PHYSICS

BOOKS - CENGAGE PHYSICS (ENGLISH)

ELECTROMAGNETIC INDUCTION

Illustration

1. A long solenoid with radius $2cm$ carries a current of $2A$. The solenoid is $70cm$ long and is composed of 300 turns of wire. Assuming ideal solenoid model, calculate the flux linked with a circular surface if

(a) it has a radius of $1cm$ and is perpendicular to the axis of the solenoid:

(i) inside,

(ii) outside.

(b)it has a radius of $3cm$ and is perpendicular to the axis of the solenoid with its center lying on the axis of the solenoid.

(c) it has a radius greater than $2cm$ and axis of the solenoid subtend an angle of 60° with the normal to the area (the center of the circular surface being on the axis of the solenoid).

(d) the plane of the circular area is parallel to the axis of the solenoid.

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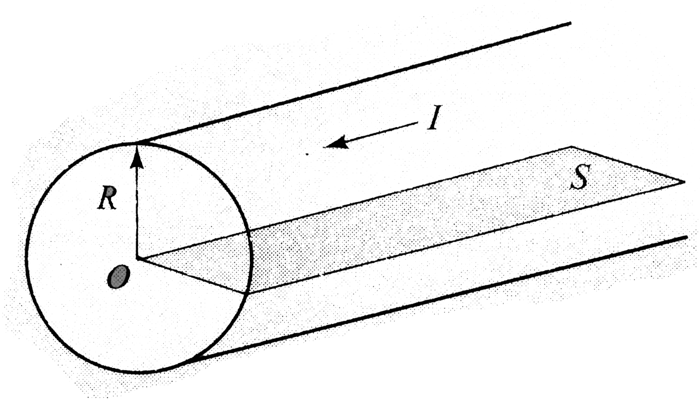
2. A long copper wire carries a current of I ampere. Calculate the magnetic flux per meter of the wire for a plane surface S inside the wire as shown in Fig.



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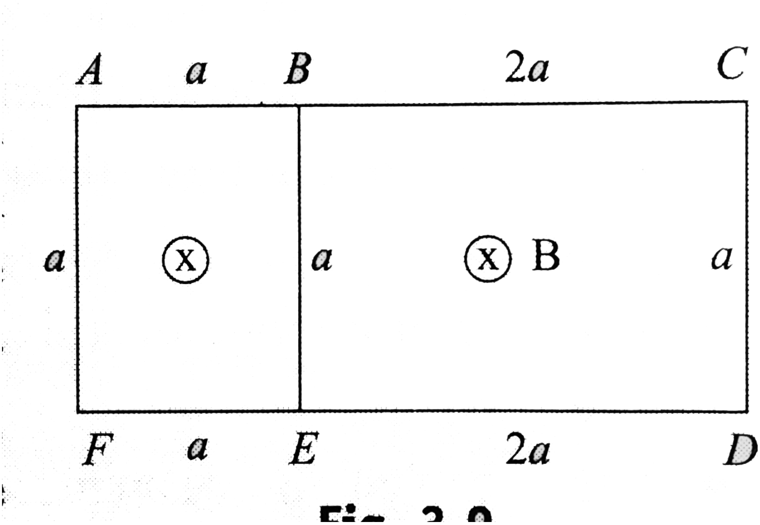
3. A closed loop with the geometry shown in Fig. 3.9 is placed in a uniform magnetic field direction into the plane of the paper. If the magnetic field decreases with time, determine the direction of the induced emf in this loop.



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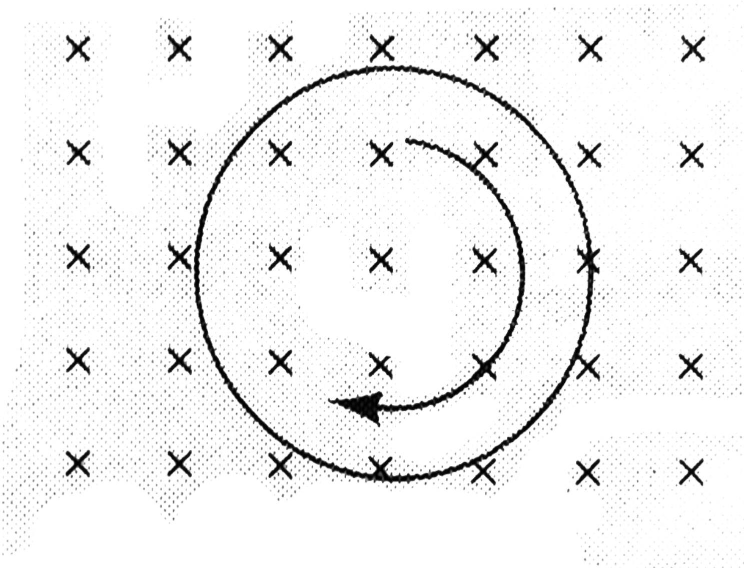
4. A circular loop of radius a having n turns is kept in a horizontal plane. A uniform magnetic field B exists in a vertical direction as shown in Fig.313. Find the emf induced in the loop if the loop is roated with a uniform angualr velocity ω about

(a) an axis passing through the center and perendicular to the plane of the loop.

(b) the diameter.



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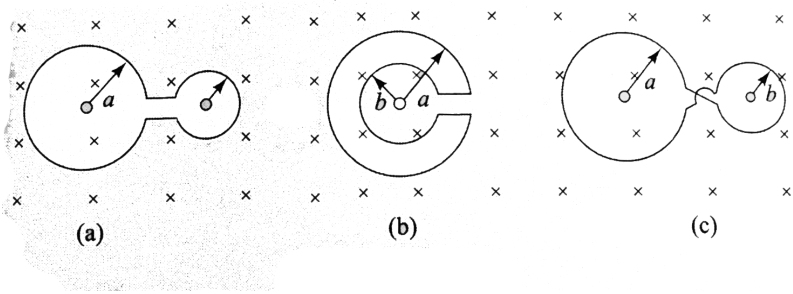
5. Figure 3.15(a) shown two circular rings of radii a and b $(a > b)$ joined together with wires of negligible resistance. Figure 3.15(b) shown thew pattern obtained by folding the small loop in the plane of the large loop.

(a) 

The pattern shown in Fig.3.15(c) is obtained by twisting the small loop of Fig.3.15(a) through 180°.

All the three arrangement are placed in a uniform time varying magnetic field $dB/dt = k$, perpendicular to the plane of the loops. if the resistance per unit length of the wire is λ, then determine the induced current in each case.

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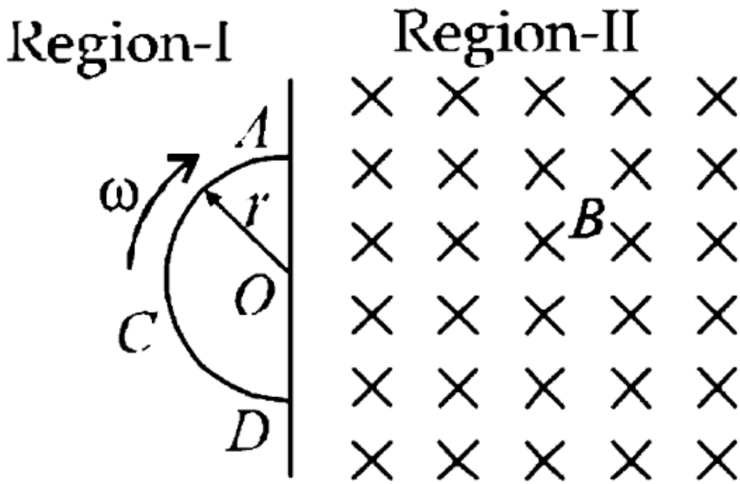
6. Space is divided by the line AD into two regions. Region I is field free and the Region II has a unifrom magnetic field B direction into the plane of the paper. ACD is a simicircular conducting loop of radius r with center at O, hte plane of the loop being in the plane of the paper. The loop is now made to rotate with a constant angular velocity ω about an axis passing through O and the perpendicular to the plane of the paper. The effective resistance of the loop is R.



(i) obtain an expression for hte magnitude of the induced cureent in the loop.

(ii) Show the direction of the current when the loop is entering into the Rigion II.

Plot a graph between the induced e.m.f and the time of roation for two periods or rotation.

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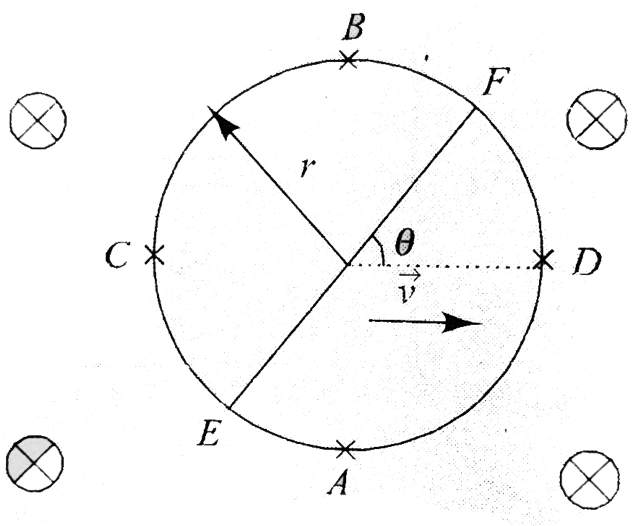
7. A circular loop of radius r moves with a constant velocity v in a region with uniform magnetic field B. Calculate the potential difference between two points $(A, B), (C, D)$, and (E, F) located on the loop.



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8. An angle aob made of a conducting wire moves along its bisector through a magnetic field B as suggested by figure. Find the emf induced between the two free ends if the magnetic field is perpendicular ot the plane of the angle.

(##HCV_VOL2_C38_S01_022_Q01##)

(##HCV_VOL2_C38_S01_022_Q02##)

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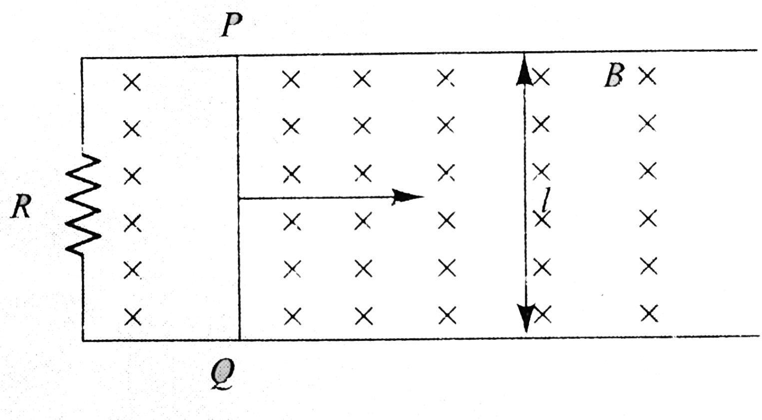
9. A conducting rod of length l slides at constant velocity v on two parallel conducting rails, placed in a uniform and constant magnetic field B perpendicular to the plane of the rails as shown in Fig.3.49. A resistance R is connected between the two ends of the rails.



(a) Idenify the cause which produces change in magnetic flux.

(b) Identify the direction of current in the loop.

(c) Determine the emf induced in the loop.

(d) Compute the electric power dissipated in the resistor.

(e) Calcualte the mechenical power required to pull the rod at a cinstant velovity.

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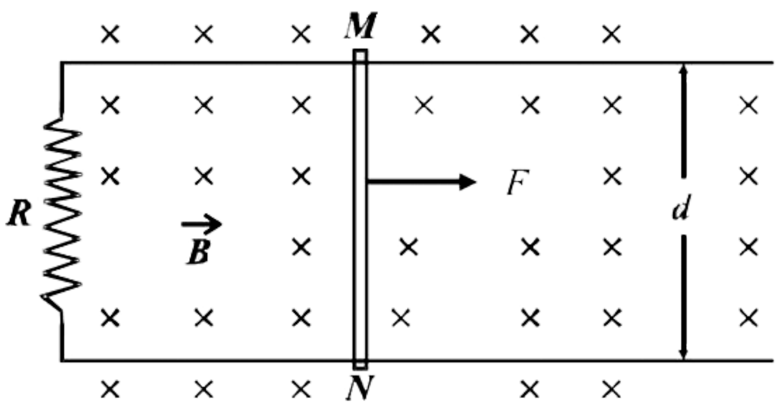
10. Two long parallel horizontal rails a, a distance d aprt and each having a risistance λ per unit length are joing at one end by a resistance R. A perfectly conduction rod MN of mass m is free to slide along the rails without friction (see figure). There is a uniform magnetic field of induction B normal to the plane of the paper and directed into the paper. A variable force F is applied to the rod MN such that, as the rod moves a constant current flows through R.



(i) Find the velocity of the rod and the applied force F as function of the distance x of the rod from R.

(ii) What fraction of the work done per second by F is converted into heat?

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11. A metal rod $1.5m$ long rotates about its one end in a vertical plane at right angles to the magnetic meridian. If the frequency of rotation is $20revs^{-1}$, find the emf induced between the ends of the rod $(B_H = 0.32G)$.

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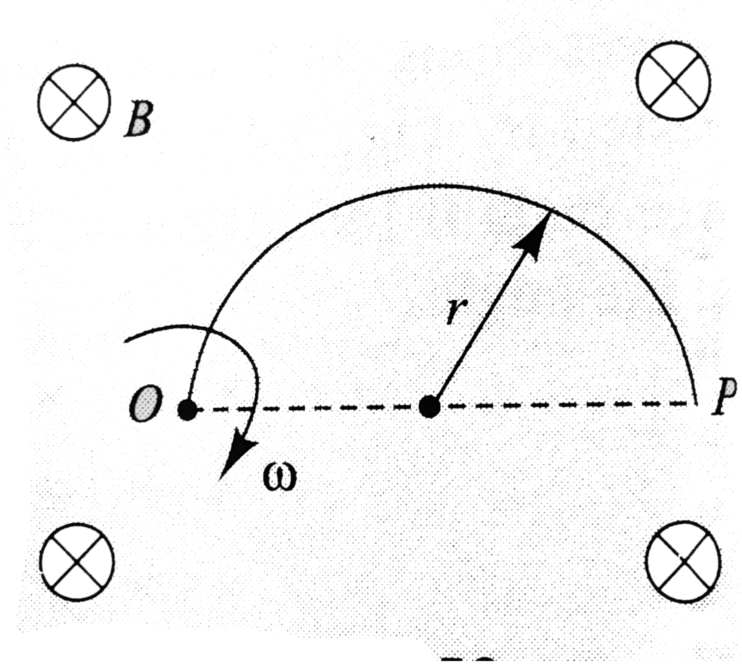
12. A wire is in the form of a semicircle of radius r. One end is attached to an axis about which it rotates with an angular speed ω. The axis is normal to the plane of the semicircle. The wire is immersed in a uniform magnetic field B parallel to the axis. find the induced emf between points

o and P of the semicircle.



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13. A metal disc of radius $R = 25cm$ rotates with a constant angular velocity $\omega = 130$ rad s^{-1} about its axis. Find the potential difference between the center and rim of the disc if

(a) the external magnetic field is absent,

(b) the external uniform magnetic field $B = 5.0\text{mT}$ directed perpendicular to the disc.

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14. A copper rod of length $0.19m$ is moving with uniform velocity $10ms^{-1}$ parallel to a long straight wire carrying a current of $5.0A$. The rod is perpendicular to the wire with its ends at distances 0.01 and $0.2m$ from it. Calculate the emf induced in the rod.

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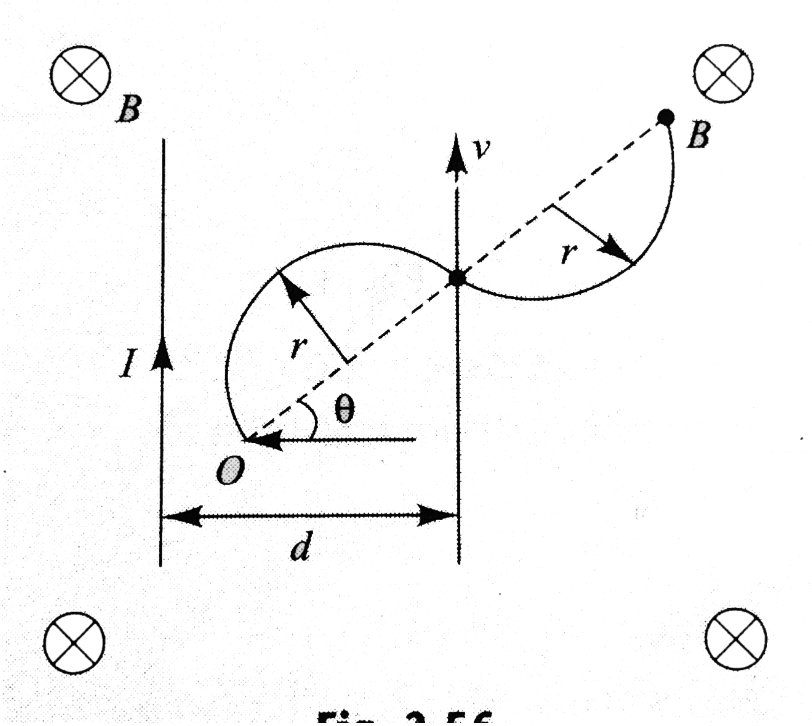
15. An infinite wire carries a current I. An S- shaped conducting rod of two semicircles esch of radius r is placed at an angle θ to the wire. The center of the conductor is at a distance d from the wire. If the rod translates parallel to the wire with a velocity v as shown in Fig. .3.56, calculate the emf induced across the ends Ob of the rod.



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16. A thin non-conducting ring of mass m carrying a charge q can freely rotate about its axis. At the initial moment, the ring was at rest and no magnetic field was present. Then a uniform magnetic field was switched on, which was perpendicular to the plane of the ring and increased with time according to a certain law: $\frac{dB}{dt} = k$.

Find the angular velocity ω of the ring as a function of k.

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17. A thin non-conducting ring of mass m carrying a charge q can freely rotate about its axis. At $t = 0$, the ring was at rest and no magnetic field was present. Then suddenly a magnetic field B was set perpendicular to the plane. Find the angular velocity acquired by the ring.

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18. A non-conducting ring of mass m and radius R has a charge Q uniformly distributed over its circumference. The ring is placed on a rough horizontal surface such that plane of the ring is parallel to the surface. A vertical magnetic field $B = B_0 t^2$ tesla is switched on. After 2 a from switching on the magnetic field the ring is just about to rotate about vertical axis through its centre.

(a) Find friction coefficient μ between the ring and the surface.

(b) If magnetic field is switched off after $4s$, then find the angle rotated by the ring before coming to stop after switching off the magnetic field.

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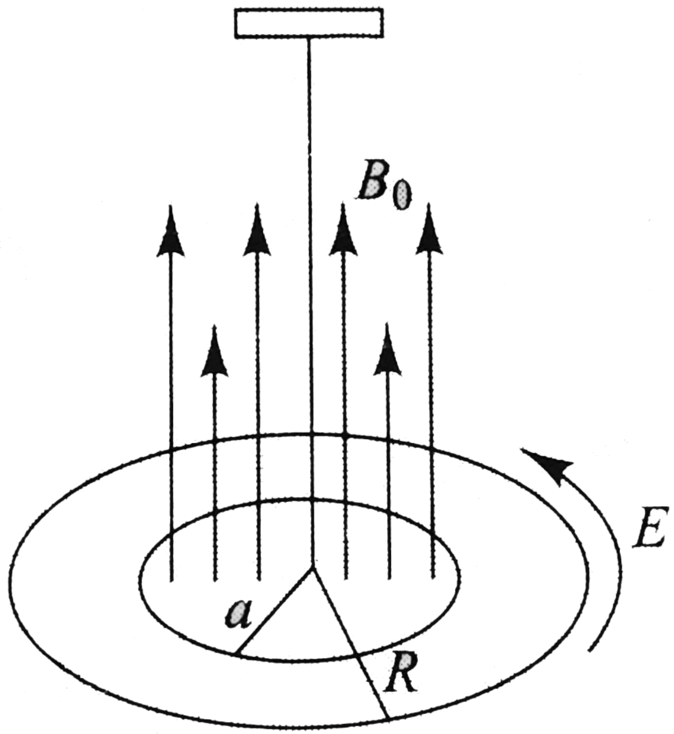
19. A line charge with linear charge density λ is wound around an insulating disc of mass M and radius R, which is then suspended horizontally as shown in Fig. 3.90, so that it is free to rotate. In the central region, of radius a, there is a uniform magnetic field B_0, pointing up. Now the magnetic field is switched off, which causes the disc to rotate.

Find the angular speed with which the disc starts rotating.



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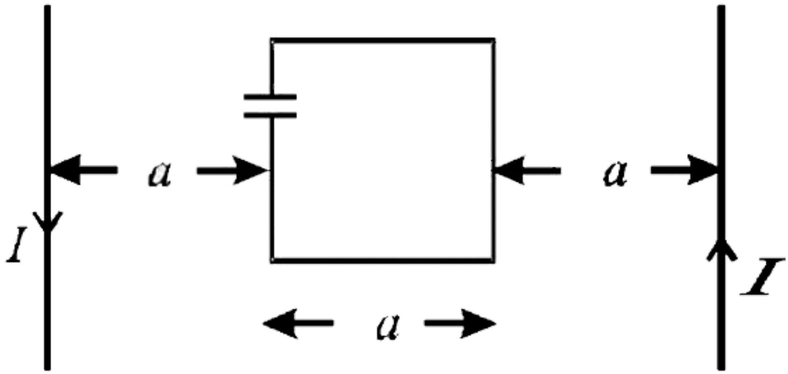
Solved Example

1. A square loop of side 'a' with a capacitor of capacitance C is located between two current carrying long parallel wires as shown. The value of I in the wires in given as $I = (I_0)\sin\omega t$.



(a) Calculate maximum current in the square loop.

(b) Draw a graph between charges on the upper plates of the capacitor vs time.

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2. A thermocol vessel contains $0.5kg$ of distilled water at $30^\circ C$. A metal coil of area $5 \times 10^{-3} m^2$, number of turns 100, mass $0.06kg$ and resistance 1.6Ω is lying horizontally at the bottom of the vessel. A uniform time-varying magnetic field is set up to pass vertically through the coil at time $t = 0$. The field is first increased from zero to $0.8T$ at a constant rate between 0 and $0.2s$ and then decreased to zero at the same rate between 0.2 and $0.4s$. the cycle is repeated 12000 times. Make sketches of the current through the coil and the power dissipated in the coil as function of time for the first two cycles. Clearly indicate the magnitude of the quantities on the axes. Assumes that no heat is lost to the vessel or the surroundings. Determine the final tempreture of water under thermal equilibrium. Specific heat of metal $= 500jkg^{-1}K^{-1}$ and the specific heat of water $= 4200jkg^{-1}K^{-1}$. Neglect the inductance of coil.

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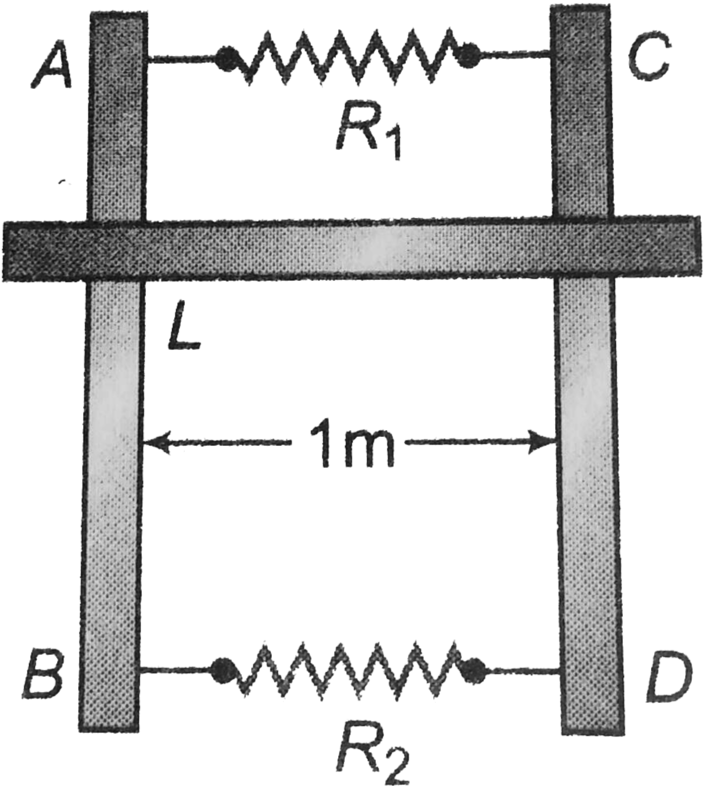
3. Two parallel vertical metallic rails AB and CD are separated by $1m$. They are connected at the two ends by resistances R_1 and R_2 as shown in the figure. A horizontal metallic bar l of mass $0.2kg$ slides without friction, vertically down the rails under the action of gravity. There is a uniform horizontal magnetic field of $0.6T$ perpendicular to the plane of the rails. It is observed that when the terminal velocity is attained, the powers dissipated in R_1 and R_2 are $0.76W$ and $1.2W$ respectively

$(g = 9.8m / s^2)$



The terminal velocity fo the bar L will be

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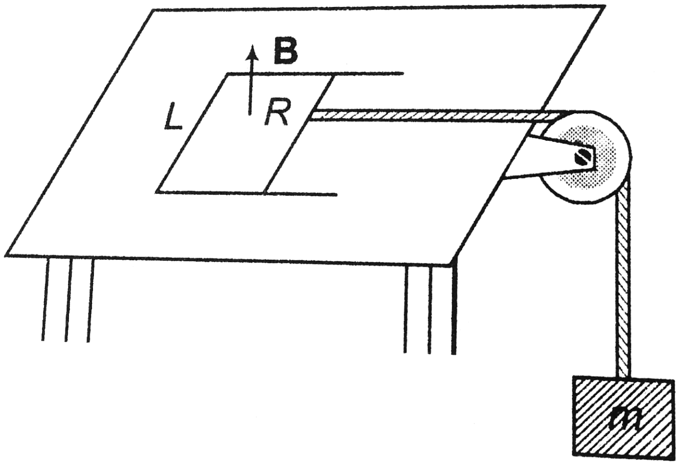
4. A pair of parallel horizontal conducting rails of negligible resistance shorted at one end is fixed on a table. The distance between the rails is L. A conducting massless rod of resistance R can slide on the rails frictionlessly. The rod is tied to a massless string which passes over a pulley fixed to the edge of the table. A mass m tied to the other end of the string hangs vertically. A constant magnetic field B exists perpendicular to the table. If the system is released from rest, calculate



a. the terminal velocity achieved by the rod and

b. The acceleration of the mass of the instant when the velocity of the rod is half the terminal velocity.

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5. in fig. The four rods have λ resistance per unit length. The arrengement is kept in a magnetic field of constant magnitude B and directed perpendicular to the plane of the figure and directing in ward. Initially, the sides as shown form a square. Now each wire starts moving with constant velocity v toward the opposite wire.

Find as a function of time:

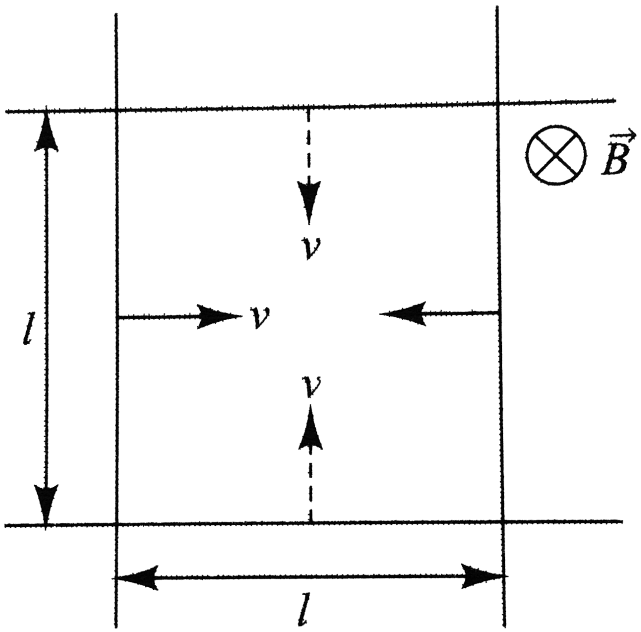
(a) induced emf in the circuit.

(b) induced current in the circuit with direction.

(c) force required on each wire to keep its velocity consatnt.

(d) total power required to maintain constant velocity.

(e) thermal power developed in the circuit.



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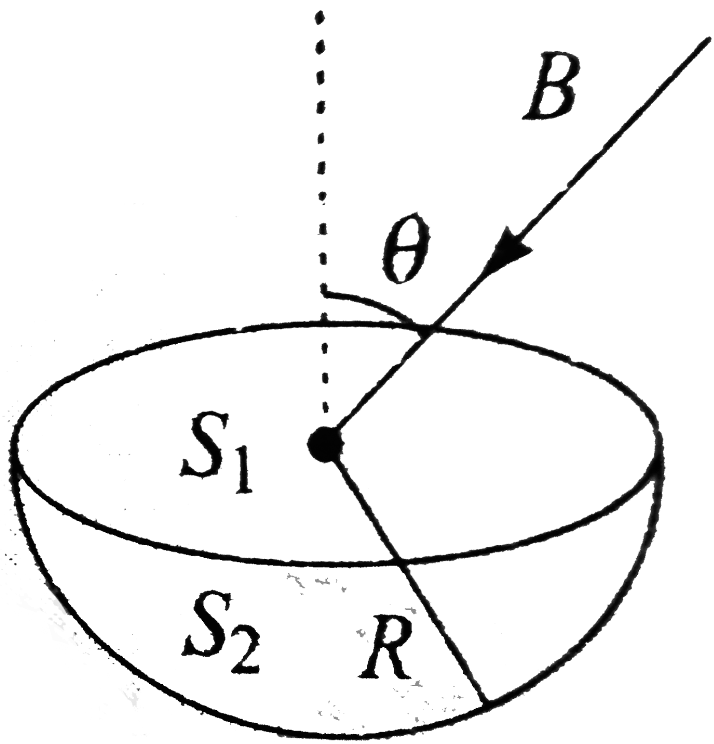
Exercise 3.1

1. Consider the hemispherical closed surface as shown in Fig. 3.19. if the hemisphere is a uniform magnetic field that makes an angle θ with the vertical, calculate the magnetic flux

(a) through the flat surface S_1.

(b) through the hemisphere surface S_2.



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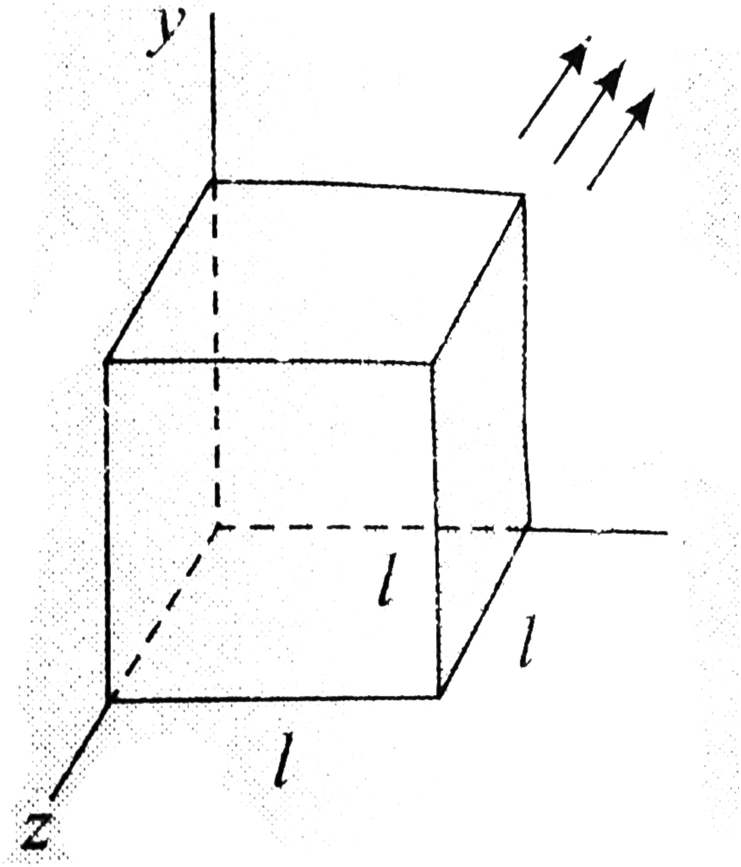
2. A cube of edge length $l = 2.50cm$ is positioned as shown in Fig. 3.20. A uniform magnetic field given by $\vec{B} = \left(5.00\hat{i} + 4.00\hat{j} + 3.00\hat{k}\right)T$ exists throughout the region.

(a) Calculate the flux through the shaded face.

(b) What is the total flux through the six faces ?



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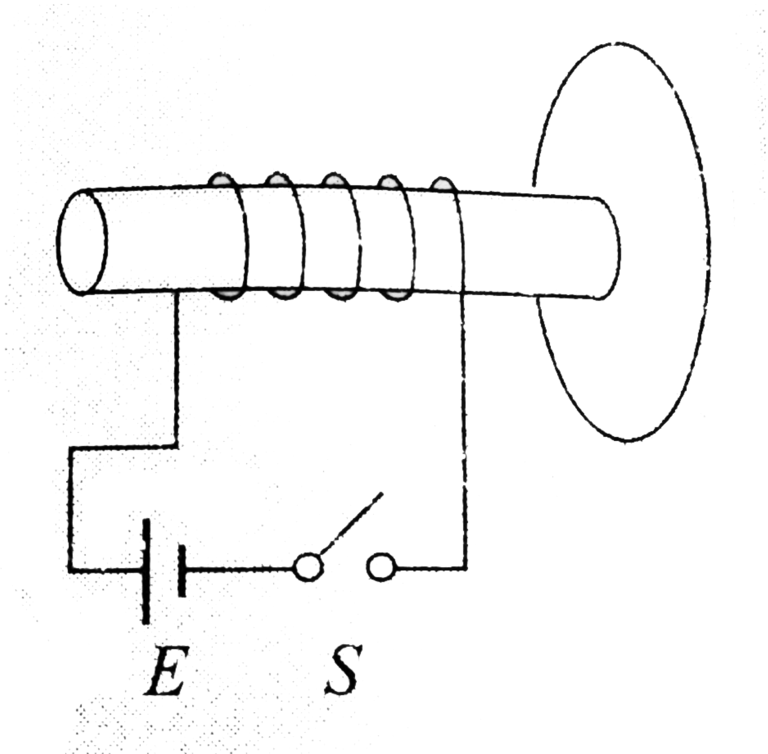
3. A conducting ring is placed near a solenoid as shown in Fig.3.21. Find the direction of the induced current in the ring.

(a) At the instant the switch in the circuit containing the solenoid is closed.

(b) After the switch has been closed for a long time.

(c) At the instant the switch is opened.



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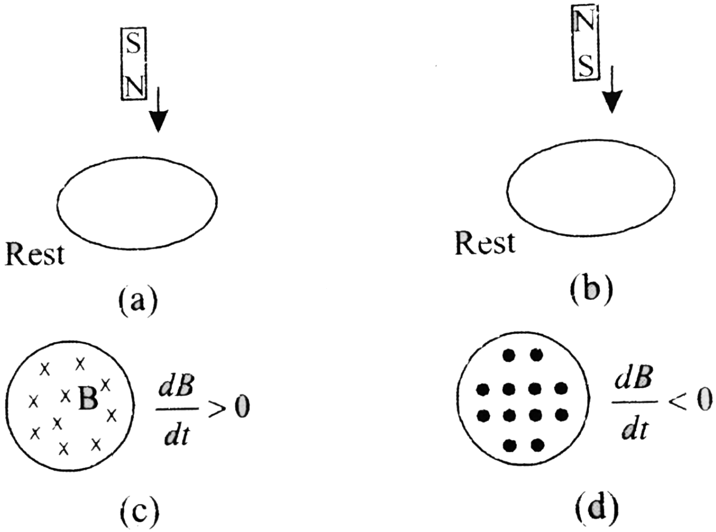
4. Identify the direction of induced current as seen from the above in the following cases.



(a)

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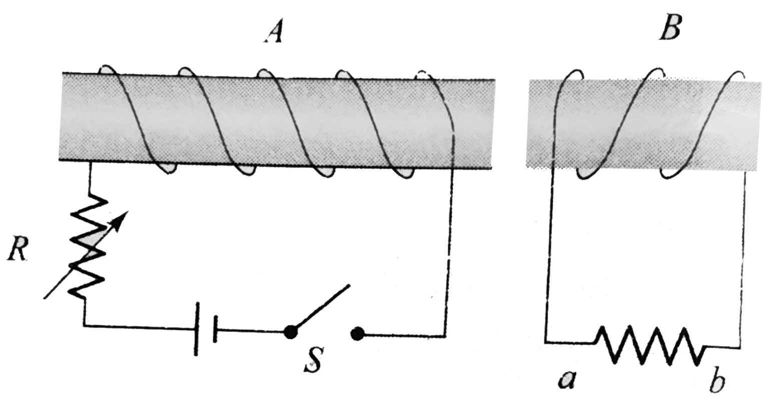
5. Using Lenz's law, determine the direction of the current in resistor ab in Fig. 3.23 when



(a) switch S is opended after having been closed for several minutes.

(b) coil B is brought closer to coil A with the swich closed. ltbr. (c) the resistance of R is decreased while the switch remains closed.

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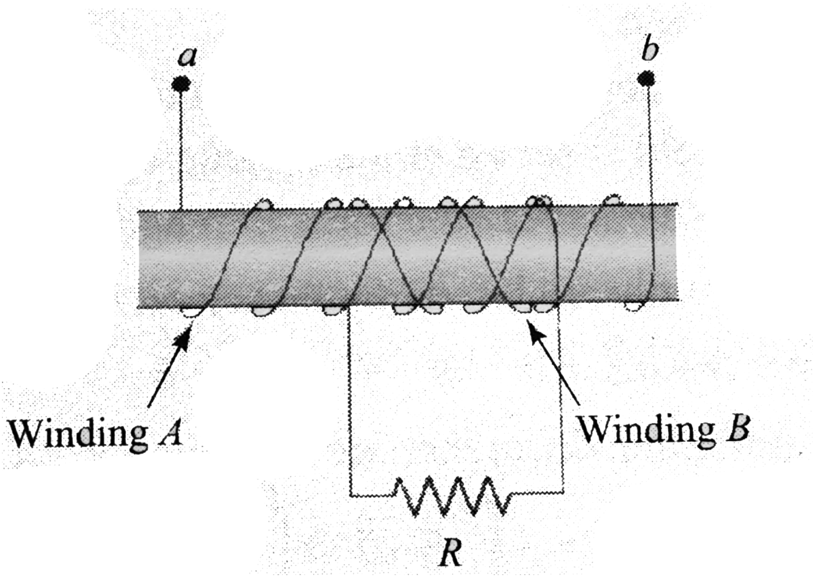
6. A carboard tube is wrapped with two winding of insulated wire wound in opposite directions as shown in Fig. 3.24. Terminal a and b of winding A may be connected to a battery through a reversing switch. State whether the induced current in the resistor R from left to right or from right to left in the following cicumstances.



(a) The current in winding A is from $a \rightarrow b$ and is increasing.

(b) The current in winding A is from $b \rightarrow a$ and is decreasing.

(c) The current in winding A is from $b \rightarrow a$ and is increasing.

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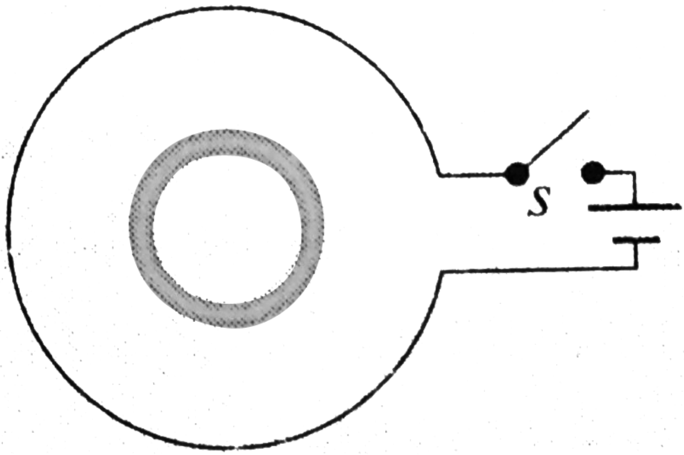
7. A small, circular ring is inside a larger loop that is connected to a battery and a switch as shown in Fig. 3.25. Use Lenz's law to find the direction of the current induced in the small ring

(a) just after switch S is closed,

(b) after Shas been closed for a long time,

(c) just after S has been reopened after being closed for a long time. ltbr.



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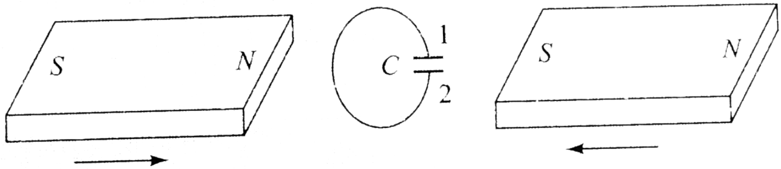
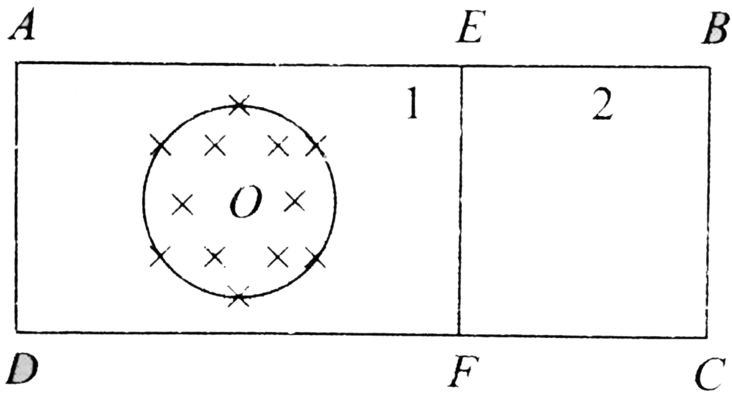
8. (a). Predict the polarity of capacitor C as shown in Fig. 3.26 when poles S and N of two identical magnets approach the coil from opposote sides with equal velocity. The plane of the loop containing the capacitor is perpendicualr to the plane of the paper.



(b). A magnetic field perpendicular to the plane of a rectangular frame of wire is concentrated about O. If the field decreases, will there be any emf induced in loop 1? What about loop 2? Explain why.



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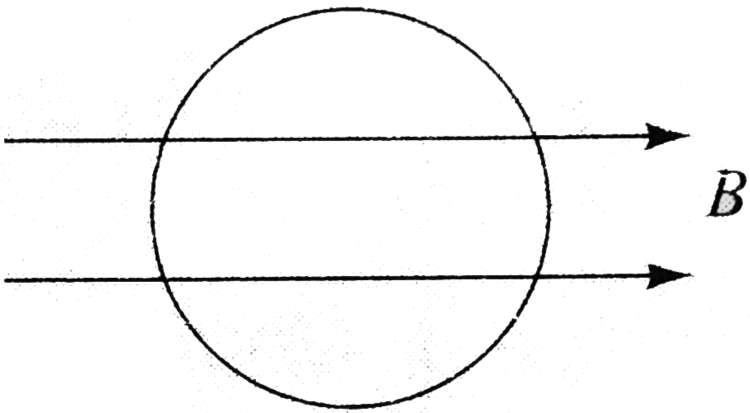
9. A coil is placed in a constant magnetic field. The magnetic field is parallel to the plane of the coil as shown in Fig. 3.28. Find the emf induced in the coil if B increasing.



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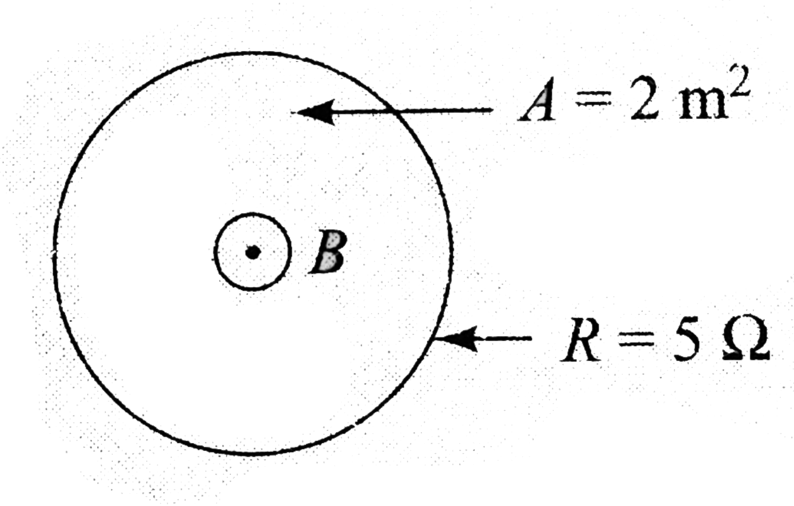
10. Shows a coil placed in a decreasing magnetic field applied perpendicular to the plane of the coil. The magnetic field is decreasing at a rate of $10Ts^{-1}$. Find out current in magnitude and direction of current.



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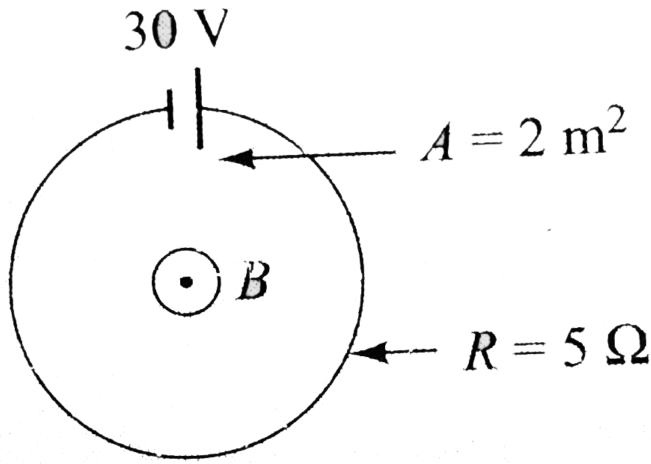
11. Shows a coil placed in a magnetic field decreasing at a rate of $10Ts^{-1}$.

There is also a source of emf $30V$ in the coil. Find the manitude and direction of the current in the coil.



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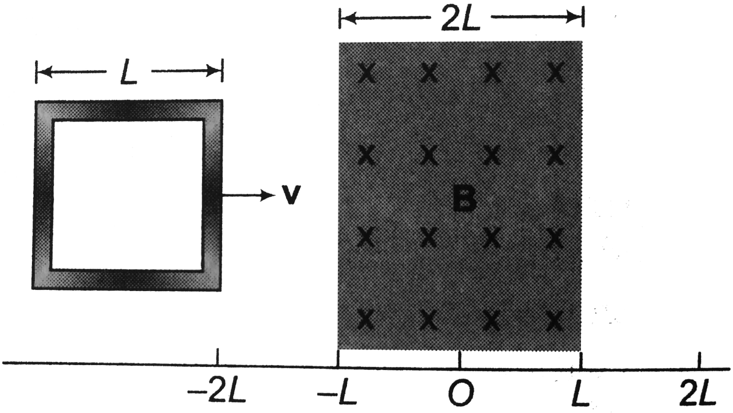
12. A square loop of wire with resistance R is moved at constant speed v across a uniform magnet field confined to a square region whose sides are twice the lengths of those of the square loop



(a) Sketch a graph of the external forces F needed to move the loop at constant speed, as a function of to sketch a graph of the external force F need tho coordinate x, from$x = -2L$ to $x = +2L$. (The coordinate x is measured from the centre of the oignetic field region to the centre of the loop. It is negative when the centre of the loop is to the left, of the centre of the magnetic field region. Take positive force to be to the right).

(b) Sketch a graph of the induced current in the loop as a function of x. Take counterclockwise currents to be positive.

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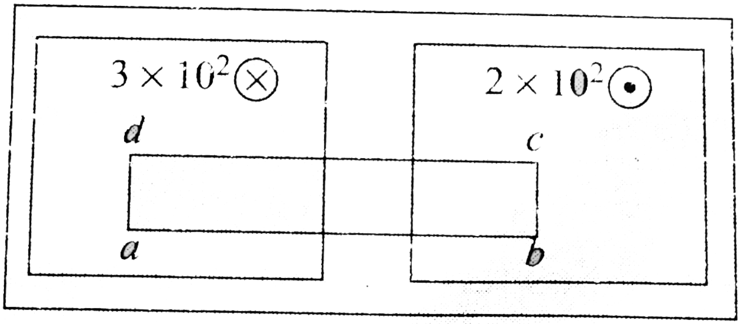
13. Two magnetic fields exits in the two regions as shown in . A loop abcd of $40 \times 10 cm$ id placed in the field. The resistance per unit length of the loop is $r = 2\Omega cm^{-1}$. All of a sudden, the loop is given a velocity $v_0 = 20cms^{-1}$ towards roght. What is the potential difference $V_c - V_b$?



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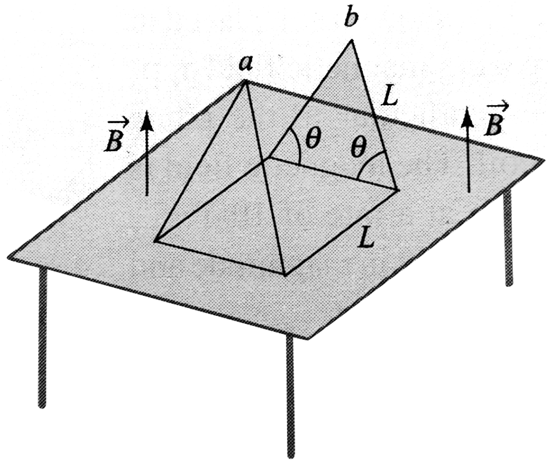
14. The wire shown in is bent in the shape of a tent, with $\theta = 60.0^\circ$ and $L = 1.50m$, and placed in a uniform magnetic field of magnitude $0.300T$ perpendicular to the tabletop. The wire is rigid but hinged at points a and b. If the tent is flattened out on the table in $0.100s$, what is the average induced emf in the wire during this time?



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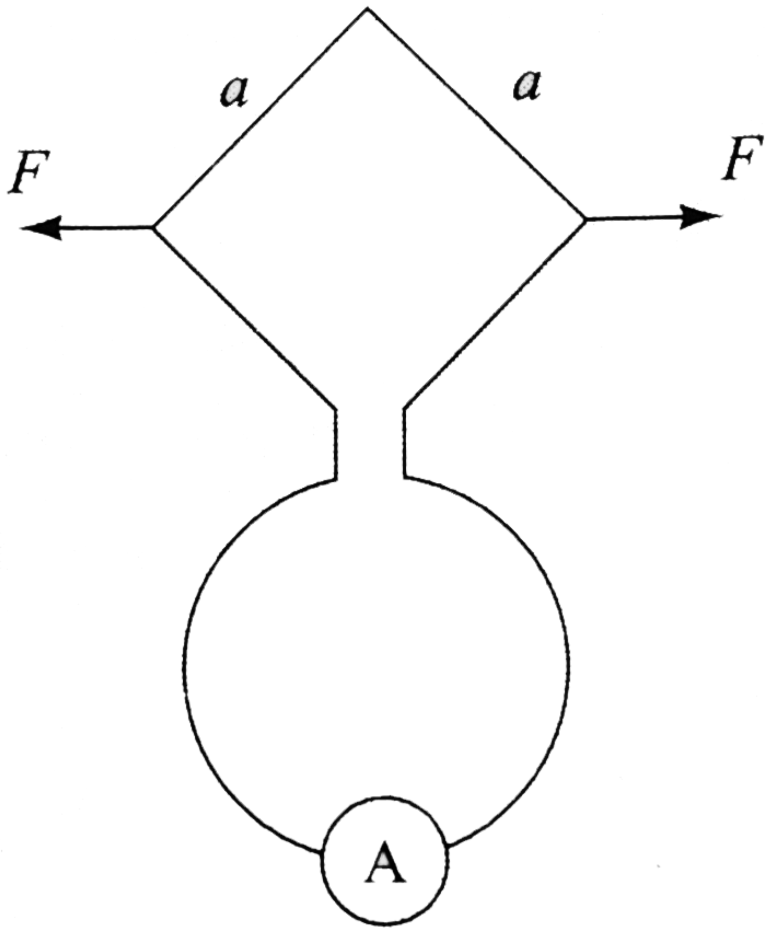
15. The plane of a square loop of wire edge length $a = 0.200m$ is perpendicualr to the Earth's magnetic field at a point where $B = 15.0\mu T$, as shown in . The total resistance of the loop and the wires connecting it to a sensitive ammeter is 0.50Ω. If the loop is suddenly collapsed by horizontal forces as shown, what is the total charge passing through the ammeter?



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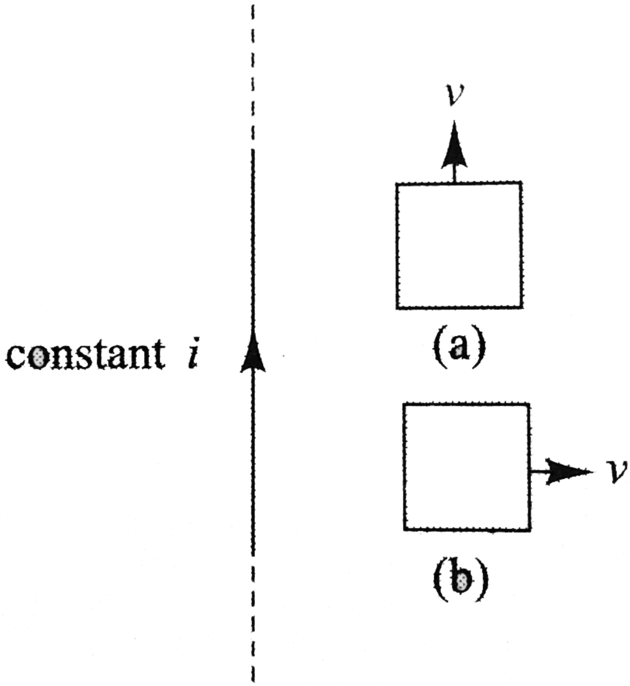
Exercise 3.2

1. Shows a long current carrying wire and two rectangular loops moving with of velocity v. Find the direction of current in each loop.



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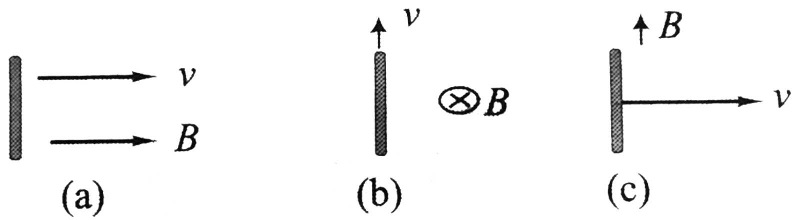
2. A rod of length l is moving velocity v "in magnetic field" b as seen in .

Find the emf induced in all three cases.



(a)

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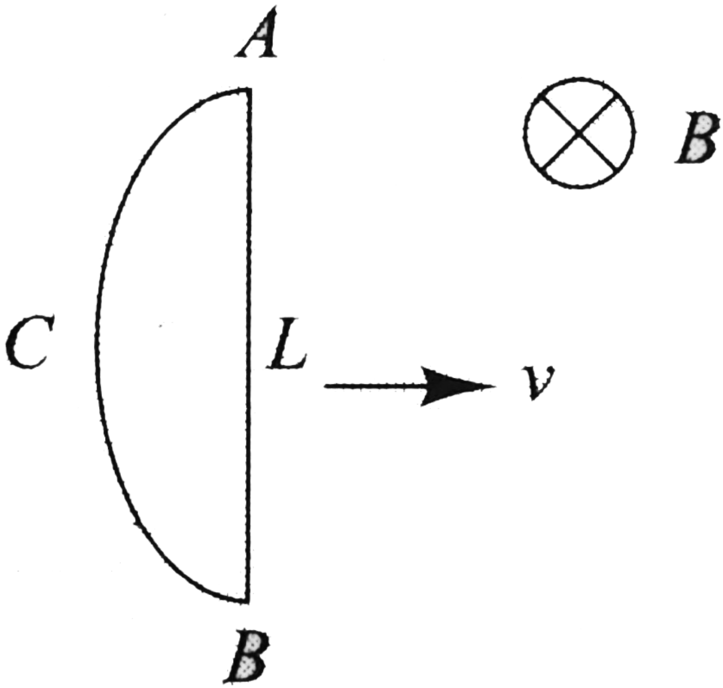
3. Shows a closed coil $ABCL$ moving in a uniform magnetic field B with a velocity v.

Find

(a) emf induced in the coil.

(b) emf induced in curve part ACB and straight AB`



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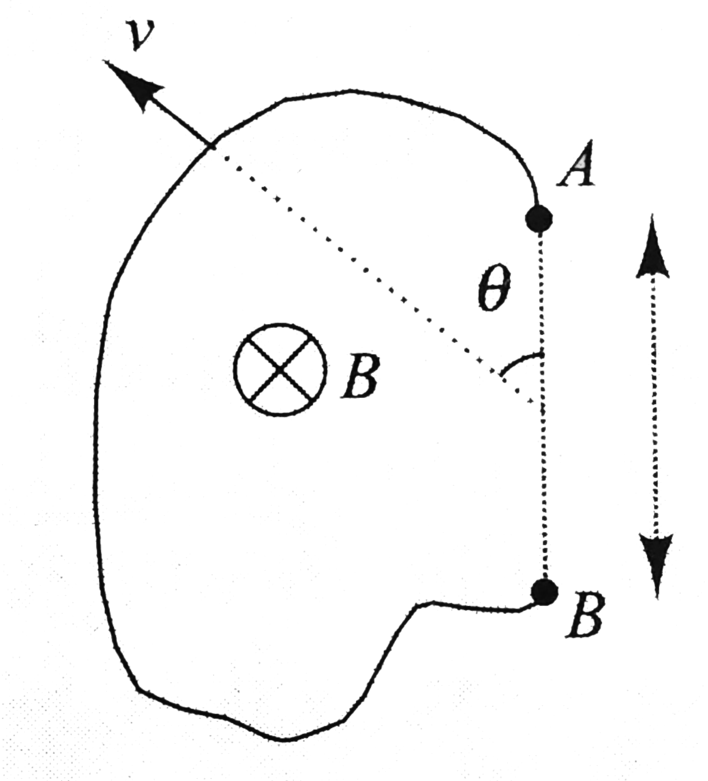
4. Shows an irregular shaped wire AB moving with velocity v. Find the emf induced in the wire.



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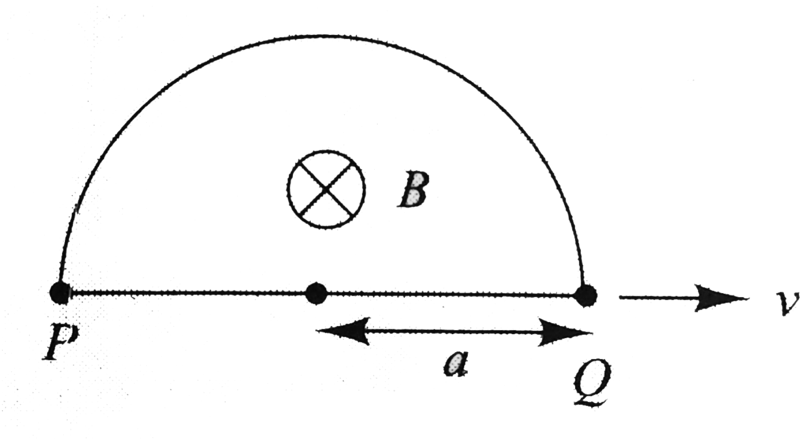
5. Find the emf across points P and Q which are diametrically opposite points of a semicircular closed loop moving in a magnetic field as shown in .



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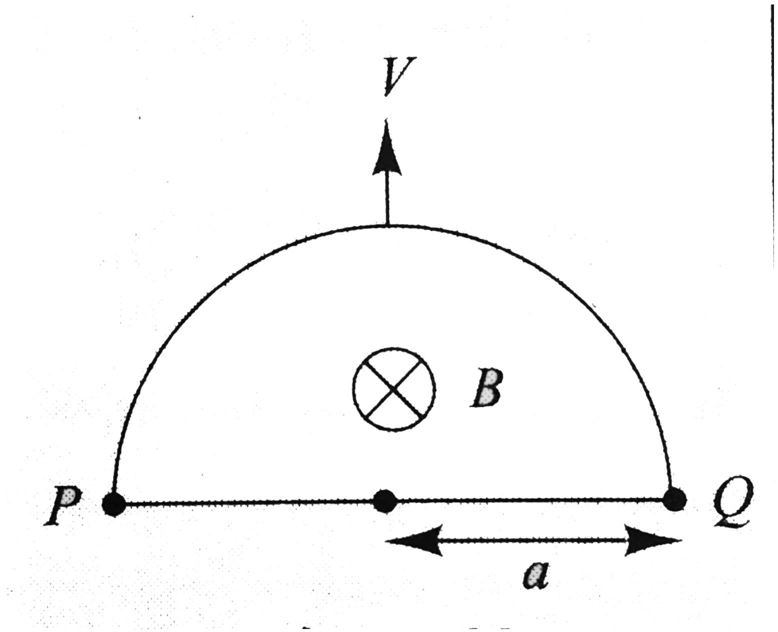
6. Find the emf across points P and Q which are diametrically opposite points a semicircular closed loop moving in a magnetic field as shown in .

Also draw the electrical equivalence od each branch.



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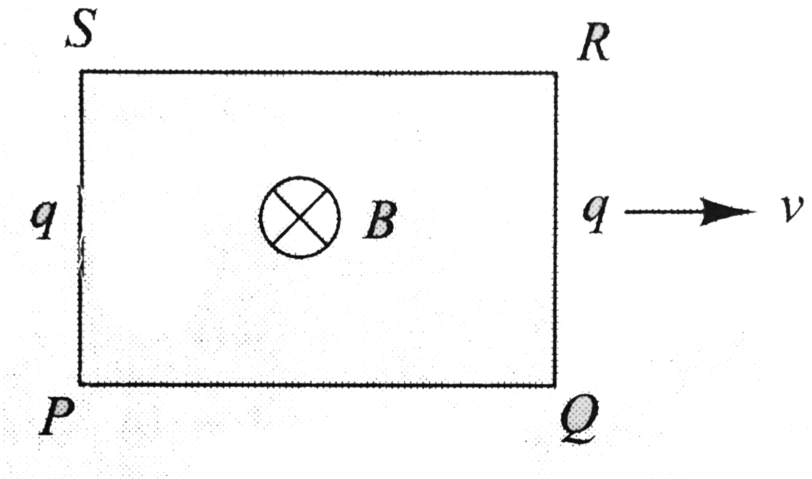
7. Shows a rectangular loop moving in a uniform magnetic equivalence of each branch. What is the net induced emf.



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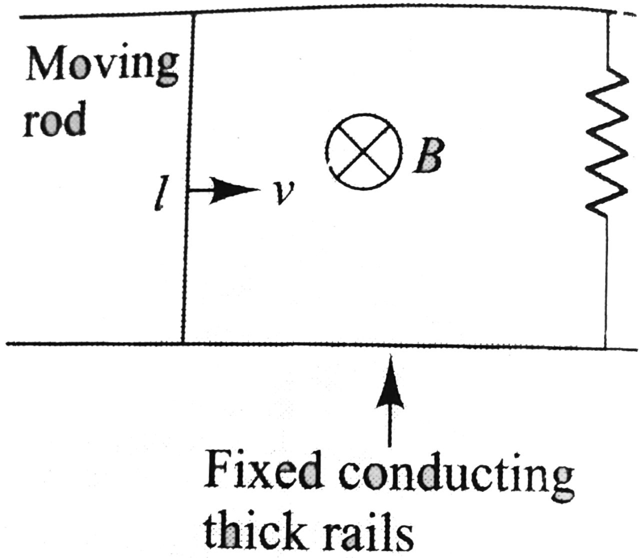
8. Shows a rod of length l and resistance r moving on two rails shorted by a resistance R. A uniform magnetic field B is present normal to the plane of rod and rails. Show the electrical equivalence of each branch.



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9. A rod of length l is kept parallel to a long wire carrying constant current i . It is moving away from the wire with a velocity v. Find the emf induced in the wire when its distance in the wire when its distance from the long wire is x.

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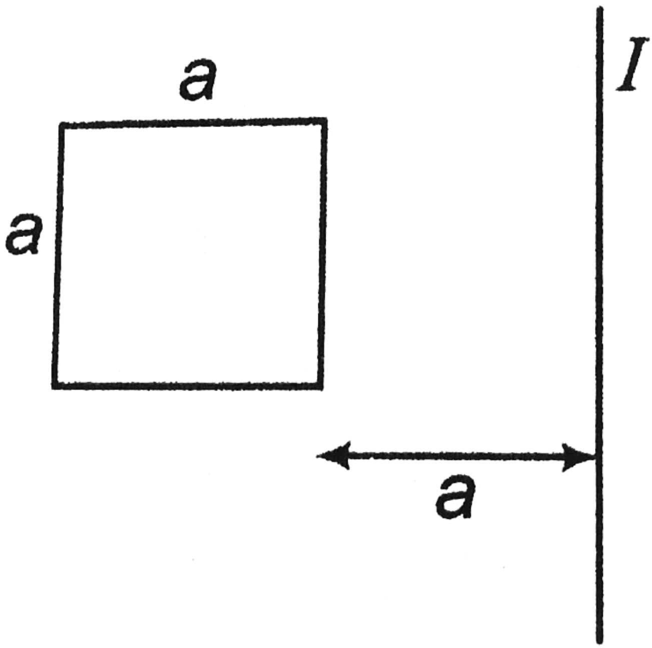
10. An infinitely long wire is placed near a square loop as shown in figure. Choose the correct options.



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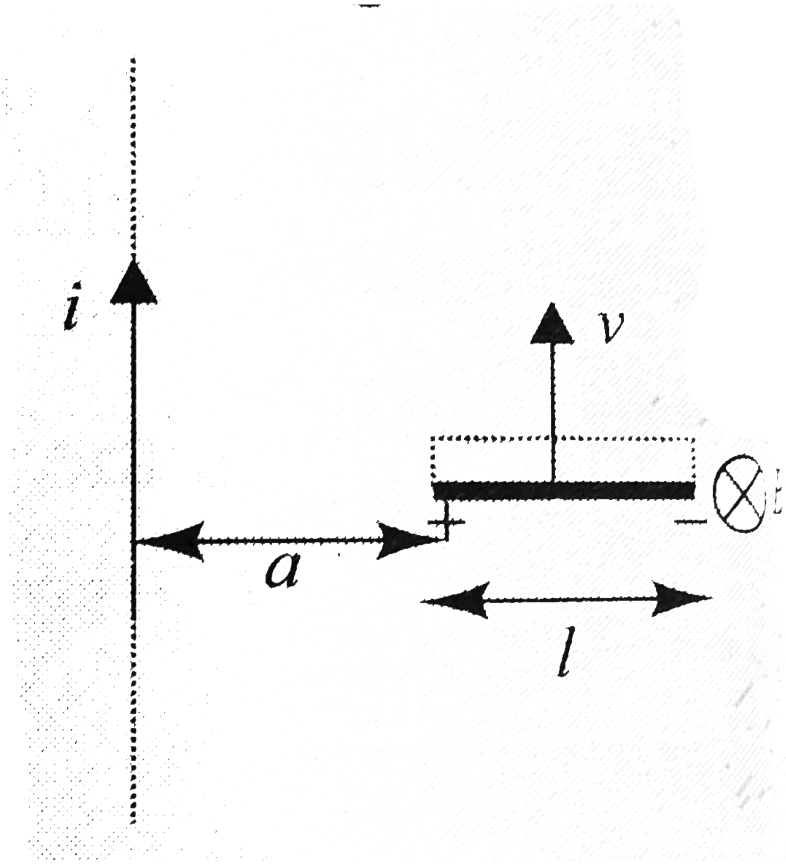
11. A rod of length l is placed perpendicular to a long wire carrying current i. The rod is moved parallel to the wire with a velocity v. Find the emf induced in the rod, if its nearest end is at a distance a from the wire.



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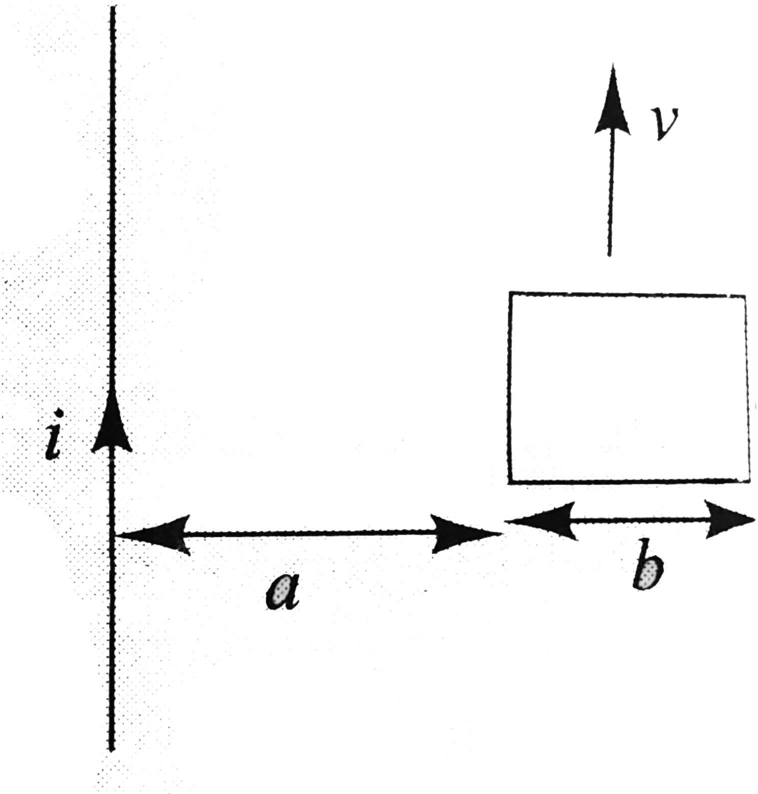
12. A rectangular loop is moving parallel to a long wire carrying current i with a velocity v. Find the emf induced in the loop (Fig. 3.68) if its nearest end is at a distance a from the wire. Draw equivalent electrical diagram.



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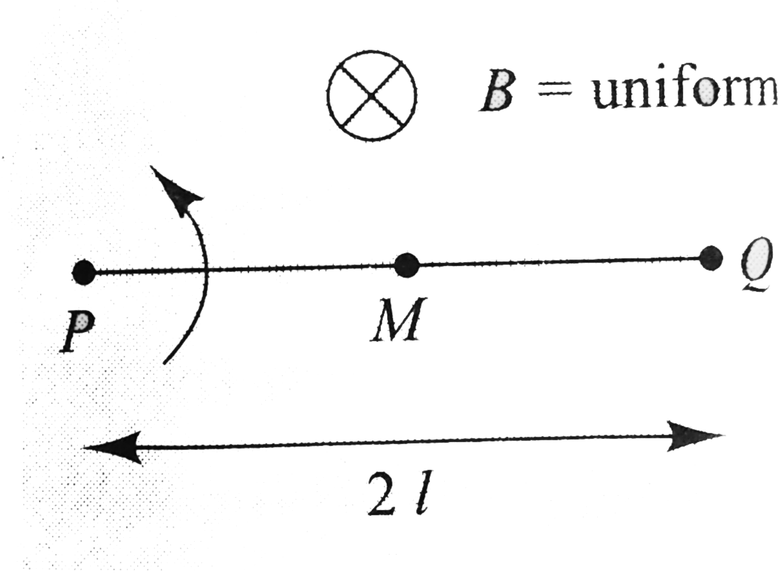
13. Rod PQ of length $2l$ is rotating about one end P in a uniform magnetic field B which is perpendicular to the plane of rotation of the rod . Point M is the mid- point of the rod. Find the induced emf between

M and Q if the potential between P and Q is $100V$.



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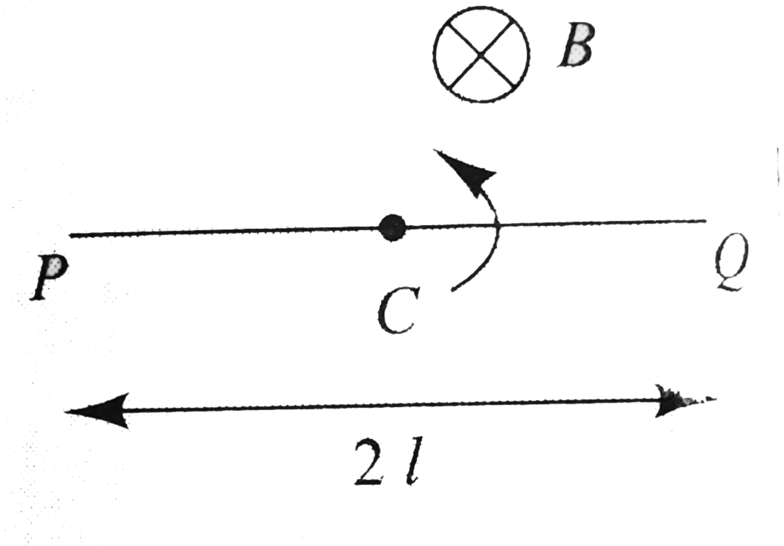
14. Rod PQ of length $2l$ is rotating about its midpoint C in a uniform magnetic field B which is perpendicular to the plane of rotation of the rod . Find the induced emf between PQ and PC. Draw the circuit diagram of parts PC and CQ.



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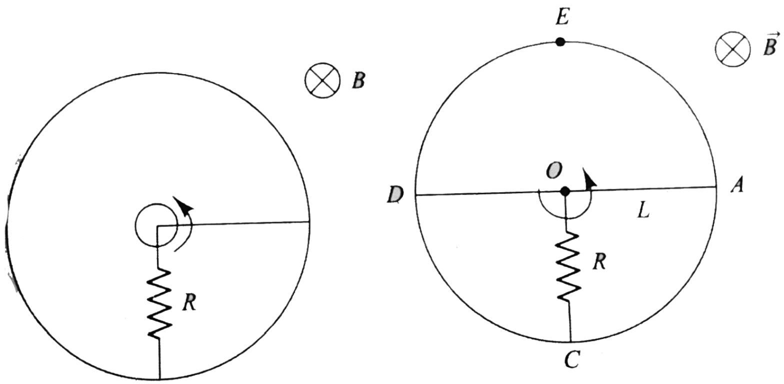
15. A rod of length L and resistance r rotates about one end as shown in . Its other end touches a conducting ring of negligible resistence. A resistence R is connected between the center and periphery. Draw the electrical equivalence and find the current in resistance R. There is a uniform magnetic field B directed as shown in .



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16. Solve problem 15 if the length of rod is $2L$ and resistance $2r$ and it is rotating about its center. Both ends of the rod now touch the conducting ring.

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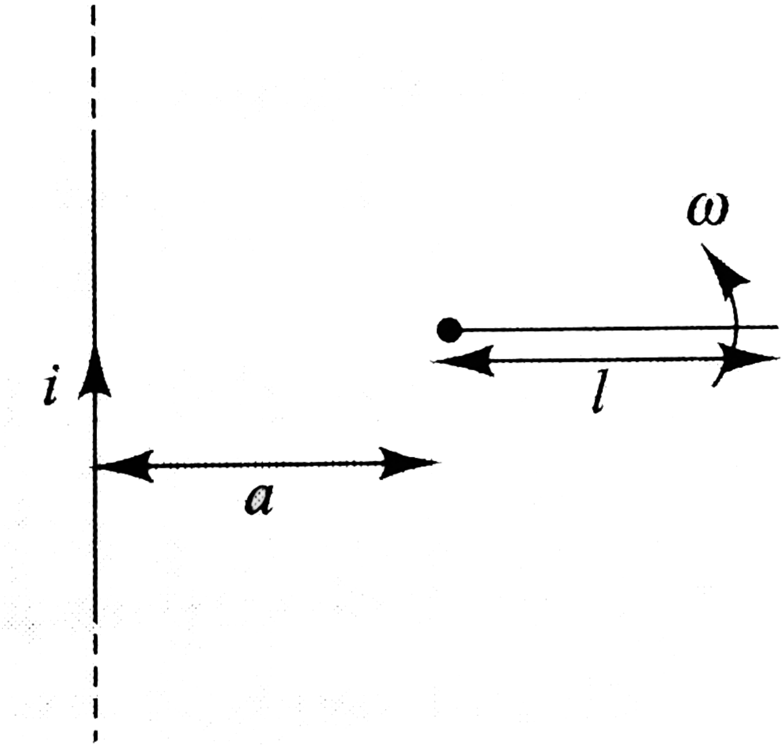
17. A rod of length l is rotating with an angular speed ω about one of its ends which is at a distance a from an infinitely long wire carrying current

i. Find the emf induecd in the rod at the instanr shown in .



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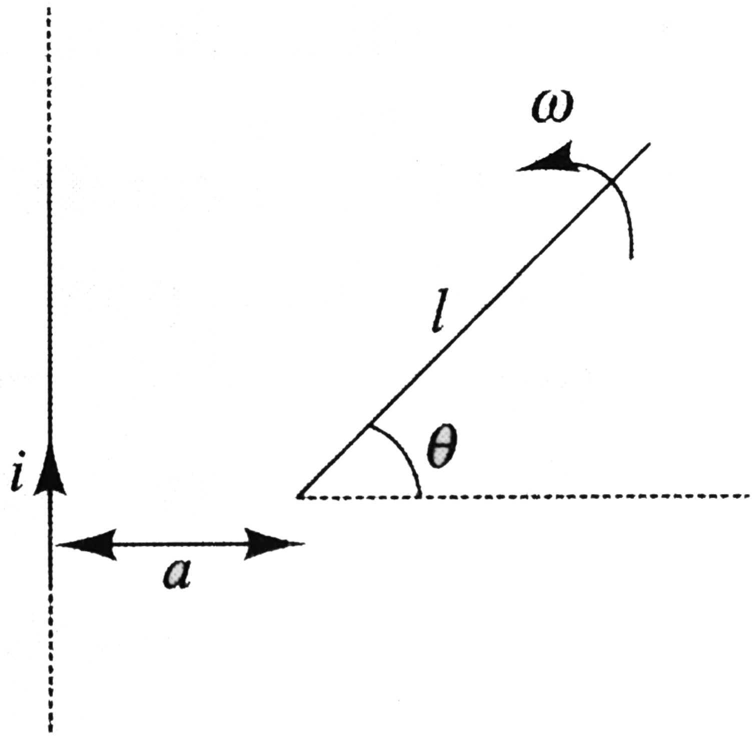
18. A rod of length l is rotating with an angular speed ω about one of its ends which is at a distance a from an infinitely lonf wire carrying current i

. Find the emf induced in the rod at the instant shown in .



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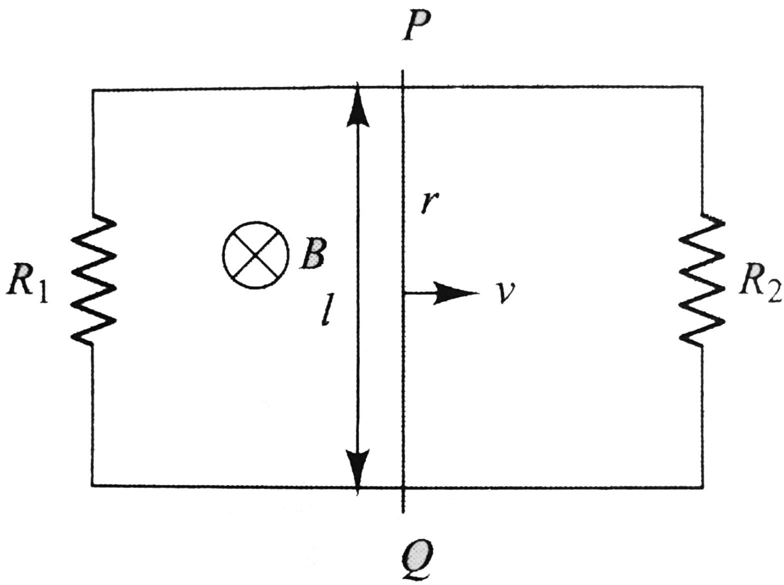
19. Shows rod PQ of mass m and resistance r moving on two fixed, resistanceless, smooth conducting rails (closed on both sides by resistances R_1 and R_2). Find the current in the rod (at the instant its velocity is v).



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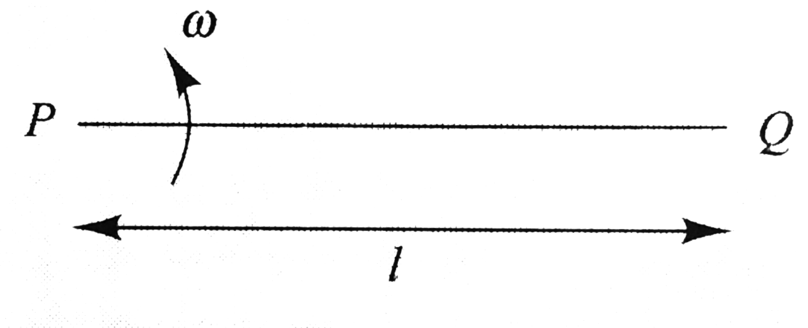
20. A rod PQ of length l is rotating about end P, with an angular velocity ω. Due to electrifugal forceed the free electrons in the rod move toward the end Q and an emf is created.The Magnetic field B is uniform and into the page. Find the induced emf.



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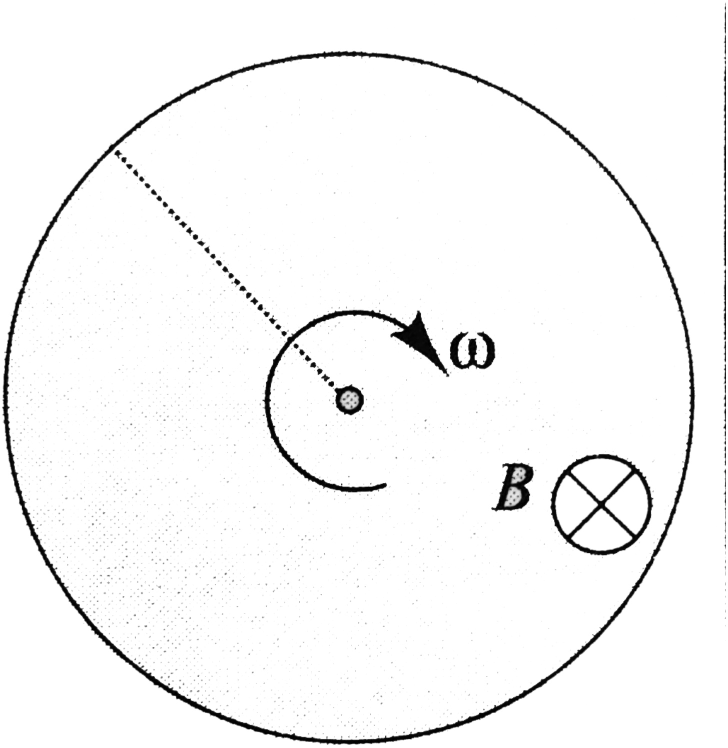
21. A ring rotates with angular velocity ω about an axis perpendicula to the plane of the ring passing through the center of the ring (Fig. 3.77). A constant magnetic field B exists parallel to the axis. Find the emf induced in the ring.



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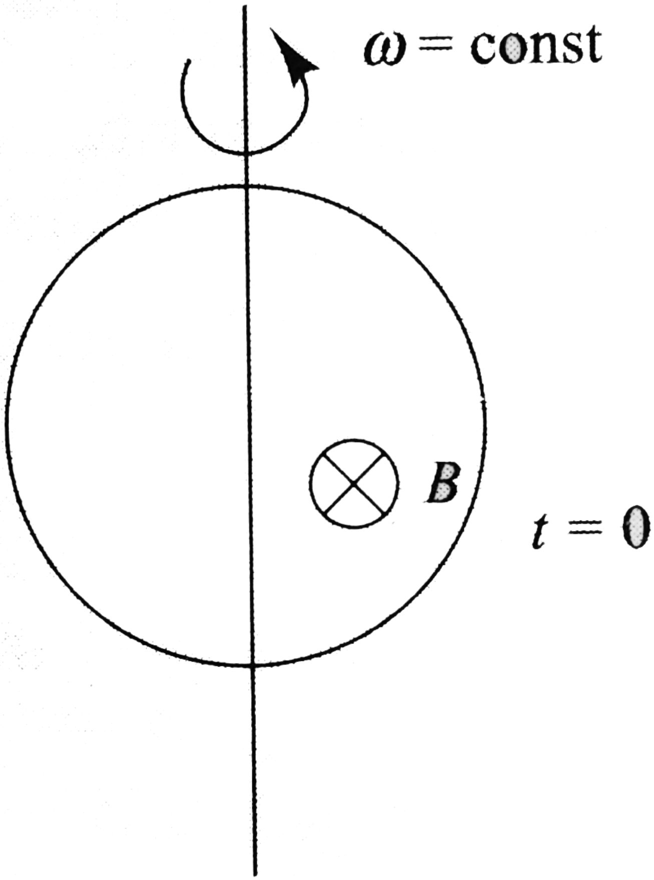
22. A ring rotates with angular velocity ω about an axis in the plane of the ring which passes through the center of the ring. A constant magnetic field B exists perpendicualr to the plane of the ring . Find the emf

induced in the ring as a function of time.



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23. A rod AB moves with a uniform velocity v in a uniform magnetic field as shown in figure

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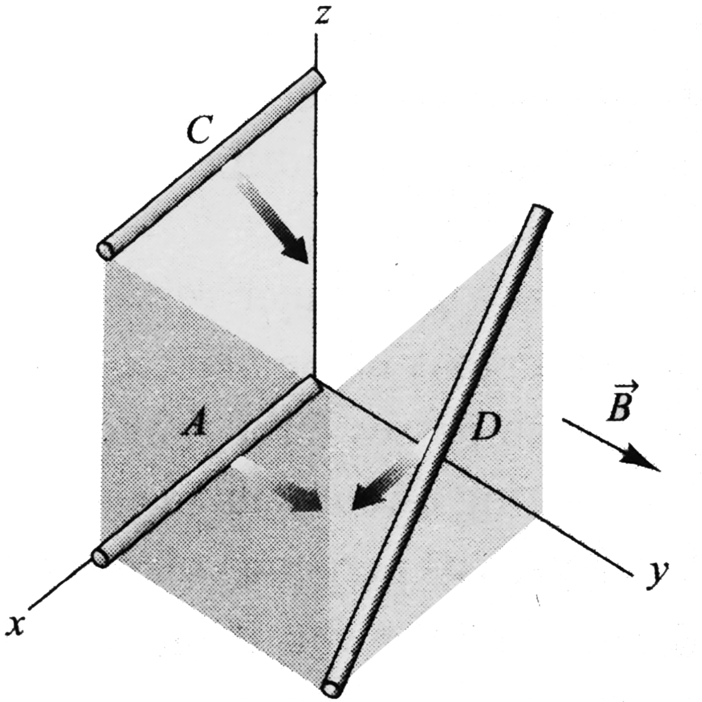
24. The cube shown in, $50.0cm$ on a side, is in a uniform magnetic field of $0.120T$, directed along the positive y-axis. Wires $A, C, \text{ and } D$ move in the direction indicated, each with a speed of $0.350ms^{-1}$. (Wire A moves parallel to the x-y plane, C moves at an angle of 45.0° below the x-y plane, and D moves parallel to the x-z plane.) What is the potential difference between the ends of each wire?



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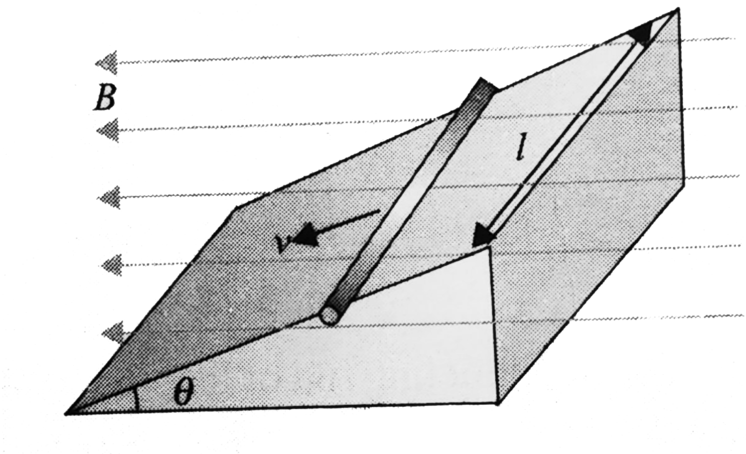
25. A rod of mass m, length l and resistance R is sliding down on a smooth inclined parallel rails with a cinstant velocity v. If a uniform horizontal magnetic field B exists, then find thevalue of B.



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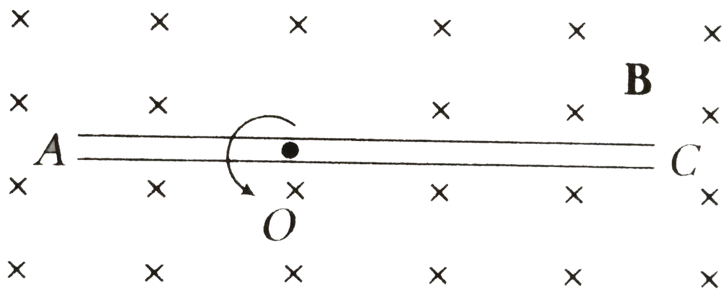
26. A conducting rod AC of length 4l is rotated about a point O in a uniform mangnetic field B directed into the paper. AO = l and OC = 3l. Then,



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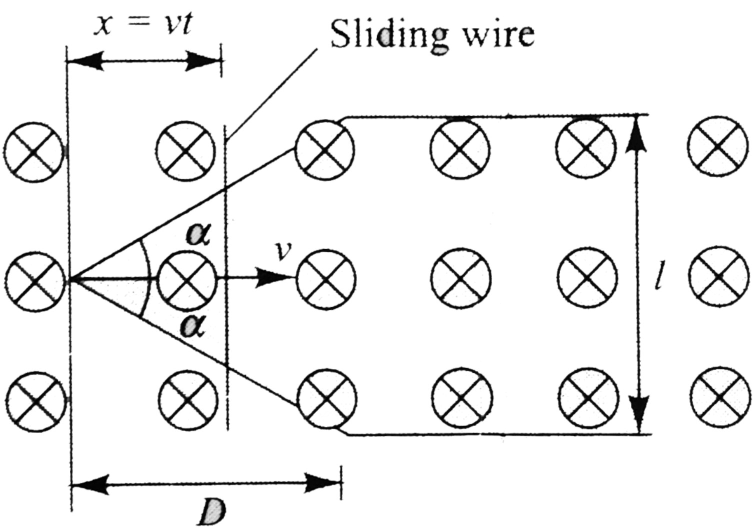
27. Consider the sliding wire circuit shown in . The wire slides at constant speed and the plane of the circuit is perpendicular to a uniform magnetic field. Show that the induced emf is given by $E = Blv^2t/D$ foe $0 < t < D/v$ What is the expression for the emf for $t > D/v$?



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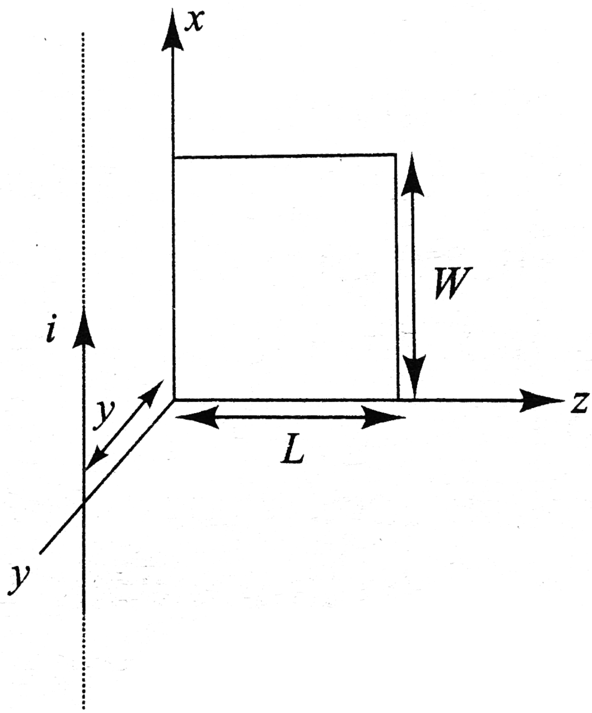
Exercises Subjective

1. A long thin wire carrying a varying current $I = i_0 \sin \omega t$ lies at a distance y above one edge of a rectangular wire loop of length L and W lying in the $x - z$ plane. What emf is induced in the loop?



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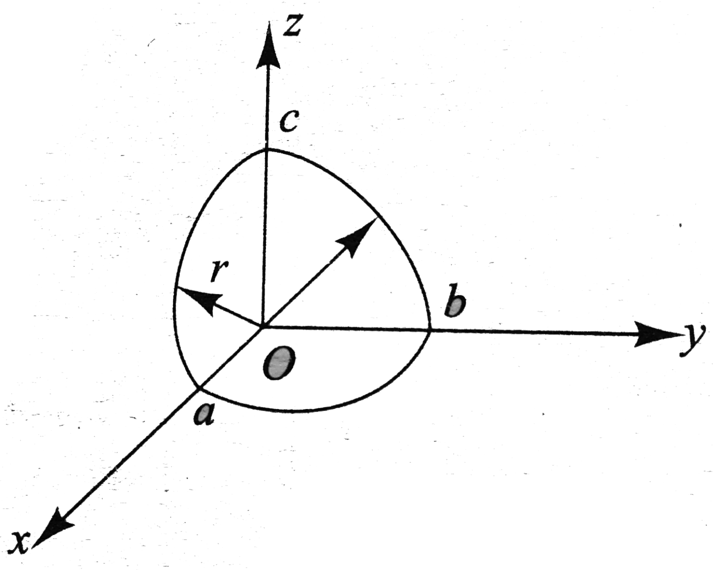
2. A wire is bent into three circular segment of radius $r = 10cm$ as shown in. Each segment is a quadrant of a circle ab lying in the $x - y$ plane, bc lying in the $y - z$ plane and ca lying in the $z - x$ plane.

(a) if a magnetic field B points in the positive x direction, what is the magnitude of the emf developed in the wire when B increases at the rate of $3mTs^{-1}$?

(b) What is the direction of teh current in the segment bc.



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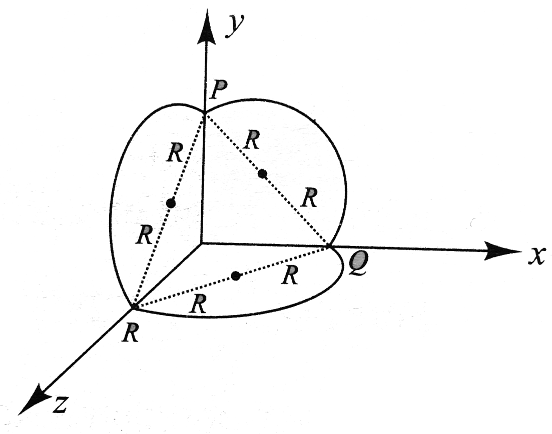
3. Three identical wires are bent into semi-circular arcs to each of radius R. These arcs are connected with each other to form a closed mesh such that one of tham lies in $x - y$ plane, one in $y - z$ plane and the other in $z - x$ plane as shown in. In the region of space, a uniform magnetic field of induction $\vec{B} = B_0\left(\hat{i} + \hat{j}\right)$ exists, whose magnitude increases at a constant rate $dB/dt = \alpha$. Calculate the magnitude of emf induced in the mesh and mark the direction of flow of induced current in the mesh.



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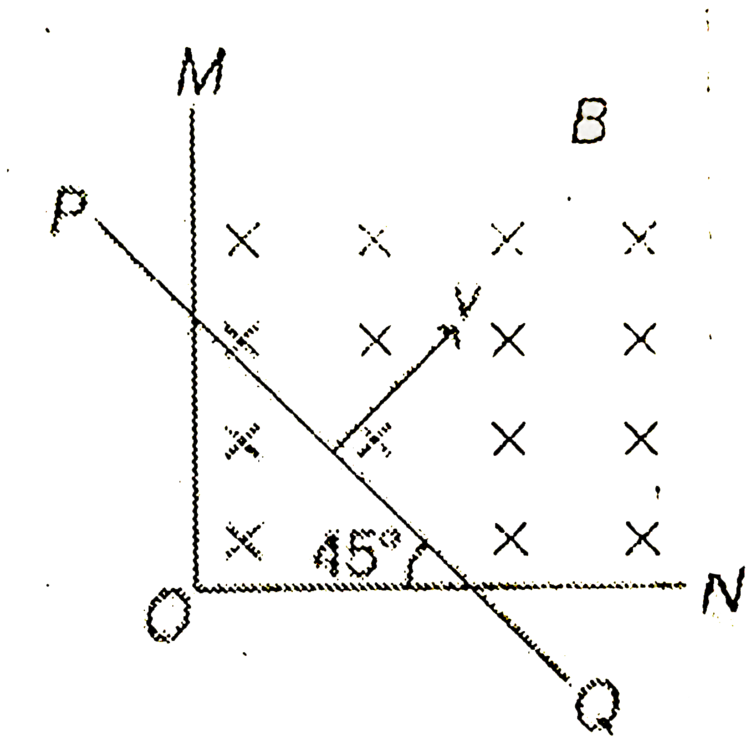
4. Electric circuit is composed of three conducting rods MO, ON and PQ as shown in the figure. The resistance of the rods per unit length is known to be 1. The rod PQ slides as shown in the figure. At t=0, rod PQ is at O. The whole system is embledded ina uniform magnetic field B, which is directed perpendicularly into page. The induced electric current is:



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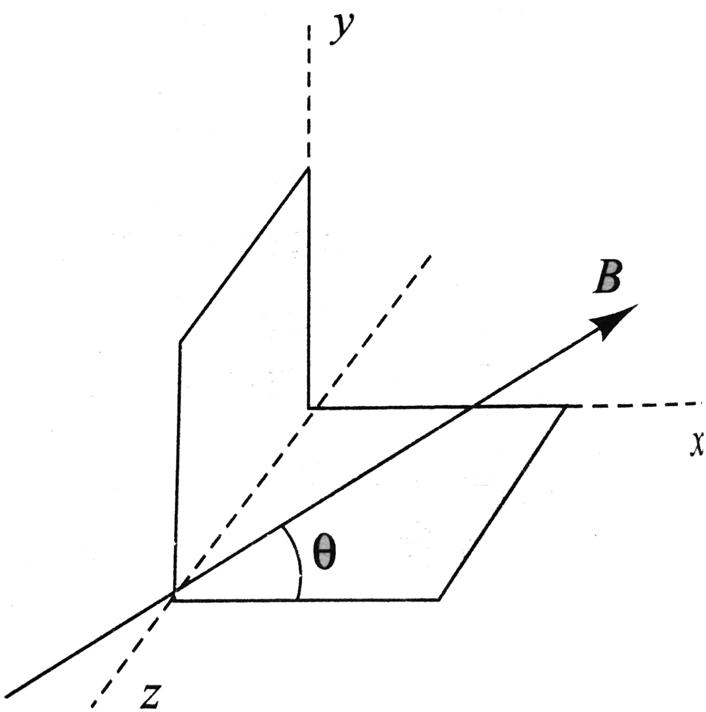
5. The wire loop, shown in , is made by taking a flat rectangular loop of sides $10cm$ and $20cm$ bending at the long sides a their midpoints to produce two mutually perpendicular square parts. The loop is laced in an oscillating magnetic field $B = B_0 \sin 2\pi vt$, with $B_0 = 1.2 \times 10^{-3} T$ and $v = 60 Hz$. The magnetic field is induced at angle θ with $x - z$ plane.

(a) Express the emf around the loop as a function of time and the angle θ.

(b) For what angle θ does the induced emf have the largest amplitude ?



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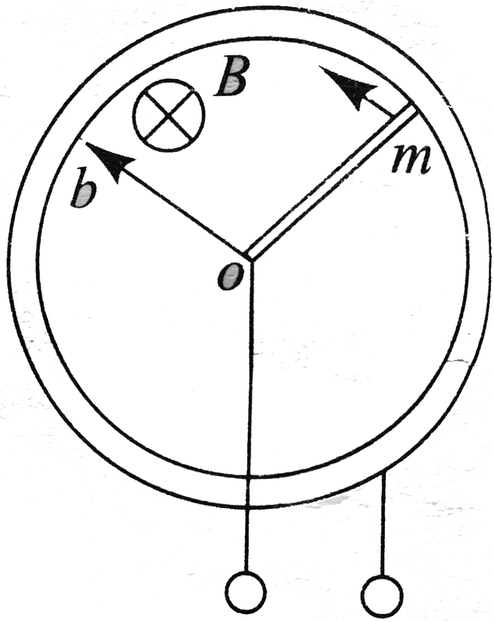
6. A rod of mass m can rotate without friction about axis sliding (also without friction) along a conducting ring of radius b arranged in a vertical plane as shown in the . The entire arrengement is placed in a uniform magnetic field with the inducetion B perpendicular to the plane of the ring. The axis and the conductor are connected to teh terminals of a current source. Determine

(a) according to which law current I flowing in the rod must vary for the rod to rotate at a constant angular speed. Being to measure the time from the instant when the rod is in its right-hand horizontal position. Consider the current to be positive when it flows from the axis of rotation toward the ring.

(b) what emf E of the source must be applied to maintain the required current? Consider the total resistance of the circuit to be constant and equal to R. Disergard the inductance of teh circuit.



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7. A square shaped, conducting wire loop of side L, total mass m and total resistance R initially lies in the horizontal $x-y$ plane, with corners at $(x, y, z) = (0, 0, 0), (0, L, 0), (L, 0, 0),$ and $(L, L, 0)$. There is a uniform upward magnetic field in the space within and around the loop. The side of the loop that extends from $(0, 0, 0) \rightarrow (L, 0, 0)$ is held in place on the x-axis, the rest of the loop is released, it begins to rotate due to the gravitational torque.

(a) Find the net torque (magnitude and direction)that acts on the loop when it has rotated through an anglr ϕ from its original orientation and is rotating dounward at an angular speed ω.

(b) Find the angular acceleration of the loop at the instant described in part (a).

(c) Compared to teh case with zero magnetic field, does it take the loop a longer or shorter time to rotate through 90° ? Explain.

(d) Is mechanical energy conserved as the loop rotates downward ? Explain.

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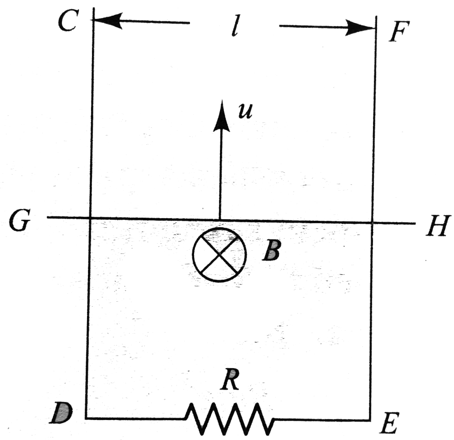
8. $CDEF$ is a fixed conducting smooth frame in vertical plane. A conducting uniform rod GH of mass m can move vertically and smoothly without losing contact with the frame. Gh always remains horizontal and is given velocity u upward and released. Taking the acceleration due to gravity as g and present other than R. Find out the time tasken by the rod to reach the highest point.



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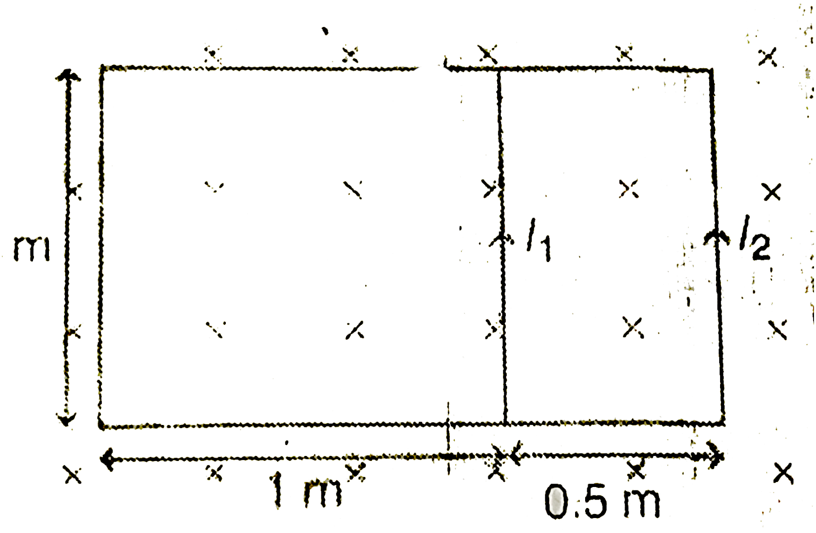
9. The entire network shown here, has uniform wire having resistance per unit length $1\Omega / m$. It is place in a uniform but time varying magnetic field (directed into the plane). If magnetic field increasing at a rate of IT/s, the ratio I_1 / I_2 equals



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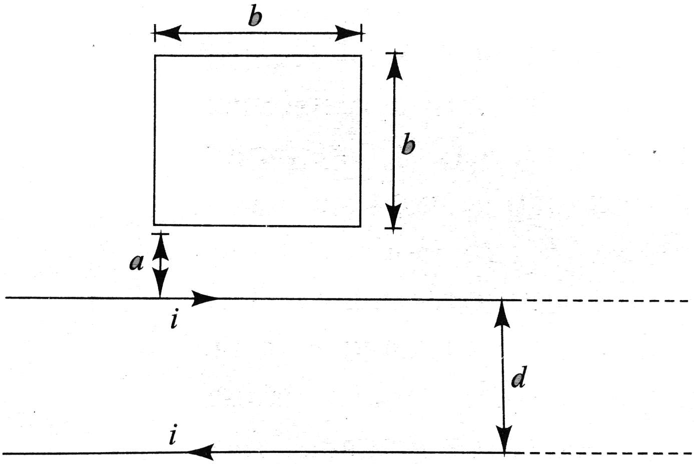
10. Two fixed long straight wires carry the same current i in opposite directions as shown in . A square loop of side b is fixed in the plane of the wires with its length parallel to one wire at a distance a shown in the figure.



(a) alculate at the induced emf in the loop if the current in both the wires is changing at the rate di / dt.

(b) What is the direction of force on the loop if di / dt is positive?

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11. Two parallel, long, straight conductor lie on a smooth plane surface. Two other parallel so as to form a square of side a initially. A uniform magnetic field B exists at right angles to the plane containing the cinductors. Now they start moving out with a constant velocity v.

(A) Will the induced emf be time dependent?

(b) Will the current be time dependent ?

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12. The rectangualr wire- frame, shown in has a width d, mass m, resistance R and a large length. A uniform magnetic field B exists to the left of the frame. A constant force F starts pushing the frame into the magnetic field at t =0. (a) Find the acceleration of the frame when its speed has increased to v. (b) Show that after some time the frame will move with a constant velocity till the whole frame enters into the magnetic field. find this velocity v_0. (c) show that the velocity at tiem t is given by $v = v_0\left(1 - e^{-\frac{Ft}{mv_0}}\right)$.

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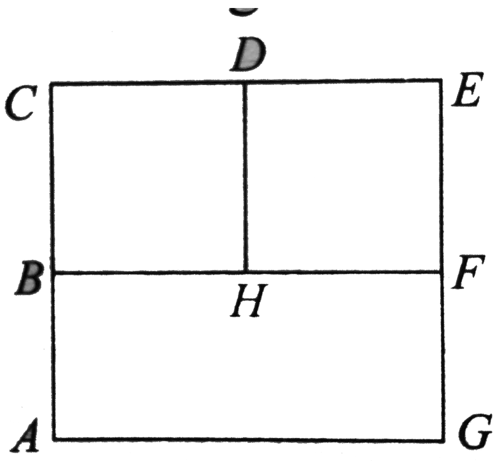
13. , $ABCEFGA$ is a square conducting frame of side $2m$ and resistance $1\Omega m^{-1}$. A uniform magnetic field b is applied perpendicular to the plane and pointing inward. It increases with time at a constant rate of $10Ts^{-1}$. Find the rate at which heat is produced in the circuit,

$AB = BC = CD = BH.$



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Exercises Single Correct

1. A horizontal straight conductor when placed along south-north direction falls under gravity, there is

A. (a) an induced current from south-to-north direction

B. (b) an induced current from north-to-south direction

C. (c) no induced emf along the length of the conductor

D. (d) an induced emf along the length of the conductor

Answer: C

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2. Two circular, similar, coaxial loops carry equal currents in the same direction. If the loops are brought nearer, what will happen?

A. (a) Current will increase in each loop

B. (b) Current will decrease in each loop

C. (c) Current will remain same in each loop

D. (d) Current will increase in one and decrease in the other

Answer: B

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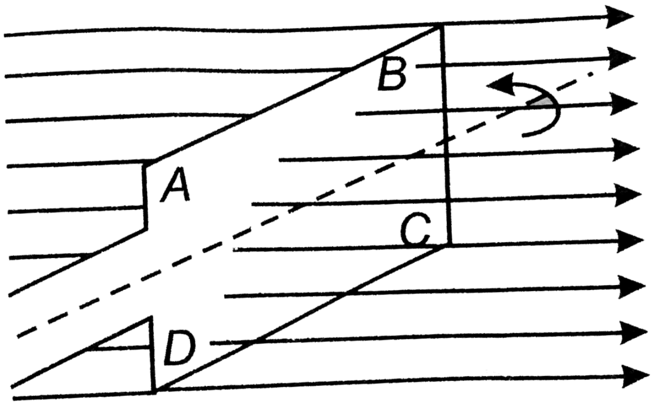
3. A rectangular coil ABCD is rotated anticlockwise with a uniform angular velocity about the axis shown In the fig. the axis of rotation of the coil as well as the magnetic field B are horizontally.the induced emf in the coilwould be minimum when the plane of the coil



A. (a) is horizontal

B. (b) makes an angle of 45° with the direction of magnetic field

C. (c) is at right angle to the magnetic field

D. (d) makes an angle of 30° with the magnetic field

Answer: C

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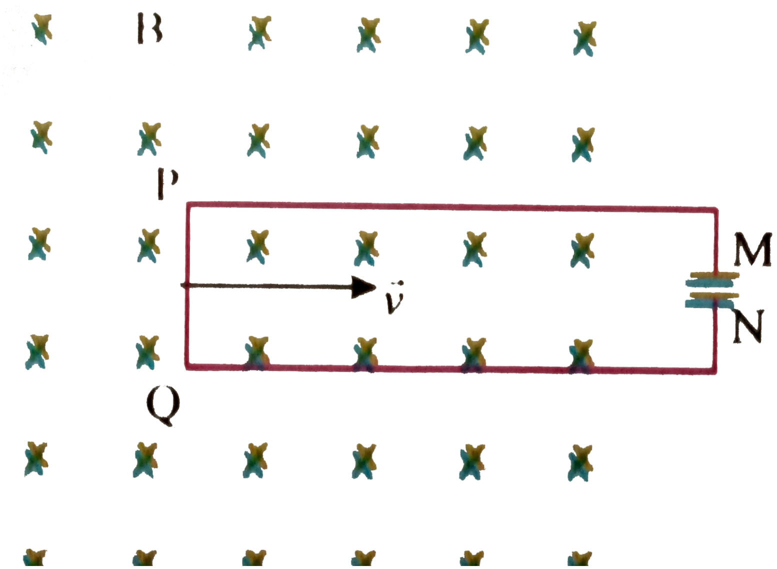
4. A rod PQ is connected to the capacitor plates. The rod is placed in a magnetic field (B) directed downwards perpendicular to the plane of the paper. If the rod is pulled out of magnetic field with velocity $\vec{v}$ as shown in Figure.



A. (a) Plate M will be positively charged.

B. (b) Plate N will be positively charged.

C. (c) Both plates will be similarly charged.

D. (d) No charge will be collected on plates.

Answer: A

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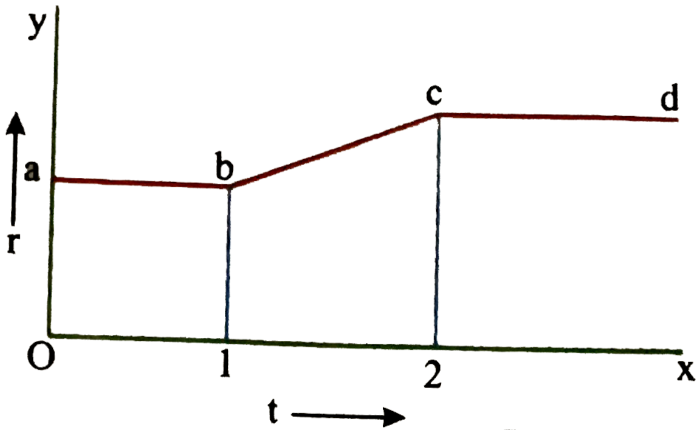
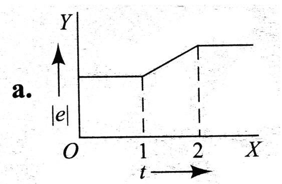
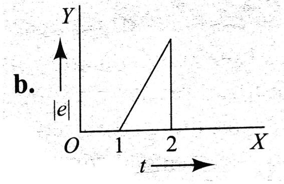
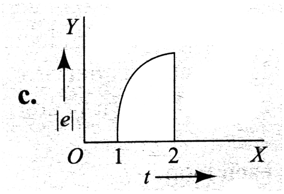
5. A flexible wire bent in the form of a circle is place in a uniform magnetic field perpendicularly to the plane of the coil. The radius of the coil changes as shown in Figure. The graph of magnetude of induced emf in the coil is represented by

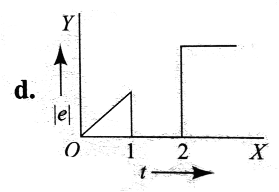


A. (a)



B. (b) 

C. (c) 

D. (d) 

Answer: B

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6. A thin circular ring of area A is held perpendicular to a uniform magnetic field of induction B. A small cut is made in the ring and a galvanometer is connected across the ends such that the total resistance of the circuit is R. When the ring is suddenly squeezed to zero area, the charge flowing through the galvanometer is

A. $\frac{BR}{A}$

B. (b) $\frac{AB}{R}$

C. (c) ABR

D. (d) B^2A/R^2

Answer: B

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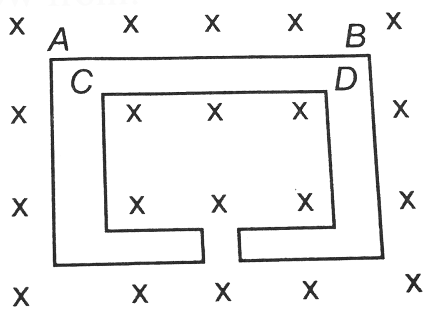
7. A wire is bent to form the double loop shown in figure. There is a uniform magnetic field directed into the plane of the loop. If the magnitude of this field is decreasing current will flow from:



A. (a) a to b and c to d

B. (b) b to a and d to c

C. (c) a to b and d to c

D. (d) b to a and c to d

Answer: C

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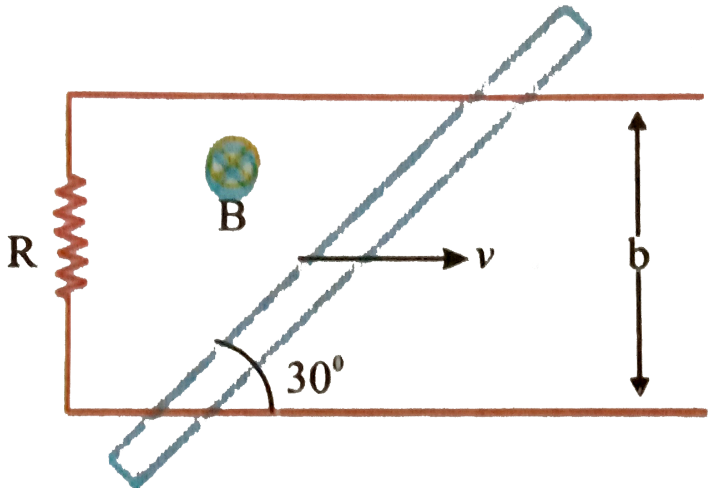
8. A wire is sliding as shown in Figure. The angle between the acceleration and the velocity of the wire is



A. (a) 30°

B. (b) 40°

C. (c) 120°

D. (d) 90°

Answer: C

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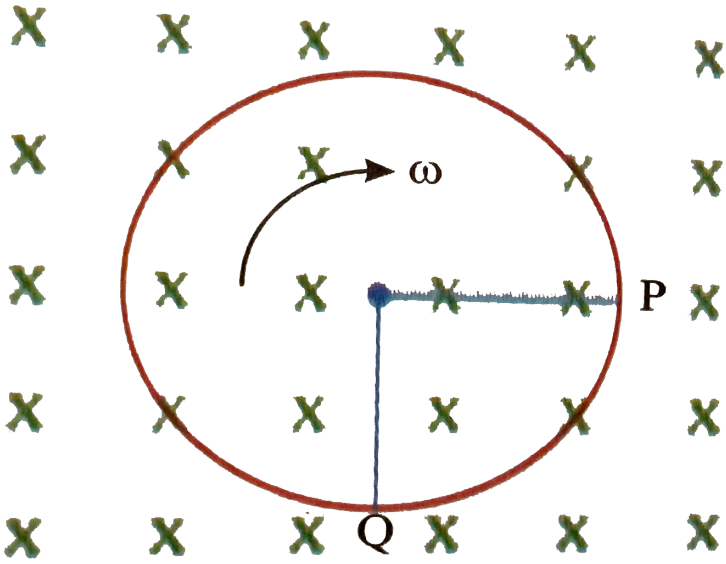
9. A conducting ring of radius $'r'$ is rolling without slipping with a constant angular velocity ω (figure). If the magnetic field strengh is B and is directed into the page the emf induced across PQ is



A. (a) $B\omega r^2$

B. (b) $B\omega\frac{r^2}{2}$

C. (c) $4B\omega r^2$

D. (d) $\pi^2 r^2 B\frac{\omega}{8}$

Answer: A

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10. A 0.1 m long coductor carrying a current of 50 A is held perpendicular to a magnetic field of 1.25 mT. The mechanical power required to move the conductor with a speed of $1ms^{-1}$ is

A. (a) $0.25mW$

B. (b) $6.25mW$

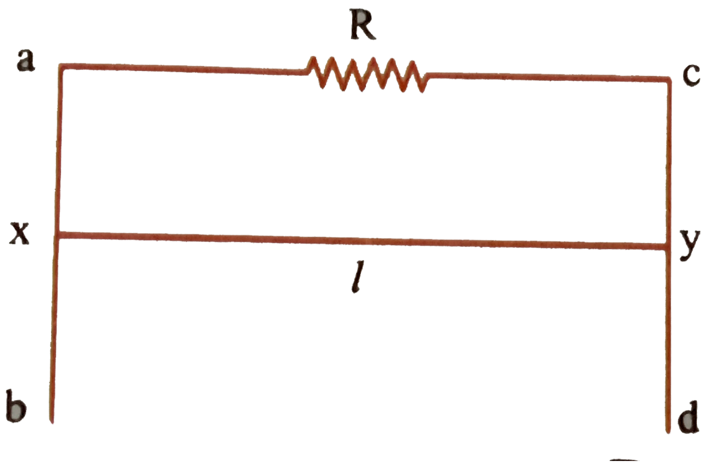
C. (c) $0.625W$

D. (d) $1W$

Answer: B

Watch Video Solution

11. A conducting wire xy of lentgh l and mass m is sliding without friction on vertical conduction rails ab and cd as shown in figure. A uniform magnetic field B exists perpendicular to the plane of the rails, x moves with a constant velocity of



A. (a) $\frac{mgR}{Bl}$

B. (b) $\frac{mgR}{Bl^2}$

C. (c) $\frac{mgR}{B^2l^2}$

D. (d) $\frac{mgR}{B^2l}$

Answer: C

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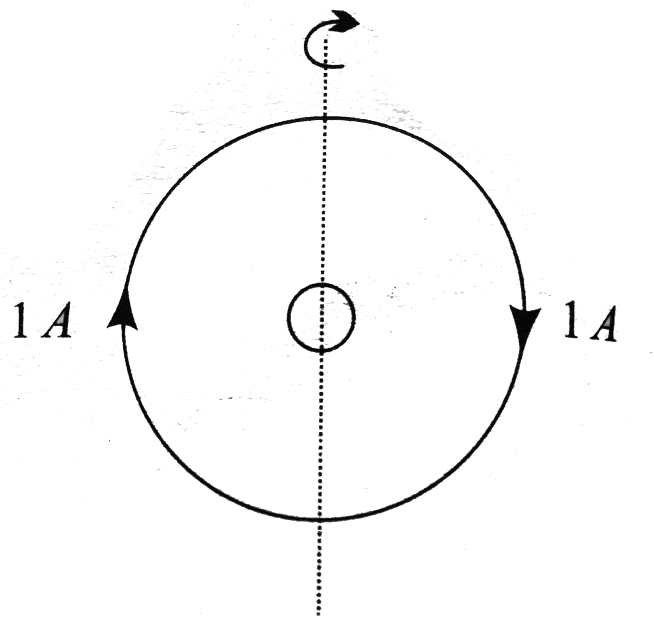
12. The linear loop has an area of $5 \times 10^{-4} m^2$ and a resistance oof 2Ω. The larger circular loop is fixed and has a radius of $0.1 m$. Both the loops are concentric and coplanner. The smaller loop is rotated with an angular velocity $\omega rad s^{-1}$ about its dismeter. The magnetic flux with the smaller loop is



A. (a) $2\pi \times 10^{-6} Wb$

B. (b) $\pi \times x 10^{-9} Wb$

C. (c) $\pi \times 10^{-9} \cos \omega t Wb$

D. (d) zero

Answer: C

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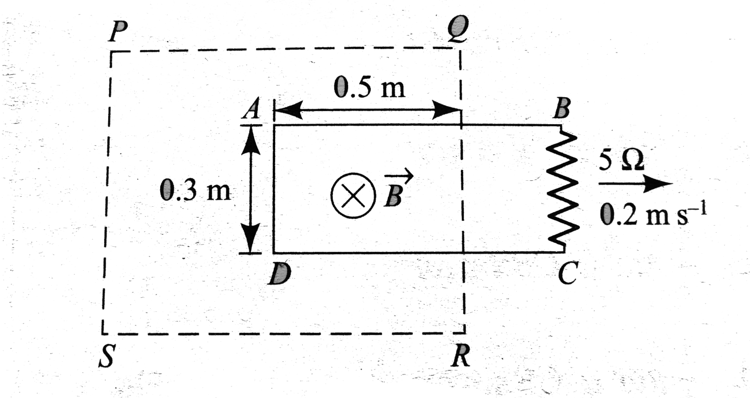
13. A circuit $ABCD$ is held perpendicular to the uinform magnetic field of $B = 5 \times 10^{-2} T$ extending over the region $PQRS$ and directed into the plane of the paper. The cicuit is moving out of the field at a uin form speed of $0.2 ms^{-1}$ for $1.5s$. During this time, the current in the 5Ω resistor is



A. (a) $0.6 mA om B \to C$

B. (b) $0.9mA\circ mB \to C$

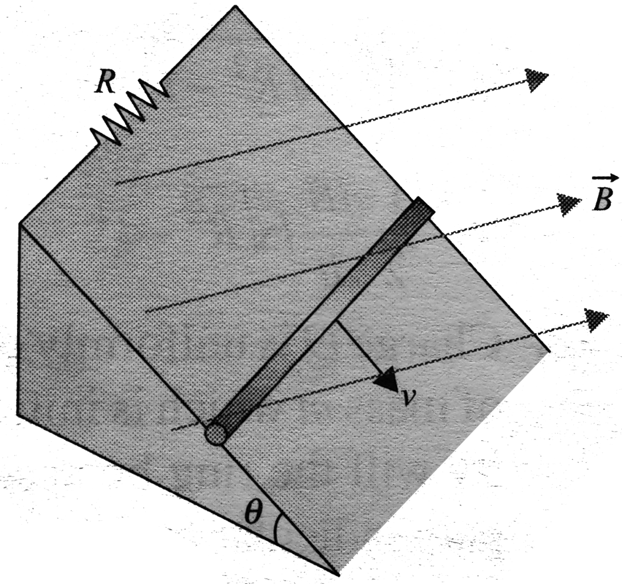
C. (c) $0.9mA\circ mC \to B$

D. (d) $0.6mA\circ mC \to B$

Answer: A

Watch Video Solution

14. a conducting wire os mass m slides down two smooth conducting bars, set at an angle θ to the horizontal as shown in . The separatin between the bars is l. The system is located in the magnetic field B, perpendicular to the plane of the sliding wire and bars. The constant velocity of the wire is



A. (a) $\dfrac{mgR\sin\theta}{B^2l^2}$

B. (b) $\dfrac{mgR\sin\theta}{Bl^3}$

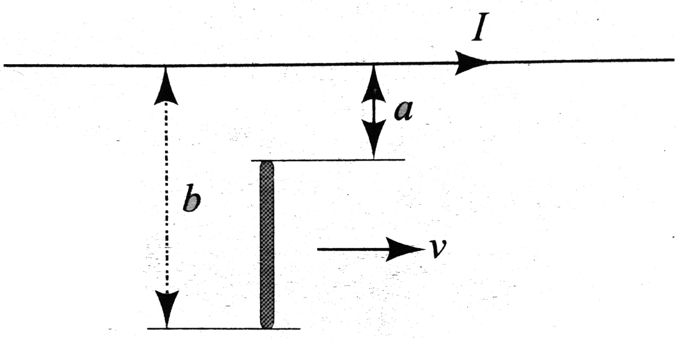
C. (c) $\dfrac{mgR\theta}{B^2l^5}$

D. (d) $\dfrac{mgR\sin\theta}{Bl^4}$

Answer: A

Watch Video Solution

15. Shows a copper rod moving with velocity v parallel to a long straight wire carrying current $= 100A$. Calculate the induced emf in the rod, where $v = 5mS^{-1}$, $a = 1cm$, $b = 100cm$.



A. (a) $0.23mV$

B. (b) $0.46mV$

C. (c) $0.16mV$

D. (d) $0.32mV$

Answer: B

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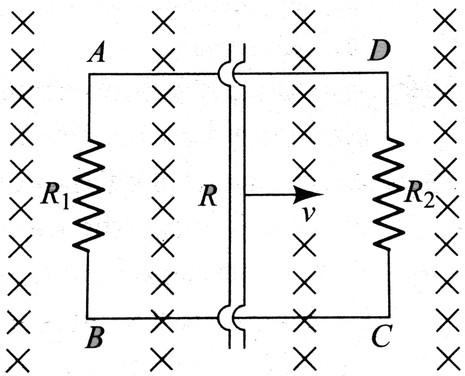
16. A rectangular loop with a sliding conductor of length l is located in a uniform magnetic field perpendicular to the plane of the loop . The magnetic induction is b. The resistances R_1 and R_2, respectively. Find the current through the conductor during its motion to the right with a constant velocity v.



A. (a) $\dfrac{Blv(R_1+R_2)}{R_1(R_1+R_2)}$

B. (b) $\dfrac{Bl^2v}{R_1+R_1R_2}$

C. (c) $\dfrac{Blv(R_1+R_2)}{R_1R_2+R(R_1+R_2)}$

D. (d) $\dfrac{Bl^2v}{R_1R_2+R(R_1+R_2)}$

Answer: C

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17. A wire ab of length l, mass m and resistance R slided on a smooth, thick pair of metallic rails joined at the bottom as shown in . The plane of the the rails makes an angle θ with the horizontal. A vertical magnetic field B exists in the ragion. if the wire slides on the rails at a constant speed v, show that $B = \frac{\sqrt{mgR\sin\theta}}{vl^2\cos^{\theta}}$.

(##HCV_VOL2_C38_E01_076_Q01##)

A. (a) $\frac{mg}{R}\frac{\sin\theta}{B^2l^2\cos^2\theta}$

B. (b) $\frac{mg}{R}\frac{\sin^2\theta}{B^2l^2\cos^2\theta}$

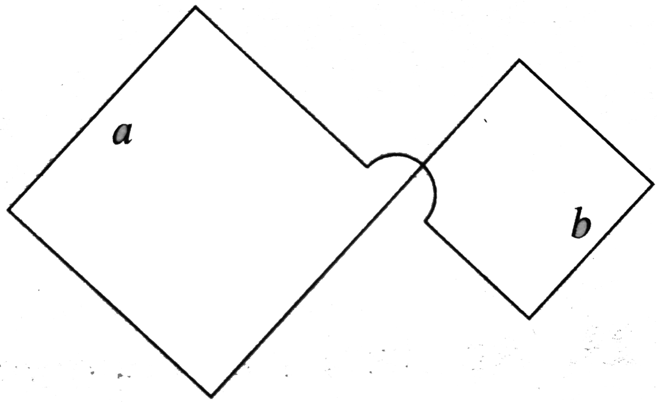
C. (c) $\frac{mgR\sin\theta}{B^2l^2\cos^2\theta}$

D. (d) $mgR\frac{\sin^2\theta}{B^2l^2\cos\theta}$

Answer: C

Watch Video Solution

18. A plane loop, shaped as two squares of sides $a = 1m$ and $b = 0.4m$ is introduced into a uniform magnetic field $\perp$ to the plane of loop . The magnetic field varies as $B = 10(-3)\sin(100t)T$. The qamplitude of the current induced in the loop if its resistance per unit length is $r = 5m\Omega m^{-1}$ is



A. (a) $2A$

B. (b) $3A$

C. (c) $4A$

D. (d) $5A$

Answer: B

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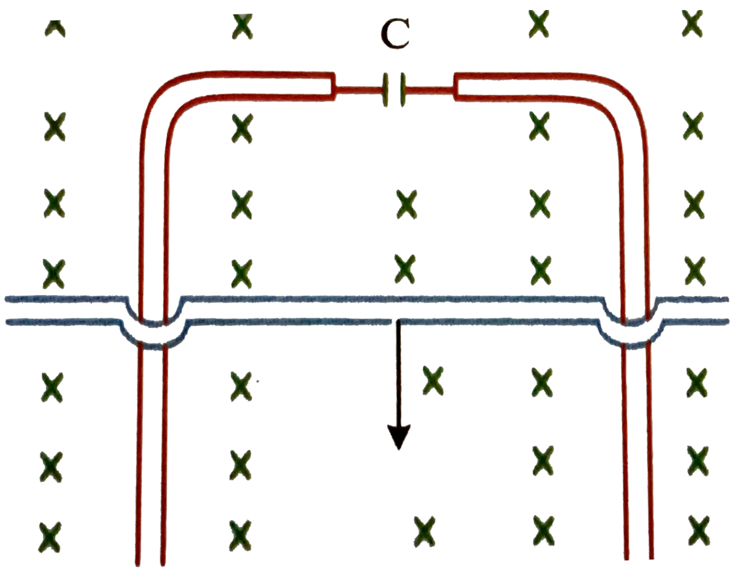
19. A conductor of length l and mass m can slide without any friction along the two vertical conductors connected at the top through a capacitor. A uniform magnetic field B is set up $\perp$ to the plane of paper. The acceleration of the conductor



A. (a) is constant

B. (b) increases

C. (c) decreases

D. (d) cannot say

Answer: C

Watch Video Solution

20. A rectangular loop of sides 10 cm and 5 cm with a cut is stationary between the pole pieces of an electromagnet.

The magnetic field of the magnet is normal to the loop. The current feeding the electromagnet is reduced, so that the field decreased from its initial value of 0.2 T at the rate of 0.02Ω. If the cut is joined and the loop has a resistance of 2.0Ω, then the power dissipated by the loop as heat is

A. (a) $5nW$

B. (b) $4nW$

C. (c) $3nW$

D. (d) $2nW$

Answer: A

Watch Video Solution

21. A magnetic flux through a stationary loop with a resistance R varies during the time interval τ as $\phi = at(\tau - t)$. Find the amount of heat the generated in the loop during that time

A. (a) $\dfrac{aT}{3R}$

B. (b) $\dfrac{a^2T^2}{3R}$

C. (c) $\dfrac{a^2T^2}{R}$

D. (d) $\dfrac{a^2T^3}{3R}$

Answer: D

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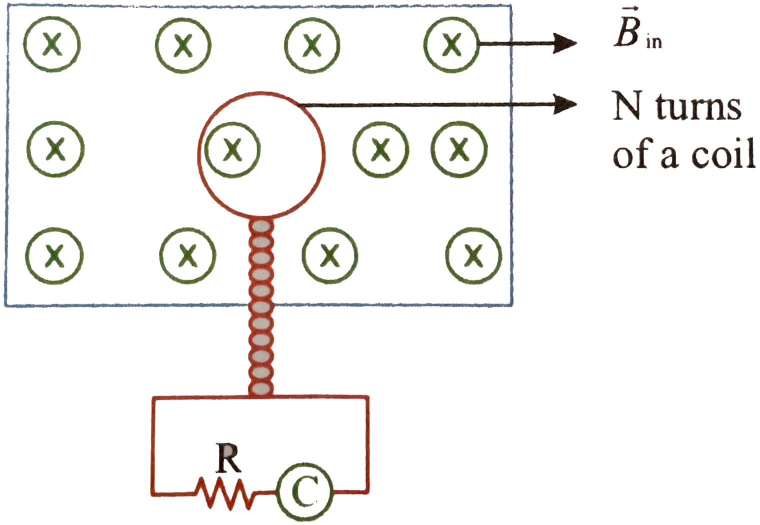
22. A flip coil consits of N turns of circular coils which lie in a uniform magnetic field. Plane of the coils is perpendicular to the magnetic field as shown in figure. The coil is connected to a current integrator which measures the total charge passing through it. The coil is turned through

180° about the diameter. The charge passing through the coil is



A. (a) $\dfrac{NBA}{R}$

B. (b) $\dfrac{\sqrt{3}NBA}{2R}$

C. (c) $\dfrac{NBA}{\sqrt{2}R}$

D. (d) $\dfrac{2NBA}{R}$

Answer: D

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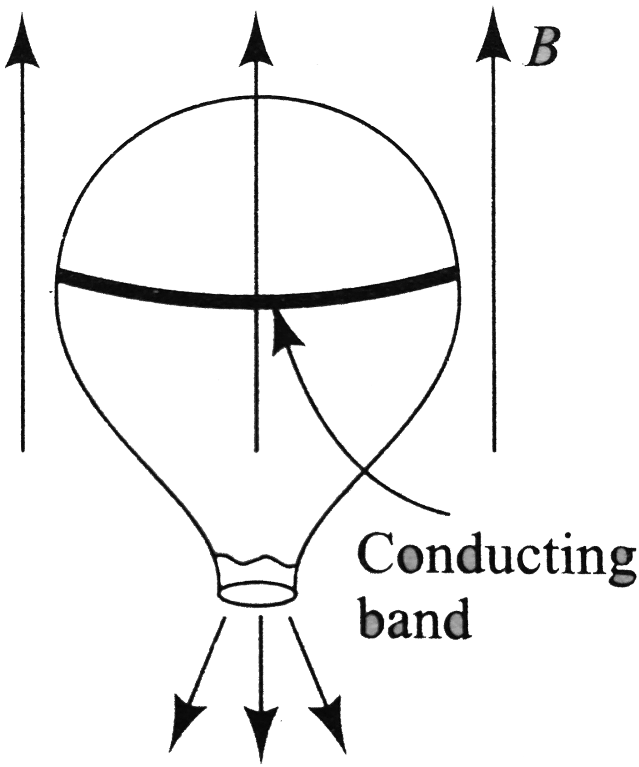
23. An elasticized conducting band is around a spherical ballon . Its plane through the center of the balloon. A uniform nmagnetic field of magnitude $0.04T$ is directed perpendicular to the plane of the band. Air is let out of the balloon at $100cm^3s^{-1}$ at an instant when the radius of the balloon is $10cm$. The induced emf in the band is



A. (a) $15\mu v$

B. (b) $25\mu v$

C. (c) $10\mu v$

D. (d) $20\mu v$

Answer: D

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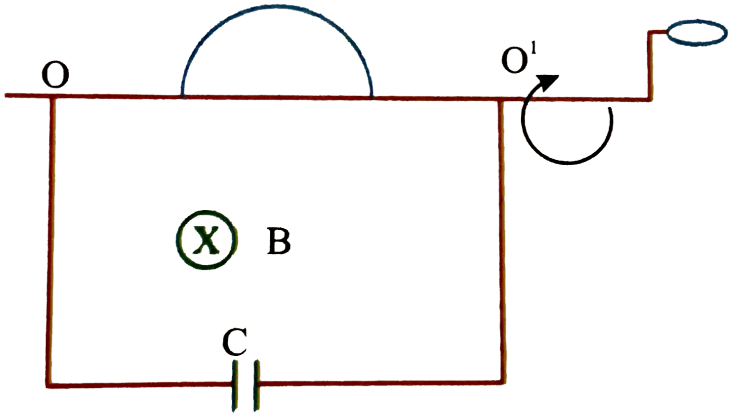
24. A copper rod is bent inot a semi-circle of radius a and at ends straight parts are bent along diameter of the semi-circle and are passed through fixed, smooth and conducting ring O and O' as shown in figure. A capacitor having capacitance C is connected to the rings. The system is located in a uniform magnetic field of induction B such that axis of rotation OO' is perpendicular to the field direction. At initial moment of time $(t = 0)$, plane of semi-circle was normal to the field direction and the semi-circle is set in rotation with constant angular velocity ω. Neglect the resistance and inductance of the circuit. The current flowing through the circuit as function of time is



A. (a) $\frac{1}{4}\pi\omega^2 a^2 Cb\cos\omega t$

B. (b) $\frac{1}{2}\pi\omega^2 a^2 CB\cos\omega t$

C. (c) $\frac{1}{4}\pi\omega^2 a^2 CB\sin\omega t$

D. (d) $\frac{1}{2}\pi\omega^2 a^2 CB\sin\omega t$

Answer: B

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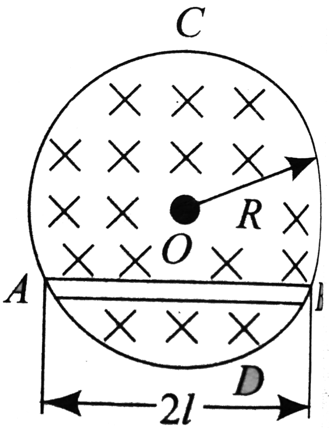
25. a uniform magnetic field of induction B fills a cylindrical volume of radius R. A rod AB of length $2l$ is placed as shown in . If B changing at the rate dB/dt, the emf that is produced by the changing magnetic field and that acts between the ends of the rod is



A. (a) $\frac{dB}{dt}l\sqrt{R^2 - l^2}$

B. (b) $\frac{dB}{dt}l\sqrt{R^2 + l^2}$

C. (c) $\frac{1}{2}\frac{dB}{dt}l\sqrt{R^2 - l^2}$

D. (d) $\frac{1}{2}\frac{dB}{dt}l\sqrt{R^2 + l^2}$

Answer: A

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26. Charge Q is uniformly distributed on a thin insulating ring of mass m which is initially at rest. To what angular velocity will the ring be accelerated when a magnetic field B, perpendicular to the plane of the ring, is switched on ?

A. (a) $\frac{QB}{2m}$

B. (b) $\frac{3QB}{2m}$

C. (c) $\frac{QB}{m}$

D. (d) $\frac{QB}{4m}$

Answer: A

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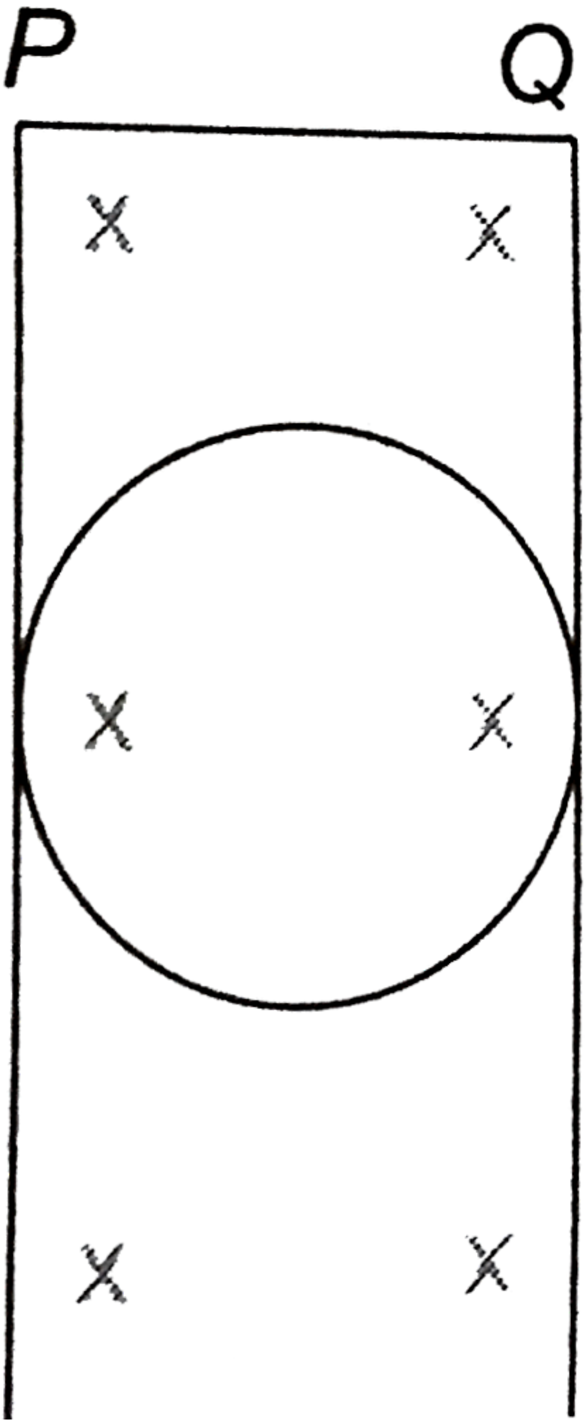
27. A vertical ring of radius r and resistance on R falls vertically. It is in contact with two vertical rails which are joined at the top. The rails are without friction and resistance. There is a horizontal uniform, magnetic field of magnitude B perpendicular to the plane of the ring and the rails.

When the speed of the ring is v , the current in the section PQ is



A. (a) 0

B. (b) $\frac{2Brv}{R}$

C. (c) $\frac{4Brv}{R}$

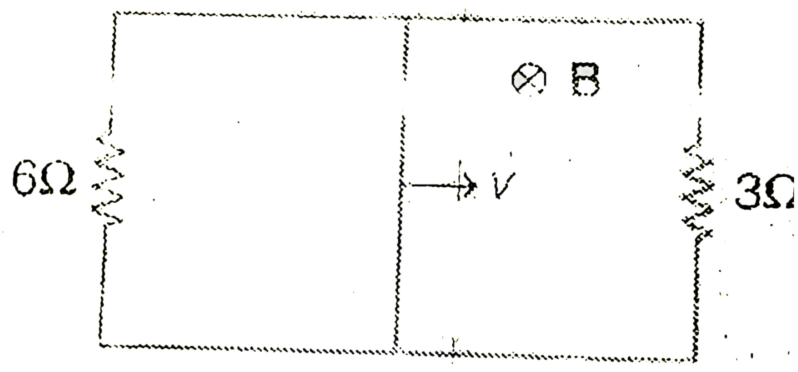
D. (d) $\frac{8Brv}{R}$

Answer: D

Watch Video Solution

28. A rectangular loop with a sliding connector of length l=10m $isthesituated \in aun$ if or $mmag \neq ticf$ or $B = 2Tperpendic\underline{a}r \to th$

r=2Omega. $Tworesis\tan cesata$6Omega and 3Omega` are connected as shown in the figure. The external force required to keep the conductor moving with a constant velocity v=2m/s



A. (a) $6n$

B. (b) $4n$

C. (c) $2n$

D. (d) $1n$

Answer: C

Watch Video Solution

29. A metal rod of resistance 20Ω is fixed along diameter of a conducting ring of radius 0.1m and on x-y plane. There is a magnetic field B=(50t) . The ring roatates with an angular velocity $\omega = 20rad/s$ about its axis. An external resistance resistance 10Ω is connected cross the centre of the ring an rim. The current through external resistance is

A. (a) $\frac{1}{4}$

B. (b) $\frac{1}{2}$

C. (c) $\frac{1}{3}$

D. (d) 0

Answer: C

Watch Video Solution

30. A metal disk of radius a rotates with a constant angular velocty ω about its axis. The potential difference between the centre and the rim of the disc is (m=mass of electron, e=charge on electron)

A. (a) $\frac{m\omega^2 a^2}{e}$

B. (b) $\frac{1}{2}\frac{m\omega^2 a^2}{e}$

C. (c) $\frac{e\omega^2 a^2}{2m}$

D. (b) $\frac{e\omega^2 a^2}{m}$

Answer: B

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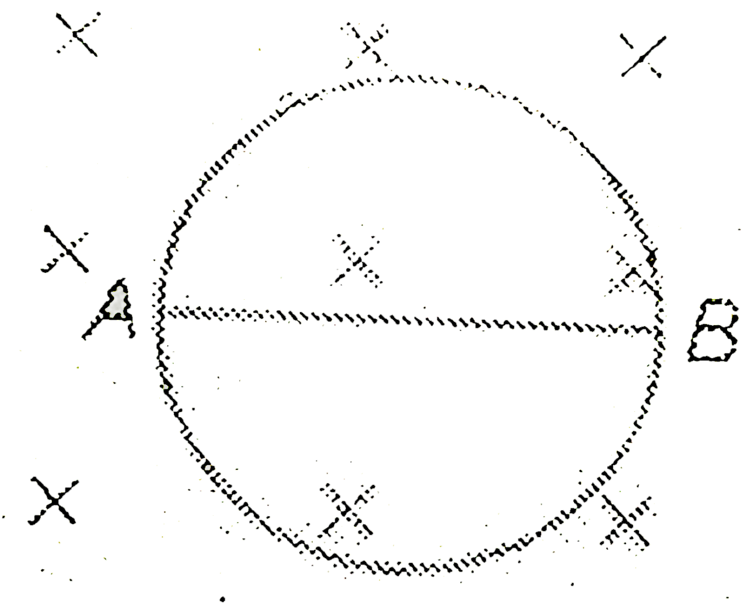
31. The radius of the circular conducting loo[shown in the figure is R. Mangetic field is decreasing at a constant rate a. Resistance per init length of the loop is ρ. Then current in wire AB is (AB is one of the diameters).



A. (a) $\frac{R\alpha}{2\rho}\text{om}A \rightarrow B$

B. (b) $\frac{R\alpha}{2\rho}\text{om}B \rightarrow A$

C. (c) $\frac{R\alpha}{\rho}\text{om}A \rightarrow B$

D. (d) 0

Answer: D

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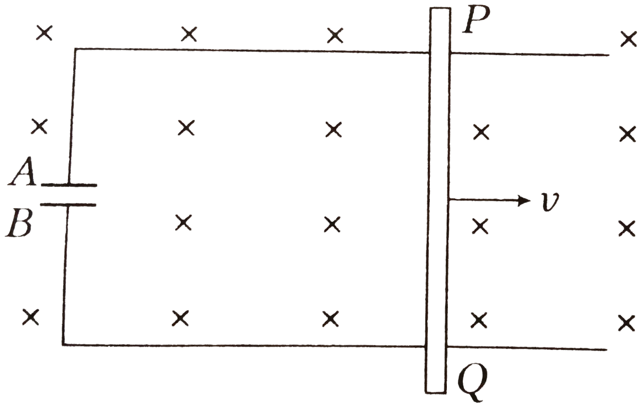
32. A conducting rod PQ of length L = 1.0 m is moving with a uniform speed $v = 2ms^{-1}$ in a uniform magnetic field B = 4.0 T directed into the paper. A capacitor of capacity C = 10μF is connected as shown in figure.

Then,



A. (a) $q_A = +80\mu C$ and $q_B - 80\mu C$

B. (b) $q_A = -80\mu C$ and $q_B + 80\mu C$

C. (c) $q_A = 0 = q_B$

D. (d) charge stored in the capacitor increases exponentially with time

Answer: A

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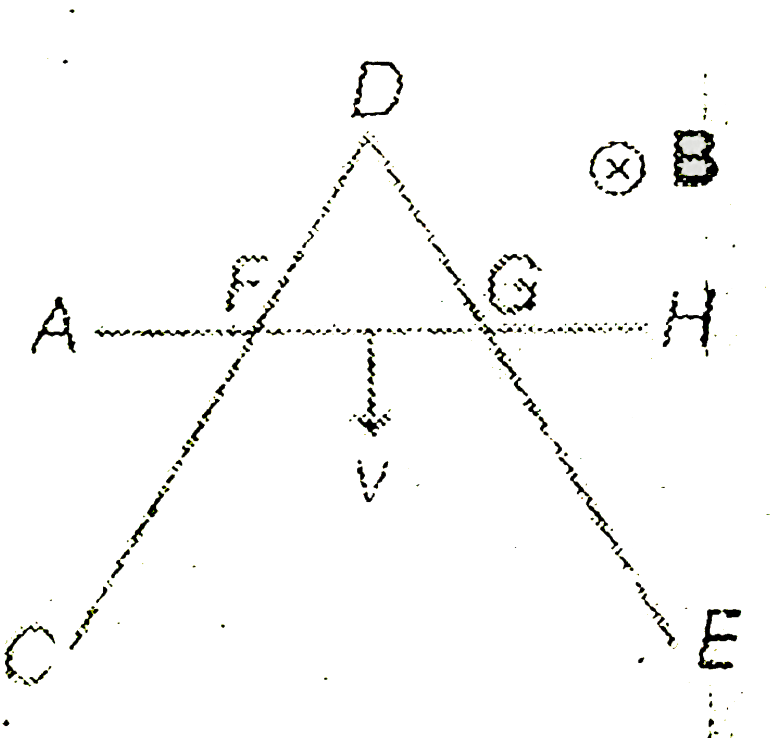
33. A long conductin gwire AH is moved over a conducitn triangular wire CDE with a constant velocity v in a uniform magnetic field B directed into the paper. Resistance per unit length of each wire is ρ. Then



A. (a) a constant clockwise induced will flow in the closed loop

B. (b) an increasing anticlockwise induced current will flow in the closed loop

C. (c) a decreasing anticlockwise induced current will flow in the closed loop

D. (d) an constant anticlockwise induced current will flow in the closed loop

Answer: D

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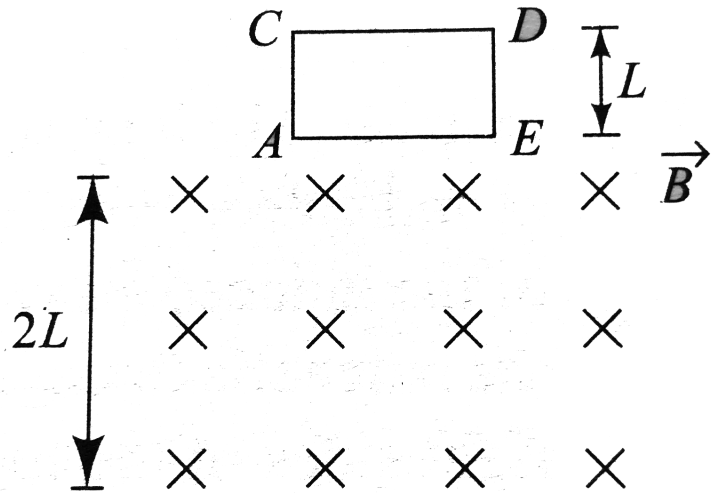
34. A square coil $ACDE$ with its plane vertically is released from rest in a horizontal uniform magnetic field $\vec{B}$ of length $2L$. The accelaration of the coilis



A. (a) less than g for all the time till the loop crosses the magnetic field completely

B. (b) less than g when it enters the field and greater than g when it comes out of the field

C. (c) g all the time

D. (d) less than g when it enters the comes out of the field but equal to g when it is within th efield

Answer: D

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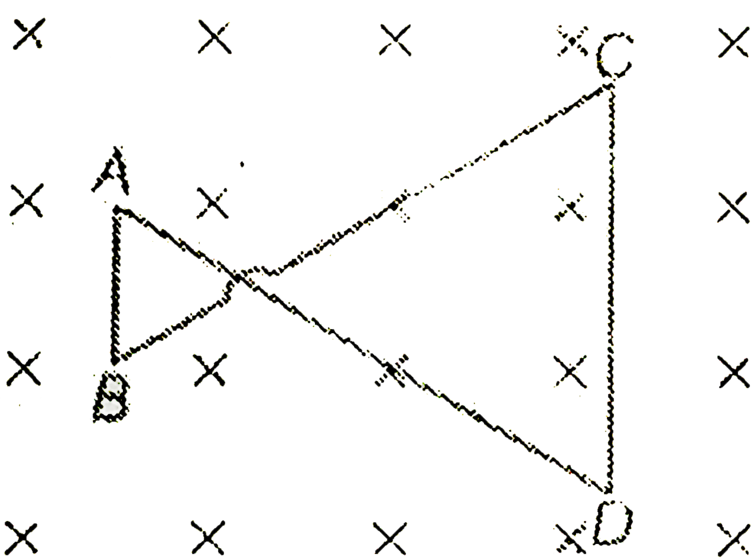
35. A conducting wire frame is placed is placed in a magnetic field which is directed into the paper. The magnetic field is increasing at a costant rae. The directions of induced currents in wires AB and CD are



A. (a) B to A and D to C

B. (b) A to B and C to D

C. (c) A to B and D to C

D. (d) B to A and C to D

Answer: A

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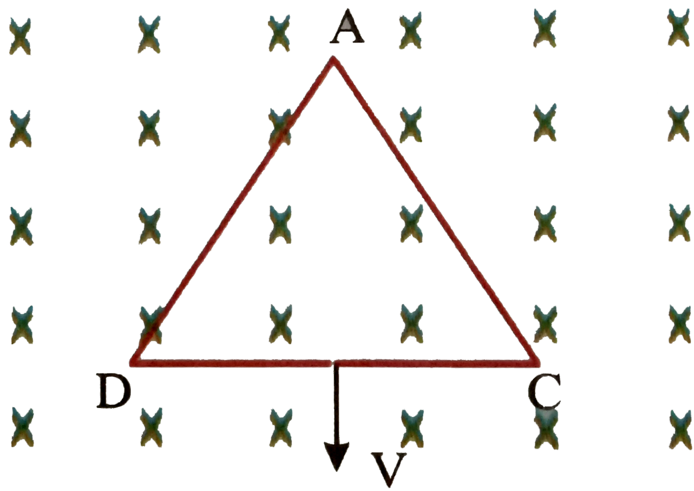
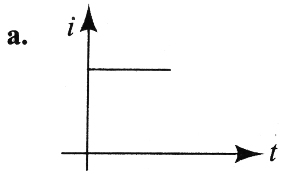
36. An equilateral triangular loop ADC having some resistance is pulled with a constant velocity v out of a uniform magnetic field directed in to the paper. At time $t = 0$, side DC of the loop at is at edge of the magnetic field.

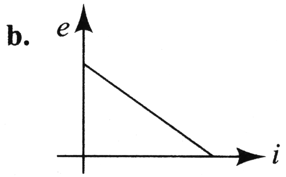


The induced current (i) versus time (t) graph will be as

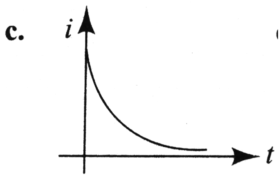
A. (a)



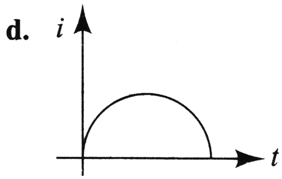
B. (b)



C. (c)



D. (d)



Answer: B

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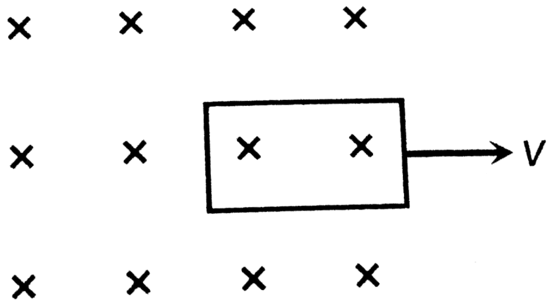
37. Figure show a square loop of side $0.5m$ and resistance 10Ω. The magnetic field has a magnitude $B = 1.0T$. The work done in pulling the loop out of the field slowly and uniformly in $2.0s$ is



A. (a) $3.125 \times 10^{-3} J$

B. (b) $6.25 \times 10^{-4} J$

C. (c) $1.25 \times 10^{-2} J$

D. (d) $5.0 \times 10^{-4} J$

Answer: A

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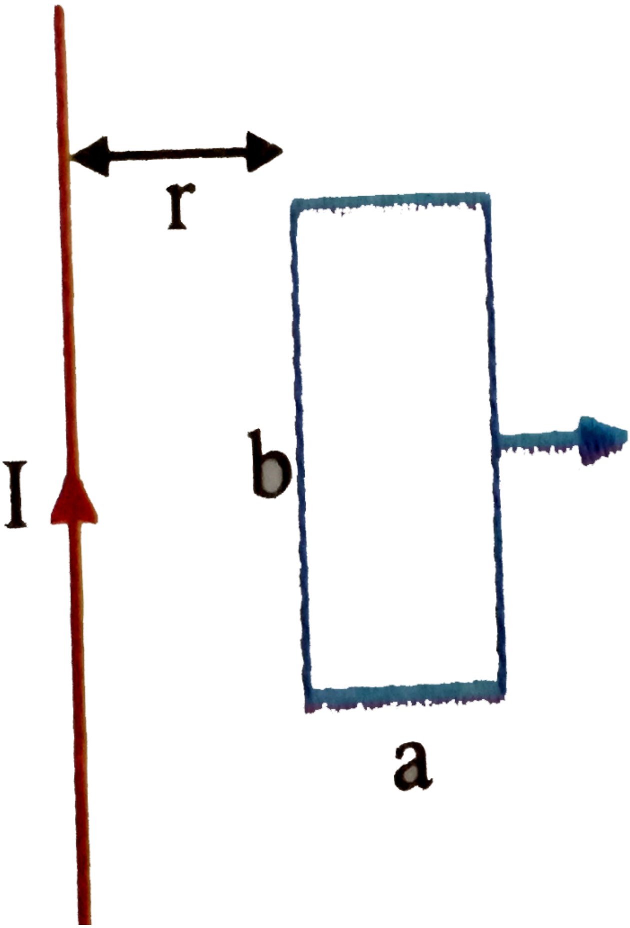
38. A rectangular loop of wire with dimensions shown in figure is coplanar with a long wire carrying current $'I'$. The distance between the wire and the left side of the loop is r. The loop is pulled to the right as indicated.

What are the directions of the induced current in the loop and the magnetic forces on the left and right sides of the loop when the loop is pulled ?



A. N/A

B. N/A

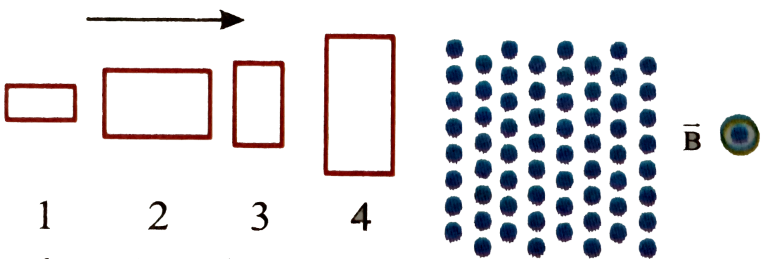
C. N/A

D. N/A

Answer: D

Watch Video Solution

39. The four wire loops shown figure have vertical edge lengths of either L, $2L$ or $3L$. They will move with the same speed into a region of uniform magnetic field $\overrightarrow{B}$ directed out of the page. Rank them according to the maximum magnitude of the induced emf greatest to least.



A. (a) $1 \text{ and } 2 tie, then 3 \text{ and } 4 tie$

B. (b) $3 \text{ and } 4 tie, then 1 \text{ and } 2 tie$

C. (C) $4, 2, 3, 1$

D. (d) $4then2$ and $3tie$, and then 1

Answer: D

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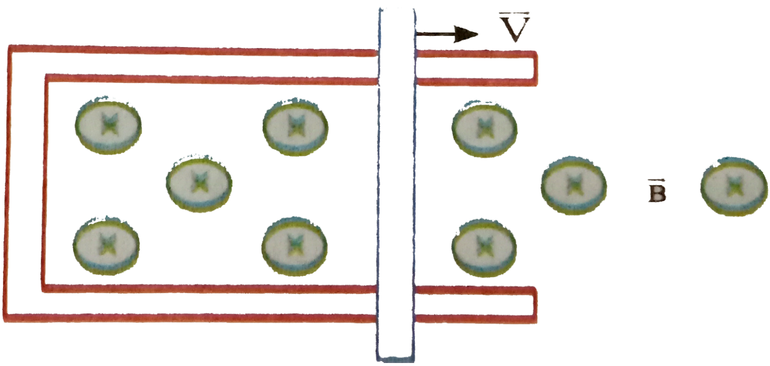
40. A rod lies across frictionless rails in a uniform magnetic field $\vec{B}$ as shown in figure. The rod moves to the right with speed V. In order to make the induced emf in the circuit to be zero, the magnitude of the magnetic field should



A. (a) not change

B. (b) increase linearly with time

C. (c) decrease linearly with time

D. (d) decrease nonlinearly with time

Answer: D

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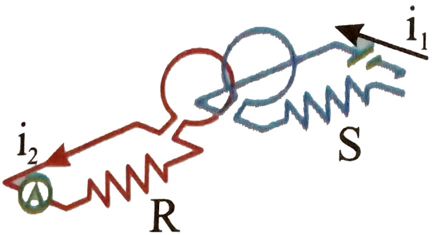
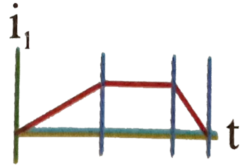
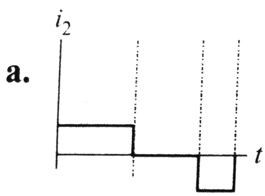
41. The current through the coil in figure (i) varies as shown in figure (ii).

Which graph best shows the ammeter A reading as a function of time?

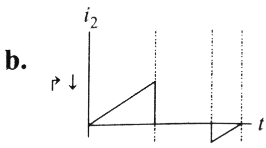


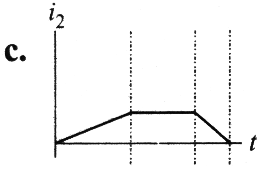


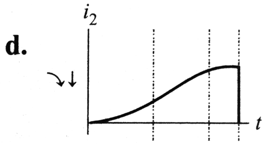
A. (a)



B. (b)



C. (c) 

D. (d) 

Answer: A

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42. An electron moves on a straight line path XY the path show . The abcd id coil adjacent in the path of electron . What will be the direction of current , if any induced in the coil ?

A. (a) the current in the coil flows clockwise

B. (b) the current in the coil flows anticlockwise

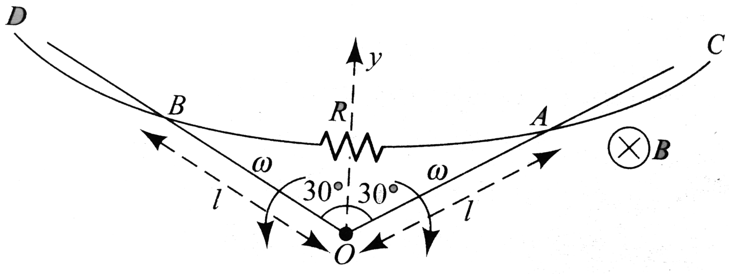
C. (c) the current in the coil is zero

D. (d) the current in the coil does not change the direction as the elctron crosses point O

Answer: C

Watch Video Solution

43. In fig. there exists a uniform magnetic field B into the plane of paper. Wire CD is in the shape of an arc and is fixed. OA and OB are the wires rotating with angular velocity ω as shown in the figure in the same plane as that of the arc about point O. If at some instant, $OA = OB = l$ and each wire makes angle $\theta = 30^{\circ}$ with y-axis, then the current through resistance R is (wires OA and OB have no resistance)



A. (a) 0

B. (b) $\frac{B\omega l^2}{R}$

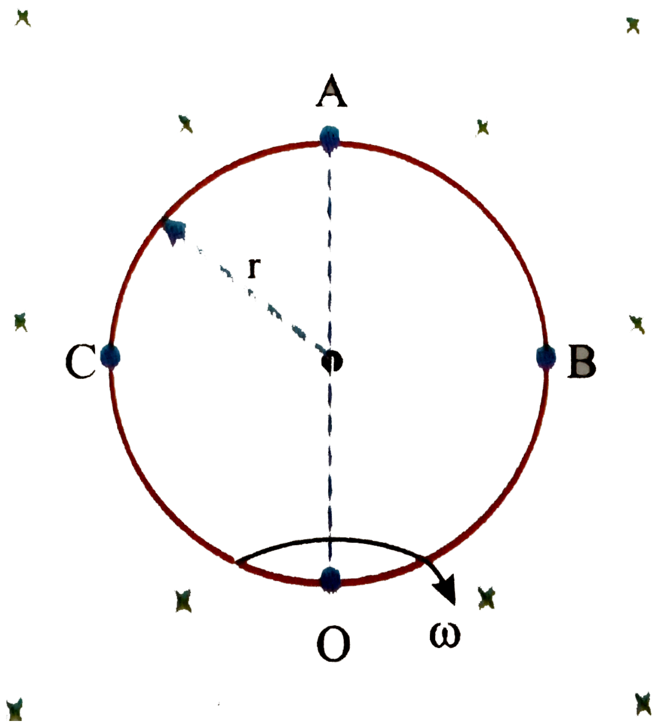
C. (c) $\frac{B\omega l^2}{2R}$

D. (d) $\frac{B\omega l^2}{4R}$

Answer: B

Watch Video Solution

44. In figure, there is conducting ring having resistance R placed in the plane of paper in a uniform magnetic field B_0. If the rings is rotating in the plane of paper about an axis passing through point O and perpendicular to the plane of paper with constant angular speed ω in clockwise direction, then



A. (a) point O will be at higher potential than A

B. (b) the potential of point B and C will be different

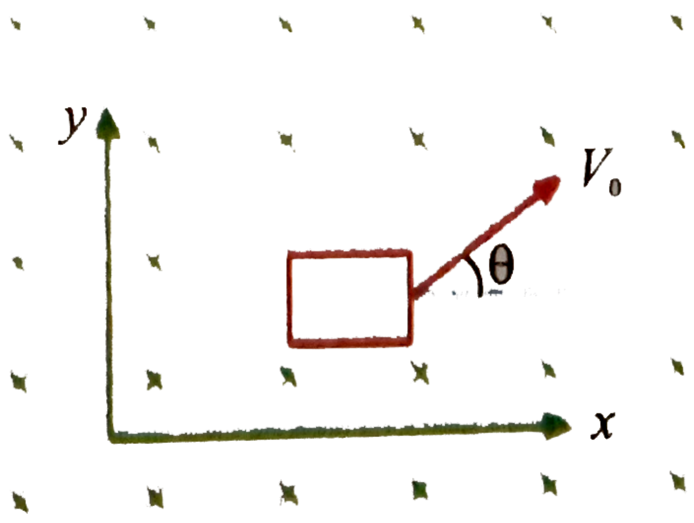
C. (c) the current in the ring will be zero

D. (d) the current in the ring will be $2B_0\omega r^2 / R$

Answer: C

Watch Video Solution

45. In the space shown a non-uniform magnetic field $\vec{B} = B_0(1+x)(-\hat{k})$ tesla is present. A closed loop of small resistance, placed in the xy plane is given velocity V_0. The force due to magnetic field on the loop is



A. (a) zero

B. (b) along + x direction

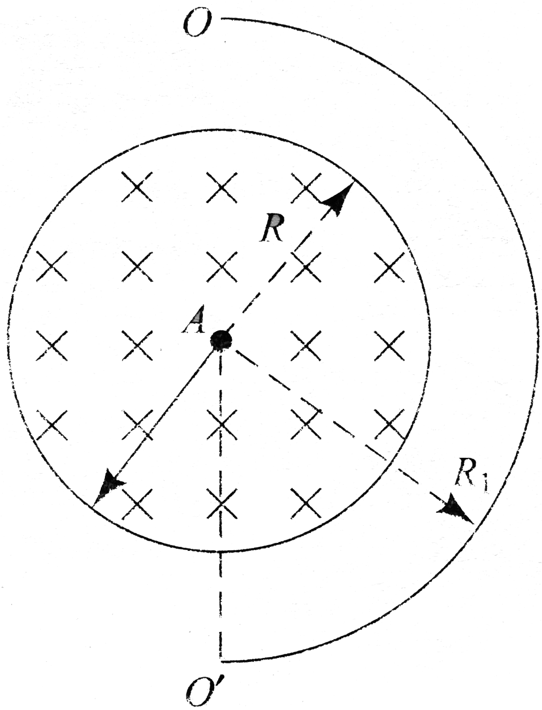
C. (c) along - x direction

D. (d) along + y direction

Answer: C

Watch Video Solution

46. There is a uniform magnetic field B in a circular region of radius R as shown in Fig. 3.149 whose magnitude changes at the rate of dB/dt. The emf circular concentric conducting arc of radius R_1 having an angle θ as shown ($-OAO' = \theta$) is



A. (a) $\frac{\theta}{2\pi}R_1^2\frac{dB}{dt}$

B. (b) $\frac{\theta}{2}R^2\frac{dB}{dt}$

C. (a) $\frac{\theta}{2\pi}R^2\frac{dB}{dt}$

D. (d) none of these

Answer: B

47. A gold rod of length l is accelerated in the horizontal direction with an accleration a_0. The rod is held between two perfactly insulating clamps. Calculate the electric field set up in the rod. Take the mass of electron as m.

A. (a) $E = \frac{ma_0}{e}$

B. (b) $E = ma_0 l$

C. (c) zero

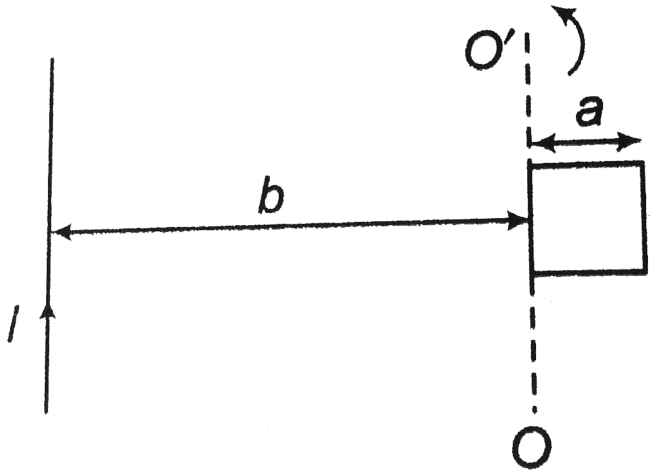
D. (d) none of these

Answer: A

Watch Video Solution

48. A square loop of side as and a straight long wire are placed in the same plane as shown in figure. The loop has a resistance R and inductance L. The frame is turned through 180° about the axis OO'.

What is the electric charge that flows through the loop?



A. (a) $\frac{\mu_0 I a}{2\pi r} 1n2$

B. (b) $\frac{\mu_0 I a}{\pi r} 1n2$

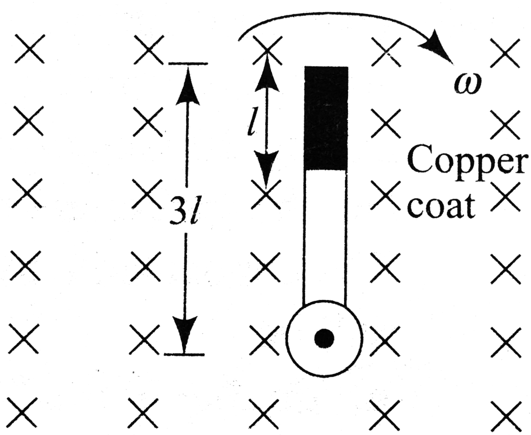
C. (c) $\frac{\mu_0 I a^2}{2\pi r}$

D. (d) cannot be found because time of roattion is not given.

Answer: B

Watch Video Solution

49. A wooden stick of length $3l$ is rotated about an end with constant angular velocity ω in a uniform magnetic field B perpendicular to the plane of motion. If the upper one-third of its length is coated with copper, the potential difference across the whole length of the stick is



A. (a) $\frac{9B\omega l^2}{2}$

B. (b) $\frac{4B\omega l^2}{2}$

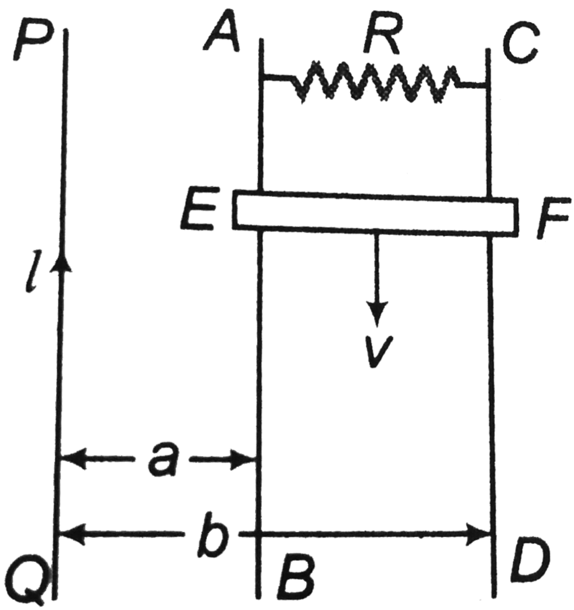
C. (c) $\frac{5B\omega l^2}{2}$

D. (d) $\frac{B\omega l^2}{2}$

Answer: C

Watch Video Solution

50. PQ is an infinite current carrying conductor. AB and CD are smooth conducting rods on which a conductor EF moves with constant velocity v as shown. The force needed to maintain constant speed of EF is



A. (a) $\frac{1}{VR}\left[\frac{\mu_0 IV}{2\pi}1n\left(\frac{b}{a}\right)\right]^2$

B. (b) $\left[\frac{\mu_0 IV}{2\pi}1n\left(\frac{b}{a}\right)\right]^2\frac{1}{VR}$

C. (c) $\left[\frac{\mu_0 IV}{2\pi}1n\left(\frac{b}{a}\right)\right]^2\frac{V}{R}$

D. (d) $\frac{V}{R}\left[\frac{\mu_0 IV}{2\pi}1n\left(\frac{b}{a}\right)\right]^2$

Answer: A

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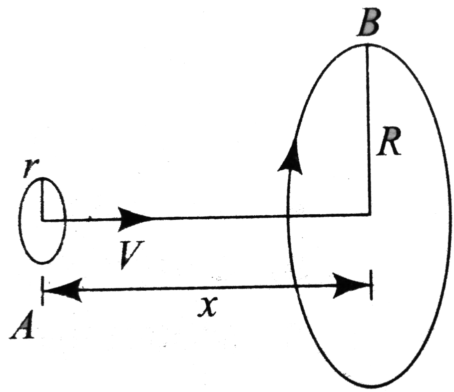
51. Loop A of radius $r > > R$ moves toward loop B with a constant velocity V such a way that their planes are always parallel. What is the distance between the two loops (x) when the induced emf in loop A is maximum?



A. (a) R

B. (b) $\frac{R}{\sqrt{2}}$

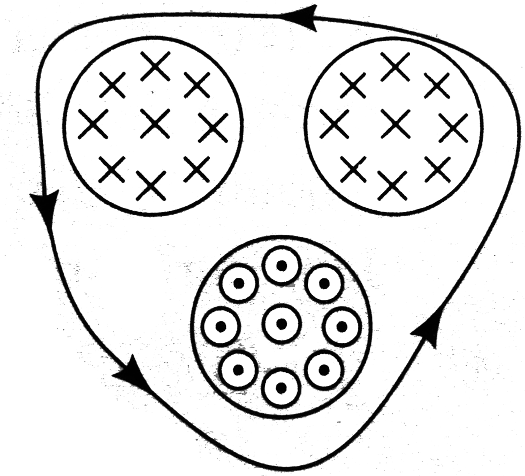
C. (c) $\frac{R}{2}$

D. (d) $R\left(1-\frac{1}{\sqrt{2}}\right)$

Answer: C

Watch Video Solution

52. Figure. shows three rigions of magnetic field each of area A, and in each rigion, magnitude of mqagnetic field decreases rate α. If $\vec{E}$ is the induced electric field, then the vlue of the line $\oint \vec{E} . d\vec{r}$ along the given loop is equal to



A. (a) αA

B. (b) $-\alpha A$

C. (c) $3\alpha A$

D. (d) $-3\alpha A$

Answer: B

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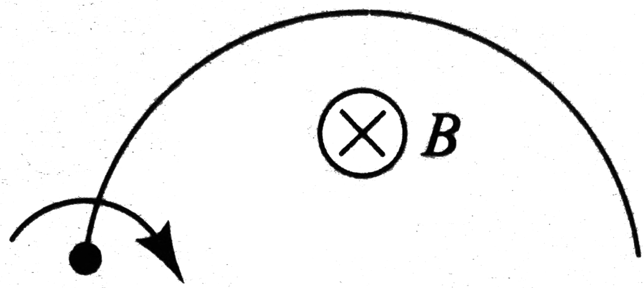
53. a semicircle wire of radius R is rotated with constant angular velocity about an axis passing through one end and perpendicular to the plane of wire. There is a uniform magnetic field of strength B. The induced emf between the ends is



A. (a) $B\omega R^2 / 2$

B. (b) $2B\omega R^2$

C. (c) is variable

D. (d) none of these

Answer: B

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54. Two identical cycle wheels (geometrically have different number of spokes connected from center to rim. One if having 20 spokes and the other having only 10 (the rim and the spokes are resistance less). One resistance of value R is connected between centre and rim. The current in R will be

A. (a) double in the first wheel than in the second wheel

B. (b) four times in the first wheel than in the second wheel

C. (C) will be double in the second wheel than that of the first wheel

D. (d) will be equal in both these wheels

Answer: D

Watch Video Solution

55. A uniform magnetic field existsin region given by $\overrightarrow{B} = 3\hat{i} + 4\hat{j} + 5\hat{k}$. A rod of length $5m$ is placed along y-axis is moved along x- axis with constant speed $1m/\sec$. Then the magnitude of induced $e.m.f$ in the rod is :

A. (a) 0

B. (B) $25V$

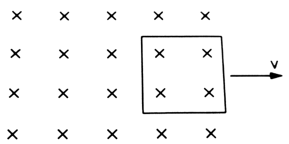
C. (c) $20V$

D. (d) $15V$

Answer: B

Watch Video Solution

56. Shows a square loop having 100 turns, an area of $2.5X10^{-3}m^2$ and a resistance of 100Ω. The magnetic field has a magnitude B =0.40 T. Find the work done in pulling the loop out of the field, slowly and uniformly is 1.0 s.



A. (a) 0

B. (b) $1mJ$

C. (c) $1\mu J$

D. (d) 0.1mJ`

Answer: D

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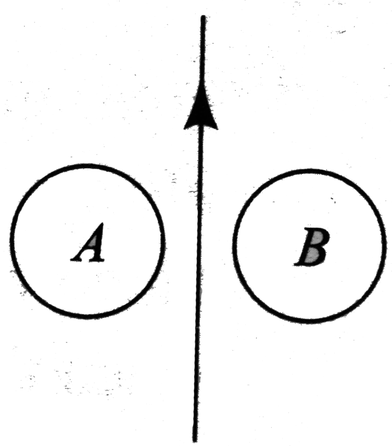
57. A and B two metallic rings pplaced at opposite sides of an infinitely long straight conducting wire as shown in Fig. 3.157. If current in the wire is slowly decreased, the direction of the induced current will be



A. (a) clockwise in A and anticlockwise in B

B. (b) anticlockwise in A and clockwise in B

C. (c) clockwise in both A and B

D. (d) anticlockwise in both A and B

Answer: B

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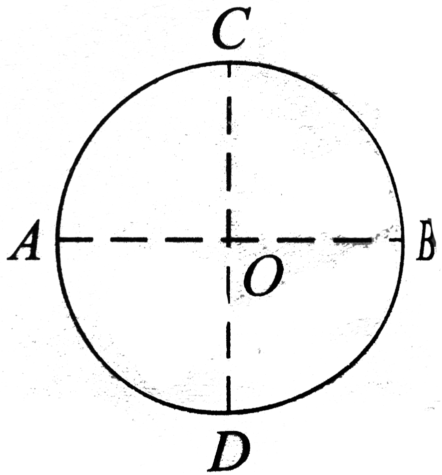
58. A vertical conducting ring of radius R falls vertically with a speed V in a horizontal uniform magnetic field B which is perpendicular to the plane of the ring. Which of the following statements is correct?



A. (a) A and B are at the same potential

B. (b) C and D are at the same potential

C. (c) current flows in clockwise direction

D. (d) current flows in anticlockwise direction

Answer: B

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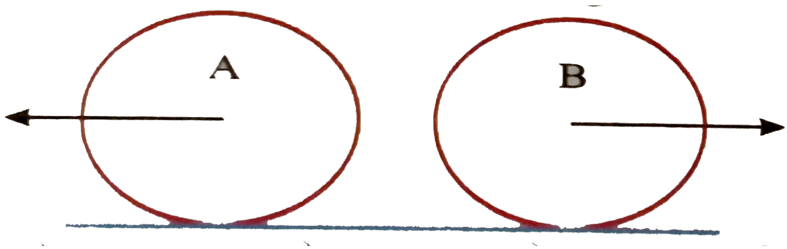
59. Two identical conducting rings A and B of radius R are rolling over a horizontal conducting plane with same speed v but in opposite direction. A constant magnetic field B is present pointing into the plane of paper. Then the potential difference between the highest points of the two rings is



A. (a) 0

B. (b) $2BvR$

C. (c) $4BvR$

D. (d) none of these

Answer: C

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60. An inducatane L and a resistance R are connected in series with a battery of emf epsilon. Find the maximum rate at which the energy is stored in the magnetic field.

A. (a) $\frac{E^2}{4R}$

B. (b) $\frac{E^2}{R}$

C. (c) $\frac{4E^2}{R}$

D. (d) $\frac{2E^2}{R}$

Answer: A

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61. A uniform magnetic field of induction B is confined to a cylindriacal region of radius R. The magnetic field is increasing at a constant rate of `(Db)/(dt)). Am electron of charge e, placed at the point P on the preriphery of the field experiences accceleration.

A. (a) $\frac{1}{2}\frac{eR}{m}\frac{dB}{dt}$ toward left

B. (b) $\frac{1}{2}\frac{eR}{m}\frac{dB}{dt}$ toward right

C. (c) $\frac{eR}{m}\frac{dB}{dt}$ toward left

D. (d) zero

Answer: A

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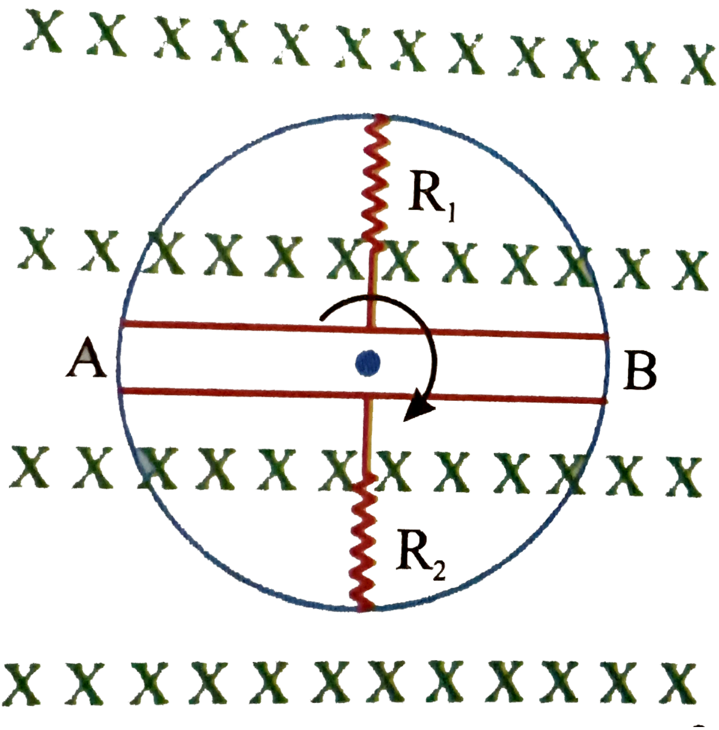
62. AB is a resistanceless conducting rod which forms a diameter of a conducting ring of radius r rotating in a uniform magnetic field B as shown in figure. The resistance R_1 and R_2 do not rotate. Then the current through the resistor R_1 is



A. (a) $\dfrac{B\omega r^2}{2R_1}$

B. (b) $\dfrac{B\omega r^2}{2R_2}$

C. (c) $\dfrac{B\omega r^2}{2R_1R_2}(R_1 + R_2)$

D. (d) $\dfrac{B\omega r^2}{2(R_1 + R_2)}$

Answer: D

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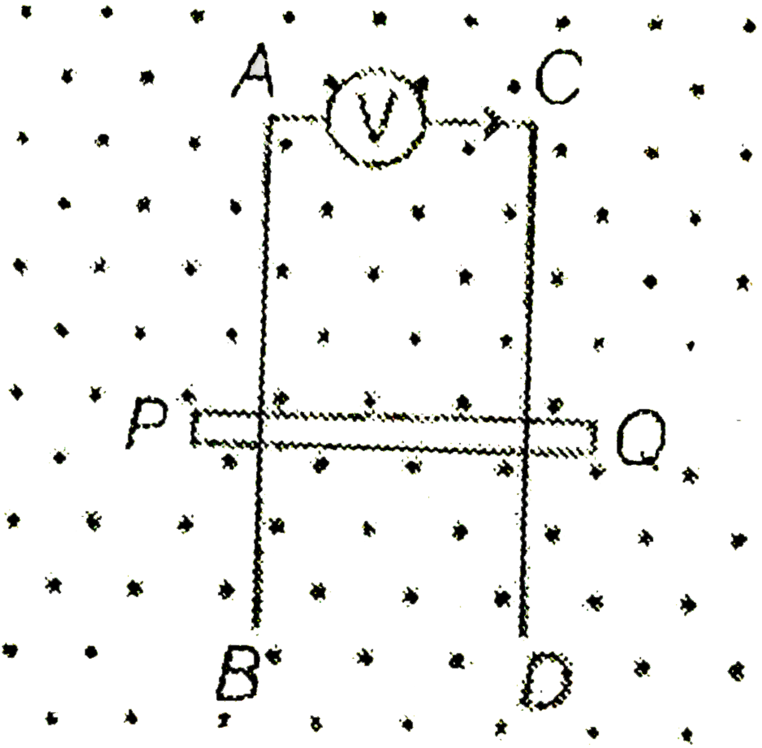
63. AB and CD are fixed conducting smooth rails plaed in a vertical plane and joined by a constant current source at tits upper end PQ is a conducting rod which is freee to slide on the rails. A horizontal uniform magnetic field exiets in space as shown. If the rod PQ is released from rest

then,



A. (a) the rod PQ will move downward with constant acceleration

B. (b) the rod PQ will move upward with constant acceleration

C. (C) the rod will remain at rest

D. (d) any of the above

Answer: D

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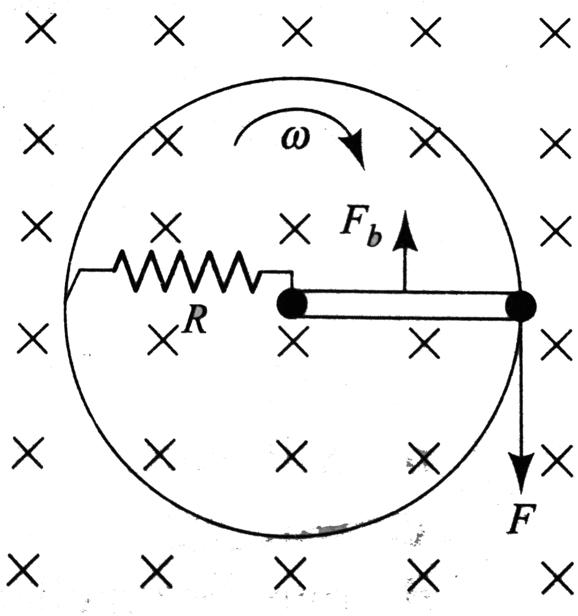
64. A metallic ring of radius r with a uniform metallic spoke of negligible mass and length r is rotated about its axis with angular velocity ω in a perpendicular uniform magnetic field B as shown in Fig. 3.163. The central end of the spoke is connected to the rim of the wheel through a resistor R as shown. The resistor does not rotate, its one end is always at the center of the ring and the other end is always in as shown is needed to maintain constant angular velocity of the wheel. F is equal to (the ring and the spoke has zero resistance)



A. (a) $\frac{B^2 \omega r^2}{8R}$

B. (b) $\frac{B^2 \omega r^2}{2R}$

C. (c) $\frac{B^2 \omega r^3}{2R}$

D. (d) $\frac{B^2 \omega r^3}{4R}$

Answer: D

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65. The current generator i_g, shown in , sends a constant current I through the circuit. The wire ab has a length l and mass m and can slide on the smooth, horizontal rails connected to l_g. The entire system lies in a vertical magnetic field B. Find velocity of the wire as a function of time.

(##HCV_VOL2_C38_E01_081_Q01##)

A. (a) $\frac{ilBt}{m}$

B. (b) $\frac{ilBt}{2m}$

C. (c) $\frac{2ilBt}{m}$

D. (d) $\frac{ilBt}{3m}$

Answer: A

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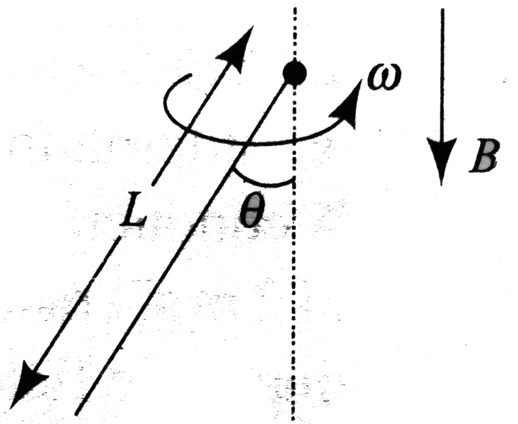
66. A rod of length L rotates in the form of a conical pendulum with an Angular velocity ω about its axis as shown in Fig. 3.165. The rod makes an angle θ with the axis. The magnitude of the motional emf developed across the two emf of the rod is



A. (a) $\frac{1}{2}B\omega L^2$

B. (b) $\frac{1}{2}B\omega L^2 \tan^2\theta$

C. (c) $\frac{1}{2}B\omega L^2 \cos^2\theta$

D. (d) $\frac{1}{2}B\omega L^2 \sin^2\theta$

Answer: D

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67. A magnetic field induction is changing in magnitude in a region at a constant rate dB/dt. A given mass m of copper drawn into a wire and formed into a loop is placed perpendicular to the field. If the values of specific resistance and density of copper are ρ and σ respectively, then the current in the loop is given by :

A. (a) $\frac{m}{2\pi\rho d}\frac{dB}{dt}$

B. (b) $\frac{m}{4\pi a^2 r}\frac{dB}{dt}$

C. (c) $\frac{m}{4\pi ad}\frac{dB}{dt}$

D. (d) $\frac{m}{4\pi\rho d}\frac{dB}{dt}$

Answer: D

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68. The magnetic field existing in a region is given by $\overrightarrow{B} = B_0\left(1 + \frac{x}{l}\right)\overrightarrow{k}$. A square loop of edge l and carrying a current I, is placed with its edges parallel to the x-y axes. Find the magnitude of the net magnetic force experienced by the loop.

A. (a) $\frac{v_0 B_0 d^2}{a}$

B. (b) $\frac{v_0 B_0 d^3}{a^2}$

C. (c) $v_0 B_0 d$

D. (d) zero

Answer: A

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69. A conductor AB of length l moves in xy plane with velocity $\vec{v} = v_0\left(\hat{i} - \hat{j}\right)$. A magnetic field $\vec{B} = B_0\left(\hat{i} + \hat{j}\right)$ exists in the region. The induced emf is

A. (a) zero

B. (b) $2B_0lv_0$

C. (c) B_0lv_0

D. (d) $sqer(2)B_0lv_0$

Answer: A

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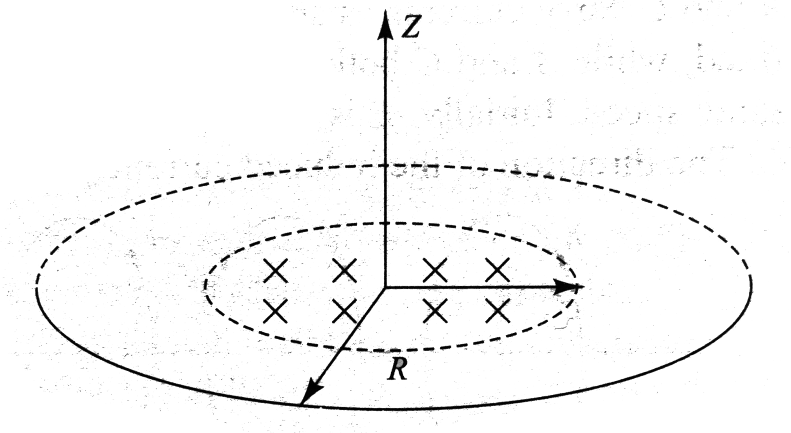
70. A line charge λ per unit length is pasted uniformly on to the wire of a wheel of mass m and radius R. The wheel has light non-conducting spokes and is free to rotate about a vertical axis as shown in $Fig. 3.166$. A uniform magnetic field extends over a radial rigion of radius r given by $B = -B_0\hat{k}(r \leq a, a < R) = 0$ (otherwise). What is the angular velocity of the wheel this field is suddenly switched off?



A. (a) $\dfrac{-2B_0\pi a^2 r}{mR}\hat{k}$

B. (b) $\dfrac{-2B_0\pi a^2 r}{3mR}\hat{k}$

C. (c) $\dfrac{B_0\pi a^2\lambda}{mR}\hat{k}$

D. (d) $\dfrac{-B_0\pi a^2\lambda}{mR}\hat{k}$

Answer: D

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71. A flexible wire loop in the shape of a circle has a radius that grows linearly with time. There is a magnetic field perpendicular to the plane of the loop that has a magnitude inversely proportional to the distance from the centre of the loop, $B(r) \propto \frac{1}{r}$ How does the emf E vary with time?

A. (a) $E \propto t^2$

B. (b) $E \propto t$

C. (c) $E \propto \sqrt{t}$

D. (d) E is constant

Answer: D

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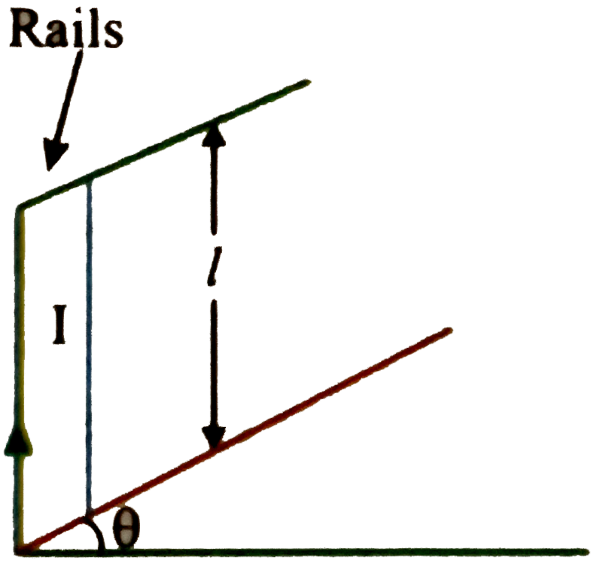
72. A conducting wire of length l and mass m is placed on two inclined rails as shown in figure. A current I is flowig in the wire in the direction shown When no magnetic field is present in the region, the wire is just on the verge of sliding. When a vertically upward magnetic field is switched on, the wire starts moving up the incline. The distance travelled by the wire as a function of time t will be



A. (a) $\frac{1}{2}\left[\frac{IBl}{m}-2g\right]t^2$

B. (b) $\frac{1}{2}\left[\frac{Ibl}{m}\times\frac{1}{\cos\theta}-2g\sin\theta\right]t^2$

C. (c) $\frac{1}{2}\left[\frac{Ibl}{m}-2g\sin\theta\right]t^2$

D. (d) $\frac{1}{2}\left[\frac{Ibl}{m}\frac{\cos 2\theta}{\cos\theta}-2s\sin\theta\right]t^2$

Answer: D

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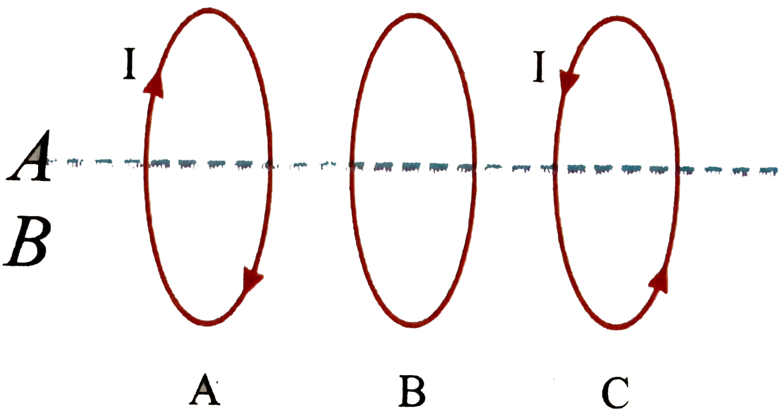
73. Three identical coils A, B and C carrying currents are placed co-axially with their planes parallel to one another. A and C carry current as shown in figure B is kept fixed while A and C both are moved towards B with the same speed. Initially, B is equally separated from A and C. The direction of the induced current in the coil B is



A. (a) same as that in coil A

B. (b) same as that in coil B

C. (c) zero

D. (d) none of these

Answer: C

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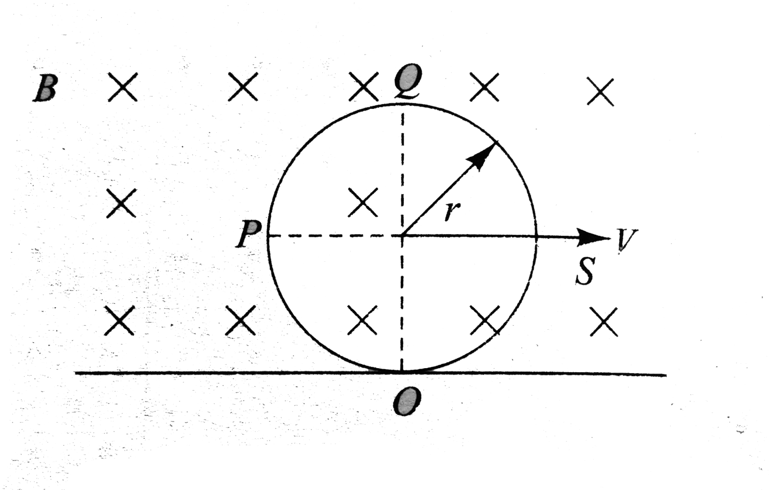
74. A conducting ring of radius r and resistance R rolls on a horizintal surface with constant velocity v. The magnetic field B is uniform and is normal to the plane of the loop. Choose the correct option.



A. (a) The induced emf between O and Q is Brv.

B. (b) An induced current $I = \frac{2Bvr}{R}$ flows in the clockwise direction.

C. (c) An induced current $I = \frac{2Bvr}{R}$ flows in the anticlockwise direction.

D. (d) No current flows.

Answer: D

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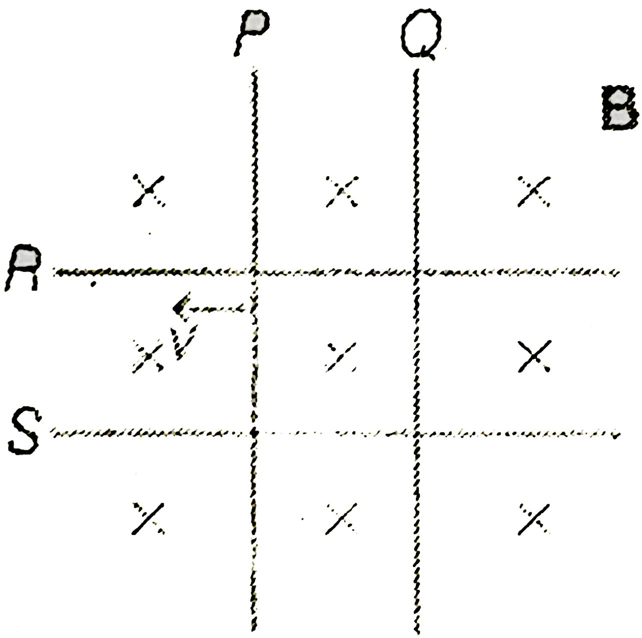
75. Two identical conductors P and Q are placed on two frictionless rails R and S in a uniform magnetic field directed into the plane. If P is moved in the direction shown in figure with a constant speed then rod Q



A. (a) will be attracted toward P

B. (b) will be repelled away from P

C. (c) will remain stationary

D. (d) may be repelled away or attracted toward P

Answer: A

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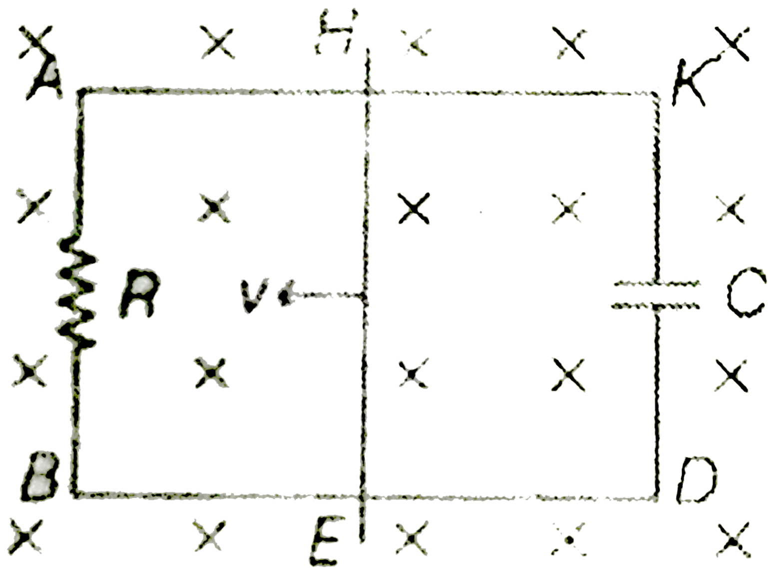
76. In the circuit shown in figure, a conducing wire HE is moved with a constant sped v towards left. The complete circuit is placed in a uniform magnetic field B perpendicular to the plane of circuit inwards. The current in HKDE is



A. (a) clockwise

B. (b) anticlockwise

C. (c) alternating

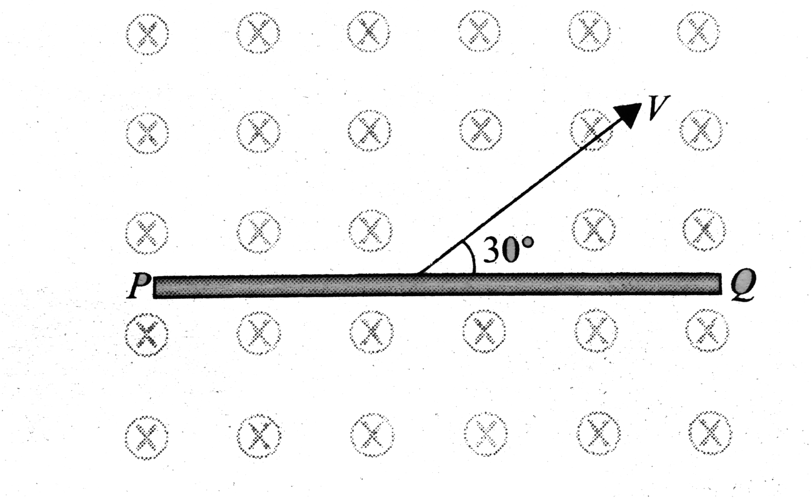
D. (d) zero

Answer: D

Watch Video Solution

77. A conducting rod PQ of length $l = 2m$ is moving at a speed of $2ms^{-1}$ making an angle of 30° with its length. A uniform magnetic field

$B = 2T$ exists in a direction perpendicular to the plane of motin. Then



A. (a) $V_P - V_Q = 8V$

B. (b) $V_P - V_Q = 4V$

C. (c) $V_Q - V_P = 8V$

D. (d) $V_Q - V_P = 4V$

Answer: B

Watch Video Solution

78. A mentallic wire is folded to from a square loop of a . It crries a cureent i and is kept perpendicular to unifrom magnetic field . If the shape of the loop changed from squre to a circle without changing length of the wire and current, the amount of wire done in doing so is

A. (a) $Bia^2\left(1-\frac{4\sqrt{3}}{9}\right)$

B. (b) $Bia^2\left(1-\frac{\sqrt{3}}{9}\right)$

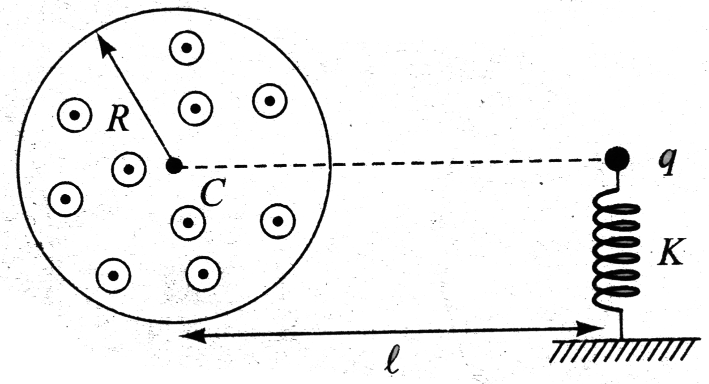
C. (c) $\frac{2}{3}Bia^2$

D. (d) zero

Answer: A

Watch Video Solution

79. There is a horizontal cylindrical uniform but time-varying nagnetic field increasing at a constant rate dB/dt as shown in Fig. 3.173. A charged particle having charge q and mass m is kept in euilibrium, at the top of a spring of spring constant K, in such a way that it is on the horizontal line passing through the center of the magnetic field as shown in the figure. The compression in the spring will be



A. (a) $\frac{1}{K}\left[mg-\frac{qR^2}{2l}\frac{dB}{dt}\right]$

B. (b) $\frac{1}{K}\left[mg+\frac{qR^2}{l}\frac{dB}{dt}\right]$

C. (c) $\frac{1}{K}\left[mg+\frac{2qR^2}{l}\frac{dB}{dt}\right]$

D. (d) $\frac{1}{K}\left[mg+\frac{qR^2}{2l}\frac{dB}{dt}\right]$

Answer: D

Watch Video Solution

Exercises Multiple Correct

1. the uniform magnetic field perpendicualr to the plane of a conducting ring of radius a change at the rate of α, then

A. (a) all the points on the ring are at the same potential

B. (b) the emf induced in the ring is $\pi a^2 \alpha$

C. (c) electric field intensity E at any point on the ring is zero

D. (d) $E = (a\alpha)/2$

Answer: A::B::D

Watch Video Solution

2. The magnetic flux ϕ linked with a conducting coil depends on time as $\phi = 4t^n + 6$, where n is positive constant. The induced emf in the coil is e

A. (a) if $0 < n < 1$, $e \neq 0$ and $|e|$ decreases with time.

B. (b) if $n = 1$, e is constant.

C. (c) If $n > 1$, $|e|$ increases with time.

D. (d) If $n > 1$, $|e|$ decreases with time.

Answer: A::B::C

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3. A circular loop of radius r, having N turns of a wire, is placed in a uniform and constant magnetic field B. The normal of the loop makes an angle θ with the magnetic that the angle θ is constant. Choose the correct statement from the following.

A. (a) emf in the loop is $Nb\omega r^2 / 2 \cos \theta$.

B. (b) emf induced in the loop is zero.

C. (c) emf must be induced as the loop crosses magnetic lines.

D. (d) emf must not be induced as flux does not change with time.

Answer: B::D

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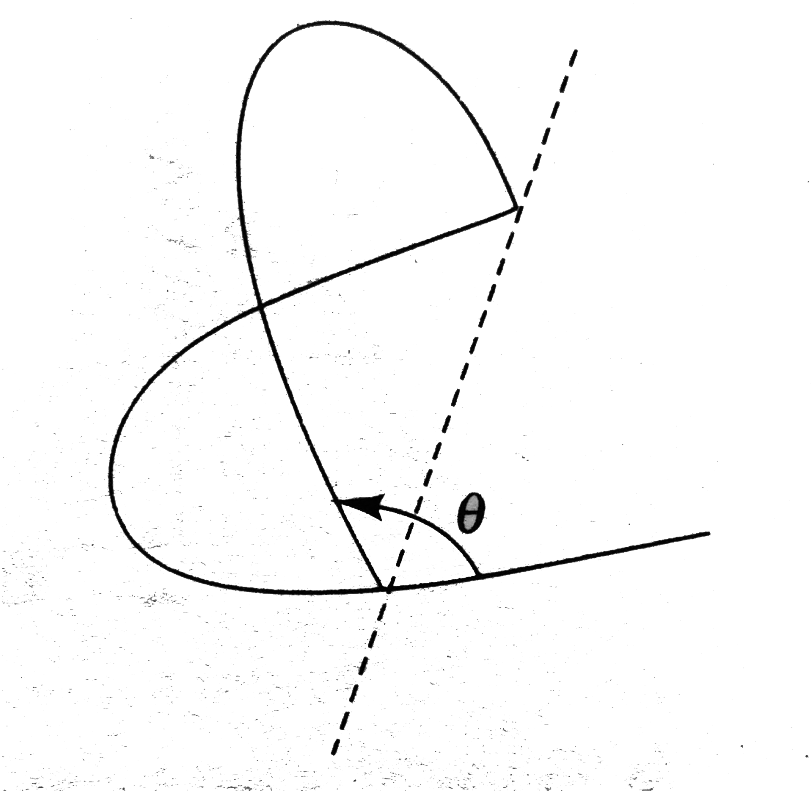
4. A uniform circular loop of radius a and resistance R palced perpendicular to a uniform magnetic field B. One half of the loop is rotated about the diameter with angular velocity ω as shown in Fig. Then, the current in the loop is



A. (a) zero, when θ is zero

B. (b) $\frac{\pi a^2 B\omega}{2R}$, when θ is zero

C. (c) zero, when $\theta = \pi/2$

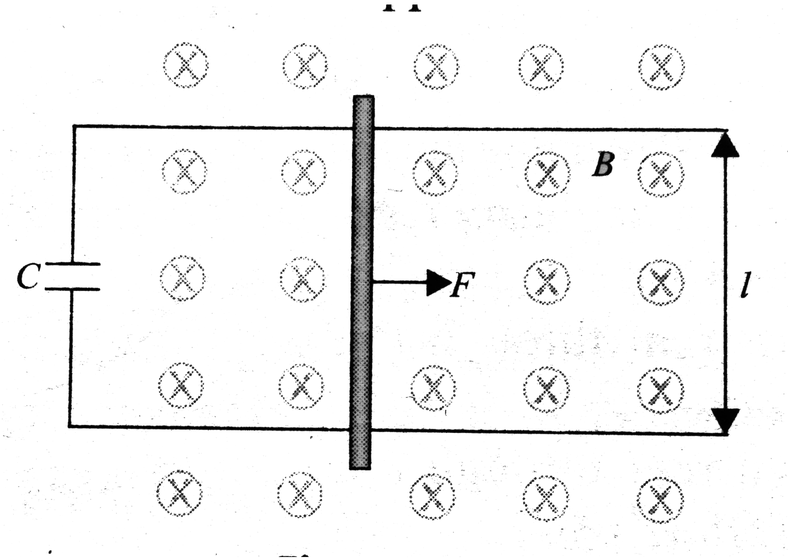
D. (d) $\frac{\pi a^2 B\omega}{2R}$, when $\theta = \pi/2$

Answer: A::D

Watch Video Solution

5. A conducting wire of length l and mass m can slide without friction on two parallel rails and is connected to capacitance C. The whole system lies in amagnetic field B and a constant force F is applied to the rod .

Then



A. (a) the rod moves with constant velocity.

B. (b) the rod moves with an acceleration of $(F)/(m+B^2l^2C)$.

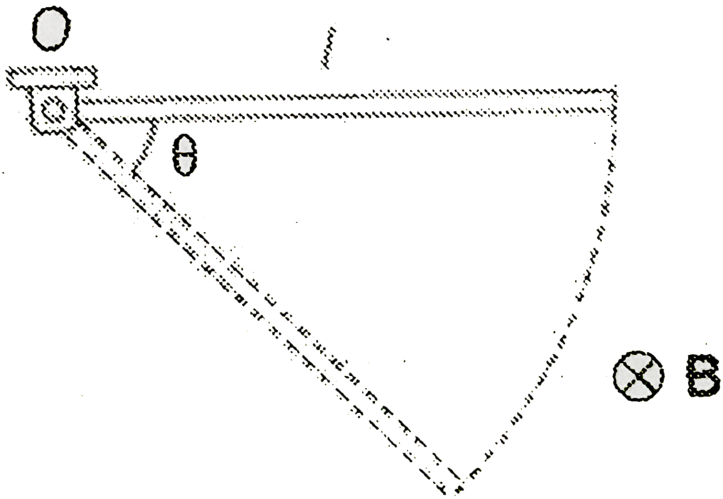
C. (c) there is constant charge on the capacitor.

D. (d) charge on the capacitor increases with time.

Answer: B::D

Watch Video Solution

6. A conducting rod of length l is hinged at point O. It is a free to rotate in a verical plane. There exists a uniform magnetic field B in horizontal direction. The rod is released from the position shown. The potential difference between the two ends of the rod is proportional to



A. (a) $l^{3/2}$

B. (b) l^2

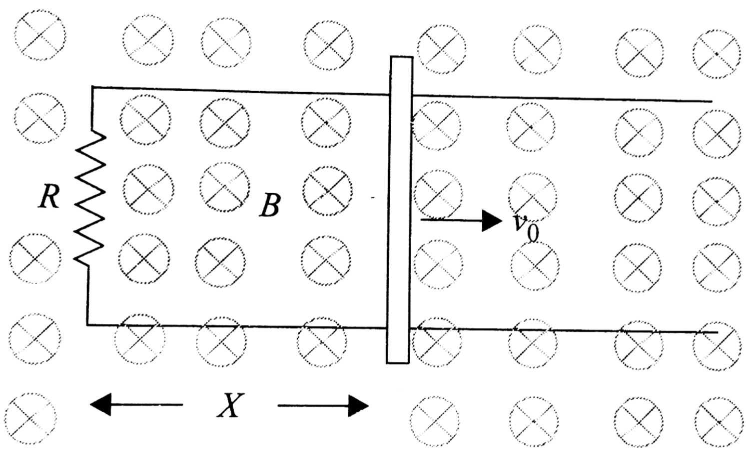
C. (c) $\sin\theta$

D. (d) $(\sin\theta)^{1/2}$

Answer: B::D

7. A conducting rod of length is moved at constant velocity v_0 on two parallel, conducting, smooth, fixed rails, that are placed in a uniform constant magnetic field B perpendicular to the plane for the rails as shown in Fig. A resistance R is connected between the two ends of the rails.

Then which of the following is/are correct:



A. (a) The thermal power dissipated in the resistor is equal to the rate of work done by an external person pulling the rod.

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

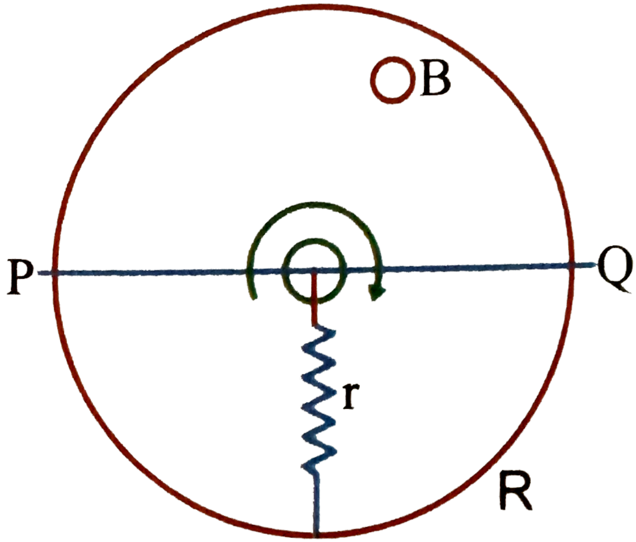
C. (c) Lenz's law is not satisfiedif the rod is accelerated by an external force.

D. (d) If resistance R is doubled, then power required to maintain the constant velocity V_0 becomes half.

Answer: A::B::D

Watch Video Solution

8. In the figure shown $'R'$ is a fixed conducting fixed ring of negligible resistance and radius $'a'$ PQ is a uniform rod of resistance r. It is hinged at the centre of the ring and rotated about this point in clockwise direction with a uniform angular velocity w. These is a uniform magnetic filled of strength $'B'$ ponting inwards. $'r'$ is a stationary resistance



A. (a) current through r is zero

B. (b) current through r is $\left(2B\omega a^2\right)/5r$

C. (c) direction of current in external resistance r is from center to circumference

D. (d) direction of current in external resistance r is from circumference to center

Answer: B::D

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9. An infinite current-carrying conductor is placed along the z-axis and a wire loop is kept in the $x - y$ plane. The current in the conductor is increasing with time. Then the

A. (a) emf induced in the wire loop is zero

B. (b) nagnetic flux passing through the wire loop is zero

C. (c) emf induced is zero but magnetic flux is not zero

D. (d) emf induced is not zero but magnetic flux is zero

Answer: A::B

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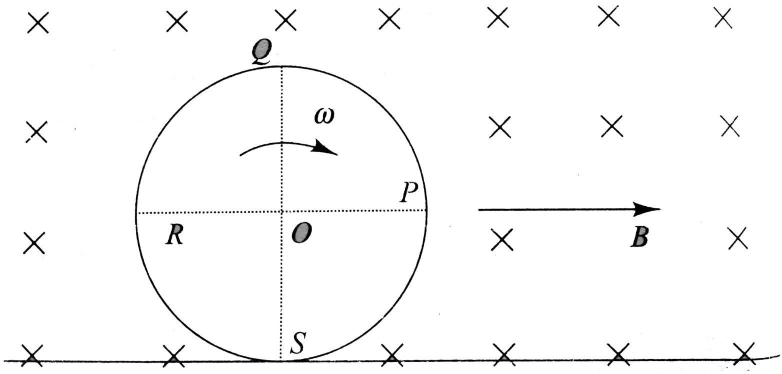
10. A disc of radius R is rolling without sliding on a horizontal surface with a velocity of center of mass v and angular velocity ω in a uniform magnetic field B which is perpendicular to the plane of the disc as shown in Fig. 3.179. O is the center of the disc and $P, Q, R, \text{ and } S$ are the four points on the disc. Which of the following statements is true?



A. (a) Due to translation, induced emf across $PS = Bvr$

B. (b) Due to translation, induced emf across $QS = 0$

C. (c) Due to translation, induced emf across $RO = 0$

D. (d) Due to translation, induced emf across $OQ = Bvr$

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

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11. A conducting loop rotates with constant angular velocity about its fixed diameter in a uniform magnetic field, whose direction is perpendicular to that fixed diameter.

A. (a) The emf will be maximum at the moment when flux is zero

B. (b) The emf will be 0 at the moment when flux ismaximum

C. (c) The emf will be maximum at the moment when plane of the loop is parallel to the magnetic field

D. (d) The phase difference between the flux and the emf $\pi/2$

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

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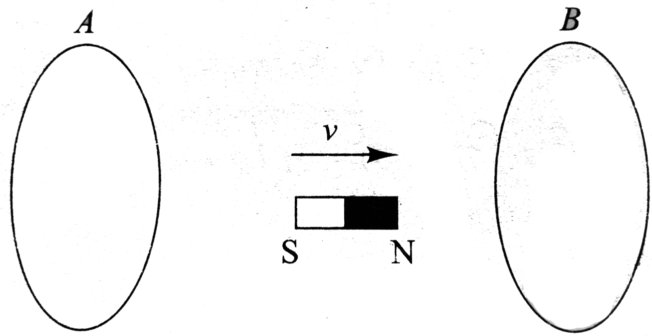
12. A bar magnet is moved between two parallel circular loops A and B with a constant velocity v as shown in Fig. 3.180.



A. (a) The current in each loop flows in the same direction

B. (b) The current in each loop flows in the opposite direction

C. (c) The loops will repel each other

D. (d) The loops attract each other

Answer: B::C

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13. A bar magnet moves toward two idential parallel circular loops with a contant velocity v as shown in Fig.

A. (a) Both the loops will atytract each other

B. (b) Both the loops will repel each other

C. (c) The induced current in A is more than that in B

D. (d) The induced current is same in both the loops

Answer: A::C

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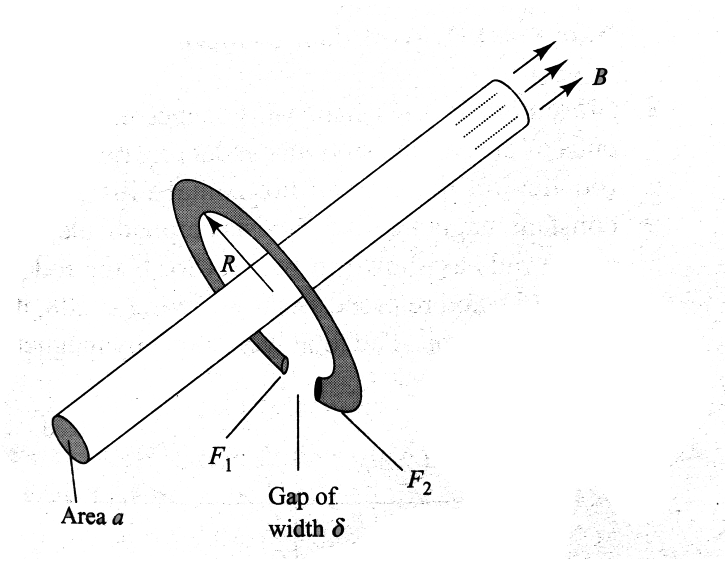
14. A highly conducting ring of radius R is perpendicular to and concentric with the axis of a long solenoid as shown in Fig. 3.182. The ring has a narrow gap of width δ in its circumference. The cross-sectional area of the solenoid is a. The solenoid has a unifoem unitial field of magnitude $B(t) = B_0 + \beta t$, where $\beta > 0$. Assuming that no charge can flow across the gap, the face (s) accumulating an excess of positive charge is /are



A. (a) F_1

B. (b) F_2

C. (c) F_1 and F_2 both

D. (d) difficult to conclude as data given are insufficient

Answer: A::D

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15. The acceleration of the charge on the gap faces will cease when the total electric field within the ring becomes zero. For this to happen, the electric field E_0 in the gap is

A. (a) $E_0 = \frac{a\beta}{\delta}$

B. (b) $E_0 = \frac{2a\beta}{\delta}$

C. (c) E_0 is dependent of R for $R > \sqrt{\frac{a}{\pi}}$

D. (d) E_0 is independent of R for $R > \sqrt{\frac{a}{\pi}}$

Answer: A::D

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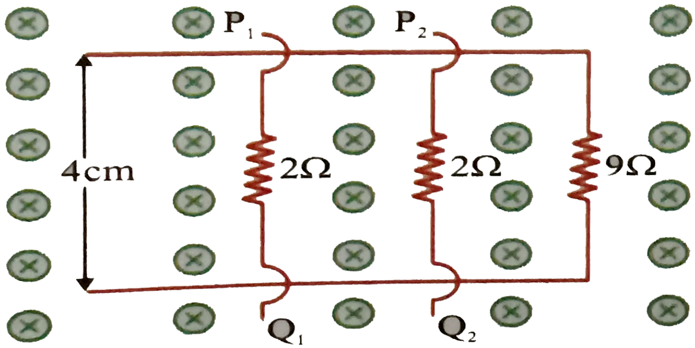
16. In the figure shown , the wires P_1Q_1 and P_2Q_2 are made to slide on the rails with same speed of $5cms^{-1}$. In this region a magnetic field of

$1T$ exists. The electric current in the 9Ω resistance is :



A. (a) zero if both wires slide toward left

B. (b) zero if both wires slide in opposite directions

C. (c) $0.2mA$ if both wires move toward left

D. (d) $0.2mA$ if both wires move in opposite directions

Answer: B::C

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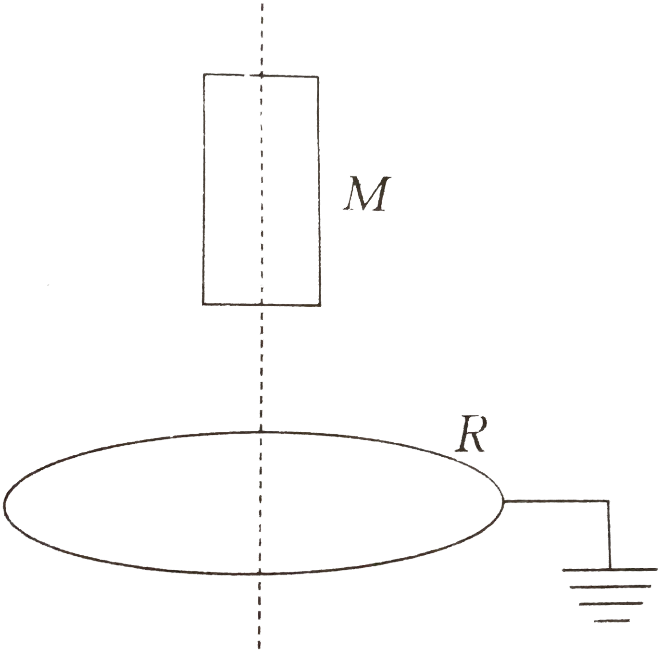
17. A small magnet M is allowed to fall through a fixed horizontal conducting ring R. Let g be the acceleration due to gravity. The acceleration of M, a will be



A. (a) $< g$ when it is above R and moving toward R

B. (b) $> g$ when it is above R and moving toward R

C. (c) $< g$ when it is below R and moving away from R

D. (d) $> g$ when it is below R and moving away from R

Answer: A::C

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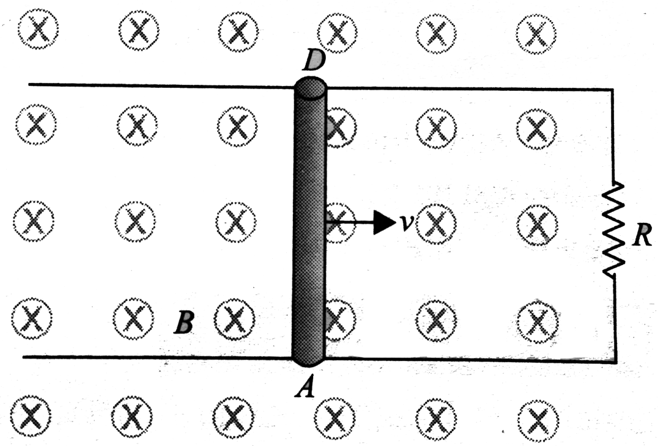
18. The counductor AD moves to the right in a uniform magnetic field directed into the plane of the paper.



A. (a) The free electron in AD will move toward A

B. (b) D will acquire a positive potential with respect to A

C. (c) A current will flow from $A \rightarrow D$ in AD in closed loop

D. (d) The current in AD flows from lower to higher potential

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

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19. The magnitude of the earth's magnetic field at a place is B_0 and angle of dip is δ. A horizontal conductor of lenth/lying along the magnetic north-south moves eastwards with a velocity v. The emf induced acroos the coductor is

A. (a) zero, if v is vertical

B. (b) $B_0 lv$, if v is vertical

C. (c) zero, if v is horizontal

D. (d) $B_0 lv$, if v is horizontal

Answer: A::D

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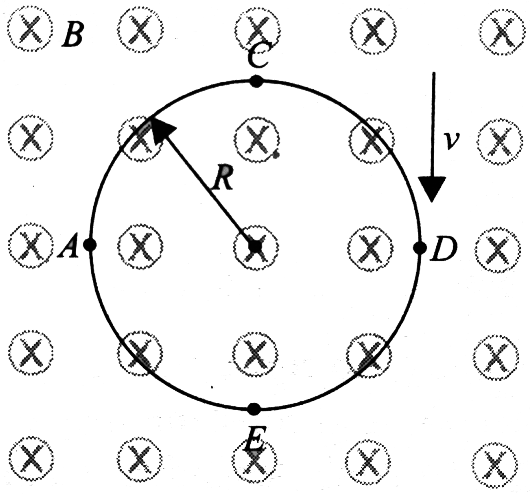
20. A vertical conducting ring ogradius R falls vertically in a horizontal magnetic field of magnitude B. The direction of B is perpendicular to the plane of the ring. When the speed of the ring is `v,



A. (a) no current flows in the ring

B. (b) A and D are at the same potential

C. (c) C and E are at the same potential

D. (d) the potential difference between A and D is $2BRv$, with D at a higher potetial

Answer: A::C::D

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21. A flat coil, C, of n turns, area A and resistance R, is placed in a uniform magnetic field of magnitude B. The plane of the coil is initially perpendicular to B. The coil,is rotated by an angle θ about a diameter and charge of amount Q flows through it. Choose the correct alternatives.

A. (a) $\theta = 90^\circ, Q = (Ban / R)$

B. (b) $\theta = 180^\circ, Q = (Ban / R)$

C. (c) $\theta = 180^\circ, Q = 0$

D. (d) $\theta = 360^\circ, Q = 0$

Answer: A::B::D

Watch Video Solution

22. In the above problem. The plane of the coil is initially kept parallel to B. The coil is rotated by an angle θ about the diameter perpendicular to

B and charge of amount Q flows through it. Choose the correct alternatives.

A. (a) $\theta = 90^\circ, Q = (Ban/R)$

B. (b) $\theta = 180^\circ, Q = (Ban/R)$

C. (c) $\theta = 180^\circ, Q = 0$

D. (d) $\theta = 360^\circ, Q = 0$

Answer: A::C::D

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23. In the above question if the coil rotates with a constant angular velocity ω, the EMF induced in it

A. (a) is zero

B. (b) changes non-linearly with time

C. (c) has a constant value $= Ban\omega$

D. (d) has a maximum value $= Ban\omega$

Answer: B::D

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Exercises Asserton - Reasoning

1. Statement I: An emf is induced ina long solenoid by a bar magnet that moves while totally inside the solenoid along axis of the solenoid.

Statement II: as the magnet moves inside the solenoid the flux through turns of the solenoid changes.

A. (a) Statement I is True, Staatement II is True, Statement II is correct expaination for Statement I.

B. (b) Statement I is True, Staatement II is True, Statement II is NOT a correct expaination for Statement I.

C. (c) statement I is True, Satement II is false.

D. (d) statement I is False, Satement II is True.

Answer: D

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2. Asseration:Lenz's law violates the principle of conservation of energy.

Reason: Induced e.m.f. opposes always the change in magnetic flux responsible for its production.

A. (a) Statement I is True, Staatement II is True, Statement II is correct expaination for Statement I.

B. (b) Statement I is True, Staatement II is True, Statement II is NOT a correct expaination for Statement I.

C. (c) statement I is True, Satement II is false.

D. (d) statement I is False, Satement II is True.

Answer: D

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3. Statement I: no electric current will be present within a region having uniform and constant magetic field.

Statement II: Within a region of unifrom and cinstant magnetic field $\vec{B}$, the path integral of magnetic field $\oint \vec{B} . d\vec{l}$ along any closed path is zero. Hence, from Ampere cirauital law $\oint \vec{B} . d\vec{l} = \mu_0 I$ (where the given terms ahve usual meaning), no current can be present within a region having uniform and constant magnetic field .

A. (a) Statement I is True, Statement II is True, Statement II is correct expaination for Statement I.

B. (b) Statement I is True, Statement II is True, Statement II is NOT a correct expaination for Statement I.

C. (c) Statement I is True, Statement II is false.

D. (d) Statement I is False, Statement II is True.

Answer: A

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4. Asseration: Time dependent magnetic field generates electric field.

Reason: Direction of electric field generated from time variable magnetic field does not obey Lenz's law.

A. (a) Statement I is True, Staatement II is True, Statement II is correct expaination for Statement I.

B. (b) Statement I is True, Staatement II is True, Statement II is NOT a correct expaination for Statement I.

C. (c) statement I is True, Satement II is false.

D. (d) statement I is False, Satement II is True.

Answer: C

Watch Video Solution

5. Asseration: Induced potential across a coil and therefore induced current is always opposite to the direction of current due to external source.

Reason: Lenz's law states that it always opposes the cause due to which it is being produced.

A. (a) Statement I is True, Staatement II is True, Statement II is correct expaination for Statement I.

B. (b) Statement I is True, Staatement II is True, Statement II is NOT a correct expaination for Statement I.

C. (c) statement I is True, Satement II is false.

D. (d) statement I is False, Satement II is True.

Answer: D

Watch Video Solution

6. Assertion : The magnetic field at the ends of a very long current carrying solenoid is half of that at the centre.

Reason : If the solenoid is sufficiently long. The field within it is uniform.

A. (a) Statement I is True, Staatement II is True, Statement II is correct expaination for Statement I.

B. (b) Statement I is True, Staatement II is True, Statement II is NOT a correct expaination for Statement I.

C. (c) statement I is True, Satement II is false.

D. (d) statement I is False, Satement II is True.

Answer: B

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7. Assertion : The energy of a charged particle moving in a uniform magnetic field does not change.

Reason : Work done by the magnetic field on a charge particle is zero.

A. (a) Statement I is True, Staatement II is True, Statement II is correct expaination for Statement I.

B. (b) Statement I is True, Staatement II is True, Statement II is NOT a correct expaination for Statement I.

C. (c) statement I is True, Satement II is false.

D. (d) statement I is False, Satement II is True.

Answer: A

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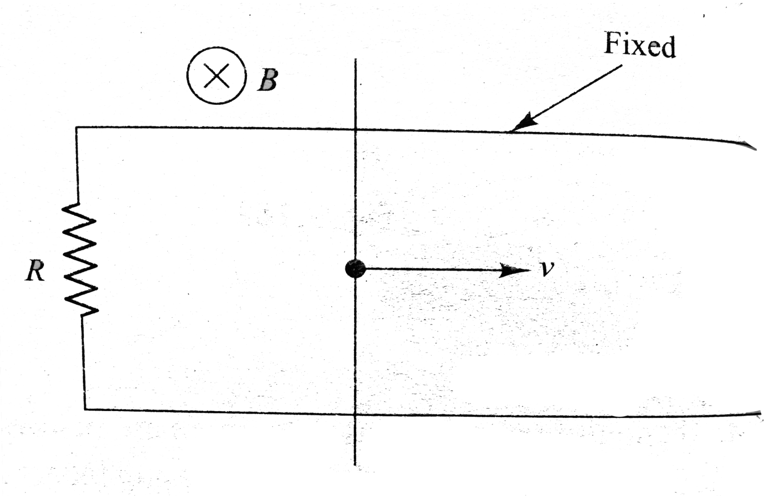
8. Statement I: A resistance R is connected between the two ends of the parallel smooth conducting rails. A conducting rod lies on these fixed horizontal rails and a uniform constant magnetic field B exists perpendicular to the plane of the rails as shown in Fig. if the rod is given a velocity v and released as shown in Fig. 3.188, it will stop after some time. the total work done by magnetic field negative.



Statement II: If force acts opposite to direction of velocity its work done is negative.

A. (a) Statement I is True, Staatement II is True, Statement II is correct expaination for Statement I.

B. (b) Statement I is True, Staatement II is True, Statement II is NOT a correct expaination for Statement I.

C. (c) statement I is True, Satement II is false.

D. (d) statement I is False, Satement II is True.

Answer: D

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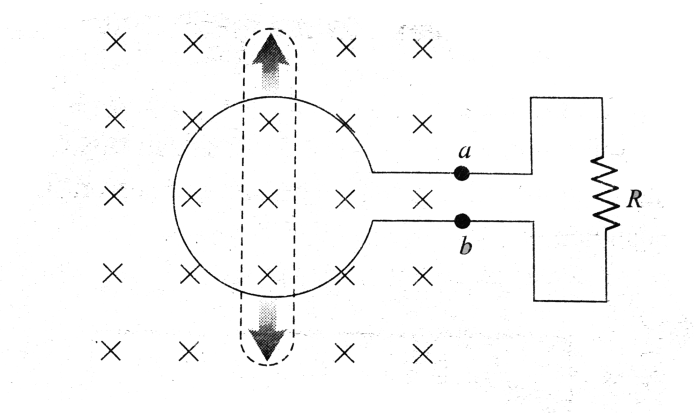
Exercises Linked Comprehension

1. A flexible circular loop $20cm$ in diameter lies in a magneic field with magnitude $1.0T$, direction lies into the plane of the page as shown in Fig. 3.187. The loop is pulled at the points indicated by the arrws, forming a loop of zero area in $0.314s$.



The average induced emf in the circuit is

A. (a) $0.2V$

B. (b) $0.1sV$

C. (c) $1V$

D. (d) $10V$

Answer: B

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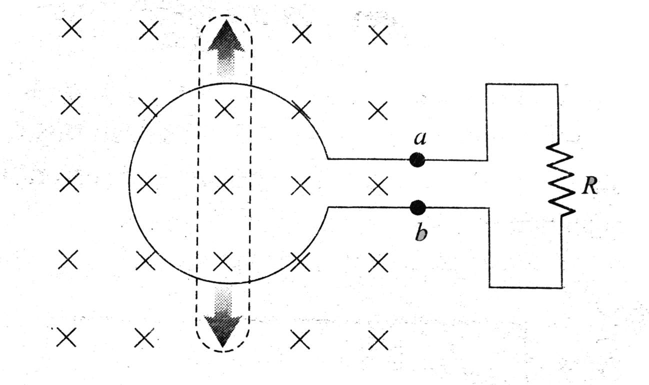
2. A flexible circular loop $20cm$ in diameter lies in a magneic field with magnitude $1.0T$, direction lies into the plane of the page as shown in Fig. 3.187. The loop is pulled at the points indicated by the arrws, forming a loop of zero area in $0.314s$.



if $R = 0, 01\Omega$, the magnitude and direction of current flowing in the loop are

A. (a) $1A$, clockwise

B. (b) $1A$, anticlockwise

C. (c) $10A$, clockwise

D. (d) $10A$, anticlockwise

Answer: C

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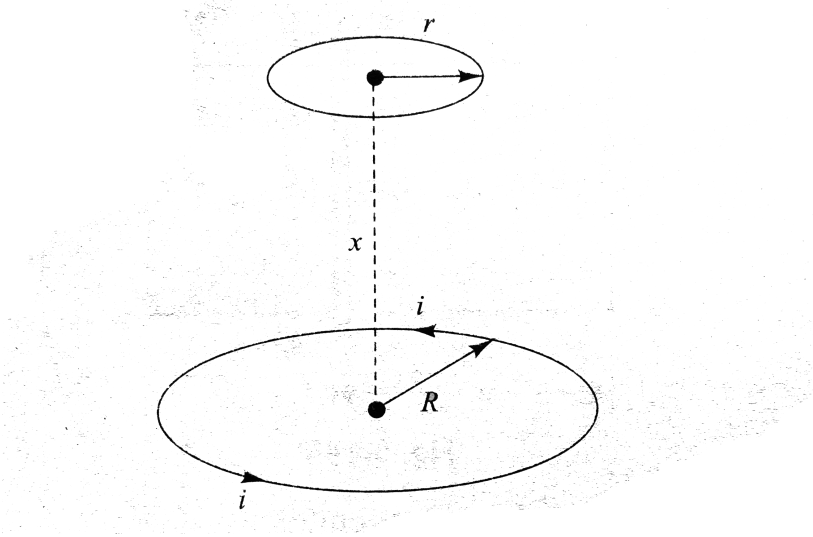
3. Figure. shows two parallel and coaxial loops. The smaller loop (radius r) is above the larger loop (radius R), by distance $x > > R$. The magnetic field due to current i in the larger loop is nearly constant throughout the smaller loop. Suppose that x is increasing at a constant rate of $dx / dt = v$.



Determine the magneitc flux through the smaller loop as a function of x.

A. (a) $\frac{\mu_0 i R^2 \pi r^2}{x^3}$

B. (b) $\frac{\mu_0 i R^2 \pi r^2}{2x^3}$

C. (c) $\frac{2\mu_0 i R^2 \pi r^2}{x^3}$

D. (d) $\frac{\sqrt{2}\mu_0 i R^2 \pi r^2}{x^3}$

Answer: B

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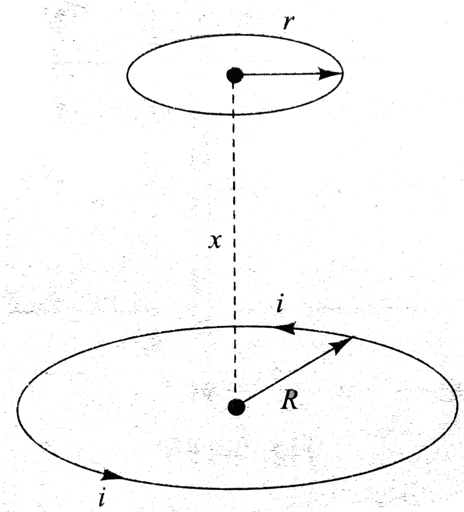
4. Figure 3.188 shows two parallel and coaxial loops. The smaller loop (radius r) is above the larger loop (radius R), by distance $x >> R$. The magnetic field due to current i in the larger loop is nearly constant throughout the smaller loop. Suppose that x is increasing at a constant rate of $dx/dt = v$.



The induced emf in the smaller loop is

A. (a) $\frac{\mu_0 \pi i R^2 r^2}{x^4} v$

B. (b) $\frac{\mu_0 \pi i R^2 r^2}{2x^4} v$

C. (c) $\frac{3}{2} \frac{\mu_0 \pi i R^2 r^2}{x^4} v$

D. (d) $\frac{\mu_0 \pi i R^2 r^2}{3x^4} v$

Answer: C

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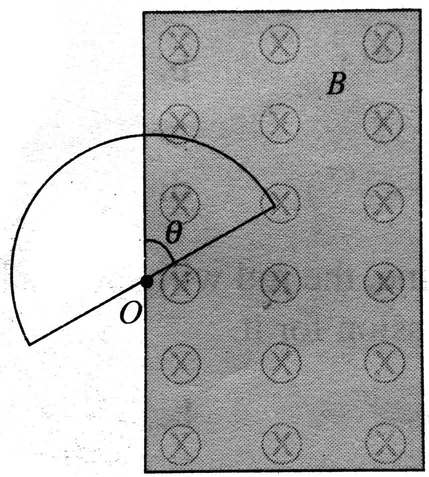
5. A wire loop enclosing a semicircle of radius R islocated on the boundary of a uniform magnetic field B. At the moment $t=0$, the loop is set into rotation with constant angular acceleration α about an axis O. The clockwise emf direction is taken to be positive.



The variation of emf as function of time is

A. (a) $\frac{1}{2}BR^2\alpha t$

B. (b) $\frac{3}{2}BR^2\alpha tA$

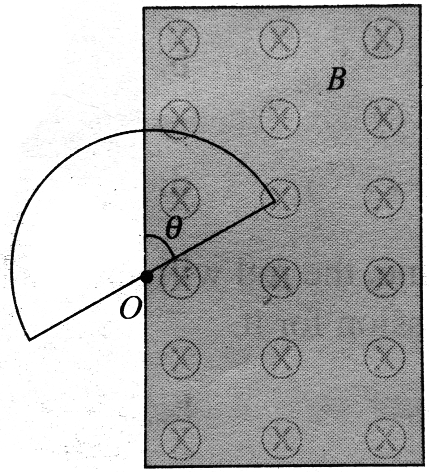
C. (c) $\sqrt{3}BR^2\alpha t$

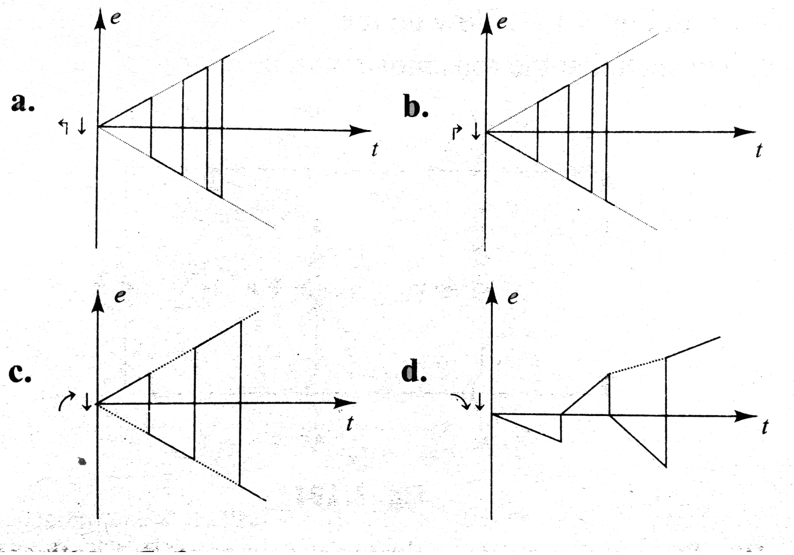
D. (d) $\frac{BR^2\alpha t}{\sqrt{2}}$

Answer: A

Watch Video Solution

6. A wire loop enclosing a semicircle of radius R islocated on the boundary of a uniform magnetic field B. At the moment $t = 0$, the loop is set into rotation with constant angular acceleration α about an axis O. The clockwise emf direction is taken to be positive.





The variation of emf as a function of time is

A. (a)

B. (b)

C. (c)

D. (d)

Answer: B

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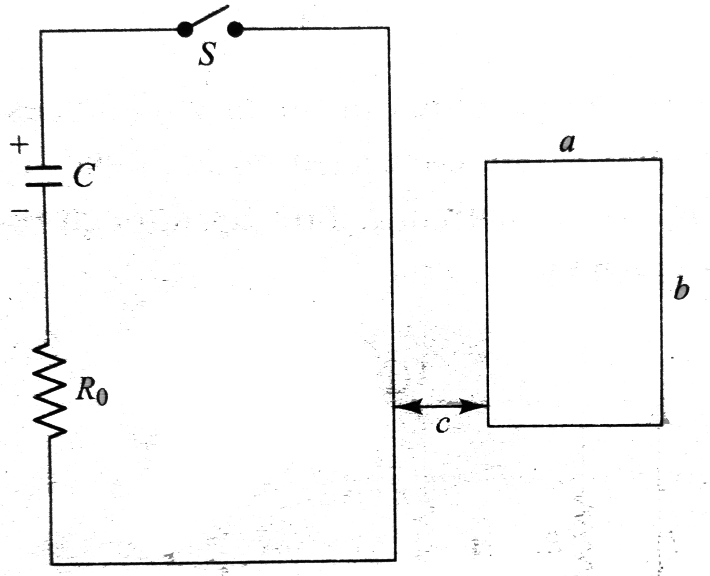
7. In the circuit shown in Fig. the capacitor has capacitance $C = 20\mu F$ and is initially charged to $100V$ with the polarity shown. The resistor R_0 has resistance 10Ω. At time $t = 0$, the switch is closed. The smaller circuit is not connected in any way to teh larger one. the wire of the smaller circuit has a resistance of $1.0\Omega m^{-1}$ and contains 25 loops. the larger circuit is a rectangle $2.0m$ by $4.0m$, while the smaller one has dimensions $a = 10.0cm$ and $b = 20.0cm$. the distance $c$is $5.0cm$. (The figure is not drawn to scale.) Both circuit are held stationary. Assume that only the wire nearest to teh smaller circuit produces. an appreciable magnetic field through it.



The current in the circuit $200ms$ after closing S is

A. (a) $\frac{5}{e}A$

B. (b) $\frac{2}{e}A$

C. (c) $\frac{15}{e}A$

D. (d) $\frac{10}{e}A$

Answer: D

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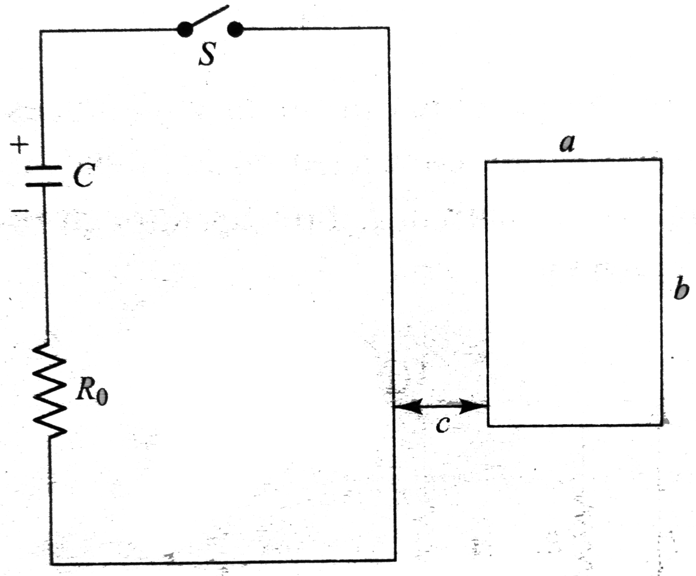
8. In the circuit shown in Fig. the capacitor has capacitance $C = 20\mu F$ and is initially charged to $100V$ with the polarity shown. The resistor R_0 has resistance 10Ω. At time $t = 0$, the switch is closed. The smaller circuit is not connected in any way to teh larger one. the wire of the smaller circuit has a resistance of $1.0\Omega m^{-1}$ and contains 25 loops. the larger circuit is a rectangle $2.0m$ by $4.0m$, while the smaller one has dimensions $a = 10.0cm$ and $b = 20.0cm$. the distance $c$is $5.0cm$. (The figure is not drawn to scale.) Both circuit are held stationary. Assume that only the wire nearest to teh smaller circuit produces. an appreciable magnetic field through it.



The curent in the smaller circuit $200\mu s$ after closing S is

A. (a) $54\mu A$

B. (b) $10\mu A$

C. (c) $15\mu A$

D. (d) $36\mu A$

Answer: A

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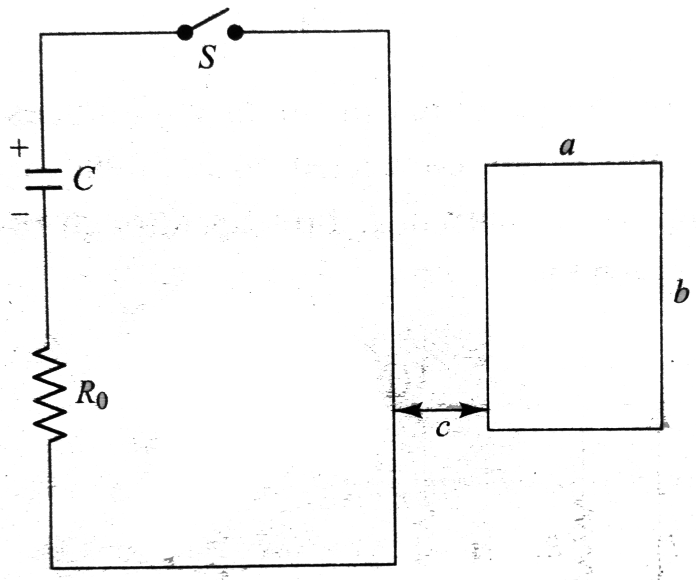
9. In the circuit shown in Fig. the capacitor has capacitance $C = 20\mu F$ and is initially charged to $100V$ with the polarity shown. The resistor R_0 has resistance 10Ω. At time $t = 0$, the switch is closed. The smaller circuit is not connected in any way to teh larger one. the wire of the smaller circuit has a resistance of $1.0\Omega m^{-1}$ and contains 25 loops. the larger circuit is a rectangle $2.0m$ by $4.0m$, while the smaller one has dimensions $a = 10.0cm$ and $b = 20.0cm$. the distance $c$is $5.0cm$. (The figure is not drawn to scale.) Both circuit are held stationary. Assume that only the wire nearest to teh smaller circuit produces. an appreciable magnetic field through it.



The direction of current in the smaller circuit is

A. (a) clockwise

B. (b) anticlockwise

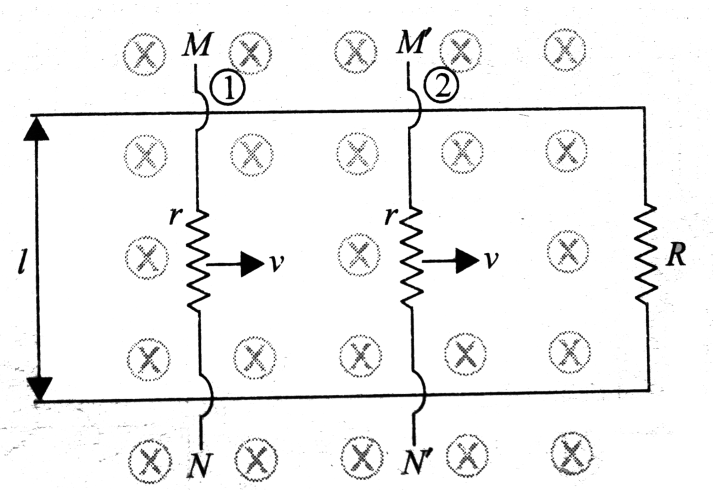
C. (c) always changes with time

D. (d) cannot be calculated

Answer: B

Watch Video Solution

10. Two long parallel conducting rails are placed in a uniform magnetic field. On one side, the rails are connected with a resistance R. Two rods MN and $M'N'$ each having resistance r are placed as showing in Fig. Now on the rods MN and $M'N'$ forces are applied such that the rods move with constant velocity v.



The current flowing through resustance R if both the rods move with the same speed v toward right is

A. (a) $\frac{Blv}{R+(r/2)}$

B. (b) $\frac{2Blv}{R+r}$

C. (c) zero

D. (d) $\frac{3Blv}{2(R+r)}$

Answer: A

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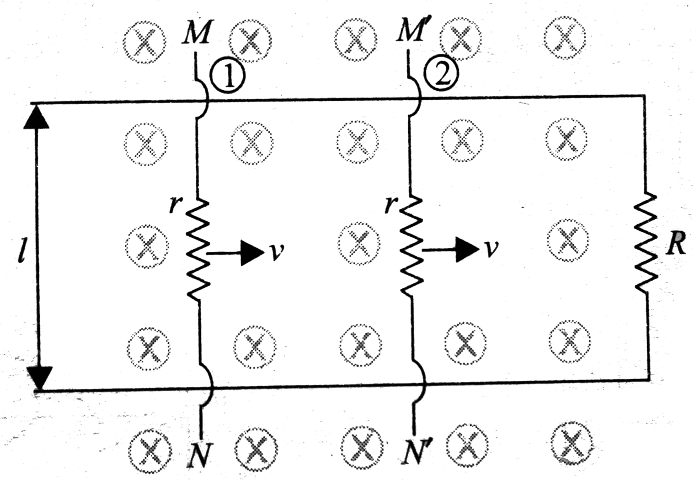
11. Two long parallel conducting rails are placed in a uniform magnetic field. On one side, the rails are connected with a resistance R. Two rods MN and $M'N'$ each having resistance r are placed as showing in Fig. Now on the rods MN and $M'N'$ forces are applied such that the rods move with constant velocity v.



(i). The current flowing through resistance R if the rod Mn moves toward left and the rod $M'N'$ moves toward the right is

A. (a) $\dfrac{Blv}{R+(r/2)}$

B. (b) $\dfrac{2Blv}{R+r}$

C. (c) zero

D. (d) $\dfrac{3Blv}{2(R+r)}$

Answer: C

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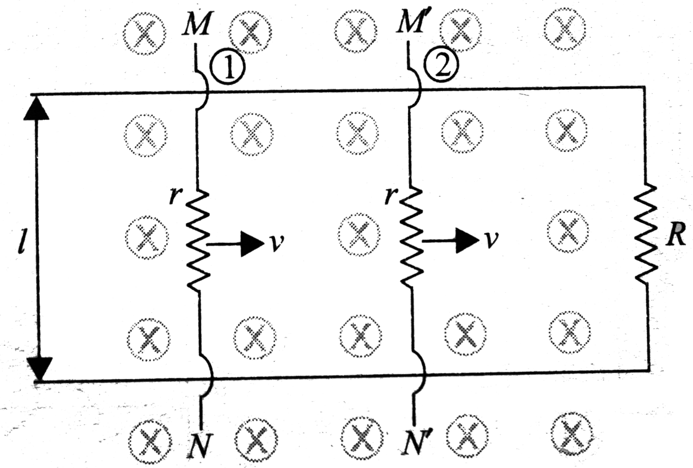
12. Two long parallel conducting rails are placed in a uniform magnetic field. On one side, the rails are connected with a resistance R. Two rods MN and $M'N'$ each having resistance r are placed as showing in Fig. Now on the rods MN and $M'N'$ forces are applied such that the rods move with constant velocity v.



The current flowing through resustance R if both the rods move with the same speed v toward right is

A. (a) $\frac{BlR_2(v_1r_2 - v_2r_1)}{R_1R_2(r_1 + r_2) + r_2r_1(R_1 + R_2)}$

B. (b) $\frac{BlR_2(v_1r_2 + v_2r_1)}{R_1R_2(r_1 + r_2) + r_2r_1(R_1 + R_2)}$

C. (c) $\frac{BlR_2(v_1r_2 - v_2r_1)}{R_1R_2(r_1 - r_2) + r_2r_1(R_1 - R_2)}$

D. (d) $\frac{BlR_2(v_1r_2 - v_2r_1)}{R_1R_2(r_1 + r_2) - r_2r_1(R_1 + R_2)}$

Answer: A

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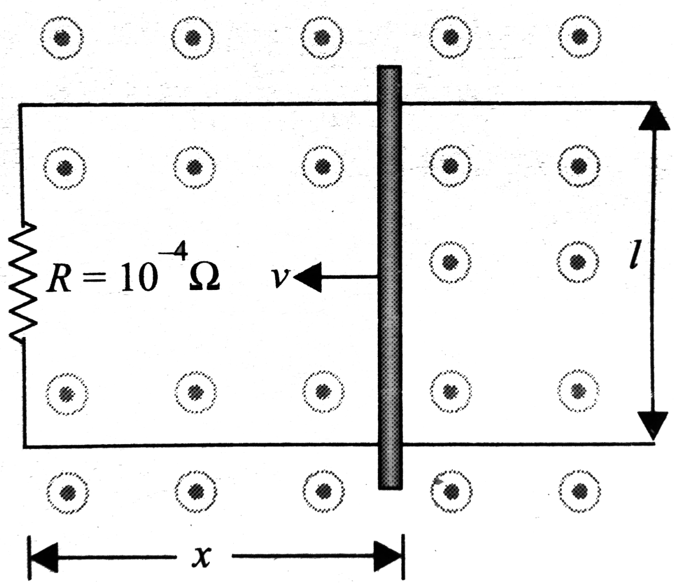
13. A metal bar is moving with a velocity of $v = 5cms^{-1}$ over a U-shaped conductor. At $t = 0$, the external magnetic field is $0.1T$ direction out of the page and is increasing at a rate of $0.2Ts^{-1}$.

Tale $l = 5cm$, and at $t = 0$, $x = 5cm$.



The emf induced in the circuit is

A. (a) $125\mu V$

B. (b) $250\mu V$

C. (c) $100\mu V$

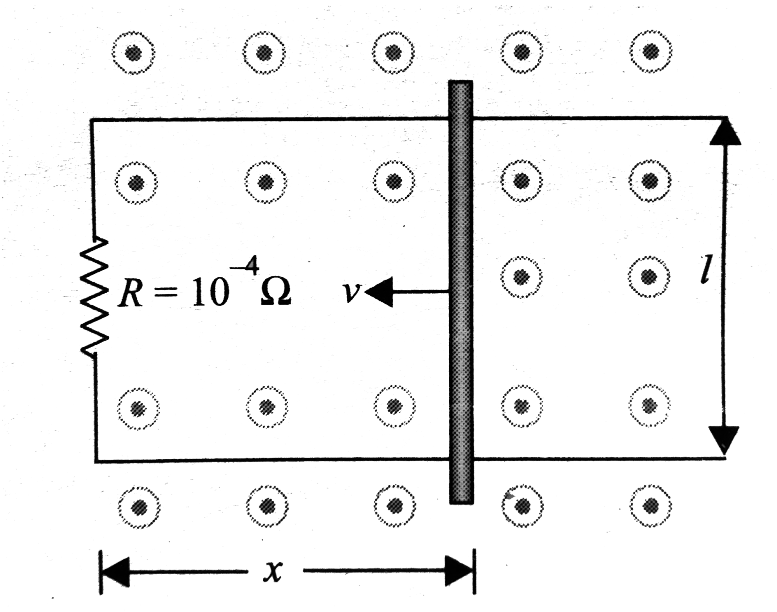
D. (d) $300\mu V$

Answer: B

Watch Video Solution

14. A metal bar is moving with a velocity of $v = 5cms^{-1}$ over a U-shaped conductor. At $t = 0$, the external magnetic field is $0.1T$ direction out of the page and is increasing at a rate of $0.2Ts^{-1}$.

Tale $l = 5cm$, and at $t = 0$, $x = 5cm$.



The current flowing in the circuit is

A. (a) $2.5A$

B. (b) $5A$

C. (c) $1A$

D. (d) $2A$

Answer: A

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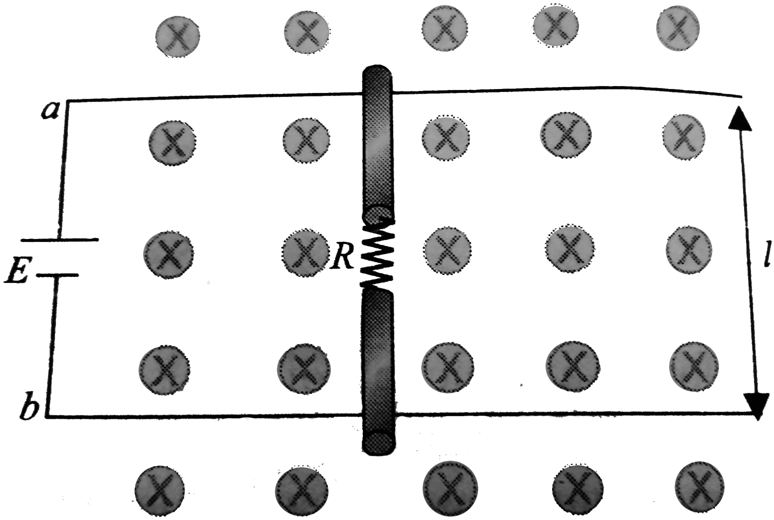
15. In Fig. shown, the rod has a resistance R, the horizontal rails have negligible friction. A battery of emf E and negligible internal resistance is connected between points a and b. The rod is released from rest.



The velocity of the rod as function of time is

A. (a) $\frac{E}{Bl}\left(1-e^{-t/\tau}\right)$

B. (b) $\frac{E}{Bl}\left(1+e^{-t/\tau}\right)$

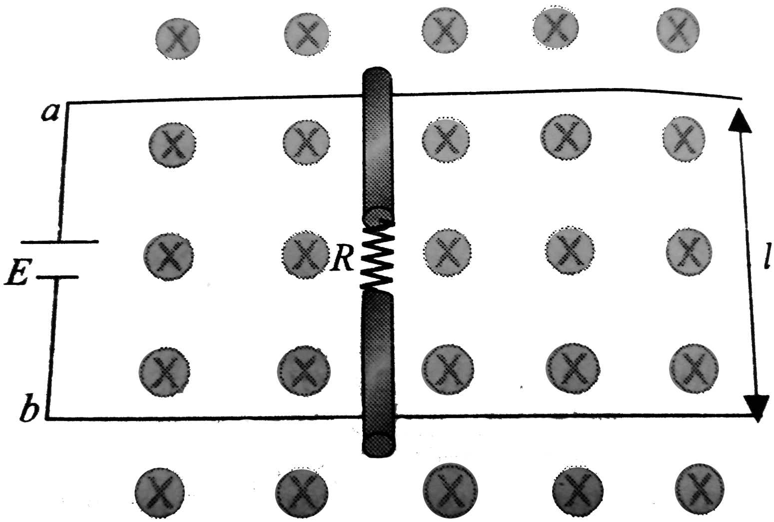
C. (c) $\frac{3}{2}\frac{E}{Bl}\left(1-e^{-t/\tau}\right)$

D. (d) $\frac{E}{2Bl}\left(1-e^{-t/\tau}\right)$

Answer: A

Watch Video Solution

16. In Fig. shown, the rod has a resistance R, the horizontal rails have negligible friction. A battery of emf E and negligible internal resistance is connected between points a and b. The rod is released from rest.



after some time, the rod will approach a terminal speed . Find an expression for it.

A. (a) $\frac{3}{2}\frac{E}{Bl}$

B. (b) $\frac{E}{2Bl}$

C. (c) $\frac{E}{Bl}$

D. (d) $\frac{2E}{Bl}$

Answer: C

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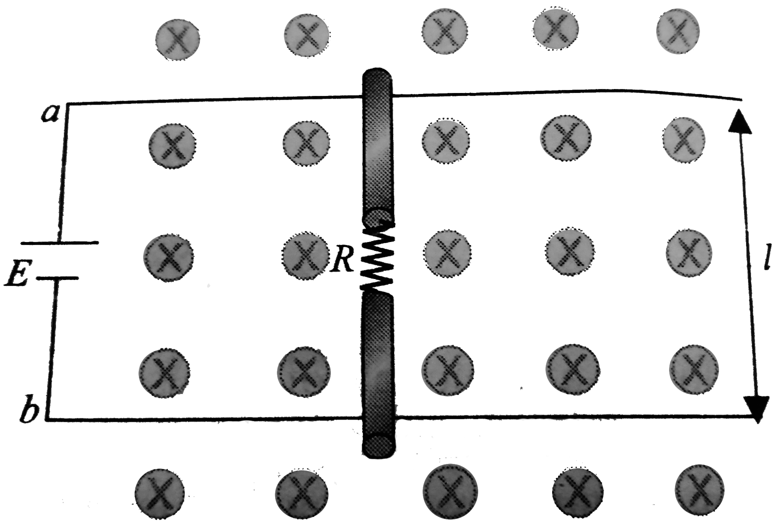
17. In Fig. shown, the rod has a resistance R, the horizontal rails have negligible friction. A battery of emf E and negligible internal resistance is connected between points a and b. The rod is released from rest.



The current when the rod attains its terminal speed is

A. (a) $\frac{2E}{R}$

B. (b) zero if both wires slide in opposite directions

C. (c) $\frac{2}{2}\frac{E}{R}$

D. (d) $\frac{E}{2R}$

Answer: B

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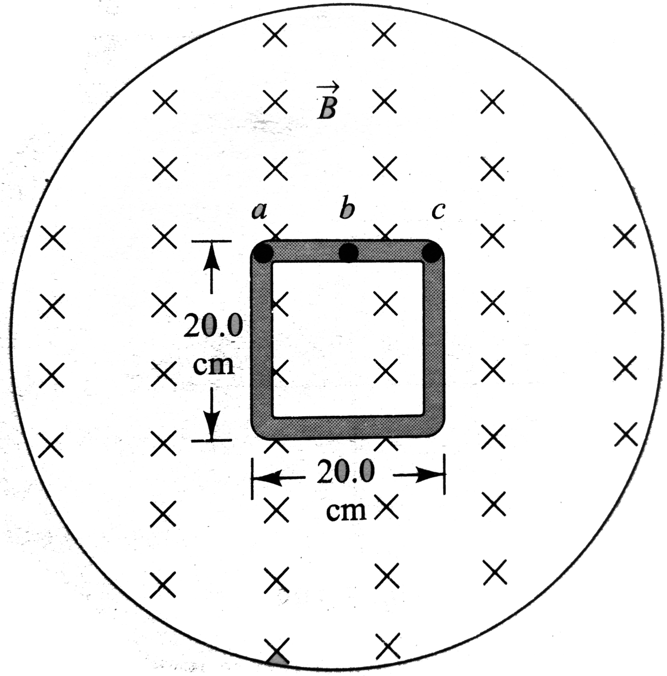
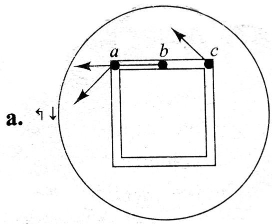
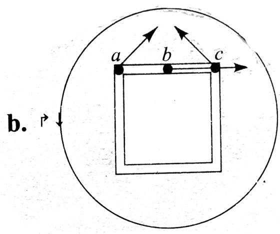
18. A square conductind loop, $20.0cm$ on a side placed in the same magnetic field as shown in Fig. 3.195, center of the magnetic field region, where $dB/dt = 0.035Ts^{-1}$.



he direction of induced electric field at points a, b and c:

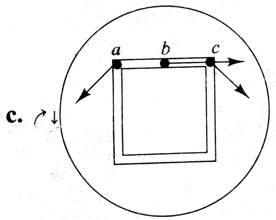


A. (a)

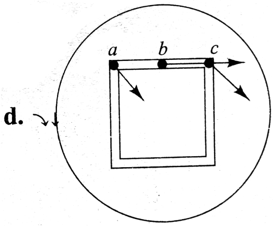


B. (b)

C. (c)



D. (d)



Answer: A

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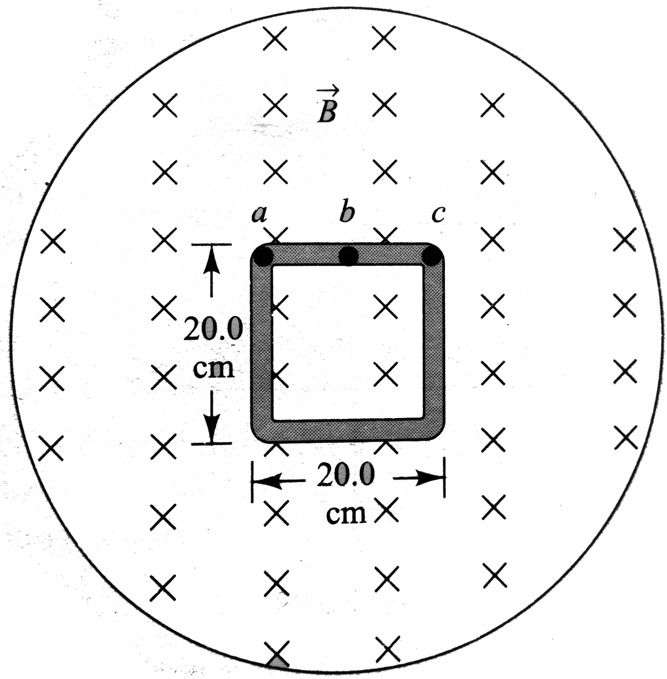
19. A square conductind loop, $20.0cm$ on a side placed in the same magnetic field as shown in Fig. 3.195, center of the magnetic field region, where $dB/dt = 0.035Ts^{-1}$.



The current induced in the loop if its resistance is 2.00Ω is

A. (a) $2.50 \times 10^{-4} A$

B. (b) $4.35 \times 10^{-4} A$

C. (c) $1.25 \times 10^{-4} A$

D. (d) $7.37 \times 10^{-4} A$

Answer: D

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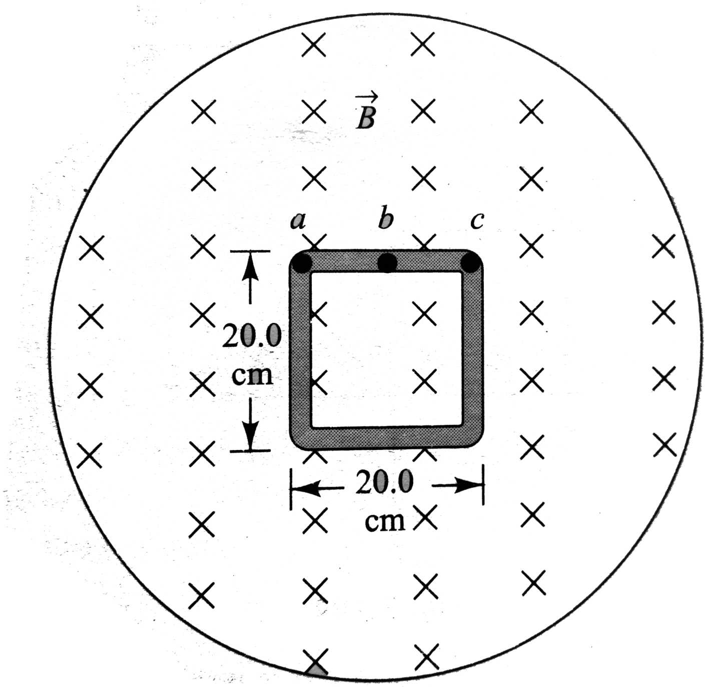
20. A square conductind loop, $20.0 cm$ on a side placed in the same magnetic field as shown in Fig. 3.195, center of the magnetic field region, where $dB/dt = 0.035 T s^{-1}$.



The potential difference between points a and b is

A. (A) $6V$

B. (b) 0

C. (c) $10V$

D. (d) $12V$

Answer: B

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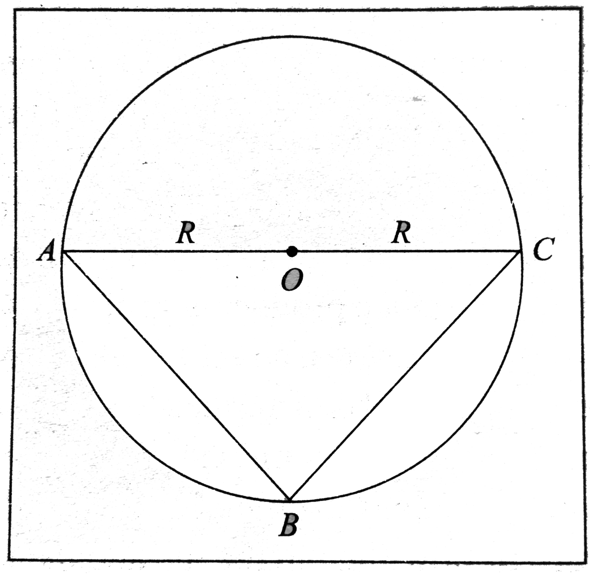
21. In a very long solenoid of radius R, if the magnetic field chabges at the rate of dB/dt. $AB = BC$

The induced emf for the trianglar circuit ABC shown in Fig. 3.196 is



A. (a) $R^2\left(\frac{dB}{dt}\right)$

B. (b) $4R^2\left(\frac{dB}{dt}\right)$

C. (c) $\frac{1}{2}R^2\left(\frac{dB}{dt}\right)$

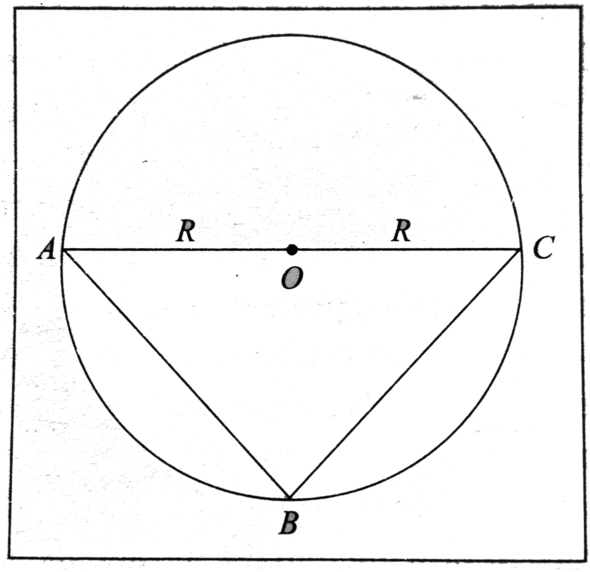
D. (d) $2R^2\left(\frac{dB}{dt}\right)$

Answer: A

Watch Video Solution

22. In a very long solenoid of radius R, if the magnetic field chabges at the rate of dB/dt. $AB = BC$

The induced emf for the trianglar circuit ABC shown in Fig. 3.196 is



A. (a) $R^2\left(\frac{dB}{dt}\right)$

B. (b) $4R^2\left(\frac{dB}{dt}\right)$

C. (c) $\frac{1}{2}R^2\left(\frac{dB}{dt}\right)$

D. (d) $2R^2\left(\frac{dB}{dt}\right)$

Answer: C

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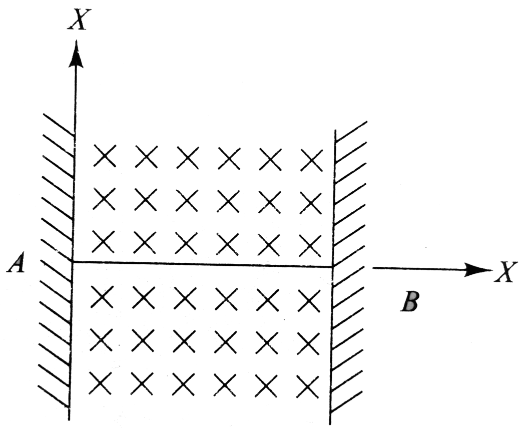
23. A standing wave $y = 2A \sin kx \cos \omega t$ is set up in the wire AB fixed at both ends by two vertical walls (see Fig. 3.197). The region between the walls contains a constant magnetic field B. Now answer the following question:



The wire is found to vibrate in the third harmonic. The maximum emf induced is

A. (a) $\frac{4(AB)\omega}{k}$

B. (b) $\frac{3(AB)\omega}{k}$

C. (c) $\frac{2(AB)\omega}{k}$

D. (d) $\frac{AB\omega}{k}$

Answer: A

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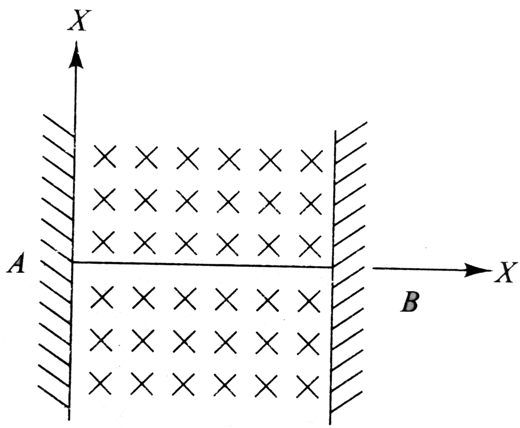
24. A standing wave $y = 2A \sin kx \cos \omega t$ is set up in the wire AB fixed at both ends by two vertical walls (see Fig. 3.197). The region between the walls contains a constant magnetic field B. The wire is found to vibrate in the third harmonic. Now answer the following question:



In the above qestion, the time when the emf becomes maximum for the time is

A. (a) $\frac{2\pi}{\omega}$

B. (b) $\frac{\pi}{\omega}$

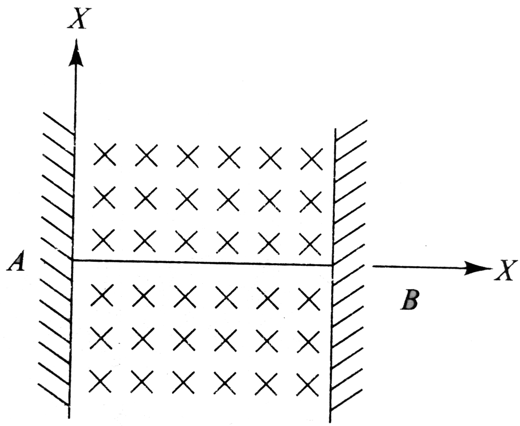
C. (c) $\frac{\pi}{2\omega}$

D. (d) $\frac{\pi}{4\omega}$

Answer: C

Watch Video Solution

25. A standing wave $y = 2A \sin kx \cos \omega t$ is set up in the wire AB fixed at both ends by two vertical walls (see Fig. 3.197). The region between the walls contains a constant magnetic field B. Now answer the following question:



In which of the following modes the emf induced in AB is always zero?

A. (a) fundamental modes

B. (b) second harmonic

C. (c) ssecond overtone

D. (d) fourth overtone

Answer: B

Watch Video Solution

26. A fan operates at 200 volt (DC) consuming $1000W$ when running at full speed . It's internal wiring has resistance 1Ω . When the fan runs at full speed , its speed becomes constant. This is because the torque due to magnetic field inside tha fan is balanced by the torque due to air resistance on the blades of the fan and torque due to friction between the fixed part and the shaft of the fan. The electrical power going into the fan is spent (i) in the internal resistance as heat, call it $P_1(ii)$ in doing work against internal friction and air resistance producing heat, sound etc. call it P_2. When the coil of fan rotates, an emf is also induced in the coil. This opposes the external emf applied to snd the current into the fan. This emf is called back-emf,call it $'e'$.

Answer the following questions when the fan is running at full speed.

The current flowing into the fan and the value of back emf e is

A. (a) $200A, 5V$

B. (b) $5A, 200V$

C. (c) $5A, 195V$

D. (d) $1A, 0V$

Answer: C

Watch Video Solution

27. A fan operates at 200 volt (DC) consuming $1000W$ when running at full speed . It's internal wiring has resistance 1Ω . When the fan runs at full speed , its speed becomes constant. This is because the torque due to magnetic field inside tha fan is balanced by the torque due to air resistance on the blades of the fan and torque due to friction between the fixed part and the shaft of the fan. The electrical power going into the fan is spent (i) in the internal resistance as heat, call it $P_1 (ii)$ in doing work against internal friction and air resistance producing heat, sound etc. call it P_2. When the coil of fan rotates, an emf is also induced in the coil. This opposes the external emf applied to snd the current into the fan. This emf is called back-emf,call it $'e'$.

Answer the following questions when the fan is running at full speed.

The value of power P_1 is

A. (a) $1000W$ s

B. (b) $975W$

C. (c) $25W$

D. (d) $200W$

Answer: C

Watch Video Solution

28. A fan operates at 200 volt (DC) consuming $1000W$ when running at full speed . It's internal wiring has resistance 1Ω . When the fan runs at full speed , its speed becomes constant. This is because the torque due to magnetic field inside tha fan is balanced by the torque due to air resistance on the blades of the fan and torque due to friction between the fixed part and the shaft of the fan. The electrical power going into the fan is spent (i) in the internal resistance as heat, call it $P_1 (ii)$ in doing work against internal friction and air resistance producing heat, sound etc. call it P_2. When the coil of fan rotates, an emf is also induced in the coil. This opposes the external emf applied to snd the current into the fan. This emf is called back-emf,call it $'e'$.

Answer the following questions when the fan is running at full speed.

The value of power P_2 si

A. (a) $1000W$ s

B. (b) $975W$

C. (c) $25W$

D. (d) $200W$

Answer: B

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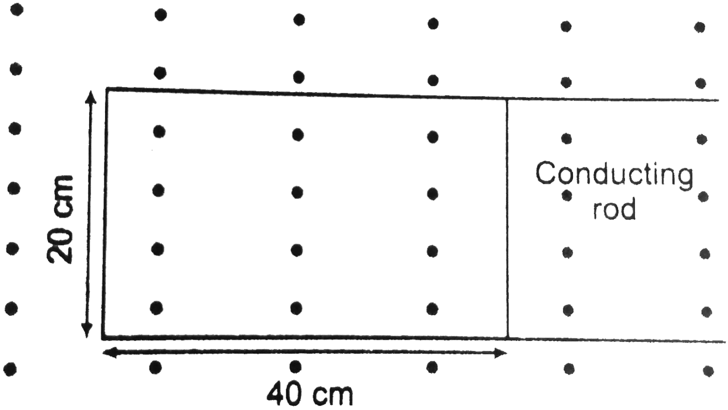
29. Figure shows a conducting rod of negligible resistance that can slide on smooth U-shaped rail made of wire of resistance $1\Omega/m$. Position of the conducting rod at $t=0$ is shown. A time dependent magnetic field $B=2t$ tesla is switched on at $t=0$



The current in the loop at $t = 0$ due to induced emf is

A. (a) $0.16A$, clockwise

B. (b) $0.08A$, clockwise

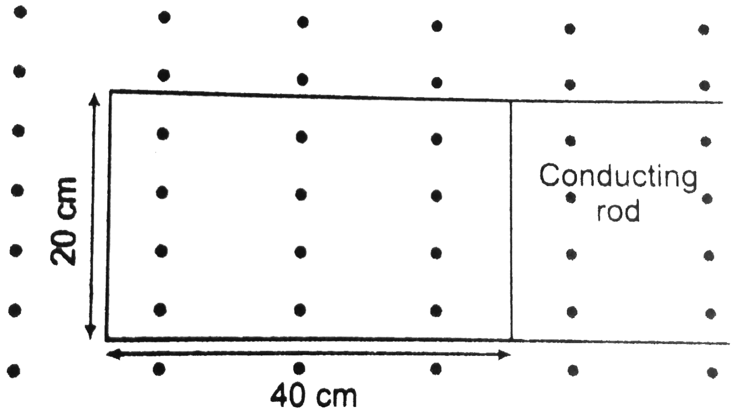
C. (c) $0.08A$, anticlockwise

D. (d) zero

Answer: A

Watch Video Solution

30. Figure shows a conducting rod of negligible resistance that can slide on smooth U-shaped rail made of wire of resistance $1\Omega/m$. Position of the conducting rod at $t = 0$ is shown. A time dependent magnetic field $B = 2t$ tesla is switched on at $t = 0$



At $t = 0$, when the magnetic field is switched on, the conducting rod is moved to the left at constant speed $5cm/s$ by some external means. At $t = 2s$, net induced emf has magnitude

A. (a) $0.12V$

B. (b) $0.08V$

C. (c) $0.04V$

D. (d) $0.02V$

Answer: B

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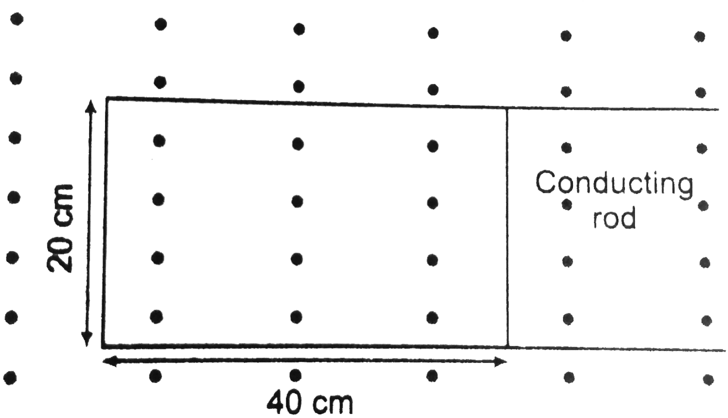
31. Figure shows a conducting rod of negligible resistance that can slide on smooth U-shaped rail made of wire of resistance $1\Omega/m$. Position of the conducting rod at $t=0$ is shown. A time dependent magnetic field $B=2t$ tesla is switched on at $t=0$



The magnitude of the force required to move the conducting rod at constant speed 5cm/s at the same instant $t=2s$, is equal to

A. (a) $0.16N$

B. (a) $0.12N$

C. (c) $0.08N$

D. (d) $0.06N$

Answer: C

Watch Video Solution

32. A brilliant student of physics developed a magnetic balance to weight objects. The mass m to be measured is hung from the center the bar. Bar is kept in a uniform magnetic field of $1.5T$ directed into the plane of the figure. Battery voltage can be adjusted to vary the current in the circuit. The horizontal bar shown is $60cm$ long and is made of extremly light weight material. It is connected to the battery via a resistance. There is no tension in the supporting wired. The magnetic force only supports the hanging weight.

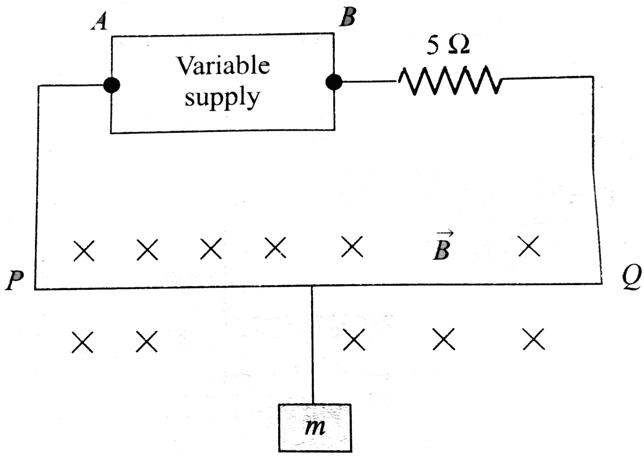


Fig. 3.199

Which point of battery is positive?

A. (a) A

B. (b) B

C. (c) either A or B

D. (d) cannot be found because time of rotation is not given.

Answer: A

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33. A brilliant student of physics developed a magnetic balance to weight objects. The mass m to be measured is hung from the center the bar. Bar is kept in a uniform magnetic field of $1.5T$ directed into the plane of the figure. Battery voltage can be adjusted to vary the current in the circuit. The horizontal bar shown is $60cm$ long and is made of extremly light weight material. It is connected to the battery via a resistance. There is no tension in the supporting wired. The magnetic force only supports the hanging weight.

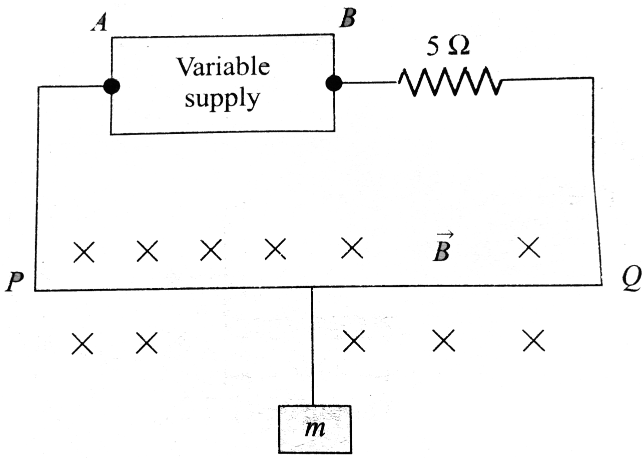

Fig. 3.199

If $V = 150V$, what is the maximum mass m ?

A. (a) $1.3kg$

B. (b) $1.8kg$

C. (c) $2.2kg$

D. (d) $2.7kg$

Answer: D

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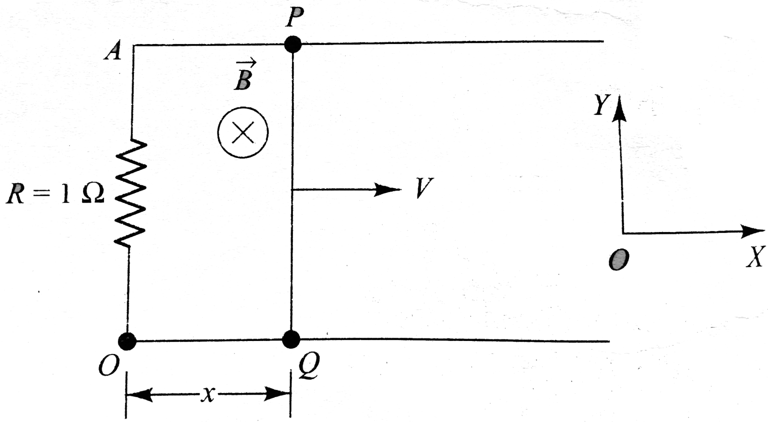
34. Consider two parallel conducting frictionless tracks kept in a gravity-free space as shown in Fig. 3.200. A movable conducting PQ, initially kept at OA, is given a velocity $10ms^{-1}$ toward right. The space contains a magnetic field which depends upon the distance moved by conductor PQ from the OA line and given by



$\overrightarrow{B} = cx\left(-\hat{k}\right)[c = cons\tan t = 1SIunit]$

The mass of the conductor PQ is $1kg$ and length of PQ is 1m. Answer the following question based on the passage.

The distance travelled by the conductor when its speed is $5ms^{-1}$ is

A. (a) $\left(\frac{15}{2}\right)^{1/3}$

B. (b) $\left(\frac{10}{3}\right)^{1/3}$

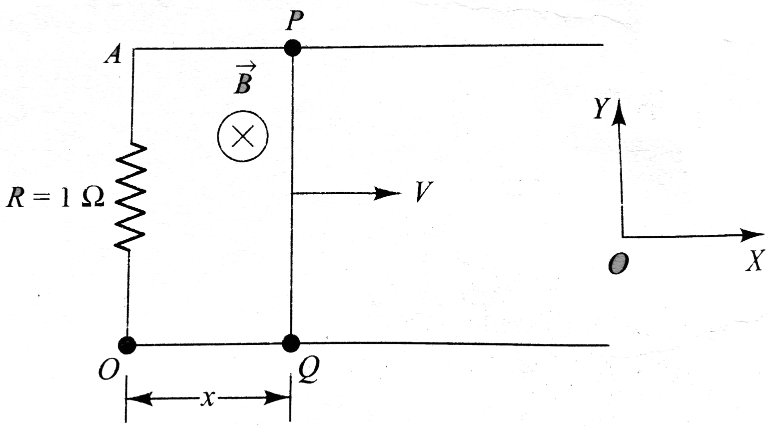
C. (c) $(10)^{1/3}$

D. (d)none of the above

Answer: A

Watch Video Solution

35. Consider two parallel conducting frictionless tracks kept in a gravity-free space as shown in Fig. 3.200. A movable conducting PQ, initially kept at OA, is given a velocity $10ms^{-1}$ toward right. The space contains a magnetic field which depends upon the distance moved by conductor PQ from the OA line and given by



$\overrightarrow{B} = cx\left(-\hat{k}\right)[c = cons\tan t = 1SIunit]$

The mass of the conductor PQ is $1kg$ and length of PQ is 1m. Answer the following question based on the passage.

The loss during the time interval $t = 0$ to time t seconds when the speed of the conductor is $5ms^{-1}$ is

A. (a) $50J$

B. (b) $30J$

C. (c) $10J$

D. (d) none of the above

Answer: D

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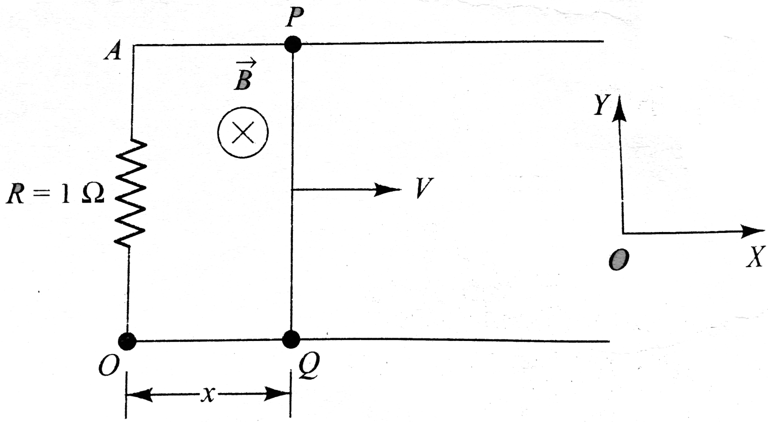
36. Consider two parallel conducting frictionless tracks kept in a gravity-free space as shown in Fig. 3.200. A movable conducting PQ, initially kept at OA, is given a velocity $10ms^{-1}$ toward right. The space contains a magnetic field which depends upon the distance moved by conductor PQ from the OA line and given by



$\vec{B} = cx\left(-\hat{k}\right)[c = cons\tan t = 1SIunit]$

The mass of the conductor PQ is $1kg$ and length of PQ is 1m. Answer the following question based on the passage.

The loss of energy during the time interval $t = 0$ to time t seconds when the speed of the conductor is $5ms^{-1}$ is

A. (a) zero

B. (b) $50J$

C. (c) $10J$

D. (d) $30J$

Answer: A

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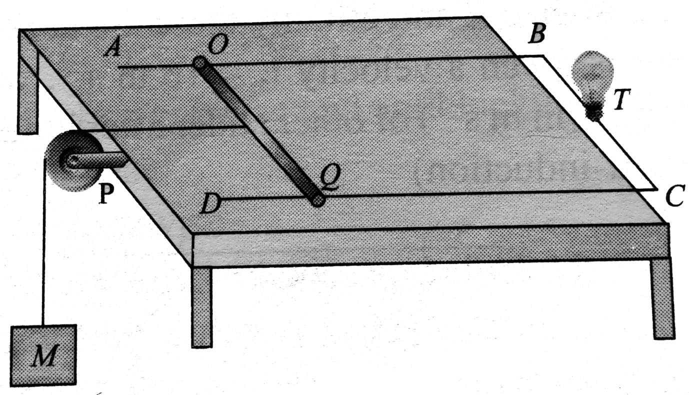
Exercises Integer

1. In Fig. $ABCD$ is a fixed smooth conducting frame in horizontal plane. T is bulb of power $100W$, P is a smooth pulley and OQ is a conducting rod. Neglect the self-inductance of the loop and resistance of any part other than the bulb. The mass M is moving down with constant velocity $10ms^{-1}$. Bulb lights at its rated power due to induced emf in the loop due to earth's magnetic field. Find the mass M (in kg) of teh block. (g = 10 ms^(2))`



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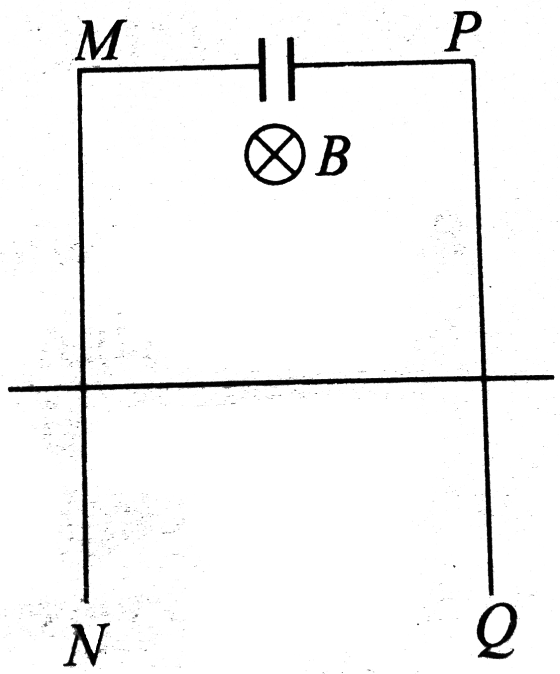
2. Figure shows a conducting rod of length $l = 10cm$, resistance R and mass $m = 100mg$ moving vertically downward due to gravity. Other parts are kept fixed. Magnetic filed is $B = 1T$. MN and PQ are vertical, smooth, the capacitor is $C = 10mF$. The rod is released from rest. Find the maximum current (in mA) in the circuit.



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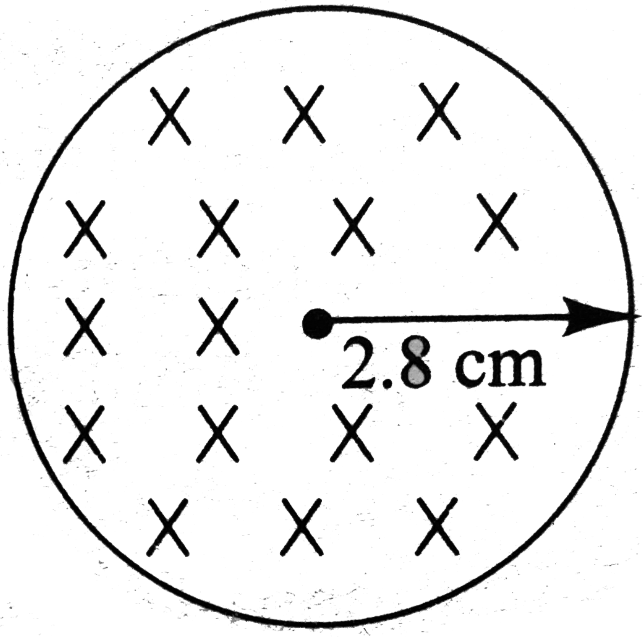
3. The magnetic field of a cyclindrical magnet that has a pole face radius $2.8 cm$ can be varied sinusoidally between the minimum value $16.8T$ and the maximum value $17.2T$ at a frequency of $50 / \pi Hz$. Cross section of the magneic field created by the nagnet is shown in Fig. 3.211. At a radial distance of $2cm$ from the axis, find the amplitude of the electric field $(\in unitsof \times 10^2 mNC^{-1})$ induced by the magnetic field variation.



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4. a long coaxial cable consits of two thin-walled conducting cyclider carries a steady current $0.1A$, and the outer cylinder provides the return path for that current. The current produced a magnetic field between the two cylinders. Find the energy stored in the magnetic field for length $5m$ of the cable. Express answer in Nj (use $1n2 = 0.7$).

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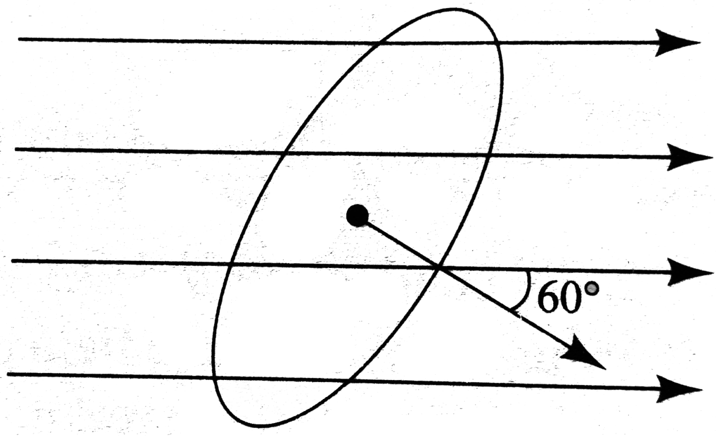
5. A circular coil of wire consists of exactly 100 turns with a total resistance 0.20Ω. The area of the coil is $100cm^2$. The coil is kept in a uniform magnetic field B as shown in Fig. 3.212. The magnetic field is increased at a constant rate of $2Ts^{-1}$. Find the induced current in the coil in A.



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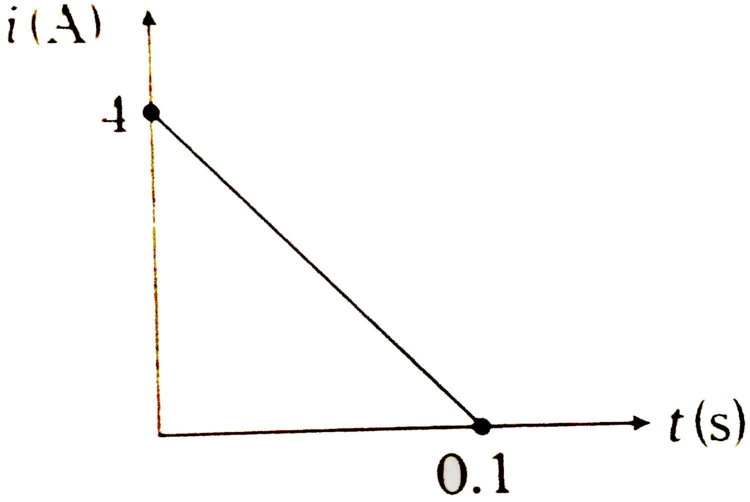
6. Some magnetic flux is changed from a coil of resistance 10Ω. As a result an induced current is developed in it, which varies with time as shown in figure. The magnitude of change in flux through the coil in Wb is



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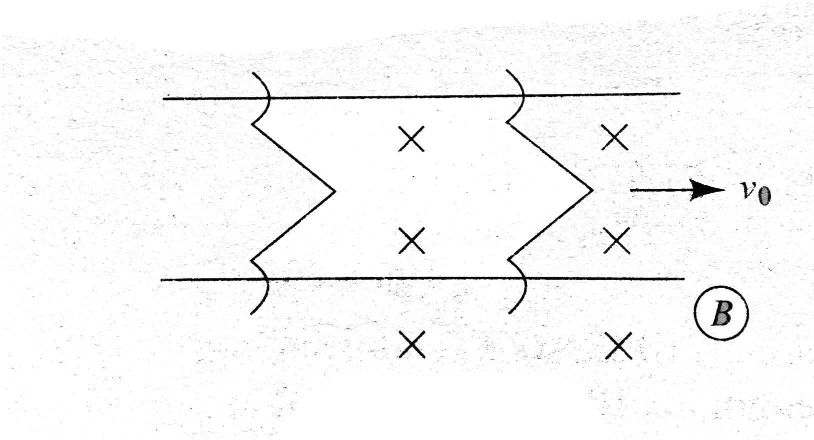
7. In Fig. there are two sliders and they can slide on two frictionless parallel wires in uniform magnetic field B, which is present everywhere. The mass of each slider is m, resistance R and initially these are at reat. Now, if one slider is given a velocity $v_0 = 16ms^{-1}$, what will be the velocity (in ms^{-1})) of other slider after long time ? (neglect the emf selfinducetion)



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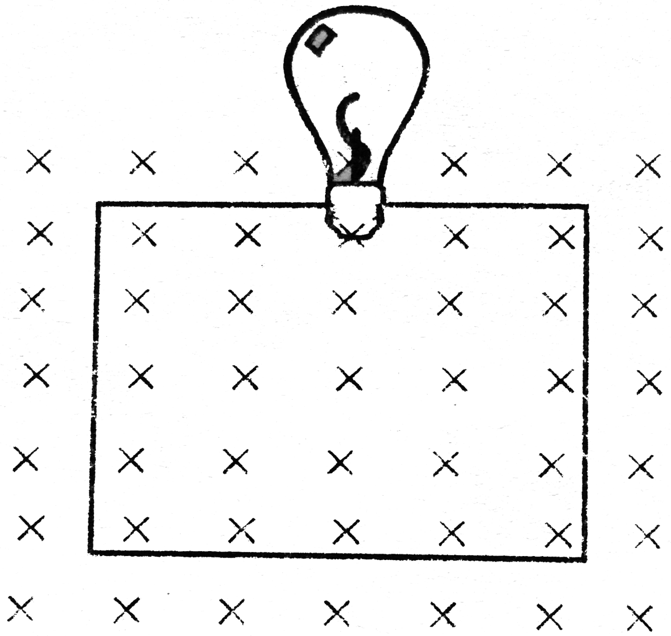
8. A square wire loop of $10.0cm$ side lies at right angles to a uniform magnetic field of $7T$. A $10V$ light bulb is in a series with the loop as shown in Fig. 3.125. The magnetic field decreasing steadily to zero over a time interval Δt. For what value of Δt (im ms), the bulb will shine with full brightness?



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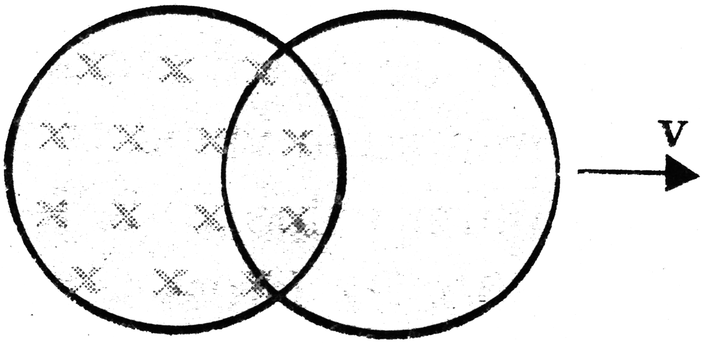
9. A uniform magnetic field $B = 0.5T$ exists in a circular region of radius $R = 5m$. A loop of radius $R = 5m$ encloses the magnetic field at $t = 0$ and then pulled at uniform speed $v = 2ms^{-1}$ In the plane of the paper.

Find the induced emf $(\text{in} V)$ in the loop at time $t = 3s$.



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Archives Fill In The Blanks

1. In a straight conducting wire, a constant current is flowing from left to right due to a source of emf. When the source is switched off, the direction of the induced current in the wire will.........

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2. A coil of metal wire is kept stationary in a non-uniform magnetic field. An e.m.f. Is induced in the coil.

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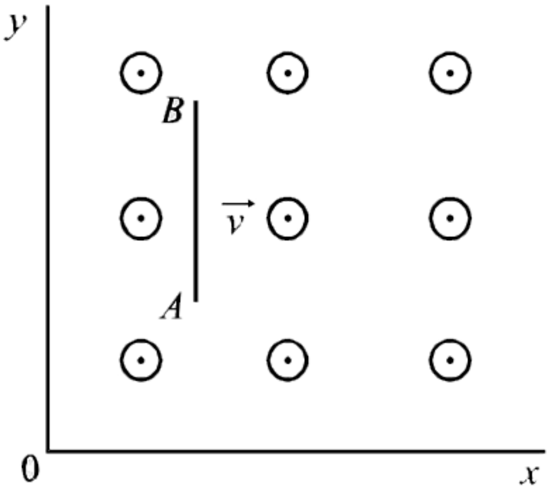
3. A conducting rod AB moves parallel to the x-axis (see Fig.) in a uniform magnetic field pointing in the positive z-direction. The end A of the rod gets positively charged.



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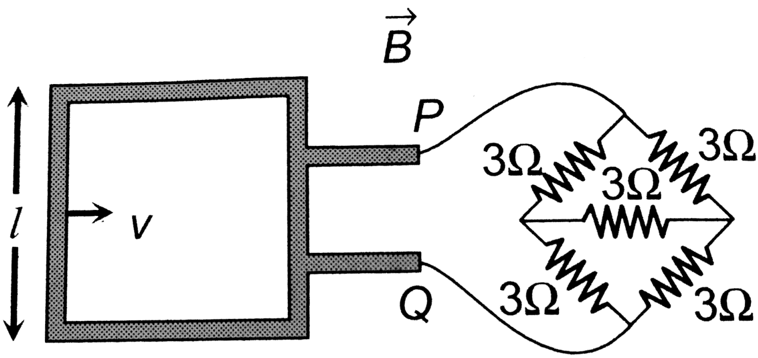
Archives Single Correct

1. A square metallic wire loop of side 0.1 m and resistance of 1Ω is moved with a constant velocity in a magnetic field of $2wb/m^2$ as shown in figure. The magnetic field field is perpendicular to the plane of the loop, loop is coonected to a network of resistances. what should be the velocity of loop so as to have a steady current of $1mA$ in loop?



A. (a) $2ms^{-1}$

B. (b) $2cms^{-1}$

C. (c) $10ms^{-1}$

D. (d) $20ms^{-1}$

Answer: B

2. A conducting square loop of side l and resistance R moves in its plane with a uniform velocity v perpendicular ot one of its sides. A uniform and constant magnetic field B exists along the perpendicualr ot the plane of the loop as shown in . The current induced in the loop is

(##HCV_VOL2_C38_E01_025_Q01##)

A. (a) BLv/Rclockwise

B. (b) BLv/R anticlockwise

C. (c) $2BLv/R$ anticlockwise

D. (d) zero

Answer: D

3. A thin circular ring of area A is perpendicualr to uniform magnetic field of induction B. A small cut is made in the ring the total and a galvanometer is connected across the ends such that the total resistance of circuit is R. When the ring suddenly squeezed to zero area, the charge flowing through the galvanometer is

A. (a) $\frac{BR}{A}$

B. (b) $(AB)/(R)$

C. (c) ABR

D. (d) $(E^2A)/R^2$

Answer: B

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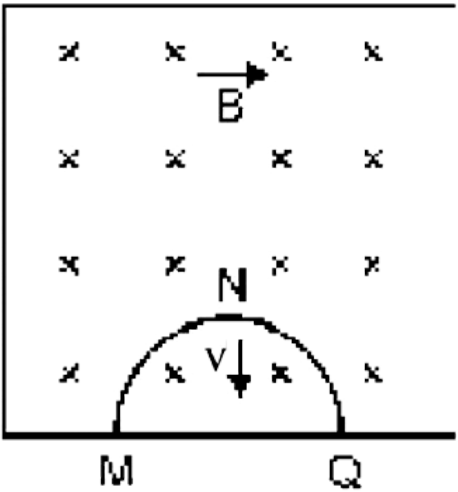
4. A thin semi-circular conducting ring of radius R is falling with its plane verticle in horizontal magnetic induction $\left(\vec{B}\right)$. At the position MNQ the speed of the ring is v, and the potential difference developed across the ring is



A. (a) zero

B. (b) $BV\pi R^2/2$ and M is at higher potential

C. (c) πRBV and Q is at higher potential

D. (d) $2RBV$ and Q is at higher potential

Answer: D

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5. A metal rod mvoess at a constant velocity in a direction perpendicular to its length . A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as it velocity. Select the correct statement from the following

A. (a) The entire rod is at the same electric potential

B. (b) There is an electric field in the rod

C. (c) The electric potential is highest at the center of rod and decrease toward its ends

D. (d) The electric potential is lowest at the center of rod and increase toward its ends

Answer: B

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6. A circular loop of radius R , carrying I, lies in $x-y$ plane with its origin . The total magnetic flux through $x-y$ plane is

A. (a) directly proportional to I

B. (b) directly proportional to R

C. (c) directly proportional to R

D. (d) zero

Answer: D

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7. Two identical circular loops of metal wires are lying on a table without touching each other. Loop A carries a current which increases with time. In response, the loop B

A. (a) remains stationary

B. (b) is attracted by the loop A s

C. (c) is repelled by the loop A

D. (d) rotates about its CM with CM fixed

Answer: C

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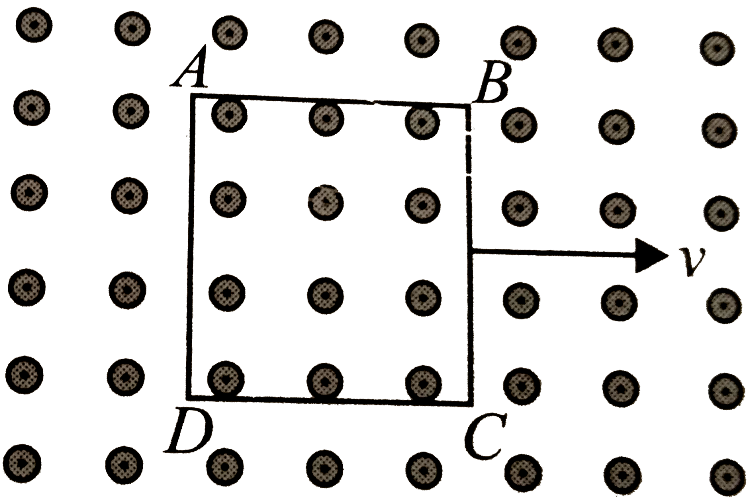
8. A metallic square loop ABCD is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in figure. An electric field is induced



A. (a) AD, but not in BC

B. (b) BC, but not in AD

C. (c) neither AD nor in BC

D. (d) both AD and BC

Answer: D

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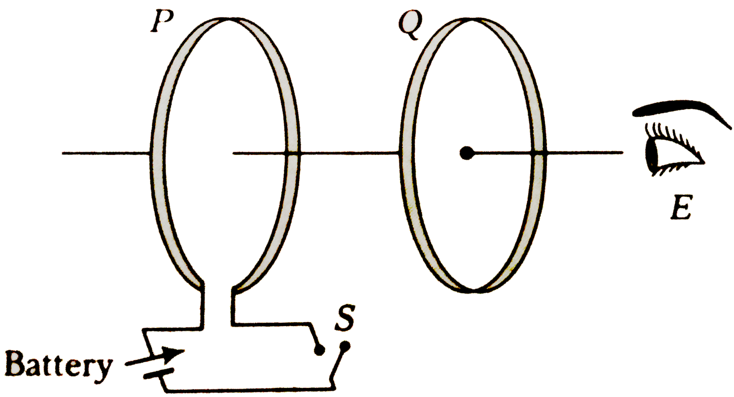
9. As shown in figure, P and Q are two co-axial conducting loops separated by some distance. When the switch S is closed, a clockwise current I_P flows in P (as seen by E) and an induced current I_{Q_1} flows in Q. The switch remains closed for a long time. When S is opened, a current I_{Q_2} flows in Q.

Then, the directions of I_{Q_1} and I_{Q_2} (as seen by E) are



A. (a) respectively clockwise and anticlockwise

B. (b) both clockwise

C. (c) both anticlockwise

D. (d) respectively anticlockwise and clockwise

Answer: D

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10. An infinitely long cylinder is kept parallel to a uniform magnetic field B directed along positive Z-axis. The direction of induced current as seen from the Z-axis will be

A. (a) zero

B. (b) anticlockwise of the positive z-axis

C. (c) clockwise ogf the positive z-axiss

D. (d) along with magnetic field

Answer: A

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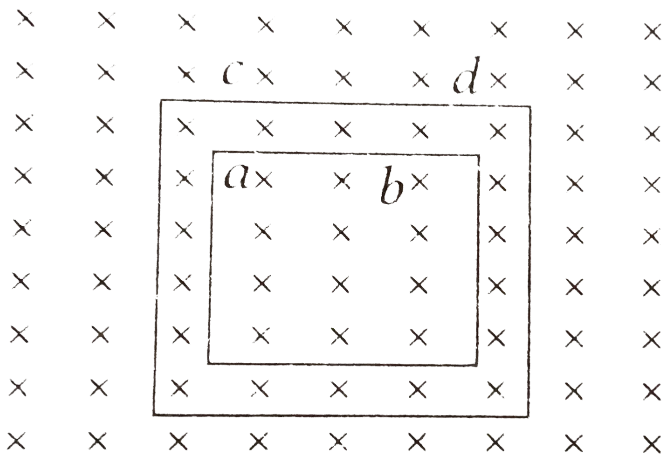
11. The figure shows certain wire segments joined together to form a coplanar loop. The loop is placed in a perpendicular magnetic field in the direction going into the plane of figure. The magnitude of the field increases with time. I_1 and I_2 are the current in the segments ab and cd.

Then,



A. (a) $I_1 > I_2$

B. (b) $I_1 < I_2$

C. (c) I_1 is in the direction ba and I_2 is in the direction cd.

D. (d) I_1 is in the direction ab and I_(2)$is \in thedirection$dc`.

Answer: D

Watch Video Solution

Archives Multiple Correct

1. A conducting square loop of side l and resistance R moves in its plane with a uniform velocity v perpendicular ot one of its sides. A uniform and constant magnetic field B exists along the perpendicualr ot the plane of the loop as shown in . The current induced in the loop is

(##HCV_VOL2_C38_E01_025_Q01##)

A. (a) BLv/R clockwise

B. (b) BLv/R anticlockwise

C. (c) $2BLv/R$ anticlockwise

D. (d) zero

Answer: D

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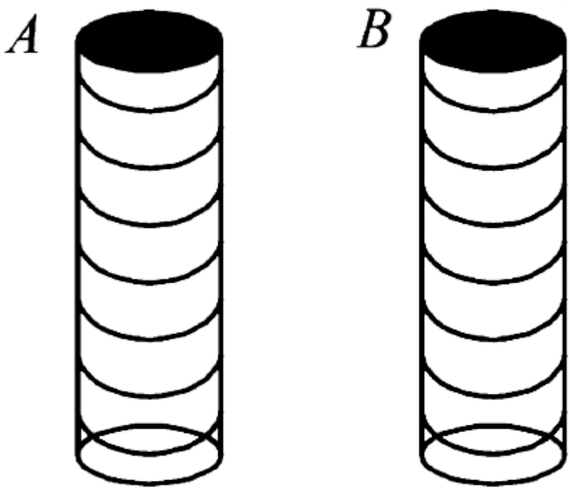
2. Two metallic rings A and B, identical in shape and size but having different reistivities ρA and ρB, are kept on top of two identical solenoids as shown in the figure . When current I is switched on in both the solenoids in identical manner, the rings A and B jump to heights h_A and h_B, repectively , with $h_A > h_B$. The possible relation(s) between their resistivities and their masses m_A and m_B is(are)



A. (a) $\rho_A > \rho_B$ and $m_A = m_B$

B. (b) $\rho_A < \rho_B$ and $m_A = m_B$

C. (c) $\rho_A > \rho_B$ and $m_A > m_B$

D. (d) $\rho_A < \rho_B$ and $m_A < m_B$

Answer: B::D

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3. A current carrying infinitely long wire is kept along the diameter of a circular wire loop, without touching it, the correct statements(s) is(are)

A. (a) The emf induced in the loop is zero if the current is constant

B. (b) The emf induced in the loop is finite if the current is constant

C. (c) The emf induced in the loop is zero if the current decrases at a steady rate.

D. (d) The emf induced in the finite if the current decreases at a steady rate.

Answer: A::C

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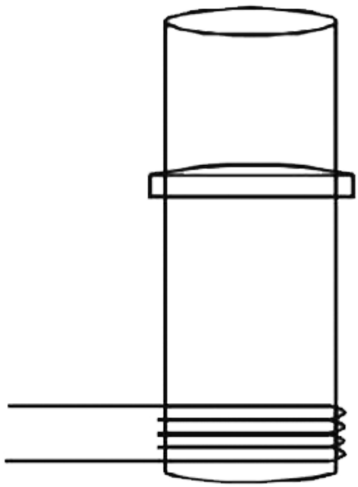
Archives Asserton - Reasoning

1. Statement-1: A vertical iron rod has ciol of wire wound over it at the bottom end. An alternating current flows in the coil. The rod goes through a conduction ring as shwon in the figure. The ring can float at a certain height above the coil.

Statement -2: In the above situation a current is inuced in the ring which interacts with the horizontal components of the magnetc field to produce an aberage force in the upward direction.



A. (a) Statement I is true, Statement II is ture, Statement II is a correct explanation for Statement I.

B. (b) Statement I is true, Statement II is true, Statement II NOT a correct explanation for Statement I.

C. (c) Statement I is True, Satement II is false.

D. (d) Statement I is false, Statement II is true.

Answer: A

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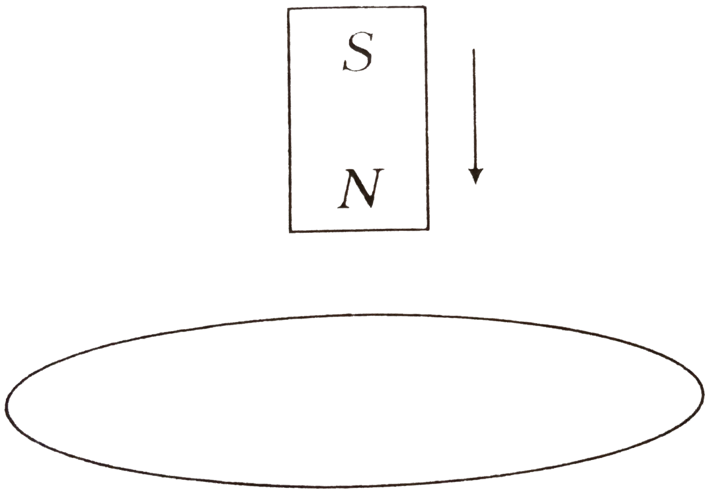
Single Correct Answer Type

1. The north pole of a magnet is brought near a metallic ring as shown in the figure. The direction of induced current in the ring will be



A. First clockwise, then anticlockwise

B. In clockwise direction

C. In anticlockwise direction

D. First anticlockwise, then clockwise

Answer: C

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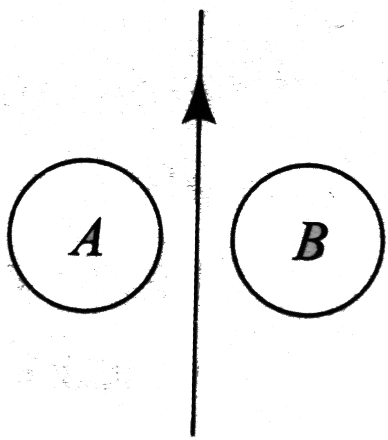
2. A and B two metallic rings placed at opposite sides of an infinitely long straight conducting wire as shown in Fig. 3.157. If current in the wire is slowly decreased, the direction of the induced current will be



A. The magnet moves with continuously increasing velocity and ultimately acquires a constant terminal velocity

B. The magnet moves with continuously decreasing velocity and ultimately comes to rest

C. The magnet moves with continuously increasing velocity but constant acceleration

D. The magnet moves with continuously increasing velocity and acceleration

Answer: A

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3. An electrons moves along the line AB. Which lies in the same plane as a circular loop of conducting wires as shown in the diagram. What will be the direction of current induced if any, in the loop?

A. No current will be induced

B. The current will be clockwise

C. The current will be anticlockwise

D. Trh current will change direction as the electron passes by

Answer: D

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4. A metallic ring is connected to a rod oscillates freely like a pendulum. If now a magnetic field is applied in horizontal direction so that the pendulum now swings through the field, the pendulum will

A. keep oscillating with the old time period

B. keep oscillating with a smaller time period

C. keep oscillating with a larger time period

D. come to rest very soon

Answer: D

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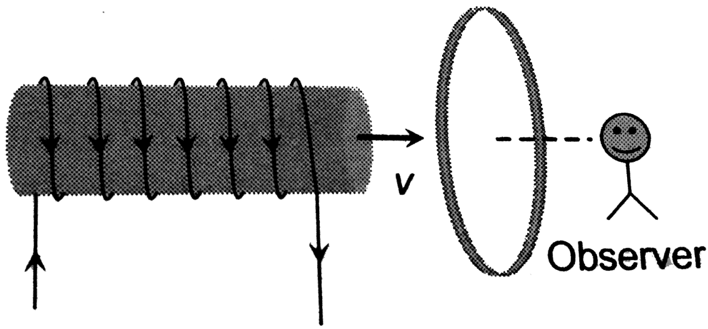
5. A current carrying solenoid id approaching a conducting loop as shown in the figure. The direction of induced current as observed by an observer on the other side of the loop will be



A. Anticlockwise

B. Clockwise

C. East

D. West

Answer: B

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6. Laser light of wavelength 1260 nm incident on a pair of slits produces an interference pattern in which the fringes are seprated by 8.1mm .A second laser light produces an interference pattern in which the fringes are seprated by 7.2 mm.Calculate the wavelength of the second light

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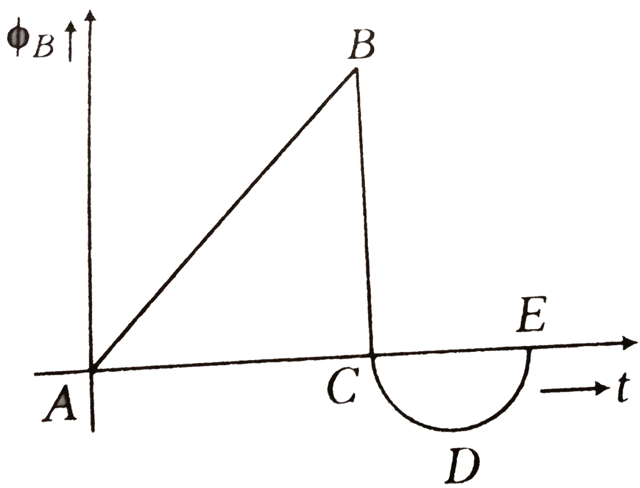
7. The graph shows the variation in magnetic flux $\phi(t)$ with time through a coil. Which of the statements given below in not correct?



A. There is a change in the direction as well as magnitude of the induced emf between B and D

B. The magnitude of the induced emf is maximum between B and C

C. There is a change in the direction as well as magnitude of induced emf between A and C

D. The induced emf is zero at B

Answer: D

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8. A horizontal loop abcd is moved across the pole piece of a magnet as shown in the figure. With a constant speed v. When the edge ab of the loop enters the pole pieces at time t=0 sec. Which one of the following graphs presents correctly the induced emf in the coil?

A. 

B.

C.

D.

Answer: D

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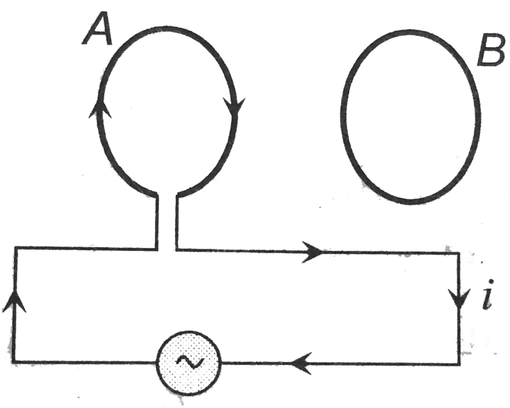
9. Two circular coils A and B are facing each other as shown in figure. The current i through A can be altered



A. There will be the repulsion between A and B if I is increased

B. There will be the attraction between A and B if I is increased

C. There will be neither attraction nor repulsion when I is changed

D. Attraction or repulsion between A and B depends on the direction of current. If does not depend whether the current is increased or decreased

Answer: A

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10. The graph gives the magnitude B(t) of a uniform magnetic field that exists throughout a conductig loop, perpendicular to the plane of the loop. Rank the five regions of the graph according to the magnitude fo the emf induced in the loop, greater first

A. $b > (d = e) < (a = c)$

B. $b > (d = e) > (a = c)$

C. $b < d < e < c < a$

D. $b > (a = c) > (d = e)$

Answer: B

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11. A double slit is illuminated by the light of wavelength 12000A .The slits are 0.1 cm apart and the screen is placed one metre away.calculate the sepration between the two adjacent minima?

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12. In youngs double slit experiment the fringes are formed at a distance of 1m from double slits of sepration 0.12mm .calculate the distance of 4th dark band from the centre of screen ?(wavelength is 12000A).

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13. In young`s double slit experiment the fringes are formed at a distance of 1m from double slits of sepration 0.12mm.calculate the distance of 6th bright band from the centre of screen ,given wavelength is 12000A.

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14. A circular coil and a bar magnet placed nearby are made to move in the same direction. The coil covers a distance of $1m$ in $0.5 \sec$ and the magnet a distance of $2m$ in $1 \sec$. The induced emf produced in the coil

A. zero

B. 1V

C. 0.5V

D. cannot be determined from the given infromation

Answer: A

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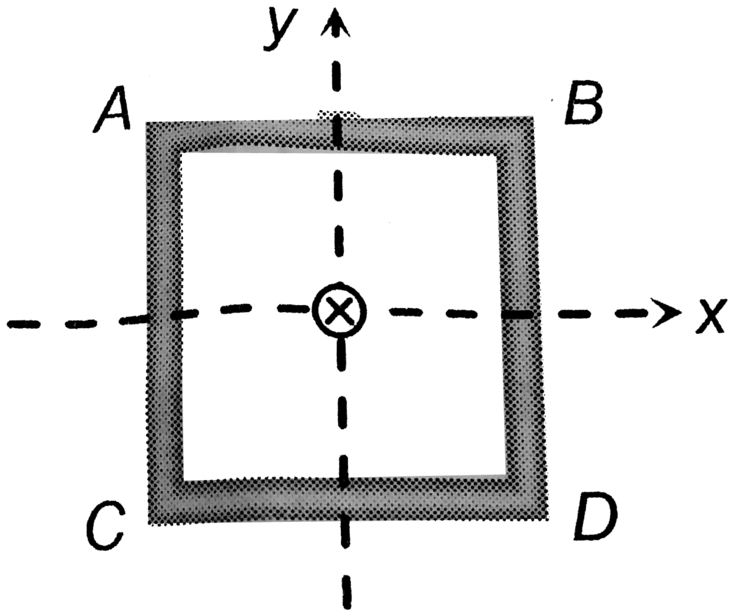
15. A square coil ABCD lying in $x - y$ plane with its centre at origin. A long straight wire passing through origin carries a current $i = 2t$ in negative z-direction. The induced current in the coil is



A. Clockwise

B. Anticlockwise

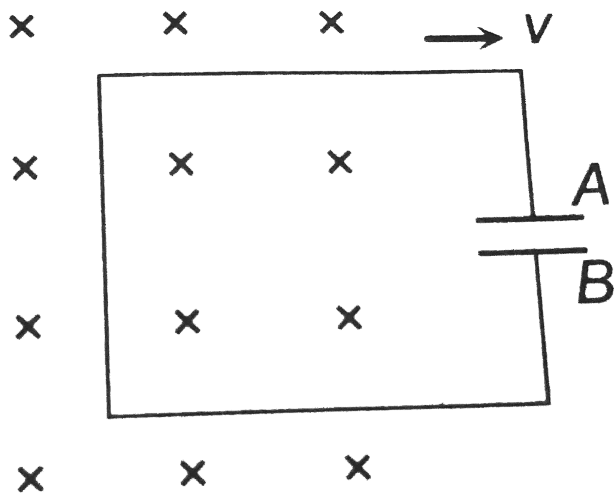
C. Alternating

D. zero

Answer: D

Watch Video Solution

16. A conductuing loop having a capacitor is moving outward from the magnetic field. Which plate of the capacitor will be positive?



A. Plate A

B. Plate B

C. Plate A and Plate B both

D. None

Answer: A

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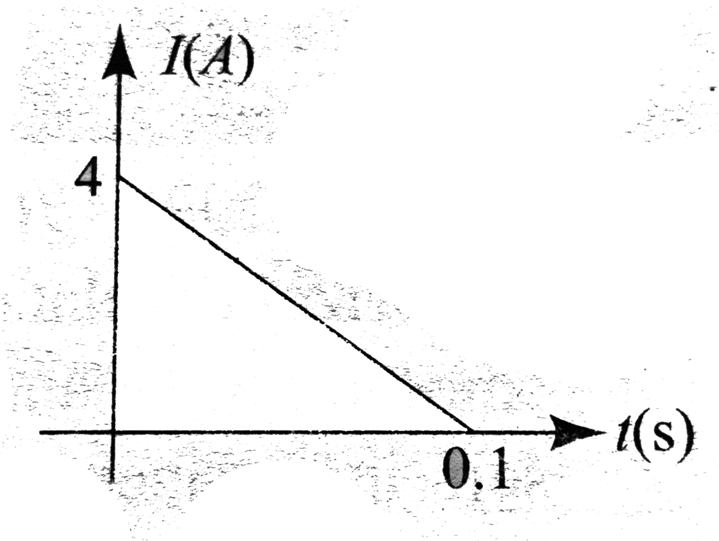
17. Some magnetic flux is changed from a coil of resitance 10Ω. As a result, an induced current is developed it, which varies with time as shown in Fig. 3.213. Find the magnitude of the change in flux through ythe coil in weber.



A. 2

B. 4

C. 6

D. none of these

Answer: A

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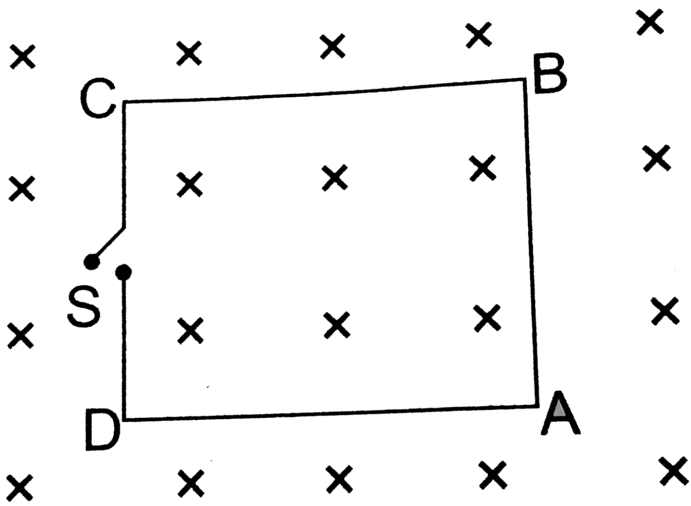
18. The magnetic field in the cylindrical region shown in figure increase at a constant rate of $20mT/\sec$. Each side of the square loop $ABCD$ has a length of $1cm$ and resistance of 4Ω. Find the current in the wire AB if the switch S is closed



A. 1.25×10^{-7}A(anticlockwise)

B. 1.25×10^{-7}A (clockwise)

C. 2.5×10^{-7} A (anticlockwise)

D. 2.5×10^{-7}A(clockwise)

Answer: A

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Multiple correct Answer Type

1. A conducting loop rotates with constant angular velocity about its fixed diameter in a uniform magnetic field, whose direction is perpendicular to that fixed diameter.

A. The emf will be maximum at the movement when flux is zero.

B. The emf will be '0' at the moment when flux is maximum.

C. The emf will be maximum at the moment when plane of the loop is parallel to the magnetic field

D. The phase difference between the flux and the emf is $\pi / 2$

Answer: A::B::D

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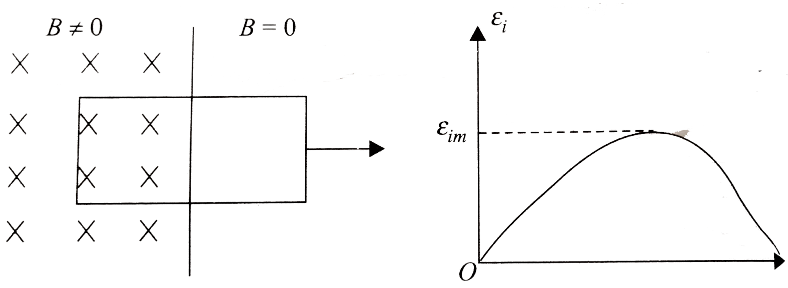
2. A plane rectangular loop is placed in a magnetic field. The emf induced in the loop due to this field is ε_1 whose maximum value is ε_{im}. The loop was pulled out of the magnetic field at a variable velocity. Assume that $\vec{B}$ is uniform and constant ε_1 is plotted against t as shown in the graph. 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 charge 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 area under the curve ($\varepsilon_i$vs t) is independent of rate of removal of coil from the field.

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

Answer: B::C

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3. A triangular loop as shown in the figure is started to being pulled out at t=0 form a uniform magnetic field with a constant velocity v. Total resistancee of the loop is constant and equal to R. Then the variation of power produced in the loop with time will be :

A. power produced in the loop increasing linearly with time till whole loop comes out

B. power produced in the loop increases parabolically till whole loop comes out

C. Current in the loop increases linearly with time till whole loop comes out

D. power produced in the loop will be constant with time

Answer: B::C

Watch Video Solution

single correct

1. A metalic square loop ABCD is moving in its own plane with velocity v is in a uniform magnetic field perpendicular to its plane as shown in the figure . An electric field is induced

A. In AD , but not in BC

B. In BC , but not in AD

C. Neither in AD nor in BC

D. In both AD and BC

Answer: d

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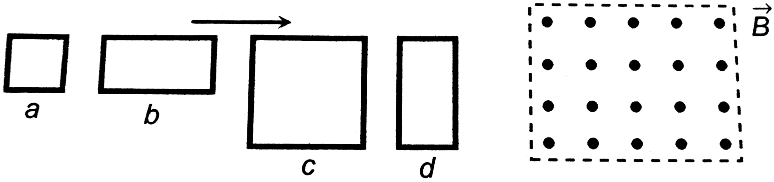
2. The figure shows four wire loops, with edge length of either L or $2L$. All four loops will move through a region of uniform magnetic field $\vec{B}$ (directed out of the page) at the same constant velocity . Rank the four loops according to the maximum magnitude of the e.m.f. induced as they move through the field, greatest first



A. $(e_c = e_d) < (e_a = e_b)$

B. $(e_c = e_d) > (e_a = e_b)$

C. $e_c > e_d > e_b > e_a$

D. $e_c < e_d < e_b < e_a$

Answer: b

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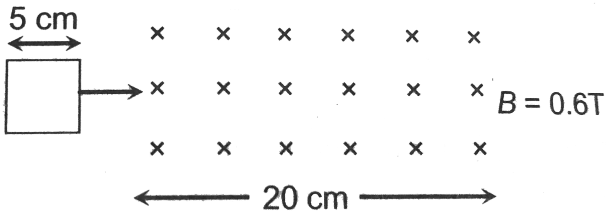
3. A square loop of side 5 cm enters a magnetic field with $1cms^{-1}$. The front edge enters the magnetic emf?



A.

B.

C.

D.

Answer: c

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4. A player with 3 meter long iron rod runs toward east with a speed of $30km/hr$. Horizontal component of eath's magnetic field is $4\times10^{-5}Wb/m^2$. If he runs with the rod in horizontal and vertical position, then the potential difference induced between the two ends of the rod in the two cases will be

A. Zero in vertical position and 1×10^{-3} V in horizontal position

B. 1×10^{-3} V in vertical position and zerp is horizontal position

C. Zero in both cases

D. 1×10^{-3} V in both cases

Answer: b

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5. At a plane the value of horizontal component of the eart's magnetic field H is $3 \times 10^{-5} weber / m^2$. A metallic rod AB of length $2m$ placed in east-west direction, having the end A towards east, falls vertically downward with a constant velocity of $50m / s$. which end of the rod becomes positively charged and what is the value of induced potential difference between the two ends?

A. End A , 3×10^{-3} mV

B. End A , 3mV

C. End B , 3×10^{-3} mV

D. End B ,3 mV

Answer: b

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6. Consider the situation shown in . The wire AB is slid on the fixed rails rails with a constant velocity. If the wire AB is replaced by a semicircular wire, the magnitude of the induced current will

(##HCV_VOL2_C38_E01_021_Q01##)

A. Increase

B. Remain the same

C. Decrease

D. Increase or decrease depending on whether the semicircle bulges towards the resistance or away from it

Answer: b

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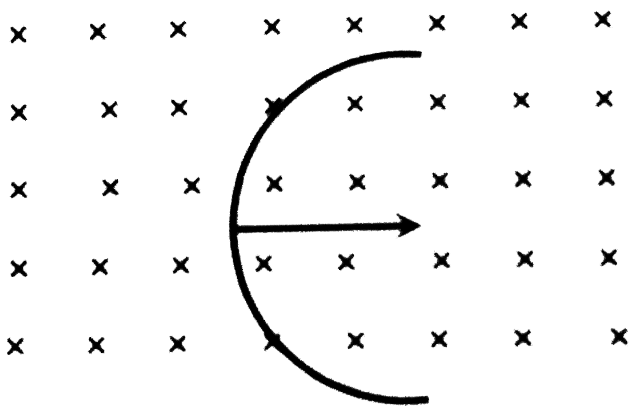
7. A straight wire of length L is bent into a semicircle. It is moved in a uniform magnetic field with speed v with diameter perpendicular to the field. The induced emf between the ends of the wire is



A. BLv

B. 2BLv

C. $2\pi BLv$

D. $\frac{2BvL}{\pi}$

Answer: d

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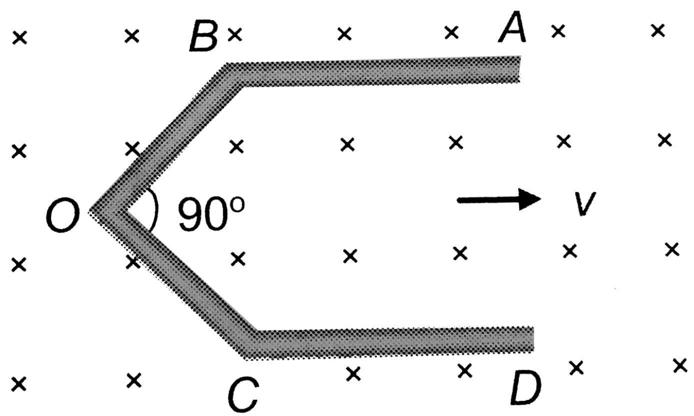
8. A conductor $ABOCD$ moves along its bisector with a velocity of $1m/s$ through a perpendicular magnetic field of $1wb/m^2$, as shown in fig. if all the four sides are of $1m$ length each, then the induced emf between points A and D is



A. 0

B. 1.41 volt

C. 0.71 volt

D. none of these

Answer: b

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9. As shown in the figure, a metal rod makes rod makes contact with a particl circuit and completes the circuit. The circuit area is perpendicular ot a magneitc field with B = 0.15 T. If the resistance of the total circuit is 3Ω, the force needed to move the rod as indicated with a constant speed of $2ms^{-1}$ will be equal to

A. 3.75×10^3 N

B. 3.75×10^{-2} N

C. 3.75×10^2 N

D. 3.75×10^{-4} N

Answer: a

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10. shows a conducting loop being pulled out of a magnetic field with a speed v. Which of lthe four plots shown in may represent the power delivered by the pulling agent as a function of the speed v ?

(##HCV_VOL2_C38_E01_022_Q01##)

(##HCV_VOL2_C38_E01_022_Q01##)

A. a

B. b

C. c

D. d

Answer: b

Watch Video Solution

comprehensive

1. In the figure shown the four rods have λ resistance per unit length. The arrangement is kept in a magnetic filed of constant magnitude B and directed perpendicular to the plane of the figure and direction inwards. Intially the sides as shown from a square. Now each wire starts moving with constant velocity v towards opposite wire. Find as a function of time:

(a) induced emf in the circuit

(b) induced current in the circuit with direction

2. In the figure shown the four rods have λ resistance per unit length . The arrangement is kept in a magnetic field of constant magnitude B and directed perpendicular to the plane of the figure and direction inwards . Initially the sides as shown form a square . Now each wire starts moving with constant velocity v towards opposite wire . Find as a function of time

.

Induced current in the circuit with direction

A. $\frac{2Bv}{\lambda}$

B. $\frac{Bv}{\lambda}$

C. $\frac{Bv}{2\lambda}$

D. zero

Answer: b

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3. In the figure shown the four rods have λ resistance per unit length . The arrangement is kept in a magnetic field of constant magnitude B and directed perpendicular to the plane of the figure and direction inwards . Initially the sides as shown form a square . Now each wire starts moving with constant velocity v towards opposite wire . Find as a function of time

.

Force required on each wire to keep its velocity constant .

A. $\frac{B^2 v}{\lambda}(l + 2vt)$

B. $\frac{B^2 v}{\lambda}(l - vt)$

C. zero

D. $\frac{B^2 v}{\lambda}(l - 2vt)$

Answer: d

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4. In the figure shown the four rods have λ resistance per unit length . The arrangement is kept in a magnetic field of constant magnitude B and directed perpendicular to the plane of the figure and direction inwards . Initially the sides as shown form a square . Now each wire starts moving with constant velocity v towards opposite wire . Find as a function of time

.

Total power required to maintain constant velocity .

A. $\dfrac{4B^2v^2}{\lambda}(l+2vt)$

B. $\dfrac{4B^2v^2}{\lambda}(l-vt)$

C. $\dfrac{4B^2v^2}{\lambda}(l-2vt)$

D. $\dfrac{B^2v^2}{\lambda}(l-2vt)$

Answer: c

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5. In the figure shown the four rods have λ resistance per unit length . The arrangement is kept in a magnetic field of constant magnitude B and directed perpendicular to the plane of the figure and direction inwards . Initially the sides as shown form a square . Now each wire starts moving with constant velocity v towards opposite wire . Find as a function of time

.

Thermal power developed in the circuit.

A. $\frac{4B^2v^2}{\lambda}(l-2vt)$

B. $\frac{4B^2v^2}{\lambda}(l-vt)$

C. $\frac{4B^2v^2}{\lambda}(l+2vt)$

D. $\frac{B^2v^2}{\lambda}(l-2vt)$

Answer: a

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single correct

1. A copper rod of length l is rotated about one end perpendicular to the magnetic field B with constant angular velocity ω . The induced e.m.f between the two ends is

A. $\frac{1}{2}B\omega l^2$

B. $\frac{3}{4}B\omega l^2$

C. $B\omega l^2$

D. $2B\omega l^2$

Answer: a

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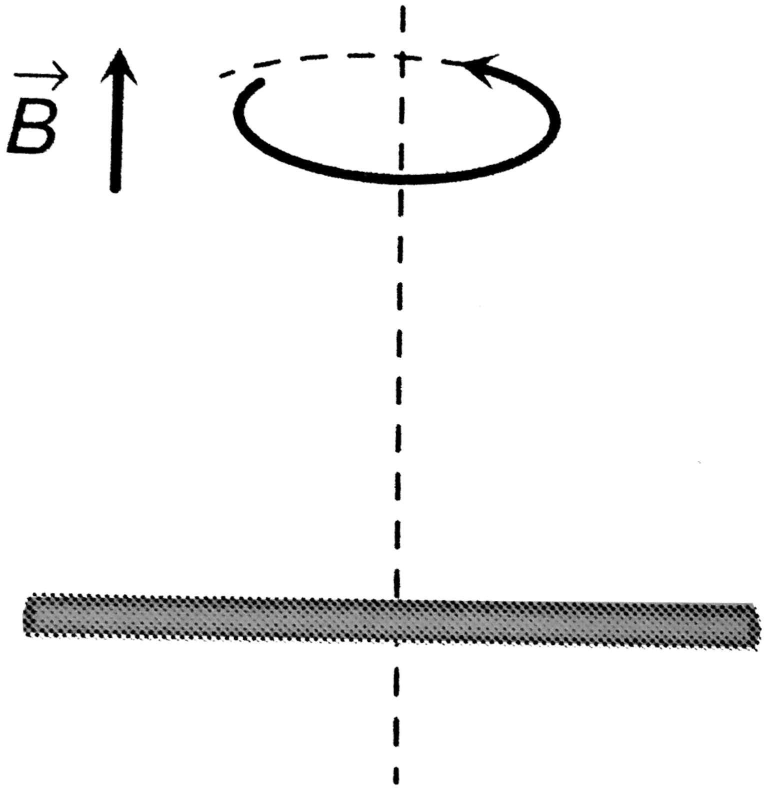
2. A conducting rod of length $2l$ is rotating with constant angular speed w about its perpendicular bisector. A uniform magnetic field B exists parallel to the axis of rotation. The e.m.f. induced between two ends of the rod is



A. $B\omega l^2$

B. $\frac{1}{2}B\omega l^2$

C. $\frac{1}{8}B\omega l^2$

D. zero

Answer: d

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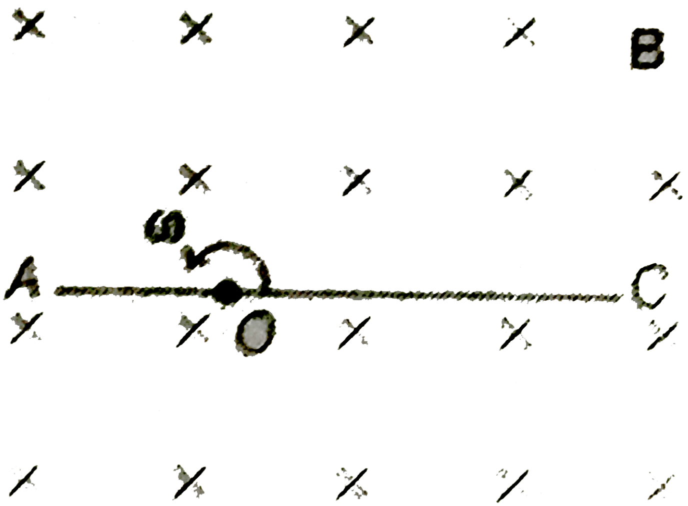
3. A conducting rod AC of length 4l is roated about a point O in a uniform magnetic field B directed into the paper. AO=l and OC =3l. Then



A. $V_A - V_O = \frac{B\omega l^2}{2}$

B. $V_O - V_C = \frac{7}{2}B\omega l^2$

C. $V_A - V_C = 4B\omega l^2$

D. $V_C - V_O = \frac{9}{2}B\omega l^2$

Answer: c

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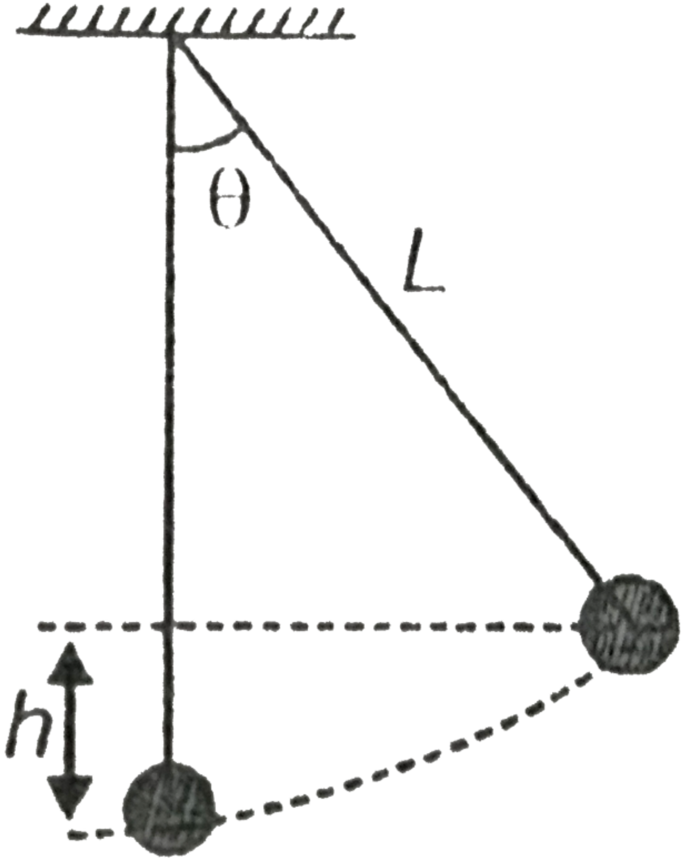
4. A simple pendulum with bob of mass m and conducting wire of length L swings under gravity through an angle 2θ. The earth's magnetic field component in the direction perpendicular to swing is B. The maximum potential difference induced across the pendulum is



A. $2BL\sin\left(\frac{\theta}{2}\right)(gL)^{1/2}$

B. $BL\sin\left(\frac{\theta}{2}\right)(gL)$

C. $BL\sin\left(\frac{\theta}{2}\right)(gL)^{3/2}$

D. $BL\sin\left(\frac{\theta}{2}\right)(gL)^{2}$

Answer: a

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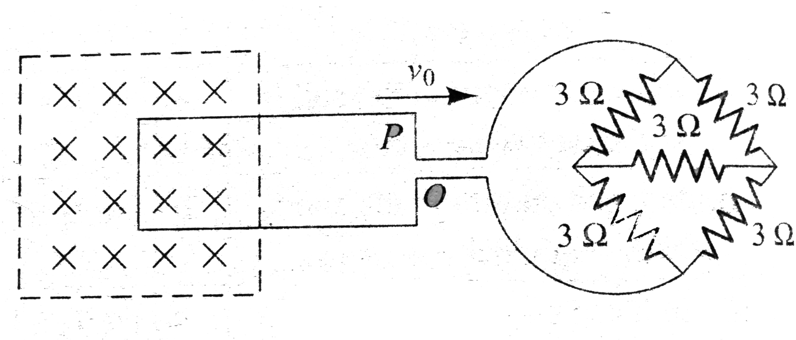
5. A square metal wire loop of side $10cm$ and resistances 1Ω is moved with constant velocity v_0 in a uniform magnetic field of induction $B = 2Wbm^{-2}$, as shown in Fig. 3.218. The magnetic field lines are perpendicular to the plane of loop network of resistances, each of value 3Ω. The speed of the loop so as to have a steady current of $1mA$ in the loop is `



A. 1 cm/sec

B. 2 cm/sec

C. 3 cm/sec

D. 4 cm / sec

Answer: b

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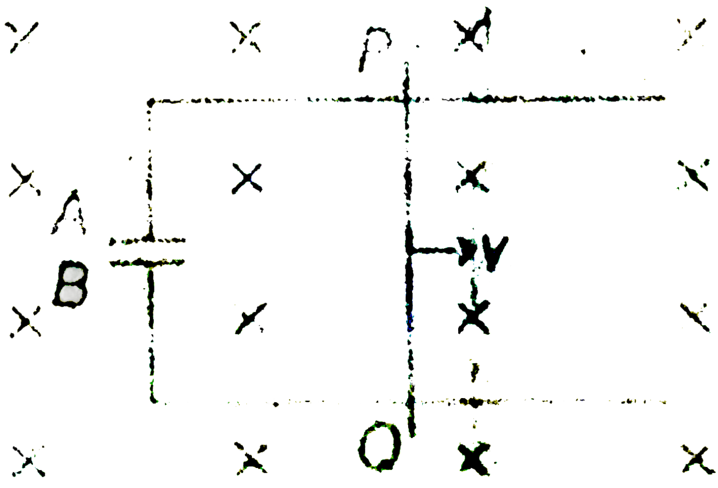
6. A conductivity rod PQ of length L=1.0m is moving with a uniform spped v=2.0m/e in a uniform magneitc field B=4.0T directed into the paper. A capacitor of capacity $C = 10\mu F$ is connected as shown in figure Then



A. $q_A = +80\mu C \text{and} q_B = -80\mu C$

B. $q_A = -80\mu C \text{and} q_B = +80\mu C$

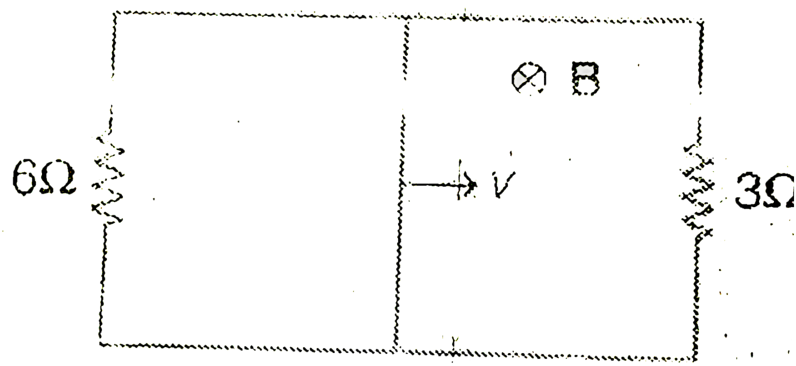
C. $q_A = 0 = q_B$

D. Charges stored in the capacitor increases exponentially with time

Answer: a

Watch Video Solution

7. A rectangular loop with a sliding connector of length l=10m $isthesituated \in aun \text{ if } \text{ or } mmag \neq ticf \text{ or } B = 2Tperpendic\underline{a}r \rightarrow th$ r=2Omega. $Tworesis \tan cesata$6Omega and 3Omega` are connected as shown in the figure. The external force required to keep the conductor moving with a constant velocity v=2m/s



A. 6 N

B. 4 N

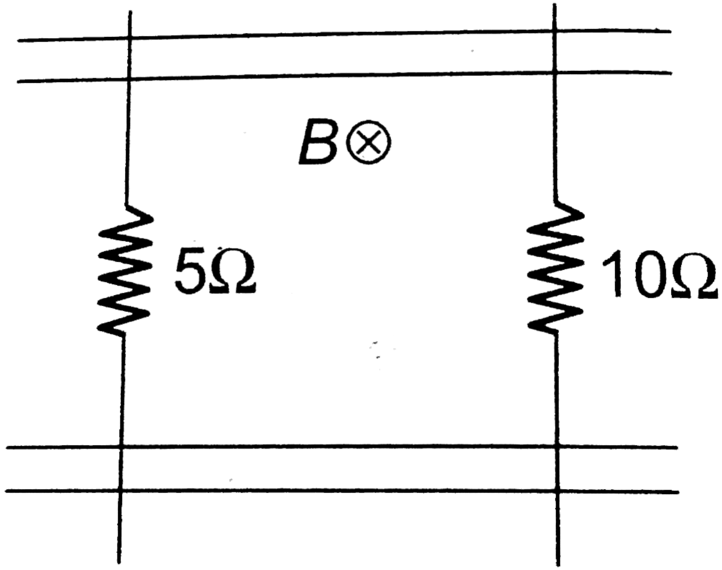
C. 2 N

D. 1 N

Answer: c

Watch Video Solution

8. A pair of parallel conducting rails lie at right angle to a uniform magnetic field of $2.0T$ as shown in the fig. two resistor 10Ω and 5Ω are to slide without friction along the rail. The distance between the conducting rails is $0.1m$. Then



A. Induced current = $\frac{1}{150}$ A directed clockwise if 10Ω resistor is pulled to the right with speed $0.5ms^{-1}$ and 5Ω resistor is held fixed

B. Induced current $\frac{1}{300}$ A directed anticlockwise if 10Ω resistor is pulled to the right with speed $0.5ms^{-1}$ and 5Ω resistor is held fixed

C. Induced current $\frac{1}{300}$ A directed anticlockwise if 5Ω resistor is pulled to the left at $0.5ms^{-1}$ and 10Ω resistor is held at rest

D. Induced current $\frac{1}{150}$ A directed anticlockwise if 5Ω resistor is pulled to the left at $0.5ms^{-1}$ and 10Ω resistor is held at rest.

Answer: d

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comprehensive type

1. Consider the situation shown in . The wire PQ has mass m, resistance r and can slide on the smooth, horizontal parallel rails separted by a distance l. The resistance of the rails is negligible. A uniform magnetic field B exists in the rectangualr region and a resistance R connects the rails outsided the field region At t= 0, the wire PQ is puched towards right with a speed v_0. find (a) the current in the loop at an instant when the speed of the wire PQ is v, (b) the acceleration of the wire at this instatn, (c) the velocity v as a function of x and (d) the maximum distance the wire will move.

(##HCV_VOL2_C38_E01_073_Q01##)

A. $\frac{Blv}{r+R}$

B. $\frac{2Blv}{r+R}$

C. $\frac{Blv}{2(r+R)}$

D. none of these

Answer: a

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2. Consider the situation shown in . The wire PQ has mass m, resistance r and can slide on the smooth, horizontal parallel rails separted by a distance l. The resistance of the rails is negligible. A uniform magnetic field B exists in the rectangualr region and a resistance R connects the rails outsided the field region At t= 0, the wire PQ is puched towards right with a speed v_0. find (a) the current in the loop at an instant when the speed of the wire PQ is v, (b) the acceleration of the wire at this instatn, (c

) the velocity v as a function of x and (d) the maximum distance the wire will move.

(##HCV_VOL2_C38_E01_073_Q01##)

A. $\dfrac{2B^2l^2v}{m(R+r)}$ towards left

B. $\dfrac{B^2l^2v}{m(R+r)}$ towards right

C. $\dfrac{B^2l^2v}{m(R+r)}$ towards left

D. none of these

Answer: c

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3. Consider the situation shown in figure. The wire PQ has mass m , resistance r and can slide on the smooth , horizontal parallel rails separated by a distance l . The resistance of the rails is negligible . A uniform magnetic field B exists in the rectangular region and a resistance R connects the rails outside the field region .

At t = 0 , the wire PQ is pushed towards right with a speed v_0 . Find the acceleration of the wire at this instant .

A. $v = v_0 - \frac{2B^2l^2x}{m(R+r)}$

B. $v = v_0 - \frac{B^2l^2x}{m(R+r)}$

C. $v = v_0 - \frac{B^2l^2x}{2m(R+r)}$

D. none of these

Answer: b

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4. Consider the situation shown in . The wire PQ has mass m, resistance r and can slide on the smooth, horizontal parallel rails separted by a distance l. The resistance of the rails is negligible. A uniform magnetic field B exists in the rectangualr region and a resistance R connects the rails outsided the field region At t= 0, the wire PQ is puched towards right with a speed v_0. find (a) the current in the loop at an instant when the speed of the wire PQ is v, (b) the acceleration of the wire at this instatn, (c

) the velocity v as a function of x and (d) the maximum distance the wire will move.

(##HCV_VOL2_C38_E01_073_Q01##)

A. $\dfrac{2mv_0(R+r)}{B^2l^2}$

B. $\dfrac{mv_0(R+r)}{2B^2l^2}$

C. $\dfrac{mv_0(R+r)}{B^2l^2}$

D. none of these

Answer: c

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5. Shows a smooth pair of thick metallic rails connected across a battery of emf ε having a negligible internal resistance. A wire ab of length l and resistance r can slide smoothly on the rails. The entire system lie in a horizontal plane and is immersed in a uniform vertical magnetic field B. At an instant t, the wire is given a small velocity v towards right. (a) find the current in it at this instant. What is the direction of the current? (b) What is the force acting on the wire at this instant? (c) Show that after some time the wire ab will slide with a constant velocity. Find this velocity.

(##HCV_VOL2_C38_E01_084_Q01##)

A. $\frac{1}{r}(E - vBl)$, from b to a

B. $\frac{1}{r}(E - vBl)$, from a to b

C. $\frac{1}{2r}(E - vBl)$ from b to a

D. none of these

Answer: a

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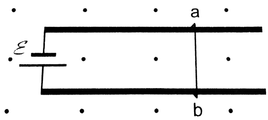
6. Shows a smooth pair of thick metallic rails connected across a battery of emf ε having a negligible internal resistance. A wire ab of length l and resistance r can slide smoothly on the rails. The entire system lie in a horizontal plane and is immersed in a uniform vertical magnetic field B. At an instant t, the wire is given a small velocity v towards right. (a) find the current in it at this instant. What is the direction of the current? (b) What is the force acting on the wire at this instant? (c) Show that after some time the wire ab will slide with a constant velocity. Find this velocity.



A. $\dfrac{lB}{r}(E - vBl)$ towards left

B. $\dfrac{lB}{r}(E - vBl)$ towards right

C. $\dfrac{lB}{2r}(E - vBl)$ towards right

D. none of these

Answer: b

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7. Shows a smooth pair of thick metallic rails connected across a battery of emf ε having a negligible internal resistance. A wire ab of length l and resistance r can slide smoothly on the rails. The entire system lie in a horizontal plane and is immersed in a uniform vertical magnetic field B. At an instant t, the wire is given a small velocity v towards right. (a) find the current in it at this instant. What is the direction of the current? (b) What is the force acting on the wire at this instant? (c) Show that after some time the wire ab will slide with a constant velocity. Find this velocity.

(##HCV_VOL2_C38_E01_084_Q01##)

A. $\frac{2E}{Bl}$

B. $\frac{E}{2Bl}$

C. $\frac{E}{Bl}$

D. none of these

Answer: c

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single correct answer

1. The magnetic field within cylindrical region whose cross - section is indicated starts increasing at a constant rate α tesla/sec . The graph showing the variation of induced field with distance r from the axis of cylinder is :

A.

B.

C.

D.

Answer: a

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2. A square non - conducting loop , 20 cm , on a side is placed in a magnetic field . The centre of side AB coincides with the centre of magnetic field . The magnetic field is increasing at the rate 2 T /s . The potential difference betweeen B and C is :

A. 30 m V

B. zero

C. 10 mV

D. 20 m V

Answer: d

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3. Refer to above question , the potential difference between C and D is :

A. 80 m V

B. zero

C. 40 mV

D. 60 mV

Answer: c

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compression type

1. A thin non conducting ring of mass m, radius a carrying a charge q can rotate freely about its own axis which is vertical. At the initial moment, the ring was at rest in horizontal position and no magnetic field was present. At instant $t = 0$, a uniform magnetic field is switched on which is vertically downward and increases with time according to the law $B = B_0 t$. Neglecting magnetism induced due to rotational motion of ring.

The magnitude of induced emf of the closed surface of ring will be

A. $\pi a^2 B_0$

B. $2a^2 B_0$

C. zero

D. $\frac{1}{2}\pi a^2 B_0$

Answer: a

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2. A thin non conducting ring of mass m, radius a carrying a charge q can rotate freely about its own axis which is vertical. At the initial moment, the ring was at rest in horizontal position and no magnetic field was present. At instant $t = 0$, a uniform magnetic field is switched on which is vertically downward and increases with time according to the law $B = B_0 t$. Neglecting magnetism induced due to rotational motion of ring.

The magnitude of an electric field on the circumference of the ring is

A. aB_0

B. $2aB_0$

C. $\frac{1}{2}aB_0$

D. zero

Answer: c

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3. A thin non conducting ring of mass m, radius a carrying a charge q can rotate freely about its own axis which is vertical. At the initial moment, the ring was at rest in horizontal position and no magnetic field was present. At instant $t = 0$, a uniform magnetic field is switched on which is vertically downward and increases with time according to the law $B = B_0 t$. Neglecting magnetism induced due to rotational motion of ring.

Angular acceleration of ring is

A. $\frac{qB_0}{2m}$

B. $\frac{qB_0}{4m}$

C. $\frac{qB_0}{m}$

D. $\frac{2qB_0}{m}$

Answer: a

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4. A thin non conducting ring of mass m, radius a carrying a charge q can rotate freely about its own axis which is vertical. At the initial moment, the ring was at rest in horizontal position and no magnetic field was present. At instant $t = 0$, a uniform magnetic field is switched on which is vertically downward and increases with time according to the law $B = B_0 t$. Neglecting magnetism induced due to rotational motion of ring.

Find intantaneous power developed by electric force acting on the ring at $t = 1$s

A. $\frac{2q^2 B_0^2 a^2}{14m}$

B. $\frac{q^2 B_0^2 a^2}{8m}$

C. $\frac{3q^2 B_0^2 a^2}{m}$

D. $\frac{q^2 B_0^2 a^2}{4m}$

Answer: d

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5. Light of wavelength 12000A is incident on a thin glass plate of refractive index 1.5 such that angle of refraction into plate is 60^o .calculate the thickness of plate which will make it appear dark by reflection?

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6. In young`s double slit experiment the fringes are formed at a distance of 2m from double slits of sepration 0.12mm.calculate the distance of 12th bright band from the centre of screen ,given wavelength is 12000A.

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7. Laser light of wavelength 315 nm incident on a pair of slits produces an interference pattern in which the fringes are seprated by 8.1mm .A second laser light produces an interference pattern in which the fringes are seprated by 7.2 mm.Calculate the wavelength of the second light

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