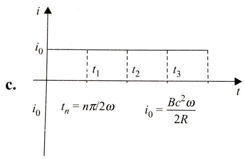
59. In a cylindrical region of radius a, magnetic field exists along its axis but the direction of magnetic field is opposite in the four quadrants of the region as shown in Fig. A or AB rotates with its end A at the centre of magnetic field and other end B slides on a smooth wire at the periphery of the region of magnetic field. At t = 0 the rod was situated along the +X direction.

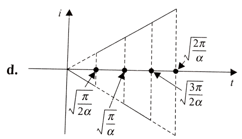


Find and plot the time dependence of the current in the resistance R when rotates with a constant angular acceleration (α)

A. 

B. 

C. 

D. 

Answer: A

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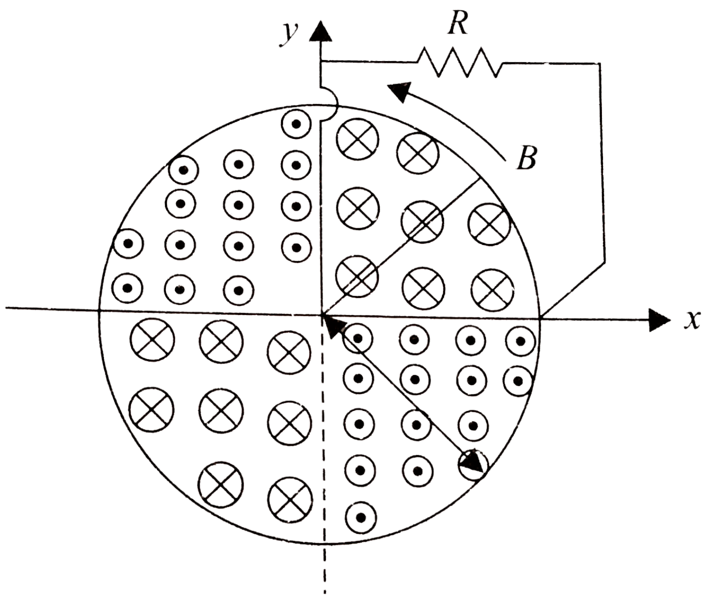
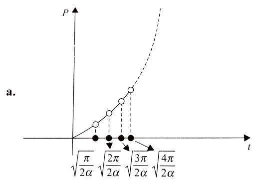
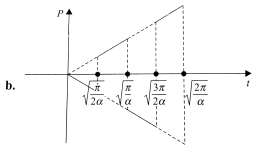
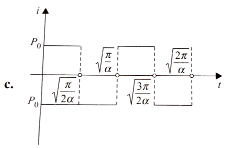
60. In a cylindrical region of radius a, magnetic field exists along its axis but the direction of magnetic field is opposite in the four quadrants of the region as shown in Fig. A or AB rotates with its end A at the centre of magnetic field and other end B slides on a smooth wire at the periphery of the region of magnetic field. At t = 0 the rod was situated along the +X direction.



Find and plot the time dependence of the thermal power in the resistance R when rod rotates with a constant angular acceleration (α)

A. 

B. 

C. 

D. None of these

Answer: A

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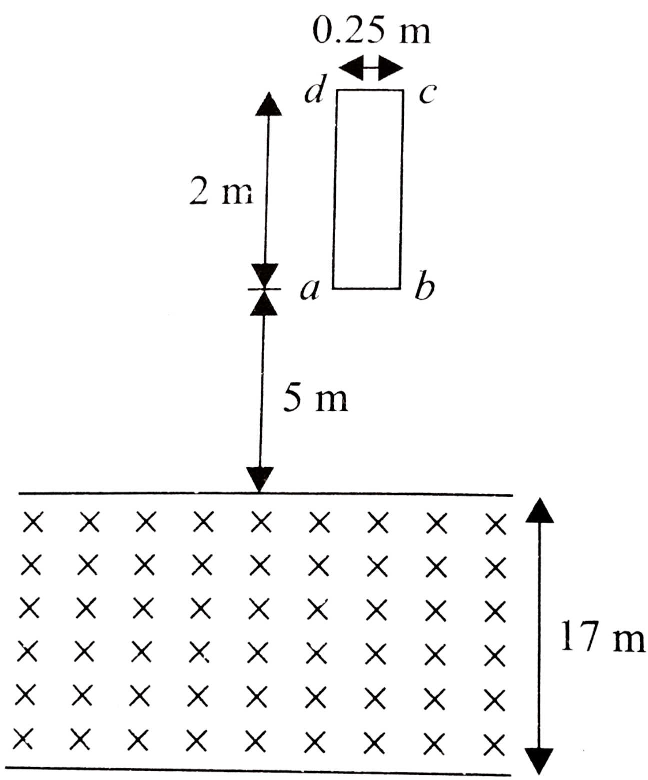
61. A rectangular wire frame of dimensions $(0.25 \times 2.0m)$ and mass 0.5 kg falls from a height 5m above a region occupied by uniform magnetic field of magnetic induction 1 T. The resistance of the wire frame is $\frac{1}{8}(\Omega)$. Find



time taken to completely enter into the field is

A. 0.2s

B. 1s

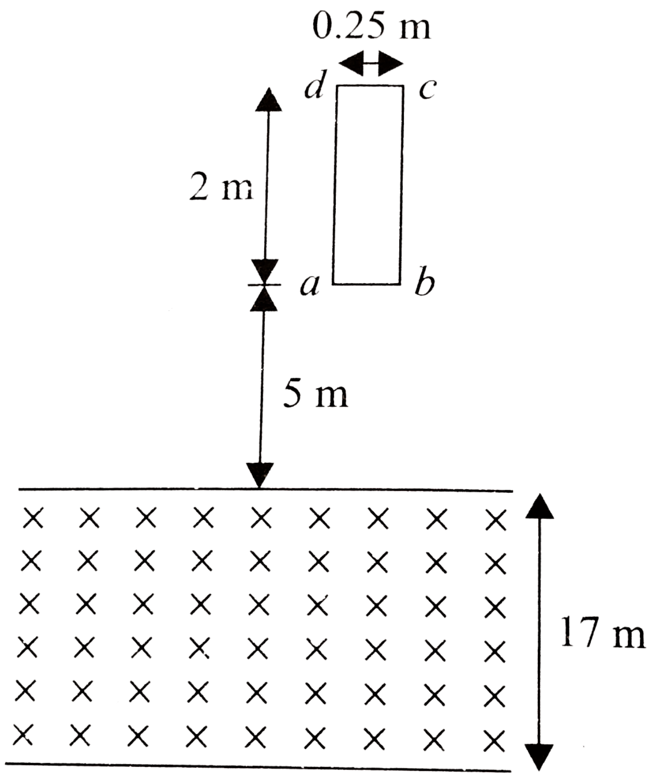
C. 2.2s

D. $\sqrt{\frac{1}{5}}s$

Answer: A

Watch Video Solution

62. A rectangular wire frame of dimensions $(0.25 \times 2.0m)$ and mass 0.5 kg falls from a height 5m above a region occupied by uniform magnetic field of magnetic induction 1 T. The resistance of the wire frame is $\frac{1}{8}(\Omega)$. Find



time taken by the wire frame when it just starts coming out of the magnetic field.

A. 0.2s

B. 1s

C. 2.2s

D. $\sqrt{\frac{1}{5}}s$

Answer: C

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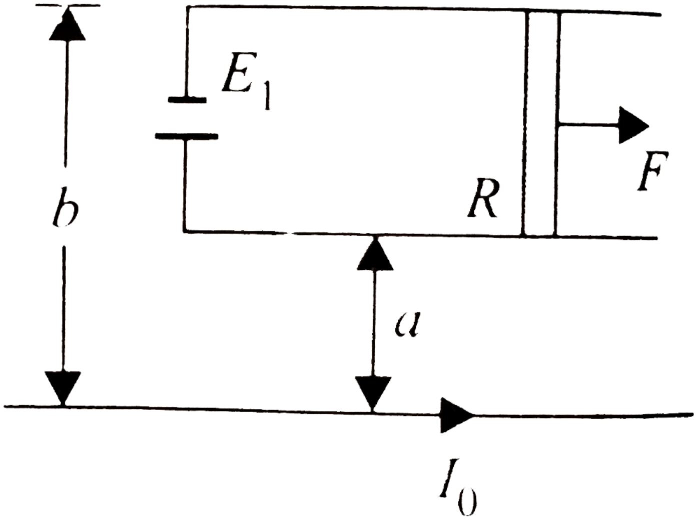
63. A metallic rod of mass m and resistance R is sliding over the 2 conducting frictionless rails as shown in Fig. An infinitely long wire carries a current I_0. The distance of the rails from the wire are b and a respectively.



Find the value of current in the circuit if the rod slides with constant velocity v_0

A. $\frac{1}{R}\left\{E-\frac{\mu_0 I_0 v_0}{2\pi} 1n\left|\frac{b}{a}\right|\right\}$

B. $\frac{1}{R}\left\{E+\frac{\mu_0 I_0 v_0}{2\pi} 1n\left|\frac{b}{a}\right|\right\}$

C. $\frac{1}{R}\left\{E-\frac{\mu_0 I_0 v_0}{\pi} 1n\left|\frac{b}{a}\right|\right\}$

D. None of these

Answer: A

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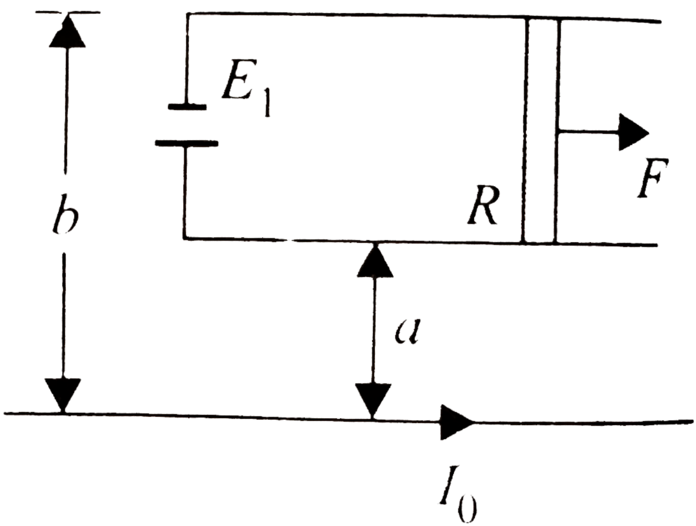
64. A metallic rod of mass m and resistance R is sliding over the 2 conducting frictionless rails as shown in Fig. An infinitely long wire carries a current I_0. The distance of the rails from the wire are b and a respectively.



Find the value of F if the rod slides with constant velocity

A. $\frac{\mu_0 I_0}{2\pi R}\left[E+\frac{\mu_0 I_0}{2\pi}v_0 1n\left|\frac{b}{a}\right|\right]1n\left(\frac{b}{a}\right)$

B. $\frac{\mu_0 I_0}{\pi R}\left[E-\frac{\mu_0 I_0}{2\pi}v_0 1n\left|\frac{b}{a}\right|\right]1n\left(\frac{b}{a}\right)$

C. $\frac{\mu_0 I_0}{2\pi R}\left[E-\frac{\mu_0 I_0}{2\pi}v_0 1n\left|\frac{b}{a}\right|\right]1n\left(\frac{b}{a}\right)$

D. None of these

Answer: C

Watch Video Solution

65. A stationary circular loop of radius a is located in a magnetic field which varies with time from $t=0 \rightarrow t=T$ according to law $B=B_0 t(T-t)$. If plane of loop is normal to the direction of field and resistance of the loop is R, calculate amount of heat generated in the loop during this interval.

A. $\dfrac{\pi^2 a^4 B_0^2 T^3}{3R}$

B. $\dfrac{\pi^2 a^4 B_0^2 T^3}{R}$

C. $\dfrac{3\pi^2 a^4 B_0^2 T^3}{R}$

D. None of these

Answer: A

Watch Video Solution

66. A stationary circular loop of radius a is located in a magnetic field which varies with time from t = 0 to t = T according to law $B = B_0 t(T - t)$. If plane of loop is normal to the direction of field and resistance of the loop is R, calculate

magnitude of charge flown through the loop from instant t = 0 to the instant when current reverses its direction.

A. $\frac{\pi^2 a^2 B_0 T^2}{R}$

B. $\frac{\pi^2 a^2 B_0 T^2}{4R}$

C. $\frac{4\pi^2 a^2 B_0 T^2}{R}$

D. None of these

Answer: B

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67. A circular ring of radius a is made from a wire having resistance (λ) per unit length. The ring is mounted on a car such that ring remains vertical. The care moves along a horizontal circle of radius R and completes n revolutions per minute. The horizontal component of earth's magnetic field be H,

The emf induced in the ring is

A. $\frac{\pi^2 a^2 nH}{10} \cos\left(\frac{\pi nt}{30}\right)$

B. $\frac{\pi^2 a^2 nH}{30} \cos\left(\frac{\pi nt}{30}\right)$

C. $\frac{\pi^2 a^2 nH}{10} \sin\left(\frac{\pi nt}{30}\right)$

D. None of these

Answer: C

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68. A circular ring of radius a is made from a wire having resistance (λ) per unit length. The ring is mounted on a car such that ring remains vertical. The care moves along a horizontal circle of radius R and completes n revolutions per minute. The horizontal component of earth's magnetic field be H,

Calculate average rate at which heat is produced in the ring

A. $\dfrac{\pi^3 a^3 H^2 n^2}{1800\lambda} Js^{-1}$

B. $\dfrac{\pi^3 a^3 H^2 n^2}{3600\lambda} Js^{-1}$

C. $\dfrac{\pi^3 a^3 H^2 n^2}{1200\lambda} Js^{-1}$

D. None of these

Answer: B

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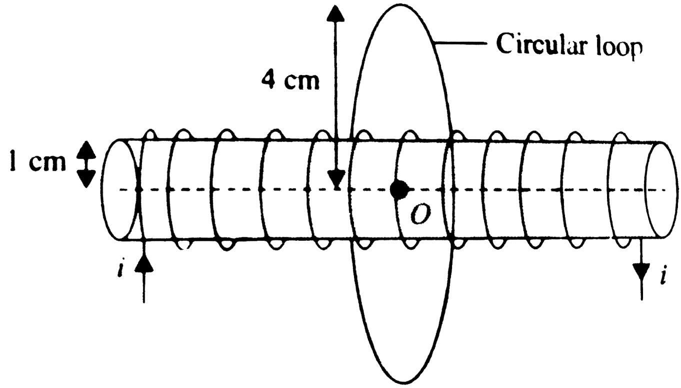
69. A long solenoid having n = 200 turns per metre has a circular cross-section of radius $a_1 = 1cm$. A circular conducting loop of radius $a_2 = 4cm$ and resistance $R = 5(\Omega)$ encircles the solenoid such that the centre of circular loop coincides with the midpoint of the axial line of the solenoid and they have the same axis as shown in Fig.



A current 't' in the solenoid results in magnetic field along its axis with magnitude $B = (\mu)ni$ at points well inside the solenoid on its axis. We can neglect the insignificant field outside the solenoid. This results in a magnetic flux $(\phi)_B$ through the circular loop. If the current in the winding of solenoid is changed, it will also change the magnetic field $B = (\mu)_0 ni$ and hence also the magnetic flux through the circular loop. Obvisouly, it will result in an induced emf or induced electric field in the circular loop and an induced current will appear in the loop. Let current in the winding of solenoid be reduced at a rate of $75A/\sec.$

Magnitude of induced current that appears in the circular loop is

A. $2.72\mu A$

B. $1.18\mu A$

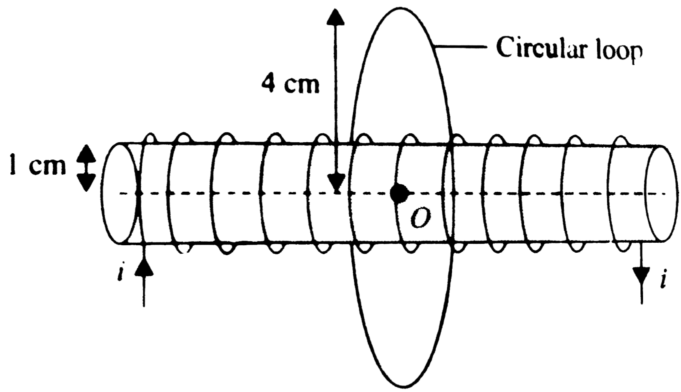
C. $19.2\mu A$

D. None of these

Answer: B

Watch Video Solution

70. A long solenoid having n = 200 turns per metre has a circular cross-section of radius $a_1 = 1cm$. A circular conducting loop of radius $a_2 = 4cm$ and resistance $R = 5(\Omega)$ encircles the solenoid such that the centre of circular loop coincides with the midpoint of the axial line of the solenoid and they have the same axis as shown in Fig.



A current 't' in the solenoid results in magnetic field along its axis with magnitude $B = (\mu)ni$ at points well inside the solenoid on its axis. We can neglect the insignificant field outside the solenoid. This results in a magnetic flux $(\phi)_B$ through the circular loop. If the current in the winding of solenoid is changed, it will also change the magnetic field $B = (\mu)_0 ni$ and hence also the magnetic flux through the circular loop. Obvisouly, it will result in an induced emf or induced electric field in the circular loop and an induced current will appear in the loop. Let current in the winding of solenoid be reduced at a rate of $75A / \sec$.

Magnetic of induced electric field strength in the circular loop is nearly We know that there is magnetic flux through the circular loop because of the magnetic field of current in the solenoid. For the purpose of circular loop, let us call it the external magnetic field. As current in the solenoid is reducing, external magnetic field for the circular loop also reduced resulting in induced current in the loop. Finally, as the solenoid current becomes zero, external field for the loop also becomes zero and stop changing. However, induced current in the loop will not stop at the instant at which the external field stops changing. This is because induced current itself produces a magnetic field that results in a flux through the loop. External field becoming zero without any further change will compel the induced current in the loop to become zero and so magnetic flux through the loop due to change in induced current will also change resulting in a further induced phenomenon that sustains currents in the loop even after the external field becomes zero.

A. $4.7 \times 10^{-7} Vm^{-1}$

B. $3.82 \times 10^{-6} Vm^{-1}$

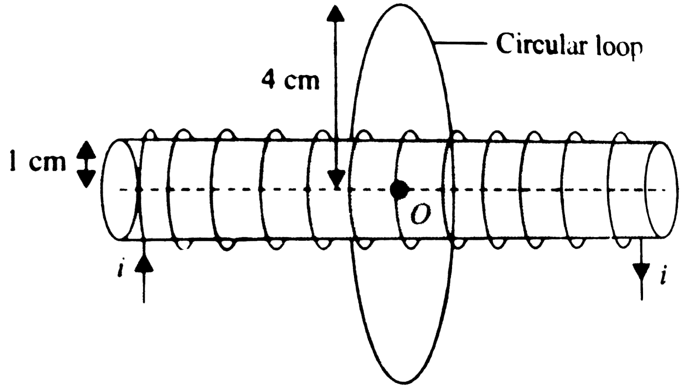
C. $2.3 \times 10^{-5} Vm^{-1}$

D. None of these

Answer: C

View Text Solution

71. A long solenoid having n = 200 turns per metre has a circular cross-section of radius $a_1 = 1cm$. A circular conducting loop of radius $a_2 = 4cm$ and resistance $R = 5(\Omega)$ encircles the solenoid such that the centre of circular loop coincides with the midpoint of the axial line of the solenoid and they have the same axis as shown in Fig.



A current 't' in the solenoid results in magnetic field along its axis with magnitude $B = (\mu)ni$ at points well inside the solenoid on its axis. We can neglect the insignificant field outside the solenoid. This results in a magnetic flux $(\phi)_B$ through the circular loop. If the current in the winding of solenoid is changed, it will also change the magnetic field $B = (\mu)_0 ni$ and hence also the magnetic flux through the circular loop. Obvisouly, it will result in an induced emf or induced electric field in the circular loop and an induced current will appear in the loop. Let current in the winding of solenoid be reduced at a rate of $75A / \sec.$

Magentic flux through the loop due to external magnetic field will be

I is the current in the loop

a_1 is the radius of solendoid and $a_1 = 1cm$ (given)

a_2 is the radius of circular loop and $a_2 = 4cm$ (given)

i is hte current in the solenoid

A. $\mu_0 ni(\pi a_1^2)$

B. $\mu_0 ni(\pi a_2^2)$

C. zero

D. $\mu_0 ni(\pi a_1^2 + \pi a_2^2)$

Answer: A

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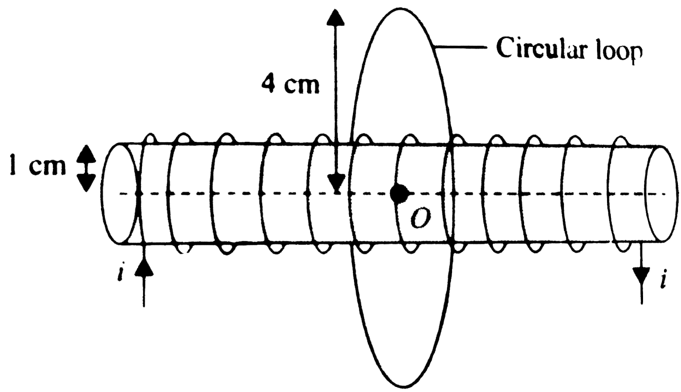
72. A long solenoid having n = 200 turns per metre has a circular cross-section of radius $a_1 = 1cm.$ A circular conducting loop of radius $a_2 = 4cm$ and resistance $R = 5(\Omega)$ encircles the solenoid such that the centre of circular loop coincides with the midpoint of the axial line of the solenoid and they have the same axis as shown in Fig.



A current 't' in the solenoid results in magnetic field along its axis with magnitude $B = (\mu)ni$ at points well inside the solenoid on its axis. We can neglect the insignificant field outside the solenoid. This results in a magnetic flux $(\phi)_B$ through the circular loop. If the current in the winding of solenoid is changed, it will also change the magnetic field $B=(\mu)_0 ni$ and hence also the magnetic flux through the circular loop. Obvisouly, it will result in an induced emf or induced electric field in the circular loop and an induced current will appear in the loop. Let current in the winding of solenoid be reduced at a rate of $75A/\sec$.

When the current in the solenoid becomes zero so that external magnetic field for the loop stops changing, current in the loop will follow a differenctial equation given by [You may use an approximation that field at all points in the area of loop is the same as at the centre

A. $\dfrac{dI}{dt} = \dfrac{R}{\mu_0 ni} I$

B. $\dfrac{dI}{dt} = -\dfrac{2R}{\pi\mu_0 a_2} I$

C. $\dfrac{dI}{dt} = -\dfrac{2R}{\mu_0 a_2} I$

D. None of these

Answer: B

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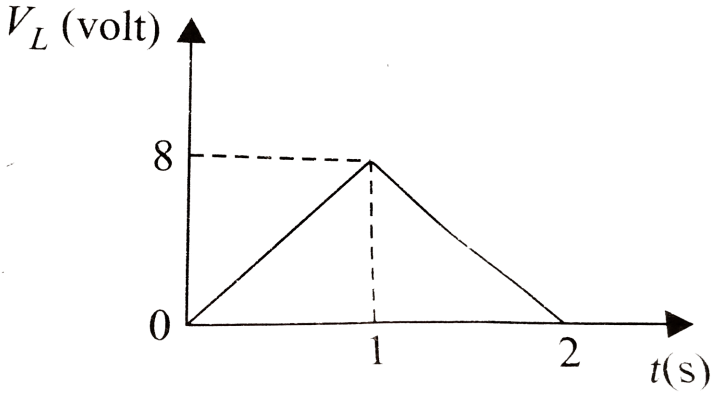
73. The potential difference across a 2-H inductor as a function of time is shown in Fig. At time $t = 0$, current is zero.



Area under $V_L - t$ graph gives

A. current

B. change in current

C. product of inductance and current

D. product of inductance and change in current

Answer: D

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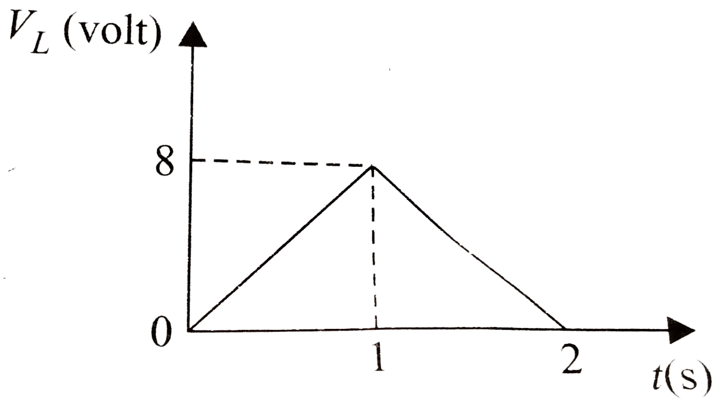
74. The potential difference across a 2-H inductor as a function of time is shown in Fig. At time t = 0, current is zero.



Current at t = 1 s is

A. $1A$

B. $2A$

C. $4A$

D. $8A$

Answer: B

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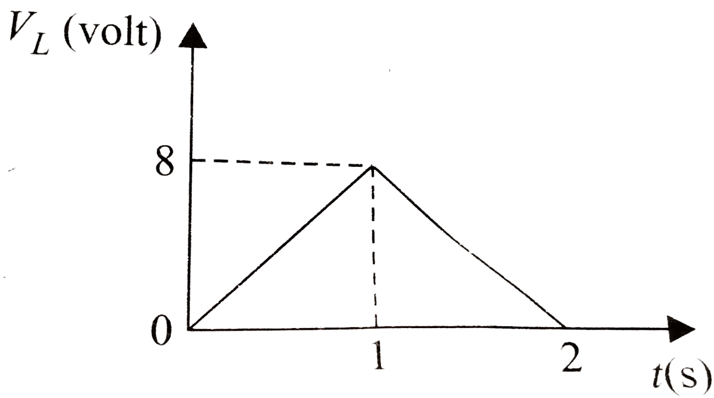
75. The potential difference across a 2-H inductor as a function of time is shown in Fig. At time t = 0, current is zero.



The variation of current versus time is

A. a straight line

B. a parabola

C. a hyperbola

D. expotential

Answer: B

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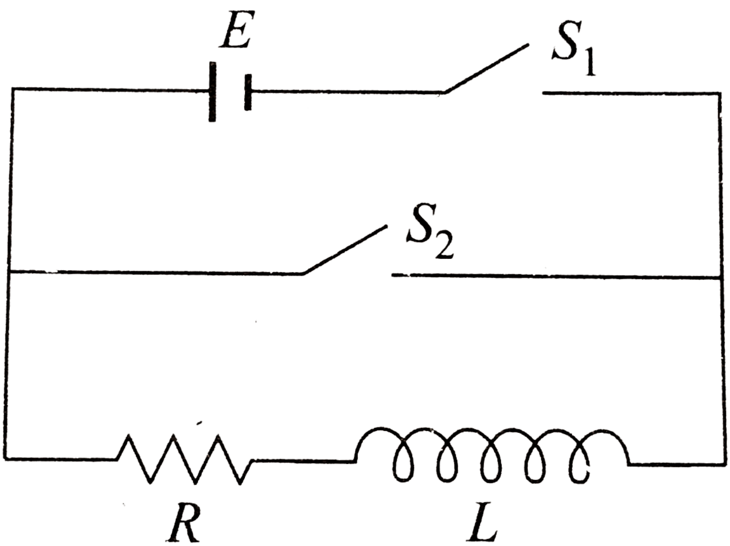
76. Consider the circuit shown below. When switch S_1 is closed, let I be the current at time t, then applying Kirchhoff's law

$$E - iR - L\frac{di}{dt} = 0 \text{ or } \int_0^i \frac{di}{E - iR} = \frac{1}{L}\int_0^1 dt$$

$$i = \frac{E}{R}\left(1 - e^{-\frac{R}{l}\cdot t}\right)$$

$\frac{L}{R}$ = time constant of circuit

When current reaches its steady value ($= i_0$, open S_1 and close S_2, the current does reach to zero finally but decays expnentially. The decay equation is given as $i = i_0 e^{-\frac{R}{L} \cdot T}$).



When a coil carrying a steady current is short circuited, the current decreases in it η times in time t_0. The time constant of the circuit is

A. $t_0 1n\eta$

B. $\frac{t_0}{1n\eta}$

C. $\frac{t_0}{\eta}$

D. $\frac{t_0}{\eta} - 1$

Answer: B

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77. Consider the circuit shown below. When switch S_1 is closed, let I be the current at time t, then applying Kirchhoff's law

$$E - iR - L\frac{di}{dt} = 0 \text{ or } \int_0^i \frac{di}{E - iR} = \frac{1}{L}\int_0^1 dt$$

$$i = \frac{E}{R}\left(1 - e^{-\frac{R}{l}\cdot t}\right)$$

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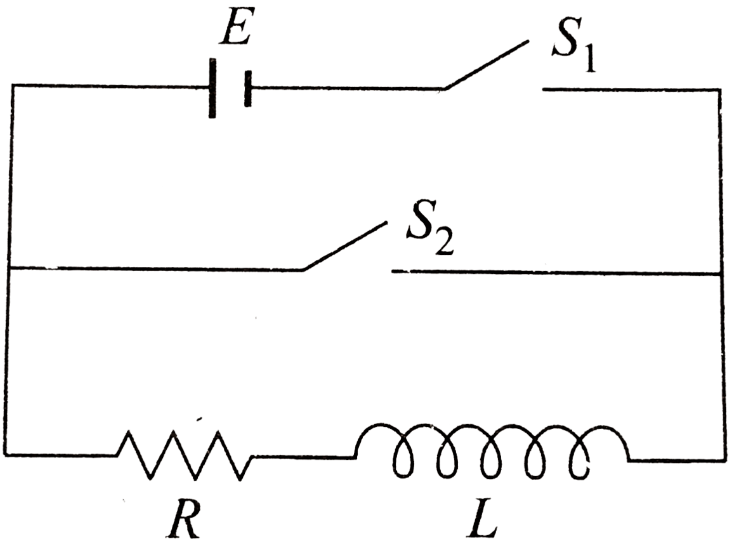
When current reaches its steady value ($= i_0$, open S_1 and close S_2, the current does reach to zero finally but decays expnentially. The decay equation is given as $i = i_0 e^{-\frac{R}{L} \cdot T}$.



Three idenctical rings. The first (a). slips without rolling and the second (b) rolls without slipping and the third rolls with slipping .

A. The same emf is induced in all three rings.

B. No emf is induced in any of the rings.

C. In each ring all points are at same potential

D. B develops max. Induced emf and A, the least.

Answer: A

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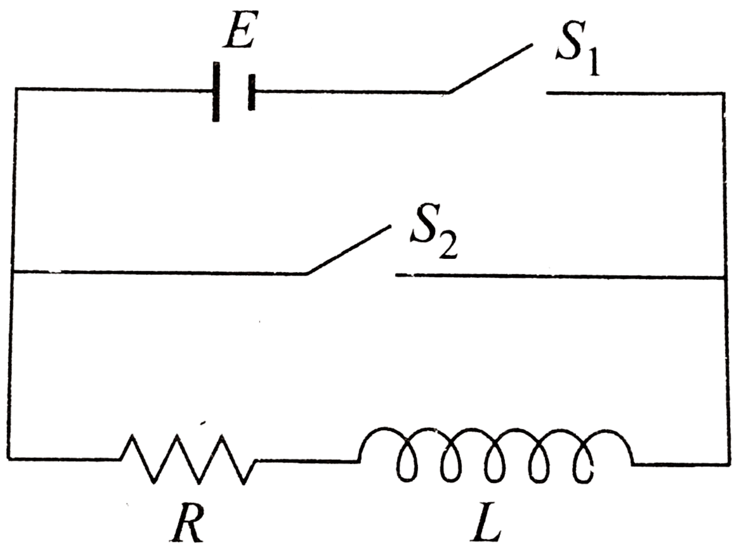
78. Consider the circuit shown below. When switch S_1 is closed, let I be the current at time t, then applying Kirchhoff's law

$$E - iR - L\frac{di}{dt} = 0 \text{ or } \int_0^i \frac{di}{E - iR} = \frac{1}{L}\int_0^1 dt$$

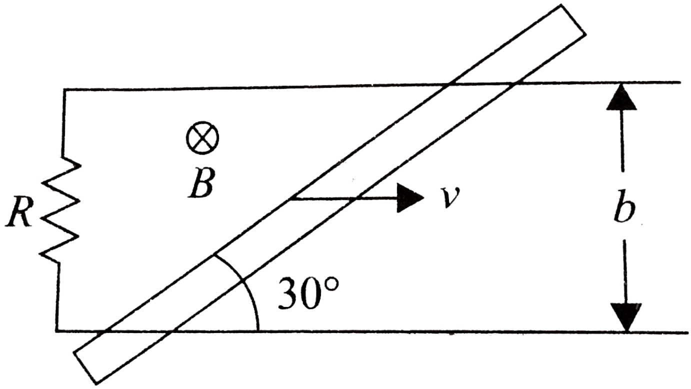
$$i = \frac{E}{R}\left(1 - e^{-\frac{R}{l}\cdot t}\right)$$

$\frac{L}{R}$ = time constant of circuit

When current reaches its steady value ($= i_0$, open S_1 and close S_2, the current does reach to zero finally but decays expnentially. The decay equation is given as $i = i_0 e^{-\frac{R}{L} \cdot T}$.



A wire is sliding as shown in fig . The angle between the acceleration and velocity of the wire is



A. 30°

B. 40°

C. 120°

D. 90°

Answer: C

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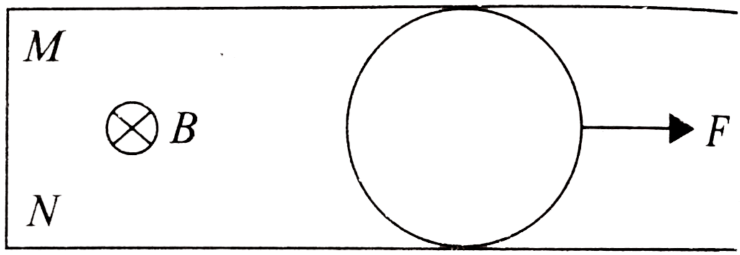
79. Two long parallel conducting horizontal rails are connected by a conducting wire at one end. A uniform magnetic field B (directed vertically downwards) exists in the region of space.



A light uniform ring of diameter d which is practically equal to separation between the rails is placed over the rails as shown in Fig. If resistance of ring be (λ) per unit length

The current in the wire MN is

A. $\dfrac{2Bv}{3\pi\lambda}$ from M to N

B. $\dfrac{Bv}{3\pi\lambda}$ from M to N

C. $\dfrac{2Bv}{3\pi\lambda}$ from N to M

D. None of these

Answer: D

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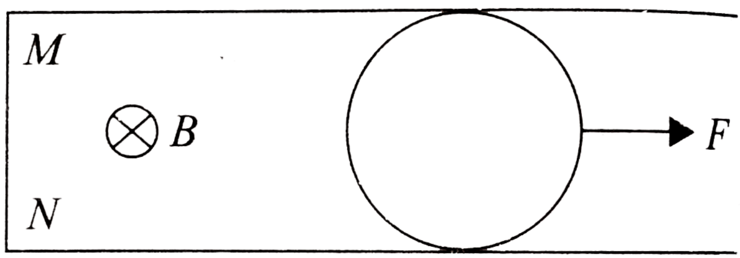
80. Two long parallel conducting horizontal rails are connected by a conducting wire at one end. A uniform magnetic field B (directed vertically downwards) exists in the region of space.



A light uniform ring of diameter d which is practically equal to separation between the rails is placed over the rails as shown in Fig. If resistance of ring be (λ) per unit length

The force required to pull the ring with uniform velocity v is

A. $\frac{4B^2vd}{3\pi\lambda}$

B. $\frac{3B^2vd}{4\pi\lambda}$

C. $\frac{2B^2vd}{3\pi\lambda}$

D. $\frac{4B^2vd}{\pi\lambda}$

Answer: D

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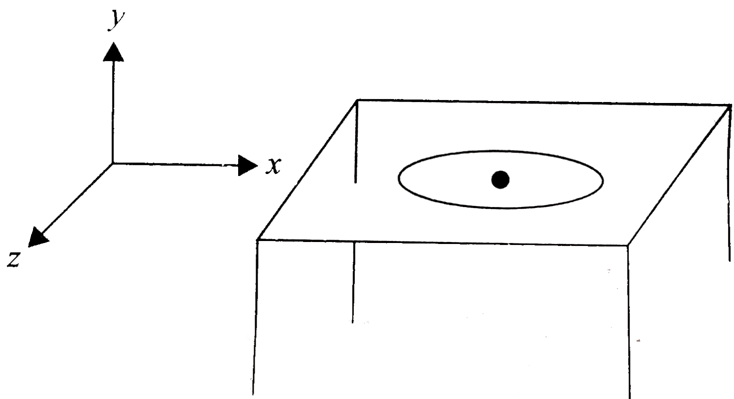
81. A uniform conducting ring of mass π kg and radius 1 m is kept on smooth horizontal table. A uniform but time varying magnetic field $B = \left(\hat{i} + t^2\hat{j}\right)T$ is present in the region, where t is time in seconds. Resistance of ring is $2(\Omega)$. Then



(x-z plane is horizontal plane)

Net Induced EMF (in Volt) on conducting ring as function of time is

A. $2\pi^2 t$

B. $2\pi^2 t^2$

C. $2\pi^2 t^3$

D. zero

Answer: D

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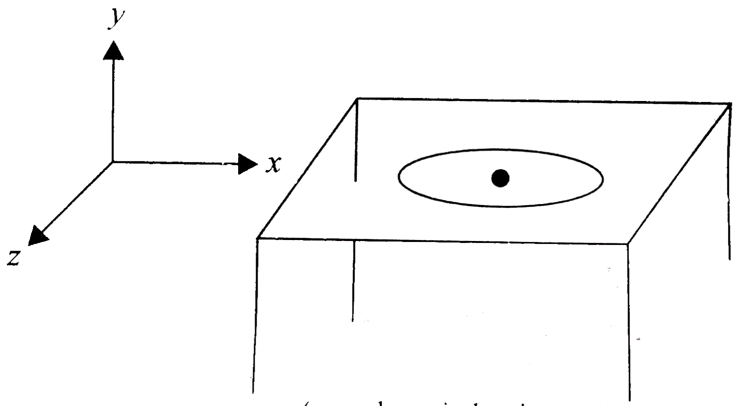
82. A uniform conducting ring of mass π kg and radius 1 m is kept on smooth horizontal table. A uniform but time varying magnetic field $B = \left(\hat{i} + t^2\hat{j}\right)T$ is present in the region, where t is time in seconds. Resistance of ring is $2(\Omega)$. Then



Time (in second) at which ring start toppling is

A. $\frac{10}{\pi}$

B. $\frac{20}{\pi}$

C. $\frac{5}{\pi}$

D. $\frac{25}{\pi}$

Answer: A

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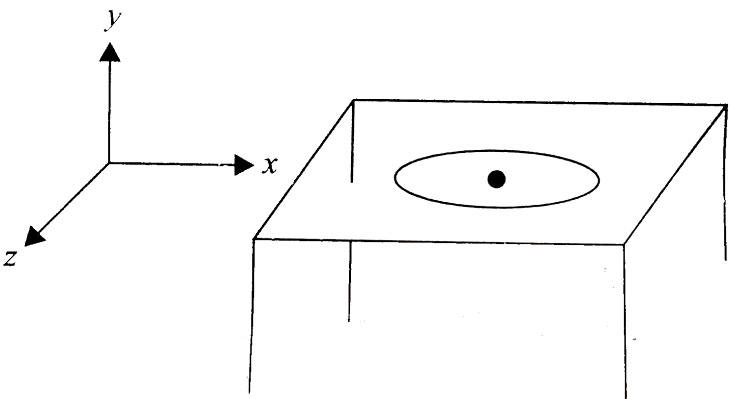
83. A uniform conducting ring of mass π kg and radius 1 m is kept on smooth horizontal table. A uniform but time varying magnetic field $B = \left(\hat{i} + t^2\hat{j}\right)T$ is present in the region, where t is time in seconds. Resistance of ring is $2(\Omega)$. Then



(x-z plane is horizontal plane)

Net Induced EMF (in Volt) on conducting ring as function of time is

A. $\frac{1}{3\pi}$

B. $\frac{2}{\pi}$

C. $\frac{2}{3\pi}$

D. $\frac{1}{\pi}$

Answer: C

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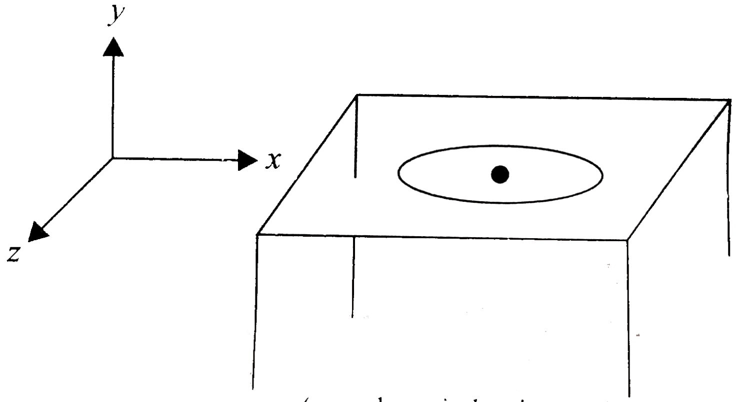
84. A uniform conducting ring of mass π kg and radius 1 m is kept on smooth horizontal table. A uniform but time varying magnetic field $B = \left(\hat{i} + t^2\hat{j}\right)T$ is present in the region, where t is time in seconds. Resistance of ring is $2(\Omega)$. Then



(x-z plane is horizontal plane)

Net Induced EMF (in Volt) on conducting ring as function

of time is

A. $\frac{10}{\pi}$

B. $\frac{20}{\pi}$

C. $\frac{5}{\pi}$

D. $\frac{25}{\pi}$

Answer: A

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Integer

1. A charged particle enters a uniform magnetic field with velocity $v_0 = 4m/s$ perpendicular to it, the length of magnetic field is $x = \left(\frac{\sqrt{3}}{2}\right)R$, where R is the radius of the circular path of the particle in the field. Find the magnitude of charge in velocity (in m/s) of the particle when it comes out of the field.

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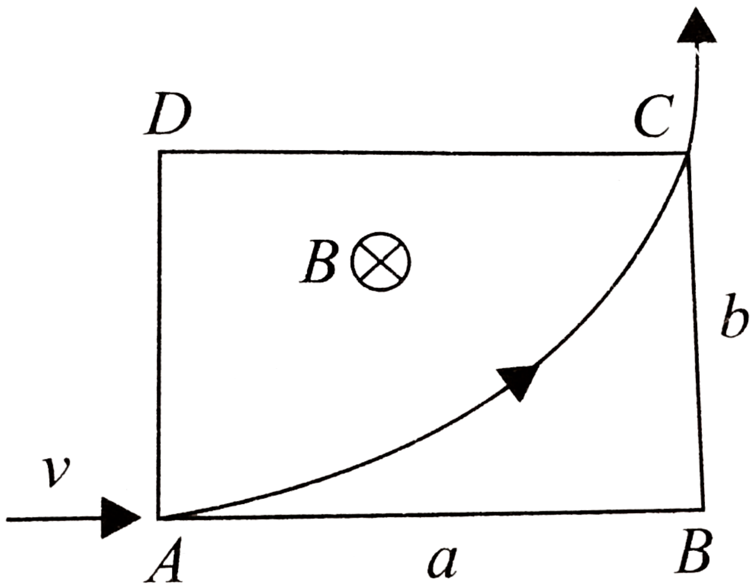
2. A charged particle of mass m = 1 mg and charge $q = 1(\mu)C$ enter along AB at point A in a uniform magnetic field B = 1.2 T existing in the rectangular region of size $a \times b$, where a = 4 m and b = 3 m. The particle leaves the region exactly at corner point C. What is the speed $v(\in ms^{-1})$ of the particle?



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3. Two parallel wires carrying equal currents i_1 and i_2 with $i_1 > i_2$. When the current are in the same direction, the $10mT$. If the direction of i_2 is reversed, the field becomes $30mT$. The ratio i_1 / i_2 is

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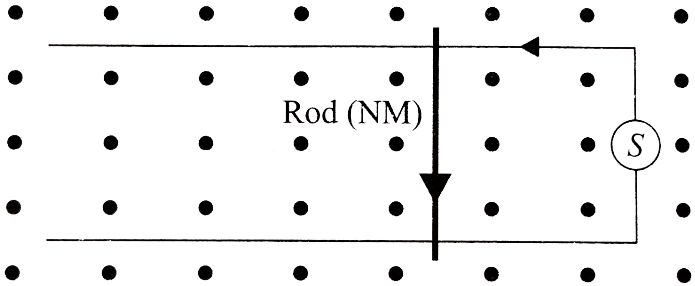
4. A conducting rod of mass 200 gm and length 10 cm can slide without friction on two long, horizontal rails. A uniform magnetic field of magnitude 5 m T exists in the region as shown. A source S is used to maintain a constant current 2 A through the rod. If motion of the rod starts from the rest, find its speed (in cm/s) after 10 s from the start of the motion



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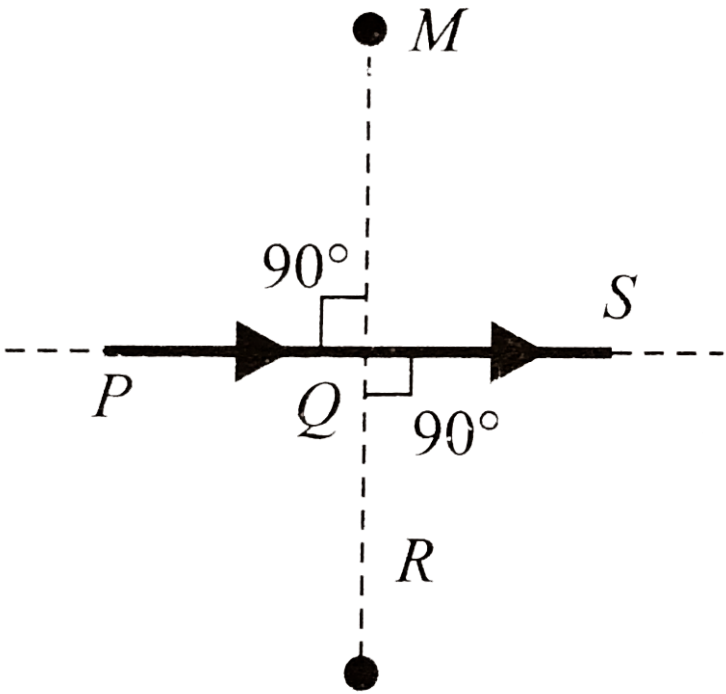
5. An infinitely long conductor PQR is bent to form a right angle as shown. A current I flows through PQR. The magnetic field due to this current at the point $M is B_1$. Now, another infinitely long straight conductor QS is connected at Q so that the current is $I/2$ in QR as well as in QS, the current in PQ remaining unchanged. The magnetic field at M is now $B_2 = 4mT$. Find the value of

$B_1(\text{in} mT)$.



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6. A magnetic field $\overrightarrow{B} = -B_0\hat{i}$ exists within a sphere of radius $R = v_0T\sqrt{3}$ where T is the time period of one revolution of a charged particle starting its motion form origin and moving with a velocity $vce(v)_0 = \frac{v_0}{2}\sqrt{3}\hat{i} - \frac{v_0}{2}\hat{j}$. Find the number of turns that the particle will take to come out of the magnetic field.

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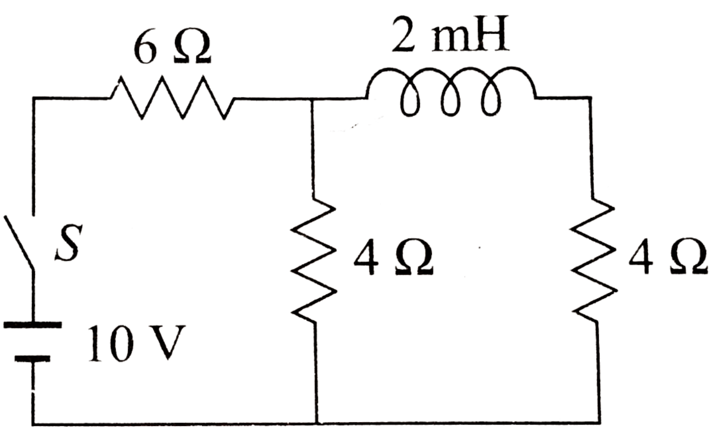
7. In the given circuit, what is the current I (in A) drawn from battery at time t = 0.



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8. A coil of inductance $L = 5/8H$ and of resistance $R = 62.8(\Omega)$ is connected to the mains alternating voltage of frequency 50 Hz. What can be the capacitance of the capacitor ($\in (\mu)F$) connected in series with the coil if the power dissipated has to remain unchanged? Take $(\pi)^2 = 10$.

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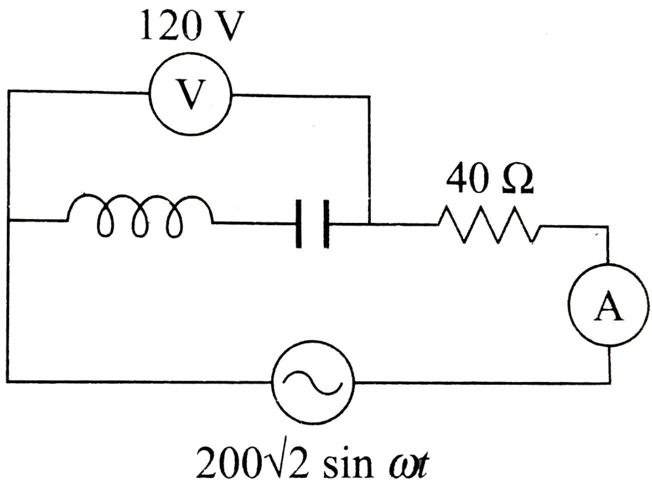
9. In the given LCR series circuit find the reading (in A) of the hot wire ammeter. (there all hot wire meters are ideal)



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10. At any instant a current of 2 A is increasing at a rate of $1A/s$ through a coil of indcutance 2 H. Find the energy (in SI units) being stored in the inductor per unit time at that instant.

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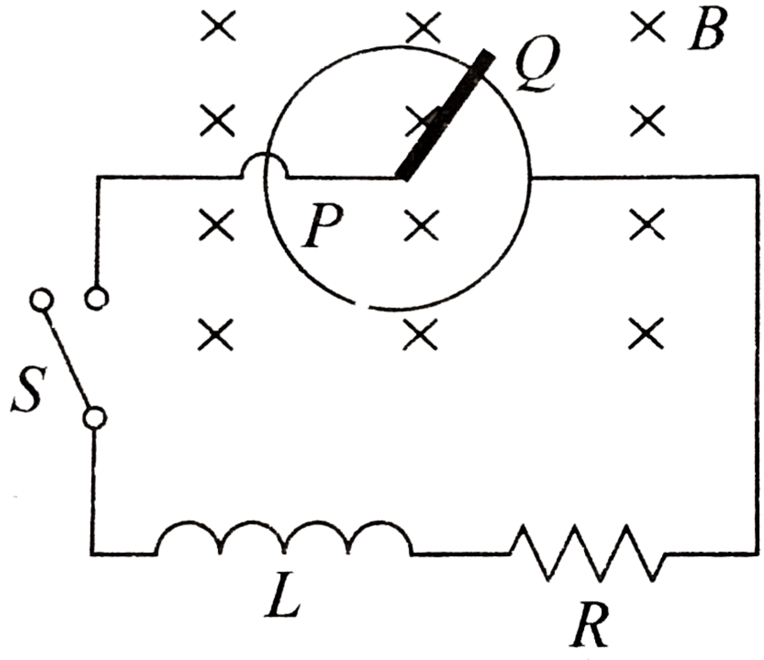
11. The diagram shows a circuit having a coil of resistance $R = 2.5(\Omega)$ and inductance L connected to a conducting rod PQ which can slide on perfectly conducting circular ring of radius 10 cm with its centre at 'P'. Assume that friction and gravity are absent and a constant uniform magnetic field of 5 T exist as shown in Fig.



At t = 0, the circuit is switched on and simultaneously a time varying external torque is applied on the rod so that it rotates about P with a constant angular velocity $40 rad/s$. Find magnitude of this torque (in milli Nm) when current reaches half of its maximum value. Neglect the self-inductance of the loop formed by the circuit.

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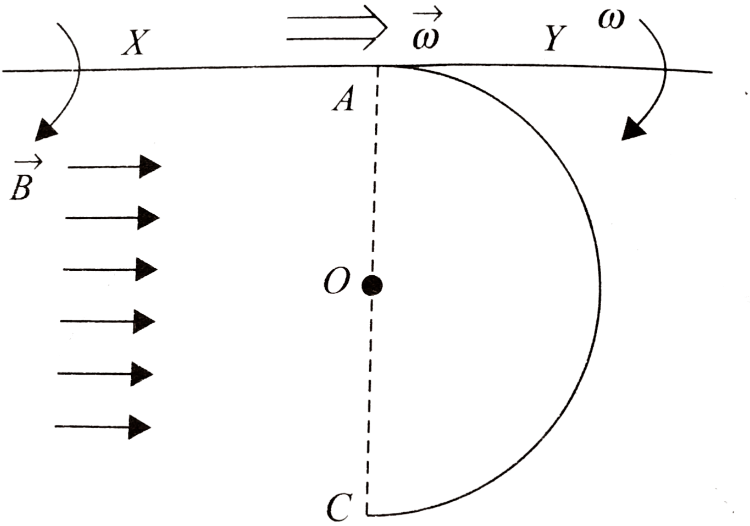
12. A thin wire AC shaped as a semi-circle of diameter d rotates with a constant angular frequency (ω) in a uniform magnetic field of indcution $\overrightarrow{B}$. The vector $\overrightarrow{\omega}$ is parallel to $\overrightarrow{B}$ and the rotation axis XY passes through the end A of the wire and is perpendicular to the diameter AC (see Fig.). $\overrightarrow{B}$ is directed left to right in the plane of the paper. The value of the line intergral $I = \int \overrightarrow{E} \cdot d\overrightarrow{r}$ taken along the wire form the point A to the point C will be $\frac{\omega B d^2}{?}$. What interger should be inserted in place of question mark.



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