PHYSICS

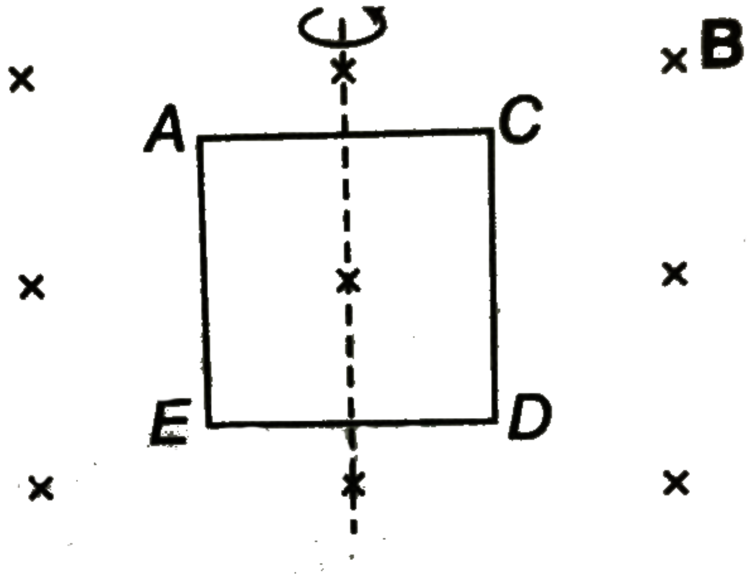
BOOKS - DC PANDEY PHYSICS (HINGLISH)

ELECTROMAGNETIC INDUCTION

Example

1. A square loop $ACDE$ of area $20cm^2$ resistance 5Ω is rotate in as magnetic field $B = 2T$ through 180° (a) in $0.01S$ and (b) in $0.02s$

Find the magnitudes of averasge values of e i and $\triangle q$ in both the cases.



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2. A coil consists of 200 turns of wire having a total reistance of 2.0Ω. Each turn is a square of side $18cm$, and a uniform magnetic field directed perpendicular to the plane of the coil is turned on. If the field changes linearly from 0 to $0.5t$ in $0.80s$, what is the magnitude of induced emf and current in the coil while the field is changing?

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3. The magnetic flux passing through a metal ring varies with time t as: $\phi_B = 3\left(at^3 - bt^2\right)T - m^2$ with $a = 2.00s^{-3}$ and $b = 6.00s^{-2}$. The resistance of the ring is 3.0Ω. Determine the maximum current induced in the ring during te interval from $t = 0$ to $t = 2.0s$.

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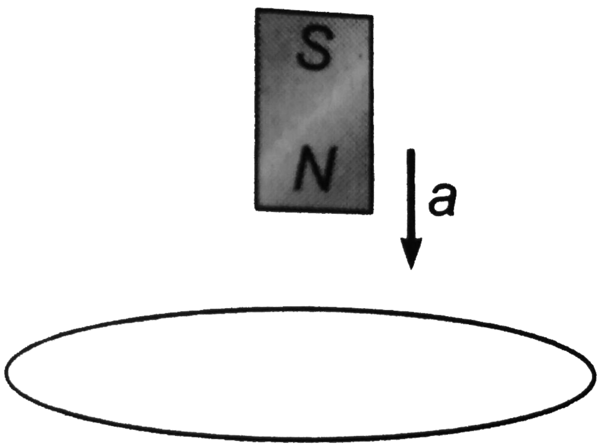
4. A bar magnet is freel falling along the axis of a circular loop as shown in Figure. State whether its acceleration a is equal to greater than or less than the acceleration due to gravity g.



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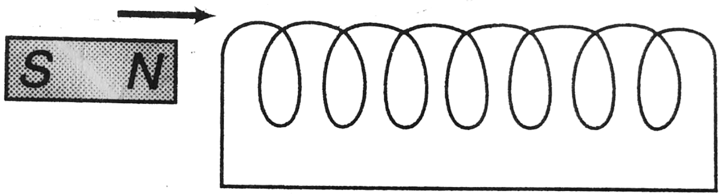
5. A bar magnet is brought near a solenoid as shown in figure. Will the solenoid attract or repel the magnet?



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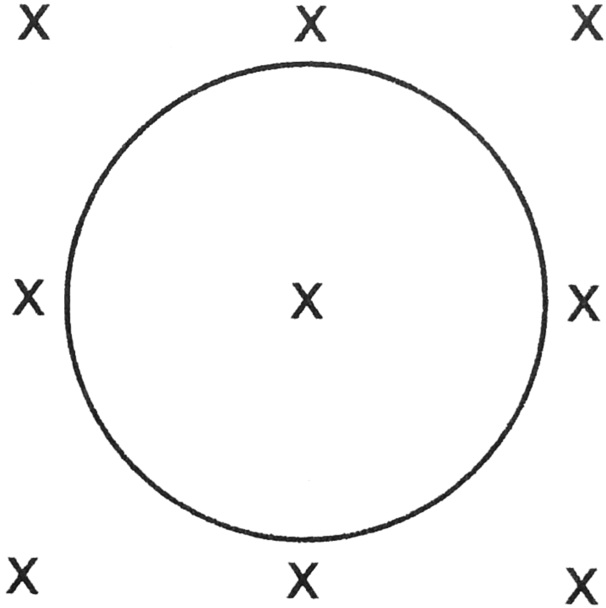
6. A circular loop is placed in magnetic field $B = 2t$. Find the direction of induced current produced in the loop.



A. Clockwise

B. Anti clockwise

C. No induced current

D. random direction

Answer: B

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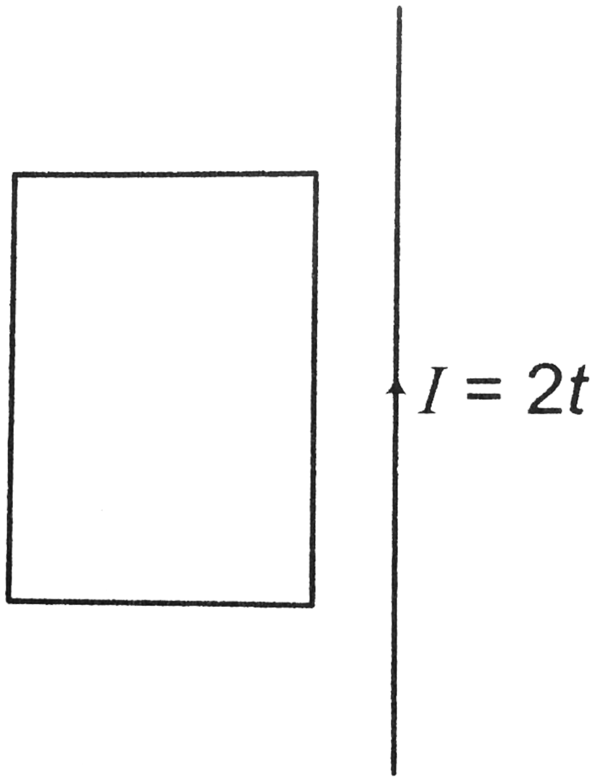
7. A rectangular loop is placed to the left of large current carrying straight wire as shown in Figure. Current varies with time as $I = 2t$. Find direction of induced current I_{in} in the square loop.



A. in complete information

B. Not induced

C. Anticlockwise

D. Clockwise

Answer: D

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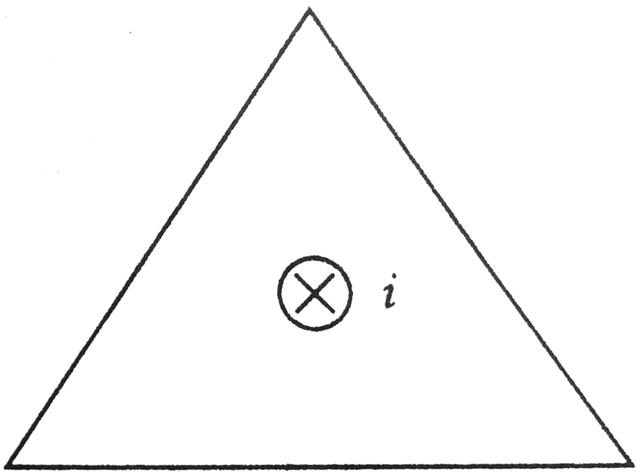
8. A current carrying straight wire passing inside a triangular loop as shown in Figure. The current in the wire is perpendicular to paper inwards. Find the direction of the induced current in the loop if current in the wire is increased.



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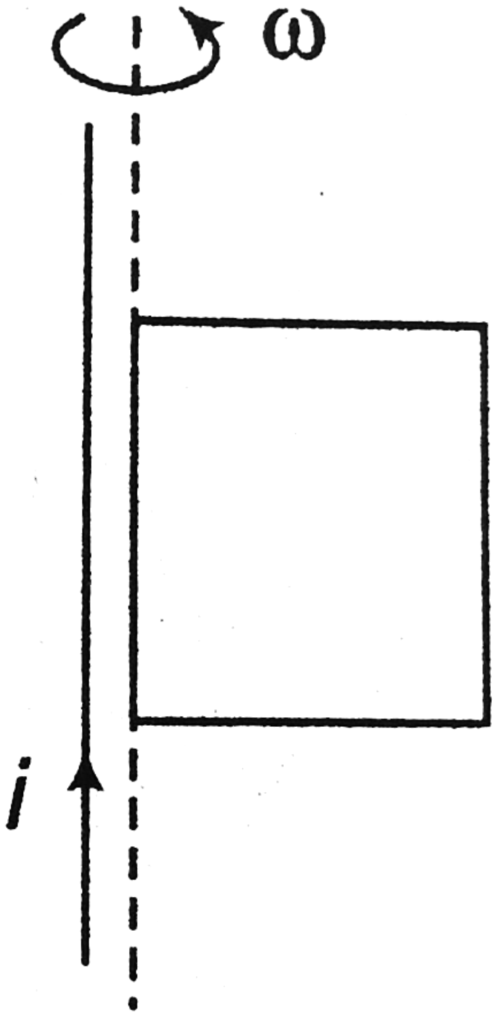
9. A rectangular loop is placed adjacent toa current carrying straight wire as shown in Figure. If the loop is rotated about an axis passing through one of its sides find the direction of induced current in the loop.



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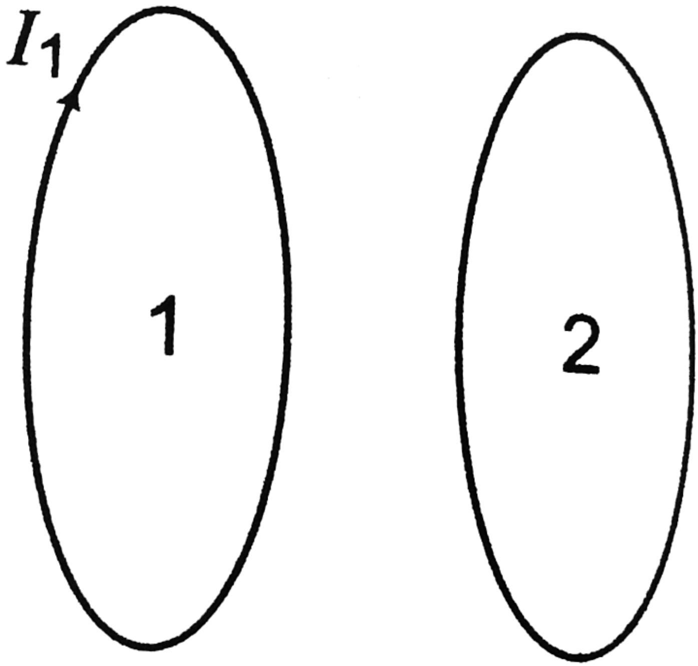
10. Two loops are facing each other as shown in Figure. State whether the loops will attract each other or repel each other if current I_1 is increased



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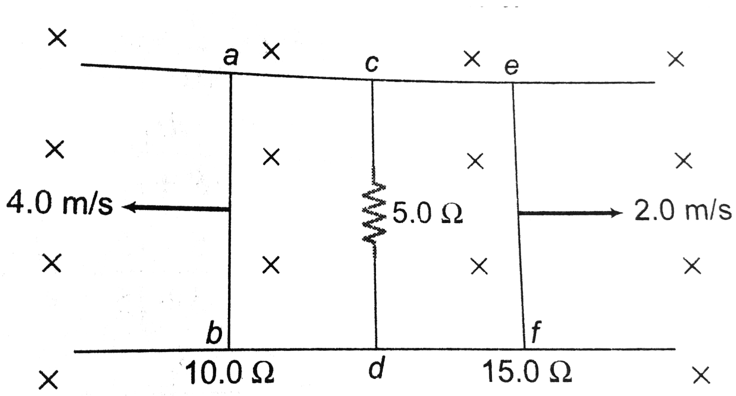
11. Two parallel rails with negligible resistance are $10.0cm$ apart. The are connected by a 5.0Ω resistor. The circuit also contains two metal rods having resistances of 10.0Ω and 15.0Ω along the rails. The rods are pulled away from the resistor at constant speeds $4.00\frac{m}{s}$ and $2.00m/s$

respectively. A uniform magnetic field of magnitude $0.01T$ is applied perpendicular to the, plane of the rails. Determine the current in the 5.0Ω resistor.



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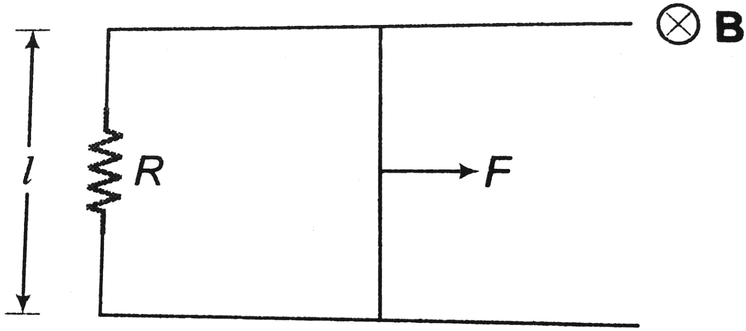
12. Figure shows the to views of a rod that can slide without friction. The resistor is 6.0Ω and a $2.5T$ magnetic field is directed perpendicularly downward into the paper. Let $l = 1.20m$.



a. Calculate the force F required to move the rod to the right at a constant speed of $2.0\frac{m}{s}$,

b. At what rate is energy deliered to the resistor?

c. Show that this rate is equal to the rate of work done by the applied force.

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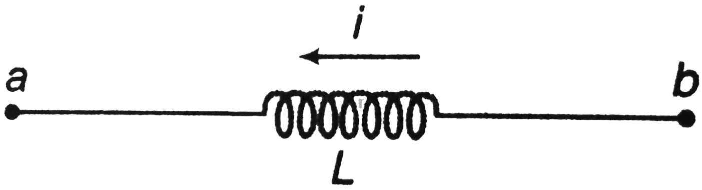
13. The inductor shown in figure has inducance $0.54H$ and carries a current in the direction shown thast is decreasing at a uniform rate $\frac{di}{dt} = 0.03A/s$.



a. Find the self induced emf

b. Which emf of the inductor a ro b is at a higher potential?

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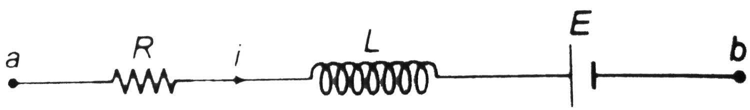
14. In the circuit diagram shown in Figure, $R = 10\Omega, L = l5H, E = 20v, i = 2A.$ This current is decreasing at a rate of $-1.0A/s$. Find V_{ab} at this instant.



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15. a. Calculate the inductance of an air core solenoid containing 300 turns if the length of the solenoid is $25.0cm$ and its cross -sectional area is $4.00cm^2$.

b. Calculate the self -induced emf in the solenoid if the current through it is decreasingg at the rate of $50.0A/s$.

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16. What inductance would be needed to store $1.0kWh$ of energy in a coil carrying a $200A$ current. $(1kWh = 3.6 \times 10^6 J)$

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17. a. What is the magnetic flux through one turn of a solenoid of self inductance $8.0 \times 10^{-5}H$ when a current of $3.0A$ flows throgh it? Assume that the solemoid has 1000 turns ans is wound from wire of diameter $1.0mm$.

b. What is the cross sectional area of the solenoid?

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18. A $10H$ inductor carries a current of $20A$. How much ice at $0^{\circ} C$ could melted by the energy stored in the magnetic field of the inductor? Latent heat of ice is $22.6 \times 10^{I} 3J / kg$

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19. A straight solenoid has 50 turns per cm in primary and total 200 turns in the secondary. The area of cross section of the solenoids is $4cm^2$. Calculate the mutual inductance. Primary is tightly kept in side the secondary.

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20. Two solenoids A and B spaced close to each other and sharing the same cylindrical axis have 400 and 700 turns, respectively. A current of $3.50A$ in coil A produced an average flux of $300 \mu T - m^2$ through each turn of A and a flux of $90.0mT - m^2$ through each turn of B.

a. Calculate the mutual inductance of the two solenoids.

b.What is the self inductance of A?

c. What emf is induced in B when the current in A increases at the rate of $0.5A/s$?

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21. A coil of resistance 20Ω and inductance $0.5H$ is switched to $DC200V$ supply. Calculate the rate of increase of current

a. at the instant of closing the switch and

b. after one time constant.

c. Find the steady state current in the circuit.

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22. A $5H$ inductor is placed in series with a 10Ω resistor. An emf of $5V$ being suddenly applied to the combination. Using these values prove the principle of conservation of energy, for time equal to the time constant.

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23. A capacitor of capacitance $25\mu F$ is charged to $300V$. It is then connected across a $10mH$ inductor. The resistance in the circuit is negligible.

a. Find the frequency of oscillation of the circuit.

b. Find the potential difference across capacitor and magnitude of circuit current $1.2ms$ after the inductor and capacitor are connected.

c. Find the magnetic energy and electric energy at $t=0$ and $t=1.2ms$.

A. $318.3Hz$ 221.2volt , $10.13A$

B. $318.3Hz$ 221.2volt , $7.13A$

C. $328.3Hz$ 221.2volt , $10.13A$

D. $118.3Hz$ 221.2volt , $10.13A$

Answer: A

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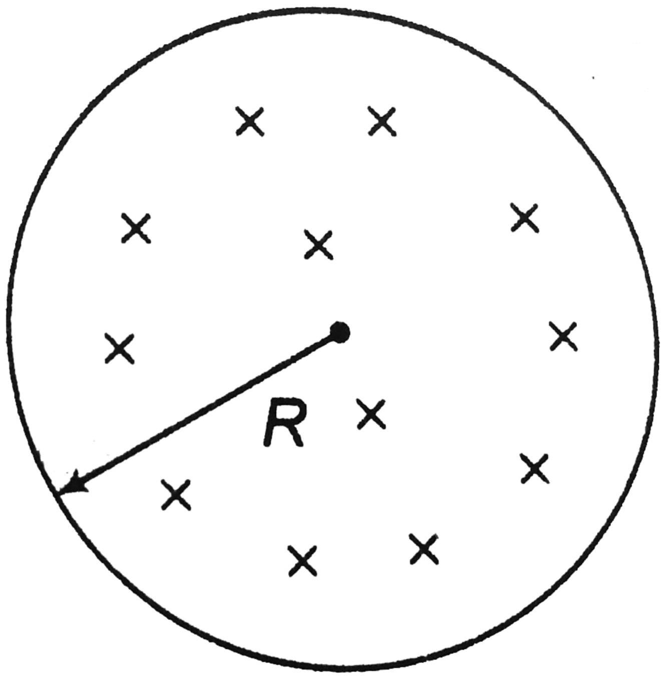
24. The magnetic field at all points within the cyllindrical region whose cross section is indicated in the accompanying Figure starts increasing at a constant rate $\alpha . T / s$. find the magnitud of electric field as a function of r, the distance from the geometric centre of the region.



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25. A long thin solenoid has $900 \text{tuns} / \text{metre}$ and radius $2.50 cm,$. The current in the solenoid is increasing at a uniform rate of $60 A / s$. What is the magnitude of the induced electric field at a point?

a. $0.5cm$ from the axis of the solenoid.

b. $1.0cm$ from the axis of the solenoid.

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26. A uniform magnetic field exists in the space $B = B_1\hat{i} + B_2\hat{j} - B_3\hat{k}$.

Find the magnetic flux through an area S, if the area S is in yz - plane.

A. B_2S

B. B_1S

C. B_3S

D. $ZERO$

Answer: B

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27. A long solenoid of radius 4 cm, length 400 cmcarries a current of 3 A. The total number of turns is 100. Assuming ideal solenoid, find the flux passing through a circular surface having centre on axis of solenoid of radius 3 cm and is perpendicular to the axis of solenoid (i) inside and (ii) at the end of solenoid.

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28. A long straight wire carrying current I and a square conducting wire loop of side l , at a distance 'a' from current wire as shown in the figure. Both the current wire and loop are in the plane of paper. Find the magnetic flux of current wire, passing through the loop.

A. $\frac{\mu_0}{2\pi}.\ Il\log_e.\ \frac{a+I}{a}$

B. $\frac{\mu_0}{4\pi}.\ Il\log_e.\ \frac{a+I}{a}$

C. $\frac{\mu_0}{2\pi}.\ Il$

D. $\frac{\mu_0}{4\pi}.\ I$

Answer: A

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29. A coil with an average diameter of 0.02 m is placed perpendicular to a magnetic field of 6000 T. If the induced e.m.f. is 11 V when magnetic field is changed to 1000 T in 4 s, what is the number of turns in the coil ?

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30. A coil consists of 200 turns of wire having a total reistance of 2.0Ω. Each turn is a square of side $18cm$, and a uniform magnetic field directed perpendicular to the plane of the coil is turned on. If the field changes linearly from 0 to $0.5T$ in $0.80s$, what is the magnitude of induced emf and current in the coil while the field is changing?

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31. The magnetic flux passing through a metal ring varies with time t as: $\phi_B = 3(at^3 - bt^2)T - m^2$ with $a = 2.00s^{-3}$ and $b = 6.00s^{-2}$. The resistance of the ring is 3.0Ω. Determine the maximum current induced in the ring during te interval from $t = 0$ to $t = 2.0s$.

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32. A square loop of side $10cm$ and resistance 0.5Ω is placed vertically in the east-west plane. A uniform magnetic field of $0.10T$ is set up across the plane in the north-east direction. The magnetic field is decreased to zero in $0.70s$ at a steady rate. The magnitude of current in this time-interval is.

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33. A wire of length l in the form of a square loop lies in a plane normal to a magnetic field B_0. If this wire is converted into a circular loop in time, then find the average induced emf.

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34. Suppose a coil of area $5m^2$, resistance 10Ω and number of turns 200 held perpendicular to a uniform magnetic field of strengh 0.4T. The coil is now turned through 180° in time 1 s. What is

(i) average induced emf

(ii) average induced current

(iii) total charge that flows through a given cross-setion of the coil?

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35. Through a long solenoid of diameter 4.1 cm, having 100 turns per cm, a current I = 1A is flowing. At its centre, a 60 turns closely packed coil of diameter 3.1 cm si placed such that the coil is coaxial with the long solenoid. The current in the solenoid is reduced to zero at a steady rate in 10 ms. What is the magnitude of emf induced in the coil while the current in the solenoid is changing?

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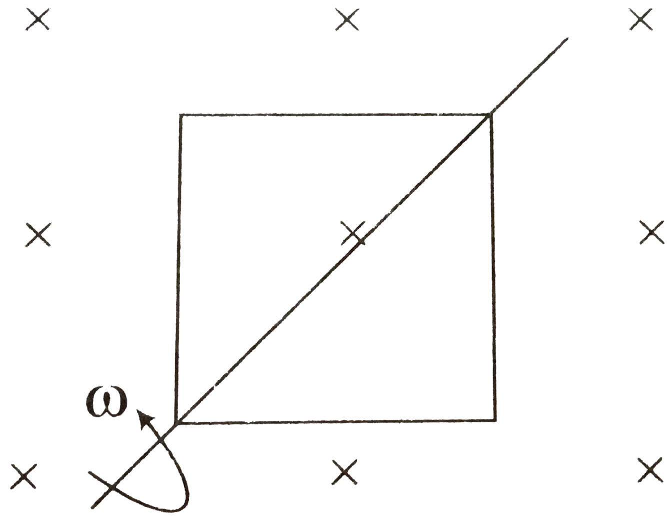
36. A square loop of edge b having M turns is rotated with a uniform angular velocity ω about one of its diagonals which is kept fixed in a horizontal position. A uniform magnetic field B_0 exists in the vertical direction.



Find (i) the emf induced in the coil as a function of time t.

(ii) the maximum emf induced.

(iii) the average emf induced in the loop over a long period.

(iv) if resistance of loop is R, amount of charge flown in time t = 0 to t = 2T.

(v) heat produced in time t = 0 to t = 2T.

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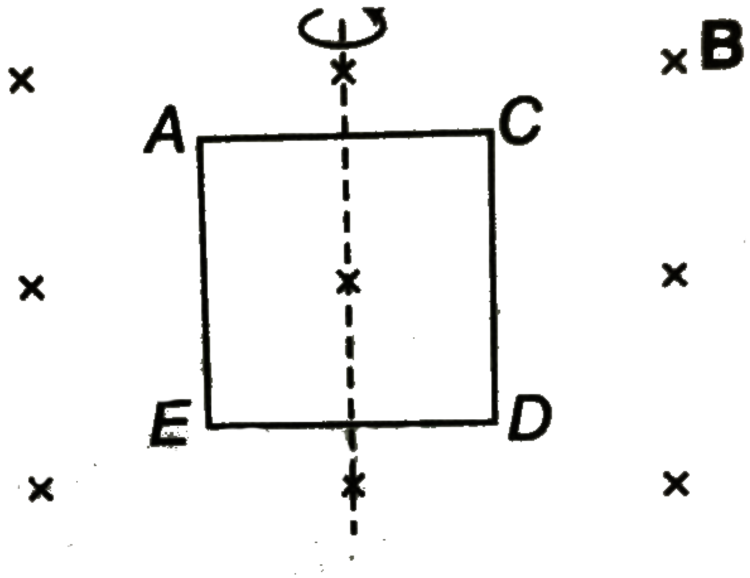
37. A square loop $ACDE$ of area $20cm^2$ resistance 5Ω is rotate in as magnetic field $B = 2T$ through 180° (a) in $0.01S$ and (b) in $0.02s$

Find the magnitudes of averasge values of e i and $\triangle q$ in both the cases.



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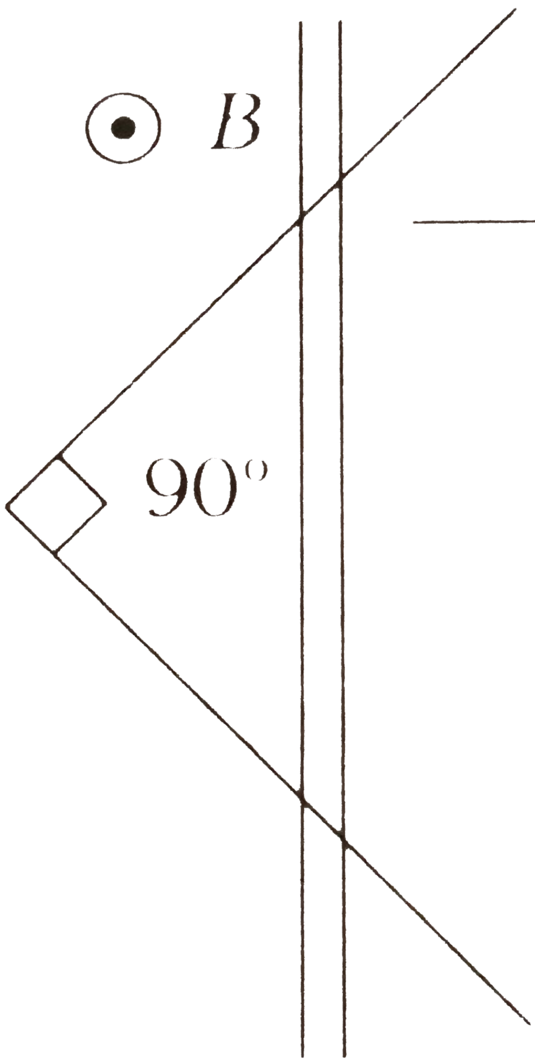
38. The two conducting rails are placed perpendicular to each other, such that their ends are joined as shown in figure. A conducting bar is now placed over the rails and start moving with constant velocity v starting from the vertex at time t = 0.

(i) The flux through the triangle (isosceles) by the rails and bar at $t = t_0$.

(ii) The emf around the triangle at that time.

(iii) In what manner does the emf around the triangle vary with time.



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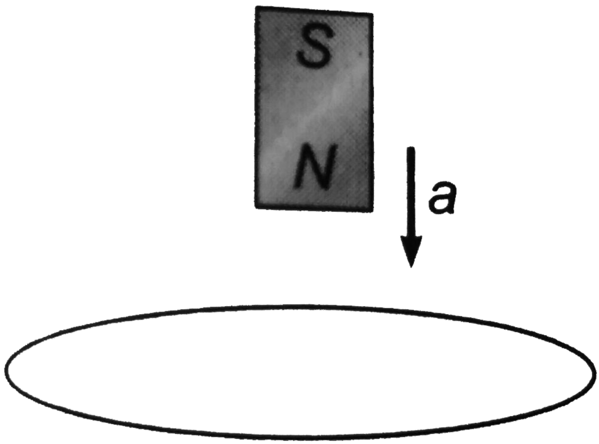
39. A bar magnet is freel falling along the axis of a circular loop as shown in Figure. State whether its acceleration a is equal to greater than or less than the acceleration due to gravity g.



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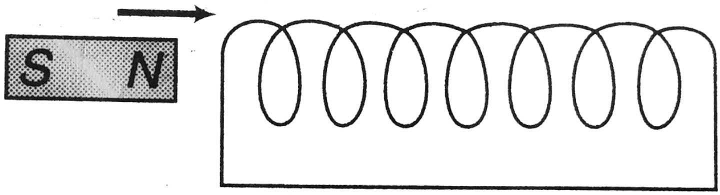
40. A bar magnet is brought near a solenoid as shown in figure. Will the solenoid attract or repel the magnet?



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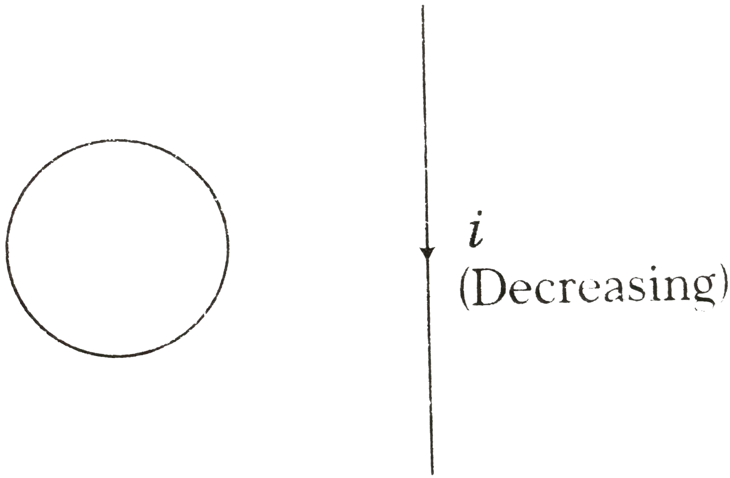
41. A circular loop is placed near a current carrying conductor as shown in figure. Find the direction of induced current, if the current, in the wire is decreasing.



A. clockwise

B. Anti-clockwise

C. first clockwise then anti-clockwise

D. none of these

Answer: A

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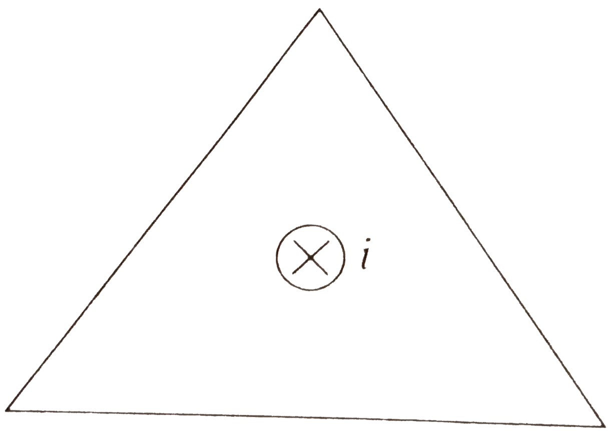
42. A current carrying straight wire passes inside a triangular coil as shown in figure. The current in the wire is perpendicular to paper inwards. Find the direction of the induced current in the loop, if current in the wire is increased.



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43. A uniform magnetic field $B = B_0 t \hat{i}$ in a region exists. A circular conducting loop of radius r and resistance R is placed with its plane in yz-plane. Determine the current through the loop and sense of the current.

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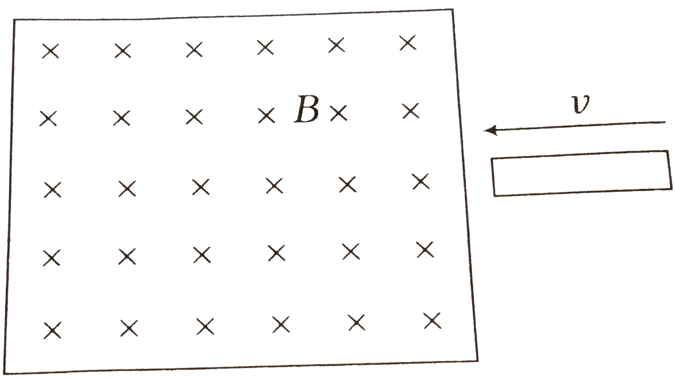
44. Through a uniform B field, A small rectangular loop is moving towards left with constant velocity as shown in the figure. Counting of time t begins at the moment, the loop starts entering the field.

Plot the variation of flux through the loop with respect to time. Also, plot the variation of induced emf w.r.t. time t.



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45. Through a conducting coil along its axis, a short bar magnet is rapidly pulled with uniform velocity with, with its north pole entering the coil first. Plot the variation of (i) flux, (ii) induced current and (iii) power dissipated in coil with time.

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46. In a uniform magnetic field, a π shaped metal frame is located perpendicular to the plane of the conductor and varying with time at the rate $(dB/dt) = 0.20T/s$. A conducting connector starts moving with an acceleration $a = 30cm/s^2$ along the parallel bars of the frame. The length of the connector is equal to l = 44 cm. Find the emf induced in the loop t = 1 s after the beginning of the motion, if at the moment t = 0, the loop area and the magnetic induction are equal to zero.

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47. A conducting rod of unit length moves with a velocity of 5m/s in a direction perpendicular to its length and perpendicular to a uniform magnetic field of magnitude $0.4T$. Find the emf induced between the ends of the stick.

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48. The horizontal component of the earth's magnetic field at a place is 4.0×10^{-4}T and the dip is 45°. A metal rod of length 20 cm is placed in the north-south direction and is moved at a constant speed of 5 cm/s towards east. Calculate the emf induced in the rod.

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49. A righ of radius 2m translates in its plane with a constant velocity $5m/s$. A uniform magnetic field 0.1 T exists in the space in a direction perpendicualr to the plane of the ring. Consider different pairs of diametrically opposite points on the ring.

(i) Between which pair of points is emf maximum? What is the value of this maximum emf?

(ii) Between which pair of points is the emf maximum? What is the value of this minimum emf?

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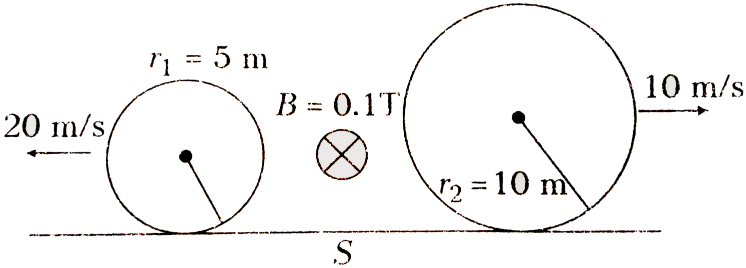
50. Two rings of radii 5m and 10m move in opposite directions with velocity 20 m/s and 10 m/s respectively, on a conducting curface S. There is a uniform magnetic field of magnitude $0.1T$ perpendicular to the plane of the rings. Find the potential difference between the highest points of the two rings.



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51. A vertical disc of diameter 10 cm makes 20 revolutions per second about a horizontal axis passing through its centre. A uniform magnetic field 10^{-1} T acts perpendicular to the plane of the disc. Calculate the potential difference between its centre and rim in volts.

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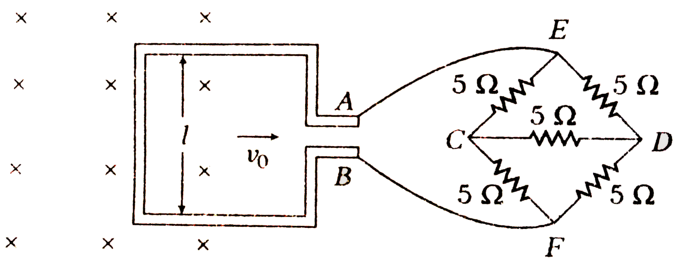
52. A square metal wire loop of side 20 cm and resistance 2Ω is moved with a constant velcoity v_0 in a uniform magnetic field of induction B = 1 Wb/m^2 as shown in the figure. The magnetic field lines are perpendicular to the plane of the loop. The loop is connected to a network of resistance each of value 5Ω. The resistances of the lead wires BF and AE are negligible. What should be the speed of the loop, so as to have a steady current of 2 mA in the loop? Give the direction of current in the loop.



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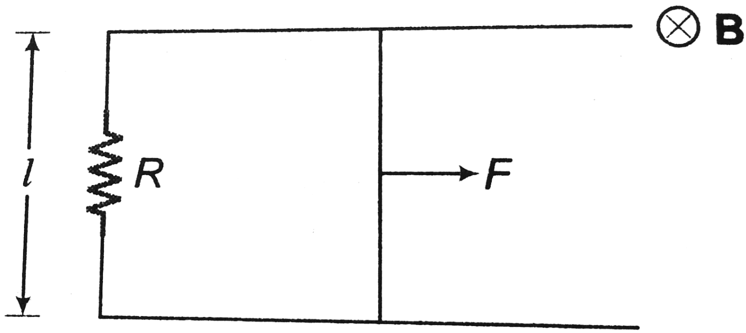
53. Figure shows the to views of a rod that can slide without friction. The resistor is 6.0Ω and a $2.5T$ magnetic field is directed perpendicularly downward into the paper. Let $l = 1.20m$.



a. Calculate the force F required to move the rod to the right at a constant speed of $2.0\frac{m}{s}$,

b. At what rate is energy deliered to the resistor?

c. Show that this rate is equal to the rate of work done by the applied force.

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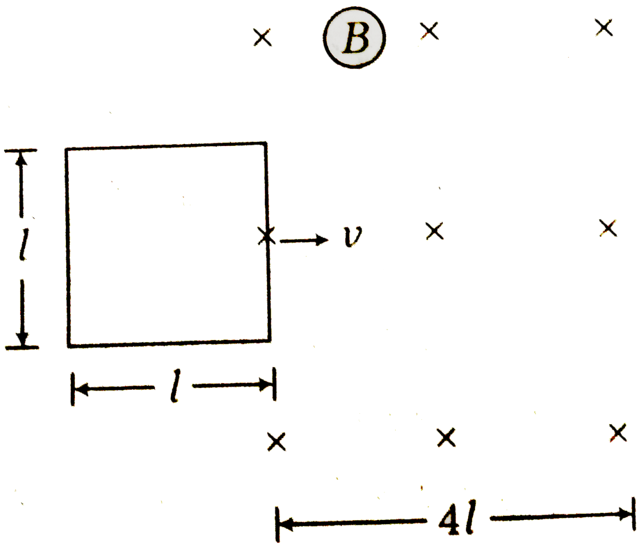
54. A square loop of side l being moved towards right at a constant speed v as shown in figure. The front edge enters the magnetic field B at t = 0. The width of field is 4l. Sketch induced emf versus time graph.



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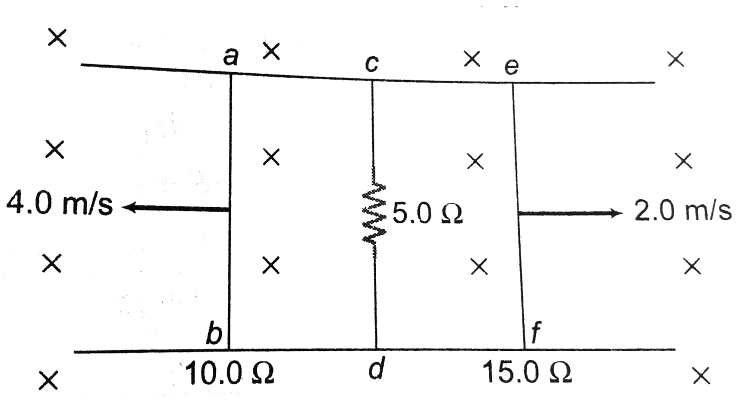
55. Two parallel rails with negligible resistance are $10.0 cm$ apart. The are connected by a 5.0Ω resistor. The circuit also contains two metal rods having resistances of 10.0Ω and 15.0Ω along the rails. The rods are pulled away from the resistor at constant speeds $4.00\frac{m}{s}$ and $2.00 m/s$

respectively. A uniform magnetic field of magnitude $0.01T$ is applied perpendicular to the, plane of the rails. Determine the current in the 5.0Ω resistor.



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56. A uniform magnetic field exists in a circular region of radius R centrad at O. The field is perpendicular to the plane of paper and is strength varies with time as $B = B_0 t$. Find the induced electric field at a distance r from the centre for (i)$r < R$, (ii) $r > R$. Also, plot a graph between $|E|$ and r for both the cases.

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57. The cruuent in an ideal, long solenoid is varied at a uniform rate of $0.02A/s$. The solenoid has 1000 turns/s and its radius is 8 cm.

(i) Consider a circle of radius 2 cm inside the solenoid with its axis coinciding with the axis of the solenoid. Write the change in the magnetic flux through this circle in 4 s.

(ii) Find the electric field induced at a point on the circumference of the circle.

(iii) Find the electric field induced at a point outside the solenoid at a distance 9 cm from its axis.

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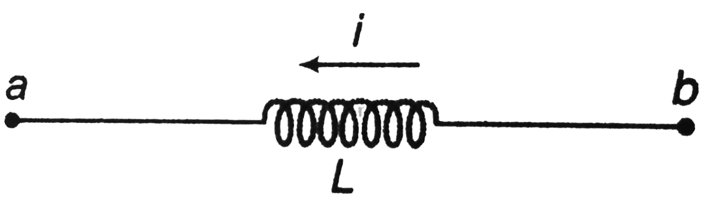
58. The inductor shown in figure has inducance $0.54H$ and carries a current in the direction shown thast is decreasing at a uniform rate $\frac{di}{dt} = 0.03A/s$.



a. Find the self induced emf

b. Which emf of the inductor a ro b is at a higher potential?

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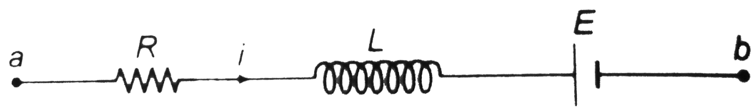
59. In the circuit diagram shown in Figure, $R = 10\Omega, L = 15H, E = 20v, i = 2A$. This current is decreasing at a rate of $-1.0A/s$. Find V_{ab} at this instant.



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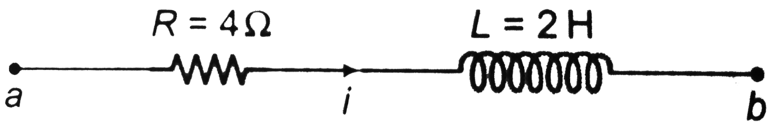
60. In the figure shown $i = 10e^{-4t}$A. Find V_L and V_{ab}



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61. a. Calculate the inductance of an air core solenoid containing 300 turns if the length of the solenoid is $25.0cm$ and its cross -sectional area is $4.00cm^2$.

b. Calculate the self -induced emf in the solenoid if the current through it is decreasingg at the rate of $50.0A/s$.

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62. What inductance would be needed to store $1.0kWh$ of energy in a coil carrying a $200A$ current. $(1kWh = 3.6 \times 10^6 J)$

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63. Two coils having self-inductances, $L_1 = 5mH$ and $L_2 = 1mH$. The current in the coil is increasing of same constant rate at a certain instant and the power supplied to the coils is also same, Find the ratio of

(i) induced voltage

(ii) current

(iii) energy stored in two coils at that instant

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64. Suppose a cube of volume $2mm^3$ is placed at the centre of a circular loop of radius 5 cm carrying current 2A.

Find the magnetic energy stored inside the cube.

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65. Calculate the mutual inductance between two coils when a current 2A changes to 6A in and 0.2 s and induces an emf of 20mV in secondary coil.

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66. A straight solenoid has 50 turns per cm in primary and total 200 turns in the secondary. The area of cross section of the solenoids is $4cm^2$.

Calculate the mutual inductance. Primary is tightly kept in side the secondary.

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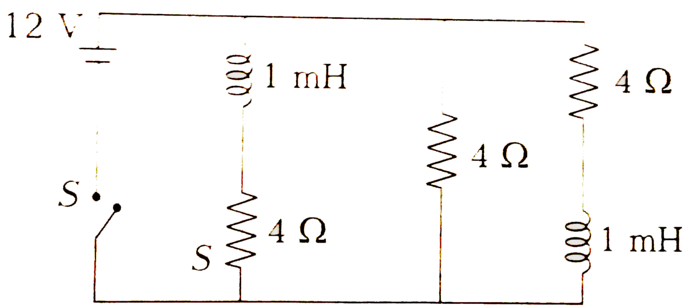
67. Find the current through the battery

(i) just after the switch is closed.

(ii) long after the switch has been closed.



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68. A coil of resistance 20Ω and inductance $0.5H$ is switched to $DC 200V$ supply. Calculate the rate of increase of current

a. at the instant of closing the switch and

b. after one time constant.

c. Find the steady state current in the circuit.

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69. Self - inductance 0.8×10^{-4}H of a uniformly wound solenoid, having resistance 3 Ω is broken up into two indentical coils. Those coils are connected in series across a 6 V battery of negligible resistance. Find time constant and steady state current.

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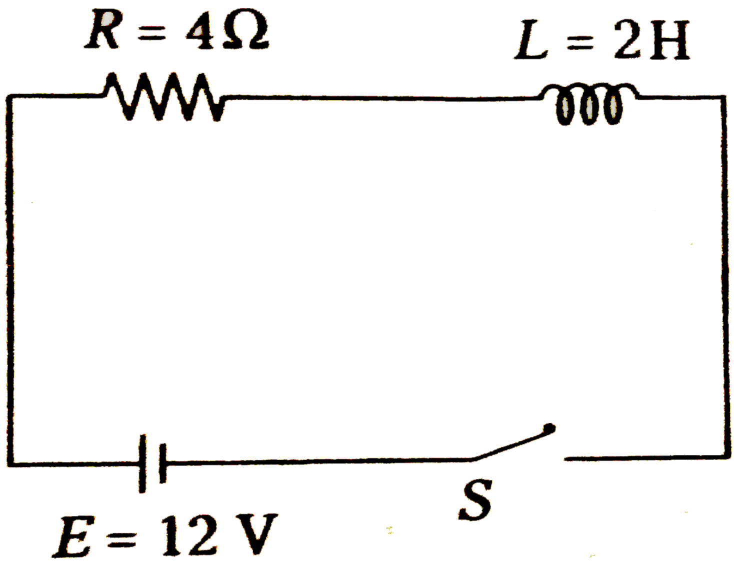

70.

At t = 0, switch S is closed, calculate

(i) initial rate of increase of current, i.e., $\frac{di}{dt}$ at $\mathrm{t} = 0$.

(ii) $\frac{di}{dt}$ at time when current in the circuit is $0.5A$.

(iii) Current at t = 0.6 s.

(iv) rate at which energy of magnetic field is increasing, rate of heat produced in resistance and rate at which energy is supplied by battery when i = 0.5 A.

(v) energy stored in inductor in steady state.

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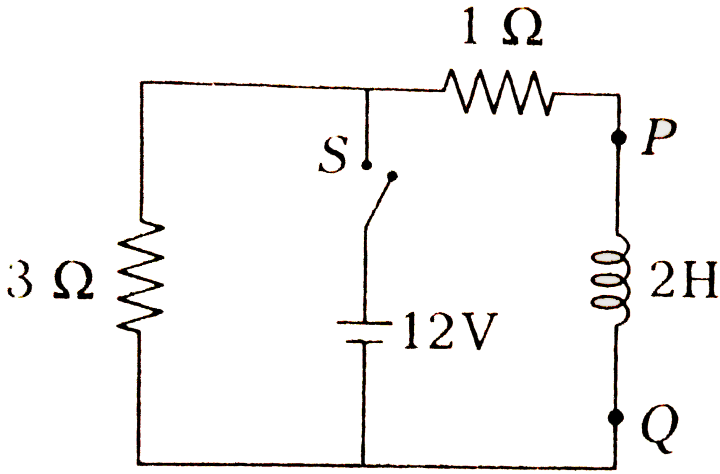
71. 

The switch is closed for a long time and then opened at time t = 0. Find the initial voltage across L after t = 0, which end is at higher potential P or Q?

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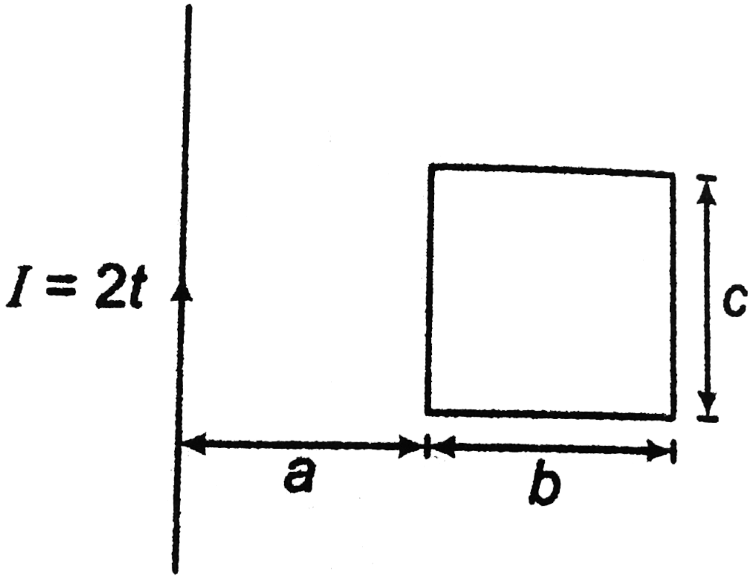
Example Type 1

1. Current in a long current carrying wire is $I = 2t$

A conducting loop is placed to the right of this wire. Find



a. magnetic flux ϕ_B passing through the loop.

b. induced $emf|e|$ prodced in the loop.

c. if total resistance of the loop is R, then find induced current I_{in} in the loop.

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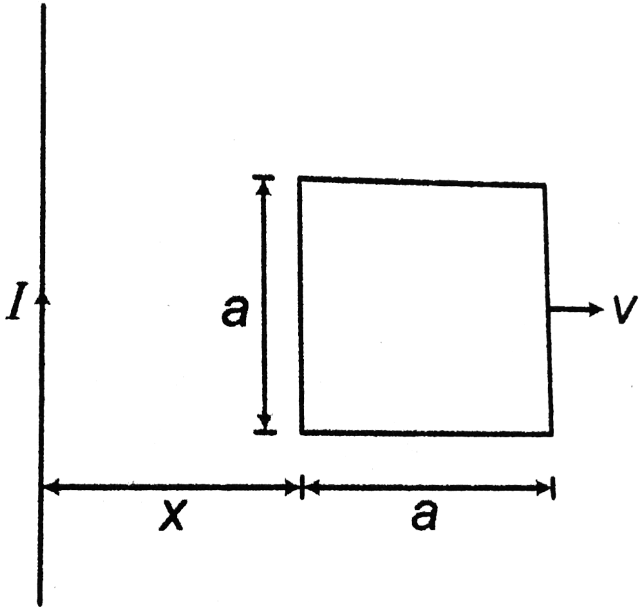
2. A constant current I flows through a long straight wire as shown in figure. A square loop starts moving towards righ with as constant speed v

.



a Find induced emf produced i the loop as a function x

b. If total resistance of the loop is R, then find induced current in the loop,

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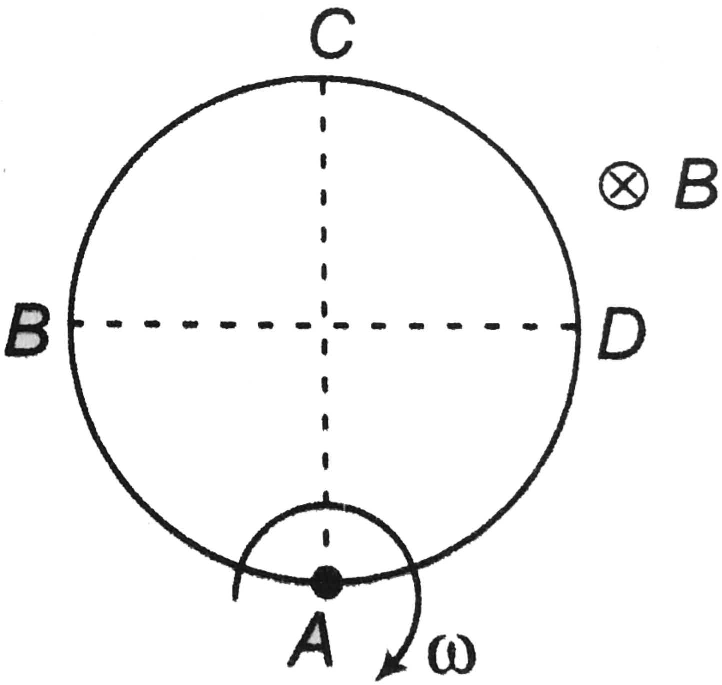
3. A conducting circular ring is rotated with angular velocity ω about point A as shown in figure. Radius of ring is a find



a. potential difference between points A and C

b. potential difference the points A and D.

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Example Type 2

1. Two different coils have self inductances $L_1 = 9mH$ and $L_2 = 2mH$.

The current in one coil is increased at a constant rate. The current in the second coil is also increased at the same constant rate. At a certain instant of time, the power given to the two coils is the same. At that time, the current the induced voltage and the energy stored in the first coil are i_1, V_1 and W_1 respectively.

Corresponding values for the second coil at the same instant are i_2, $V-2$ and W_2 respectively. Then,

A. $\frac{i_1}{i_2} = \frac{1}{4}$

B. $\frac{i_1}{i_2} = 4$

C. $\frac{W_1}{W_2} = \frac{1}{4}$

D. $\frac{V_1}{V_2} = 4$

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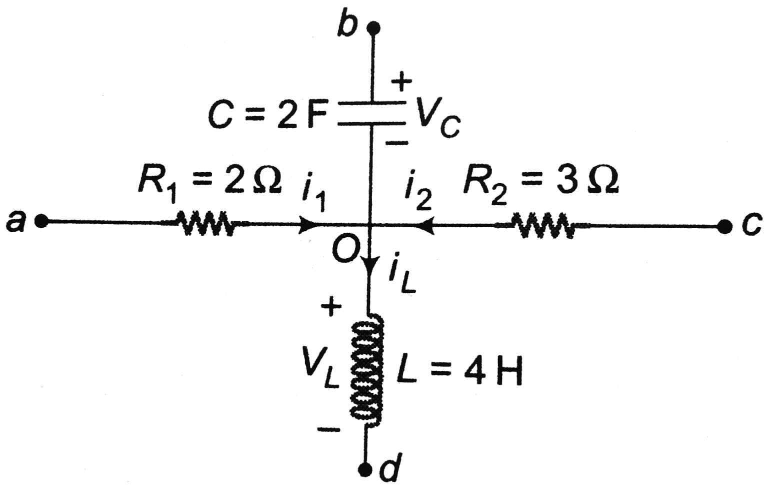
2. In the Figure shown $i_1 = 10e^{-2t}A, i_2 = 4A$ and $V_C = 3e^{-2t}V$.

Determine



a. i_L and V_L b. V_{ac}, V_{ab}, V_{cd}

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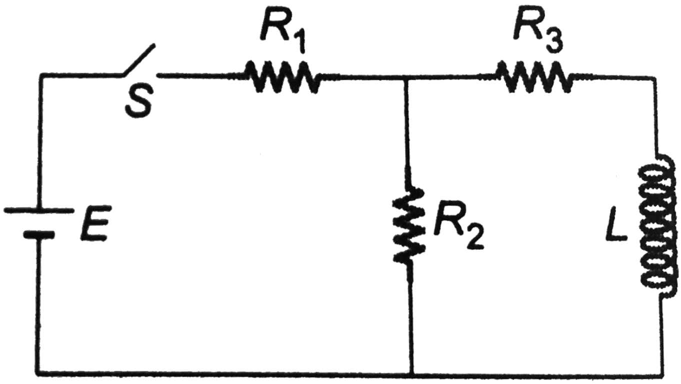
Example Type 3

1. For the ciruit shown in figure $E = 50V$, $R_1 = 10\Omega$, $R_2 = 20\Omega$, $R_3 = 30\Omega$ and $L = 2.0mH$. Find



a. Immediately after switch S is closed

b. A long time after S is closed.

c. Immediaately after S is reopened

d. A long time after S is reopened.

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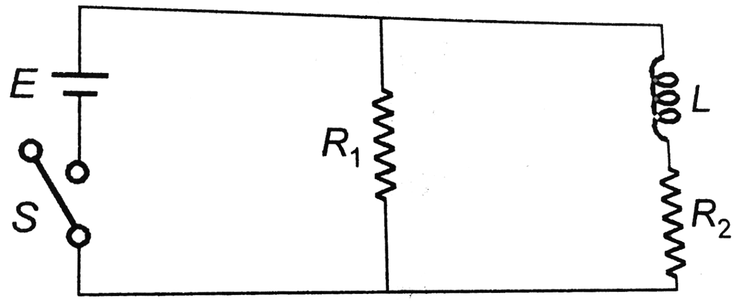
2. An inductor of inductance $L = 400 mH$ and resistors of resistances $R_1 = 2\Omega$ and $R_2 = 2\Omega$ are connected to a battery of emf $E = 12V$ as shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at time $t = 0$.



What is the potential dro across L s a function of time? After the steady state is reached, the switch is opened. What is the direction ad the magnitude of current throough R_1 as a function of time?

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3. A solenoid has an inductance of $10H$ and a resistance of 2Ω. It is connected to a $10V$ battery. How long will it take for the magnetic energy to reach $1/4$ of its maximum value?

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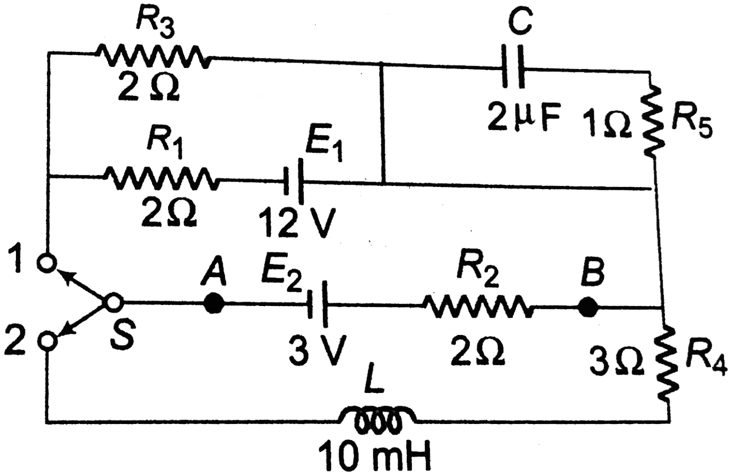
4. A circuit containing a two position switch S is shown in figure



a. The switch S is in position 1. Find the potential differecne $V_A - V_B$ and the rte of production of joule heat in R_1

b. If now the switch S is put in position 2 at $t = 0$. Find ltbRrgt i steady current in R_4 and ii hte time when current in R_4 is half the steady value. Also calculate the energy stored in the inductor L at that time.

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Example Type 4

1. In an $L-C$ circuit, $L=3.3H$ and $C=840pF$. At $t=0$ charge on the capacitor is $105\mu C$ and maximum. Compute the following quantities at $t=2.0ms$.

a. The energy stored in the capacitor.

b. The total energy in the circuit,

c. The energy stored in the inductor.

A. $6.0J$, $1.56J$, 0.56

B. $6.0J$, $6.56J$, 1.56

C. $4.0J$, $6.56J$, 0.56

D. $6.0J$, $6.56J$, 0.56

Answer: D

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2. An inductor of inductance $2.0mH$ s connected across a charged capacitor of capacitance $5.0\mu F$ and the resulting LC circuit is set oscillating at its natural frequency. Let Q denote the instantaneous charge on the capacitor and I the current in the circuit. It is found that the maximum value of charge Q is $200\mu C$.

a. When $Q = 100\mu C$, what is the value of $\left|\frac{dI}{dt}\right|$?

b. When $Q = 200\mu C$, what is the value of I?

c. Find the maximum value of I.

d. When I is equal to one-half its maximum value, what is the value of $|Q|$?

A. When $Q = 100\mu C$, what is the value of $\backslash dI / dt \backslash ?$

B. When $Q = 200\mu C$ what is the value of I?

C. Find the maximum value of I.

D. When I is equal to one-half of its maximum value, what is the value of $|Q|$?

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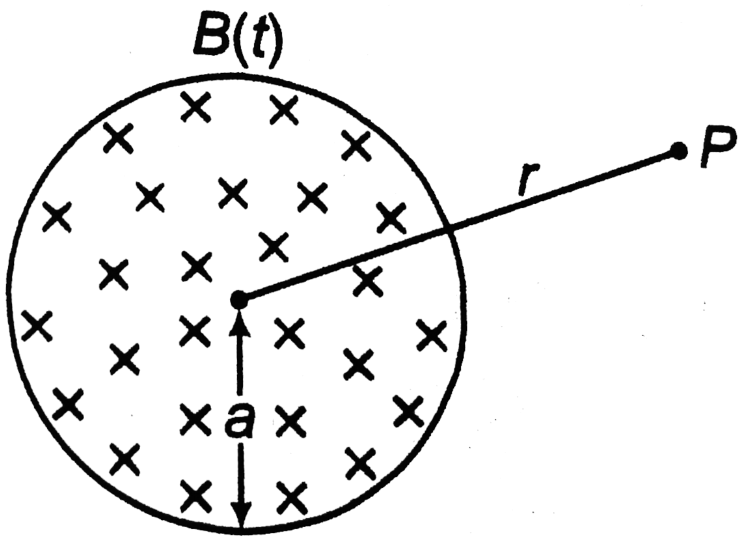
Example Type 5

1. A uniform but time varying magnetic field $B(t)$ exist in a circular region of radius a and is directed into the plane of the paper as shown. The magnitude of the induced electric field at point P at a distance r form the centre of the circular region.



A. is zero

B. decreases as $\frac{1}{r}$

C. increases as r

D. decreases as $\frac{1}{r^2}$

Answer: B

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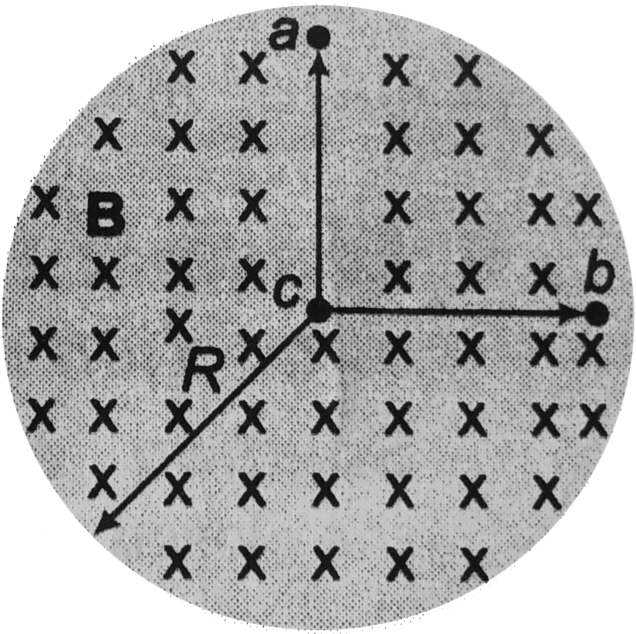
2. The magnetic field B at all points within a circular region of the radius R is uniform space and directed into the plane of the page in figure. If the magnetic field is increasing at a rate dB/dt what are the magnitude and direction of the force on as stationary positive point charge q located at points a, b, c? (Point a is a distance r above the centre of the region, point b is a distance r to the right to the centre and point c is at the centre of the region).



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Example Type 6

1. If X is a capacitor C, then the constant accelerationn a of the wire.

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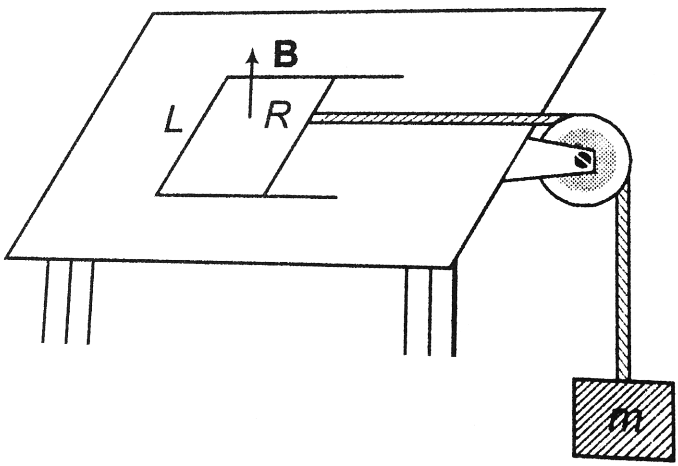
2. A pair of parallel horizontal conducting rails of negligible resistance shorted at one end is fixed on a table. The distance between the rails is L. A conducting massless rod of resistance R can slide on the rails frictionlessly. The rod is tied to a massless string which passes over a pulley fixed 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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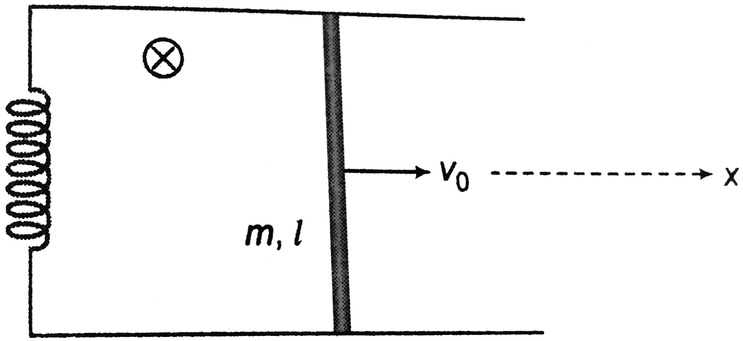
3. A loop is formed by two parallel conductors connected by a selenoid with inductance L and a condutcing rod of mass which can freely (without friction) slide over the conductors. The conductors are located i a horizontal plane in as uniform vertical magnetic field B.The distance between the conductors is l.



At the moment $t=0$ the rod is impaert dan initial velocity v_0 directed to the right. find the law of its motion $d(t)$ if the electric resistance of the loop is negligible

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Miscellaneous Examples

1. A sensitive electronic device of resistance 175Ω is to be connected to a source of emf by a switch. The device is designed to operate with a current of $36mA$ but to avoid damage to the device, the current can rise to no more than $4.9mA$ in the first $58\mu s$ after the switch the closed. To protect the device it is connected in series with an inductor.

a. What emf must the source have?

b. What inductance is required?

c. What is the time constant?

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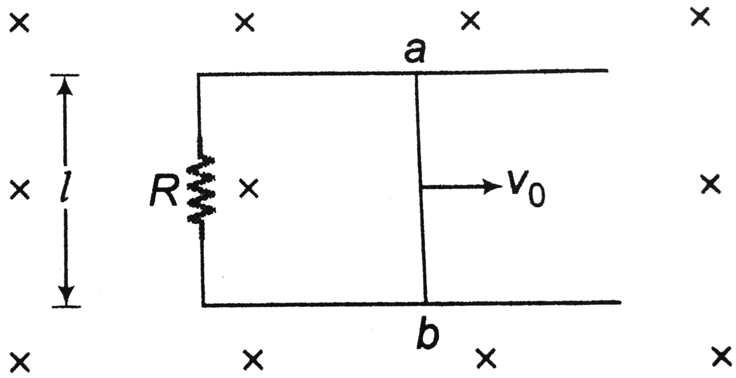
2. A conducting rod shown in figure of mass m and length l moves on two frictionless horizontal parallel rails in the presence of a unifom magnetic field directed into the page., The rod is given an initial velocity v_0 to the right and is released at $t=0$. Find s a function of time

a. the volocity of the rod

b. the induced current and

c. the magntitude of the induced emf.



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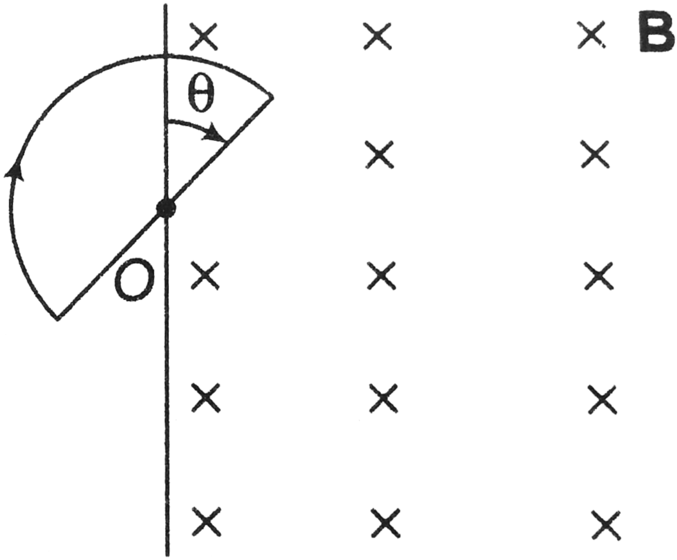
3. A wire loop enclosing as semicircle of radius R is located on the boudary of uniform magnetic field B. At the moment $t = 0$, the loop is set into rotation with a costant angular acceleration α about an axis O coinciding with a line of vector B on the boundary. Find the emf induced in the loop as a function of time. Draw the approximate plot of this function.The arrow in the figure shows the emf direction taken to be positive.



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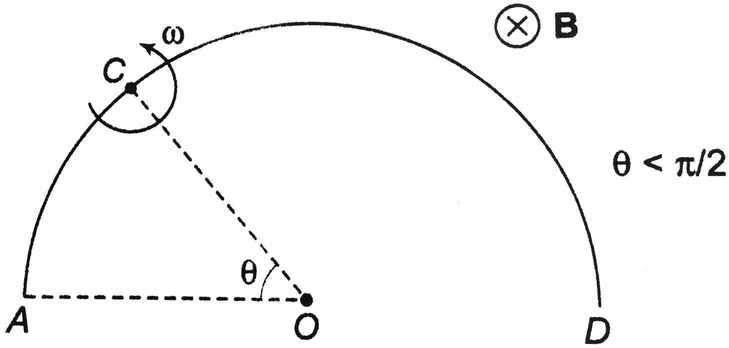
4. A uniform wire of resistance per unit length λ is bent into semicircle of radius a. The wire rotates with angular velocity ω in a vertical plane about a orizontal is passing through C. A uniform magnetic field B exists in space in a direction perpendicular to paper inwards.



a. Calculate potential difference between points A and D. which point is at higher potential?

b. If points A and D are connected by a conducting wire of zero resistance, find the potential difference between A and C.

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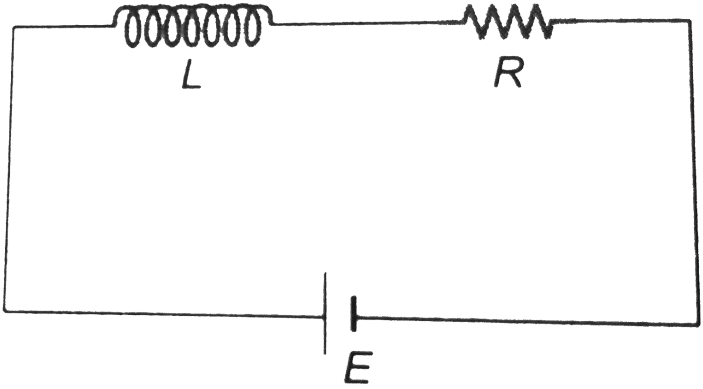
5. A battery of emf E and of negligible internal resistance is connected in a $L-R$ circuit as shown in figure. The inductor has a piece of soft iron inside it. When steady state is reached in the piece of soft iron is abruptly pulled out suddenly so that the inductance of the inductor decreases to nL with $n < 1$ with battery remaining connected. Calculate.



a. Current as a function of time assuming $t = 0$ at the instant when piece is pulled.

b. the work done to pull out the piece.

c. thermal power generated in the circuit as as function of time.

d. power supplied by the battery as a function of time.

HOW TO PROCEED When the inductance of an inductor is abruptly changed, the flux passing through it remains constant.

$\phi =$ constant

$\therefore Li =$ constant $\left(L = \frac{\phi}{i}\right)$

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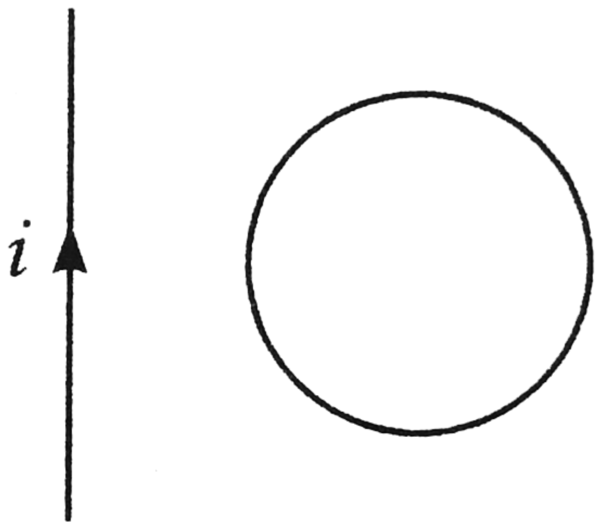
Exercise 27.1

1. Figure shows a conducting loop placed near a long straight wire carrying a current i as shown, if the current increases continuously, find the direction of the induced current in the loop.



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2. A metallic loop is placed in a non-uniform steady magnetic field. Will an emf be induced in the loop?

A. NO

B. MAY BE

C. YES

D. INCOMPLETE INFO

Answer: A

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3. Write the dimensions of $\frac{d\phi_B}{dt}$.

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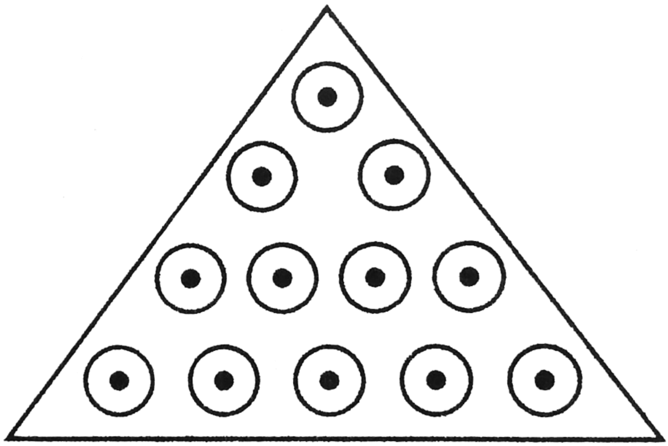
4. A triangular loop is placed in a dot $\odot$ magnetic field as shown in figure. Find the direction of induced current in the loop if magnetic field is increasing.



A. Anti-clockwise

B. random

C. Clockwise

D. no induced current

Answer: C

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5. Two circular loops lie side by side in the same plane. One is connected to a source that supplies an increasing current, the other is a simple closed ring. Is the induced current in the ring is in the same direction as that in the loop connected to the source or opposite? What if the current in the first loop is decreasing?

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6. A wire in the form of a circular loop of radius $10cm$ lies in a plane normal to a magnetic field of $100T$. If this wire is pulled to take a square shape in the same plane in $0.1s$, find the average induced emf in the loop.

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7. A closed coil consists of 500 turns has area $4cm^2$ and a resistance of 50Ω. The coil is kept with its plane perpendicular to a uniform magnetic field of $0.2W\frac{b}{m^2}$. Calculate the amount charge flowing through the coil if it is rotated through 180°

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8. The magnetic field in a certain region is given by $B = \left(4.0\overrightarrow{i} - 1.8\overrightarrow{k}\right) \times 10^{-3}T$. How much flu passes through a $5.0cm^2$ area loop in this region if the loop lies flat on the xy-plane?

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Exercise 27.2

1. A horizontal wire $0.8m$ long is falling at a speed of $5m/s$ perpendicular to a uniform magnetic field of $1.1T$, which is directed from east to west. Calculate the magnitude of the induced ernf. Is the north or south end of the wire positive?

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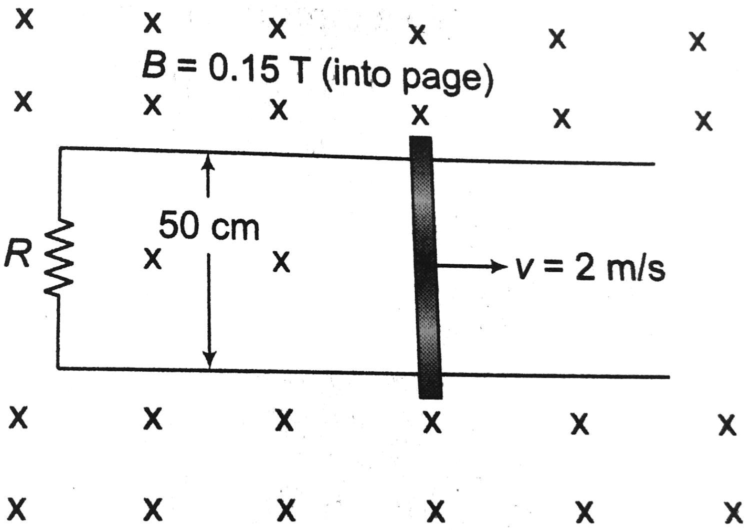
2. As shown in figure, a metal rod completes the circuit. The circuit area is perpendicular to a magnetic field with $B = 0.15T$. If the resistance of the total circuit is 3Ω, how large a force is needed to move the rod as indicated with a constant speed of 2 m/s?



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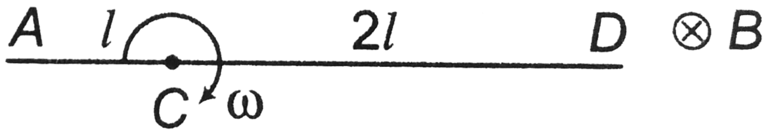
3. A rod of length $3l$ rotated with an angular velocity ω as shown in figure. The unfiorm magnetic field B is into the paper. Find

(a) $V_A - V_C$ (b) $V_A - V_D$



A. $\frac{B\omega(2l)^2}{4}$ $\frac{B\omega(2l)^2}{2}$ $-3B\omega l^2/2$

B. $\frac{B\omega(2l)^2}{2}$ $\frac{B\omega(2l)^2}{2}$ $-3B\omega l^2/2$

C. $\frac{B\omega(2l)^2}{2}$ $\frac{B\omega(2l)^2}{2}$ $3B\omega l^2/2$

D. $\frac{B\omega(2l)^2}{2}$ $\frac{B\omega(l)^2}{2}$ $-3B\omega l^2/2$

Answer: B

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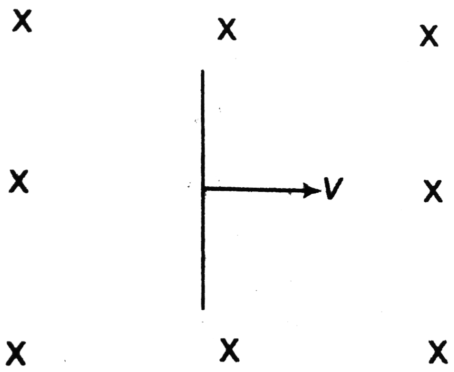
4. As the bar shown in figure moves in a direction perpendicular to the field, is an external force required to keep it moving with constant speed.



A. NO

B. YES

C. MAY BE

D. IN COMPLETE INFO

Answer: A

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Exercise 27.3

1. The current through an inductor of $1H$ is given by $i = 31 \sin t$. Find the voltage across the inductor.

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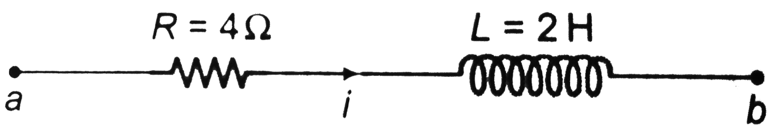
2. In the figure shown $i = 10e^{-4t}$A. Find V_L and V_{ab}



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3. The current (in Ampere) in an inductor is given by $l = 5 + 16t$, where t in seconds. The selft - induced emf in it is $10mV$. Find

(a) the self-inductance, and

(b) the energy stored in the inductor and the power supplied to it at $t = 1s$

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4. (a) Calculate the self-inductance of a solenoid that is tightly wound with wire of diameter $0.10cm$, has a cross-sectional area $0.90cm^2$ and is $40cm$ long

(b) If the current through the solenoid decreases uniformly from 10 A to $0A$ in $0.10s$, what is the emf induced between the ends of the solenoid?

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Exercise 27.4

1. Calculate the mutual inductance between two coils when a current of $4A$ changes to $12A$ in $0.5s$ in primary and induces an emf of $50mV$ in the secondary. Also, calculate the induced emf in the secondary if current in the primary changes from $3A$ to $9A$ is $0.02s$.

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2. A coil has 600 turns which produces $5 \times 10^{-3} Wb/turn$ of flux when $3A$ current flows in the wire. This produced 6×10^{-3} Wb/turn in 1000 turns secondary coil. When the opened, the current drops to zero in $0.2s$ in primary. Find

(a) mutual inductance,

(b) the induced emf in the secondary,

(c) the self-inductance of the primary coil.

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3. Two coils have mutual inductance $M = 3.25 \times 10^{4} H$. The current i_1 in the ffrst coil increases at a uniform rate of $830A/s$.

(a) What is the magnitude of the induced emf in the second coil? Is it constant?

(b) Suppose that the current described is in the second coil rather than the first. What is the induced emf in the first coil?

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Exercise 27.5

1. Show that $\frac{L}{R}$ has units of time.

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2. A coil of inductance $2H$ and resistance 10Ω are in a series circuit with an open key and a cell of constant $100V$ with negligible resistance. At time $i = 0$, the key is closed. Find

(a) the time constant of the circuit.

(b) the maximum steady current in the circuit.

(c) the current in the circuit at $f = 1s$.

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3. In the simple $L - R$ circuit, can the emf induced across the inductor ever be greater than the emf of the battery used to produce the current?

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Exercise 27.6

1. Show that $\sqrt{LC}$ has units of time.

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2. While comparing the $L-C$ oscillations with the oscillations of spring-block system, with whom the magnetic energy can be compared and why?

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3. In an $L-C$ circuit, $L=0.75H$ and $C=18\mu F$, (a) At the instant when the current in the inductor is changing at a rate of $3.40Ns$, what is the charge on the capacitor? (b) When the charge on the capacitor is 4.2×10^{-4} C, what is the induced emf in the inductor?

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4. An $L-C$ circuit consists of a $20.0mH$ inductor and a $0.5\mu F$ capacitor. If the maximum instantaneous current is $0.1A$, what is the greatest potential difference across the capacitor?

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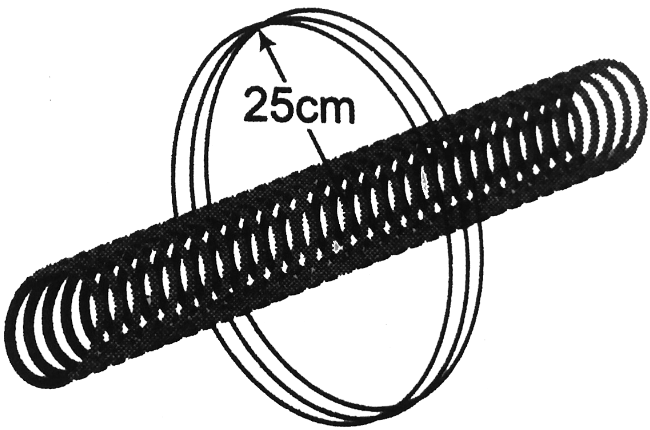
Exercise 27.7

1. A long solenoid of cross-sectional area $5.0cm^2$ is wound with 25 turns of wire per centimetre. It is placed in the middle of a closely wrapped coil of 10 turns and radius 25 cm as shown.



(a) What is the emf induced in the coil when the current through the solenoid is decreasing at a rate $-0.20A/s$?

(b) What is the electric field induced in the coil?

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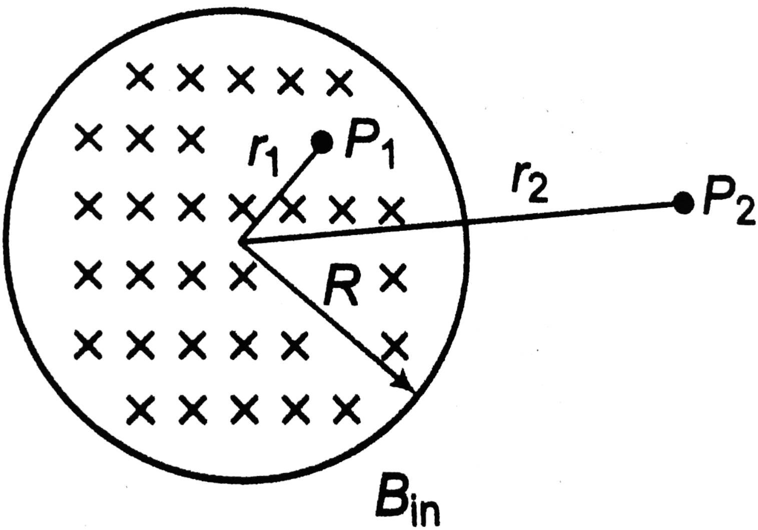
2. For the situation described in figure, the magnetic field changes with time according to

$B=\left(2.00t^3-4.00t^2+0.8\right)t$ and $r_2=2R=5.0cm$



(a) Calculate the force on an electron located at P_2 at $t=2.00s$

(b) What are the magnitude and direction of the electric field at P_1 when $t = 3.00s$ and $r_1 = 0.02m$.

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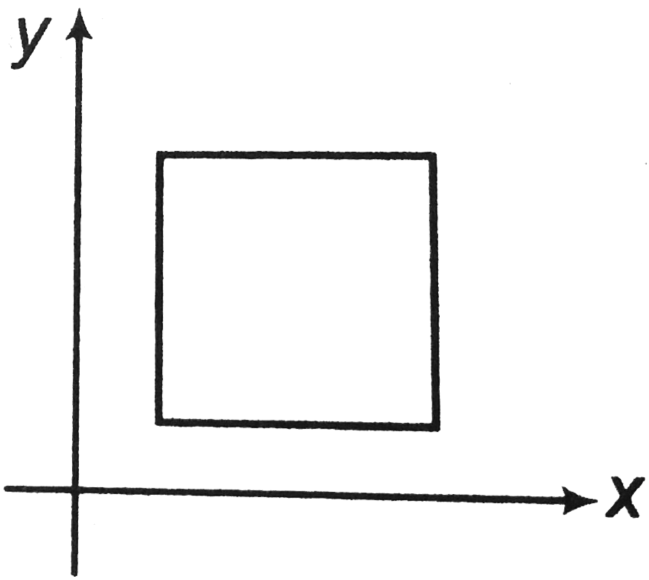
Level 1 Assertion And Reason

1. Assertion : A square loop is placed in x-y plane as shown in figure. Magnetic field in the region is $B = -B_0 x\hat{k}$. The induced current in the loop is anti-clockwise.



Reason : If inward magnetic field from such a loop increases, then current should be anti-clockwise.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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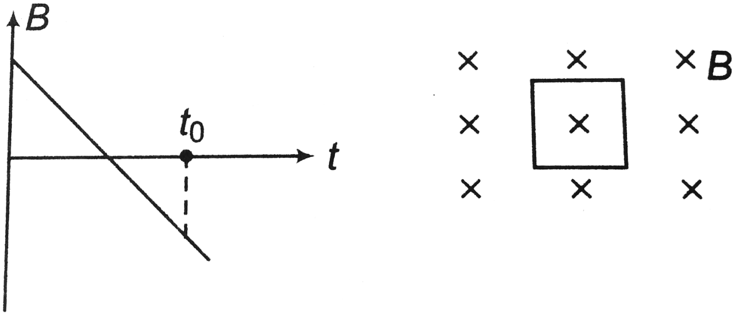
2. Assertion: Magnetic field B (shown inwards) varies with time t as shown. At time to induced current in the loop is clockwise



Reason : If rate of change of magnetic flux from a coil is constant, charge should flow in the coil at a constant rate.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: B

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3. Assertion : Electric field produced by a variable magnetic field can't exert a force on a charged particle.

Reason : This electric field is non-conservative in nature.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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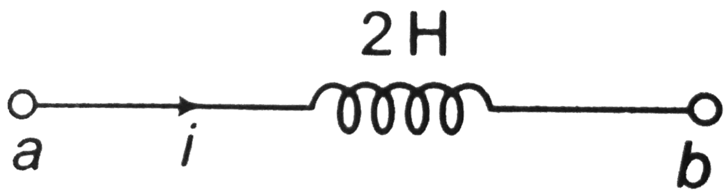
4. Assertion: Current flowing in the circuit is $i = 2t - 8$.



At $t = 1s$, $V_a - V_b = \ +4V$

Reason: $V_a - V_b$ is $+4V$ all the time.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: A::B

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5. Assertion : Angular frequency of LC oscillations is $2rad/s$ and maximum current in the circuit is $1A$. Then, maximum rate of change of current should be $2A/s$.

Reason: $\left(\frac{dI}{dt}\right)_{\max} = (I_{\max})\omega$

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

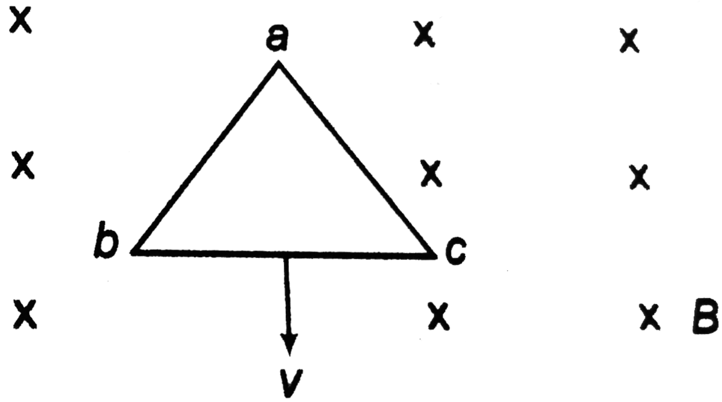
C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: A

Watch Video Solution

6. Assertion : A conducting equilateral loop abc is moved translationally with constant speed v in uniform inward magnetic field B as shown. Then : $V_a - V_b = V_b - V_c$



Reason : Point a is at higher potential than point b.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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7. Assertion : Motional induced emf $e = Bvl$ can be derived from the relation $e = -\frac{dth\eta}{dt}$

Reason : Lenz's law is a consequence of law of conservation of energy.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: B

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8. Assertion : If some ferromagnetic substance is filled inside a solenoid, its coefficient of self induction L will increase.

Reason : By increasing the current in a coil, its coefficient of self induction L can be increased.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

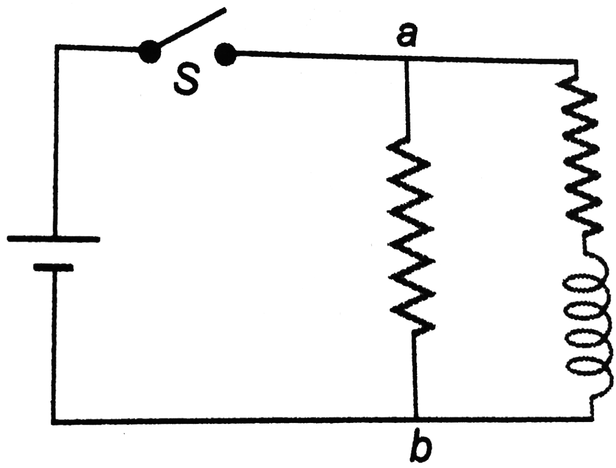
C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: C

Watch Video Solution

9. Assertion : In the circuit shown in figure, current in wire ab will become zero as soon as switch is opened.



Reason : A resistance does not oppose increase or decrease of current through it.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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10. Assertion : In parallel, current distributes in inverse ratio of inductance . $i \propto \frac{1}{L}$

Reason : In electrical circuits, an inductor can be treated as a resistor.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: C

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Level 1 Objective

1. The dimensions of self inductance are

A. $[MLT^{-2}A^{-2}]$

B. $[ML^2T^{-1}A^{-2}]$

C. $[ML^2T^{-2}A^{-2}]$

D. $[ML^2T^{-2}A^{-1}]$

Answer: C

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2. When the number of turns in the two circular coils closely wound are doubled (in both) their mutual inductance becomes

A. four times

B. two times

C. remains same

D. sixteen times

Answer: A

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3. Two coils carrying current in opposite direction are placed co- axially with centres at some finite separation. If they are brought close to each other then, current flowing in them should

A. decrease

B. increase

C. remain same

D. become zero

Answer: B

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4. A current carrying ring is placed in a horizontal plane. A charged particle is dropped along the axis of the ring to fall under the influence of gravity

A. the current in the ring may increase

B. the current in the ring may decrease

C. the velocity of the particle will increase till it reaches the centre of the ring

D. the acceleration of the particle will decrease continously till it reaches the centre of the ring

Answer: C

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5. Identify the incorrect statement. Induced electric field

A. is produced by varyin manetic field

B. is non conservative in nature

C. cannot exist in a region not occupied by magnetic field

D. None of these

Answer: C

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6. Two coils have a mutual inductance of $0.005H$. the current changes in the first coil according to equation $I = I_0 \sin \omega t$, where $I_0 = 10A$ and $\omega = 100\pi rad / s$. The maximum value of emf (in volt) in the second coil is

A. 2π

B. 5π

C. π

D. 4π

Answer: B

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7. An inductance of $2H$ carries a current of $2A$. To prevent sparking when the circuit is broken a capacitor of $4\mu F$ is connected across the inductance. The voltage rating of the capacitor is of the order of

A. $10^3 V$

B. $10V$

C. $10^5 V$

D. $10^6 V$

Answer: A

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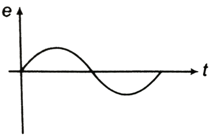
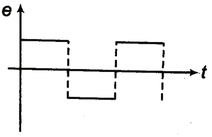
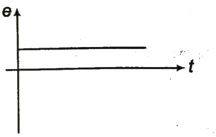
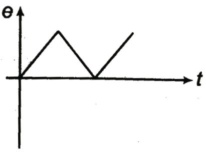
8. A conducting rod is rotated about one end in a plane perpendicular to a uniform magnetic field with constant angular velocity. The correct graph between the induced emf (e) across the rod and time (t) is

A. (a) 

B. (b) 

C. (c) 

D. (d) 

Answer: C

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9. A magnet is taken towards a conducting ring in such a way that a constant current of $10mA$ is induced in it. The total resistance of the ring is 0.5Ω. In $5s$, the magnetic flux through the ring changes by

A. $0.25mWb$

B. $25mWb$

C. $50mWb$

D. $15mWb$

Answer: B

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10. 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 the generated in the loop during that time

A. $\dfrac{a\tau^2}{2R}$

B. $\dfrac{a^2\tau^2}{3R}$

C. $\dfrac{2a^2\tau^3}{3R}$

D. $\dfrac{a\tau}{3R}$

Answer: B

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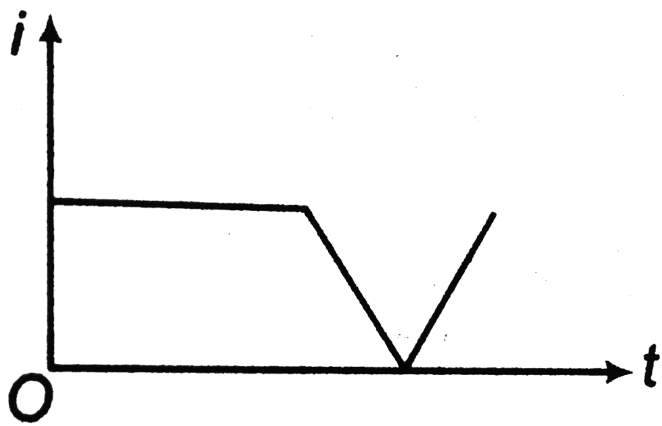
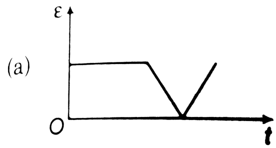
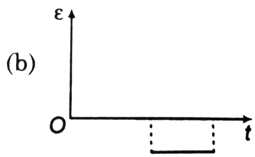
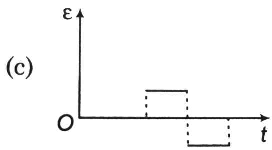
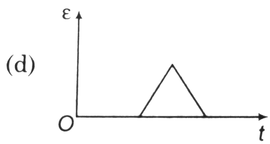
11. The current i in an inductionn coil varies with time t according to the graph shown in the figure. Which of the following grahs shows athe induced emf (ε) in the coil with time?



A. 

B. 

C. 

D. 

Answer: C

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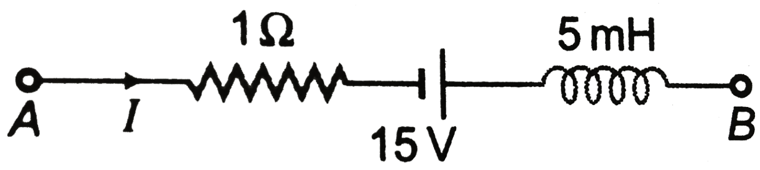
12. The network shown in the figure is a part of complete circuit. What is the potential difference $V_B - V_A$ when the current I is $5A$ and is decreasing at a rate of $10^3 A / s$?



A. $5V$

B. $10V$

C. $15V$

D. $20V$

Answer: C

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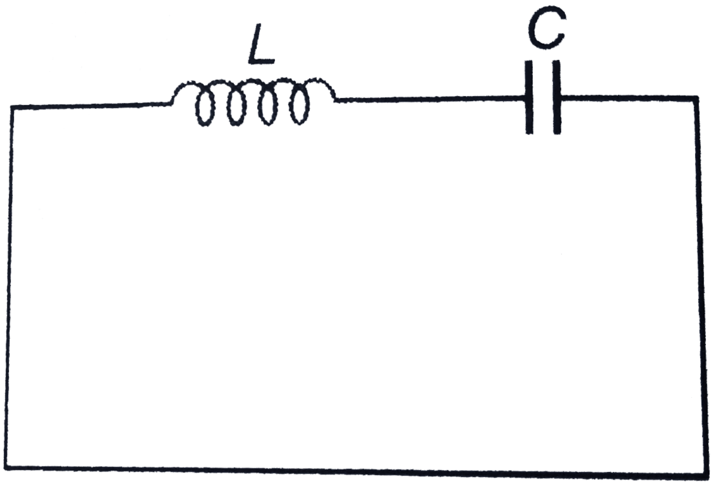
13. In an LC circuit the capacitor has maximum charge q_0. The value of $\left(\frac{dI}{dt}\right)_{\max}$ is



A. $\frac{q_0}{LC}$

B. $\frac{q_0}{\sqrt{LC}}$

C. $\frac{q_0}{LC} - 1$

D. $\frac{q_0}{LC} + 1$

Answer: A

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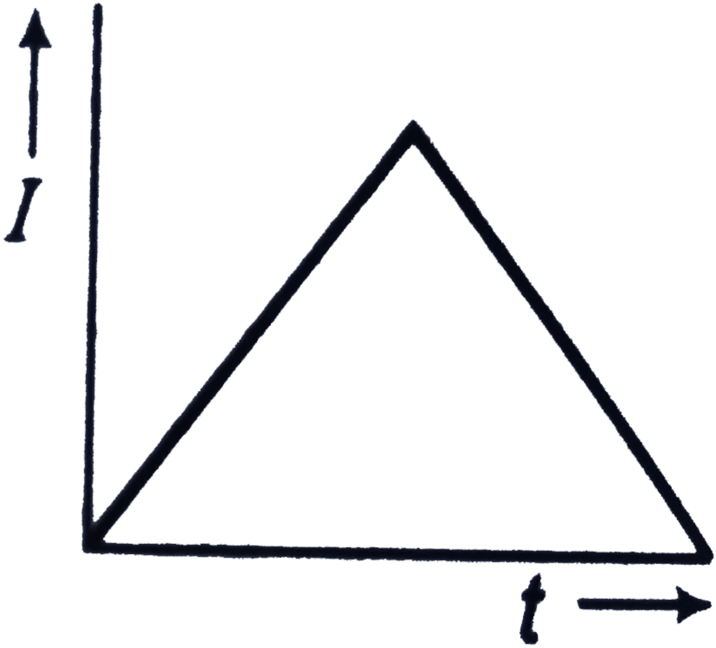
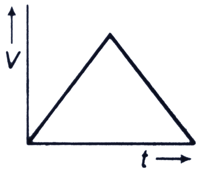
14. An alternating current I in an inductance coil varies with time t according to the graph as shown: Which one of the following graph gives the variation of voltage with time?

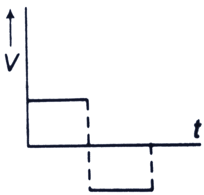


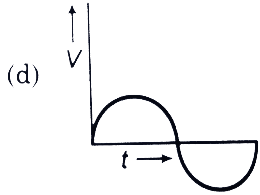
A. (a)



B. ` (##DCP_V04_C27_E01_055_002.png" width="30%">

C. (c)



D. 

Answer: C

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15. A loop of area $1m^2$ is placed in a magnetic field $B = 2T$, such that plane of the loop is parallel to the magnetic field. If the loop is rotated by 180°, the amount of net charge passing through any point of loop, it its resistance is 10Ω is

A. $0.4C$

B. $0.2C$

C. $0.8C$

D. $0C$

Answer: A

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16. A rectangular loop of sides a and b is placed in xy-placed. A uniform but time varying magnetic field of strength $B = 20t\hat{i} + 10t^2\hat{j} + 50\hat{k}$ is present in the region. The magnitude of induced emf in the loop at time t is

A. $20 + 20t$

B. 20

C. $20t$

D. zero

Answer: D

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17. The armature of a DC motor has 20Ω resistance. It draws a current of $1.5A$ when run by $200VDC$ supply The value of back emf induced in it will be

A. $150V$

B. $170V$

C. $180V$

D. $190V$

Answer: B

Watch Video Solution

18. In a transformer the output current and voltage are respectively $4A$ and $20V$. If the ratio of number of turns in the primary to secondary is $2:1$ what is the input current and voltage?

A. $2A$ and $40V$

B. $8A$ and $10V$

C. $4A$ and $10V$

D. $8A$ and $40V$

Answer: A

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19. When a loop moves towards a stationary magnet with speed v, the induced emf in the loop is E. If the magnet also moves away from the lop with the same speed, then the emf inducted in the loop is

A. E

B. $2E$

C. $\frac{E}{2}$

D. zero

Answer: D

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20. A short magnet is allowed to fall from rest along the axis of a horizontal conducting ring. The distance fallen by the magnet in one second may be

A. $5m$

B. $6m$

C. $4m$

D. none of these

Answer: C

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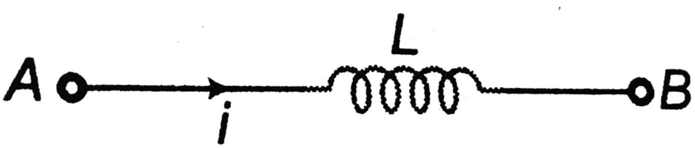
21. In figure, if the current i decreases at a rate α then $V_A - V_B$ is



A. zero

B. $-\alpha L$

C. αL

D. No relation exists

Answer: B

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22. A coil has an inductance of $50mH$ and a resistance of 0.3Ω. If a $12V$ emf is applied across the coil, the energy stored in the magnetic field after the current has built up of its steady state value is

A. $40J$

B. $40mJ$

C. $20J$

D. $20mJ$

Answer: A

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23. A constant voltage is applied to a series $R - L$ circuit by closing the switch. The voltage across inductor $(L = 2H)$ is $20V$ at $t = 0$ and drops of $5V$ and $20ms$. The value of R in Ω is

A. $100 \ln 2\Omega$

B. $100(1 - \ln 2)\Omega$

C. $100 \ln 4\Omega$

D. $100(1 - \ln 4)$

Answer: C

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24. A coil of area $10cm^2$ and 10 turns is in magnetic field directed perpendicular to the plane and changing at a rate of $10^8 gauss/s$. The resistance of coil is 20Ω. The current in the coil will be

A. $0.5A$

B. $5 \times 10^{-3}A$

C. $0.05A$

D. $5A$

Answer: D

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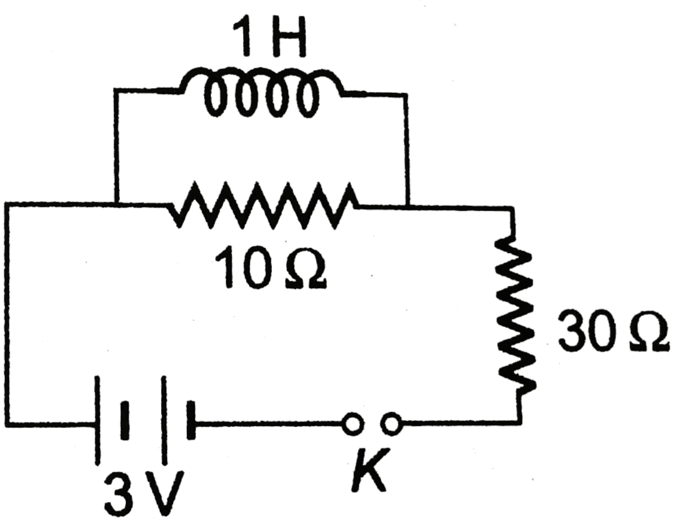
25. In figure final value of current in 10Ω resistor, when plug of key K is inserted is



A. $\frac{3}{10}A$

B. $\frac{3}{20}A$

C. $\frac{3}{11}A$

D. zero

Answer: D

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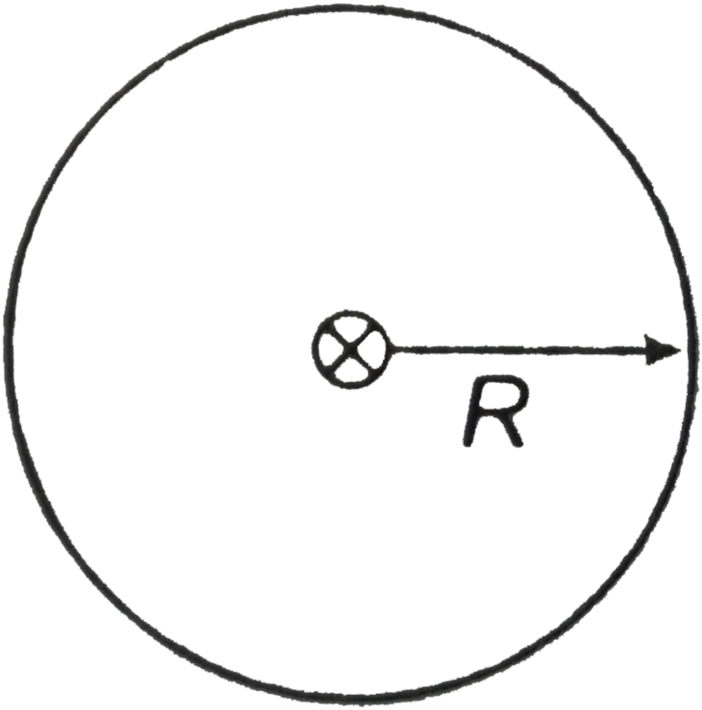
26. A circuit consists of a circular loop of radius R kept in the plane of paper and an infinitely long current carrying wire kept perpendicular to the plane of paper and passing through the centre of loop. The mutual inductance of wire and loop will be



A. $\frac{\mu_0 \pi R}{2}$

B. 0

C. $\mu_0 \pi R^2$

D. $\frac{\mu_0 R^2}{2}$

Answer: B

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27. A flat circular coil of n turns, area A and resitance R is placed in a uniform magnetic field B. The pane of coil is initially perpedicular of B. when the coil is rotated through an angle of 180° about one of its diameter, a charge Q_1 flows through the coil When the same coil after charge Q_2 flows through it. then Q_2 / Q_1 is

A. 1

B. 2

C. $1/2$

D. 0

Answer: D

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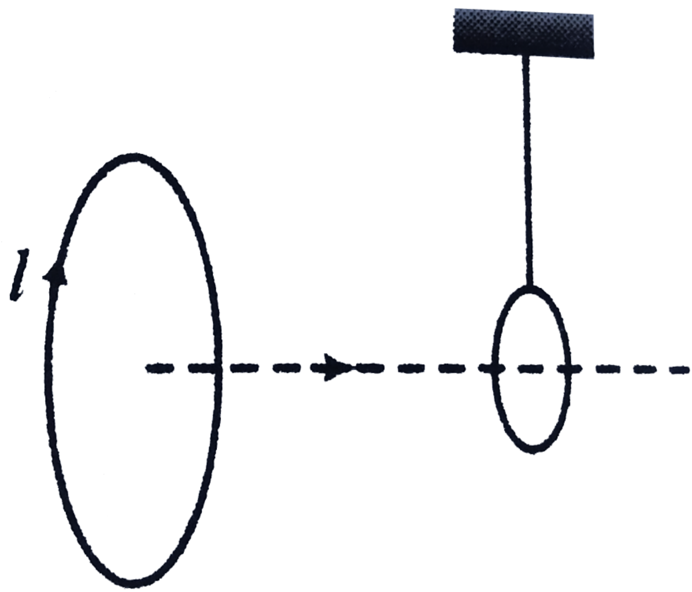
28. A small circular loop is suspended from an insulating thread. Another coaxial circular loop carrying a current I and having radius much larger than the first loop starts moving towards the smaller loop. The smaller loop will



A. be attracted towards the bigger loop

B. be repelled by the bigger loop

C. experience no free

D. All of the above

Answer: B

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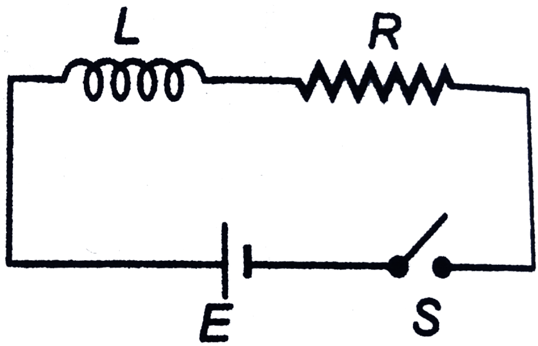
29. In the circuit shown in figure $L = 10H, R = 5\Omega, E = 15V$. The switch S is closed at $t = 0$. At $t = 2s$ the current in the circuit is



A. $3\left(1 - \frac{1}{e}\right)A$

B. $3\left(1 - \frac{1}{e^2}\right)A$

C. $3\left(\frac{1}{e}\right)A$

D. $3\left(\frac{1}{e^2}\right)A$

Answer: A

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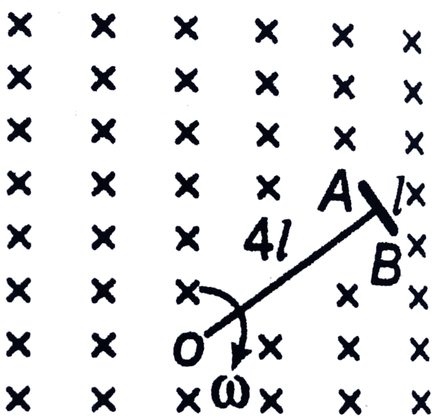
30. In the figure shown a T-shaped conductor moves with constant angular velocity ω in a plane perpendicular to uniform magnetic field B. The potential difference $V_A - V_B$ is



A. zero

B. $\frac{1}{2}B\omega l^2$

C. $2B\omega l^2$

D. $B\omega l^2$

Answer: A

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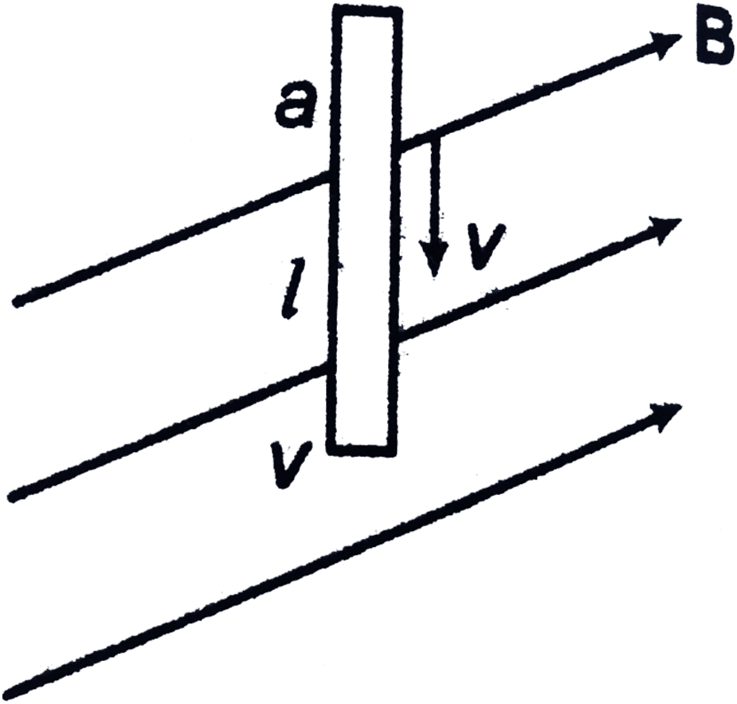
31. A conducting rod of length l falls verticaly under gravity in a region of uniform magnetic field B. The field vectors are inclined at an angle θ with the horizontal as shown in figure. If the instantaneous velocity of the rod is v, the induced emf in the rod ab is



A. Blv

B. $Blv\cos\theta$

C. $Blv\sin\theta$

D. zero

Answer: D

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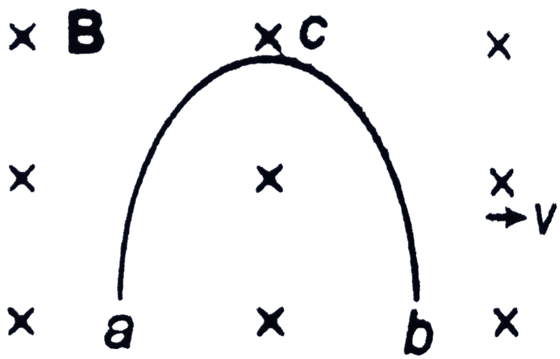
32. A semi circular conducting ring acb of radius R moves with constant speed v in a plane perpendicular to uniform magnetic field B as shown in figure.



Identify the correct statement.

A. $V_a - V_c = BRv$

B. $V_b - V_c = BRv$

C. $V_a - V_b = 0$

D. None of these

Answer: C

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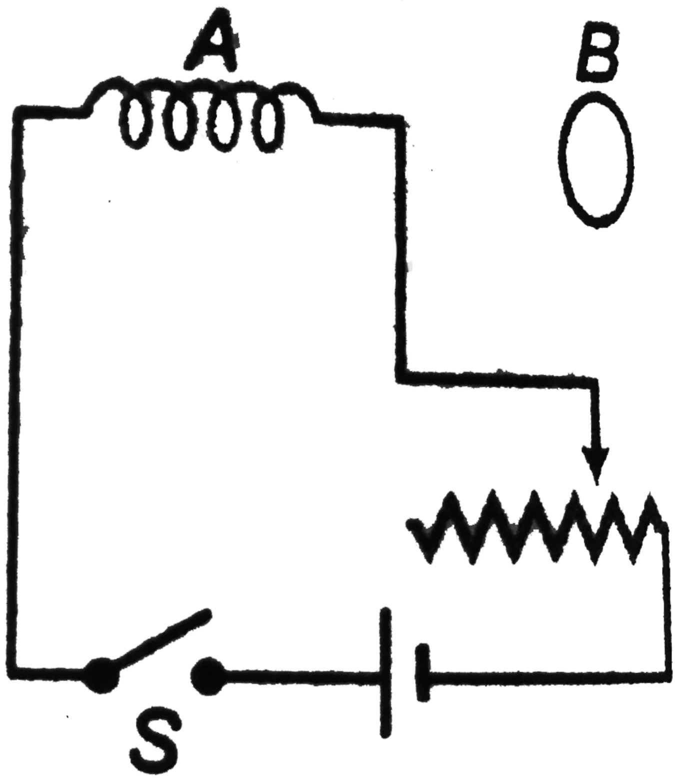
33. The ring B is coaxial with a solenoid A as shown in figure. As the switch S is closed at $t = 0$, the ring B



A. is attracted towards AS

B. is repelled by A

C. is initially repelled and then attracted

D. is initially attracted and then repelled

Answer: B

Watch Video Solution

34. If the instantaneous magnetic flux and induced emf produced in a coil is ϕ and E respectively, then a according to Faraday's law of electromagetic induction

A. E must be zero if $\phi = 0$

B. $E \neq 0 \quad \text{if} \quad \phi = 0$

C. $E \neq 0$ but ϕ may or may not be zero

D. E=0 then ϕ must be zero

Answer: C

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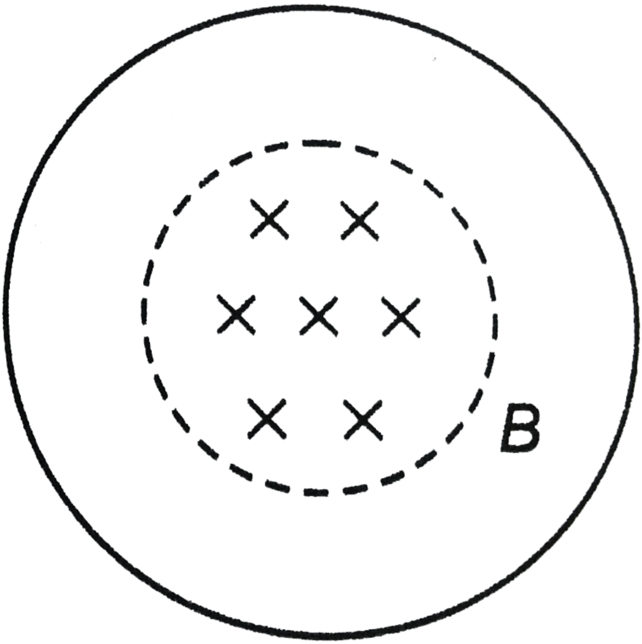
35. The figure shows a conducting ring of radius R. A uniform steady magnetic field B lies perpendicular to the plane of the ring a circular region $r(<R)$. If the resistance per unit length of the ring is λ, then the current induced in the ring when its radius gets doubled is



A. $\dfrac{BR}{\lambda}$

B. $\dfrac{2BR}{\lambda}$

C. zero

D. $\dfrac{Br^2}{4R\lambda}$

Answer: C

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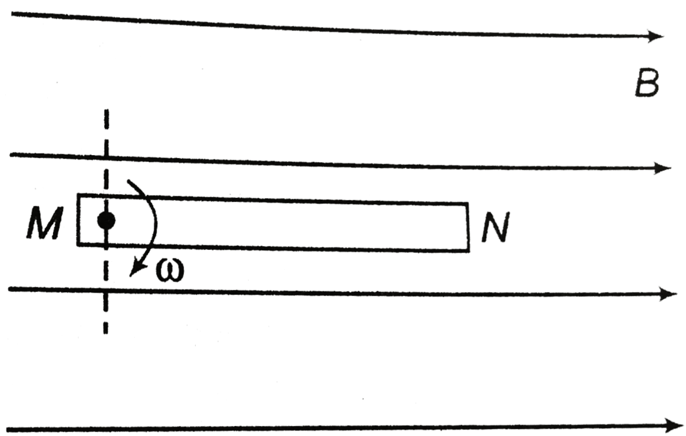
36. A metallic rod of length l is hinged at the point M and is rotating about an axis perpendicular to the plane of paper with a constant angular velocity ω. A uniform magnetic field of intensity B is acting in the region (as shown in the figure) parallel to the plane of paper. The potential difference between the points M and N



A. is always zero

B. varies between $\frac{1}{2}B\omega l^2$ to 0

C. is always $\frac{1}{2}B\omega l^2$

D. is always $B\omega l^2$

Answer: A

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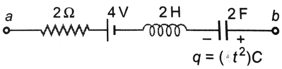
Objective Questions

1. In the figure shown V_{ab} at $t = 1s$ is



A. $30V$

B. $-30V$

C. $20V$

D. $-20V$

Answer: B

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2. A uniform but increasing with time magnetic field exists in as cylindrical region. The direction of force on an electron at P as

A. towards right

B. towards left

C. into the plane of paper

D. out of the plane of paper

Answer: A

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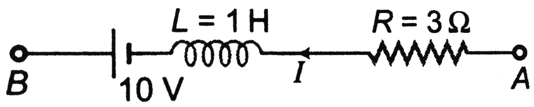
3. In the given branch AB of as circuit a current $I=(10t+5)A$ is flowing, where t is time in second . At $t=0$, the potential difference between points A and $B(V_A - V_B)$ is



A. $15V$

B. $-5V$

C. $-15V$

D. $5V$

Answer: A

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Level 1 Subjective

1. An inductor is connected to a battery through a switch. The emf induced in the inductor is much larger when the switch is opened as compared to the emf induced when the switch is closed. Is this statement true or false?

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2. A coil formed by wrapping 50 turns of wire in the shape of a square is positioned in a magnetic field so that the normal to the plane of the coil makes an angle of 30°. with the direction of the field. When the magnetic field is increased uniformly from $200\mu T$ to $600\mu T$ in $0.4s$, an emf of magnitude 80.0 mV is induced in the coil. What is the total length of the wire?

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3. A loop of wire enclosing an area S is placed in a region where the magnetic field is perpendicular to the plane. The magnetic field B varies with time according to the expression $B = B_0 e^{-at}$ where a is some constant. That is, at $t = 0$. The field is B_0 and for $t > 0$, the field decreases exponentially. Find the induced emf in the loop as a function of time.

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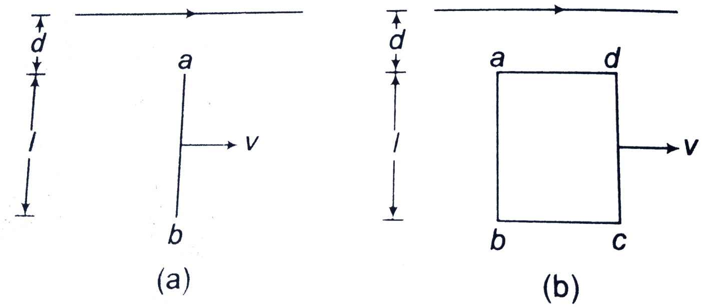
4. The long straight wire in figure (a) carries a constant current i. A metal bar of length i is moving at constant velocity v as shown in figure. Point a is a distance d from the wire.



(a) Calculate the emf induced in the bar.

(b) Which point a or b is at higher potential?

(c) If the bar is replaced by a rectangular wire loop of resistance R, what is the magnitude of current induced in the loop?

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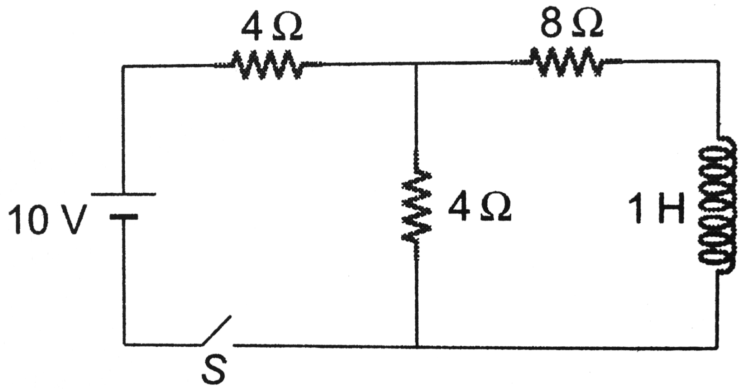
5. The switch in figure is closed at time $t = 0$. Find the current in the inductor and the current through the switch as functions of time thereafter.



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6. A small coil is introduced between the poles of an electromagnet so that its axis coincides with the magnetic field direction. The cross-sectional area of the coil is equal to $S = 3.0mm^2$, the number of turns is $N = 60$. When the coil turns through 180° about its diameter, a galvanometer connected to the coil indicates a charge $q = 4.5\mu C$ flowing through it. Find the magnetic induction magnitude between the poles, provided the total resistance of the electric circuit equals $R = 40\Omega$.

A. $2.5T$

B. $1.5T$

C. $0.5T$

D. $5T$

Answer: C

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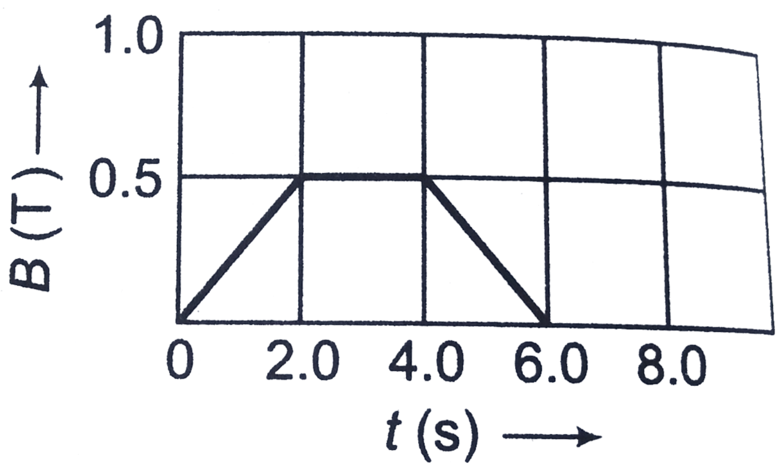
7. The magnetic field through a single loop of wire, $12cm$ in radius and of 8.5Ω resistance, changes with time as shown in figure. Calculate the emf in the loop as a function of time. Consider the time intervals

(a) $t = 0$ to $t = 2.0s$ (b) $t = 2.0s$ to $t = 4.0s$ (c) $t = 4.0s$ to $t = 6.0s$.

The magnetic field is perpendicular to the plane of the loop.



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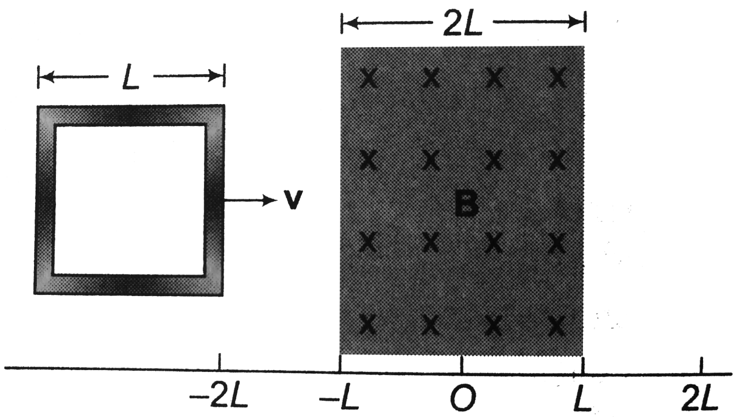
8. A square loop of wire with resistance R is moved at constant speed v across a uniform magnet field confined to a square region whose sides are twice the lengths of those of the square loop



(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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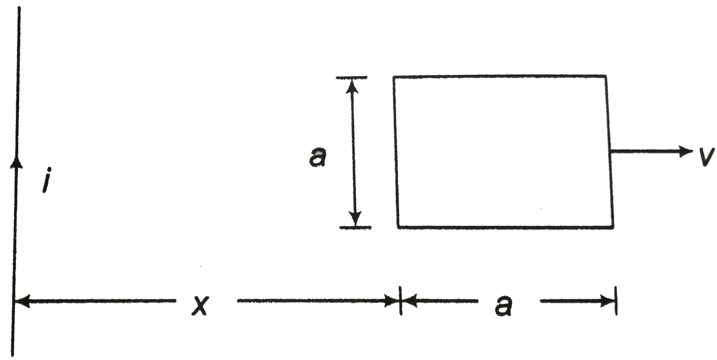
9. A square frame with side a and a long straight wire carrying a current i are located in the same plane as m shown in figure. The fram translates to the right with a constant velocity v. Find the emf induced in the frame as a function of distance x.



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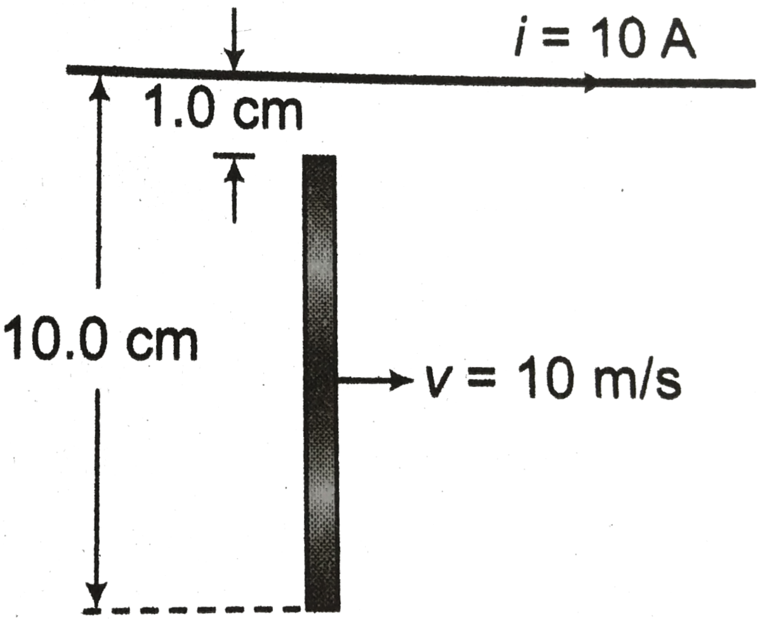
10. In figure, a wire perpendicular to a long straight wire is moving parallel to the later with a speed $v = 10m/s$ in the direction of the current flowing in the later. The current is $10A$. What is the magnitude of the potential difference between the ends of the moving wire?



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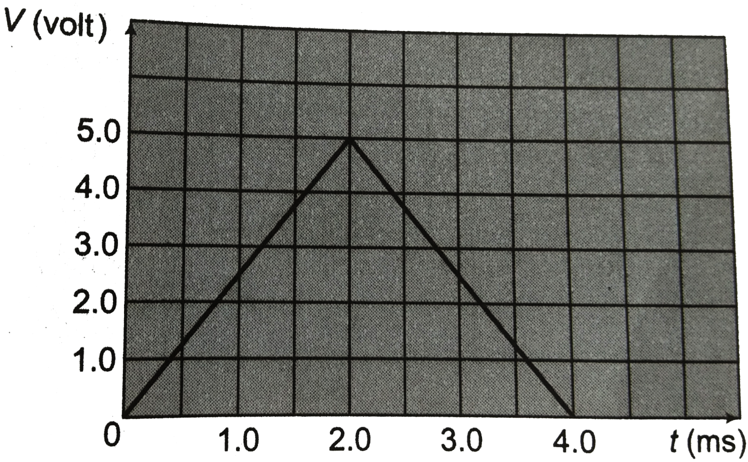
11. The potential difference across a $150mH$ inductor as a function of time is shown in figure. Assume that the initial value of the current in the inductor is zero. What is the current when $t = 2.0ms$? and $t = 4.0ms$?



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12. At the instant when the current in an inductor magnitude of the self-induced emf is $0.0640A/s$, the magnitude fo the self- induced emf is $0.0160V$.

(a) What is the inductance of the inductor?

(b) If the inductor is a solenoid with 400 turns, what is the average magnetic flux through each turn when the current is $0.720A$?

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13. Two toroidal solenoids are wound around the same pipe so that the magnetic field of one passes through the turns of the other. Solenoid 1 has 700 turns and solenoid 2 has 400 turns. When the current in solenoid 1 is $6.52A$, the average flux through each turn of solenoid 2 is $0.0320Wb$.

(a) What is the mutual inductance of the pair of solenoids?

(b) When the current in solenoid 2 is $2.54A$, what is the average flux through each solenoid 1?

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14. A coil of inductance $1H$ and resistance 10Ω is connected to a resistanceless battery of emf $50V$ at time $t = 0$. Calculate the ratio of rthe rate which magnetic energy is stored in the coil to the rate at which energy is supplied by the battery at $t = 0.1s$.

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15. A $3.56H$ inductor is placed in series with a 12.8Ω resistor. An emf of $3.24V$ is then suddenly applied across the RL combination.

(a) At $0.278s$ after the emf is applied what is the rate at which energy is being delivered by the battery?

(b) At $0.278s$, at what rate is energy appearing as thermal energy in the resistor? (c) At$0.278s$, at what rate is energy being stored in the magnetic field?

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16. A $35.0V$ battery with negligible internal resistance, a 50.0Ω resistor, and a $1.25mH$ inductor with negligible resistance are all connected in series with an open switch. The switch is suddenly closed

(a) How long after closing the switch will the current through the inductor reach one-half of its maximum value?

(b) How long after closing the switch will the energy stored in the inductor reach one-half of its maximum value?

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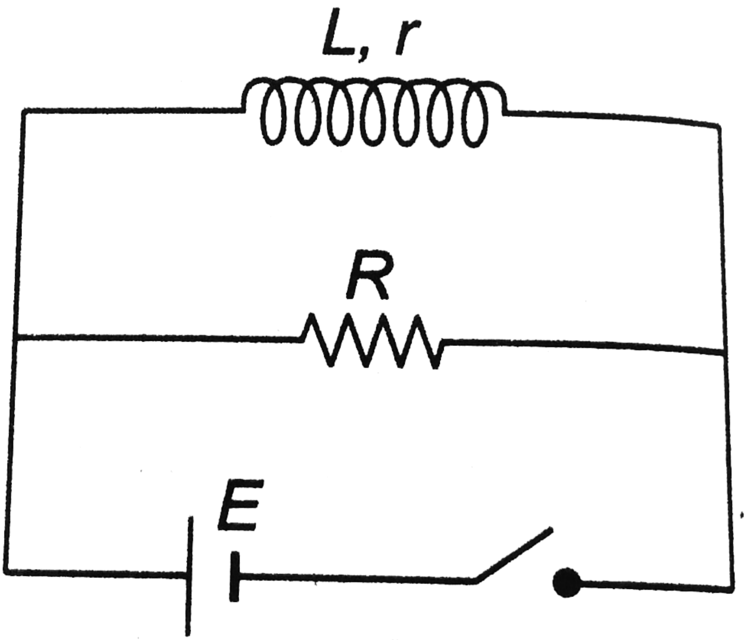
17. A solenoid of inductance L with resistance r is connected in parallel to a resistance R. A battery of emf E and of negligible internal resistance is connected across the parallel combination as shown in the figure. At time $t = 0$, switch S is opened, calculate

(a) current through the solenoid after the switch is opened.

(b) amount of heat generated in the solenoid.



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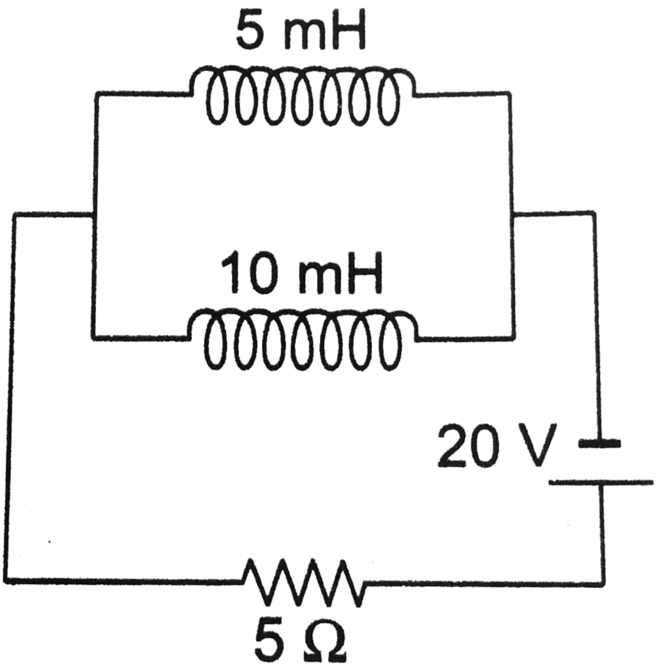
18. In the given circuit, find the current through the $5mH$ inductor in steady state.



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19. In an oscillating $L-C$ circuit in which $C = 4.00\mu F$, the maximum potential difference capacitor during the oscillations is $1.50V$ and the maximum current through $50.0mA$.

(a) What is the inductance L?

(b) What is the frequency of the oscillations?

(c) How much time does the charge on the capacitor take to rise from zero to its maximum value?

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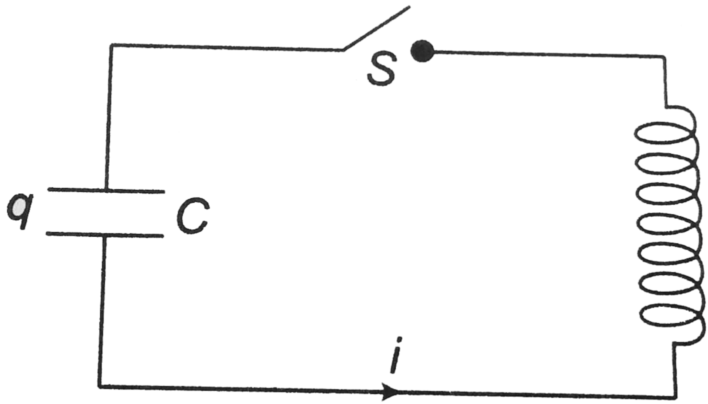
20. In the $L - C$ circuit shown, $C = 1\mu F$. With capacitor charged to $100V$, switch S is suddenly closed at time $t = 0$. The circuit then oscillates at $10^3 Hz$

(a) Calculate co and T

(b) Express q as a function of time

(c) Calculate L

(d) Calculate the average current during the first quarter-cycle.



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21. An $L-C$ circuit consists of an inductor with $L = 0.0900H$ and a capacitor of $C = 4 \times 10^{-4} F$. The initial charge on the capacitor is $5.00 \mu C$, and the initial current in the inductor is zero.

(a) What is the maximum voltage across the capacitor?

(b) What is the maximum current in the inductor?

(c) What is the maximum energy stored in the inductor?

(d) When the current in the inductor has half its maximum value, what is the charge on the capacitor and what is the energy stored in the inductor?

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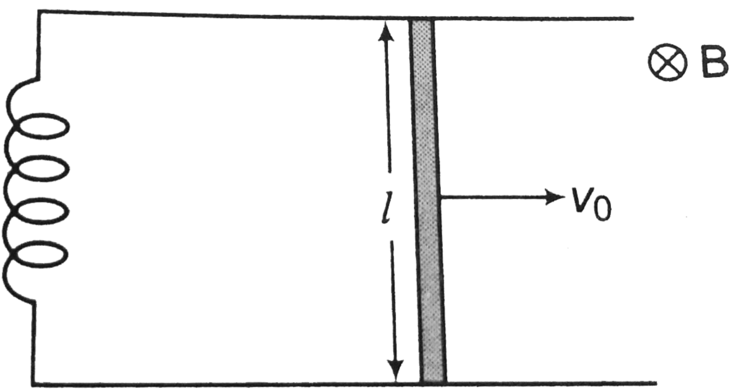
Level 2 Single Correct

1. Two ends of an inductor of inductance L are connected to two parallel conducting wires. A rod of length l and mass m is given velocity v_0 as shown. The whole system is placed in perpendicular magnetic field B. Find the maximum current in the inductor. (Neglect gravity and friction)



A. $\dfrac{mv_0}{L}$

B. $\sqrt{\frac{m}{L}v_0}$

C. $\frac{mv_0^2}{L}$

D. None of these

Answer: B

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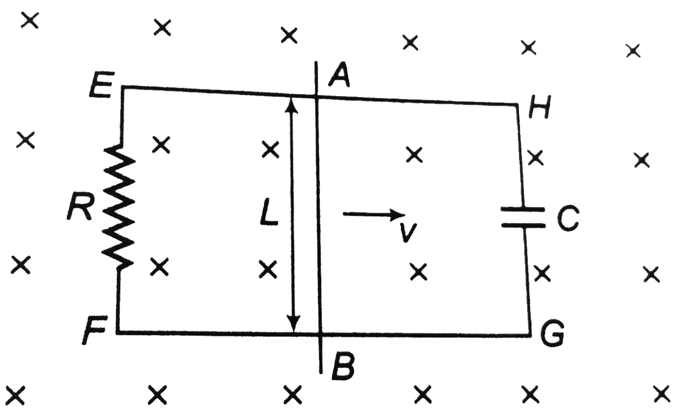
2. A conducting rod is moving with a constant velocity v over the parallel conducting rails which are connected at the ends through a resistor R and capacitor C as shown in the figure. Magnetic field B is into the plane. Consider the following statements.



i. Current in loop $AEFBA$ is anti clockwise, ii. Current in loop $AEFBA$ is clockwise

iii Current through the capacitor is zero

iv Energy stored in the caspacitor is $\frac{1}{2}CB^2L^2v^2$

Which is the following options in correct?

A. Statements i and iii are correct

B. Statements ii and iv are correct

C. statements i, iii and iv are correct

D. None of these

Answer: C

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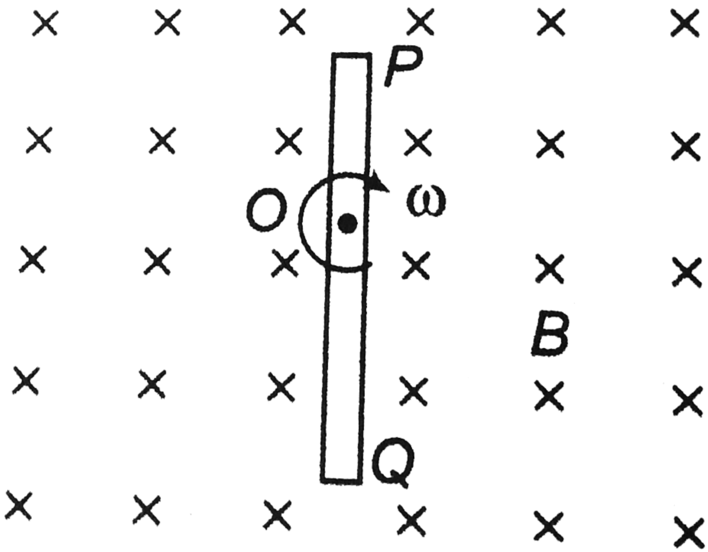
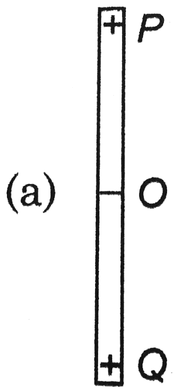
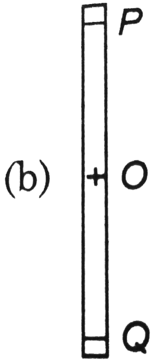
3. A rod is rotating with a constant angular velocity ω about point O (its centre) in a magnetic field B as shown. Which of the folloiwng figure correctly shows the distribution of charge inside the rod?

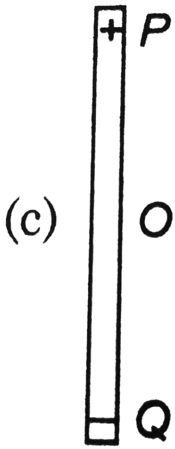


A.

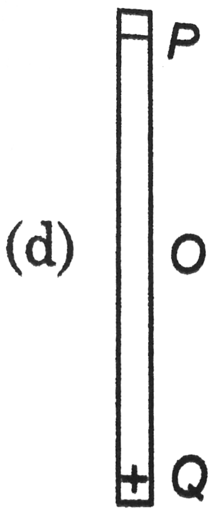




B.



C.



D.

Answer: A

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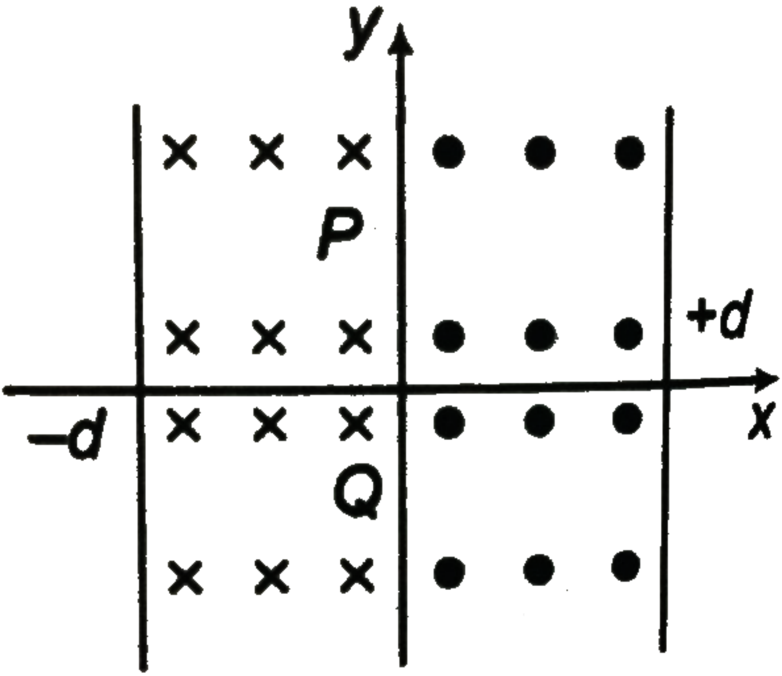
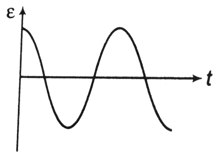
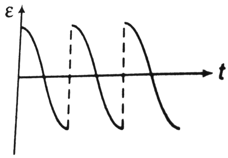
4. A straight conductig rod PQ is executing SHM in xy-plane from $x = -d$ to $x = +d$. Its mean position is $x = 0$ and its length is along y-axis. There exists a uniform magnetic field B from $x = -d$ to $x = 0$ pointing inward normal to the paper andfrom $x = 0$ to $x = +d$ there exists another uniform magnetic field of same magnetic B but pointing outward normal to the plane of the paper. At the instant $t = 0$, the rod is at $x = 0$ and moving to the right. The induced emf (epsilon) acorss the rod PQ vs time (t) graph will be



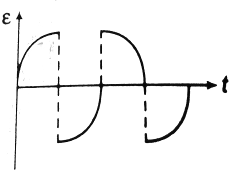
A. (a)

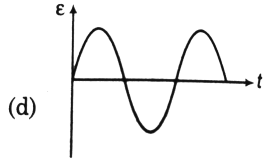


B. (b)



C. (c)



D. 

Answer: B

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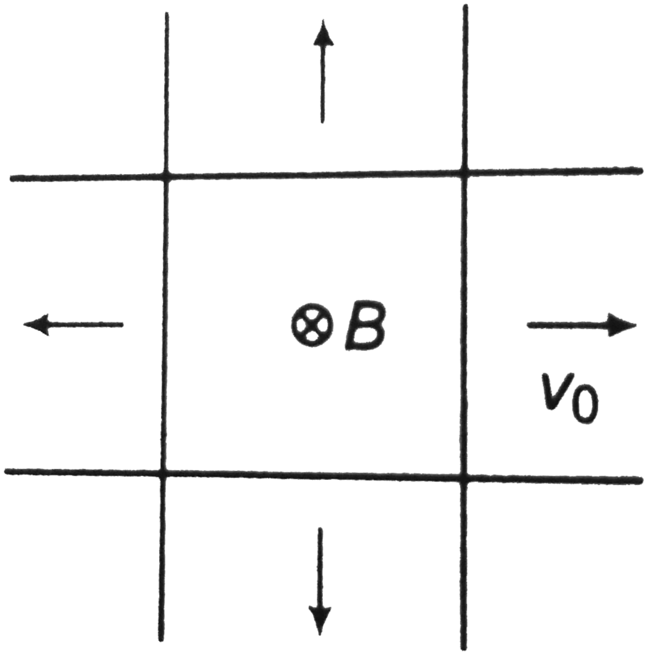
5. Two parallel long straight conductors lie on a smooth plane surface. Two other parallel conductors rest on them at right angle so as to form a square of side a. A uniform magnetic field B exists at right angle to the plane containing the conductors. Now, conductors starts moving outward with a constant velocity v_0 at $t = 0$. Then, induced current in the loop at any time is (λ is resistance per unit length of the conductors)



A. $\dfrac{aBv_0}{\lambda(a+v_0t)}$

B. $\dfrac{aBv_0}{2\lambda}$

C. $\dfrac{Bv_0}{\lambda}$

D. $\dfrac{Bv_0}{2\lambda}$

Answer: C

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6. A conducting square loop is placed in a magnetic field B with its plane perpendicular to the field. Now the sides of the loop start shrinking at a constant rate α. the induced emf in the loop at an instant when its side is a is

A. $2a\alpha B$

B. $a^2\alpha B$

C. $2a^2\alpha B$

D. $a\alpha B$

Answer: A

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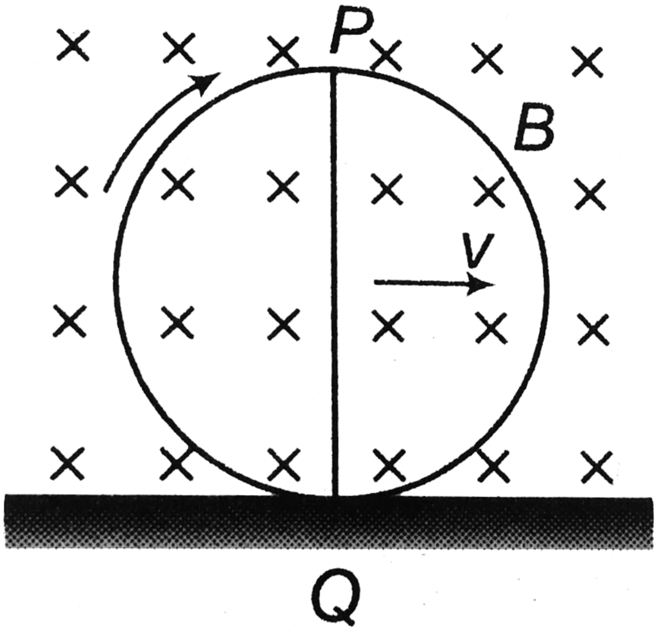
7. A conducnting straight wire PQ of length l is fixed along as diameter of a non conducting ring as shown in the figure. The ring is given a pure rolling motion on as horizontal masgnetic field B in horizontal direction perpendicular to the plane of ring. The magnitude of induced emf in the wire PQ at the position shown in figure will be



A. Bvl

B. $2Bvl$

C. $3Bv\frac{l}{2}$

D. zero

Answer: A

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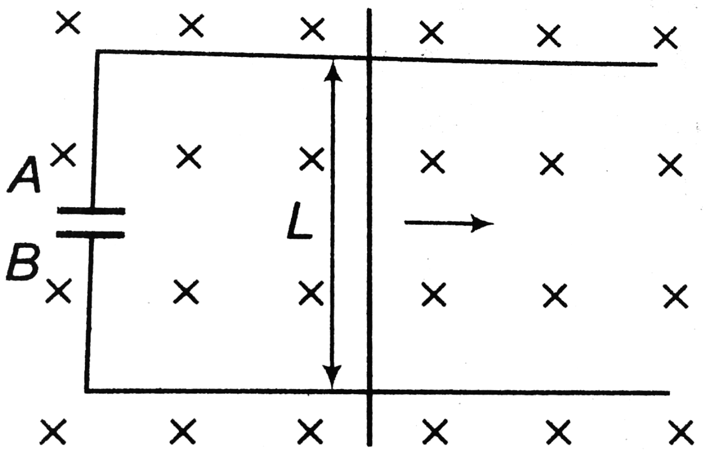
8. A conducting rod of length $L = 0.1m$ is moving with a uniform sped $v = 0.2m/s$ on conducting raisli a magnetic field $B = 0.5T$ as shown. On one side, the end of the rails is connected to a capacitor of capacitance $C = 20\mu F$. Then, the charge on the capacitor's plates are



A. $q_A = 0 = q_B$

B. $q_A = +20\mu C$ and $q_B = -20\mu C$

C. $q_A = +0.2\mu C$ and $q_B = -0.2\mu C$

D. $q_A = -0.2C$ and $q_B = -0.2\mu C$

Answer: C

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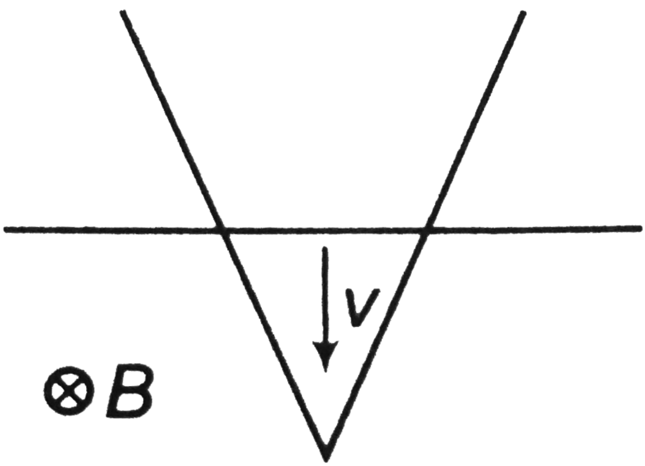
9. A wire is bent in the form of a V shape and placed in a horizontal plane. There exists a uniform magnetic field B perpendicular to the plane of the wire. A uniform conducting rod starts sliding over the V shaped wire with a constant speed v as shown in the figure. If the wire no resistance, the current in rod wil



A. increase with time

B. decrease with time

C. remain constant

D. always be zero

Answer: C

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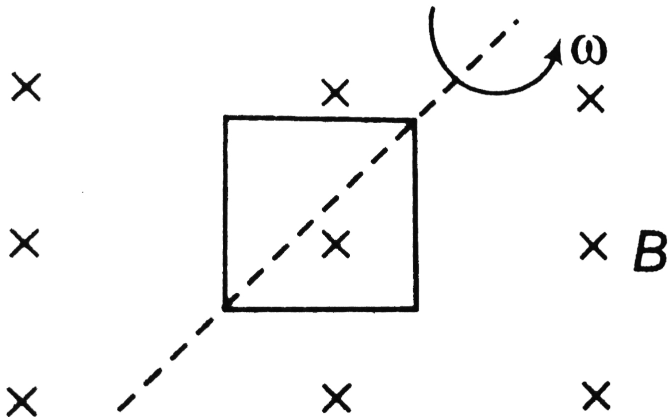
10. A square loop of side b is rotated in a constant magnetic field B at angular frequency ω as shown in the figure. What is the emf induced in it?



A. $b^2 B\omega \sin \omega t$

B. $bB\omega \sin^2 \omega t$

C. $bB^2 \cos \omega t$

D. $b^2 b\omega$

Answer: A

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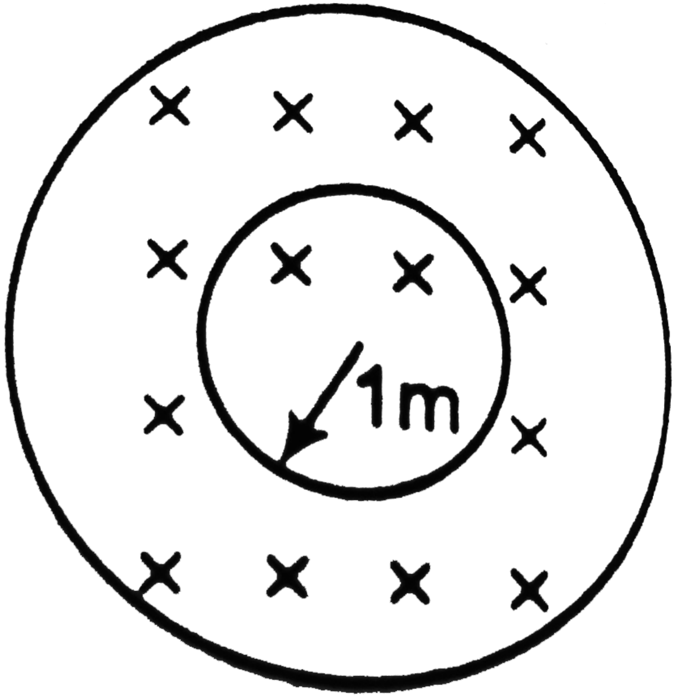
11. A uniform but time varying magnetic field exists in a cylindrical region as shown in the figure. The direction of magnetic field is into the plane of the paper and its magnitude is decreasing at a constant rate of $2 \times 10^{-3} T / s$. A particle of charge $1 \mu C$ is moved slowly along circle of radius $1m$ by an external force as shown in figure. The plane of the circle of radius $1m$ by an external force as shown in figure. The plane of he circle lies in the plane of the paper and it is concentric with the cylindrical region. The work done by the external force in moving this charge along the circle will be



A. zero

B. $2\pi \times 10^{-9} J$

C. $\pi \times 10^{-9} J$

D. $4\pi \times 10^{-6} J$

Answer: B

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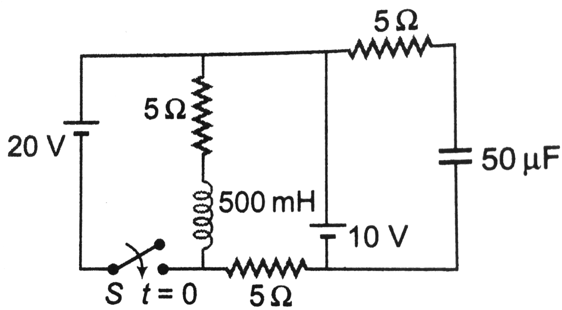
12. Switch S is closed $t = 0$, in the circuit shown. The change in flux in the inductor $(L = 500 mH)$ from $t = 0$ to an instant when it reaches steady state is



A. $2WB$

B. $1.5Wb$

C. $0Wb$

D. None of these

Answer: B

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13. A coil having an inductance L and a resistance R is connected to a battery of $emf\varepsilon$. Find the time elapsed before (a) the current reaches half its maximum value, (b) the power dissipated in heat reaches half its maximum value and (c) the magnetic field energy stored in the circuit reaches half its maximum value.

A. $\frac{R}{L}\ln\left[\frac{\sqrt{2}}{\sqrt{-1}}\right]$

B. $\frac{L}{R}\ln\left[\frac{\sqrt{2}-1}{\sqrt{2}}\right]$

C. $\frac{L}{R}\ln\left(\frac{\sqrt{2}}{\sqrt{2}-1}\right)$

D. $\frac{R}{L}\ln\left[\frac{\sqrt{2}-1}{\sqrt{2}}\right]$

Answer: C

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14. Electric charge q is distributed uniformly over a rod of length l. The rod is placed parallel to a ling wire carrying a current i. The separation between the rod and the wire is . The force needed to move the rod along its length with a uniform velocity v is

A. $\frac{\mu_0 iqv}{2\pi a}$

B. $\frac{\mu_0 iqv}{4\pi a}$

C. $\frac{\mu_0 iqvl}{2\pi a}$

D. $\frac{\mu_0 iqvl}{4\pi a}$

Answer: A

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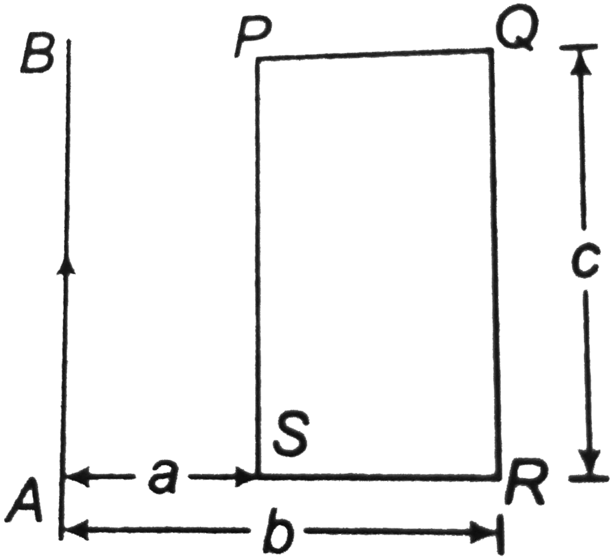
15. AB is an infinitely long wire placed in the plane of rectangular coil of dimension as shown in the figure. Calculate the mutual inductance of wire AB and coil $PQRS$



A. $\dfrac{\mu_0 b}{2\pi} \dfrac{\ln a}{b}$

B. $\dfrac{\mu_0 c}{2\pi} \dfrac{\ln b}{a}$

C. $\dfrac{\mu_0 abc}{2\pi(b-a)^2}$

D. None of these

Answer: B

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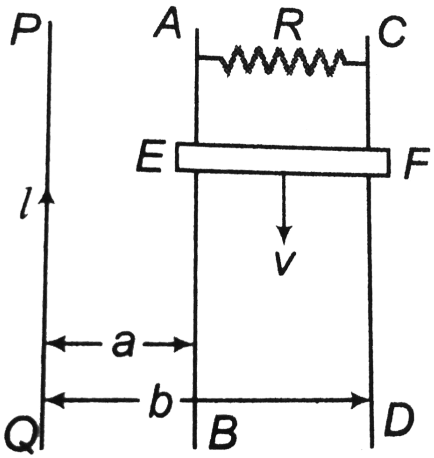
16. PQ is an infinite current carrying conductor. AB and CD are smooth conducting rods on which a conductor EF moves with constant velocity v as shown. The force needed to maintain constant speed of EF is



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

B. $\frac{v}{R}\left[\frac{\mu_0 IV}{2\pi}\frac{\ln(a)}{b}\right]^2$

C. $\frac{v}{R}\left[\frac{\mu_0 IV}{2\pi}\frac{\ln(b)}{a}\right]^2$

D. None of these

Answer: A

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17. Find the flux of point charge q through the square surface ABCD as shown $(\#\#JM_{21}\_M2_{20210224}\_PHY_{09}\_Q01\#\#)$

A. (A) $\frac{q}{6}\varepsilon_0$ (B) $\frac{q}{\varepsilon_0}$ (C) $\frac{q}{4}\varepsilon_0$ (D) $\frac{q}{2}\varepsilon_0$

B. Find the flux of point charge q through the square surface ABCD as shown $(\#\#JM_{21}\_M2_{20210224}\_PHY_{09}\_Q01\#\#)$

C. not varying with r

D. varying as r^2

Answer: B

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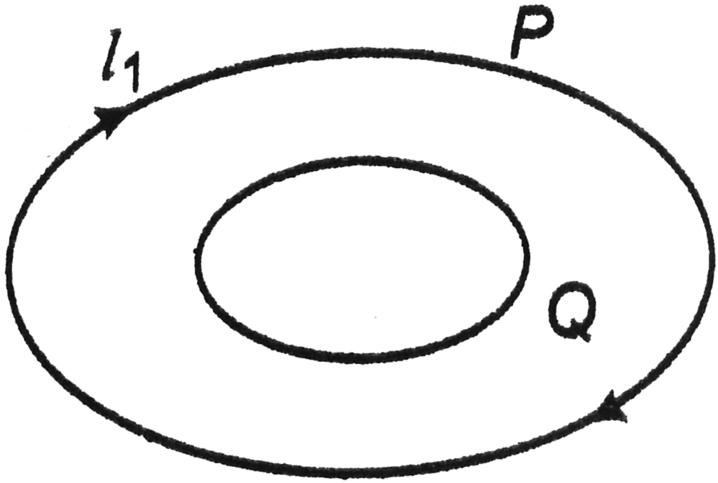
18. Two circular loops P and Q are concentric and coplanar as shown in figure. The loop Q is smaller than. P. If the current I_1 flowing i loop P is decreasing with time, then the curren I_2 in the loop Q



A. flows in the same direction as that of P

B. flows in the opposite direction as that of Q

C. is zero

D. None of the above

Answer: A

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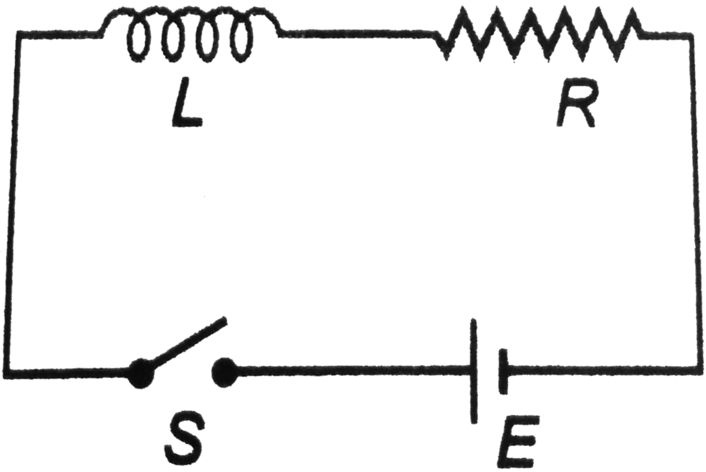
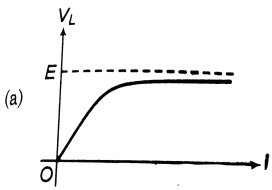
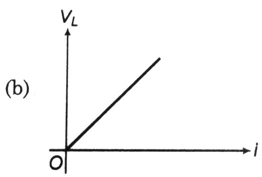
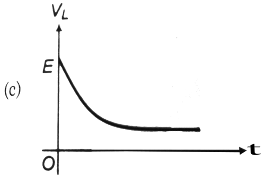
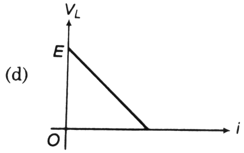
19. In the circuit shown in figure, the switch S is closed at $t = 0$. If V_L is the voltge induced across the inductor and i is the instantaneous current, the correct variation of V_L versus is given by



A. 

B. 

C. 

D. 

Answer: D

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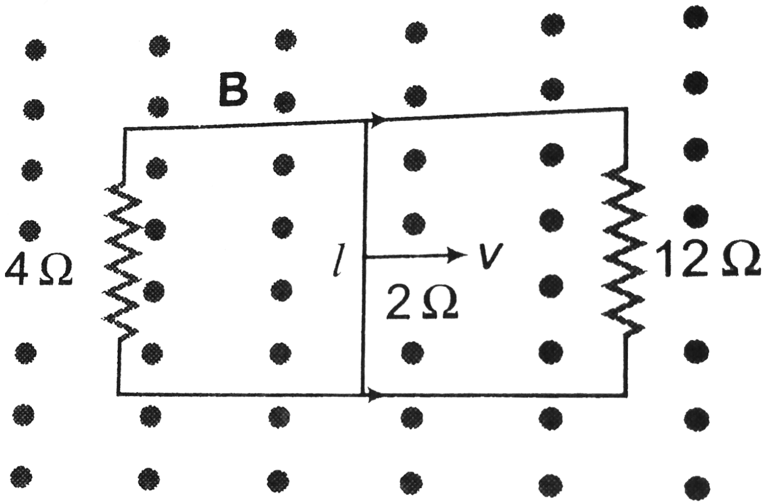
20. In the figure shown as uniform magnetic field $|B| = 0.5T$ is perpendicular to the plane of circuit. The sliding rod of length $l = 0.25m$ moves uniformly with constant speed $v = 4ms^{-1}$. If the resistance of the sllides is 2Ω, then the current flowing through the sliding rod is



A. $0.1A$

B. $0.17A$

C. 0.08

D. $0.03A$

Answer: A

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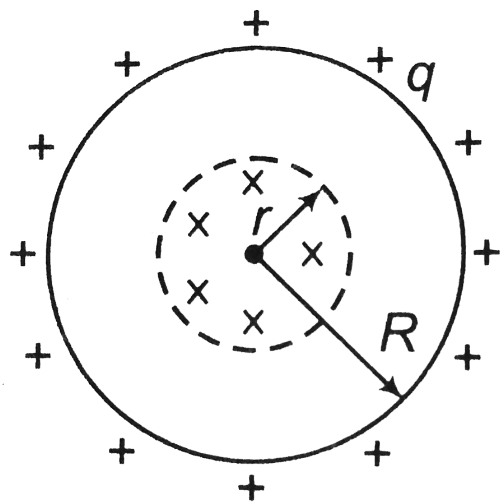
21. The figure shows a non conducting ring of radius R carrying a charge q. In a circular region of Radius r, a uniform magnetic field B perpendicular to the plane of the ring varies at a constant rate $\frac{dB}{dt} = \beta$. The torque on the ring is



A. $\frac{1}{2} q r^2 \beta$

B. $\frac{1}{2} q R^2 \beta$

C. $q r^2 \beta$

D. zero

Answer: A

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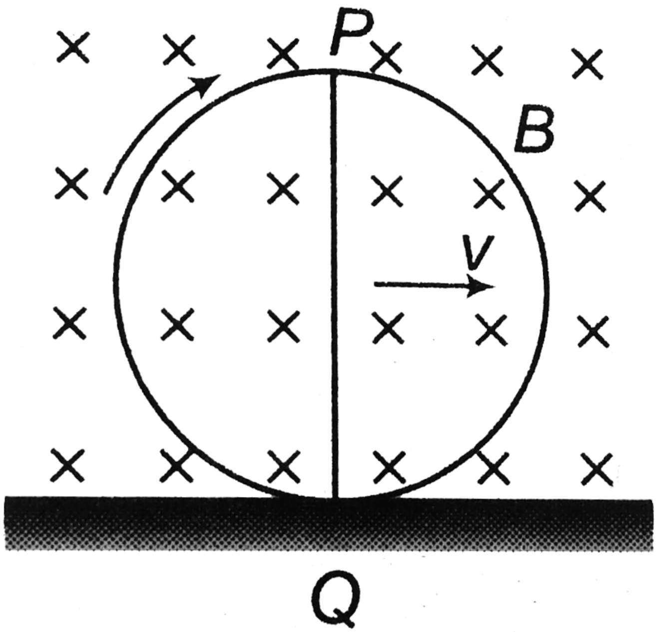
22. A conducnting straight wire PQ of length l is fixed along as diameter of a non conducting ring as shown in the figure. The ring is given a pure rolling motion on as horizontal masgnetic field B in horizontal direction perpendicular to the plane of ring. The magnitude of induced emf in the wire PQ at the position shown in figure will be



A. $2BvR$

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

C. $8BvR$

D. $4BvR$

Answer: D

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23. A uniformly wound long solenoid of inductance L and resistance R is cut into two parts in the ratio η: 1, which are then connected in parallel. The combination is then connected to a cell of emf E. The time constant of the circuit is

A. $\dfrac{L}{R}$

B. $\dfrac{L}{(\eta+1)R}$

C. $\left(\dfrac{\eta}{n+1}\right)\dfrac{L}{R}$

D. $\left(\dfrac{\eta+1}{\eta}\right)\dfrac{L}{R}$

Answer: A

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24. When a choke coil carrying a steady current is short circuited, the current in it decreases to $\beta(< 1)$ times its initial value in a time T. The time constant of the choke coil is

A. $\frac{T}{\beta}$

B. $\frac{T}{\ln\left(\frac{1}{\beta}\right)}$

C. $\frac{T}{\ln\beta}$

D. $T\ln\beta$

Answer: B

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25. In the steady state condition the rate of heat produced in a choke coil is P. The time constant of the choke coil is τ. If now the choke coil is short circuited, then the total head dissipated in the coil is

A. $P\tau$

B. $\frac{1}{2}P\tau$

C. `(Ptau)/(ln2)

D. $P\tau\ln 2$

Answer: B

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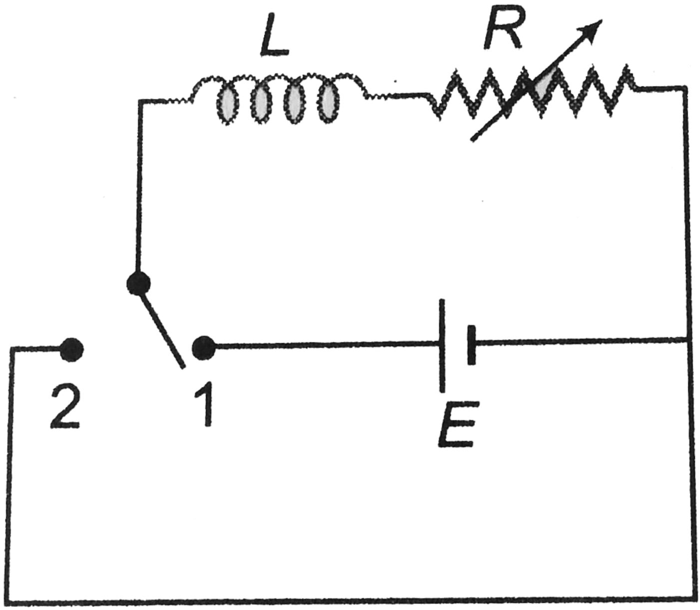
26. In the circuit shown in the figure initialy the switch in position 1 for a long time, then suddenly at $t=0$ the switch is shifted to position 2. It is required that a constant current should flow in the circuit, the value of resistance R in the circuit



A. should be decreased at constant ratee

B. should be increased at a constant rate

C. should be maintained constant

D. not possible

Answer: D

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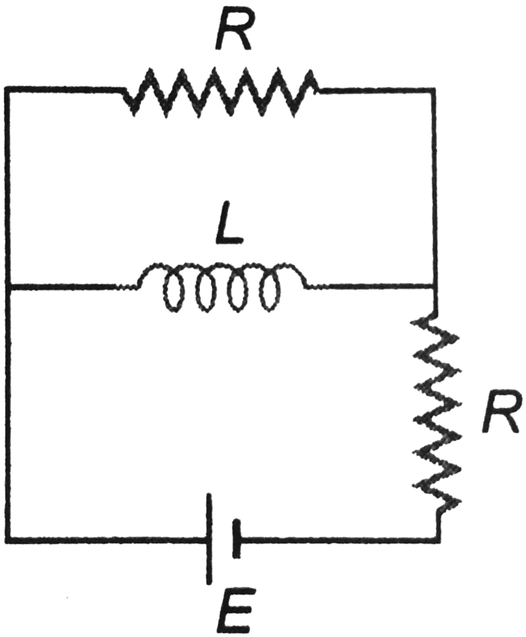
27. The figure shows an $L-R$ circuit the time constant for the circuit is



A. $\frac{L}{2}R$

B. $\frac{2L}{R}$

C. $\frac{2R}{L}$

D. $\frac{R}{2L}$

Answer: B

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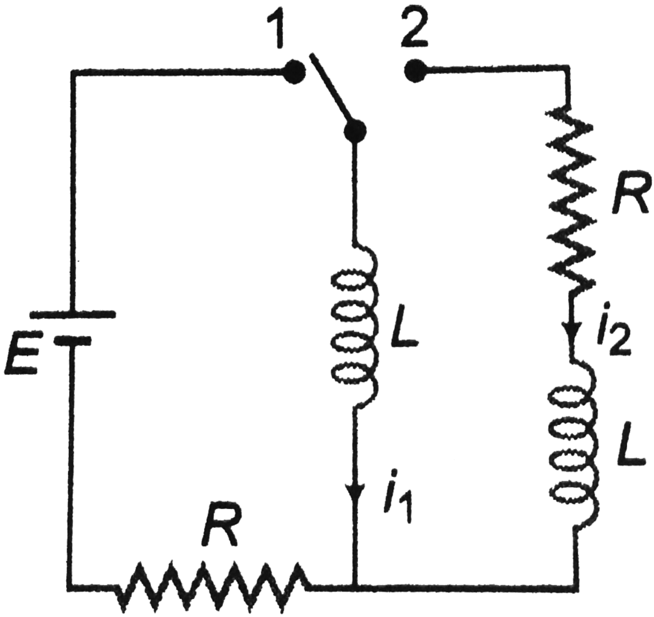
28. In figure, the switch is in the position 1 for long time, then the switch is shifted to position 2 at $t = 0$. At this instant the value of i_1 and i_2 are



A. $\frac{E}{R}, 0$

B. $\frac{E}{R}, \frac{-E}{R}$

C. $\frac{E}{2R}, \frac{-E}{2R}$

D. None of these

Answer: B

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29. In a decaying $L-R$ circuit, the time after which energy stores in the inductor reduces to one fourth of its initial values is

A. $(\ln 2)\dfrac{L}{R}$

B. $0.5\dfrac{L}{R}$

C. $\sqrt{2}\dfrac{L}{R}$

D. $\left(\dfrac{\sqrt{2}}{\sqrt{2}-1}\right)\dfrac{L}{R}$

Answer: A

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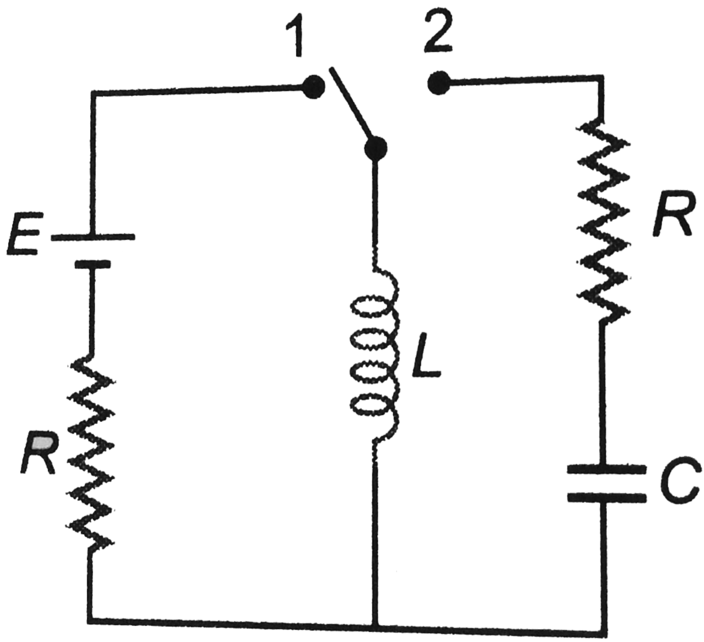
30. Initially the switch is in positions 1 for as long time then shifted to position 2 at $t=0$ as shown in figure. Just after closing the switch, the magnitude of current through the capacitor is



A. zero

B. $\frac{E}{2R}$

C. $\frac{E}{R}$

D. None of these

Answer: C

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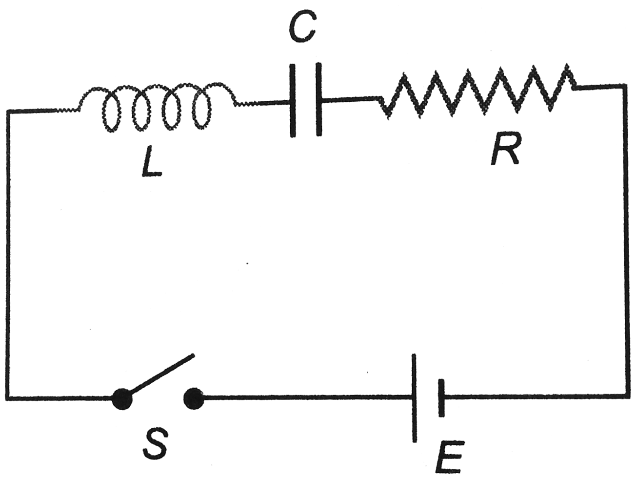
31. When the switch S is closed at $t = 0$, identify the correct statement just after closing the switch as shown in figure



A. the current in the circuit is maximum

B. equal and opposite voltages are dropped across inductor and resistor

C. the entire voltage is dropped across inductor

D. All of the above

Answer: C

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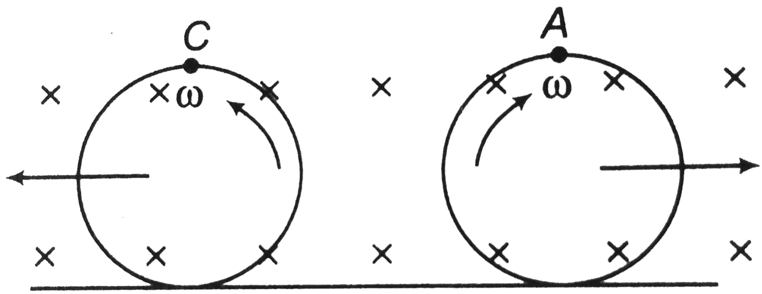
32. Two metallic rings of radius R are rolling on a metallic rod. A magnetic field of magnitude B is applied in the region. The magnitude of potential difference between points A and C on the two rings (as shown) , will be



A. 0

B. $4B\omega R^2$

C. $8B\omega R^2$

D. $2B\omega R^2$

Answer: B

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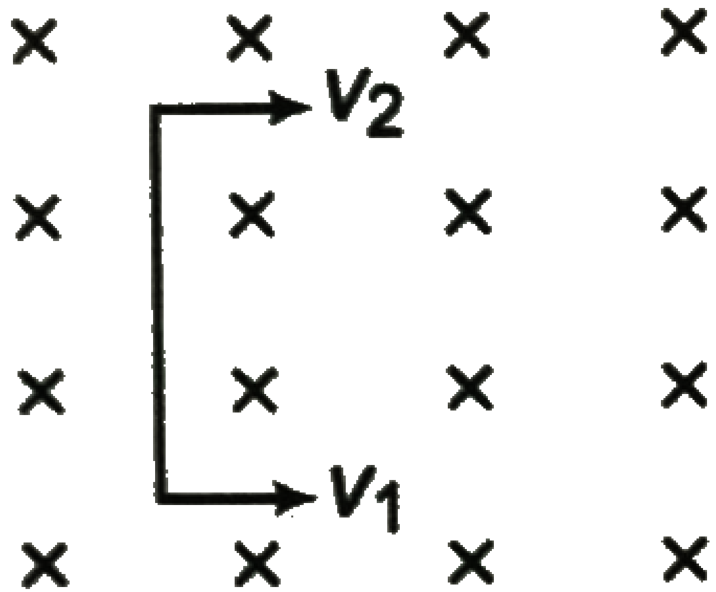
33. In the figure, magnetic field points into the pane of paper and the conducting rod of length l is moving in this field such that the lowest point has a velocity v_1 and the topmost point has the velocity $v_2 (v_2 > v_1)$. The emf induced is given by



A. $Bv_1 l$

B. $Bv_2 l$

C. $\frac{1}{2} B(v_2 + v_1) l$

D. $\frac{1}{2} BI(v_2 - v_1) l$

Answer: C

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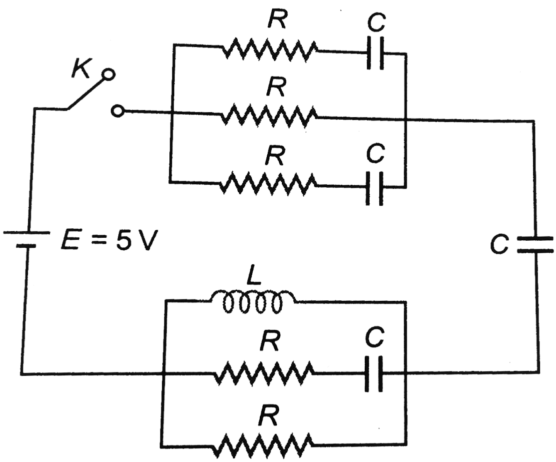
34. Find the current passing through battery immediately after key (K) is closed. It is given that initially all the capacitors are uncharged. (Given that $R = 6\Omega$ and $C = 4\mu F$)



A. $1A$

B. $5A$

C. $3A$

D. $2A$

Answer: A

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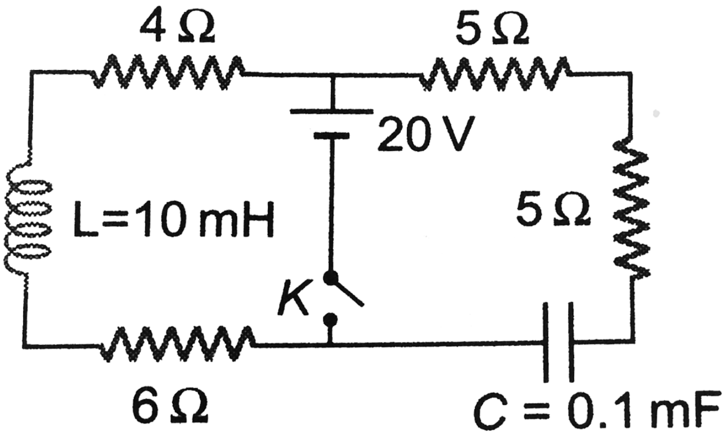
35. In the circuit shown the key (K) is closed at $t = 0$, the current through the key at the instant $t = 10^{-3} \ln, 2$ is



A. $2A$

B. $8A$

C. $4A$

D. zero

Answer: A

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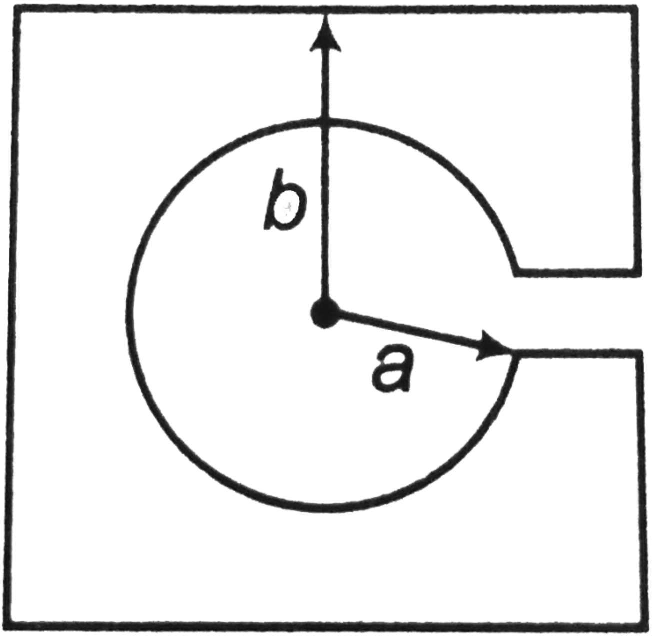
36. A loop shown in the figure is immersed in the varying magnetic field $B = B_0 t$, directed into the page. If the total resistance of the loop is R, then the direction and magnitude of induced current in the inner circle is



A. clockwise $\dfrac{B_0\left(\pi a^2 - b^2\right)}{R}$

B. anticlockwise $\frac{B_0\pi(a^2+b^2)}{R}$

C. clockwise $\frac{B_0(\pi a^2+4b^2)}{R}$

D. $clockwise \frac{B_0(4b^2-\pi a^2)}{R}$

Answer: D

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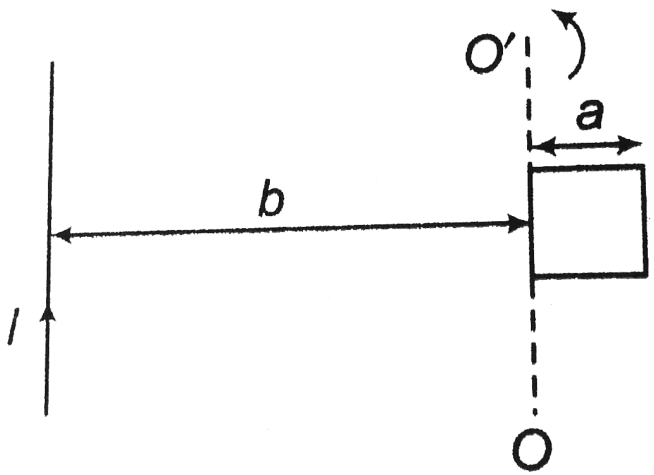
37. A square loop of side as and a straight long wire are placed in the same plane as shown in figure. The loop has a resistance R and inductance L. The frame is turned through 180° about the axis OO'. What is the electric charge that flows through the loop?



A. $\frac{\mu_0 I a}{2\pi R}\ln\left(\frac{2a+b}{b}\right)$

B. $\frac{\mu_0 I a}{2\pi R}\ln\left(\frac{b}{b^2-a^2}\right)$

C. $\frac{\mu_0 I a}{2\pi R}\ln\left(\frac{a+2b}{b}\right)$

D. Noneof these

Answer: D

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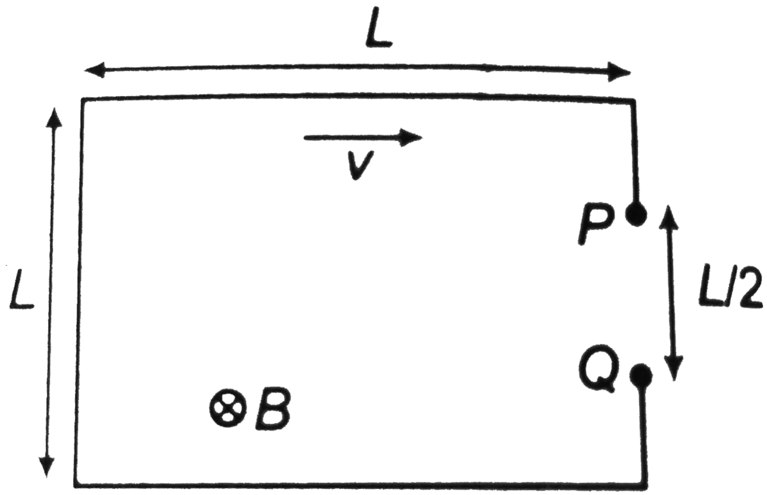
Level 2 More Than One Correct

1. The loop shown moves with a velocity v in a uniform magnetic field of magnitude B, directed into the paper. The potential differene between point P and Q is e. Then



A. $e = \frac{1}{2}BLv$

B. $e = BLv$

C. P is positive with respect to Q

D. Q is positive with respect to P

Answer: A::C

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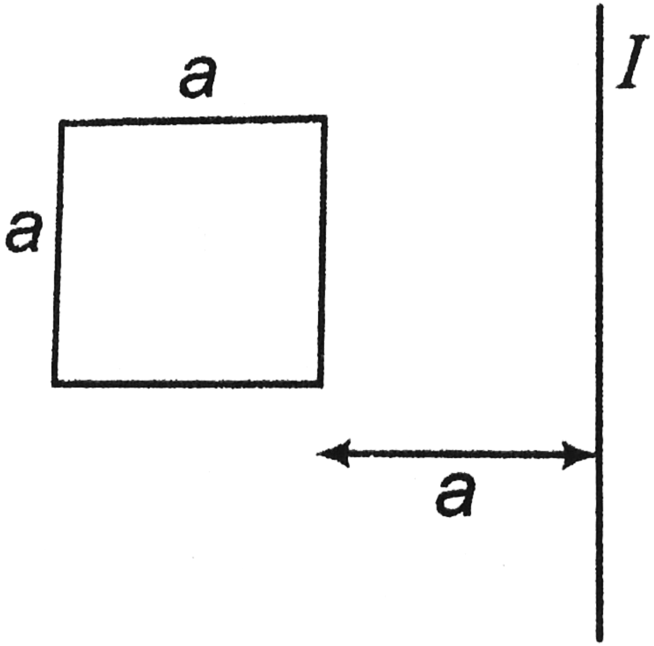
2. An infinitely longg wire is placed near a square loop as shown in figure.

Choose the correct options.



A. the mutul inductance betweenthe two is $\frac{\mu_0 a}{2\pi}\ln(2)$

B. the mutual inductance between the two is $\frac{\mu_0}{2\pi}\ln(2)$

C. if a constasnt current is passed in the straight wire in upward direction and loop is brought close to the wire then induced current in the loop is clockwise

D. in the above conditions, induced current in the loop is anti clockwise

Answer: A::C

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3. Choose the correct options

A. SI unit of magnetic flux is henry ampere

B. SI unit of coefficient of self inductance is J/A

C. SI unit of coefficient of self inductance is $\frac{\text{volt second}}{\text{ampere}}$

D. SI unit of magnetic induction is weber

Answer: A::C

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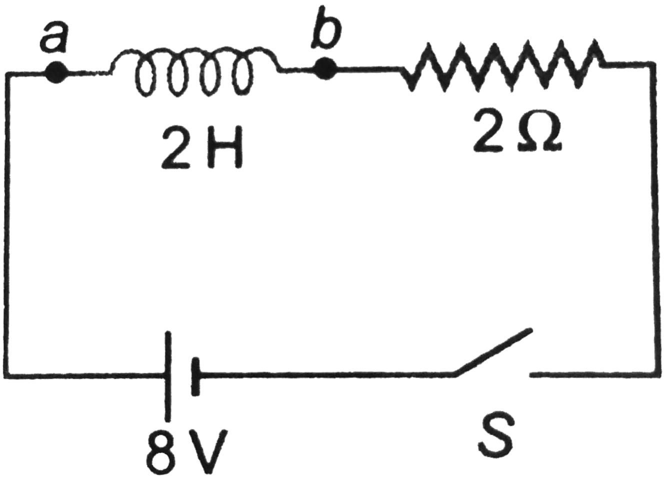
4. In the circuit shown in figure, circuit is closed at time $t = 0$. At time $t = \ln(2)$ second



A. rate of energy supplied by the battery is 16 J/s

B. rate of heat dissipated across resistance is 8J/s

C. rate of heat dissipated across resistance is 16 J/s

D. $V_a - V_b = 4V$

Answer: A::B::D

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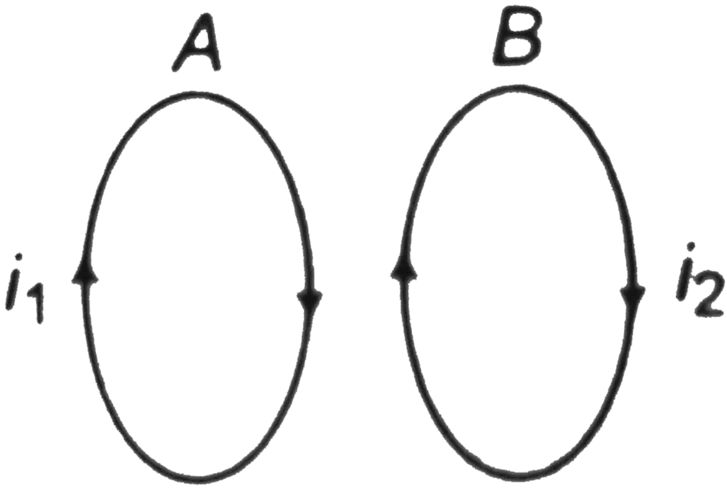
5. Two circular coils are placed adjacent to each other. Their planes are parallel and currents through them i_1 and i_2 are in same direction. Choose the correct options.



A. when A is brought near B, current i_2 will decrease

B. in the above process current i_2 will increase

C. when current i_1 is increased, current i_2 will decrease

D. in the above process current i_2 will increase

Answer: A::C

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6. A coil of area $2m^2$ and resistane 4Ω is placed perpendicular to a uniform magnetic field of $4T$. The loop is rotated by 90° in 0.1 second. Choose the correct options.

A. average induced emf in the coil is $8V$

B. average induced current in the circuit is $20A$

C. $2C$charge wil flow i the coil in above period

D. Heat produced in the coil in the above period can't be determined from the given datas

Answer: B::C::D

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7. In $L-C$ oscillations

A. time period of oscillation is $\frac{2\pi}{\sqrt{LC}}$

B. maximum curret in circuit is $\frac{q_0}{\sqrt{LC}}$

C. maximum rate of change of current in circuit is $\frac{q_0}{LC}$

D. maximum potential difference across the inductor is $\frac{q_0}{2C}$ Here q_0 is maximum charge on capacitor.

Answer: B::C

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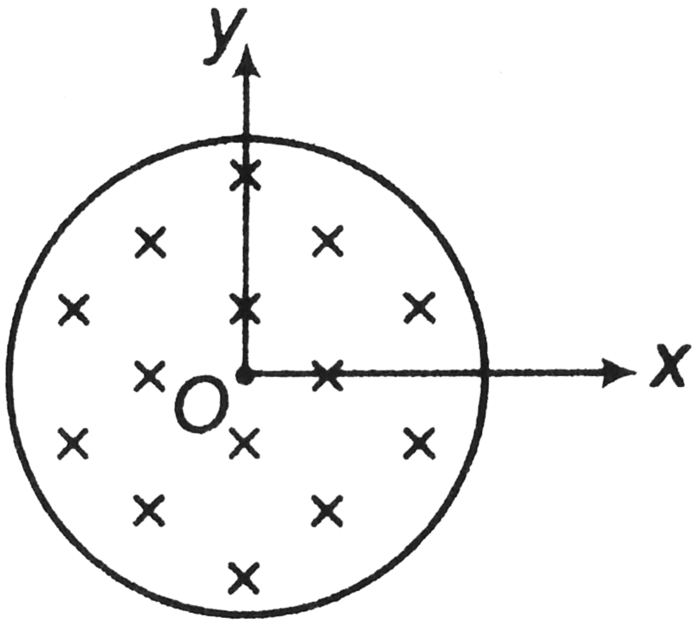
8. Magnetic field in cylindrical region of radius R in inward direction is as shown in figure.



A. an electron will expereince no force kept is $(2R, 0, 0)$ if magnetic

field increases with time

B. in the above situation, electron will experience the force in negative

y-axis

C. if a proton is kept at $\left(0, \frac{R}{2}, 0\right)$ and magnetic field is decreasing

then it will experience the force in positive x-direction

D. if a proton is kept at $(-R, 0, 0)$ and magnetic field is increasing

then it will experience force in negative y-axis

Answer: B::C::D

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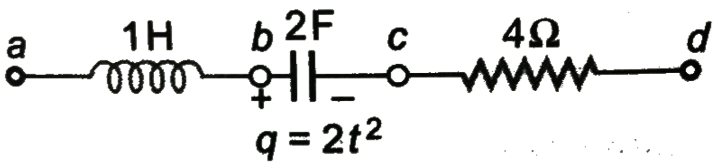
9. In the figure shown q is in coulomb and t in second. At time $t = 1s$



A. $V_a - V_b = 4V$

B. $V_b - V_c = 1V$

C. $V_c - V_d = 16V$

D. $V_a - V_b = 20V$

Answer: A::B::C

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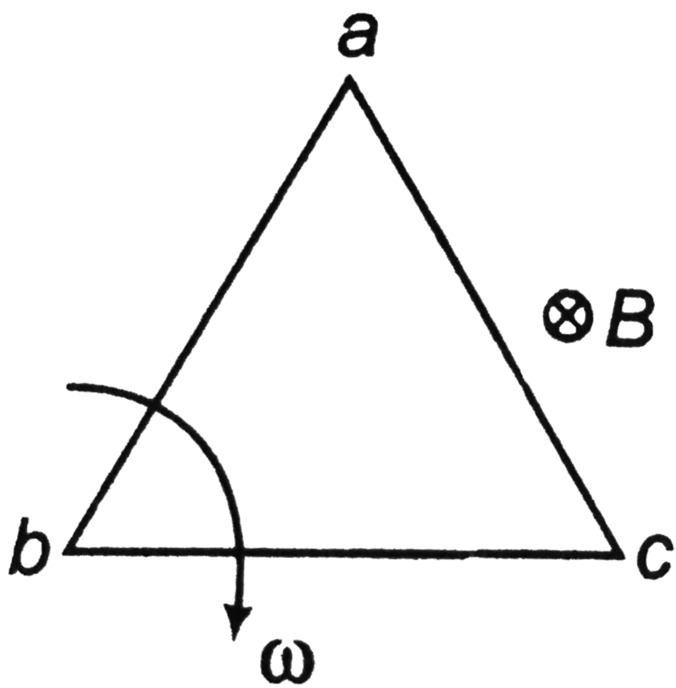
10. An equilateral triangular conducting frame is rotated with angular velocity ω in a uniform magnetic field B as shown. Side of triangle is l. choose the correct options



A. $V_a - V_c = 0$

B. $V_a - V_c = \frac{B\omega l^2}{2}$

C. $V_a - V_b = \frac{B\omega l^2}{2}$

D. $V_c - V_b = \frac{B\omega l^2}{2}$

Answer: A::C

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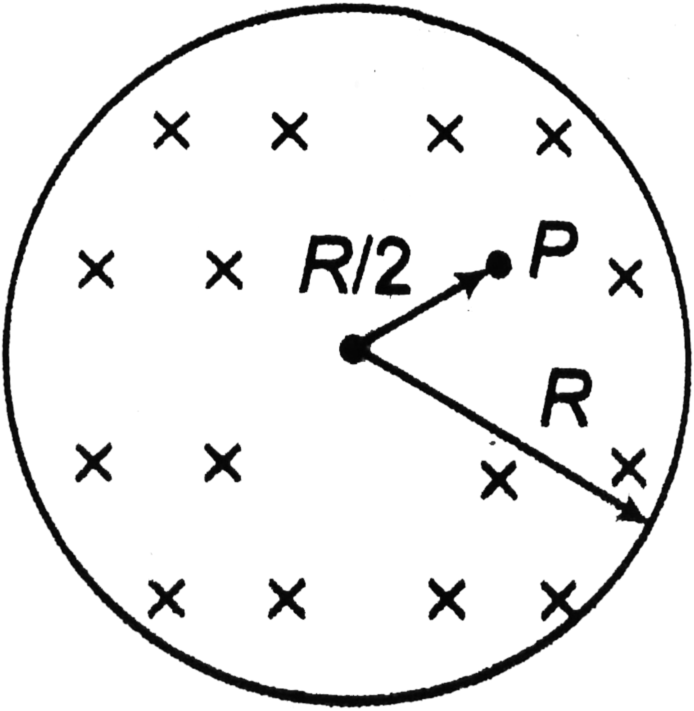
Level 2 Comprehension Based

1. A uniform but time varying magnetic field $B = (2t^3 + 24t)T$ is present in a cylindrical region of radius $R = 2.5$ cm as shown in figure.



The force on an electron at P at $t = 2.0$ s is

A. $96 \times 10^{-21} N$

B. $48x10^{-21} N$

C. $24 \times 10^{-21} N$

D. zero

Answer: B

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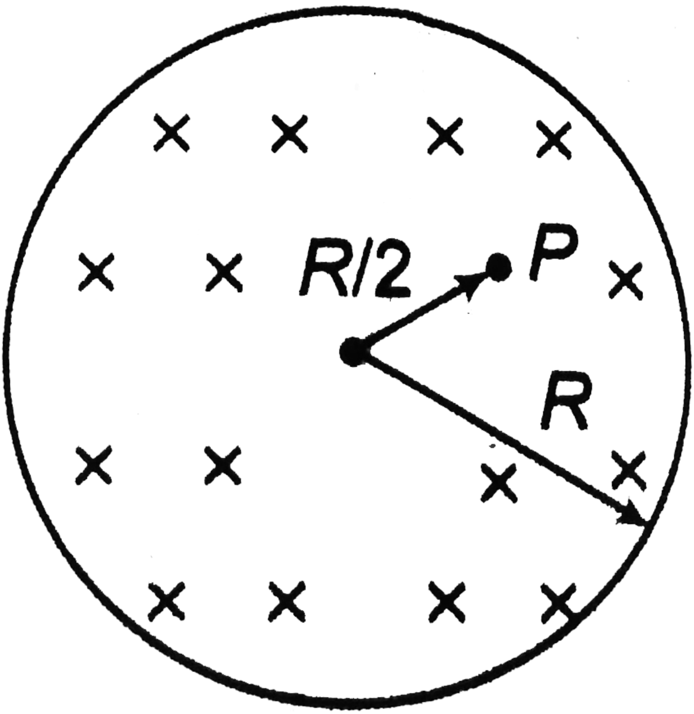
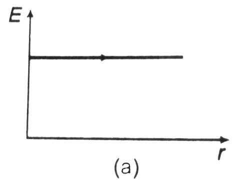
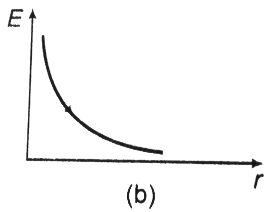
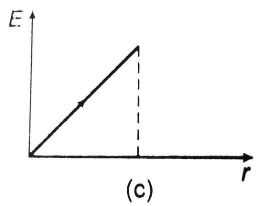
2. A uniform but time varying magnetic field $B = (2t^3 + 24t)T$ is present in a cylindrical region of radius $R = 2.5cm$ as shown in figure.

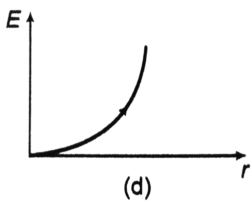


The variation of electric field at any instant as a function of distance measured from the centre of cylinder in first problem is

A. 

B. 

C. 

D. 

Answer: C

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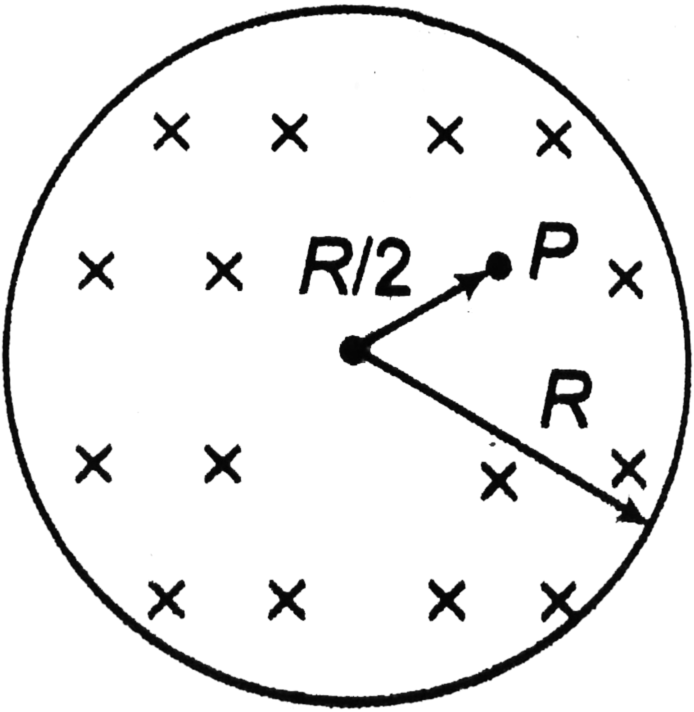
3. A uniform but time varying magnetic field $B = (2t^3 + 24t)T$ is present in a cylindrical region of radius $R = 2.5cm$ as shown in figure.



In the previous problem, the direction of circular electric lines at $t = 1s$ is

A. clockwise

B. anti clociwise

C. no current is induced

D. cannot be predicted

Answer: B

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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 $B=B_0t$. 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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5. 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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6. 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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7. 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. $\dfrac{2q^2 B_0^2 a^2}{14m}$

B. $\dfrac{q^2 B_0^2 a^2}{8m}$

C. $\dfrac{3q^2 B_0^2 a^2}{m}$

D. $\dfrac{q^2 B_0^2 a^2}{4m}$

Answer: D

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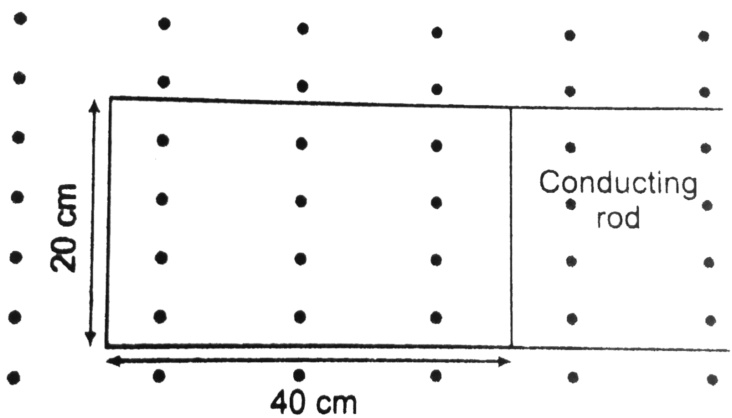
8. Figure shows a conducting rod of negligible resistance that can slide on smooth U-shaped rail made of wire of resistance $1\Omega/m$. Position of the conducting rod at $t=0$ is shown. A time dependent magnetic field $B=2t$ tesla is switched on at $t=0$



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

A. $0.16A$, clockwise

B. $0.08A$, clockwise

C. $0.16A$, anti clockwise

D. zero

Answer: A

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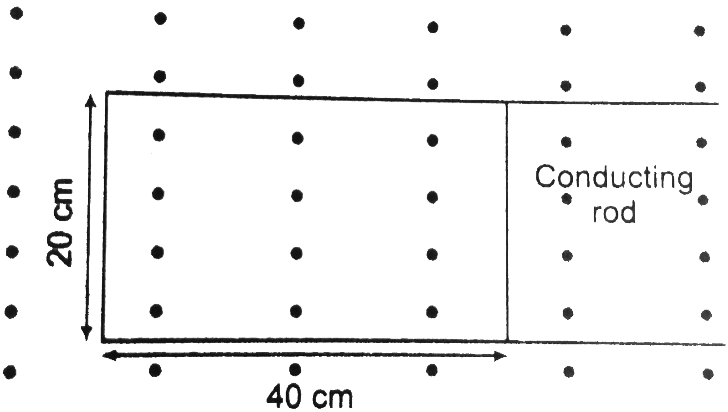
9. Figure shows a conducting rod of negligible resistance that can slide on smooth U-shaped rail made of wire of resistance $1\Omega/m$. Position of the conducting rod at $t=0$ is shown. A time dependent magnetic field $B=2t$ tesla is switched on at $t=0$



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. $0.12V$

B. $0.12V$

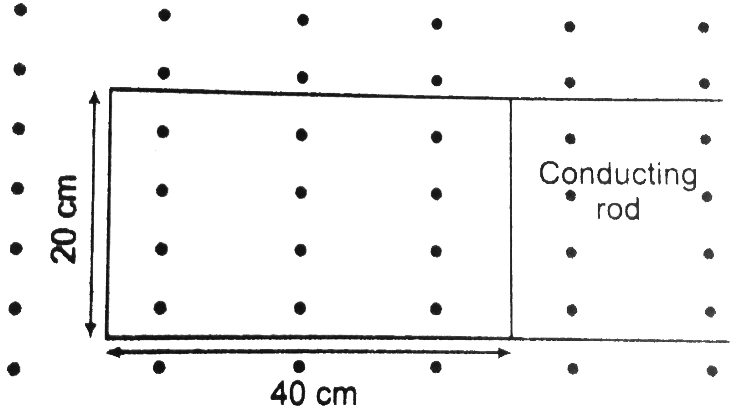
C. $0.04V$

D. $0.02V$

Answer: B

Watch Video Solution

10. 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. $0.096N$

B. $0.12N$

C. $0.08N$

D. $0.064N$

Answer: C

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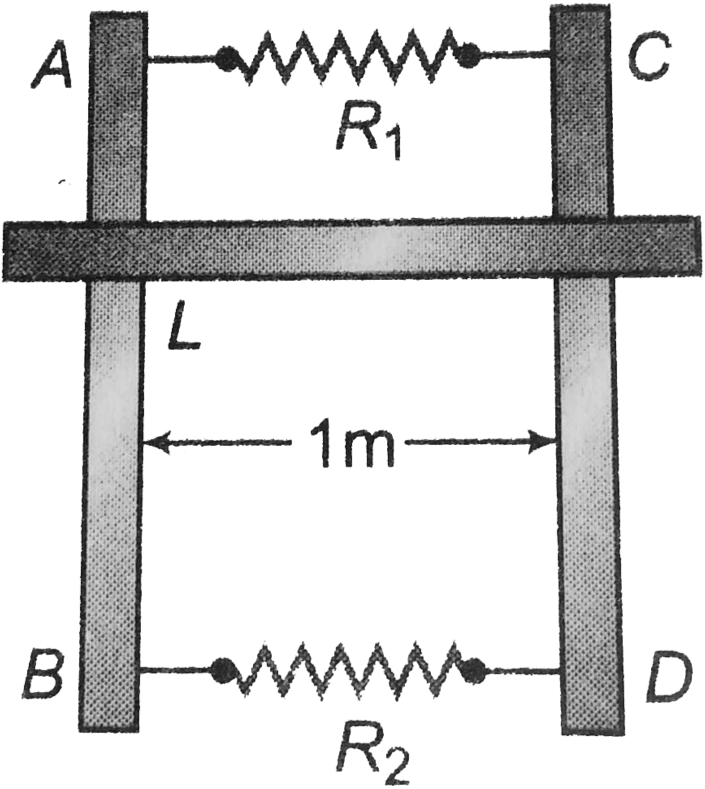
11. Two parallel vertical metallic rails AB and CD are separated by $1m$. They are connected at the two ends by resistances R_1 and R_2 as shown in the figure. A horizontal metallic bar l of mass $0.2kg$ slides without friction, vertically down the rails under the action of gravity. There is a uniform 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 $\left(g = 9.8m\,/\,s^2\right)$



The terminal velocity fo the bar L will be

A. $2m/s$

B. $3m/s$

C. $1m/s$

D. None of these

Answer: C

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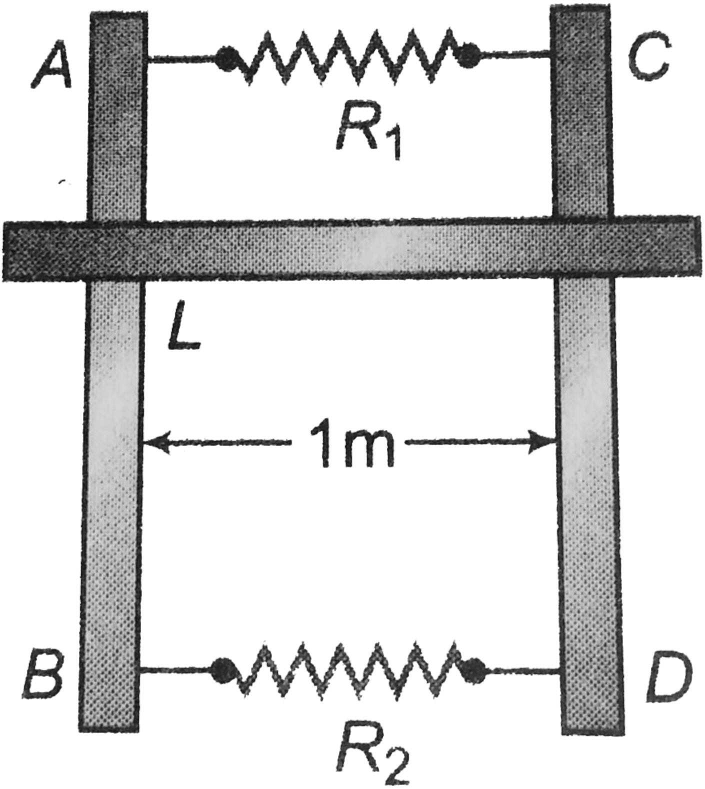
12. Two parallel vertical metallic rails AB and CD are separated by $1m$. They are connected at the two ends by resistances R_1 and R_2 as shown in the figure. A horizontal metallic bar l of mass $0.2kg$ slides without friction, vertically down the rails under the action of gravity. There is a uniform 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 $\left(g = 9.8m/s^2\right)$



The value of R_1 is

A. 0.47Ω

B. 0.82Ω

C. 0.12Ω

D. None of these

Answer: A

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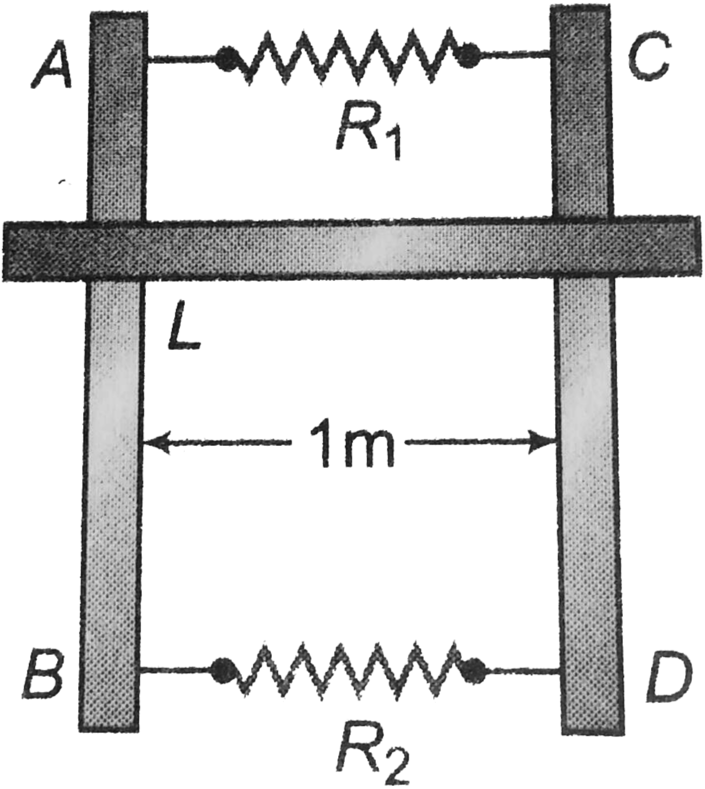
13. Two parallel vertical metallic rails AB and CD are separated by $1m$. They are connected at the two ends by resistances R_1 and R_2 as shown in the figure. A horizontal metallic bar l of mass $0.2kg$ slides without friction, vertically down the rails under the action of gravity. There is a uniform 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 value of R_2 is

A. 0.6Ω

B. 0.5Ω

C. 0.4Ω

D. 0.3Ω

Answer: D

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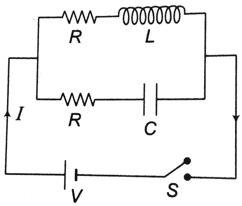
SUBJECTIVE TYPE

1. In the circuit diagram shown, initially there is no energy in the inductor and the capacitor, The switch is closed at $t = 0$. Find the current I as a function of time if $R = \sqrt{L/C}$



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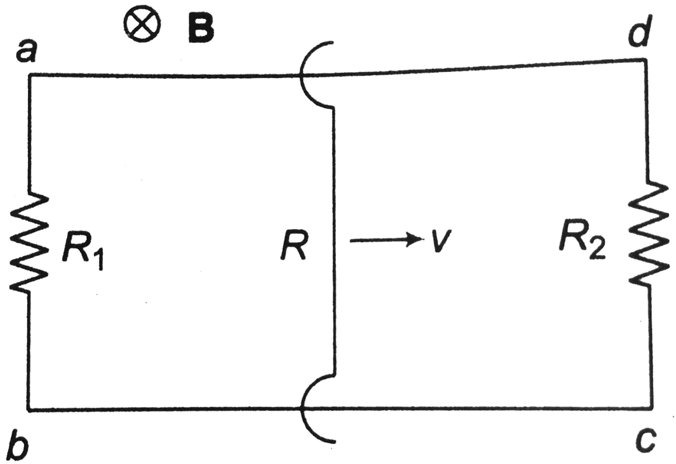
Level 2 Subjective

1. A rectangular loop with a sliding connector of length l is located in a uniform magnetic field perpendicular to the loop plane. The magnetic induction is equal to B. The connector has an electric resistance R, the sides ab and cd have resistances R_1 and R_2. Neglecting the self-inductance of the loop, find the current flowing in the connector during its motion with a constant velocity v.



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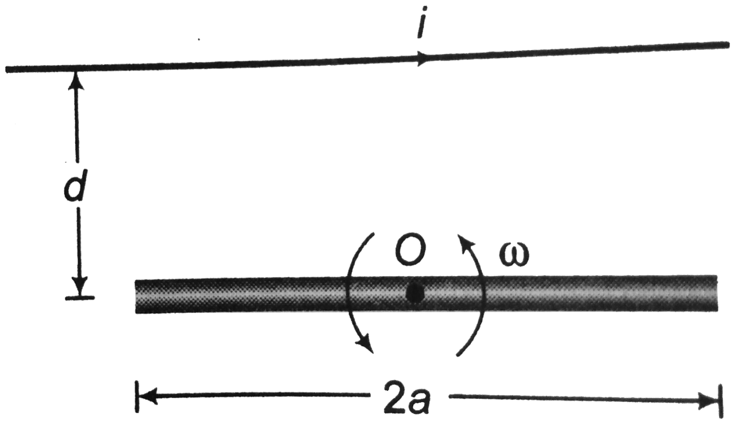
2. A rod of length $2a$ is free to rotate in a vertical plane, about a horizontal axis O passing through its mid-point. A long straight, horizontal wire is in the same plane and is carrying a constant current i as shown in figure. At initial moment of time, the rod is horizontal and starts to rotate with constant angular velocity ω, calculate emf induced in the rod as a function of time.



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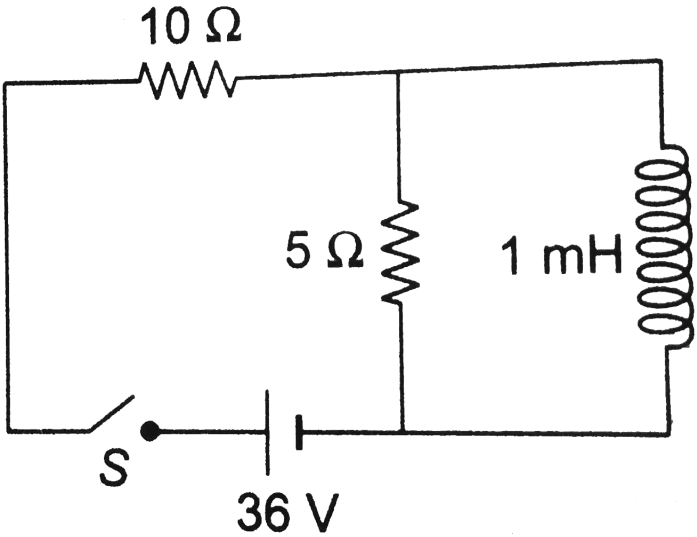
3. In the circuit arrangement shown in figure, the switch S is closed at $t = 0$. Find the current in the inductance as a function of time? Does the

current through 10Ω resistor vary with time or remains constant.



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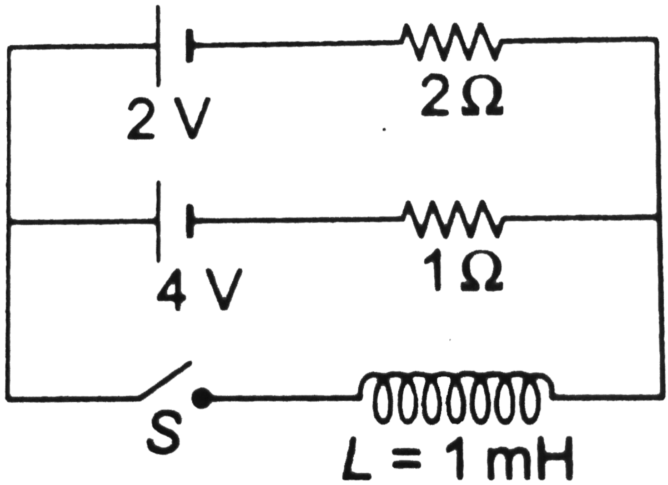
4. In the circuit shown, switch S is closed at time $t = 0$. Find the current through the inductor as a function of time t.



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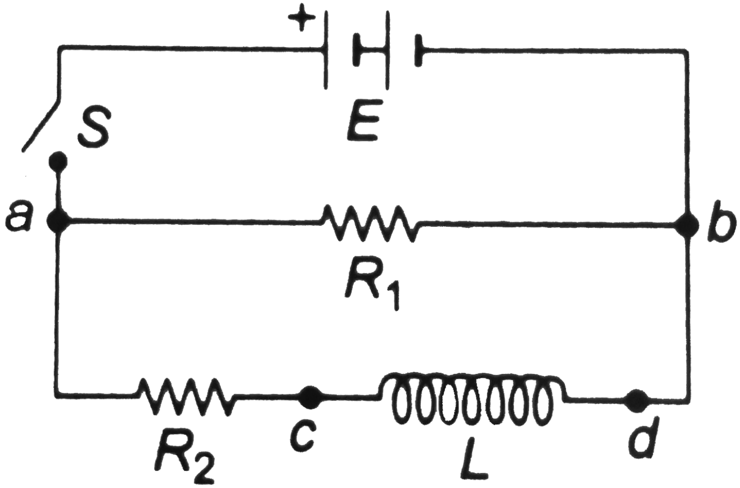
5. In the circuit shown in figure, $E = 120V$, $R_1 = 30.0\Omega$, $R_2 = 50.0\Omega$ and $L = 0.200H$. Switch S is closed at $t = 0$. Just after the switch is closed.



(a) What is the potential difference V_{ab} across the inductor R_1?

(b) Which point, a or b, is at higher potential?

(c) What is the potential difference V_{cd} across the inductor L?

(d) Which point, c or d, is at a higher potential? The switch is left closed for a long time and then is opened. Just after the switch is opened

(e) What is the potential difference V_{ab} across the resistor R_1?

(f) Which point a or b, is at a higher potential?

(g) What is the potential difference V_{cd} across the inductor L?

(h) Which point, c or d, is at a higher potential?

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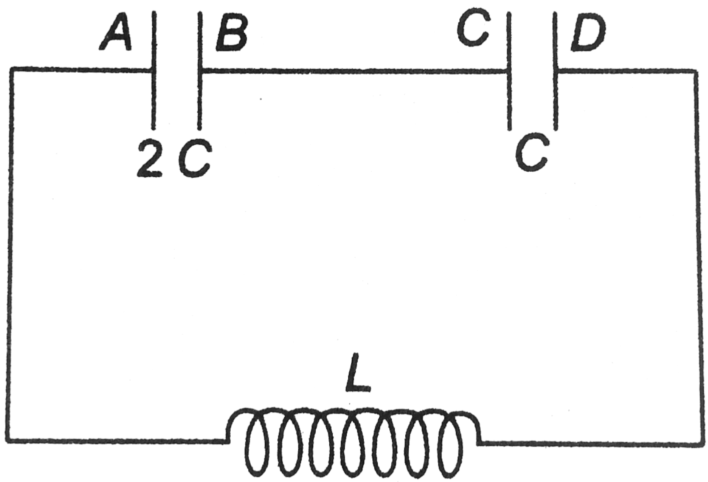
6. Two capacitors of capacitances $2C$ and C are connected in series with an inductor of inductance L. Initially, capacitors have charge such that $V_B - V_A = 4V_0$ and $V_C - V_D = V_0$. Initial current in the circuit is zero. Find



(a) maximum current that will flow in the circuit,

(b) potential difference across each capacitor at that instant,

(c) equation of current flowing towards left in the inductor.

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7. A $1.00 mH$ inductor and a $1.00 \mu F$ capacitor are connected in series. The current in the circuit is described by $i = 20t$, where t, is in second and i is in ampere. The capacitor initially has no charge. Determine

(a) the voltage across the inductor as a function of time,

(b) the voltage across the capacitor as a function of time,

(c) the time when the energy stored in the capacitor first exceeds that in the inductor.

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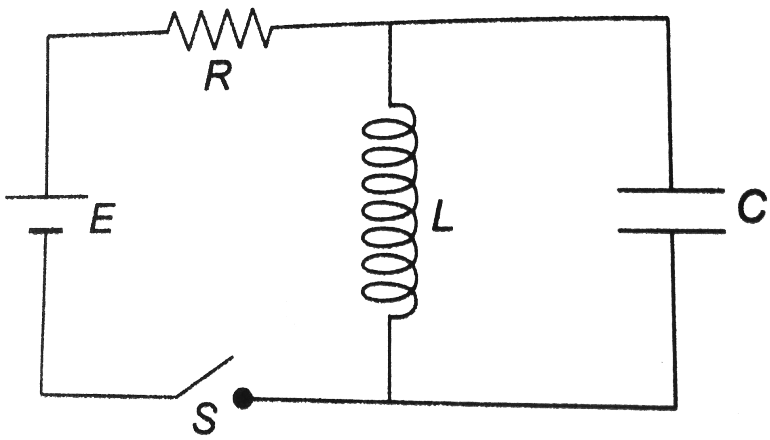
8. In the circuit shown in the figure, $E = 50.0 V, R = 250 \Omega$ and $C = 0.500 \mu F$. The switch S is closed for a long time, and no voltage is measured across the capacitor. After the switch is opened, the voltage across the capacitor reaches a maximum value of $150 V$. What is the inductance L?



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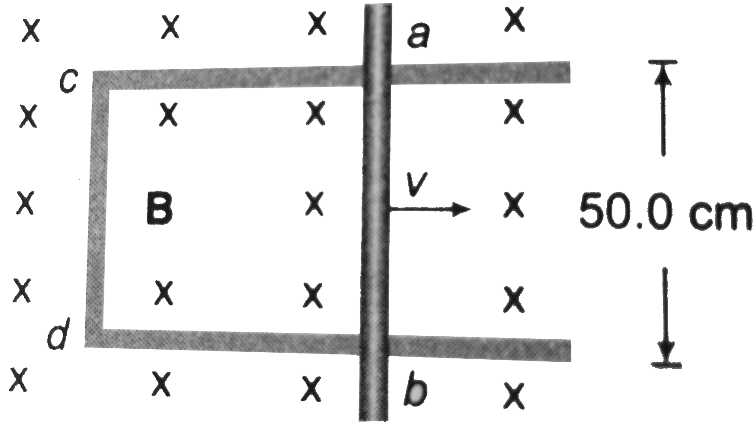
9. The conducting rod ab shown in figure makes contact with metal rails ca and db. The apparatus is in a uniform magnetic field $0.800T$, perpendicular to the plane of the figure.



(a) Find the magnitude of the emf induced in the rod when it is moving toward the right with a speed $7.50 m / s$.

(b) In what direction does the current flow in the rod?

(c) If the resistance of the circuit abdc is 1.50Ω (assumed to be constant), find the force (magnitude and direction) required to keep the rod moving to the right with a constant speed of $7.50 m / s$. You can ignore friction.

(d) Compare the rate at which mechanical work is done by the force (Fu) with the rate at which thermal energy is developed in the circuit $(I^2 R)$.

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10. 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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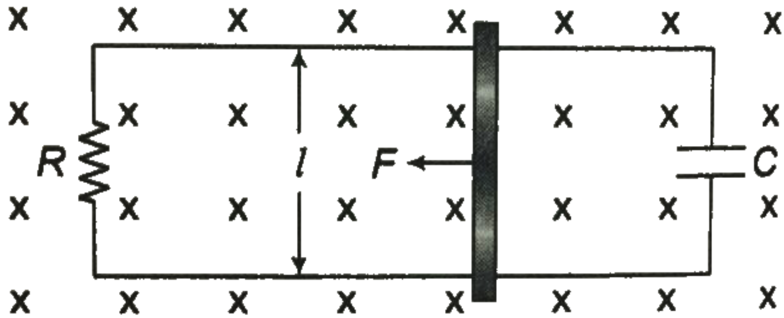
11. Two parallel long smooth conducting rails separated by a distance l are connected by a movable conducting connector of mass m. Terminals of the rails are connected by the resistor R and the capacitor C as shown in figure. A uniform magnetic field B perpendicular to the plane of the rail is switched on. The connector is dragged by a constant force F. Find the speed of the connector as a function of time if the force F is applied

at $t = 0$. Also find the terminal velocity of the connector.



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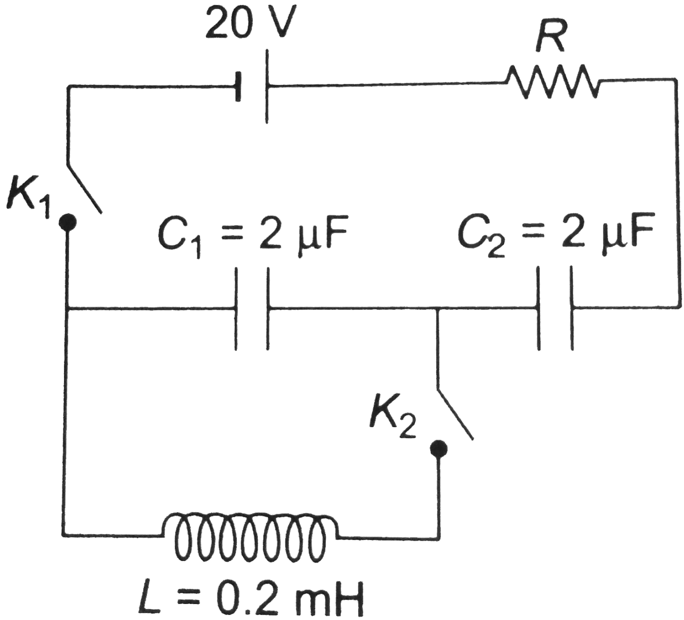
12. A circuit containing capacitors C_1 and C_2, shown in the figure is in the steady state with key K_1 and K_2 opened. At the instant $t = 0$, K_1 is opened and K_2 is closed.



(a) Find the angular frequency of oscillations of $L - C$ circuit.

(b) Determine the first instant t, when energy in the inductor becomes one third of that in the capacitor.

(c) Calculate the charge on the plates of the capacitor at that instant.

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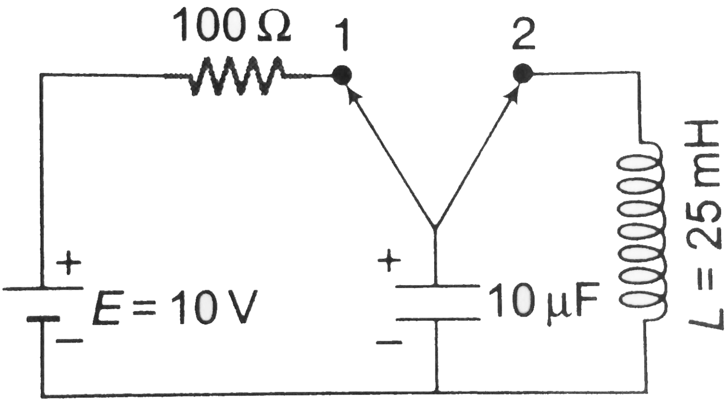
13. Initially, the capacitor is charged to a potential of $5V$ and then connected to position 1 with the shown polarity for $1s$. After $1s$ it is connected across the inductor at position 2



(a) Find the potential across the capacitor after $1s$ of its connection to position 1.

(b) Find the maximum current flowing in the $L - C$ circuit when capacitor is connected across the inductor. Also, find the frequency of LC oscillations.

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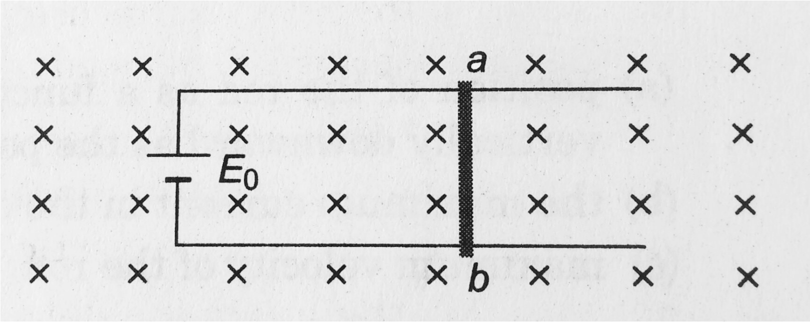
14. A rod of mass m and resistnce R sldes on frictionless and resistanceless rails a distance l a part thast innclude a source of emf E_0 (see figure). The rod is initially at rest. Find the expression for the

a. Velocity of the rod v(t). b. current in the loop i(t).



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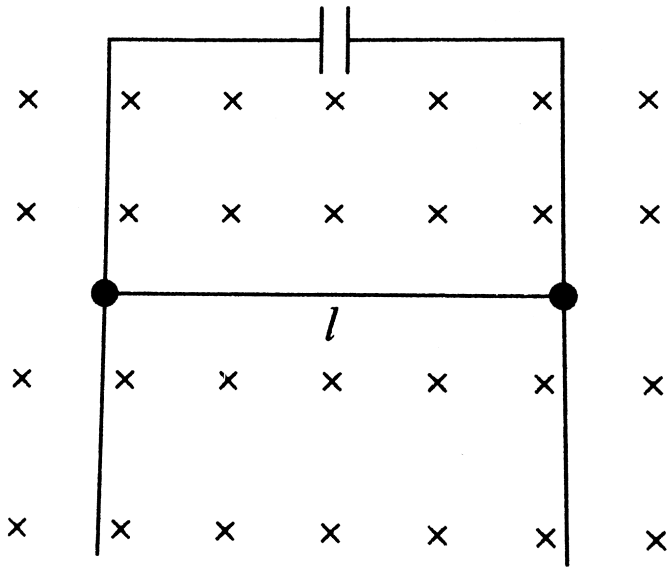
15. Two metal bars are fixed vertically and are connected on the top by a capacitor C. A sliding conductor of length land mass m slides with its ends in contact with the bars. The arrangement is placed in a uniform horizontal magnetic field directed normal to the plane of the figure. The conductor is released from rest. Find the displacement $x(t)$ of the conductor as a function of time t.



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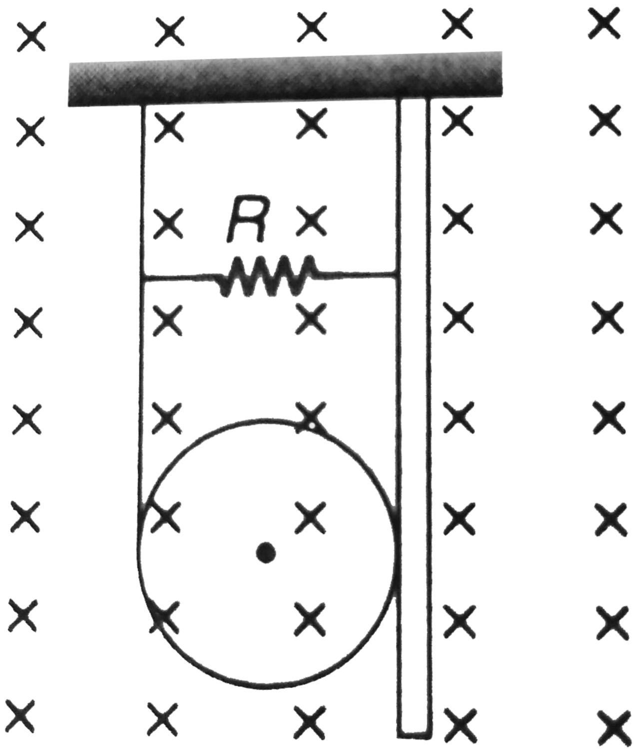
16. A conducting light string is wound on the rim of a metal ring of radius r and mass m. The free end of the string is fixed to the ceiling. A vertical infinite smooth conducting plane is always tangent to the ring as shown in the figure. A uniform magnetic field Bis applied perpendicular to the plane of the ring. The ring is always inside the magnetic field. The plane and the strip are connected by a resistance R. When the ring is released,

find



a. the curent in the resistance R as as function of time.

b. the terminal velocity of the ring.

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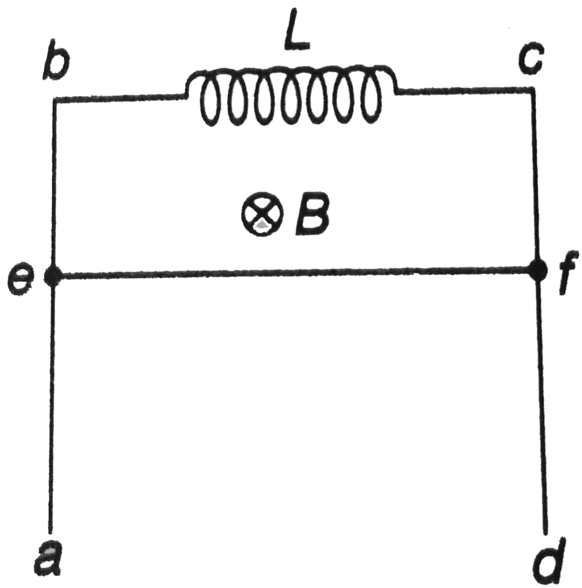
17. A conducting frame abcd is kept in a vertical plane. A conducting rod of of mass m and length l can slide smoothly on it remaining always horizontal. The resistance of the loop is negligible and inductance is constant having value L. The rod is left from rest and allowed to fall under gravity and inductor has no initial current. A magnetic field of constant magnitude Bis present throughout the loop pointing inwards. Determine



(a) position of the rod as a function of time assuming initial position of the rod to be $x = 0$ and vertically downward as the positive x-axis.

(b) the maximum current in the circuit.

(c) maximum velocity of the rod

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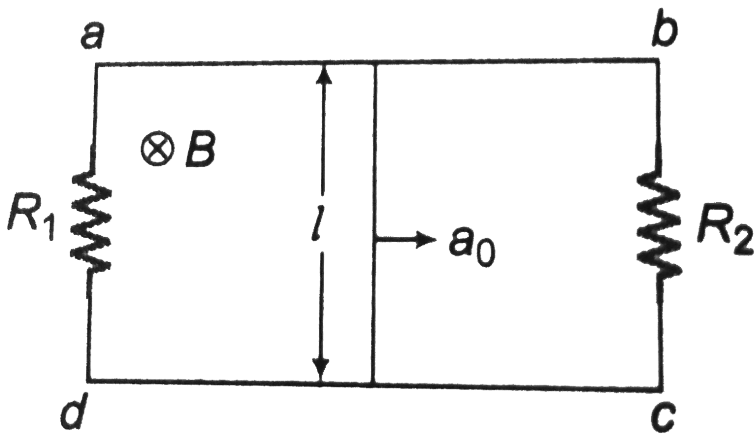
18. A rectangular loop with a sliding conductor of length l is located in a uniform magnetic field perpendicular to the plane of loop. The magnetic induction perpendicular to the plane of loop Is equal to B. The part ad and be has electric resistance R_1 and R_2, respectively. The conductor starts moving with constant acceleration a_0, at time $t = 0$. Neglecting the self-inductance of the loop and resistance of conductor. Find



(a) the current through the conductor during its motion.

(b) the polarity of $abcd$ terminal.

(c) external force required to move the conductor with the given acceleration.

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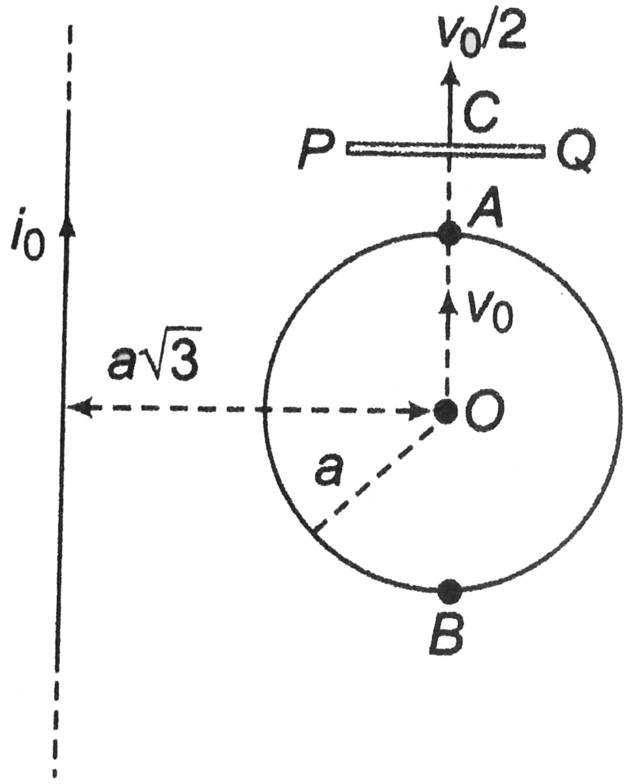
19. A conducting circular loop of radius a and resistance per unit length R is moving with a constant velocity v_0 , parallel to an infinite conducting wire carrying current i_0. A conducting rod of length $2a$ is approaching the centre of the loop with a constant velocity $\frac{v_0}{2}$ along the direction 2 of the current. At the instant $t = 0$, the rod comes in contact with the loop at A and starts sliding on the loop with the constant velocity. Neglecting the resistance of the rod and the self-inductance of the circuit, find the following when the rod slides on the loop.



(a) The current through the rod when it is at a distance of $\left(\frac{a}{2}\right)$ from the point A of the loop.

(b) Force required to maintain the velocity of the rod at that instant.

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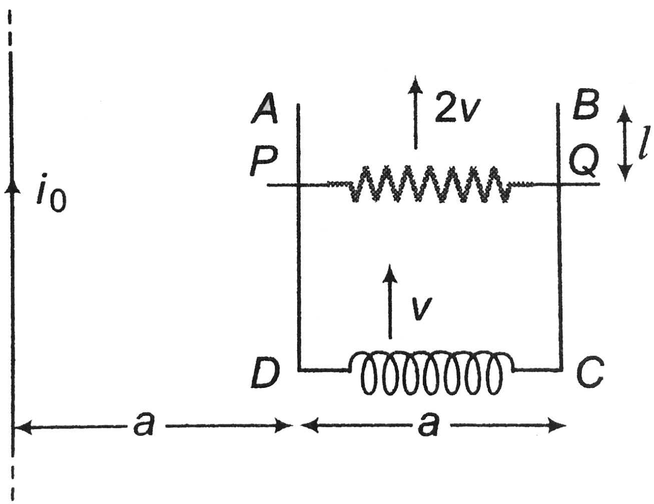
20. U-frame $ABCD$ and a sliding rod PQ of resistance R, start moving with velocities v and $2v$ respectively, parallel to a long wire carrying current i_0. When the distance $AP = 1$ at $t = 0$, determine the current through the inductor of inductance L just before connecting rod PQ loses contact with the U-frame.



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Check point

1. The magnetic flux linked with a vector area $\overrightarrow{A}$ in a uniform magnetic field $\overrightarrow{B}$ is

A. $B \times A$

B. AB

C. $B.\ A$

D. $\frac{B}{A}$

Answer: C

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2. The unit of magnetic flux is

A. Wbm^{-2}

B. Wb

C. H

D. Am^{-1}

Answer: B

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3. The dimensions of magnetic flux are

A. $\left[MLT^{-2}A^{-2}\right]$

B. $\left[ML^{2}T^{-2}A^{-2}\right]$

C. $\left[ML^{2}T^{-1}A^{-2}\right]$

D. $\left[ML^{2}T^{-2}A^{-1}\right]$

Answer: D

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4. The magnetic flux linked with a coil, in webers is given by the equation $\phi = 3t^2 + 4t + 9$. Then, the magnitude of induced emf at t = 2 s

A. 2 V

B. 4 V

C. 8 V

D. 16 V

Answer: D

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5. A coil having an area A_0 is placed in a magnetic field which changes from B_0 to $4B_0$ in time interval t. The emf induced in the coil will be

A. $3A_0B_0/t$

B. $4A_0B_0/t$

C. $3B_0 / A_0 t$

D. $4B_0 / A_0 t$

Answer: A

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6. The magnetic flux ϕ (in weber) in a closed circuit of resistance 10Ω varies with time t (in secnod) according to equation $\phi = 6t^2 - 5T + 1.$ The magnitude of induced current at $t = 0.25$ s is

A. 1.2 A

B. 0.8 A

C. 0.6 A

D. 0.2 A

Answer: D

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7. When the current through a solenoid increases at a constant rate, the induced current in the solenoid

A. is a constant and is in the direction of the inducing current

B. is a constant and is opposite to the direction of the inducing current

C. increase with time and is in the direction of inducing current

D. increase with time and is opposite to the direction of inducing current

Answer: B

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8. The magnetic flux across a loop of resistance 10Ω is given by $\phi = (5t^2 - 4t^2 + 1)Wb$. How much current is induced in the loop after 0.2 s?

A. 0.4 A

B. 0.2 A

C. 0.04 A

D. 0.02 A

Answer: B

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9. A circular ring of diameter 20cm has a resistance 0.01Ω How much charge will flow through the ring if it is rotated from positon perpendicular to the uniform magnetic field of B=2T to a position parallel to field?

A. 4 C

B. 6.28 C

C. 3.14 C

D. 2.5 C

Answer: B

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10. Magnetic flux in a circuite containing a coil of resistance 2Ωchange from $2.0Wb$ to $10Wb$ in $0.2\sec$. The charge passed through the coil in this time is

A. 5.0 C

B. 4.0 C

C. 1.0 C

D. 0.8 C

Answer: B

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11. The direction of induced e.m.f. during electromagnetic induction is given by

A. Faraday's law

B. Lenz's law

C. Maxwell's law

D. Ampere's law

Answer: B

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12. Two different wire loops are concentric and lie in the same plane. The current in the outer loop is clockwise and increasing with time. The induced current in the inner loop then is

A. clockwise

B. zero

C. counter-clockwise

D. in a direction that depends on the ratio of the loop radii

Answer: C

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13. Lenz's law is consequence of the law of conservation of

A. charge

B. momentum

C. energy

D. current

Answer: C

Watch Video Solution

14. The north pole of a long horizontal bar magnet is being brought closer to a vertical conducting plane along the perpendicular direction. The direction of the induced current in the conducting plane will be

A. horizontal

B. vertical

C. clockwise

D. anti-clockwise

Answer: D

Watch Video Solution

15. There is a uniform magnetic field directed perpendicular and into the plane of the paper. An irregular shaped conducting loop is slowly changing into a circular loop in the plane of the paper. Then

A. current is induced in the loop in the anti-clockwise direction

B. current is induced in the loop in the clockwise direction

C. AC is induced in the loop

D. No current is induced in the loop

Answer: A

Watch Video Solution

16. A conducing rod of length l is falling with a velocity v perpendicular to a unifrom horizontal magnetic field B . The potential difference between its two ends will be

A. 2 B/v

B. B/v

C. $\frac{1}{2}B/v$

D. $B^2l^2v^2$

Answer: B

Watch Video Solution

17. A with of length 50 cm moves with a velocity of 300 m/min, perpendicular to a magnetic fiel. If the emf induced in the wire is 2 V, then the magnitude of the field in tesla is

A. 2

B. 5

C. 0.8

D. 2.5

Answer: C

Watch Video Solution

18. A 10 m wire kept in east-west direction is falling with velocity 5 m/s perpendicular to the field $0.3 \times 10^{4} Wb/m^{2}$ due north and horizontal.

The boat carried a vertical areal 2 m long. If the speed of the boat is $1.50ms^{-1}$, then the magnitude of the induced emf in the wire of areal is

A. 0.15 V

B. 1.5 Mv

C. 1.5 V

D. 15.0 V

Answer: B

Watch Video Solution

19. A boat is moving due east in a region where the earth's magnetic field is $5.0 \times 10^{-5} NA^{-1}m^{-1}$ due north and horizontal. The boat carries a vertical aerial 2 m long. If the speed of the boat is $1.50ms^{-1}$, the magnitude of the induced emf in the wire of aerial is

A. 1 mV

B. 0.75 mV

C. 0.50 mV

D. 0.15mv

Answer: D

Watch Video Solution

20. 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. zero

B. $B_0 lv \sin \delta$

C. $B_0 lv$

D. $B_0 lv \cos \delta$

Answer: B

Watch Video Solution

21. A conducing circular loop is placed in a uniform magnetic field of indution B tesla with its plane normal to the field. Now, radius of the loop starts shrinking at the rate (dr/dt). Then the induced e.m.f. at the instant when the radius is r is:

A. $\pi r B(dr/dt)$

B. $2\pi r B(dr/dt)$

C. $\pi r^2 (dB/dt)$

D. $(\pi r^2/2)B(dr/dt)$

Answer: B

Watch Video Solution

22. The current flowing in two coaxial coils in the same direction. On increasing the distance the two, the electric current will

A. remain unaltered

B. increase in one and decrease in the second

C. increase in both

D. decrease in both

Answer: C

Watch Video Solution

23. A circular coil of mean radius of $7cm$ and having 4000 turns Is rotate at the rate of 1800 revolution per minute in the earth 's magnetic field (B=0.5 gauss), the maximum e.m.f. induced in coil will be

A. $1.158V$

B. $0.57V$

C. $0.29V$

D. $5.8V$

Answer: B

Watch Video Solution

24. A coil of N turns and mean cross-sectional area A is rotating with uniform angular velocity ω about an axis at right angle to uniform magnetic field B. The induced emf E in the coil will be

A. $NBA\sin\omega t$

B. $NB\omega\sin\omega t$

C. $NB/A\sin\omega t$

D. $NBA\omega\sin\omega t$

Answer: D

Watch Video Solution

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

A. $62.5mW$

B. $625mW$

C. $6.25mW$

D. $12.5mW$

Answer: C

Watch Video Solution

26. A metal rod of length 2 m is rotating with an angualr velocity of 100 rads^{-1} in plane perpendicular to a uniform magnetic field of 0.3 T. The potential difference between the ends of the rod is

A. 30 V

B. 40 V

C. 60 V

D. 600 V

Answer: C

Watch Video Solution

27. A conducting rod of length l is moving in a transverse magnetic field of strength B with veocity v. The resistance of the rod is R. The current in the rod is

A. $\frac{Blv}{R}$

B. Blv

C. zero

D. $\frac{B^2v^2l^2}{R}$

Answer: C

Watch Video Solution

28. A rectangular coil rotates about an axis normal to the magnetic field, If E_m is the maximum value of the induced emf, then the instantaneous emf when plane of the coil makes an angle of 45° with the magnetic field is

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

B. $\frac{1}{4}E_m$

C. $\frac{1}{\sqrt{2}}E_m$

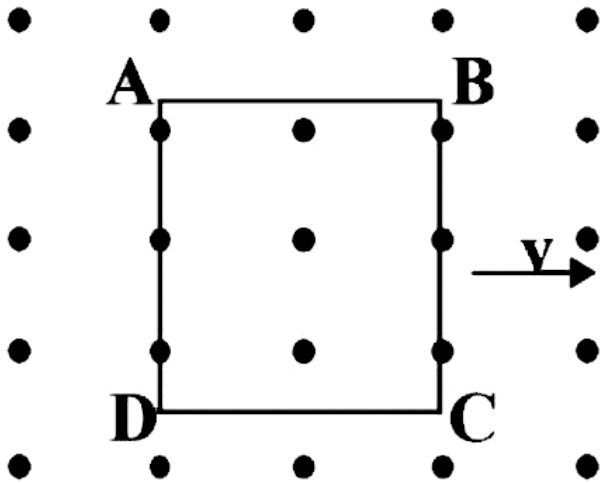
D. E_m

Answer: C

Watch Video Solution

29. 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 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

Watch Video Solution

30. Consider the following statements: (a)An emf can be induced by moving a conductor in a magnetic field. (b)An emf can be induced by changing the magnetic field.

A. Both A and B are true

B. A is true but B is false

C. B is true but A is false

D. Both A and B are false

Answer: A

Watch Video Solution

31. The SI unit of inductance, the henry can be written as :

A. weber/ampere

B. volt-second/ampere

C. $\text{joule}/(\text{ampere})^2$

D. ohm-second

Answer: B

Watch Video Solution

32. A long solenoid has 500 turns. When a current of $2A$ is passed through it, the resulting magnetic flux linked with each turn of the solenoid is $4 \times 10^{-3} Wb$. The self-inductance of the solenoid is

A. 1.0 H

B. 4.0 H

C. 2.5 H

D. 2.0 H

Answer: A

Watch Video Solution

33. If a current of 10 A changes in one second throught a coil, and the induced emf is 10 V, then the self-inductance of the coil is

A. $\frac{2}{5}H$

B. $\frac{4}{5}H$

C. $\frac{5}{4}H$

D. 1/2 H

Answer: D

Watch Video Solution

34. When the current in a coil charges from 2A to 4A in 0.05 s, emf of 8 volt is induced in the coil. The coefficient of self induction of the coil is -

A. 1H

B. 2H

C. 4H

D. 8H

Answer: B

Watch Video Solution

35. The current passing through a choke coil of 5 hery is decreasing at the rate of $2 ampere / \sec$. The e.mf. Devlopeing across the coil is

A. 10 V

B. $-10V$

C. 2.5 V

D. $-2.5mV$

Answer: A

Watch Video Solution

36. In a coil of self-inuctance 0.5 henry, the current varies at a constant rate from zero to 10 amperes in 2 seconds. The e.m.f. generated in the coil is

A. 10 V

B. 5 V

C. 2.5 V

D. 1.25 V

Answer: C

Watch Video Solution

37. The self inductance of a long solenoid cannot be increased by

A. increasing its area of cross-section

B. increasing its length

C. changing the medium with greater permeability

D. increasing the current through it

Answer: D

Watch Video Solution

38. Self-inductance of a coil is 50mH. A current of 1 A passing through the coil reduces to zero at steady rate in 0.1 s, the self-induced emf is

A. 5 V

B. 0.05 V

C. 50 V

D. 0.5 V

Answer: D

Watch Video Solution

39. The self inductance of a coil is L . Keeping the length and area same, the number of turns in the coil is increased to four times. The self inductance of the coil will now be

A. $\frac{1}{4}L$

B. L

C. 4 L

D. 16 L

Answer: D

Watch Video Solution

40. In circular coil, when no. of turns is doubled and resistance becomes $\frac{1}{4}th$ of initial, then inductance becomes

A. 4 times

B. 2 times

C. 8 times

D. no change

Answer: A

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41. The self inductance of a solenoid of length L, area of cross-section A and having N turns is-

A. $\frac{\mu_0 N^2 S}{L}$

B. $\frac{\mu_0 NS}{L}$

C. $\mu_0 N^2 LS$

D. $\mu_0 NLS$

Answer: A

Watch Video Solution

42. A solenoid has 2000 turns would over a length of 0.30 m. The area of its cross-section is $1.2 \times 10^{-2} m^2$. If an initial current of 2 A in the solenoid is reversed in 0.25 s, then the emf induced in the coil is

A. $6 \times 10^{-4} V$

B. $4.8 \times 10^{-3} V$

C. $6 \times 10^{-2} V$

D. $32.1 \times 10^{-2} V$

Answer: D

Watch Video Solution

43. A 50 mH coil carries a current of 2 ampere. The energy stored in joules is

A. 1

B. 0.1

C. 0.05

D. 0.5

Answer: B

Watch Video Solution

44. In an inductor of inductance $L = 100mH$, a current of $I = 10A$ is flowing. The energy stored in the inductor is

A. 5 J

B. 10 J

C. 100 J

D. 1000 J

Answer: A

Watch Video Solution

45. Two pure inductors each of self-inductance L are connected in parallel but are well separted from each other. The total inductance is

A. 2 L

B. L

C. $\frac{L}{2}$

D. $\frac{L}{4}$

Answer: C

Watch Video Solution

46. Two coils X and Y are placed in a circuit such that when the current changes by 2 A in coil X. The magnetic flux changes by 0.4 Wb in Y. The value of mutual inductance of the coils is

A. 0.2 H

B. 5 H

C. 0.8 H

D. 4 H

Answer: A

Watch Video Solution

47. Two coils have a mutual inductance $0.005H$. The current changes in the first coil according to equation $I = I_0 \sin \omega t$, where $I_0 = 10A$ and $\omega = 100\pi$radian//sec`. The maximum value of e.m.f. in the second coil is

A. 2π

B. 5π

C. π

D. 4π

Answer: B

Watch Video Solution

48. The mutual inductance between a primary and secondary circuit is $0.5H$. The resistance of the primary and the secondary circuits are $20ohms$ and $5ohms$ respectvely. To genrate a current of $0.4A$ in the secondary,current in the primary must be changed at the rate of

A. $4.0As^{-1}$

B. $1.6As^{-1}$

C. $16.0As^{-1}$

D. $8.0As^{-1}$

Answer: A

Watch Video Solution

49. The coefficient of mutual induction between two circuits is equal to the, emf produced in one circuit when the current in the second circuit is

A. kept steady at 1 A

B. cut-off ai 1 A level

C. changed at the rate of $1As^{-1}$

D. changed from $1As^{-1}$ to $2As^{-1}$

Answer: C

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50. Two circuits have coefficient of mutual induction of 0.09 henry. Average e.m.f. induced in the secondary by a change of current from 0 to 20 ampere in 0.006 second in the primary will be

A. 120 V

B. 80 V

C. 200 v

D. 300 V

Answer: D

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51. A varying current at the rate of $3A/s$ in a coil generates an e.m.f. of $8mV$ in a nearby coil. The mutual inductance of the two coils is

A. 2.66 mH

B. 2.66×10^{-3}mH

C. 2.66 H

D. 0.266 H

Answer: A

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52. A solenoid is placed inside another solenoid, the length of both being equal carrying same magnitude of current. The parameters like radius and number of turns are in the ratio 1:2 for the two solenoids. The mutual inductance on each other would be

A. $M_{12} = M_{21}$

B. $M_{12} = 2M_{21}$

C. $2M_{12} = M_{21}$

D. $M_{12} = 4M_{21}$

Answer: A

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53. Two coils of self-inductance $2mH$ and $8mH$ are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coil is

A. 4 mH

B. 16 mH

C. 10 mH

D. 6 mH

Answer: A

Watch Video Solution

54. Two coils of self-inductance L_1 and L_2 are placed closed to each other so that total flux in one coil is completely linked with other. If M is mutual inductance between them, then

A. $M = L_1 L_2$

B. $M = L_1 / L_2$

C. $M = \sqrt{L_1 L_2}$

D. $M = (L_1 L_2)^2$

Answer: C

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55. An ideal coil of 10 henry is joined in series with a resistance of 5 ohm and a battery of 5 volt. 2 second after joining, the current flowing in ampere in the circuit will be

A. e^{-1}

B. $(1 - e^{-1})$

C. $(1 - e)$

D. e

Answer: B

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56. An L-R circuit has a cell of e.m.f. E , which is switched on at time t = 0. The current in the circuit after a long time will be

A. zero

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

C. $\dfrac{E}{L}$

D. $\dfrac{E}{\sqrt{L^2+R^2}}$

Answer: B

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57. During current growth in an L-R circuit the time constant is the time in which the magnitude of current becomes

A. l_0

B. $l_0 / 2$

C. $0.63 l_0$

D. $0.37 l_0$

Answer: C

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

A. Current in the circuit

B. magnetic field energy

C. Power delivered by the battery

D. Emf induced in the inductor

Answer: A

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59. Eddy currents are produced when

A. a metal is kept in varying magnetic field

B. a metal is kept in a steady magnetic field

C. a circular coil is placed in a magnetic field

D. through a circular coil current is passed

Answer: A

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60. Which of the following is not an application of eddy currents?

A. Induction furnace

B. Galvanometer damping

C. Speedometer of automobiles

D. X-ray crystallography

Answer: D

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Taking it together

1. L, C and R represent the physical quantities, inductance, capacitance and resistance respectively. The combination(s) which have the dimensions of frequency are

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

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

C. $\frac{1}{\sqrt{LC}}$

D. $\frac{C}{L}$

Answer: D

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2. The self inductance L of a solenoid of length l and area of cross-section A, with a fixed number of turns N increases as

A. Both l and A increase

B. l decrease and A increase

C. l increase and A decrease

D. bBoth l and A decrease

Answer: B

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3. In electromagnetic induction, the induced charge in a coil is independent of

A. change in the flux

B. time taken to change the flux

C. resistance in the circuit

D. None of the above

Answer: B

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4. A coil and a bulb are connected in series with a dc source, a soft iron core is then inserted in the coil. Then

A. intensity of the bulb remains the same

B. intensity of the bulb decrease

C. intensity of the bulb increase

D. the bulb ceases to glow

Answer: B

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5. A magnet is brought towards a coil (i) speedily (ii) slowly then the induced e.m.f.//induced charge will be respectively

A. more in first case/more in first case

B. more in first case/equal in both case

C. less in first case/more in second case

D. less in first case/equal in both case

Answer: B

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6. A coil of area $10cm^2$ and 10 turns is in magnetic field directed perpendicular to the plane and changing at a rate of $10^8 gauss/s$. The resistance of coil is 20Ω. The current in the coil will be

A. $5A$

B. $0.5A$

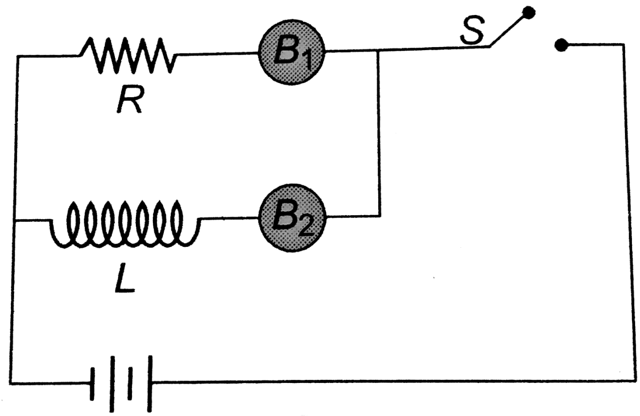
C. $0.05A$

D. $5 \times 10^8 A$

Answer: A

Watch Video Solution

7. The adjoining figure shows two bulbs B_1 and B_2 resistor R and an inductor and L. When the switch S is turned off



A. The bulb B_2 lights up earlier than B_1 and finally both the bulbs shine equally bright

B. B_1 lights up earlier and finally both the bulbs acquire equal brightness

C. B_2 lights up earlier and finally B_1 shines brighter than B_2

D. B_1 and B_2 light up together with equal brightness all the time

Answer: C

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

A. remains stationary

B. is attracted by loop A

C. is repelled by loop A

D. rotates about its centre of mass with CM fixed

Answer: C

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9. A coil having 500 square loops each of side $10cm$ is placed normal to a magnetic flux which increase at the rate of $1.0\frac{\text{tesla}}{\text{second}}$. The induced r.m.f. in volts is

A. 0.1

B. 0.5

C. 1

D. 5

Answer: D

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10. A coil having an area $2m^2$ is placed in a magnetic field which changes from $1Wb/m^2$ to $4Wb/m^2$ in an interval of 2 second. The average e.m.f. induced in the coil will be

A. 4 V

B. 3 V

C. 1.5 V

D. 2 V

Answer: B

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11. Two circular loops of equal radii are placed coaxially at some separation. The first is cut and a battery is inserted in between to drive a current in it. The current changes slightly because of the variation in resistance with temperature. Durig this period, the two loops

A. attract each other

B. repel each other

C. do not exert any force on each other

D. attract or repel each other depending on the sense of the current

Answer: D

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12. A small, conducting circular loop is placed inside a long solenoid carrying a current. The plane of the loop contains the axis of the solenoid.

If the current in the solenoid is varied, the current induced in the loop is

A. clockwise

B. anti-clockwise

C. zero

D. clockwise or anti-clockwise depending on whether the resistance is increased or decreased

Answer: c

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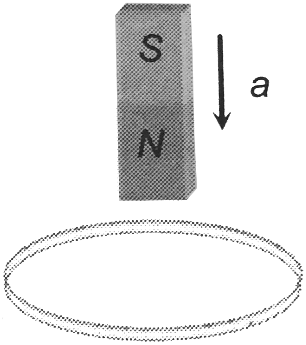
13. A metallic ring is attached with the wall of a room. When the north pole of a magnet is brought near to it, the induced current in the ring will be



A. anti-clockwise

B. clockwise

C. first anti-clockwise and then clockwise

D. first clock wise and then anti-clockwise

Answer: A

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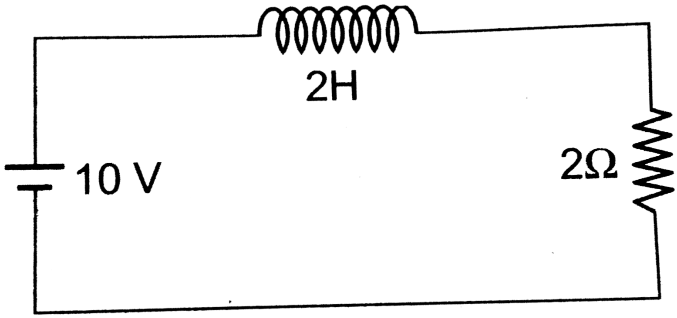
14. In the figure magnetic energy stored in the coil is



A. zero

B. infinite

C. 25 J

D. None of the above

Answer: C

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15. An emf of $15V$ is applied in a circuit containing $5H$ inductance and 10Ω resistance. The ratio of the currents at time $t = \infty$ and $t = 1s$ is

A. $\dfrac{e^{1/2}}{e^{1/2}-1}$

B. $\dfrac{e^{2}}{e^{2}-1}$

C. $1-e^{-1}$

D. e^{-1}

Answer: B

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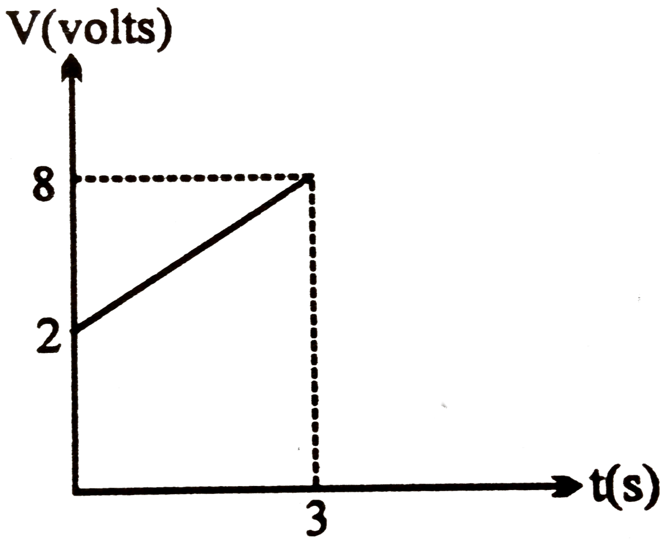
16. A circuit element is placed in a closed box. At time t=0, constant current generator supplying a current of 1 amp, is connected across the box. Potential difference across the box varies according to graph shown in figure. The element in the box is:



A. a resistance of 2Ω

B. a battery of emf 6 V

C. an inductance of 2 H

D. a capacitance of 0.5 F

Answer: D

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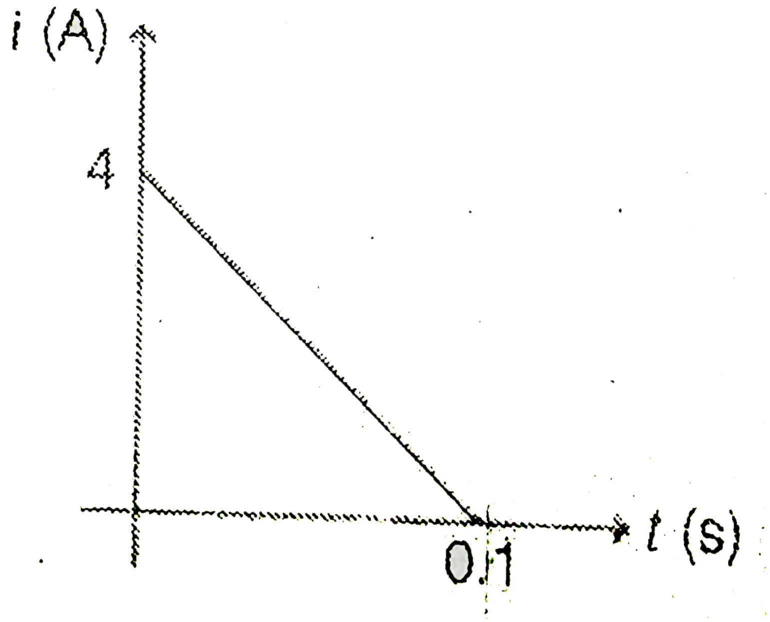
17. Some magnetic flux is changed from a coil resistance 10Ω. As a result an induced current developed in it. Which varies with time as shown figure, The magnitude of changes f in flux through the coil (in webers) is



A. 2

B. 4

C. 6

D. None of these

Answer: A

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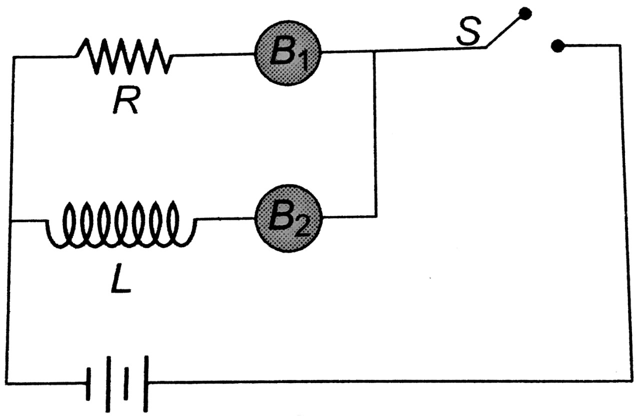
18. The adjoining figure shows two bulbs B_1 and B_2 resistor R and an inductor and L. When the switch S is turned off



A. Both B_1 and B_2 die out promptly

B. Both B_1 and B_2 die out with some delay

C. B_2 dies out promptly but B_1 with some delay

D. B_1 dies out promptly but B_2 with some delay

Answer: C

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19. A coil of 40Ω resistance has 100 turns and radius $6mm$ us connected to ammeter of resistance of $160ohms$. Coil is placed perpendicular to the magnetic field. When coil is taken out of the field, $32\mu C$ charge flows through it. The intensity of magnetic field will be

A. 6.55 T

B. 5.66 T

C. 2.55 T

D. 0.566 T

Answer: D

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20. A coil has an area of $0.05m^2$ and it has 800 turns. It is placed perpendicular in a magnitude field of strength $4 \times 10^{-5} Wb/m^2$, it is rotated through 90° in 0.1 sec. the average e.m.f. induced in the coil is

A. 0.056 V

B. 0.046 V

C. 0.026 V

D. 0.016 V

Answer: D

Watch Video Solution

21. In a magnetic field of $0.05T$, area of a coil changes from $101cm^2$ to $100cm^2$ without changing the resistance which is 2Ω. The amount of charge that flow during this period is

A. $2.5 \times 10^{-6}C$

B. $2 \times 10^{-6}C$

C. $10^{-6}C$

D. $8 \times 10^{-6}C$

Answer: A

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22. the resistance and inductance of series circuit are 5Ω and $20H$ respectively. At the instant of closing the switch, the current is increasing at the rate $4A - s$. The supply voltage is

A. 20 V

B. 80 V

C. 120 V

D. 100 V

Answer: B

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23. The number of turns in the coil of an ac genrator is 5000 and the area of the coil is $0.25m^2$. The coil is rotate at the rate of $100\text{cycles}/\text{sec}$ in a magnetic field of $0.2W/m^2$. The peak value of the emf generated is nearly

A. 786 kV

B. 440 kV

C. 220 kV

D. 157 kV

Answer: D

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24. A wheel with ten metallic spokes each $0.50m$ long is rotated with a speed of $120rev/\min$ in a plane normal to the earth's magnetic field at the place. If the magnitude of the field is 0.4 gauss, the induced e.m.f. between the axle and the rim of the wheel is equal to

A. $1.256 \times 10^{-3} V$

B. $6.28 \times 10^{-4} V$

C. $1.256 \times 10^{-4} V$

D. $6.28 \times 10^{-5} V$

Answer: D

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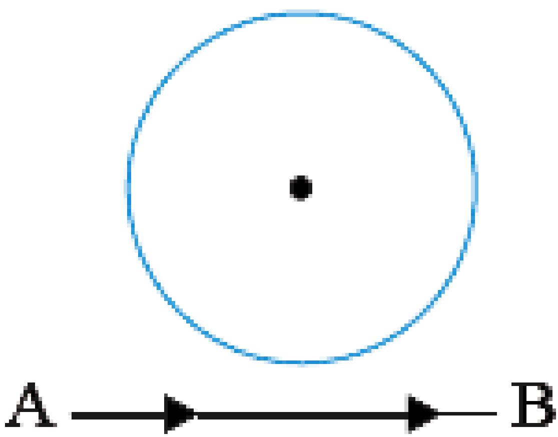
25. A charge particle moves along the line AB, which lies in the same plane of a circular loop of conduting wire as shown in the fig . Then :



A. No current will be induced

B. The current will be clockwise

C. The current will be anti-clockwise

D. The current will change direction as the electron passes through

Answer: D

Watch Video Solution

26. An electric potential difference will be induced between the ends of the conductor shown in the diagram when it moves in the direction

A. P

B. Q

C. L

D. M

Answer: D

Watch Video Solution

27. A long horizontal metallic rod with length along the east-west direction is falling under gravity. The potential difference between its two ends will

A. be zero

B. be constant

C. increase with time

D. decrease with time

Answer: C

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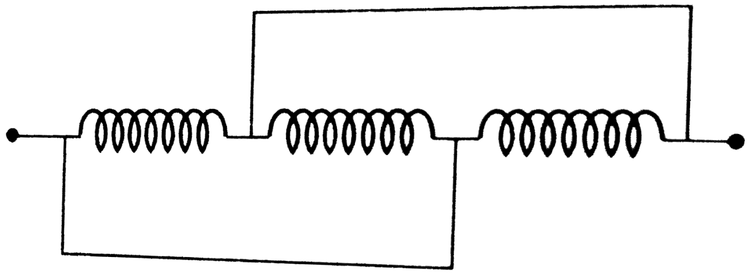
28. Pure inductance of $3.0H$ is connected as shown below. The equivalent inductance of the circuit is



A. 1 H

B. 2 H

C. 3 H

D. 9 H

Answer: A

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29. Two inductances connected in parallel are equivalent to a single inductance of $1.5H$ and when connected in series are equivalent to a single inductance of 0.8 H. The difference in their inductance is

A. 3 H

B. 7.5 H

C. 2 H

D. 4 H

Answer: D

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30. An inductance L and a resistance R are first connected to a battery. After some time the battery is disconnected but L and R remain connected in a closed circuit. Then the current reduces to 37% of its initial value in

A. RL second

B. $\frac{R}{L}$ second

C. $\frac{L}{R}$ second

D. $\frac{1}{LR}$second

Answer: C

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31. The time constant of an inductance coil is $2 \times 10^{-3}s$. When a 90Ω resistance is joined in series, the same constant becomes $0.5 \times 10^{-3}s$. The inductance and resistance of the coil are

A. 30mH,30Ω

B. 30mH,60Ω

C. 60mH,30Ω

D. 60mH,60Ω

Answer: C

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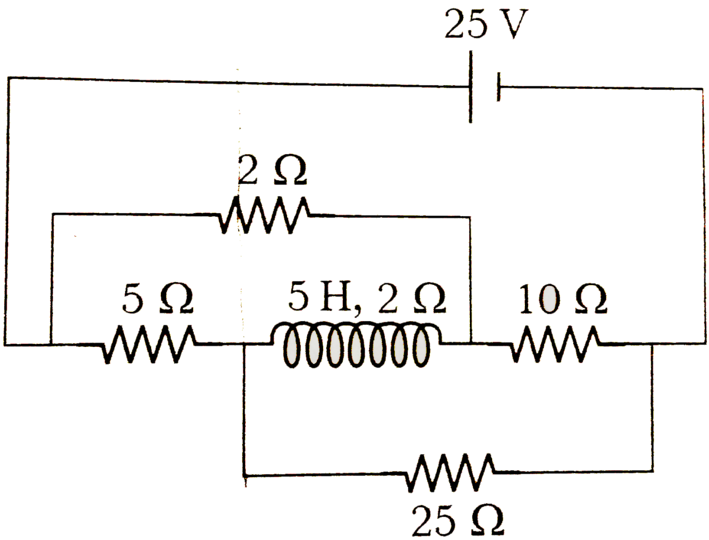
32. In the circuit shown , what is the energy stored in the coil at steady state?



A. 21.3 J

B. 42.6 J

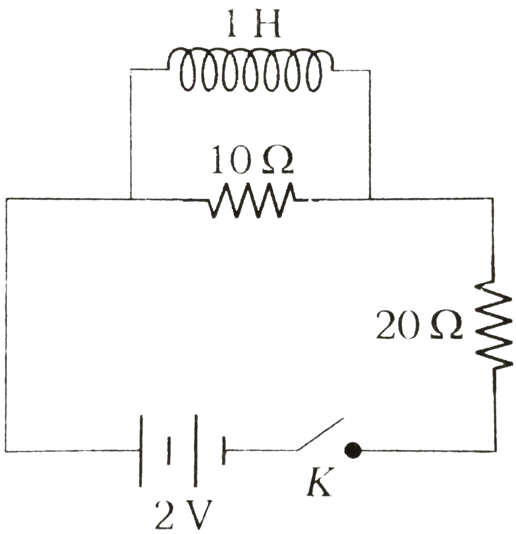
C. zero

D. 213 J

Answer: C

Watch Video Solution

33. In the following figure, what is the final value of current in the 10Ω resistance when the plug of key K is inserted?



A. $(3/10)A$

B. $(3/20)A$

C. $(3/11)A$

D. Zero

Answer: D

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34. A square loop of side L, resistance R placed in a uniform magnetic field B acting normally to the plane of the loop. If we attempt to pull it out of the field with a constant velocity v, then the power needed is

A. BRlv

B. $\frac{B^2 l^2 v^2}{R}$

C. $\frac{B l^2 v^2}{R}$

D. $\frac{B v l}{R}$

Answer: B

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35. A square of side L meters lies in the x-y plane in a region, where the magnetic field is give by $B = B_0\left(2\hat{i} + 3\hat{j} + 4\hat{k}\right)$T, where B_0 is constant. The magnitude of flux passing through the square is

A. $2B_0L^2Wb$

B. $3B_0L^2Wb$

C. $4B_0L^2Wb$

D. $\sqrt{29}B_0L^2Wb$

Answer: C

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36. A conducting looop of area $5.0cm^2$ is placed in a magnetic field which varies sinusoidally with time as $B = 0.2\sin 300t$. The normal to the coil makes an angle of 60° with the field. The emf induced at $t = (\pi/900)s$

A. $7.5 \times 10^{-3}V$

B. zero

C. $15 \times 10^{-3}V$

D. $20 \times 10^{-3}V$

Answer: A

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

A. clockwise of the positive Z-axis

B. anti positive Z-axis clockwise of the positive z-axis

C. zero

D. along the magnetic field

Answer: C

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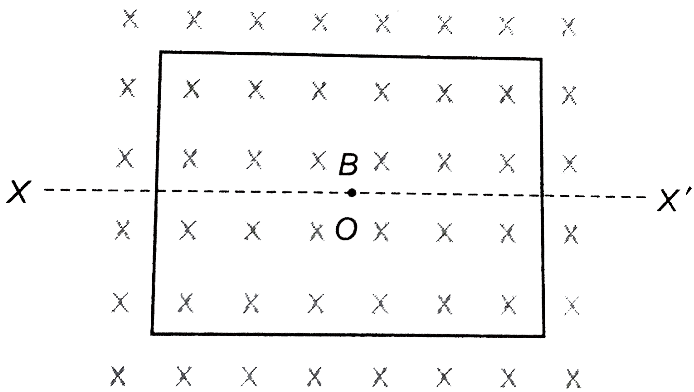
38. A rectangular coil is placed in a region having a uniform magnetic field B perpendicular to the plane of the coil. An emf will not be induced ion the coil if the



A. magnetic field is increased uniformly

B. magnetic field is switched off

C. coil is rotated about an axis XX'

D. coil is rotated about an axis perpendicular to the plane of the coil and passing through its centre O

Answer: D

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39. If a coil of 40 turns and area $4.0 cm^2$ is suddenly remove from a magnetic field, it is observed that a charge of $2.0 \times 10^{-4} C$ flows into the coil. If the resistance of the coil is 80Ω, the magnetic flux density in Wb/m^2 is

A. 0.5

B. 1

C. 1.5

D. 2

Answer: B

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40. A coil of wire of a certain radius has 600 turns and a self-inductance of $108 mH$. The self-inductance of a 2^{nd} similar coil of 500 turns will be

A. 74 mH

B. 75 mH

C. 76 mH

D. 77 mH

Answer: B

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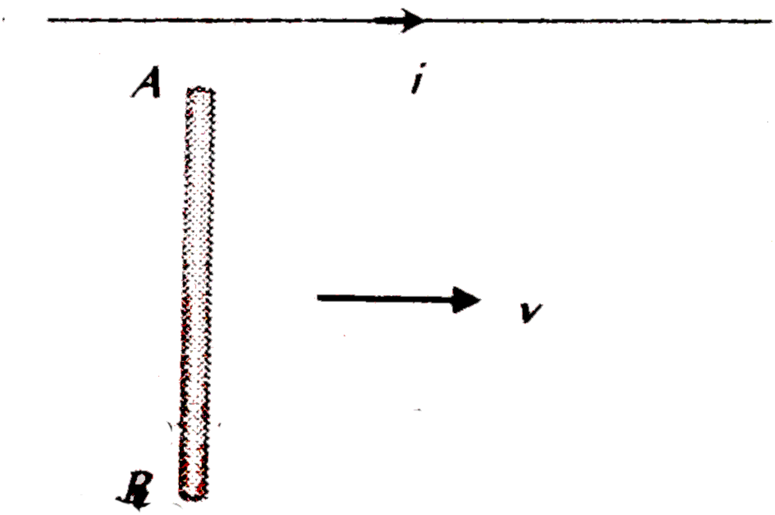
41. The current carrying wire and the rod AB are in the same plane. The rod moves parallel to the wire with a velocity v . Which one of the following statements is true about induced emf in the rod



A. End A will be at lower potential with respect to B

B. A and B will be at the same potential

C. There will be be no induced emf in the rod

D. Potential at A will be higher than that at B

Answer: D

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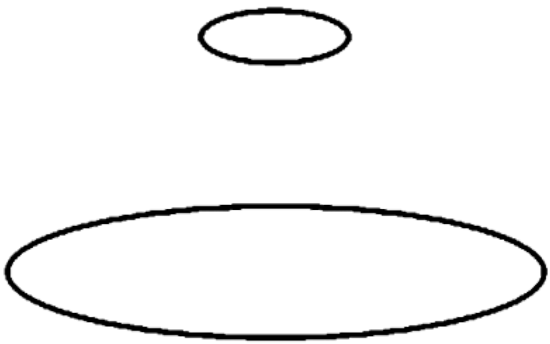
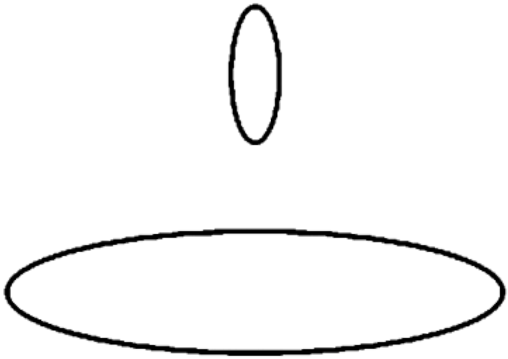
42. Two circular coils can be arranged in any of the three situation shown in the figure. Their mutual inductance will be



(a)

,



(b)

,

(c)

A. maximum in situation (A)

B. maximum in situation (B)

C. maximum in situation (C)

D. the same in all situations

Answer: A

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43. A coil of inductance $300mh$ and resistance 2Ω is connected to a source of voltage $2V$. The current reaches half of its steady state value in

A. 0.15 s

B. 0.3 s

C. 0.05 s

D. 0.1 s

Answer: D

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44. An inductor of 2 H and a resitance of 10Ω are conncts in series with a bttery of 5 V. The intial rate of change of current is

A. $0.5 As^{-1}$

B. $2.0 As^{-1}$

C. $2.5 As^{-1}$

D. $0.25 As^{-1}$

Answer: C

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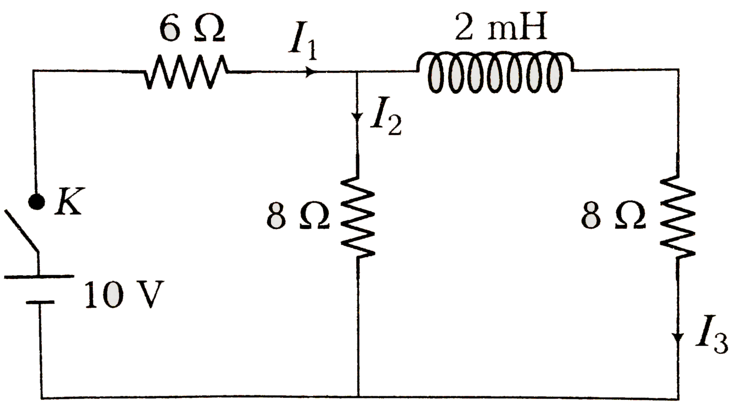
45. In the circuit shown in the figure, what is the value of I_1 just after pressing the key K?



A. 5/7 A

B. 5/11 A

C. $1A$

D. None of these

Answer: A

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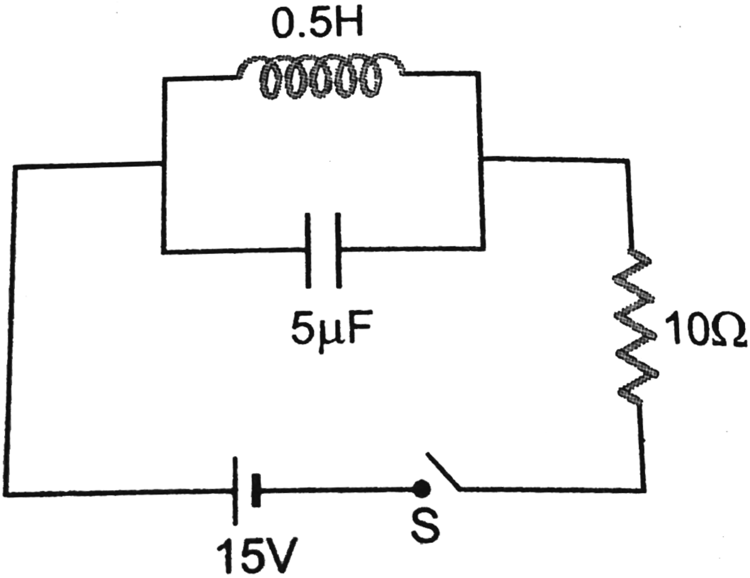
46. In the circuit shown in Fig. current through the battery at $t = 0$ and $t = \infty$ is



A. 1.5 A, 1.5 A

B. 0, 0

C. 1, 1.5 A

D. 1.5 A, 0

Answer: A

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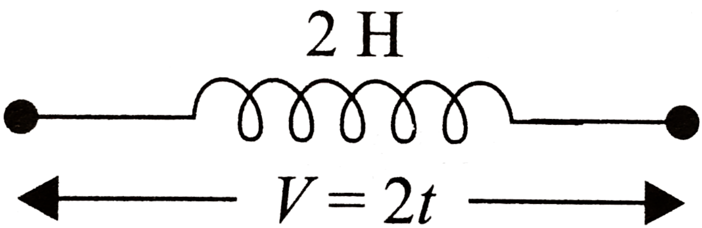
47. A time varying voltage V= 2t (Volt) is applied across and ideal inductor of inductance L =2H as shown in Fig. Then (assume current to be zero at t =0)



A. current versus time graph is a parabola

B. energy stored in magnetic field at t = 2 s is 4 J

C. potential energy at time t = 1 s in magnetic field is increasing at a rate of $1Js^{-1}$

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

Answer: A::B::C

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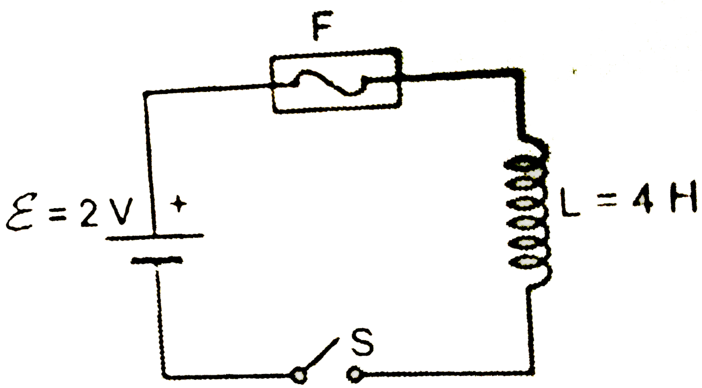
48. The network shown in the figure is part of a complete circuit. If at a certain instant, the current I is $5A$ and is decreasing at a rate $10^3 A/s$ then $V_B - V_A$ is



A. 5 V

B. 10 V

C. 15 V

D. 20 V

Answer: C

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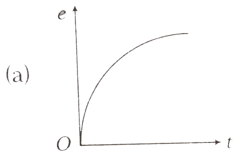
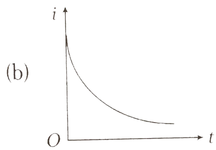
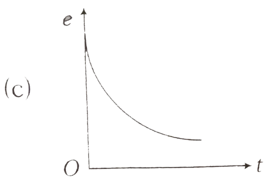
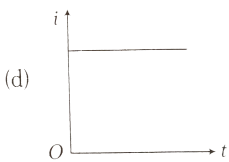
49. Switch S of the circuit shows in Fig is closed at $t = 0$. If e denotes the induced emf in L and I is the current flowing through the circuit at time t, which of the following graphs is//are correct?

A. 

B. 

C. 

D. 

Answer: C

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50. Coefficient of coupling between two coils of self-inductances L_1 and L_2 is unity. It means

A. 50% flux of L_1 is linked with L_2

B. 100% flux of L_1 is linked with L_2

C. $\sqrt{L_1}$ time of flux of L_1 is linked with L_2

D. None of the above

Answer: B

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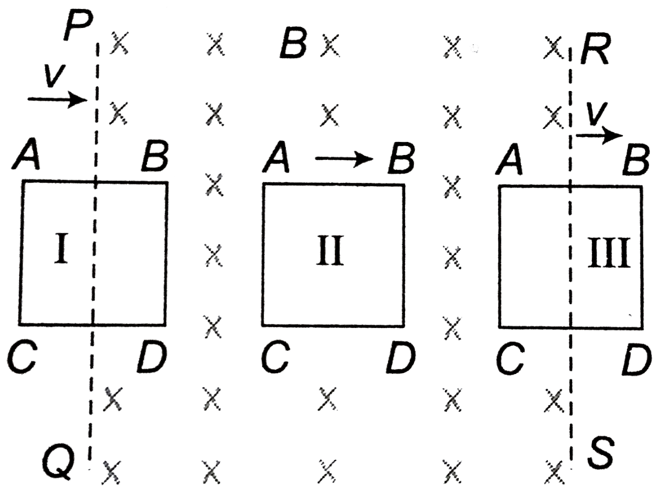
51. A square loop $ABCD$ of edge a moves to the right with a velocity v parallel to AB . There is a uniform magnetic field of magnitude B , direction into the paper, in the region between PQ and RS only. I, II and III are three ppositions of the loop.

(i) The emf induced in the loop has magnitude B a v in all three position

(iii) Induced emf is anticlockwise in position II

(iv) The induced emf is clockwise in position III



A. (i), (iii)

B. (ii), (iii), (iv)

C. (i), (ii)

D. (iii),(iv)

Answer: B

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52. A rectangular, a square , a circular and an elliptical loop, all in the $(x - y)$ plane, are moving out of a uniform magnetic field with a constant velocity $\vec{v} = v\hat{i}$. The magnetic field is directed along the negative z-axis direction. The induced emf, during the passage of these loops , out of the field region, will not remain constant for :

A. the rectangular, circular and elliptical loops

B. the circular and the elliptical loops

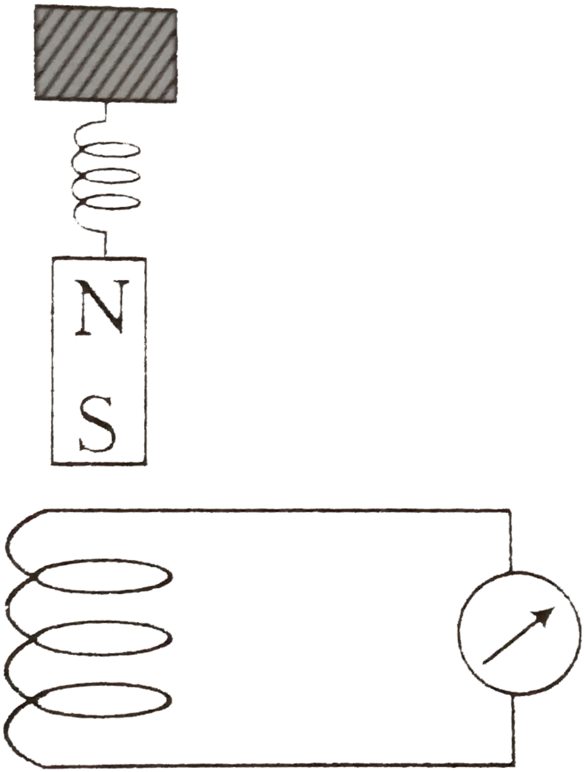
C. only the elliptical loop

D. any of the four loops

Answer: B

Watch Video Solution

53. A magnet N-S is suspended from a spring and while at oscillates, the magnet moves in and out of the coil C. The coil is connected to a galvanometer G.



Then, as the magnet oscillates,

A. G shows deflection to the left and right with constant amplitude

B. G shows deflection on one side

C. G shows no deflection

D. G shows deflection to the left and right but the amplitude steadily decreases

Answer: D

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54. A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to the magnetic lines of force. When a current is passed through the coil it starts oscillating, It is very difficult to stop. But if an aluminium plate is placed near to the coil, it stops. This is due to :

A. development of air current when the plate is placed

B. induction of electrical charge on the plate

C. shielding of magnetic lines of force as aluminium is a paramagnetic material

D. electromagnetic induction in the aluminium plate give rise to electromagnetic damping

Answer: D

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55. The conducting circular loops of radii R_1 and R_2 are placed in the same plane with their centres coinciding. If $R_1 > > R_2$, the mutual inductance M between them will be directly proportional to

A. R_1 / R_2

B. R_2 / R_1

C. R_1^2 / R_2

D. R_2^2 / R_1

Answer: D

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56. A short-circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to the current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be

A. halved

B. the same

C. doubled

D. quadrupled

Answer: B

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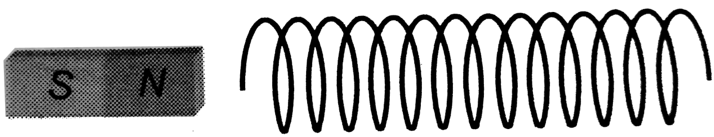
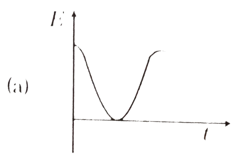
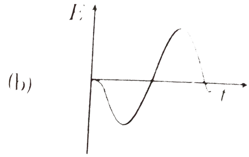
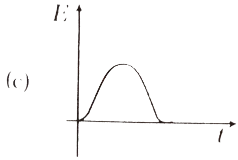
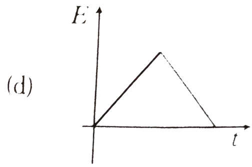
57. The variation of induced emf (E) with time (t) in a coil if a short bar magnet is moved along its axis with a constant velocity is best represent as



A. 

B. 

C. 

D. 

Answer: B

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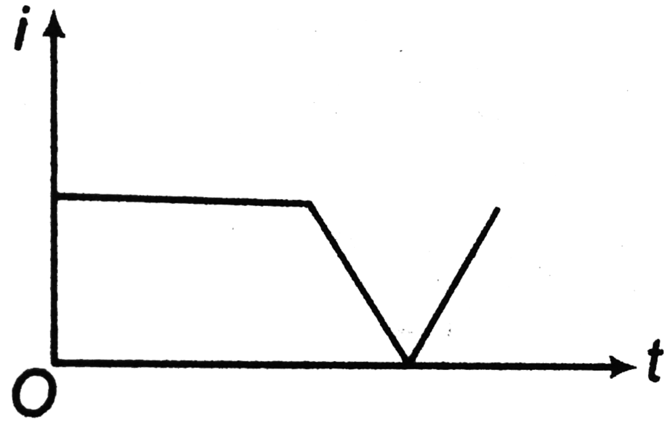
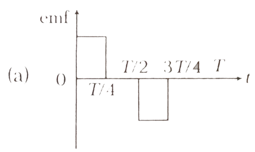
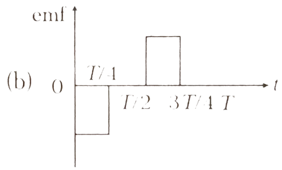
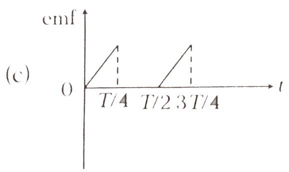
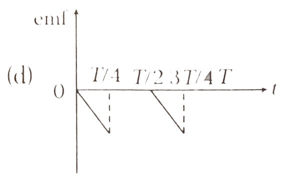
58. The current i in an inductionn coil varies with time t according to the graph shown in the figure. Which of the following grahs shows athe induced emf (ε) in the coil with time?



A. 

B. 

C. 

D. 

Answer: B

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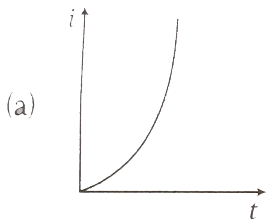
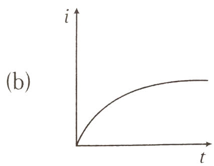
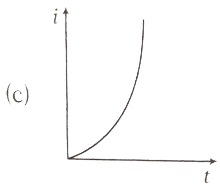
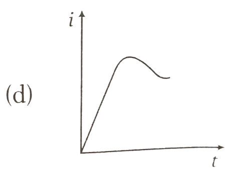
59. When a battery is connected across a series combination of self inductance L and resistance R , the variation in the current i with time t is best represented by

A. 

B. 

C. 

D. 

Answer: B

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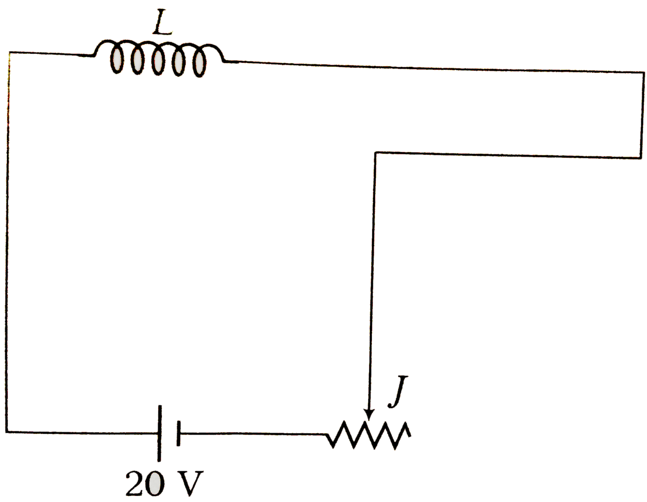
60. In the circuit shown in the figure, the jockey J is being pulled towards right, so that the resistance in the circuit is increasing. It's a value at some instant is 5Ω. The current in the circuit at this instant will be



A. $4A$

B. less than 4 A

C. more than

D. may be less than or more than 4 A depending on the value of L

Answer: C

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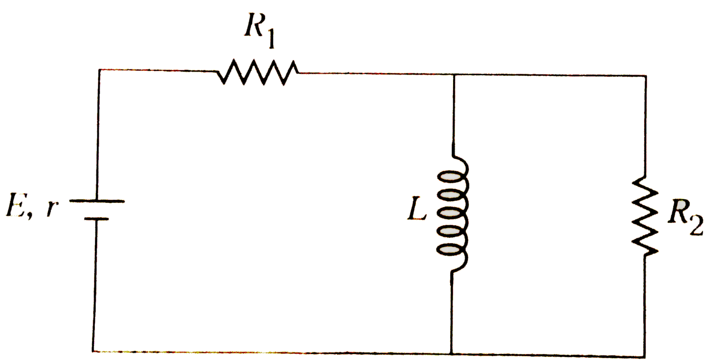
61. The value of time constant for the given circuit is



A. $\dfrac{L}{R_1 + r + R_2}$

B. $\dfrac{L}{(R_1 + r)}$

C. $\dfrac{L(R_1 + R_2 + r)}{(R_1 + r)R_2}$

D. None of these

Answer: C

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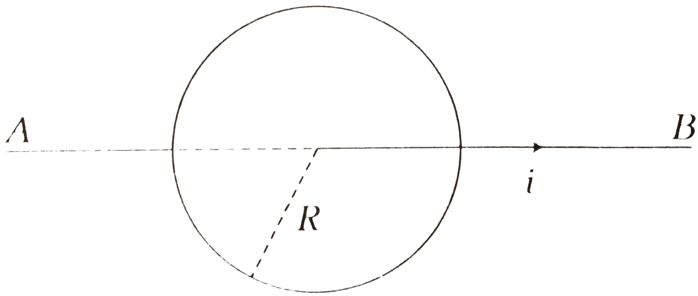
62. A infinitely long conductor AB lies along the axis of a circular loop of radius R. If the current in the conductor AB varies at the rate of x ampere/second, then the induced emf in the loop is



A. $\frac{\mu_0 x R}{2}$

B. $\frac{\mu_0 x R}{4}$

C. $\frac{\mu_0 \pi x R}{2}$

D. Zero

Answer: D

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63. A physicist works in a laboratory where the magnetic field is $2T$. She wears a necklace enclosing area $0.01m^2$ in such a way that the plane of the necklace is normal to the field and is having a resistance $R = 0.01\Omega$. Because of power failure, the field decays to $1T$ in time 10^{-3} seconds. The what is the total heat produced in her necklace?$(T = tesla)$

A. 10 J

B. 20 J

C. 30 J

D. 40 J

Answer: A

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64. A wheel with ten metallic spokes each $0.50m$ long is rotated with a speed of $120rev / \min$ in a plane normal to the earth's magnetic field at the place. If the magnitude of the field is 0.4 gauss, the induced e.m.f. between the axle and the rim of the wheel is equal to

A. $1.256 \times 10^{-3}V$

B. $6.28 \times 10^{-4}V$

C. $1.256 \times 10^{-4}V$

D. $6.28 \times 10^{-5}V$

Answer: D

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65. An airplane in which the distance between the tips of wings is $50m$ is flying horizontal with a speed of $360km / hr$ over a place where the vertical components of earth magnetic field is $2.0 \times 10^{-4} webr / m^2$. The potential different between the tips of wings would be

A. 0.1 V

B. 0.01 V

C. 0.2 V

D. 1.0 V

Answer: D

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66. 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. $\frac{Blv}{R}$clockwise

B. $\frac{Blv}{R}$ anti-clockwise

C. $\frac{2Blv}{R}$ anti-clockwise

D. zero

Answer: A

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67. Two rails of a railway track, insulated from each other and the ground, are connected to a millivoltmetre. What is the reading of the millivoltmetre when a train travels at a speed of 20 ms^{-1} along the track? Given that the vertical component of earth's magnetic field is $0.2 \times 10^{-4} \mathrm{Wbm}^{-2}$ and the rails are separated by 1 m

A. 4 mV

B. 0.4 mV

C. 80 mV

D. 10 mV

Answer: B

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68. A Pair of coils of turns n_1 and n_2 are kept close together. Current passing through the first is reduced at r, and emf 3 mV is developed across the other coil. If the second coil carries current which is then reduced at the rate 2 r, the emf produced across the first coil will be

A. $\frac{6n_1}{n_2} mV$

B. $\frac{6n_2}{n_1} mV$

C. 6 mV

D. 3/2 mV

Answer: C

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69. A loop made of straight edegs has six corners at $A(0, 0, 0), B(L, O, 0)C(L, L, 0), D(0, L, 0)E(0, L, L)$ and $F(0, 0, L)$.

Where L is in meter. A magnetic field $B = B_0\left(\hat{i} + \hat{k}\right)T$ is present in the region. The flux passing through the loop $ABCDEFA$ (in that order) is

A. B_0L^2Wb

B. $2B_0L^2Wb$

C. $\sqrt{2}B_0L^2Wb$

D. $4B_0L^2Wb$

Answer: B

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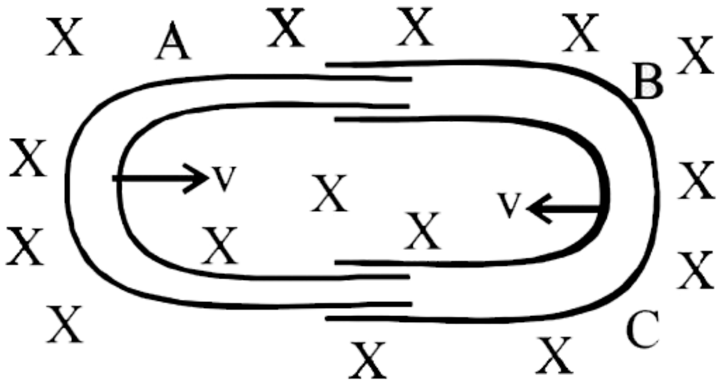
70. One conducting U tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube maoves towards the other at a constant speed v. Then the emf induced in the circuit in terms of B, l and v where l is the width of each tube will be



A. zero

B. 2 Blv

C. Blv

D. $-Blv$

Answer: B

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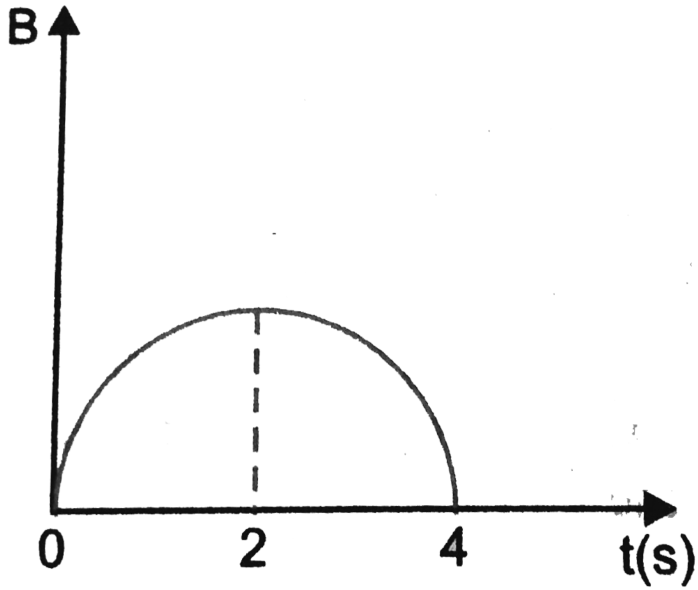
71. In a closed loop, which has some inductance but negligible resistance, uniform but time varying magentic field is applied directed into the plane of the loop. Variation of field with time is shown in Fig. Initially current in loop was zero. Then .



A. emf induced in the loop is zero at t = 2 s

B. current in the loop will be maximum at r = 2 s

C. direction of emf in the loop will change at t = 2 s

D. None of the above

Answer: A::C

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72. A magnetic field given by B(t) $= 0.2t - 0.05t^2$ tesla is directed perpendicular to the plane of a circular coil containing 25 turns of radius 1.8 cm and whose total resistance is 1.5Ω. The power dissipation at 3 s is approximately

A. $1.37\mu W$

B. $7\mu W$

C. zero

D. $4\mu W$

Answer: D

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73. 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 will be

A. $<$ g when it is above R and moving towards R

B. $>$ g when it is above R and moving towards R

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

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

Answer: A::C

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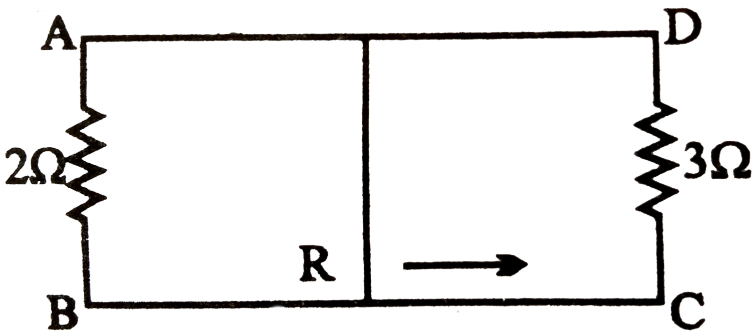
74. A rectangular loop with a sliding connector of length $10cm$ is situated in uniform magnetic field perpendicular to plane of loop. The magnetic induction is 0.1 tesla and resistance of connector (R) is $1ohm$. The sides AB and CD have resistances $2ohm$ and $3ohm$ respectively. Find the current in the connector during its motion with constant velocity one



A. $\frac{1}{242}A$

B. $\frac{1}{220}A$

C. $\frac{1}{55}A$

D. $\frac{1}{440}A$

Answer: B

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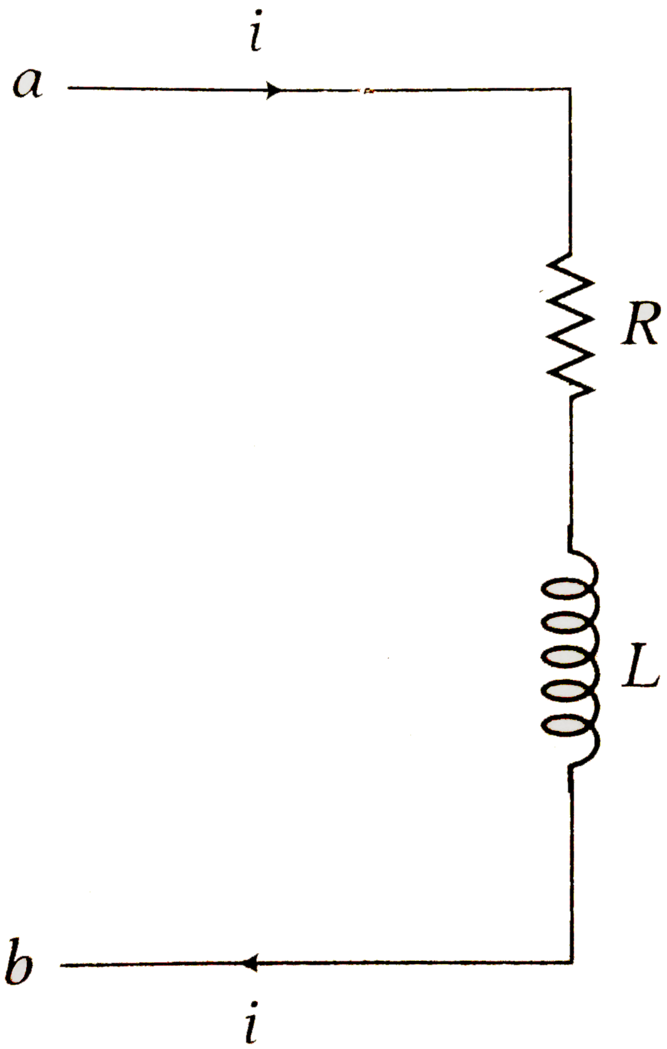
75. When the current in the portion of the circuit shown in the figure is 2 A and increasing at the rate of $1As^{-1}$, then the measured potential difference $V_{ab} = 8V$.

However, when the current is 2 A and decreasing at the rate of $1As^{-1}$,

then the measured potential difference $V_{ab} = 4V$.

The values of R and L are



A. 3Ω and 2 H respectively

B. 3Ω and 3 H respectively

C. 2Ω and 1 H respectively

D. 3Ω and 1 H respectively

Answer: A

Watch Video Solution

76. Two different coils have self-inductances $L_1 = 8mH$ and $L_2 = 2mH$. The current in one coil is increased at a constant rate. The current in the second coil is also increased at the same constant rate. At a certain instant of time, the power given to the two coil is the same. At that time, the current, the induced voltage and the energy stored in the first coil are i_1, V_1 and W_1 respectively. Corresponding values for the second coil at the same instant are i_2, V_2 and W_2 respectively. Then:

A. $\frac{i_1}{i_2} = \frac{1}{4}$

B. $\frac{i_1}{i_2} = 4$

C. $\frac{W_1}{W_2} = \frac{1}{4}$

D. $\frac{V_2}{V_1} = \frac{1}{4}$

Answer: B

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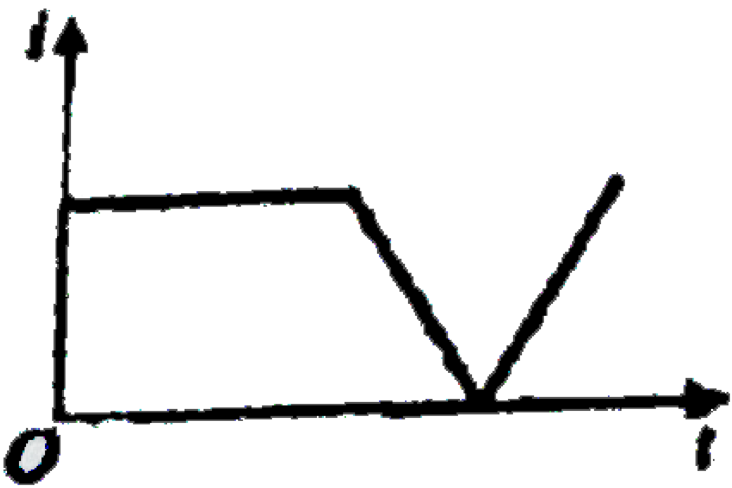
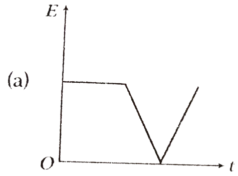
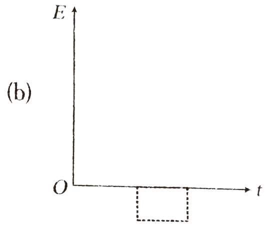
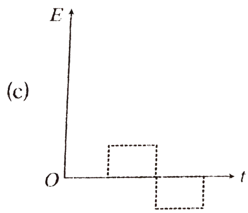
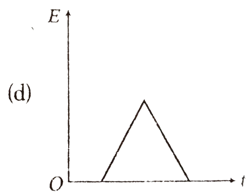
77. The current i in an induction coil varies with time t according to the graph shown in the figure-5.250. Which of the following graphs shows the induced EMF in the coil with time ?



A. 

B. 

C. 

D. 

Answer: C

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78. A coil of inductance $L = 50\mu H$ and resistance = 0.5Ω is connected to a battery of emf = 5V.

A resistance of 10Ω is connected parallel to the coil. Now, at the same instant the connection of the battery is switched off. Then, the amount of heat generated in the coil after switching off the battery is

A. 1.25 mJ

B. 2.5 mJ

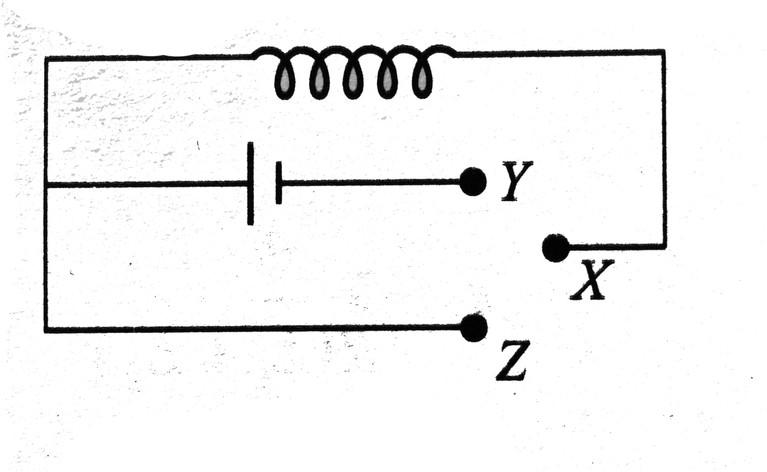
C. 0.65 mJ

D. 0.12 mJ

Answer: D

Watch Video Solution

79. In the circuit shows in Fig, the coil has inductance and resistance. When X is joined to Y, the time constant is τ during the growth of current. When the steady state is reached, heat is produced in the coil at a rate P. X is now joined to Z. After joining X and Z:



A. the total heat produced in the coil is $P\tau$

B. the total heat produced in the coil is $\frac{1}{2}P\tau$

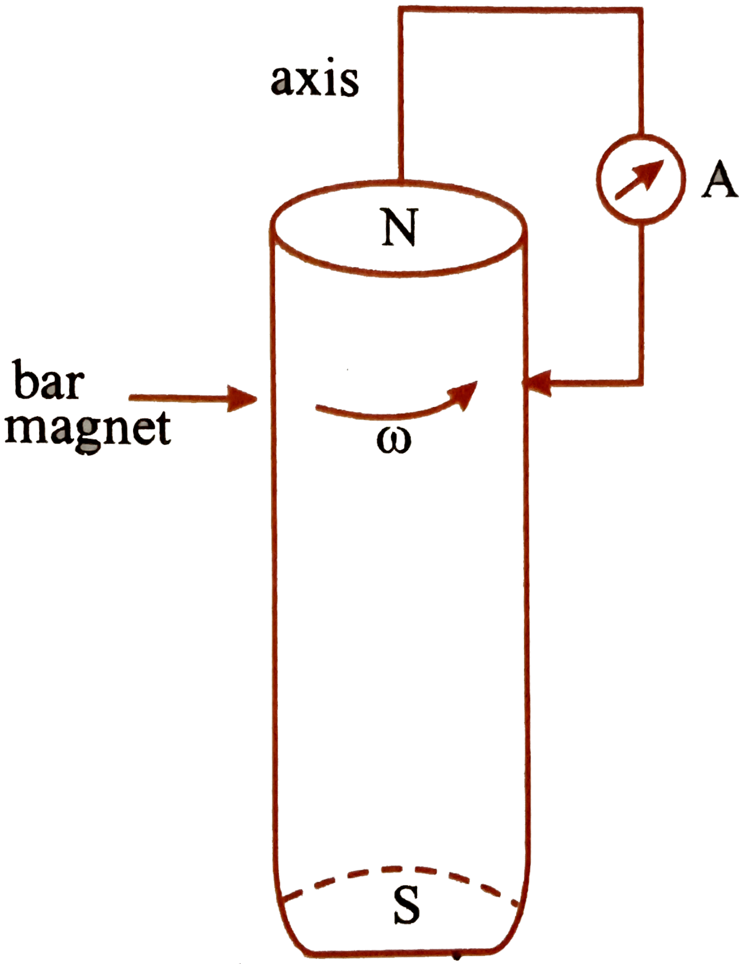
C. the total heat produced in the coil is $2P\tau$

D. the data given is not sufficient to reach a conclusion

Answer: B

Watch Video Solution

80. A cylindrical bar magnet is rotated about its axis (Figure). A wire is connect from the axis and is made to touch the cylindrical surface through a contact. Then



A. a direct current flows in the ammeter A

B. no current flows in the ammeter A

C. an alternating sinusoidal current flows through ammeter A with a time period $T = \frac{2\pi}{\omega}$

D. a time varying non-sinusoidal current flows through the ammeter A

Answer: B

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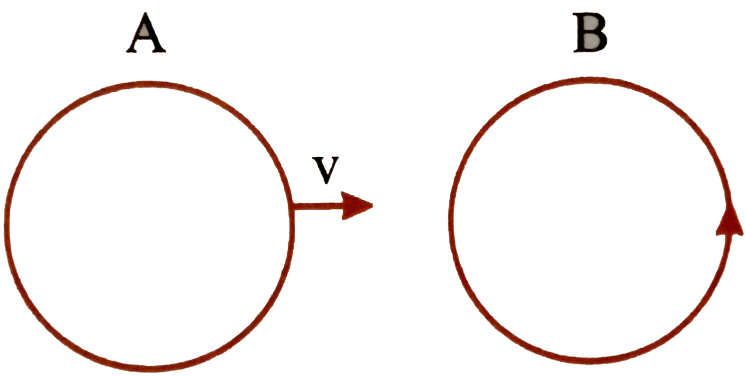
81. There are two coils A and B as shown in Figure. A current starts flowing in B as shown, when A is moved towards B and stops when A stops moving. The current in A is counterclockwise. B is kept stationary when A moves. We can infer that



A. there is a constant current in clockwise direction in A

B. there is a varying current in A

C. there is no current in A

D. there is a cinstant current in the counter-clockwise direction in A

Answer: D

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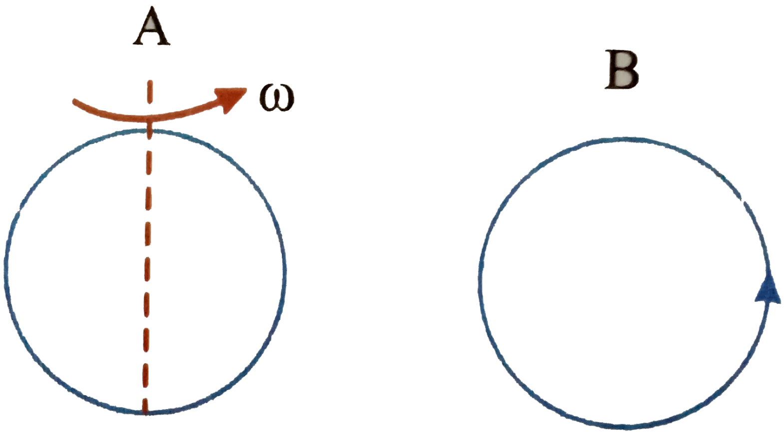
82. Same as problem 4 except the coil A is made to rotate about a vertical axis in the plane of the coil (Figure). No currents flows in B if A is at rest. The current in coil A, when the current in B (at $t = 0$) is counterclockwise and the coil A is as shown at this instant, $t = 0$, is



A. constant current clockwise

B. varying current clockwise

C. varying current counter-clockwise

D. constant current counter-clockwise

Answer: A

Watch Video Solution

83. 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. 5 nW

B. 4 nW

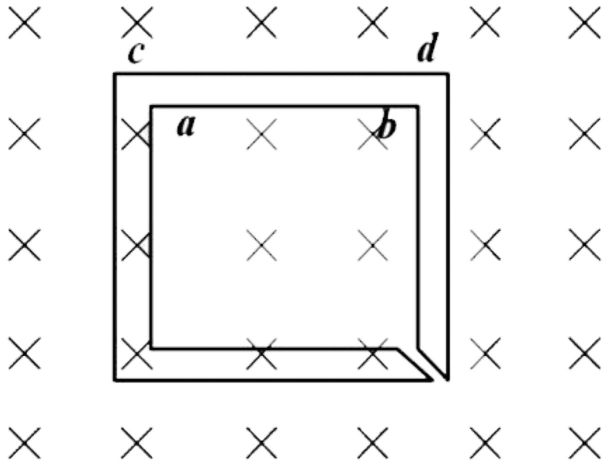
C. 3 nW

D. 2 nW

Answer: A

View Text Solution

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



A. $I_1 > I_2$

B. $I_1 < I_2$

C. I_1 is in the direction ba and I_2 is in the direction cd

D. I_1 is in the direction ab and I_2 is in the direction dc

Answer: D

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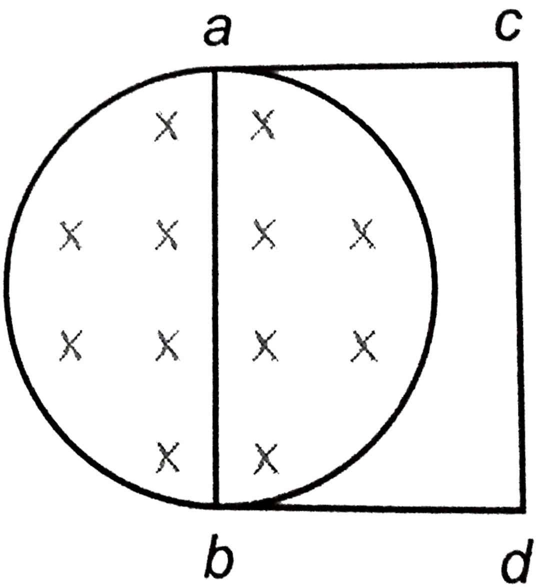
85. A uniform magnetic field B exists in a cylindrical region of radius $I0cm$ as shown in figure. A uniform wire or length $80cm$ and resistance 44.0Ω is bent into a square frame and is placed with one side along a diameter of the cylindrical region. if the magnetic field increases at a constant rate of $0.0I0T / \sec$, the current induced in the frame



A. $3.9 \times 10^{-5} A$

B. $4.0 \times 10^{5} A$

C. $4.1 \times 10^{-5} A$

D. $3.9 \times 10^{-4} A$

Answer: A

Watch Video Solution

86. shows a circular wheel of radius 10.0 cm whose upper half, shown dark in the figure, is made of iron and the lower half of wood. The two junctions are joined by an iron rod. A uniform magnetic field B of magnitude $2.00X10^{-4}T$ exists in the space above the central line as suggested by the figure. The wheel is set into pure rolling on the horizontal surface. The wheel is set into pure rolling on the horizontal surface. If it takes 2.00 seconds for the iron part to come down and the wooden part to go up, find the average emf induced during this period.

(##HCV_VOL2_C38_E01_061_Q01##)

A. $1.57 \times 10^{-6}V$

B. $1.5 \times 10^{5}V$

C. $15.7 \times 10^{-6}V$

D. $1.55 \times 10^{-6}V$

Answer: A

Watch Video Solution

87. A wire of length 10cm translates in a direction making an angle of 60° with its length. The plane of motion is perpendicular ot a uniform magnetic field of 1.0 T that exists in the space. Find the emf induced between the ends of the rod if the speed of translation of $20 cms^{-1}$.

A. $1.7 \times 10^{-3} V$

B. $17 \times 10^{-3} V$

C. $0.17 \times 10^{-3} V$

D. $1.7 \times 10^{-4} V$

Answer: B

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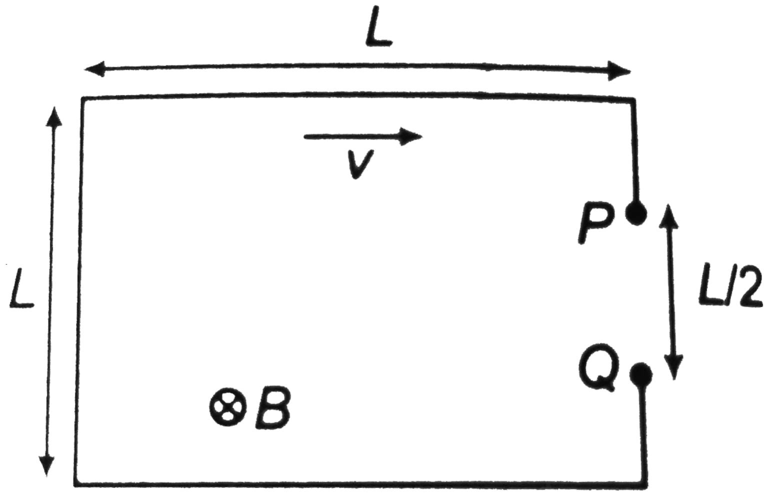
88. The loop shown moves with a velocity v in a uniform magnetic field of magnitude B, directed into the paper. The potential differene between point P and Q is e. Then



A. (ii), (iii)

B. (i), (iv)

C. (i), (iii)

D. (ii), (iv)

Answer: C

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89. 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

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90. A square loop of wire with side length 10 cm is placed at angle of 45° with a magnetic field that changes uniformly from 0.1 T to zero in 0.7s. The induced current in the loop (its resistance is 1Ω) is

A. 1.0 mA

B. 2.5 mA

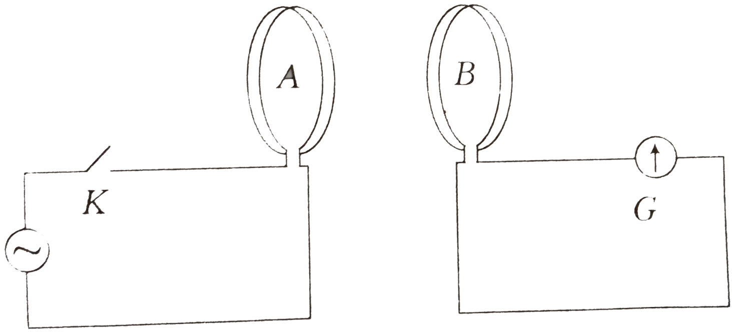
C. 3.5 mA

D. 4.0 mA

Answer: A

Watch Video Solution

91. The diagram below shows two coils A and B placed parallel to each other at a very small distance. Coil A is connected to an AC supply. G is a very sensitive galvanometer. When the key is closed



A. constant deflection will be observed in the galvanometer for 50 Hz supply

B. visible small variations willl be observed in the galvanometer for 50 Hz input

C. oscillations in the galvanometer may be observed when the input AC voltage has a frequency of 1 to 2 Hz

D. No variation will be observed in the galvanometer even when the input AC voltage is 1 or 2 Hz

Answer: C

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92. A magnet is dropped down an infinitely long vertical copper tube

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

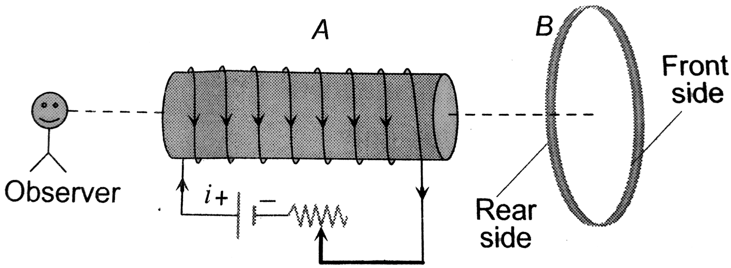
C. the magnet moves with continuously increasing velocity but constant acceleration

D. the magnet moves with continuously increasing velocity and acceleration

Answer: A

Watch Video Solution

93. An aluminium ring B faces an electromagnet A. The current I through A can be altered



A. whether I increases or decreases, B will not experience any force

B. if I decreases, A will repel B

C. if I increases, A will attract B

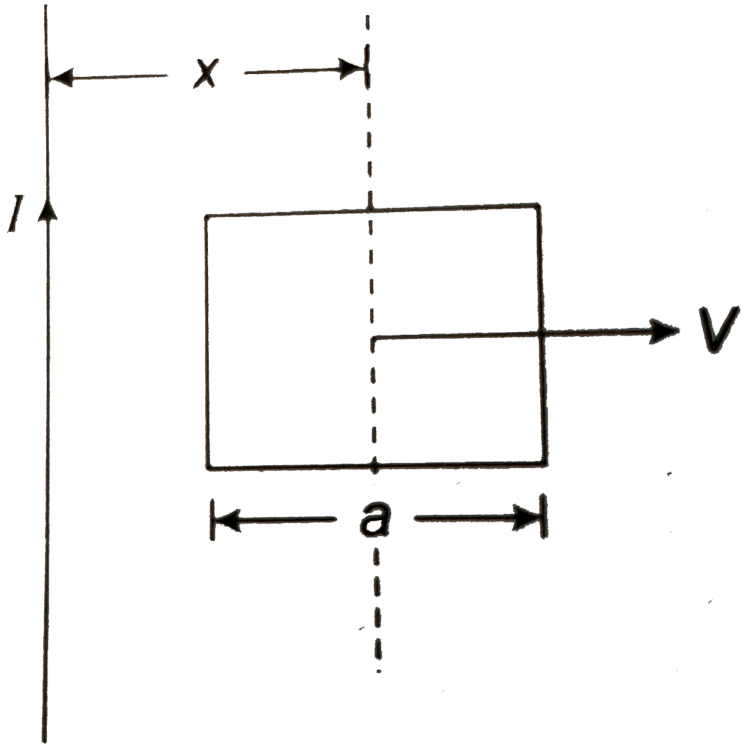
D. if I increases, A will repel B

Answer: D

Watch Video Solution

94. A conducting square frame of side $'a'$ and a long straight wire carrying current I are located in the same plane as shown in the figure.

The frame moves to the right with a constant velocity $'V'$. The emf induced in the frame will be proportional to



A. $\frac{1}{(2x-a)^2}$

B. $\frac{1}{(2x+a)^2}$

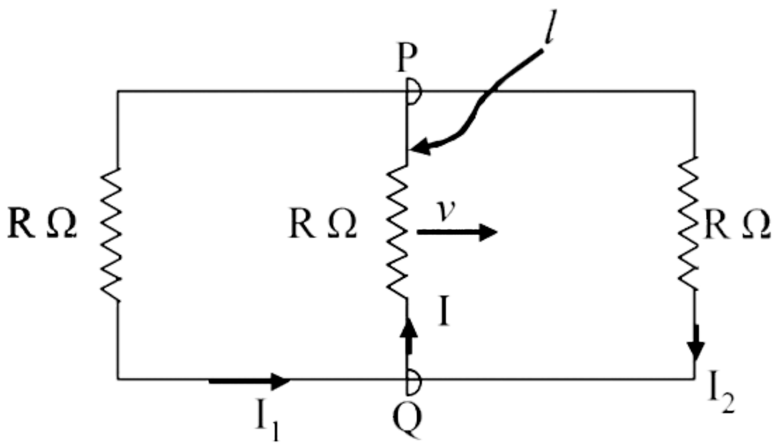
C. $\frac{1}{(2x-a)(2x+a)}$

D. $1/x^2$

Answer: C

Watch Video Solution

95. A rectangular loop has a sliding connector PQ of length l and resistance $R(\Omega)$ and it is moving with a speed v as shown. The set-up is placed in a uniform magnetic field going into the plane of the paper. The three currents I_1, I_2 and I are



A. $I_1 = I_2 = \frac{Blv}{6R}, I = \frac{Blv}{3R}$

B. $I_1 = -I_2 = \frac{Blv}{R}, I = \frac{2Blv}{R}$

C. $I_1 = I_2 = \frac{Blv}{3R}, I = \frac{2Blv}{3R}$

D. $I_1 = I_2 = I = \frac{Blv}{R}$

Answer: C

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96. Two concentric coils each of radius equal to $2\pi cm$ are placed at right angles to each other $3ampere$ and $4ampere$ are the currents flowing in each coil respectively. The magnetic induction in $weber/m^2$ at the centre of the coils will be

$(\mu_0 = 4\pi \times 10^{-7} Wb/A.m)$

A. 12×10^{-5}

B. 10^{-5}

C. 5×10^{-5}

D. 7×10^{-5}

Answer: C

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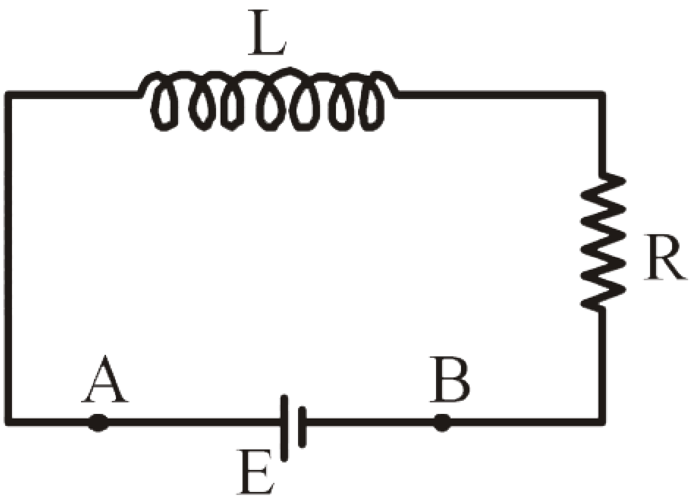
97. An inductor (L = 100 mH), a resistor $(R = 100\Omega)$ and a battery (E = 100 V) are initially connected in series as shown in the figure. After a long time the battery is disconnected after short circuiting the points A and B. The current in the circuit 1 ms after the short circuit is



A. eA

B. 0.1A

C. 1A

D. 1/eA

Answer: D

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98. Three solenoid coils of same dimension, same number of turns and same number of layers of windings are taken. Coil 1 with inductance L_1 was would using a wire of resistance $11\Omega / m$, coil 2 with inductance L_2 was wound using the similar wire but the direction of winding was reversed in each layer, coil 3 with inductance L_3 was wound using a superconducting wire. The self-inductance of the coils L_1, L_2 and L_3 are

A. $L_1 = L_2 = L_3$

B. $L_1 = L_2, L_3 = 0$

C. $l_1 = l_3, l_2 = 0$

D. $L_1 > L_2 > L_3$

Answer: B

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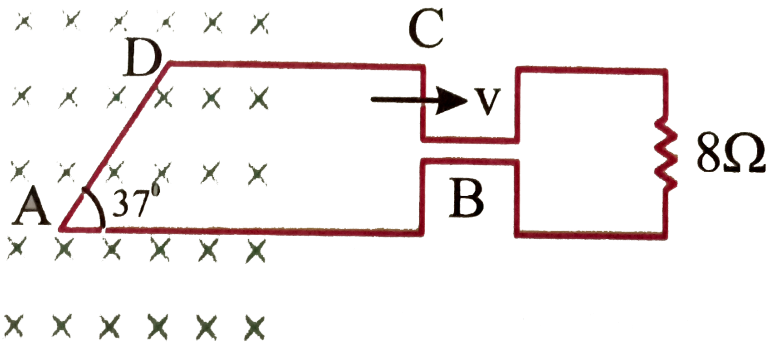
99. The loop $ABCD$ is moving with velocity $'v'$ towards right. The magnetic field is $4T$. The loop is connected to a resistance of 8Ω. If steady current of $2A$ flows in the loop then value of $'v'$ if loop has a resistance of 4Ω, is : (Given $AB = 30cm$, $AD = 30cm$)



A. $\frac{50}{3}ms^{-1}$

B. $20ms^{-1}$

C. $10ms^{-1}$

D. $\frac{100}{3}ms^{-1}$

Answer: D

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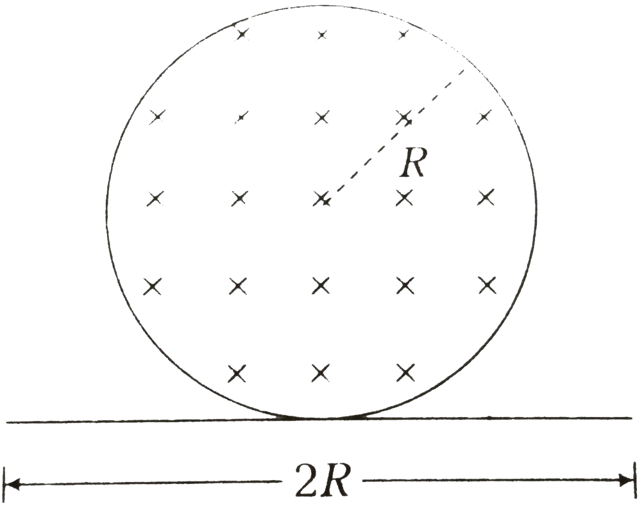
100. A uniform but time varying magnetic field is present in a circular region of radius R. The magnetic field is perpendicular and into the plane of the loop and the magnitude of field is increasing at a constant rate α. There is a straight conducting rod of length 2R placed as shown in figure.



The magnitude of induced emf across the rod is

A. $\pi R^2 \alpha$

B. $\frac{\pi R^2 \alpha}{2}$

C. $\frac{R^2 \alpha}{\sqrt{2}}$

D. $\frac{\pi r^2 \alpha}{4}$

Answer: D

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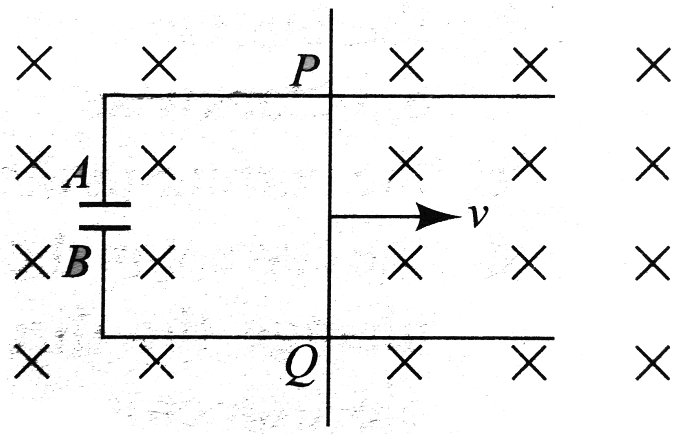
101. A conducting rod PQ of length $L = 1.0m$ is moving with a uniform speed $v = 2.0ms^{-1}$ in a uniform magnetic field $B = 4.0T$ directed into the plane of the paper.

A capacitor of capacity $C = 10\mu F$ is connected as shown in , then



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

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

C. $q_A = 0 = q_B$

D. charge stored in the capacitor increases exponentially with time

Answer: A

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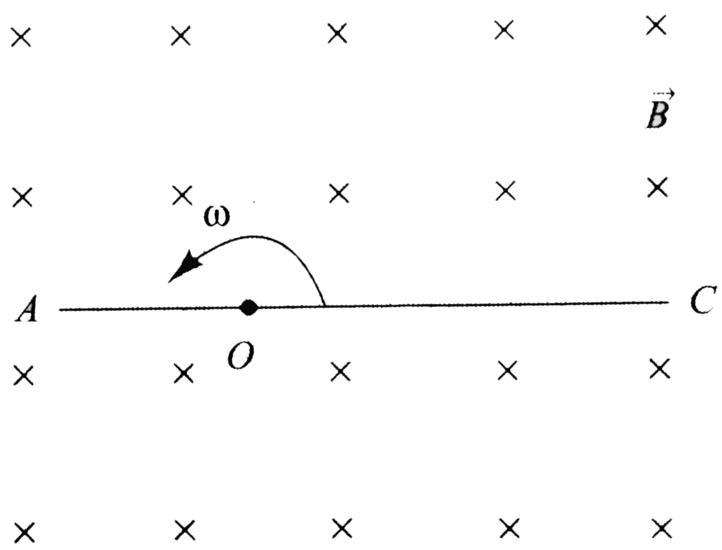
102. A conducting rod AC of length $4l$ is rotated about point O in a uniform magnetic field $\vec{B}$ directed into the plane of the paper. $AO = l$ and $OC = 3l$. Find $V_A - V_C$.



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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103. The current in an $L - R$ circuit builds upto $3/4th$ of its steady state value in $4\sec$. Then the time constant of this circuit is

A. $\frac{1}{\ln 2}s$

B. $\frac{2}{\ln 2}s$

C. $\frac{3}{\ln 2}s$

D. $\frac{4}{\ln 2}s$

Answer: B

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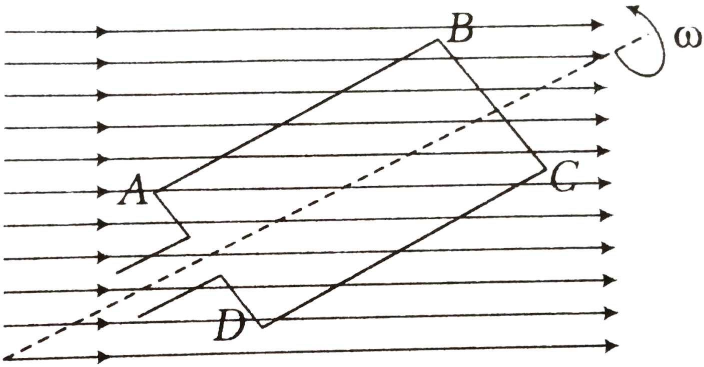
104. A rectangular coil ABCD which is rotated at a constant angular veolcity about an horizontal as shown in the figure. The axis of rotation of the coil as well as the magnetic field B are horizontal. Maximum current will flow in the circuit when the plane of the coil is



A. inclined at 30° to the magnetic field

B. perpendicular to the magnetic field

C. inclined at 45° to the magnetic field

D. parallel to the magnetic field

Answer: B

Watch Video Solution

105. A right angled triangle abc, made from a metallic wire, moves at a uniform speed v in its plane as shown in . A uniform magnetic field B exists in the perpendicular direction. Find the emf induced (a) in the loop abc, (b) in the segment bc, (c) in the segment ac and (d) in the segment ab.

(##HCV_VOL2_C38_E01_066_Q01##)

A. Zero,vB(bc),+ve at c, zero, v B(bc),+ve at a

B. vB(bc), +ve at c, zero, zero, v B(bc),+ve at a

C. zero,zero,vB(bc),+ve at c, v B(bc), +ve at a

D. v B(bc), +ve at c,vB(bc), +ve at a, zero,zero

Answer: A

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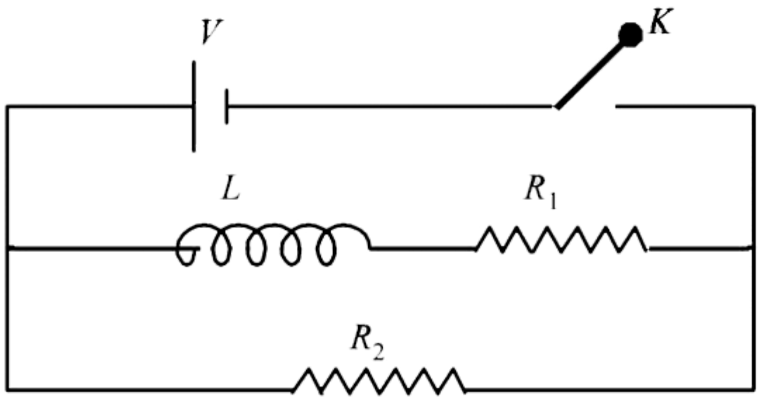
106. In the circuit shown below, the key K is closed at t =0. The current through the battery is



A. $\dfrac{V(R_1+R_2)}{R_1+R_2}$ at $\mathrm{t}=0$ and $\dfrac{V}{R_2}$ at $\mathrm{t}=\infty$

B. $\dfrac{V(R_1+R_2)}{\sqrt{R_1^2+R_2^2}}$ at $\mathrm{t}=0$ and $\dfrac{V}{R_2}$ at $\mathrm{t}=\infty$

C. $\dfrac{V}{R_2}$ at t =0 and $\dfrac{V(R_1+R_2)}{R_1R_2}$ at $\mathrm{t}=\infty$

D. $\dfrac{V}{R_2}$ at $\mathrm{t}=0$ and $\dfrac{V(R_1+R_2)}{\sqrt{R_1^2+R_2^2}}$ at $\mathrm{t}=\infty$

Answer: C

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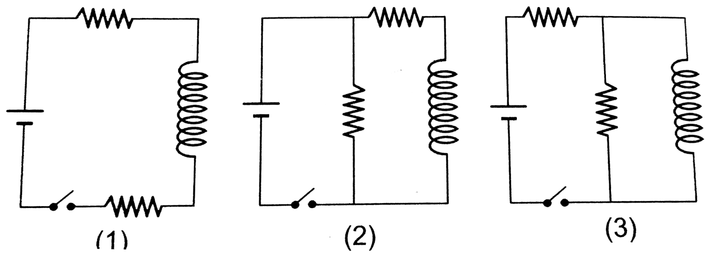
107. The figure shows three circuit with identical batteries, inductors, and resistors. Rank the circuit according to the current through the battery (i) just after the switch is closed and (ii) a long time later, greatest first



A. (i) $i_2 > i_3 > i_1, (i_1 = 0)$ (ii) $i_2 > i_3 > i_1$

B. (i) $i_2 < i_3 < i_1, (i_1 \neq 0)(ii)i_2 > i_3 > i_1$

C. (ii) $i_2 = i_3 = i_1, (i_1 = 0)$ (ii) $i_2 < i_3 < i_1$

D. $(i)i_2 = i_3 > i_1, (i_1 \neq 0)$ (ii) $i_2 > i_3 > i_1$

Answer: A

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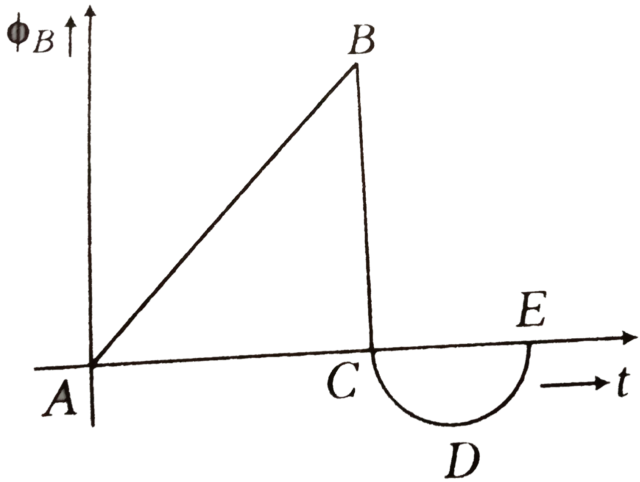
108. The graph shows the variation in magnetic flux $\phi(t)$ with time through a coil. Which of the statements given below in not correct?



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 not zero at B

Answer: D

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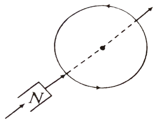
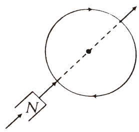
109. Which of the following figure correctly depicts the Lenz's law. The arrows show the movement of the labelled pole of a bar magnet into a closed circular loop and the arrows on the circle show the direction of the induced current

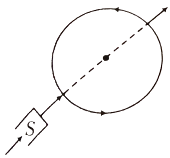
A. (a)



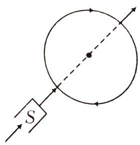
B. (b)



C. (c)



D. (d)



Answer: A

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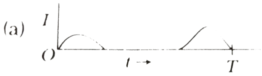
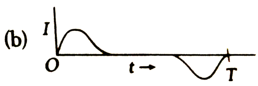
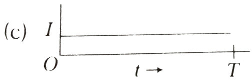
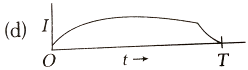
110. A metalic ring is dropped down, keeping its plane perpendicular to a constant and horizontal magnetic field. The ring enters the region of mangetic fied at $t=0$ and completely emerges out $t=Ts$. The current in the ring varies as:

A. 

B. 

C. 

D. 

Answer: B

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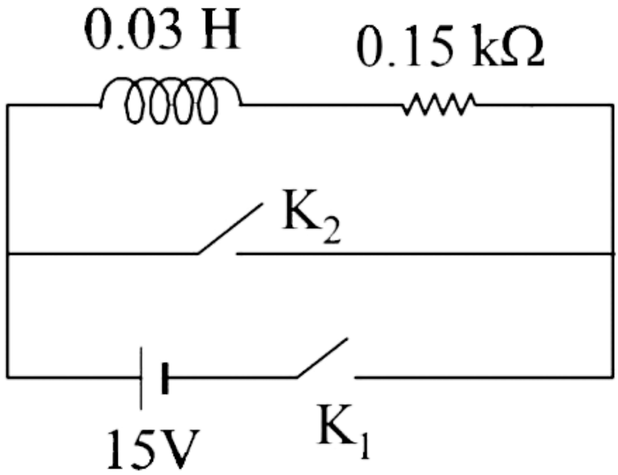
111. An inductor (L =0.03 H) and a resistor $(R = 0.15k(\Omega))$ are connected in series to a battery of 15 V EMF in a circuit shown below. The key K_1 is opened and Key K_2 is closed simultaneously. At t =1 ms, the current in the circuit will be $(e^5 = 150)$



A. 100 mA

B. 67 mA

C. 6.7 mA

D. 0.67 mA

Answer: D

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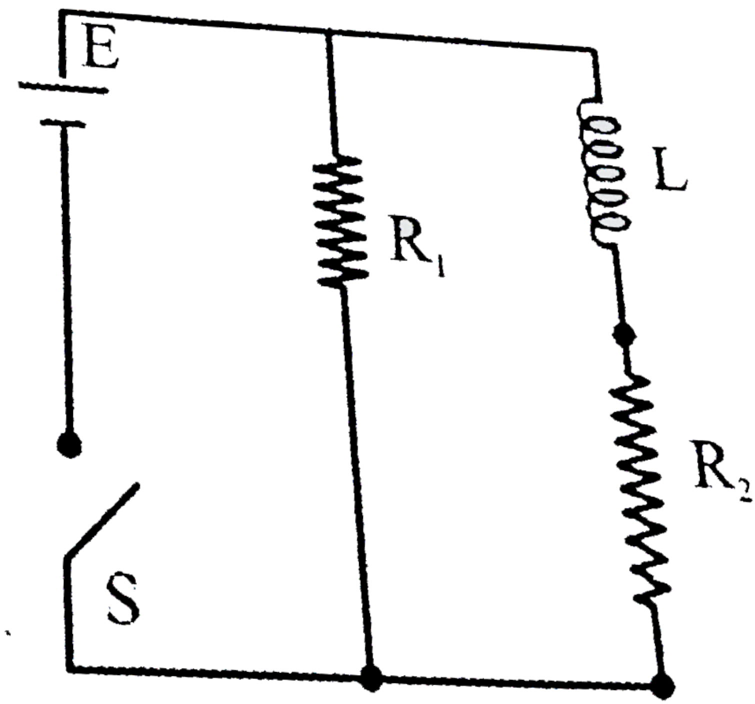
112. An inductor of inductance L = 400 mH and resistors of resistance $R_1 = 2\Omega$ and $R_2 = 2\Omega$ are connected to a battery of emf 12 V as shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at $t = 0$. The potential drop across L as a function of time is



A. $6e^{-5t}V$

B. $\frac{12}{t}e^{-3t}V$

C. $6\left(1 - e^{\frac{-1}{0.2}}\right)V$

D. $12e^{-5t}V$

Answer: D

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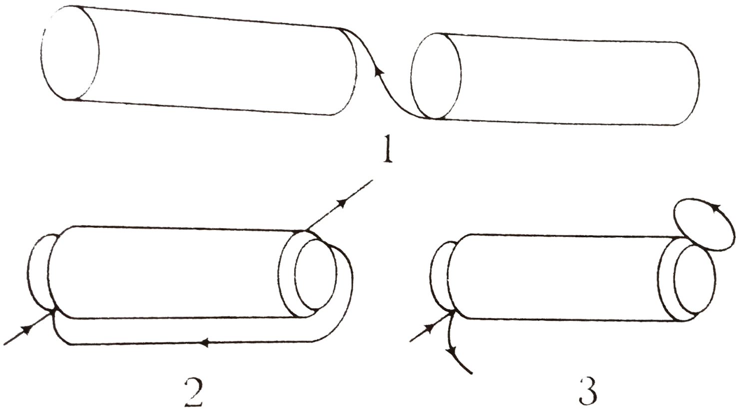
113. There are two solenoid of same length and inductance L but their diameters differ to the extent that one can just fit into the other. They are connected in three different ways in series.

(1) They are connected in series but separated by large distance.

(2) They are connected in series with one inside the other and senses of the turns coinciding.

(3) Both are connected in series with one inside the other with senses of the turns opposites,

as depicted in figures 1, 2 and 3 respectively. The total inductance of the solenoids in each of the case 1, 2 and 3 are respectively.



A. $0, 4L_0, 2L_0$

B. $4L_0, 2L_0, 0$

C. $2L_0, 0, 4L_0$

D. $2L_0, 4L_0, 0$

Answer: D

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114. A rectangular loop of length $'l'$ and breadth $'b'$ is placed at a distance of x from an infinitely long wire carrying current $'i'$ such that the direction of current is parallel to breadth. If the loop moves away from the current wire in a direction perpendicular to it with a velocity $'v'$, the magnitude of the e.m.f. in the loop is: ($\mu_0 =$ permeability of free space)

A. $\dfrac{\mu_0 iv}{2\pi x}\left(\dfrac{l+b}{b}\right)$

B. $\dfrac{\mu_0 i^2 v}{4\pi^2 x}\log\left(\dfrac{b}{l}\right)$

C. $\dfrac{\mu_0 ilbv}{2\pi x(l+x)}$

D. $\dfrac{\mu_0 ilbv}{2\pi}\log\left(\dfrac{x+l}{x}\right)$

Answer: C

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115. A circular coil of one turn of radius $5.0cm$ is rotated about a diameter with a constant angular speed of 80 revolutions per minute. A uniform magnetic field $B = 0.0IT$ exists in a direction perpendicular to the axis of rotation, the maximum emf induced, the average emf induced in the coil over a long period and the average of the squares of emf induced over a long period is

A. $6.4 \times 10^{-4} V, zero, 2.2 \times 10^{-7} V^2$

B. $6.6 \times 10^{-4} V, zero, 2.0 \times 10^{-7} V^2$

C. $6.8 \times 10^{-4} V, zero, 2.5 \times 10^{-7} V^2$

D. $6.4 \times 10^{-4} V, zero, 2.0 \times 10^{-6} V^2$

Answer: B

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116. A non-conducting ring having q uniformly distributed over its circumference is placed on a rough horizontal surface. A vertical time varying magnetic field $B = 4t^2$ is switched on at time t = 0. Mass of the ring is m and radius is R.

The ring starts rotating after 2 s, the coefficient of friction between the ring and the table is

A. $\frac{4qmR}{g}$

B. $\frac{2qmR}{g}$

C. $\frac{8qR}{mg}$

D. $\frac{qR}{2mg}$

Answer: C

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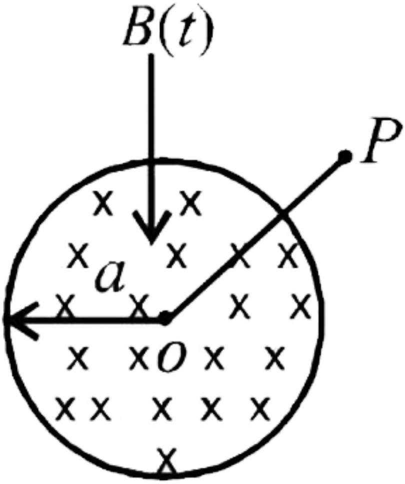
117. A uniform but time-varying magnetic field B(t) exists in a circular region of radius a and is directed into the plane of the paper, as shown. The magnitude of the induced electric field at point P at a distance r from the centre of the circular region



A. is zero

B. decrease as $\frac{1}{r}$

C. increases as r

D. decreases as $\frac{1}{r^2}$

Answer: B

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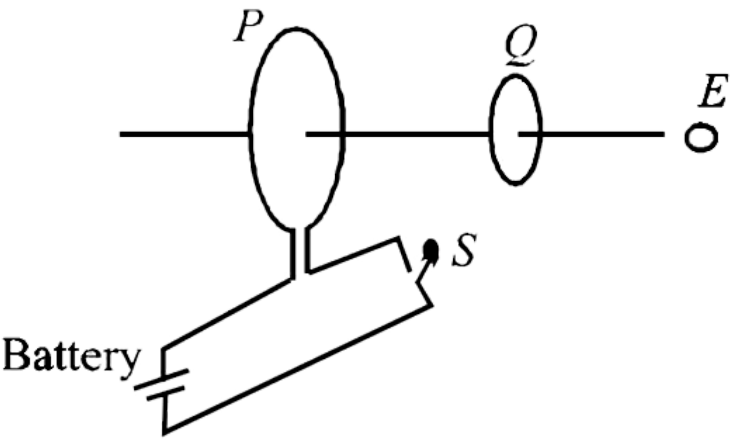
118. As shown in the figure, P and Q are two coaxial conducting loops separated by some distance. When the switch S is closed, a clockwise current I_P (as seen by E) and an induced current I_{Q1} flows in Q. The switch remains closed for a long time. when S is opened, a current I_{Q2} flows in Q. Then the direction IQ_1 and IQ_2 (as seen by E) are



A. respectively clockwise and anti-clockwise

B. both clockwise

C. both anti-clockwise

D. respectively anti-clockwise and clockwise

Answer: D

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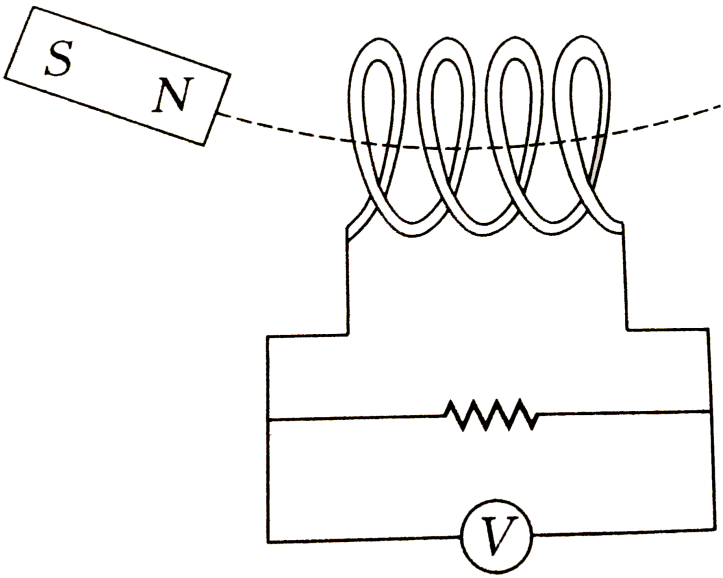
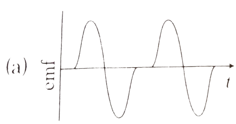
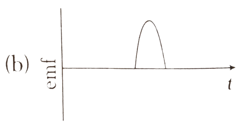
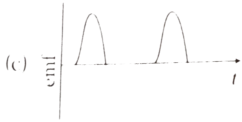
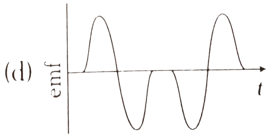
119. A magnet is made to oscillate with a particular frequency, passimg through a coil as shown in figure. The time variation of the magnitude of emf generated across the coil during one cycle



A. 

B. 

C. 

D. 

Answer: A

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Medical entrance special format questions

1. Assertion Magnetic flux and the electric flux have the same units.

Reason Flux passing throught a surface gives an idea about the field lines crossing that surface

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: D

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2. Assertion : In the phenomenon of mutual induction, self induction of each of the coils persists.

Reason : Self induction arises when strength of current in same coil changes. In mutual induction, current is changing in both the individual coils.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: B

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3. Assertion When two magnets are brought closer to each other, then they will always repel each other.

Reason According to Lanz's law induced effects always opposes the cause.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: D

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4. Assertion Mutual inductance of two coils depends on the distance between the coils and their orientation.

Reason It does not depend on the magnetic material filled between the coils.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: C

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5. Assertion Coefficient of self-induction of an inductor depends upon the rate of change of current passing through it.

Reason From, $e = -L\frac{di}{dt}$

We can see that, $L = \frac{-e}{(di/dt)}$ or $L \propto \frac{1}{(di/dt)}$

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: D

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6. Assertion If a magnet is brought closer to a current carrying loop along its axis, then current always decreases in the loop.

Reason Magnet is repelled by the loop.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: B

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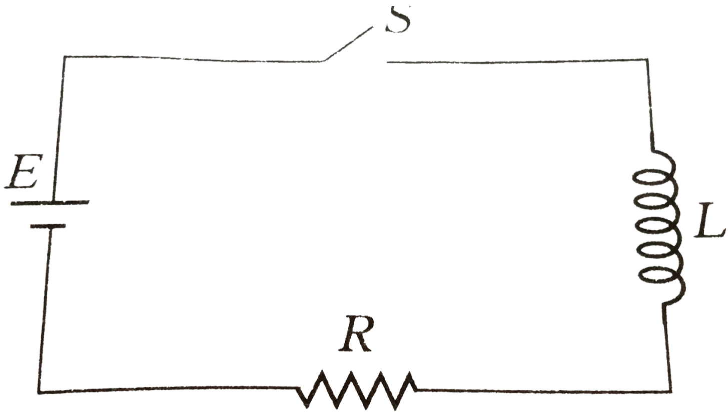
7. Assertion In the figure, just after closing the switch the potential drop across inductor is maximum.



Reason The rate of change of current just after closing the switch is maximum.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: A

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8. Assertion If current shown in the figure is increasing, then

$$V_A > V_B$$

Reason IF current passing through an inductor is constant, then both ends of the inductor are at same potential.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: B

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9. Assertion If two inductors are in paralled, then current in distributes in inverse ratio of their inductance.

Reason In parallel, potential difference remains constant.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: A

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10. Assertion An induced emf of 2 V is developed in a circular loop, if current in the loop is changed at a rate of 4 As^{-1} .IF 4 A of current is passed through this loop, then flux linked with this coil will be 2 Wb.

Reason Flux linked with the coil is

$$|\phi| = \left|\frac{e}{di/dt}\right| i$$

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: A

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11. Assertion If a straight wire is moved in a magnetic field, no emf will be induced across its two ends as the circuit is not closed.

Reason Since, the circuit is not closed, induced current will be zero.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: D

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12. Assertion If a loop is placed in a non-uniform (with respect to position) magnetic field, then induced emf is produced in the loop.

Reason In a non-uniform magnetic field, magnetic flux passing through the loop will change. Therefore, induced emf is produced.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: D

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13. Assertion If current passing through a circular loop is doubled, then magnetic flux linked with the circular loop will also become two times.

Reason No flux will link through the coil by its own current.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: C

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14. Assertion Two concentric conducting rings of different radii are placed in space. The mutual inductance of both the rings is maximum, if the rings are coplanar.

Reason For two co-axial conducting rings of different radii, the magnitude of magnetic flux in one ring due to current in other ring is maximum when both rings are coplanar.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: A

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15. Statement-1 : The induced e.m.f. and current will be same in two identical loops of copper and aluminium, when rotated with same speed in the same magnetic field.

Statement-2 : Induced e.m.f. is proportional to rate of change of magnetic field while induced current depends on resistance of wire.

A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: D

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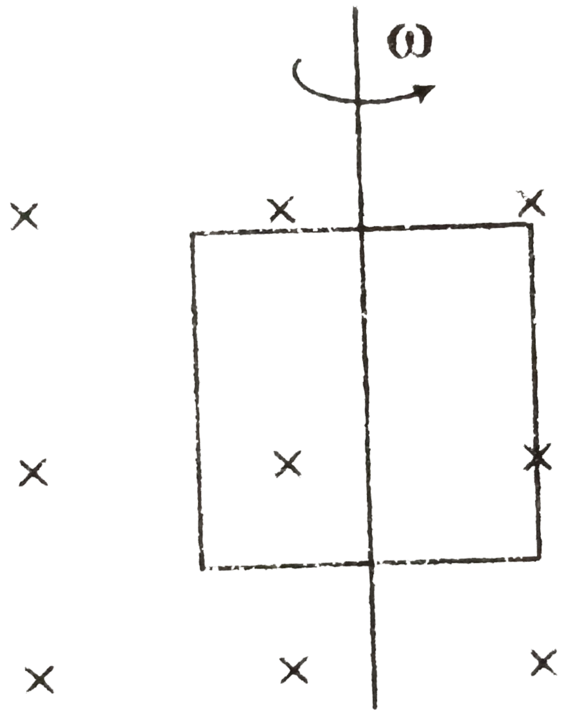
16. Assertion A conducting loop is rotated in a uniform magnetic field with constant angular velocity ω as shown in figure. At time t = 0, plane of the loop is perpendicular to the magnetic field. Induced emf produced in the loop is maximum when plane of loop is parallel to magnetic field.

Reason When plane of loop is parallel to magnetic field, then magnetic flux passing through the loop is zero.



A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: B

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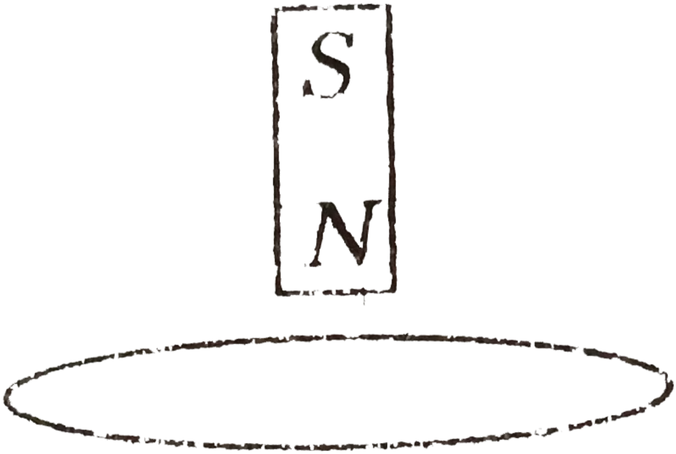
17. Assertion A magnetic is dropped along the axis of a circular conducting loop as shown in figure. Then, acceleration of magnet is always less than g.

Reason when magnet is above the loop, then it will repel the magnet and when it is below the loop, then it will attract the magnet.

Reason When magnet is above the loop, then it will repel the magnet and when it is below the loop, then it will attract the magnet.



A. If both Assertion and Reason are corrent and Reason is the corrent explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is ture.

Answer: A

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Match the columns

1. Match the following columns.

	Column I		Column II
$A.$	Tesla	p	$[ML^2A^{-2}T^{-2}]$
$B.$	Weber	q	$[MLA^{-2}T^{-1}]$
$C.$	Weber m^{-2}	$q.$	$[MA^{-1}T^{-2}]$
$D.$	Henry	$s.$	None

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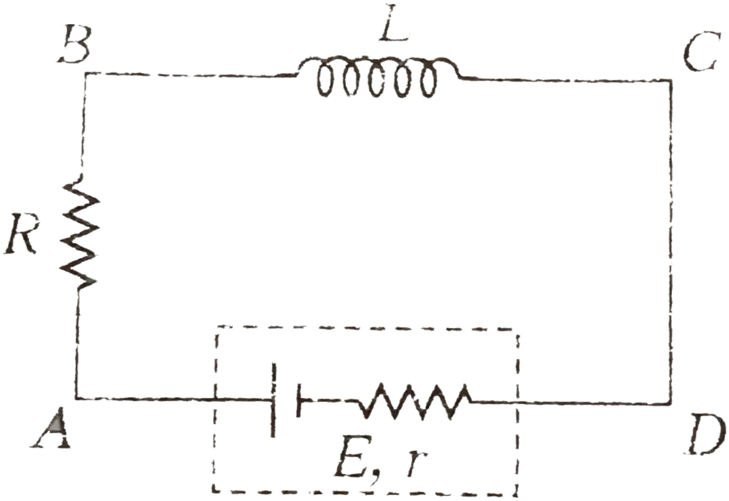
2. In the circuit shown in figure, E = 10 V, r = 1Ω,

R = 4Ω and L = 5H. The circuit is closed at time t = 0.

Then, match the following two columns.



	Column I		Column II
A.	V_{AD} at t = 0	p	$4V$
B.	V_{BC} at t = 0	q	$8V$
C.	V_{AB} at t =∞	r.	$0V$
D.	V_{AD} at t = ∞	s.	$10V$

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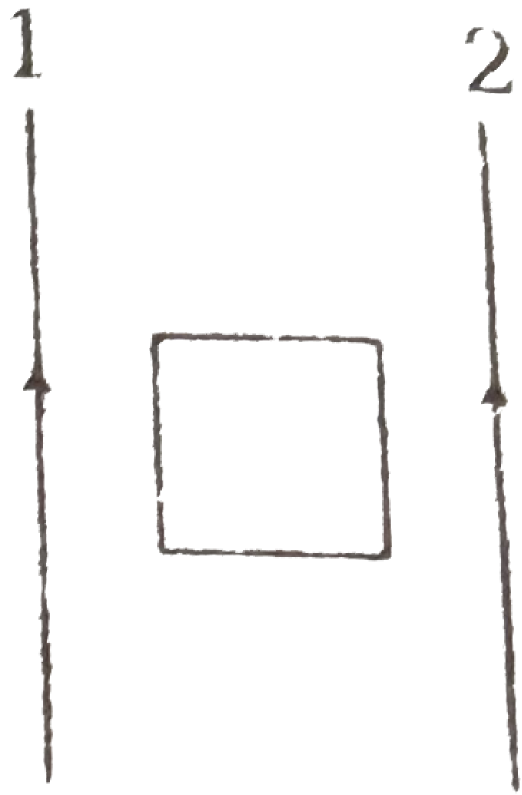
3. A square loop is symmetrically placed between two infinitely long current carrying wires in the same direction. Magnitude of currents in both the wires are same. Now, match the following two columns.



	Column I		Colums II
$A.$	Loop is moved towards right	$p.$	Induced current in the loop is clo
$B.$	Loop is moved towards left	$q.$	Induced current in the loop is an
$C.$	Wire-1 is moved towards left	$r.$	Induced current in the loop is zer
$D.$	Wire-2 is moved towards right	$s.$	Induced current in the loop is no

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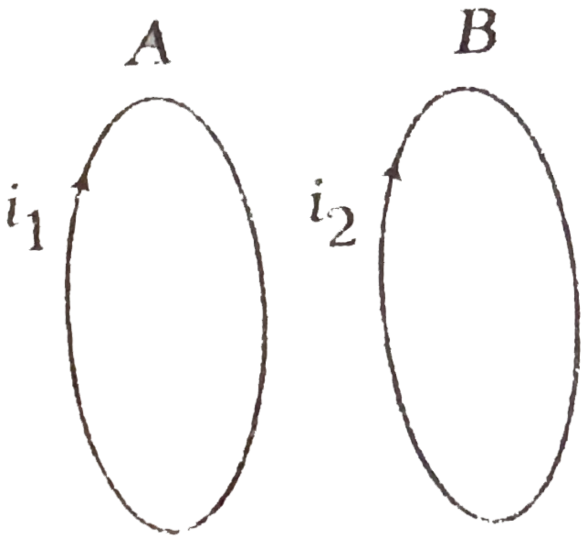
4. Two co-axial identical circular current carrying loops are shown in figure, currents in them are in the same directions. Now, match the following two columns.



	Column I		Colums II
A.	Current i_1 is increased	*p.*	Loops will attract each other
B.	Current i_2 is decreased	*q.*	Loops will repel each other
C.	Loop-1 is moved towards loop-2	*r.*	Current i_1 will increase
D.	Loop-2 is moved away from loop-1	*s.*	Current i_2 will increase

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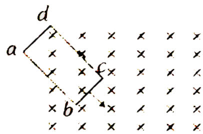
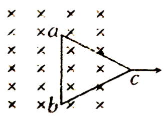
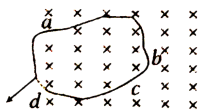
5. Match the items of Column I with those of Column II.

	Column I (Planar loops of different shapes)		Column II (Direction of induced current)
A.		p.	$b\,a\,c\,b$
B.		q.	$c\,d\,a\,b\,c$
C.		r.	$b\,c\,d\,a\,b$

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1. A long solenoid has 1000 turns. When a current of $4A$ flows through it, the magnetic flux linked with each turn of the solenoid is $4 \times 10^{-3} Wb$. The self-inductance of the solenoid is

A. 3 H

B. 2 H

C. 1 H

D. 4 H

Answer: C

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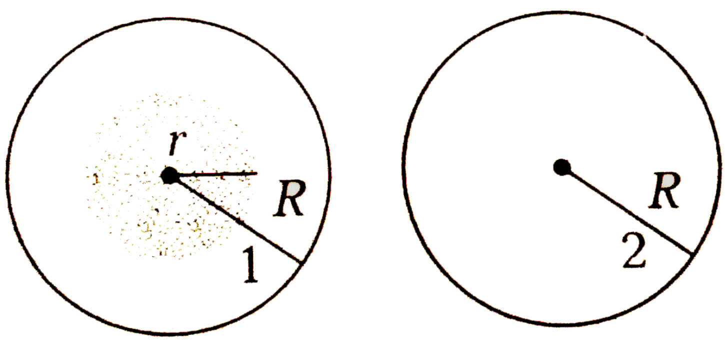
2. A uniform magnetic field is restricted within a region of radius r. The magnetic field changes with time at a rate $\frac{dB}{dt}$. Loop 1 of radius R $>$ r encloses the region r and loop 2 of radius R is outside the region of magnetic field as shown in figure. Then, the emf generated is



A. Zero in loop 1 and zero in loop 2

B. $-\frac{dB}{dt}\pi r^2$ in loop 1 and $-\frac{dB}{dt}\pi^2$ in loop 2

C. $-\frac{dB}{dt}\pi R^2$ in loop 1 and zero in loop 2

D. $-\frac{dB}{dt}\pi r^2$ in loop 1 and zero in loop 2

Answer: C

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3. The self-inductane of a coil having 500 turns is 50 mH. The magnetic flux through the cross-sectional area of the coil while current through it is 8 mA is found to be

A. $4 \times 10^{-4} Wb$

B. $0.04 Wb$

C. $0.8 \mu Wb$

D. 40 m Wb

Answer: C

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4. The phase difference between the flux linkage and the induced e.m.f. in a rotating coil in a uniform magnetic field

A. $\pi/2$

B. $\pi/3$

C. $-\pi/6$

D. π

Answer: A

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5. A rectangular copper coil is placed in a uniform magnetic field of induction 40 mT with its plane perpendicular to the field. The area of the coil is shrinking at a constant rate of $0.5 m^2 s^{-1}$. The emf induced in the coil is

A. 10 mV

B. 20 mV

C. 80 mV

D. 40 mV

Answer: B

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6. Changing magnetic fields can set up current loops in nearby metal bodies and the currents are called as

A. eddy currents

B. flux currents

C. alternating currents

D. leaking currents

Answer: A

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7. A rod of 10 cm length is moving perpendicular to uniform magnetic field of intensity $5 \times 10^{-4} \mathrm{Wbm}^{-2}$. If the acceleration of the rod is $5ms^{-1}$, then the rate of increase of induced emf is

A. $25 \times 10^{-4} Vs^{-1}$

B. $2.5 \times 10^{-4} Vs^{-1}$

C. $20 \times 10^{-4} Vs^{-1}$

D. $20 \times 10^{-4} Vs^{-1}$

Answer: B

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8. The identical loops of copper and aluminium are moving with the same speed in a magnetic field. Which of the following statements true?

A. Induced emf and induced current are same in both loops

B. Induced emf remains same, induced current changes in both loops

C. Induced emf changes but induced current remains same in both loops

D. Induced emf will be more in aluminium loop

Answer: B

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9. A straight conductor 0.1 m long moves in a uniform magnetic field 0.1 T. The velocity of the conductor is $15ms^{-1}$ and is directed perpendicular to the field. The emf induced between the two ends of the conductor is

A. 0.10 V

B. 0.15 V

C. 1.50 V

D. 15 V

Answer: B

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10. The initial rate of increase of current, when a battery of emf 6 V is connected in series with an inductance of 2 H and resistance 12Ω , is

A. $0.5As^{-1}$

B. $1As^{-1}$

C. $3As^{-1}$

D. $3.5As^{-1}$

Answer: C

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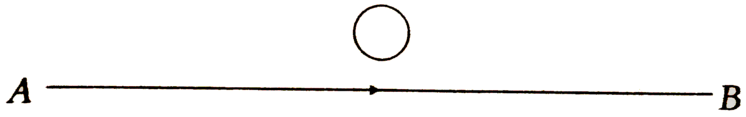
11. The current flows from A to B as shown in the figure. What is the direction of current in circle?



A. Clockwise

B. Anti-clockwise

C. Straight line

D. None of these

Answer: D

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12. A very small circular loop of radius a is initially (at t = 0) coplanar and concentric with a much larger fixed circular loop of radius b. A constant current I flows in the larger loop. The smaller loop is rotated with a constant angular speed ω about the common diameter. The emf induced in the smaller loop as a function of time t is

A. $\frac{\pi a^2 \mu_0 I}{2b} \omega \cos \omega t$

B. $\frac{\pi a^2 \mu_0 I}{2b} \omega \sin \omega^2 t^2$

C. $\frac{\pi a^2 \mu_0 I}{2b} \omega \sin \omega t$

D. $\frac{\pi a^2 \mu_0 I}{2b} \omega \sin^2 \omega t$

Answer: C

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13. A straight conductor of length 0.4 m is moved with a speed of 7 m/s perpendicular to the magnetic field of intensity of $0.9 Wb / m^2$. The induced e.m.f. across the conductor will be

A. 5.04 V

B. 1.26 V

C. 2.52 V

D. 25.2 V

Answer: C

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14. The current in self -inductance $L = 40$ mH is to be be increased uniformly from 1 A to 11 A is 4 millisecond . The emf induce in inductor during the process is

A. 100 V

B. 0.4 V

C. 40 V

D. 440 V

Answer: A

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15. The induced emf in a coil of 10 H inductance in which current varies from 9 A to 4 A in 0.2 s is

A. 200 V

B. 250 V

C. 300 V

D. 350 V

Answer: B

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16. A conductor of length 5 cm is moved paralllel to itself with a speed of $2m/s$, perpendicular to a uniform magnetic field of $10^{-3}Wb/m^2$. the induced emf generated is

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

B. $1 \times 10^{-3}V$

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

D. $2 \times 10^{-4} V$

Answer: C

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17. Two identical coils A and B are kept on a horizontal tube side by side without touching each other. If the current in the coil A increases with time, in response, the coil B

A. is attracted by A

B. remains stationary

C. is repelled

D. rotates

Answer: C

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18. A rectangular coil of 100 turns and size $0.1m \times 0.05m$ is placed perpendicular to a magnetic field of 0.1 T. If the field drops to 0.05 T in 0.05 s, the magnitude of the emf induced in the coil is

A. $\sqrt{2}$

B. $\sqrt{3}$

C. $\sqrt{0.6}$

D. 0.5

Answer: D

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19. Electromagnetic induction is not used in

A. speedometer

B. transformer

C. AC generator

D. induction furnace

Answer: D

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20. Two coils have the mutual inductance of 0.05 H. The current changes in the first coil as $I = I_0 \sin \omega t$, where $I_0 = 1A$ and $\omega = 100\pi \text{rad/s}$. The maximum emf induced in secondary coil is

A. 2.5 V

B. 10 V

C. $6\pi V$

D. $5\pi V$

Answer: D

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21. The magnetic flux linked with a circuit of resistance $100 ohm$ increase from 10 to 60 webers. The amount of induced charge that flows in the circuit is (in coulomb)`

A. 0.5

B. 5

C. 50

D. 100

Answer: A

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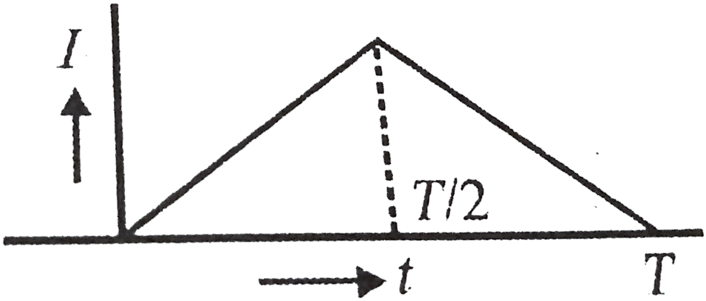
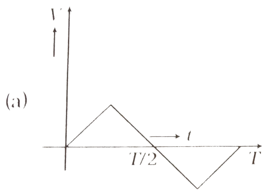
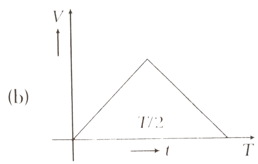
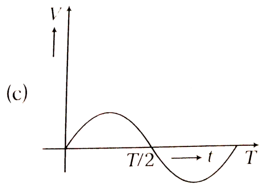
22. The current (I) in the inductance is varying with time according to the plot shown in figure.

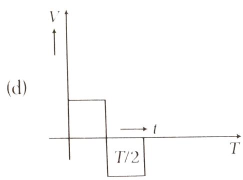


Which one of the following is the correct variation of voltage with time in the coil?

A.


B.


C.


D.


Answer: D

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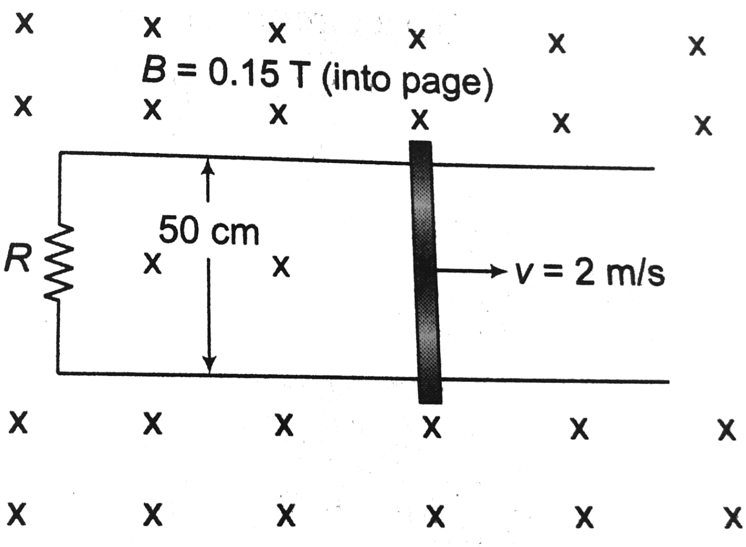
23. As shown in figure, a metal rod completes the circuit. The circuit area is perpendicular to a magnetic field with $B = 0.15T$. If the resistance of the total circuit is 3Ω, how large a force is needed to move the rod as indicated with a constant speed of 2 m/s?



A. $3.75 \times 10^{-3} N$

B. $2.75 \times 10^{-3} N$

C. $6.57 \times 10^{-4} N$

D. $4.36 \times 10^{-4} N$

Answer: A

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24. If emf induced in a coil is 2V by changing the current in it from 8 A to 6 A in 2×10^{3} s . Then , the coefficient of self -induction is

A. $2 \times 10^{-3} H$

B. $10^{-3} H$

C. $0.5 \times 10^{-3} H$

D. $4 \times 10^{-3} H$

Answer: A

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25. A wire of length $1m$ is moving at a speed of $2ms^{-1}$ perpendicular to its length and a homogeneous magnetic field of $0.5T$. The ends of the wire are joined to a circuit of resistance 6Ω. The rate at which work is being done to keep the wire moving at constant speed is

A. 1W

B. $\frac{1}{3}W$

C. $\frac{1}{6}W$

D. $\frac{1}{12}W$

Answer: C

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