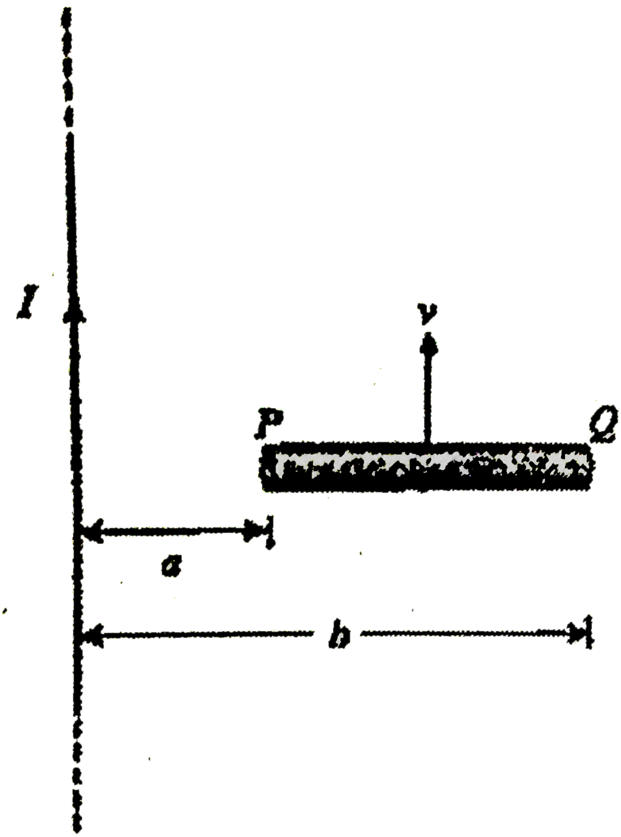
PHYSICS

BOOKS - GK PUBLICATIONS PHYSICS (HINGLISH)

ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENT

Illustrative Example

1. A copper rod of length L is moving at a uniform speed v parallel to along straight wire carrying a current of I as shown in figure-5.25. The rod is perpendicular to the wire with its ends at distance a and b from if . Calculate the motional EMF induced in the rod.



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2. A circular cpper disc of 10 cm in diameter rotates at 1800 revolution per minute about an axis through its centre and at right angles to disc. A uniform field of induction B of $1Wb^{-2}m$ is perpendicular to disc. What potential difference is developed between the axis of the disc and the rim?

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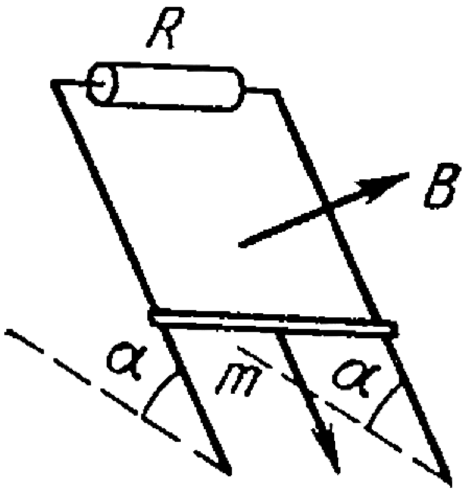
3. A copper connector of mass m slides down two smooth cooper bars, set at an angle α to the horizontal due to gravity (Fig). At the top the bars is equal to l. The system is located in a unifrom magnetic field of induction B, perpendicular to the plane in which the connector slides. The resistances of the bars, the connector and the sliding contacts, as well as the self-inductance of the loop, are assumed to be negligible. Find the steady-state velocity of the connector.



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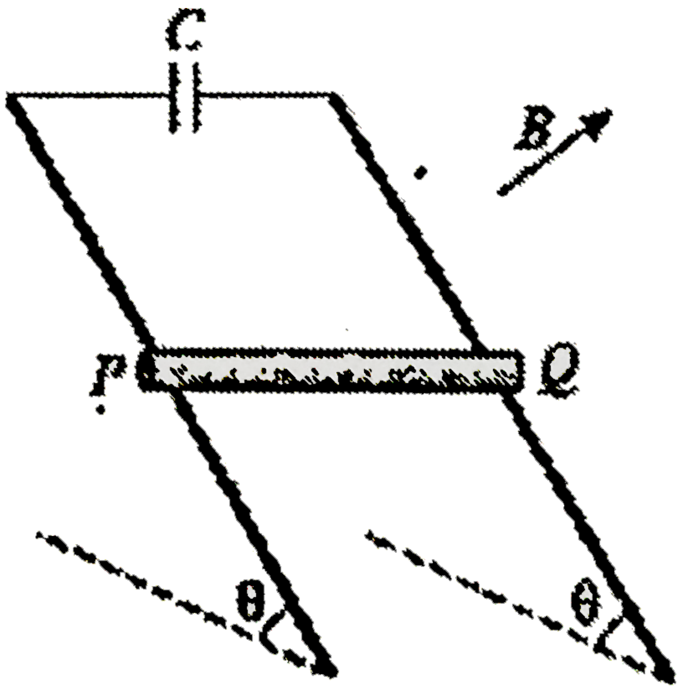
4. A straight horizontal conductor PQ of length l, and mass_ m slides down on two smooth conducting fixed parallel rails, set inclined at an angle 9 to the horizontal as shown in figure-5.30.



The top end of the bar are connected with a capacitor of capacitance C. The system is placed in a uniform magnetic field, in the direction perpendicular to the inclined plane formed by the rails as shown in figure. If the resistance of the bars and the sliding conductor are negligible calculate the acceleration of sliding conductor as a function of time ifit is released from rest at t= 0

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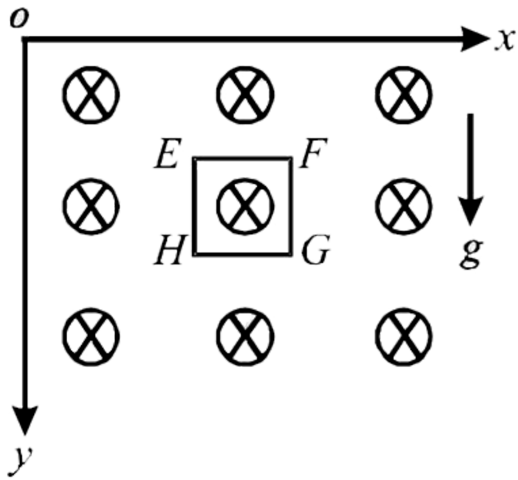
5. A magnetic field $B = B_0(y/a)(\hat{\ })k$ is into the paper in the +z direction, B_0 and a are positive constants. A square loop EFGH of side a, mass m and resistance R, in x-y plane, starts falling under the influence of gravity see figure. Note the direction of x and y axis in figure.



Find

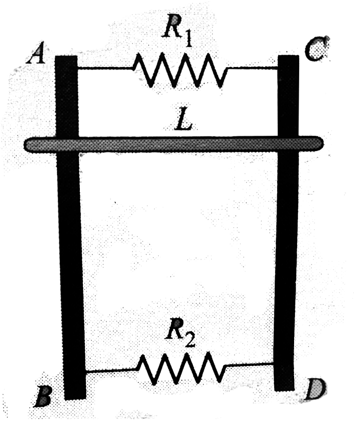
(a) the induced current in the loop and indicate its direction.

(b) the total Lorentz force acting on the loop and indicate its direction, and

(c) an expression for the speed of the loop, v(t) and its terminal value.

6. Two parallel vertical metellic rails AB and CD are separated by $1m$. They are connecting at two ends by resistances R_1 and R_2 as shown in Fig. 3.96. A horizontal metallic bar L mas $0.2kg$ slides without friction vertically down the rails under the action of gravity. There is a uniform horozontal magnetic field of $0.6T$ perpendicular to the plane of the rails. It is observed that when the terminal velocity is attained, thwe power dissipated in R_1 and R_2 are 0.76 and $1.2W$, respectively. Find the terminal velocity of the bar L and the values of

R_1 and R_2.



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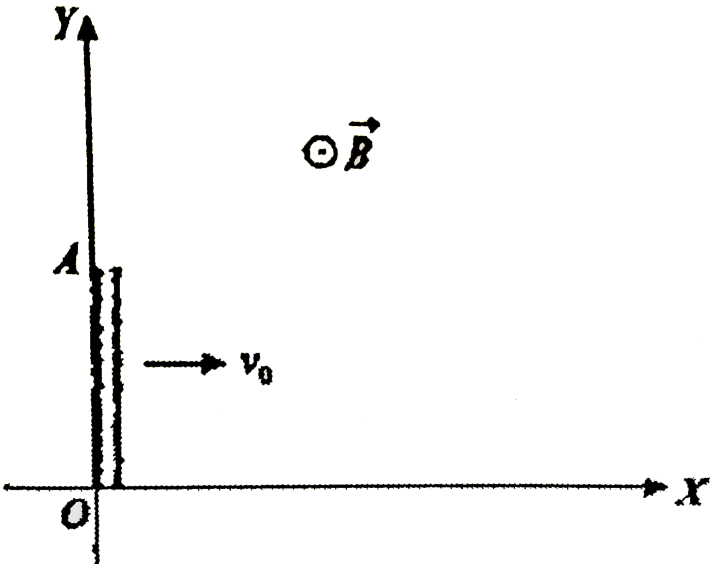
7. Figure,5.36 shows a conductor OA of length l placed along y-axis with one end at origin. In this region a non-uiform magnetic field exist along $+Z$-direction of which magnitude depends only n its Y coordinate which is given as

$$B = B_0\left(1 + \frac{y^2}{l^2}\right)T$$

If the conductor OA starts translating with velocity $\vec{v} = v_0\hat{i}$, find the EMF induced in conductor.



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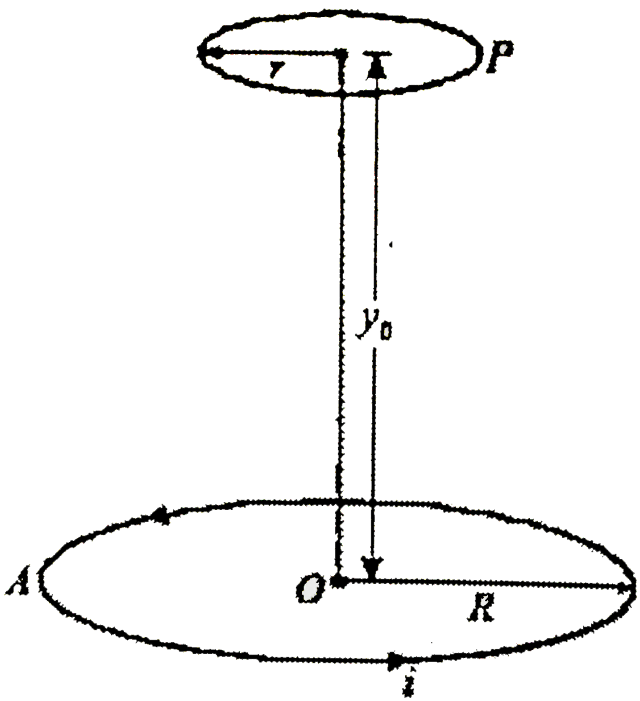
8. A coil A of radius R and number of turns n carries a current i and it is placed in a horizontal plane. A small conducting ring P of radius $r(r << R)$ is placed at a height y_0 above the centre of the coil A as shown in figure-5.38. Calculate the induced EMF in the ring when the ring in allowed to fall freely. Express the induced EMF as a function of instantaneous speed of the falling ring and its height above the center of the coil A.



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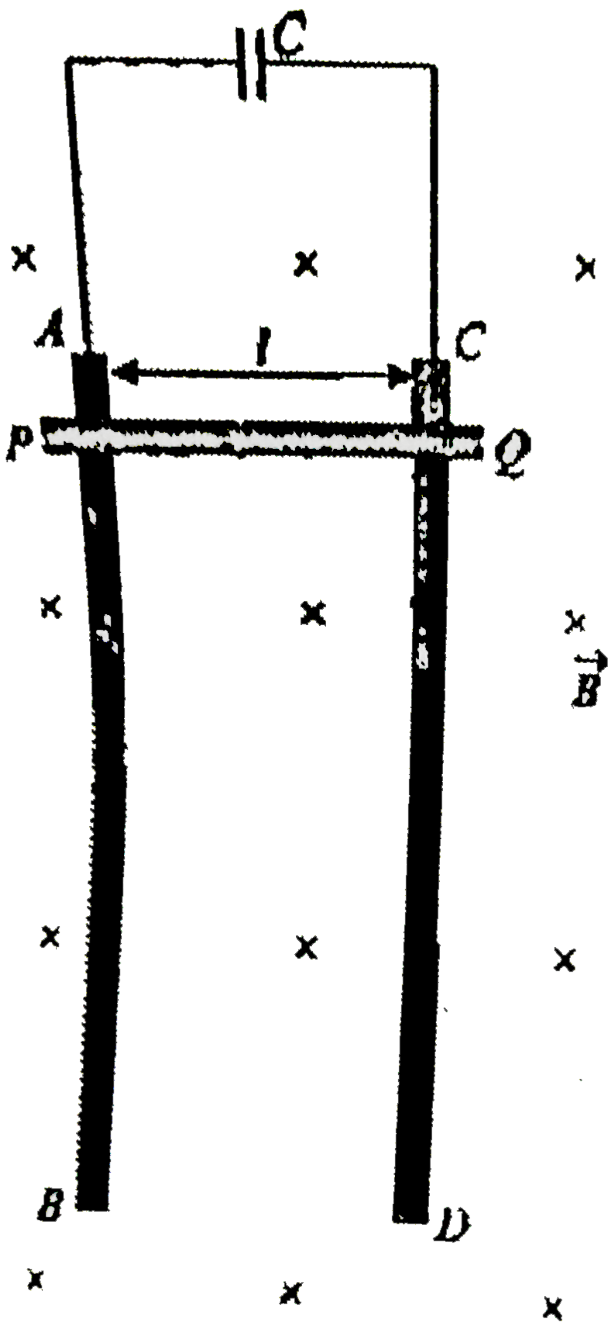
9. Figure-5.39 shows two vertical smooth rails AB and CD separated by a distance l. Ends A and C are connected with capacitor of capacitance C. A rod PQ of mass m is horizontally kept in touch with both rails as shown. If it is released at t=0 and it remains in contact with rails during its fall, find the charge on capacitor as function of time. Neglect resistance of connecting wires and rails.



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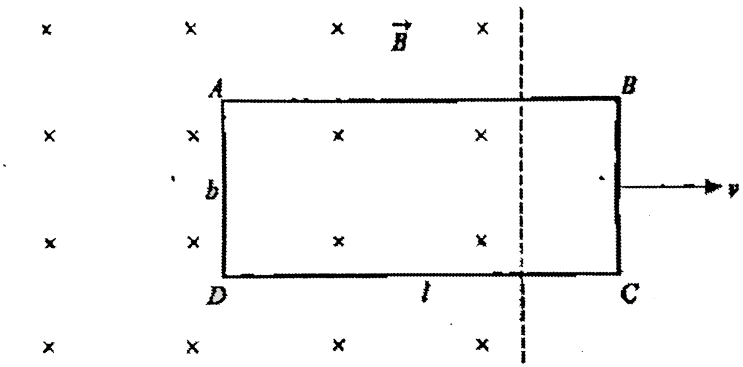
10. Figure-5.41 shows a rectangular wire loop ABCD with length l and breadth b. the wire is having a resistance λl per unit length. If the loop is pulled out from the magnetic field at a uniform speed v as shown in fiure-5.00, find the potential difference across points of the loop $V_B - V_C$ and $V_A - V_D$.



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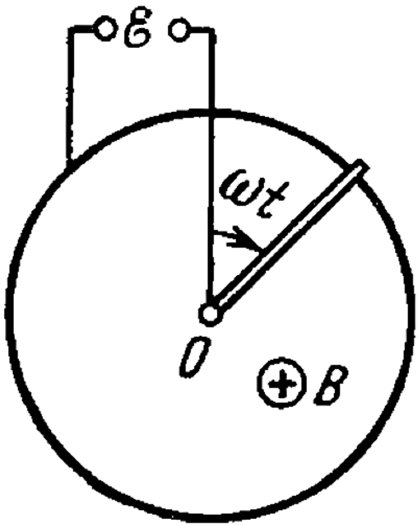
11. A metal rod of mass m can rotate about a horizontal axis O, sliding along a circular conductor of radius a (fig). The arrangment is located in a unifrom magnetic field of induction B directed perpendicular to the ring plane. The axis and the ring are connected to an emf source to form a circuit of resistance R. Neglecting the friction, circuit induction and ring resistance, find the law according to which the source and must very to make the rod rotate with a constant angular velocity ω.



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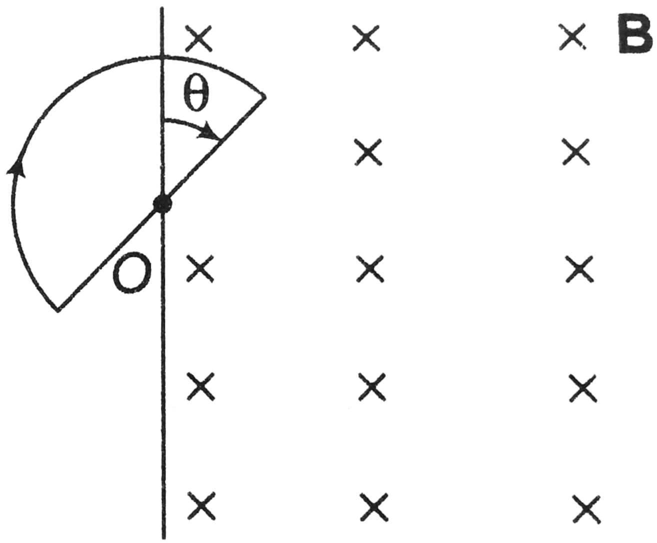
12. A wire loop enclosing as semicircle of radius R is located on the boudary of uniform magnetic field B. At the moment $t = 0$, the loop is set into rotation with a costant angular acceleration α about an axis

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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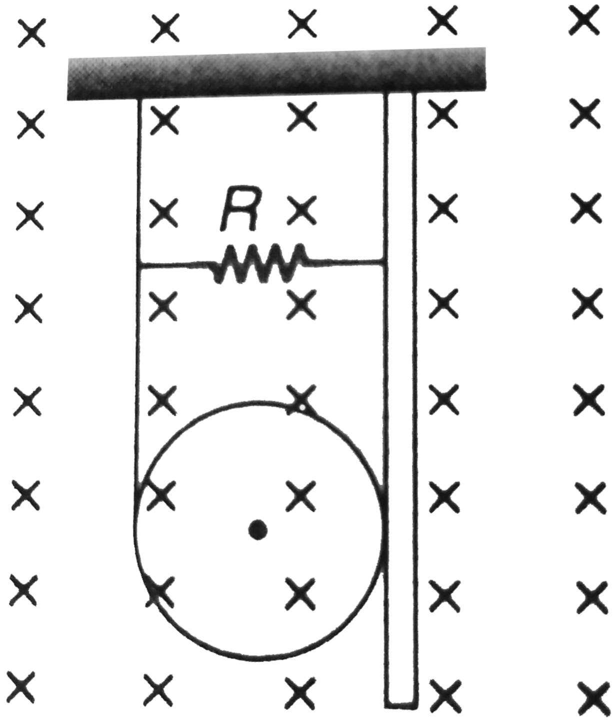
13. A conducting light string is wound on the rim of a metal ring of radius r and mass m. The free end of the string is fixed to the ceiling. A vertical infinite smooth conducting plane is always tangent to the ring as shown in the figure. A uniform magnetic field Bis applied perpendicular to the plane 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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14. Two concentric coplanar circular loops made of wire with resistance per unit length $10^{-4} \Omega / m$, have diameters 0.2 m and 2m. A time varying potential difference (4+2.5t) volt is applied to the larger loop. Calculate the current in the smaller loop.

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

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16. A long straight solenoid of cross-sectional diameter d and with n turns per unit of its length has a round turn of copper wire of cross-sectional area A and density ρ is tightly put on its winding. Find the current flowing in the turn if the current in the solenoid winding is increased with a constant rate I ampere per second.

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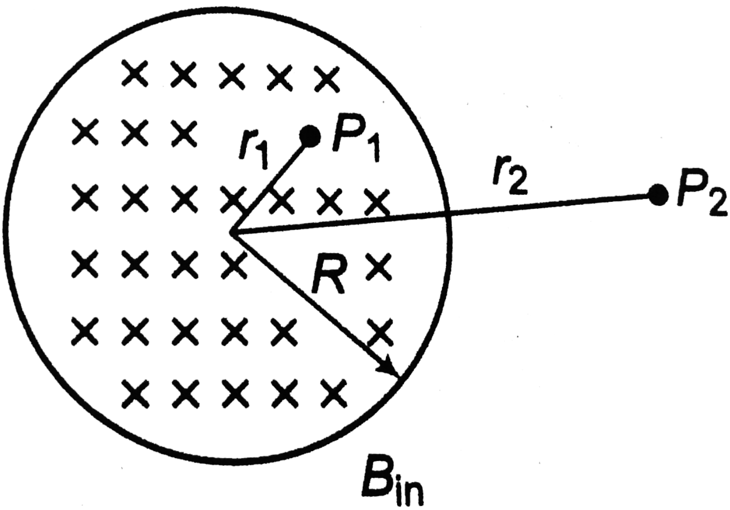
17. For the situation described in figure, the magnetic field changes with time according to $B = (2.00t^3 - 4.00t^2 + 0.8)t$ and $r_2 = 2R = 5.0cm$



(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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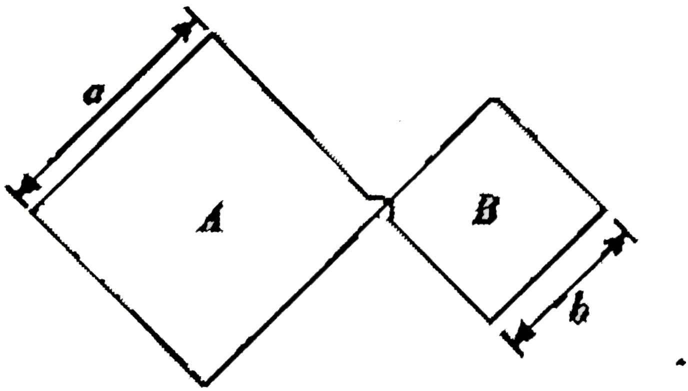
18. A plane loop shown in figure-5.71 is shaped in the from of two squares with sides a and b and it is introduced into a uniform magnetic field at right angles, to the loop's plane. The magnetic induction varies with time as $B = B_0 \sin \omega$t. find the amplitude of the current induced in the loop if its resistance per unit length is equal to r. the induction of the loop is negligible.



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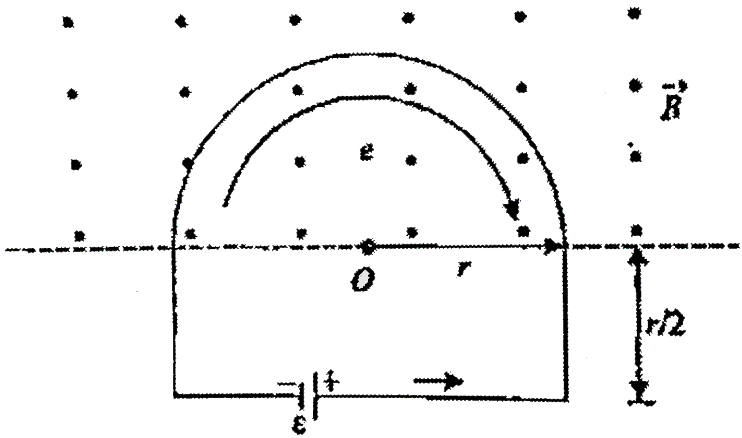
19. Figure-5.72 shows a conducting loop of which semi-circular part lies in the magnetic induction B which varies with time, given as

$B = at^3 + ct^3 + fT$

The wire is having a resistance $R\omega / m$. Find current in loop at time t=2s.



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20. A thin non-conducting ring of mass m carrying a charge q can freely rotate about its axis. At the initial moment the ring was at rest and no magnetic field was present. Then a practically unifrom magnetic field was switched on, which was perpendicular to the planeof the ring and increased with time according to a certain law $B(t)$, Find the angluar velocity ω of the ring as a function of the induction $B(t)$.

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21. An infinitesimal bar magnet of dipole moment M is pointing and moving with speed v in the x-direction. A closed circular conducting loop of radius a and negligible self-inductance lies in the $y-z$ plane with its centre at $x=0$ and its axis coinciding with x-axis. find the force opposing the motion of the magnet, if the resistance of the loop is R . Assume that the distance x of the magnet from the centre of the loop is much greater than a .

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22. A closed coil having 50 turns, area $300cm^2$, is rotated from a position where it plane makes an angle of 45° with a magnetic field of flux density 2.0T to a position perpendlcular to the field in a time of 0.1s. What is the average EMF induced in the coil ?

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23. How many meters of a thin wire are required to manufacture a solenoid of length $l_0 = 100cm$ and inductance $L = 1.0mH$ if the solnoid's cross - sectional diameter is condiserably less than its length ?

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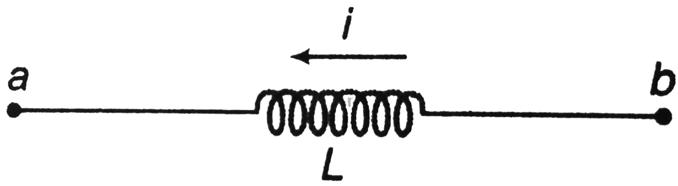
24. The inductor shown in figure has inducance $0.54H$ and carries a current in the direction shown thast is decreasing at a uniform rate $\frac{di}{dt} = 0.03A/s.$



a. Find the self induced emf

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

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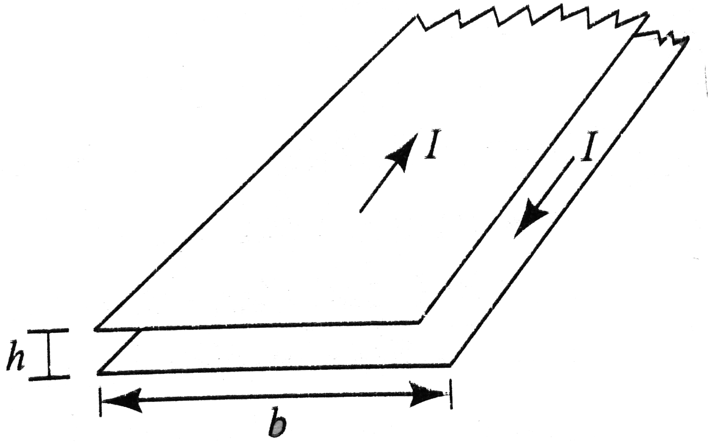
25. Calculate the inductance of a unit length of a double tape line as shows in Fig if the tapes are separated by a distance h which is considerably less than their width b.



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26. Calculate the inducatance of a doughunt solenoid whose inside radius is equal to b and cross-section has the form of a square with side a. The solenoid winding consists of N turns. The

space inside the solenoid is filled up with unifrom paramagnetic having permeability μ.

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27. An iron core is inserted into a solenoid 0.5 m long with 400 turns per unit length. The area of cross-section of the solenoid is $0.001m^2$. (a) Find the relative permeability of the core when a current of 5 A flows through the solenoid winding. Under these conditions, the magnetic flux through the cross-section of the solenoid is 1.6×10^{-3} Wb. (b) Find the inductance of the solenoid under these conditions.

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28. 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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29. Calculate the time constant τ of a straight solenoid of length l having a single layer winding of copper wire whose total mass is equal to m . The cross-sectional diameter of the solenoid is assumed to be considerably less than its length. Given density of copper p_0 and resistivity p.

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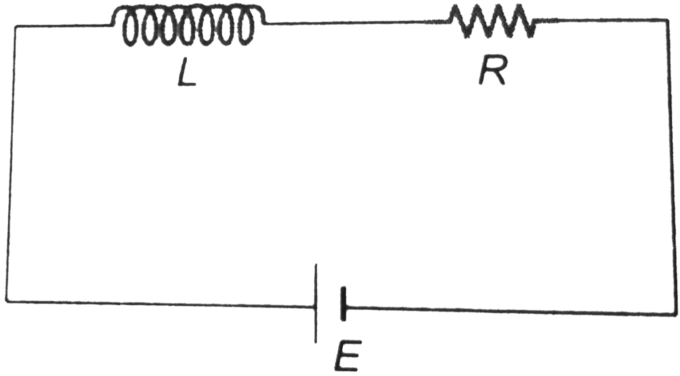
30. A battery of emf E and of negligible internal resistance is connected in a $L-R$ circuit as shown in figure. The inductor has a piece of soft iron inside it. When steady state is reached in the piece of soft iron is abruptly pulled out suddenly so that the inductance of the inductor decreases to 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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31. A thin wire ring of radius a and resitance r is located inside a long solenoid is equal to l, its cross-sectional radius , to b. At a certain moment the solenoid was connected to a source of a constant voltage V. The total resistance of the circuit is equal to R. Assuming the the radial force acting per unit length of the ring.

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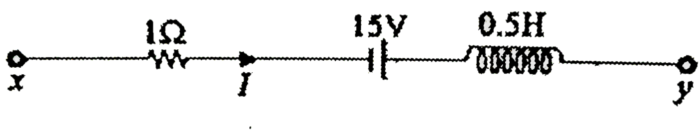
32. A section of an electrical circuit XY is shown in figure-5.100 which carries a current of 5A which is decreasing at the rate of $10A/s$. Find the potential difference $V_y - V_x$,



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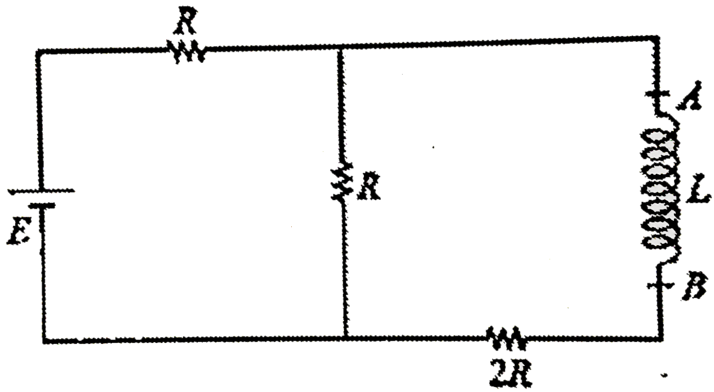
33. Figure-5.102 shows a RL circuit. If at t-0 switch is closed, find the current in inductor as a function of time.



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34. A solenoid of resistance 50Ω and inductance $80H$ is connected to a $200V$ battery. How long will it take for the current to reach 50% of its final equilibrium value? Calculate the maximum energy stored.

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35. The current in a coil of self inductance 2.0 henry is increasing according to $i = 2\sin t^2$ ampere. Find the amount of energy spent during the period when the current changes from 0 to 2 amp.

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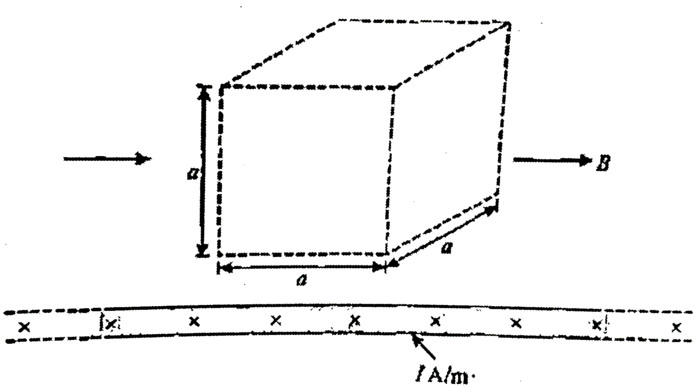
36. Find the magnetic field energy in a cubical region of edge 'a' above a large current carrying sheet carrying a uniform linear current density I

A/m.



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37. 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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38. A thin uniformly charged ring of radius $a = 10cm$ rotates about its axis with an angular velocity $\omega = 100rad/s$. Find the ratio of volume energy densities of magnetic and electric fields on the axis of the ring at a point removed from its centre by a distance $l = a$

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39. 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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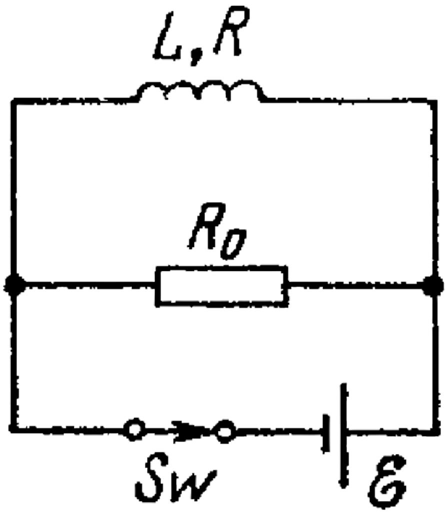
40. A coil of inductance $L = 2.0 \mu H$ and resitance $R = 1.0 \Omega$ is connected to a source of constant $emf E = 3.0 V$. A resistance $R_s = 2.0 \Omega$ is connected in parallel with the coil. Find the amount of heat generated in the coil after the swich Sw is disconnecied. The internal resistance of the source is negligible.



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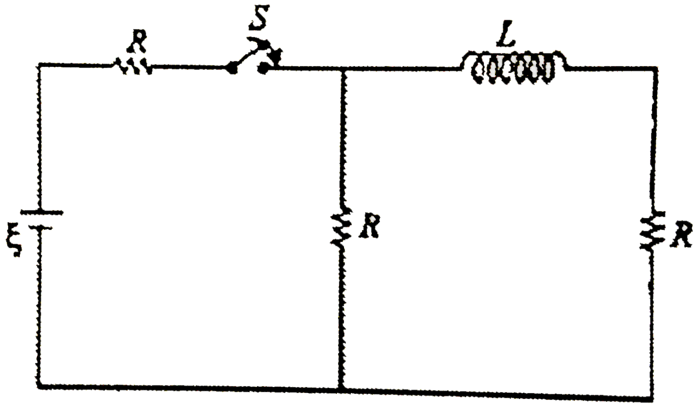
41. In cirucit shown in figure-5.111, find the current through battery just after closing the switch and after a long time in steady state.



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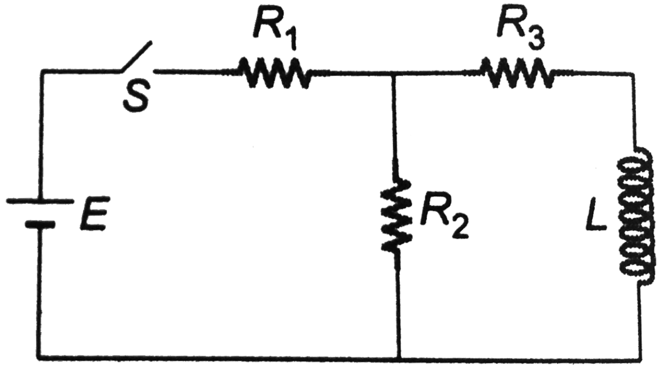
42. For the ciruit shown in figure $E = 50V$, $R_1 = 10\Omega$, $R_2 = 20\Omega$, $R_3 = 30\Omega$ and $L = 2.0mH$.

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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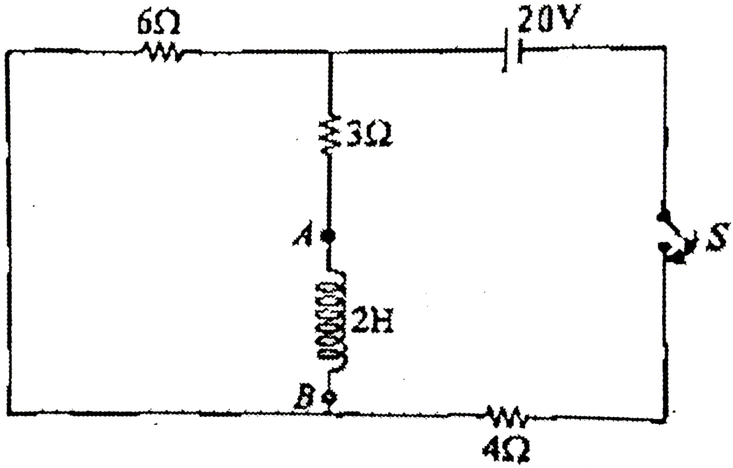
43. In the circuit shown in figure-5.115, find the current in inductor as a function of time if switch is closed at t=0.



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44. In a process of current decay in an inductor through a resistance, if in time t, current falls to η times $(\eta < 1)$ the initial value, find the time constant of circuit.

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45. A coil of 100 turns and 1cm radius is kept coaxially within a long solenoid of 8 turns per cm and 5 cm radius. Find the mutual inductance.

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46. Calculate the mutual inductance of a long straight wire and a rectangular frame with sides a and b. The frame and the wire lie in the same plan, with the side b being closent to the wire, separated by a distance l from it and oriented parallel to it.

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47. An inductor of inductance L is cut in three equal parts and two of these parts are interconnected (a) in series, (b) in parallel. Assuming the mutual inductance between the parts to be negligible, calculate the inductance of the combination of the combination in both the cases.

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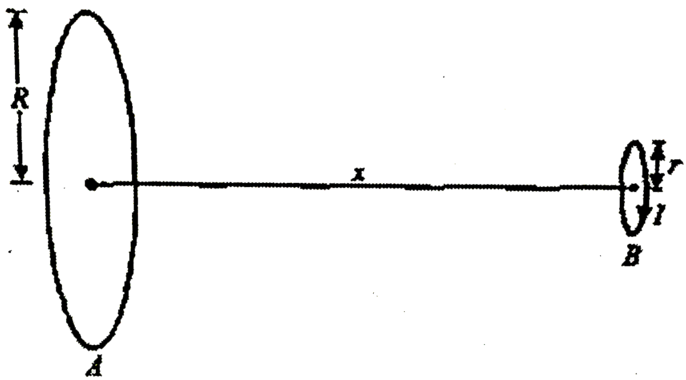
48. Figure-5.136 shows two coaxial coils of radii r and R $(R > > r)$ kept at large separation x

$(x > \ > R)$. Calculate the magnetic flux passing through coil A due to a current I in coil B.



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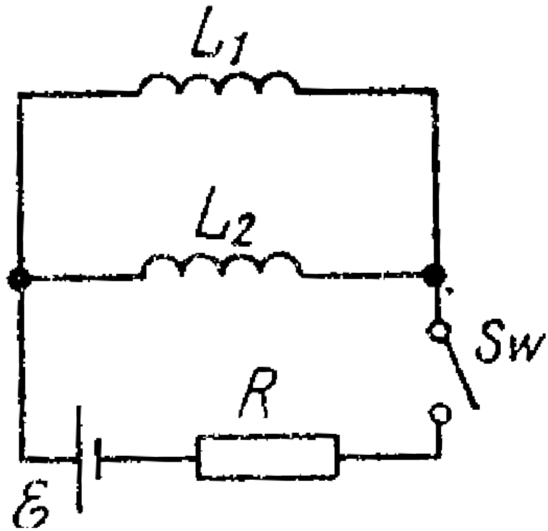
49. In the circuit shown in Fig. $emfE$, a resistance R, and coil inductances L_1 and L_2 are known. The internal resistance of the source and the coil resistances are neglible. Find the steady-state currents in the coils after the swich Sw was shorted.



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50. Two coaxial circular loops of radius $0.5m$ and $5 \times 10^{-2}m$ are separated by a distance $0.5m$ and carry currents $2A$ and $1A$ respectively. The force between the loops due to mutual induction is

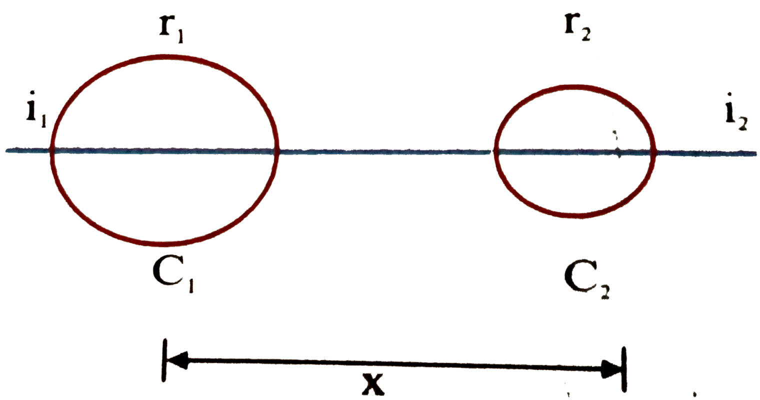

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Illustration

1. There are two stationary loops with mutual inductance L_{12}. The current is one of the loops starts to be varied as $I_1 = \alpha t$ where α is a current,

t is time. Find the time dependence $I_2(t)$ of the current in the other loop whose inductance is L_2 and resistance R.

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2. 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 $t = 1.2ms$.

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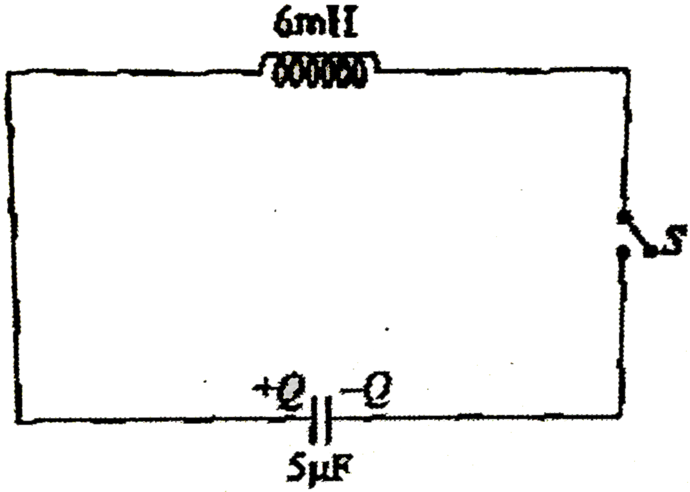
3. In circuit shown in figure charge on capacitor is $Q = 100\mu C$. If switch is closed at t=0 find current in circuit when charge on capacitor reduces to $50\mu C$.

Also find the maximum current in circuit.



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4. 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.

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5. 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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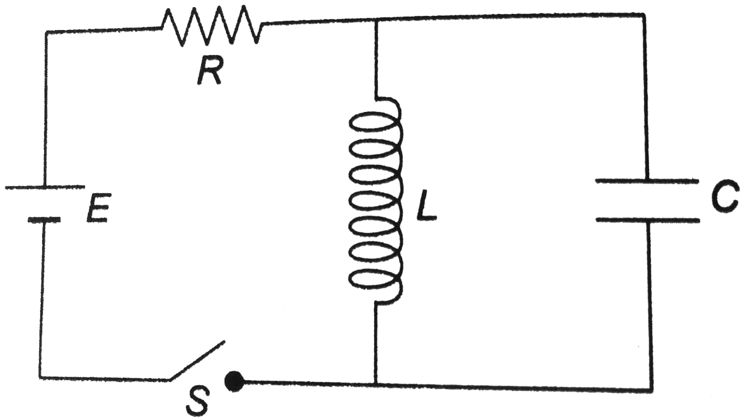
6. In the circuit shown in the figure, $E = 50.0V, R = 250\Omega$ and $C = 0.500\mu F$. The switch S is closed for a long time, and no voltage is measured across the capacitor. After the switch is opened, the voltage across the capacitor reaches a

maximum value of $150V$. What is the inductance L?



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7. An inductor of inductance $2.0mH$ is connected across a charged capacitor of capacitance $5.0\mu F$ and the resulting $L-C$ circuit is set oscillating at its natural frequency. Let Q denote the instantaneous change on the capacitor and i the

current in the circuit. It is found that the maximum value of Q is $200\mu C$.

(a) When $Q = 100\mu C$, what is the value of $|di / dt|$?

(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 $|Q|$?

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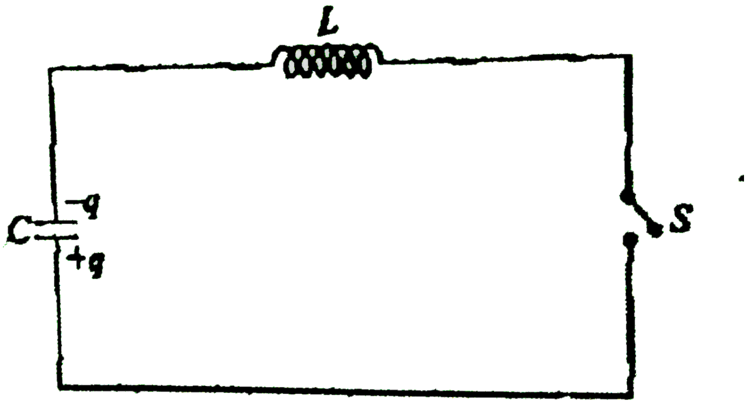
8. In figure-5.143 ifS is closed at t=0, find charge on capacitor as a function of time. Time inductor is active with initial current I_0 in it.



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9. A bar magnet haxs its pole strength 4.5 Am and length 12 cm. the cross sectional area of the magnet is $0.9cm^2$. Find the total dipole moment of the magnet and intensity of magnetsiation of the magnetic material.

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10. For a magnetising field of intensity $2 \times 10^3 A / m$, aluminium at $280K$ acquires intensity of magnetisation of $4 \cdot 8 \times 10^{-2} Am^{-1}$. Find the susceptibility of aluminium at $280K$. If the temperature of the metal is raised to $320K$, what will be its susceptibility and intensity of magnetisation?

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11. A piece of iron of mass 8.4 kg is repeatedly magnetised and demagnetised by an external periodic time varying magnetic field of frequency 50Hz. In the iron piece it is measured that rate of heat dissipation is $6.4 \times 10^4 J/hr$. If iron density is $7200 Kg/m^3$ find the energy dissipated in iron piece per cycle per unit volume of it.

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12. An electric bulb is designed to operate at 12 volts DC. If this bulb is connected to an AC source and gives normal brightness, what would be the peak voltage of the source?

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13. The current in a discharging LR circuit is given by $I = i_0 e^{-\frac{t}{\tau}}$ where τ is the time constant of the circuit. Calculate the rms current for the period $t = 0$ to $t = \tau$.

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14. A direct current of 2A and an AC of peak value 2A flows through resistances 2Ω and 1Ω respectively. Find the ratio of heat produced in the two resistances in same interval.

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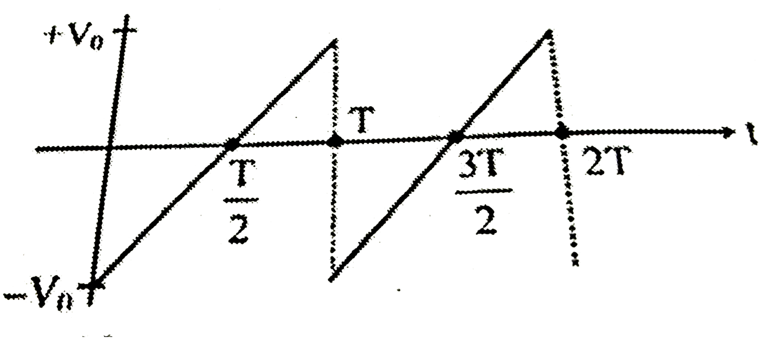
15. Rms value of the saw-tooth voltage of peak value V_0 as shown in-



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16. A $10\mu F$ capacitor in series with a 40Ω resistance is connected to a 110 V, 60Hz supply. (a) What is the maximum current in the circuit ? (b) What is the time lag between current maximum and voltage maximum ?

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17. An electric lamp which runs at 40V and consumes 10A current is connected to AC mains at

100V, 50Hz supply. Calculate the inductance of the required choke for lamp to glow at full brightness.

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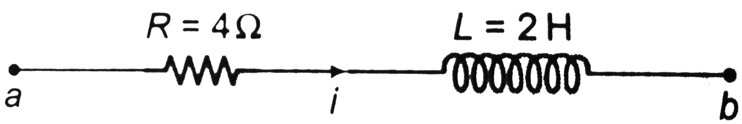
18. In the figure shown $i = 10e^{-4t}$A. Find V_L and V_{ab}



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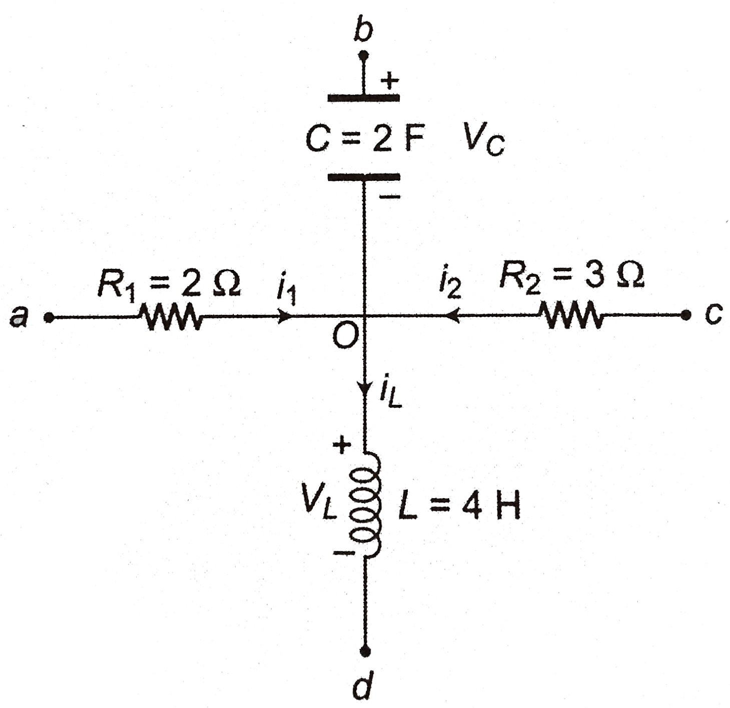
19. In the figure shown, $i_1 = 10e^{2t}A$, $i_2 = 4A$ and $V_c = 3e^{-2t}V$ Determine

(a) i_L and V_L

(b) V_{ac} , V_{ab} and V_{cd}



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20. When 100 DC is applied across a solenoid, a steady current of 1A flows in it. When 100V AC is applied across the same solenoid, current drops to 0.5A. If the frequency of AC source is $\frac{50\sqrt{3}}{\pi}$ Hz, find the resistance and inductance of the solenoid.

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21. In a circuit a resistance of 40Ω and capacitor of capacitance $\frac{1250}{9\pi}\mu F$ are connected in series across a 500V, 120Hz AC source Find the effective current in circuit and phase difference between current and source EMF.

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22. A 12Ω resitance and an inductance of 0.05/ πH with negligible resistance are connected in series. Across the end of this circuit is connected a 130 V alternating voltage of frequency 50Hz. Calculate the alternating current in the circuit and potential difference across the resistance and that across the inductance.

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23. An AC source of angular frequency ω is fed across a resistor R and a capacitor C in series. The current registered is I. If now the frequency of source is changed to $\omega/3$ (but maintaining the same voltage), the current in the circuit is found to be halved. The ratio of reactance to resistance at the original frequency ω will be.

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24. In a series RL circuit with $L = \frac{175}{11} mH$ and $R = 12\Omega$ and AC source of emf $e = 130\sqrt{2}V$, 50Hz is applied. Find the circuit impedance and phase difference of EMF and current in circuit.

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25. A $200km$ long telegraph wire has capacitance of $0.014\mu F / km$ If it carries an alternating current of 50×10^3 Hz what should be the value of an inductance required to be connected in series in series so that impedance isw minimum .

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Practice Exercise 5.1

1. A coil of area $500cm^2$ and having 1000 turns is held perpendicular to a uniform field of 0.4 gauss. The coil is turned through 180° in $1/10\sec$. Calculate the average induced e.m.f.

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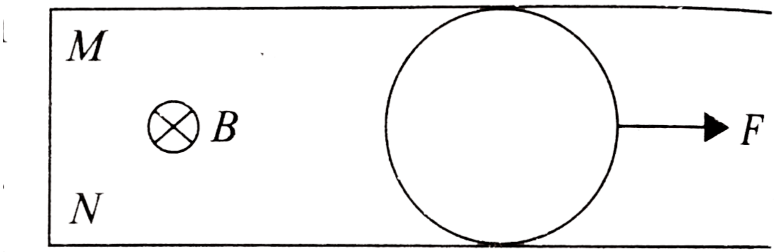
2. Two long parallel conducting horizontal rails are connected by a conducting wire at one end. A uniform magnetic field B (directed vertically downwards) exists in the region of space.



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

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

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3. A very small circular loop of area $5 \times 10^{-4} m^2$, resistance 2Ω and negligible inductance is initially coplanar and concentric with a much larger fixed circular loop of radius $0.1m$. A constant current of $1A$ is passed in the bigger loop and the smaller loop is rotated with angular velocity $\omega rad / \sec$ about a diameter. Calculate (a) the flux linked with the smaller loop, (b) induced emf (c) induced current in the smaller loop, as a function of time.

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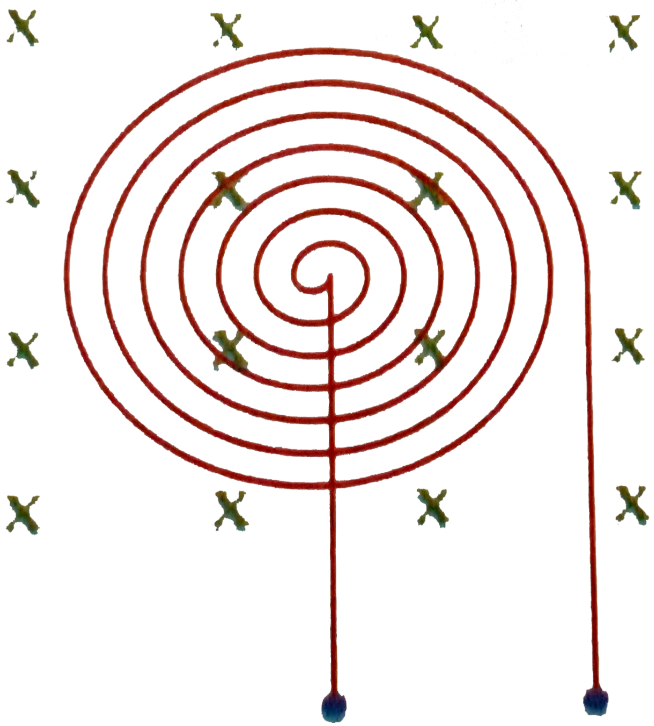
4. A flat circular coil having N turns (tightly wound D) is placed in a time varying magnetic field $B = B_0 \sin \omega t$. The outer radius of the coil is R. Determine the maximum value of the induced emf in the circuit.



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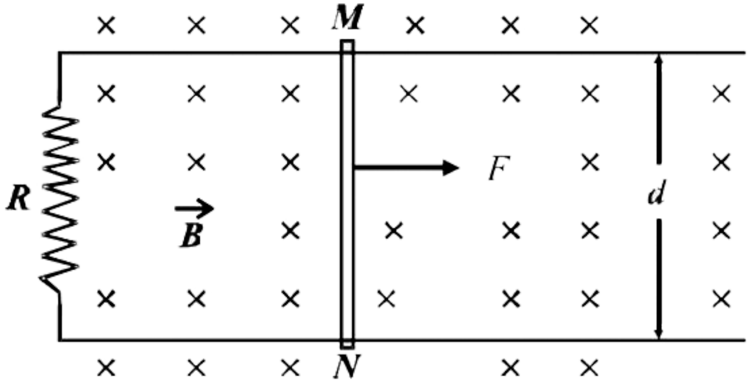
5. Two long parallel horizontal rails a, a distance d aprt and each having a risistance λ per unit length are joing at one end by a resistance R. A perfectly conduction rod MN of mass m is free to slide along the rails without friction (see figure). There is a uniform magnetic field of induction B normal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



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

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

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6. A wire frame of area $3.92 \times 10^{-4} m^2$ and resistance 20Ω is suspended freely from a 0.392m long thread. There is a uniform magnetic field of 0.784 T and the plane of wire-frame is made to oscillate under gravity by displacing it through $2 \times 10^{-2} m$ from its initial position along the direction of magnetic field. The plane of the frame is always along the direction of thread and does not rotate about it . What is the induced EMF in wire-frame us a function of time ? Also find the maximum current in the frame.

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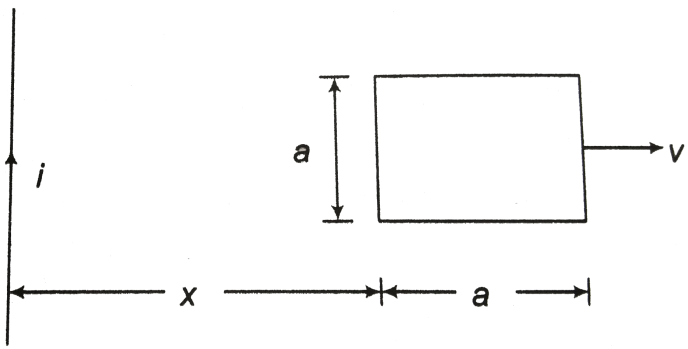
7. A square frame with side a and a long straight wire carrying a current i are located in the same plane as m shown in figure. The fram translates to the right with a constant velocity v. Find the emf induced in the frame as a function of distance x.



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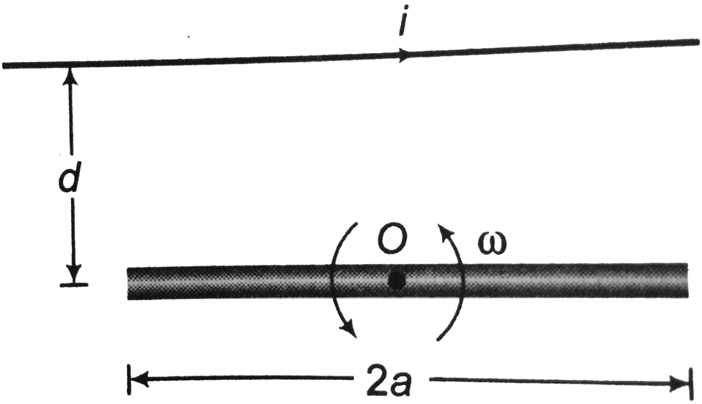
8. A rod of length $2a$ is free to rotate in a vertical plane, about a horizontal axis O passing through its mid-point. A long straight, horizontal wire is in the same plane and is carrying a constant current i

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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9. Two long wires are placed on a pair of parallel rails perpendicular to the wires. The spacing

between the rails d is large compared with x, the distance between the wires. Both wires and rails are made of a material of resistivity ρ per unit length. A magnetic flux density B is applied perpendicular to the rectangle by the wires and rails. One wire is moved along the rails with a uniform speed v while the other is held stationary. Determine how the force on the stationary wire varies with x and show that it vanishes for a value of x approximately equal to

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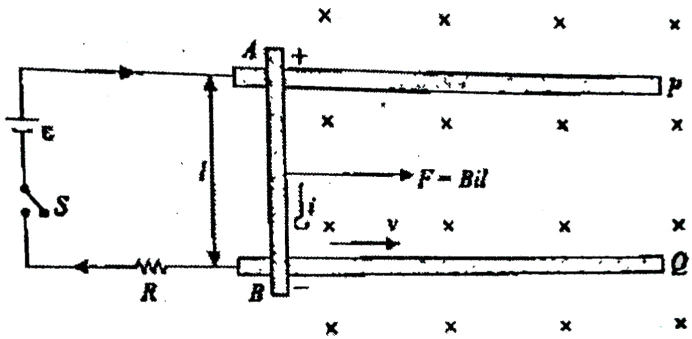
10. A uniform rod AB of mass m and length l is placed over two smooth conducting rails P and Q. If the witch shown as closed at t=0, find the velocity of rod AB as a function of time.



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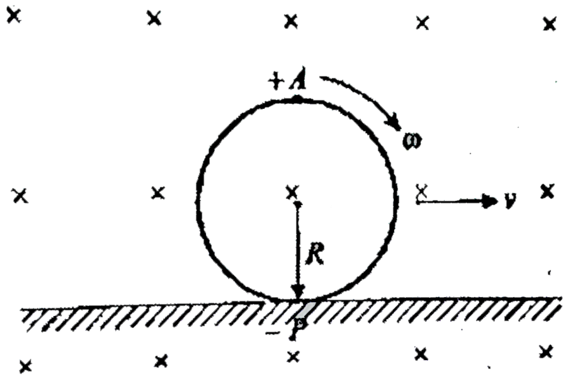
11. In figure-5.54 a wire ring of radius R is in pure rolling on a surface. Find the EMF induced across the top and bottom points of the ring at any instant.



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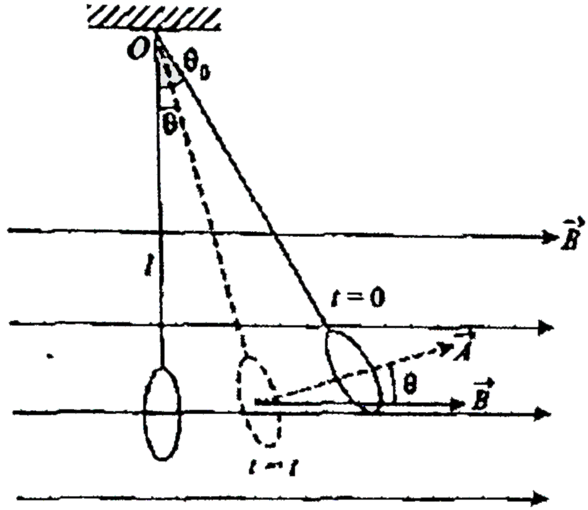
12. Figure-5.55 shows a small circular coil of area A suspended from a point O by a string of length l in a uniform magnetic induction B in a uniform magnetic induction B in horizontal direction. If the coil is set into oscillation like a simple pendulum by

displacing it a small angle θ_0 as shown, find EMF induced in coil as a function of time. Assume the plane of coil is always in plane of string.



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Practice Exercise 5.2

1. 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

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2. A long solenoid having 1000 turns per cm carries an alternating current of peak value 1 A. A search coil having a cross-sectional area of $1 \times 10^{-4} m^2$ and 20 turns is kept in the solenoid so that its plane is perpendicular to the axis of the solenoid. The search coil registers a peak voltage of

2.5×10^{-2} V. Find the frequency of the current in the solenoid.

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3. Two infinite long straight parallel wires A and B are separted by 0.1m distance and carry equal currents in opposite directions. A square loop of wire C of side 0.1m lies in the plane of A and B. The loop of wire C is kept parallel to both A and B at a distance of 0.1m from the nearest wire. Calculate the EMF induced in the loop C while the currents in A and B are increasing at the rate of $10^3 A/s$. Also indicate the direction of current in the loop C.

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4. A flat circular coil of 200 turns of diameter 25 cm is laid on a horizontal table and connected to a ballistic galvanometer. The complete circuit is having resistance of 800Ω. When the coil is quickly turned over, the spot of light swings to a maximum reading of 30 divisions. When a $0.1\mu F$ capacitor charged to 6 V is discharged through the same ballistic galvanometer, a maximum reading of 20 division is obtained. Calculate the vertical component of the earth's magnetic induction.

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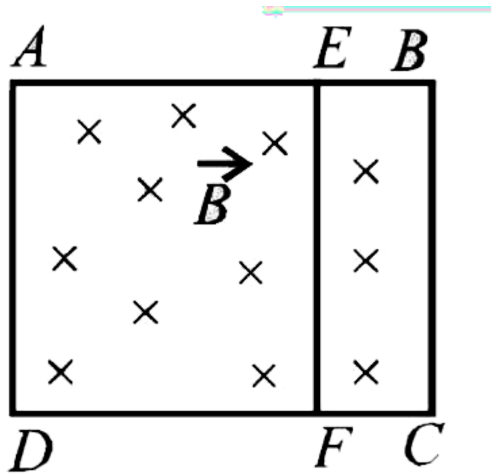
5. A rectangular frame ABCD, made of a uniform metal wire, has a straight connection between E and F made of the samae wire, as shown in fig. AEFD is a square of side 1m, and EB=FC=0.5m. The entire circuit is placed in steadily increasing, uniform magnetic field directed into the plane of the paper and normal to it. The rate of change of the magnetic field is $1T/s$. The resistance per unit length of the wire is $1\omega/m$. Find the magnitude and directions of the currents in the segments AE, BE and EF.



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6. In a long staright solenoid with cross-sectional radius a and number of turns per unit length n a current varies with a constant velocity $\dot{I} A/s$. Find the magntidue of the eddy current field strength as a function of the distance r from the solenoid axis. Draw the appoximate plot of this function.

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7. A thin non-conducting ring 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 and no magnetic field was present. At instant $t = 0$, a uniform magnetic field is switched on which is vertically downwards and increase with time according to the law $B = B_0 t$. Neglecting magnetism induced due to totational motion of the ring. Now answer the following questions.

The power developed by the forces acting on the ring, as a function of time :

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8. In the middle of a long solenoid there is a coaxial ring of square cross-seciton, made of conducting materaial with respectivity are equal to h its inside and outside radii are equal to a and b respectively. Find the current induced in the ring if the magnetic induction produced by the solenoid varies with time as $B = \beta t$, where βt, where β is constant. THe inductance of the ring is to be neglected.

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9. A long solenoid of diameter 0.1 m has 2×10^4 turns per meter. At centre of the solenoid is 100 turns coil of radius 0.01 m placed with its axis coinciding with solenoid axis. The current in the solenoid is decreased at a constant rate form + 2 A to - 2 A in 0.05 s. Find the e.m.f. induced in the coil. Also, find the total charge flowing through the coil during this time, when the resistance of the coil is $10\pi^2 ohm.$

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10. A long solenoid of cross-sectional radius a has a thin insulates wiere ring tightly put on its winding, one half of the ring has the resistance η times that of the other half. The magneticv induction produced by the solenoid varies with the time as $B = bt$, where b is a constant. Find the magnitude of the electric field strength in the ring.

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11. A magnetic field induction is changing in magnitude at a constant rate dB/dt. A given mass m of copper is drawn into a wire of radius α and formed into a loop of radius r is placed perpendicular to the field. Show that induced current in the loop is given by $i = \frac{m}{4\pi p\delta}\frac{dB}{dt}$

p : resistivity, δ : density of copper.

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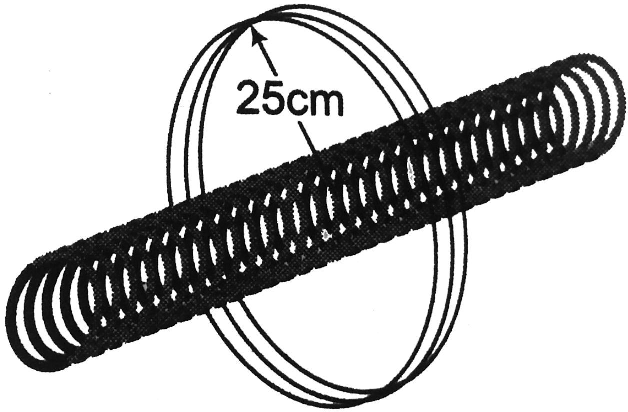
12. A long solenoid of cross-sectional area $5.0cm^2$ is wound with 25 turns of wire per centimetre. It is placed in the middle of a closely wrapped coil of 10 turns and radius 25 cm as shown.



(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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13. In a coil of resistance R, magnetic flux due to an external magnetic field varies with time as $\phi = k(C - t^2)$. Where k and C are positive constants. Find the total heat produced in coil in time t=0 to t=C.`

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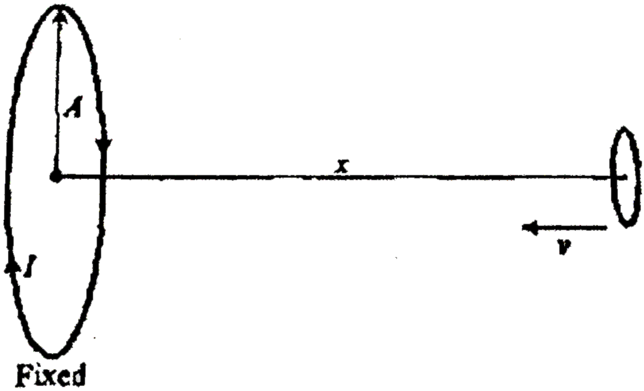
14. Figure-5.77. shows a fixed coil of N turns and radius a carrying a current I. At a distance x from its centre another small coaxial coil of radius $b(b < < a)$ and resistance R is moving toward the first coil at a uniform speed v. Find the induced current in smaller coil.



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Practice Exercise 5.3

1. Find the self inductance of a unit length of a cable consisting of two thin walled coaxial metallic cylinders if the radius of the outside cylinder is

$\eta(\eta > 1)$ times that of the inside one. The permeability of the medium between the cylinders is assumed to be equal to unity.

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2. Find the inductane of a unit length of a double line if the radius of each wire is η times less than the distance between the axes of the wires. The field inside the wires is to be neglected, the permeability is assumed to be equal to unity throughout, and $\eta > \,\, > 1$.

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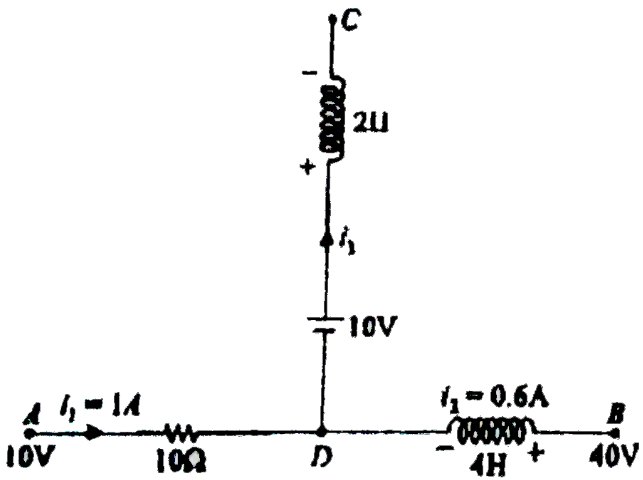
3. find potential of point C at the instant shown.

The rate of increase of current in resistance is $2.5A/s$.



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4. A long cylinder of radius a carrying a uniform surface charge rotates about its axis with an angular velocity ω. Find the magnetic field energy per unit length of the cylinder if the linear charge density equals λ and $\mu = 1$.

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5. A long coaxial cable consists of two concentric cylinders of radii a and b. The central conductor of the cable carries a steady current I and the outer conductor provides the return path of the current. Calculate the energy stored in the magnetic field of length l of such a cable

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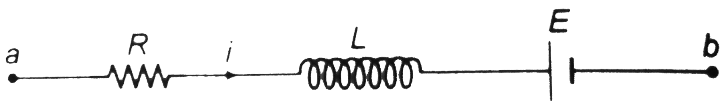
6. In the circuit diagram shown in Figure, $R = 10\Omega$, $L = l5H$, $E = 20v$, $i = 2A$. This current is decreasing at a rate of $-1.0A/s$. Find V_{ab} at this instant.



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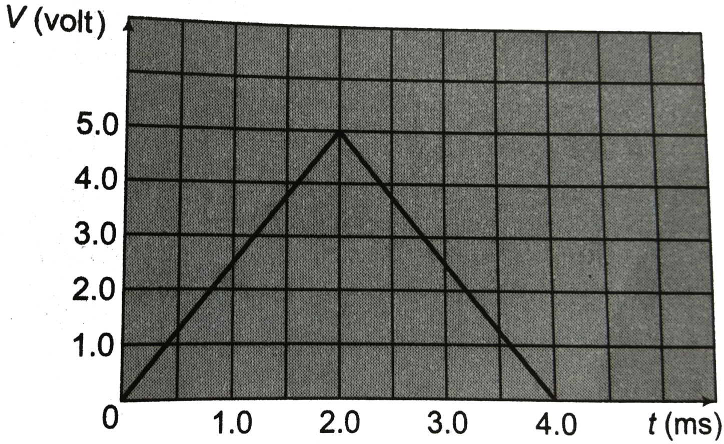
7. The potential difference across a $150mH$ inductor as a function of time is shown in figure. Assume that the initial value of the current in the inductor is zero. What is the current when

$t = 2.0ms$? and $t = 4.0ms$?



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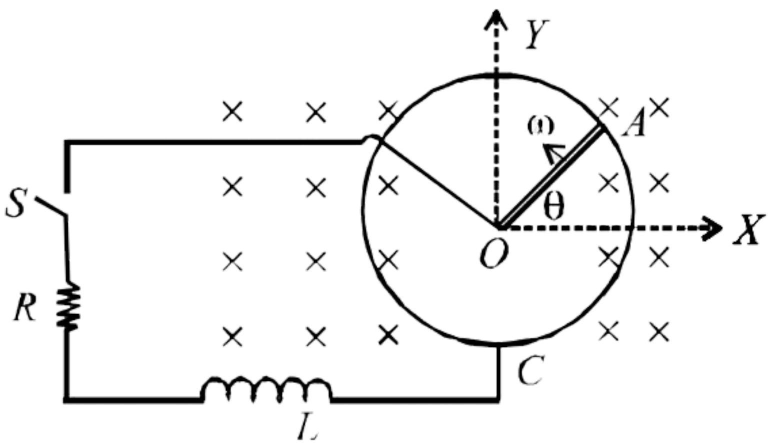
8. A metal rod OA of mann 'm' and length 'r' is kept rotating with a constantangular speed ω in a vertical plane about a horizontal axis at the end O. The free end A is arraged to slide without friction along fixed conduction circular ring in the same plane as that of rotation. A uniform and constant magnetic induction $\overrightarrow{B}$ is applied perpendicular and into the plane of rotation as shown in the figure below. An inductor L and an external resistance R are connected through a swithch S between the point O and a point C on the ring to form an electrical circuit. Neglect the resistance of the ring and the rod. Initially, the switch is open.



(a) What is the induced emf across the teminal of the switch?

(b) The switch S is closed at time t=0.

(i) Obtain an expression for the current as a function of time.

(ii) In the steady state, obtin the time dependence of the torque required to maintain the constant angular speed, given that the rod OA was along th positive X-axis at t=0.

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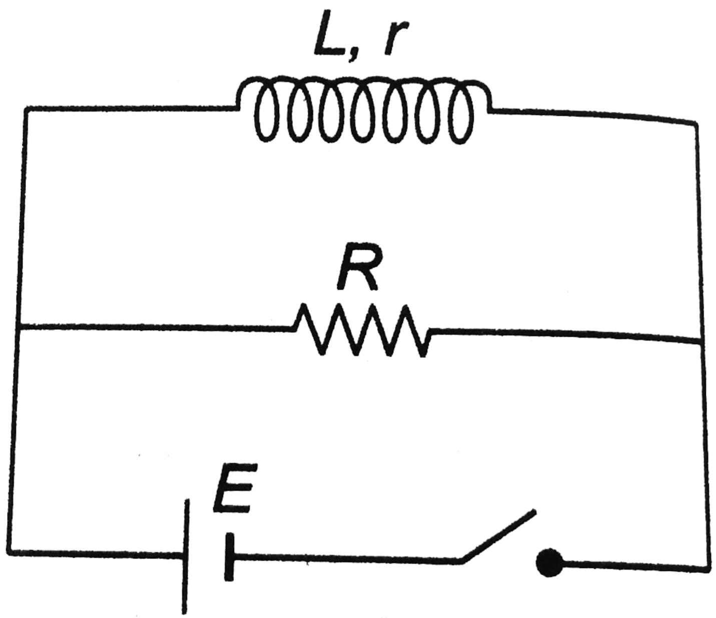
9. A solenoid of inductance L with resistance r is connected in parallel to a resistance R. A battery of emf E and of negligible internal resistance is connected across the parallel combination as shown in the figure. At time $t = 0$, switch S is opened, calculate

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

(b) amount of heat generated in the solenoid.



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10. A closed circuit consits of a source of constant and E and a choke coil of inductance L connected in series. The active resistance of the whole circuit is equal to R. At the moment $t = 0$ the choke coil inductance was decreased abrupty η times. FInd the current in the circuit as a function of time t.

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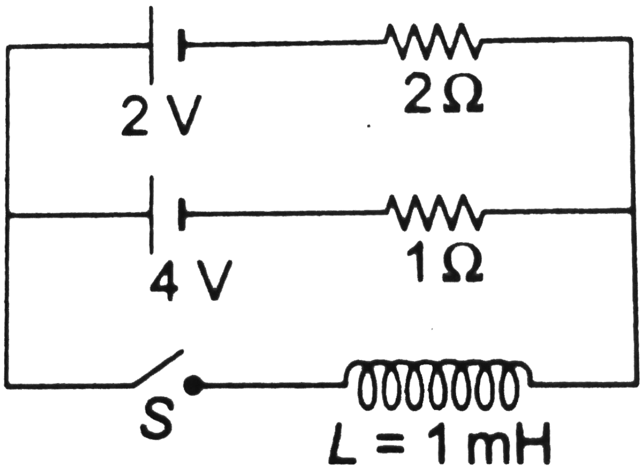
11. In the circuit shown, switch S is closed at time $t = 0$. Find the current through the inductor as a function of time t.



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12. Find the total field energy of magnetic field stored per unit length inside a long cylindrical wire of radius R and carrying a current I.

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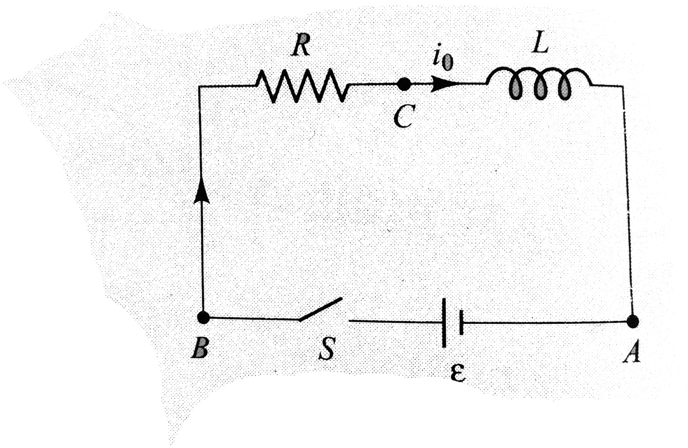
13. Figure shows a circuit consisting of an ideal cell, an inductor L, and a resistor R, connected in series. Let switch S be closed at $t = 0$. Suppose at $t = 0$, the current in the inductor is i_o, then find out the equation of current as a function of time.



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Practice Exercise 5.4

1. Two thin concentric wires shpaed as circles with radii a and b lie in the same plane. Allowing for $a < \; < b$, find:

(a) their mutual inductane,

(b) the magnetic flux through the surface enclosed by the outside wire, when the inside wire carries a current I.

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2. 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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3. Find the appoximate formula expressing the mutual inductance of two thin coaxial loops of the same radius a if their centres are separated by a distance l, with $l > > a$

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4. The equivalent inductance of two inductors is $2.4H$ when connected in parallel and $10H$ when connected in series then the value of inductance of two inductors ?

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5. A circular coil P of 100 turns and radius $2cm$ is placed coaxially at the center of another circular coil Q of 100 turns and radius $20cm$. Calculate (a) the mutual inductance of the coils

(b) the induced emf in coil P when the current in the coil Q decreases from $5A$ to $3A$ in 0.04 sec (Take $\pi^2 = 10$)

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6. A long solcnoid of length 1m, cross-sectional area $10cm^2$, having 1000 turns has wound about its centre a small coil of 20 turns. Compute the mutual inductance of the pair of solenoid and the coil . What is the induced EMF in the coil when the current in the solenoid changes at the rate of $10A/s$?

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7. An inductor with an inductance of 2.5H and a resistance of 8Ω is connected to the terminals of a battery with an EMF 6V and negligible internal resistance. Find

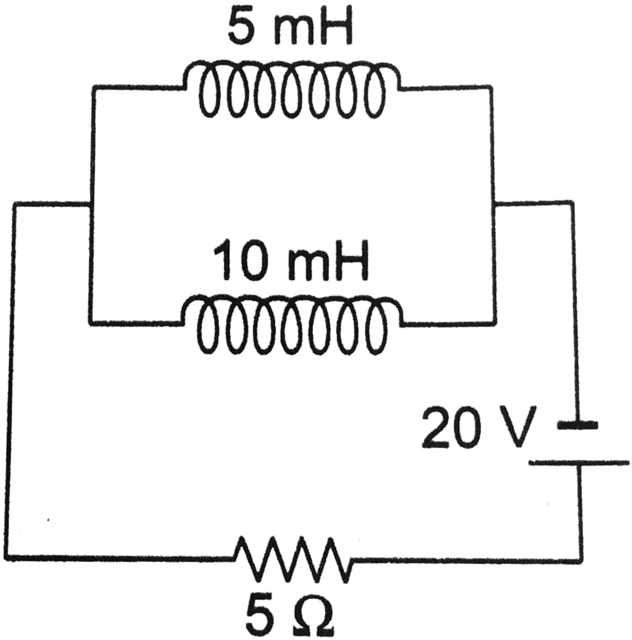
(a) The initial rate of increase of current in the circuit

(b) The rate of increase of current at the instant when the current is 0.50A

(c) The current 0.25s after the circuit is closed

(d) The final steady state current

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



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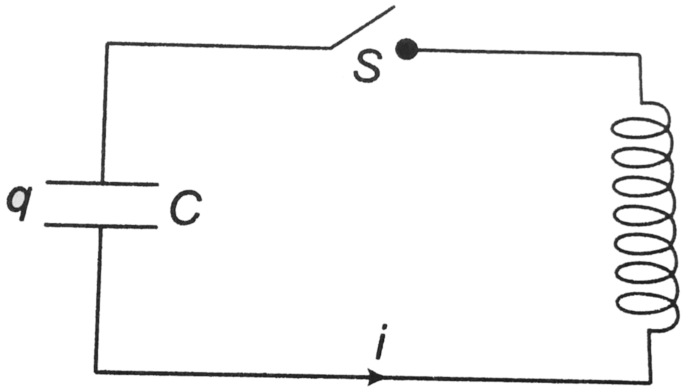
9. In the $L-C$ circuit shown, $C=1\mu F$. With capacitor charged to $100V$, switch S is suddenly closed at time $t=0$. The circuit then oscillates at $10^3 Hz$

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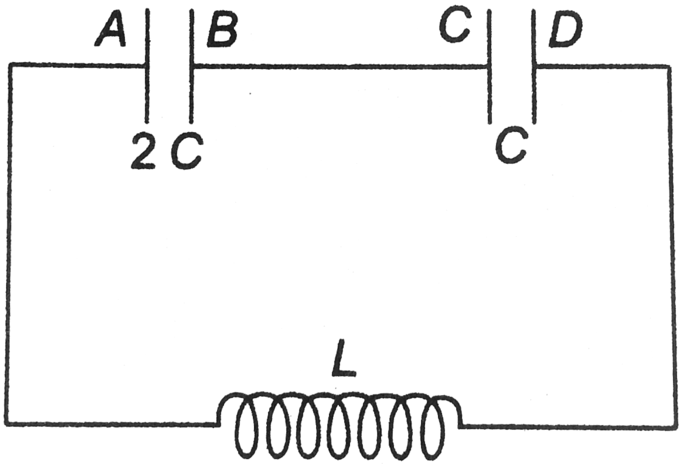
10. Two capacitors of capacitances $2C$ and C are connected in series with an inductor of inductance L. Initially, capacitors have charge such that $V_B - V_A = 4V_0$ and $V_C - V_D = V_0$. Initial current in the circuit is zero. Find



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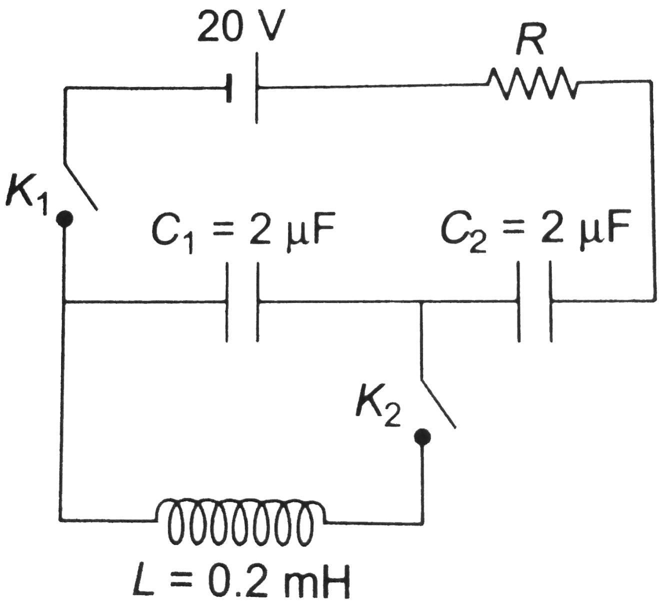
11. A circuit containing capacitors C_1 and C_2, shown in the figure is in the steady state with key K_1 closed and K_2 opened. At the instant $t = 0$, K_1 is opened and K_2 is closed.



(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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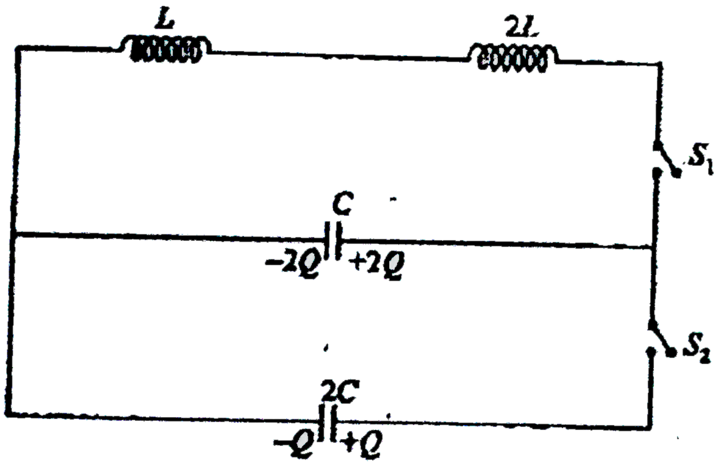
12. In circuit shown in figure-5.149 if switches S_1 and S_2 are closed at t=0, find the oscillation frequency of charge in this circuit. Neglect mutual induction between inductors.



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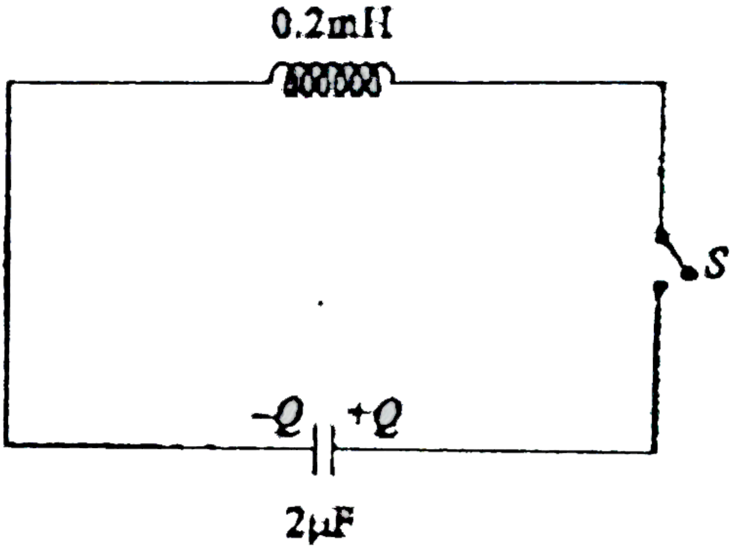
13. Figure-5.150 shows LC circuit with initial charge on capacitor $200\mu C$. If at t=0 switch is closed, find the first instant when energy stored in inductor becomes one third that of capacitor.



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Practice Exercise 5.5

1. An AC voltage is given as $e = e_1 \sin \omega t$. Find the RMS value of this voltage.

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2. In a wire direct current i_1 and an AC current $i_2 = i_{20} \sin \omega t$ is superposed. Find the RMS value of current in wire.

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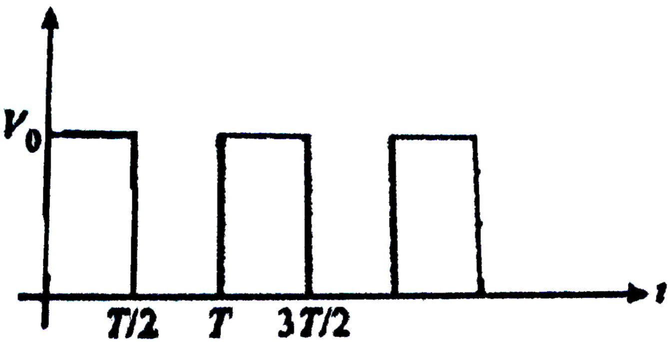
3. Calculate the RMS value of the EMF for a cycle of which time variation is shown in figure-5.172



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4. In a given AC circuit through a specific branch the current varies as a function of time given as

$i = i_0 \sin^2 \omega t \qquad 0 \leq \omega t < \pi$

and $i = i_0 \sin \omega t \qquad \pi \leq \omega t < 2\pi$

Calculate the average current per cycle of this AC.

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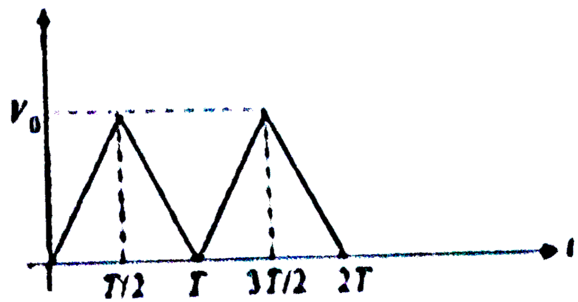
5. Calculate the root mean square value of the voltage of the given variation of an alternating EMF with time in graph as shown in figure-5.173.



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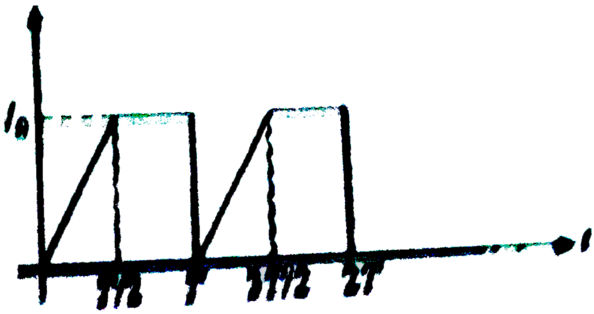
6. In previous question calculate the average voltage per cycle of the alternating EMF.

Watch Video Solution

7. Calculate the average value of the AC per cycle for which time function of the current is shown in figure-5.174.



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Practice Exercise 5.6

1. A series circuit consists of a resistance of 15Ω, an inductance of 0.08H and a capacitor of capacitance $30\mu F$. The applied voltage has frequency of $500 rad / s$. Does the current lead or lag the apllied voltage and by what angle.

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2. An 220V AC voltage at a frequency of 40 cycles/s is applied to a circuit containing a pure inductance of 0.01H and a pure resistance of 6Ω in series. Calculate

(a) The current supplied by source

(b) The potential difference across the resistance

(c) The potential difference across the inductance

(d) The time lag between maxima of current and EMF in circuit

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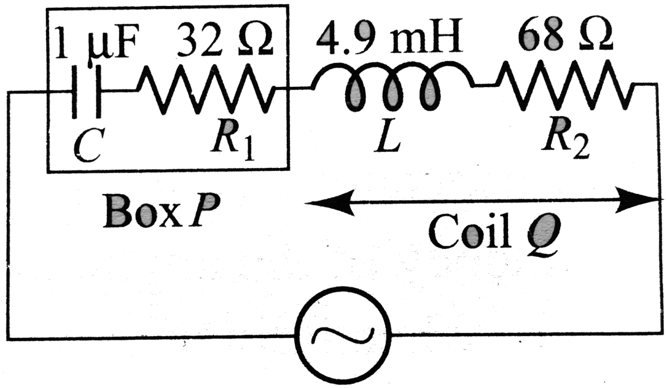
3. A box P and a coil Q are connected in series with an ac source of variable frequency. The emf of the source is constant at 10 V. Box P xontains a capacitance of 32Ω. Coil Q has a self inductance of

4.9 mH and a resistance of 68Ω in series. The frequency is adjusted so that maximum current flows in P and Q.



The voltage across P is

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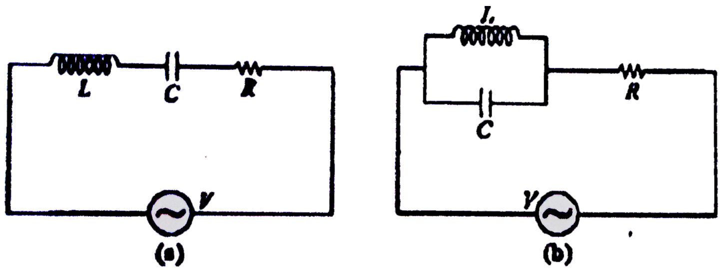
4. An AC source is connected to two circuits as shown in figure-5.229. Obtain the current through

resistance R at resonance in both the circuits.



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5. A resistor R an inductance L and a capacitor C are all connected in series with an ac supply The resistance of R is $16 ohm$ and for the given frequency the inductive reactance of L is 24 ohm and the capacitive reactance of C is $12 ohm$ If the current in the circuit is $5A$ find

(a) the potential difference across R, L and C

(b) the impedance of the circuit

(c) the voltage of the ac supply and

(d) the phase angle .

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6. A series circuit consists of a resistance, inductance and capacitance. The apllied voltage and the current at any instant are given as

e=141.4 cos (300t-10^(@)) and i=5 cos (3000t-55^(@))`

The inductance is 0.01H. Calculate the values of the resistance and capacitance.

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7. A circuit with $R = 70\Omega$ in series with a parallel combination of L=1.5H and $C = 30\mu F$ is a driven by a 230 V supply of angular frequency $300rad / s$.

(a) Find the impedance of the circuit.

(b) What is the RMS value of total current ?

(c) What are the current amplitudes in the L and C arms of the circuit ? (d) How will the circuit behave at $\omega = 1 / \sqrt{LC}$?

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8. A resistance of 10Ω is joined in series with an inductance of 0.5H. What capacitance should be put in series with the combination to obtain the maximum current ? What will be this maximum current ? What will be the potential difference across the resistance, inductance and capacitance ? The current is being supplied by 200 V, 50Hz AC mains.

Watch Video Solution

Practice Exercise 5.7

1. A series LCR circuit containing a resistance of 120Ω has angular resonance frequency $4 \times 10^5 rads^{-1}$. At resonance the vlotage across resistance and inductance are 60V and 40 V, repectively,

At what frequency, the current in the circuit lags the voltage bu 45° ?

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2. 2000V- 200V, 20kVA transformer has 66 turns in the secondary. Calculate the primary and secondary full-load current, neglect power losses in transformer.

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3. A circuit draws a power of 550 watt from a source of 220 volt, $50Hz$. The power factor of the circuit is 0.8 and the current lags in phase behind the potential difference. To make the power factor of the circuit as 1.0, The capacitance should be connected in series with it is

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4. A series LCR circuit with $L = 0.12H, C = 480nF,$ and $R = 23\Omega$ is connected to a $230V$ variable frequency supply.

(a) What is the source frequency for which current amplitude is maximum? Find this maximum value.

(b) What is the source frequency for which average power absorbed by the circuit is maximum? Obtain the value of maximum power.

(c) For which frequencies of the source is the power transferred to the circuit half the power at resonant frequency?

(d) What is the Q-factor of the circuit?

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5. A $20V$ 5 watt lamp is used in ac main $220V$ and frequency 50 c.p.s.

What pure resistance should be included in place of the above passive elements so that the lamp can run on its rated voltage?

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6. An inductor-coil , a capacitor and an AC source of rms voltage $24V$ are connected in series. When the frequency of the source is varied, a maximum rms current of $6.0A$ is observed. If this inductor coil is connected to a battery of $emf 12V$ and internal resistance 4.0Ω, what will be the current?

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7. In a step - down transformer having primary to secondary turn ratio $20:1$ the input voltage applied is $250V$ and output current is $8A$ Assuming 100% efficiency calculate the

(a) voltage across secondary coil

(b) current in primary coil

(c) power output .

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8. Inductance (L), capacitance (C) and resistance (R) are constained in a box. When 250 V DC is applied to the terminals of the box, a current of 1.0A floes in the circuit. When an AC source of $250V_{rms}$ at $2250 rad \sec^{-1}$ is connected, a current of $1.25A_{rms}$ flows. It is observed that the current rises with frequency and becomes maximum at $4500 rad \sec^{-1}$. find the values of L,C and R. draw the circuit diagram.

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9. In series LCR circuit $R = 120\Omega$ and it has resonant frequency $4000 rad / \sec$. At resonance, the voltage across resistance and inductance is 60 V and 40 V respectively. Find the value of L and C in circuit.

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10. A transformer has 200 turns in primary coil and 600 turns in secondary coil. If a 220 V DC is applied across primary coil what will be the voltage across secondary coil.

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11. A transformer is used to light a 140 W, 24 V lamp from 240 V AC mains. The current in mains cable is 0.7 A, find the efficiency of transformer.

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Discussion Question-

1. How will be inductive reactance and capacitive reactance change on decreasing the frequency of alternating current to zero from an initial value?

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2. A cylindrical bar magnet is kept along the axis of coil. Will there be a current induced in the coil if the magnet is rotated about its axis ? Give reasons.

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3. The element of an electric heater is in the form of a coil. Once it is heated by dc voltage and then by ac voltage of equal potential difference. Will the production of heat in both cases be same of different?

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4. Consider the self-inductance per unit length of a solenoid at its centre and that near its ends. Which of the two is greater?

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5. A capacitor only is connected to an AC source. What will be the phase difference between the current flowing in the circuit and the potential difference between the plates of the capacitor?

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Watch Video Solution

6. What is the maximum value of power factor ? When does it occur ?

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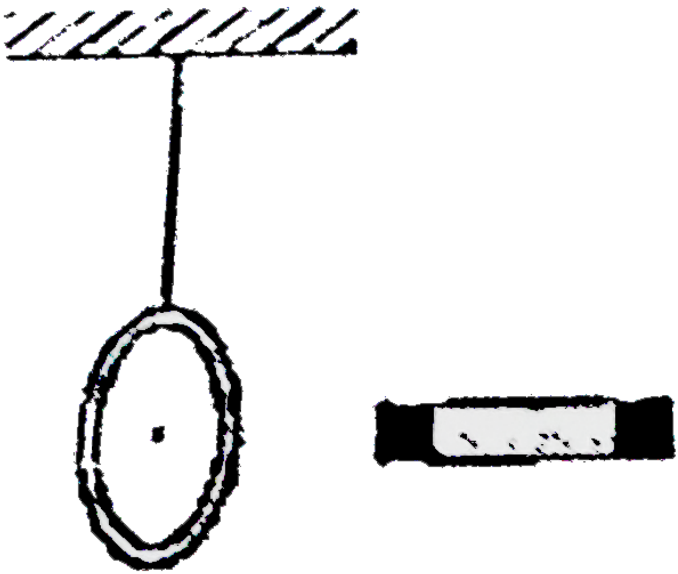
7. A copper ring is suspended in a vertical plane by a thread. A stell bar is passed through the ring in a horizontal direction and then a magnet is passed through it moving along the axis of ring. Will the motion of the bar and the magnet affect the position of the ring?



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8. For tuning radio for various stations, we change the capacitance of an air-capacitor. In order to tune the radio with a high frequency station, whether the moving plates of the variable capacitor will have to be taken inside the stationary plates or outside them ?

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9. Explain why resistance coils are usually double wound.

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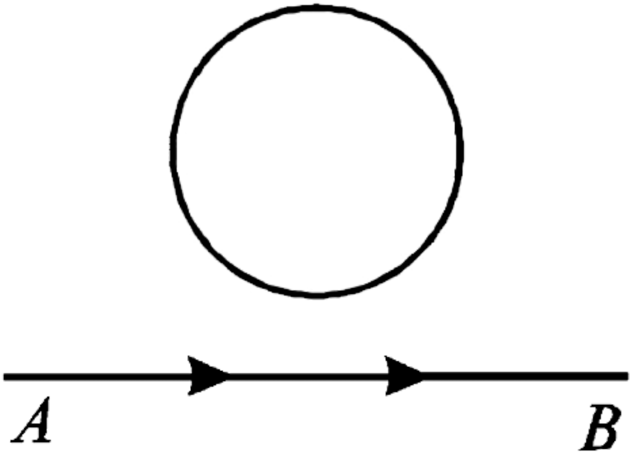
10. A current from A to B is increasing in magnitude. What is the direction of induced current. If any,in

the loop as shown in the figure?



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11. Can a transformer be used to alter DC voltage?

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12. A pure inductance is connected to an AC source. What will be the phase difference between the current and the EMF in the circuit?

Watch Video Solution

13. Dynamo core is laminated because

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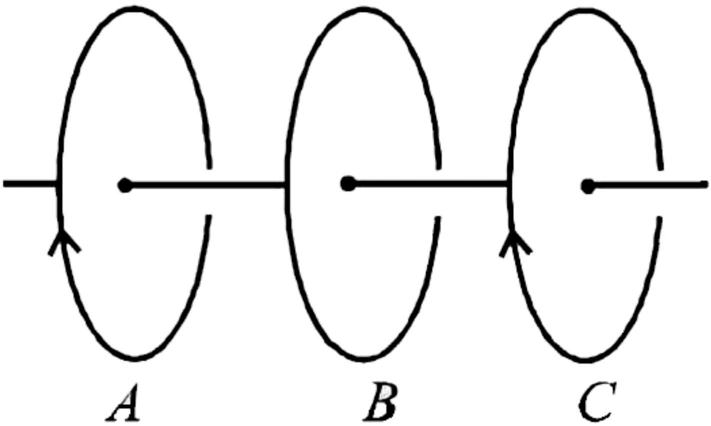
14. A copper ring and a wooden ring of same dimension are placed so that there is same magnetic flux through each. Is induced current or induced EMF same in each case when flux · starts varying at the same rate in both.

Watch Video Solution

15. Three indentical closed coils A,B and C are placed with their planes parallel to one another. Coils A and C carry equal currents as shown in fig. Coils B and C are fixed in position and coil A is moved towards B with uniform motion. Is there any indenced current in B? If no, give reasons. If yes mark the direction of the induced current in he diagram.



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16. The resistance of a coil for direct current is 10Ω. An alternating current is sent through it. Will its resistance remain the same ?

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17. A copper ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. Will the acceleration of the falling magnet be equal to, greater than or less than that due to gravity?

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18. A bulb and a capacitor are connected in series to an a.c. source of varialbe frequency. How will the brightness of the bulb change on increasing the frequency of a.c. source ?

Watch Video Solution

19. A body is suspended from the lower end of a vertical spring. What shall be the effect on the position of the body when a current is sent through the spring? Does it depend upon the direction of current in the spring?

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20. Faraday's laws are consequency of conservation of

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21. An artificial satellite with a metal surface is orbiting the earth around the equator : Will the earth's magnetism induce some current in it ?

Watch Video Solution

Conceptual MCQs

1. For an LCR series circuit with an aac source of angular frequency ω.

A. Circuit will be capacitive if $\omega > \frac{1}{\sqrt{LC}}$

B. Circuit will be inductive if $\omega = \frac{1}{\sqrt{LC}}$

C. Power factor of circuit will by unity of capacitive reactance equals inductive reactance.

D. Current will be leading voltage if $\omega > \frac{1}{\sqrt{LC}}$

Answer: C

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2. 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. $\dfrac{a^2T^2}{3R}$

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

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

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

Answer: B

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3. The total charge flown through a conducting loop in a given time duration when it is moved in magnetic field depend on: (

A. The rate of change of magnetic flux

B. Initial magnetic flux only

C. The total change in magnetic flux

D. Final magnetic flux only

Answer: C

Watch Video Solution

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

A. Is constant and is in the direction of the increasing current in it

B. Is a constant and is opposite to the direction of the increasing current in it.

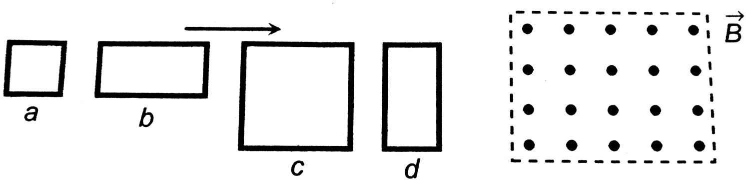
C. Increases with time and is in the direction of increasing current in it.

D. Increases with time and is opposite to the direction of the increasing current in it

Answer: B

Watch Video Solution

5. The figure shows four wire loops, with edge length of either L or $2L$. All four loops will move through a region of uniform magnetic field $\overrightarrow{B}$ (directed out of the page) at the same constant velocity . Rank the four loops according to the maximum magnitude of the e.m.f. induced as they move through the field, greatest first



A. $(e_c = e_d) < (e_a = e_b)$

B. $(e_c = e_d) > (e_a = e_b)$

C. $e_c > e_d > e_b > e_a$

D. $e_c < e_d < e_b < e_a$

Answer: A

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

A. Current will increase in each loop

B. Current will decrease in each loop

C. Curren will remain same in each loop

D. Current will increase in one and decrease in the other.

Answer: D

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7. 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. Electronagnetic induction in the aluminium plate giving rise to electroagnetic damping by eddy currents

B. Development of air current when the plate is placed

C. Induction of electrical charge on the plate

D. Shiclding of magnetic lines of force as aluminium is a paramagnetic material.

Answer: B

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8. In a given solenoid if the number of turns and the length of the solenoid are doubled keeping the area of cross-section same, then it's inductance:

A. Remains the same

B. Is halved

C. Is doubled

D. Becomes foru times

Answer: C

Watch Video Solution

9. Eddy currents are produced in a matterial when it is

A. A metal body is kep in a time varying magnetic field

B. A metal body is kept in the steady magnetic field

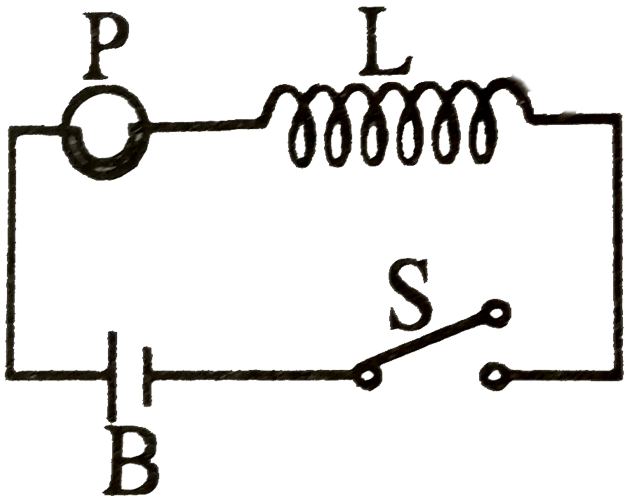
C. A circular coil is placed in a magnetic field

D. Through a circular coil current is passed.

Answer: B

Watch Video Solution

10. In figure, a lamp P is in series with an iron-core inductor L. When the switch S is closed, the brightness of the lamp rises relatively slowly to its full brightness than it would do without the inductor. This is due to



A. the low resistance of P

B. the induced EMF in L

C. the low resistance of L

D. the high voltage of the battery B

Answer: B

Watch Video Solution

11. 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 continuosly till it reaches the centre of the ring.

Answer: A

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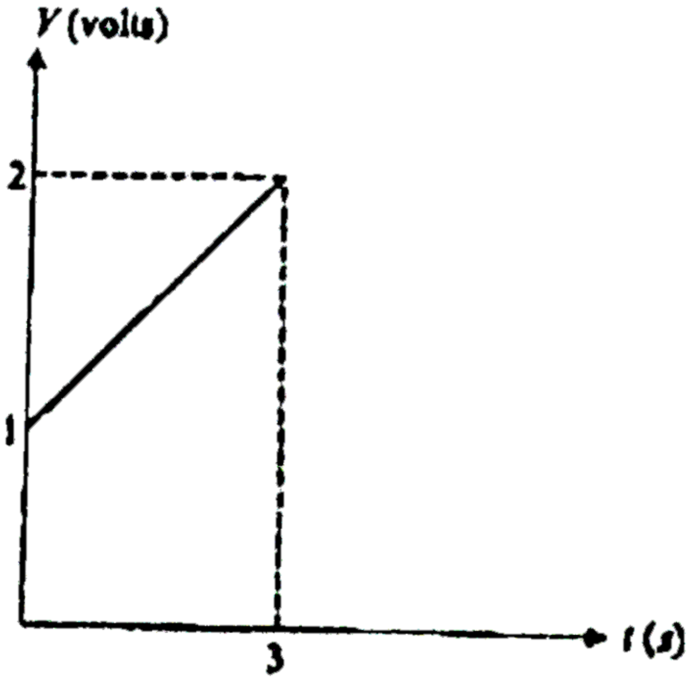
12. A circuit element is placed in a closed box. At time I= 0, constant current generator supplying a current of IA, is connected across the box. Potential difference across the box varies according to graph shown in figure-5.248. The element in the box is:



A. Resistance of 2Ω

B. Battery of emf $6 V$

C. Inductance of 2H

D. Capacitors of 3F

Answer: C

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13. Identify the incorrect statement. Induced electric field

A. Is produced by varyig magnetic field

B. is not conservative in nature

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

D. None of the above

Answer: B

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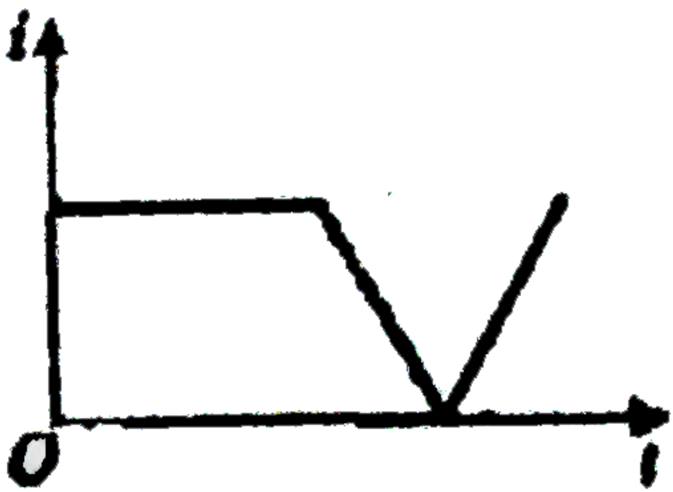
14. A periodic voltage V varies with time t as shown in the figure 5.249. Tis the time period. The RMS value of the voltage for one cycle is :



A. $\frac{V_0}{g}$

B. $\frac{V_0}{2}$

C. V_0

D. $\frac{V_0}{4}$

Answer: D

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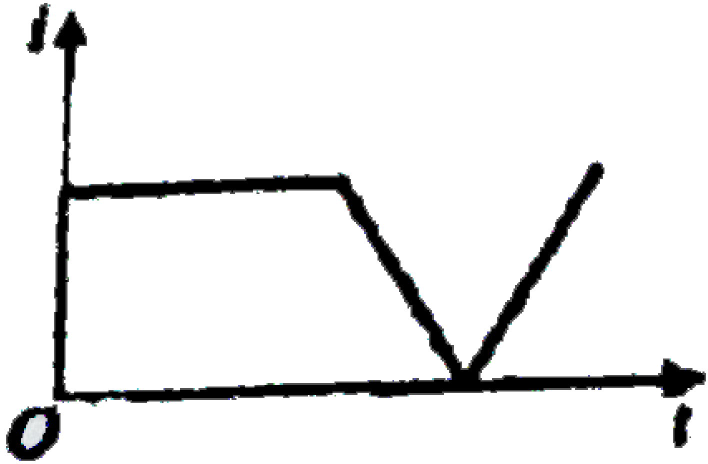
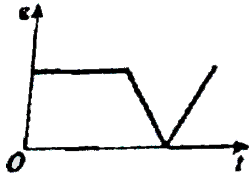
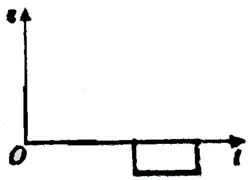
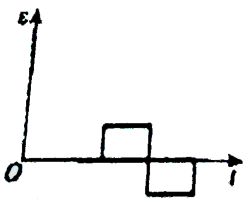
15. The current i in an induction coil varies with time t according to the graph shown in the figure-5.250. Which of the following graphs shows the induced

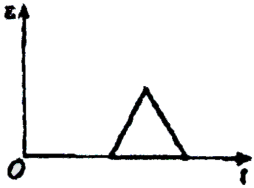
EMF in the coil with time ?



A. 

B. 

C. 

D. 

Answer: D

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16. In an RLC circuit, capacitance is changed from C to 2C. For the resonant frequency to remain unchanged, the inductance should be changed from L to :

A. 4L

B. 2L

C. L/2

D. L/4

Answer: B

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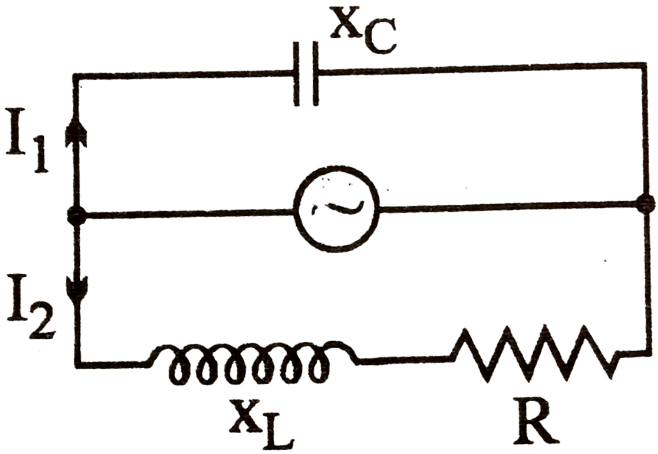
17. In the shown AC circuit phase different between current I_1 and I_2 is



A. $\dfrac{\pi}{2} - \dfrac{\tan^{-1}(X_L)}{R}$

B. $\dfrac{\tan^{-1}(X_L - X_C)}{R}$

C. $\dfrac{\pi}{2} + \dfrac{\tan^{-1}(X_L)}{R}$

D. $\dfrac{\tan^{-1}(X_L - X_C)}{R} + \dfrac{\pi}{2}$

Answer: A

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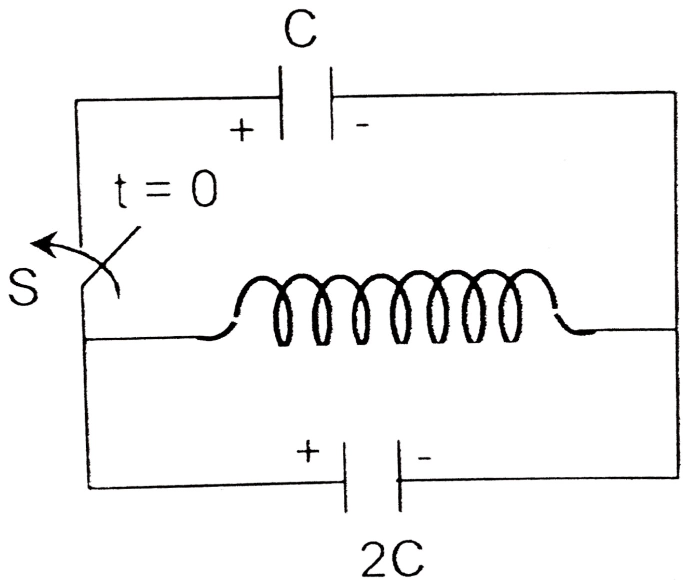
18. In the given LC circuit if initially capacitor C has change Q on it and $2C$ has charge $2Q$. The polarities are as shown in the figure. Then after closing the switch s at $t = 0$



A. Energy will get equally distributed in both the capcitor just after closing the switch.

B. Initial rate of growth of current in inductor is

2Q/3CL

C. Maximumum energy in the inductor will be

$4Q^2/3C$

D. None of these

Answer: D

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19. In a series RLC circuit, the fequency. Passing through a coil as shown in figure-5.253. The time variation of the magnitude of EMF generated across the coil during one cycle is:

A. Capacitive

B. Inductive

C. Purely resistive

D. Selective

Answer: D

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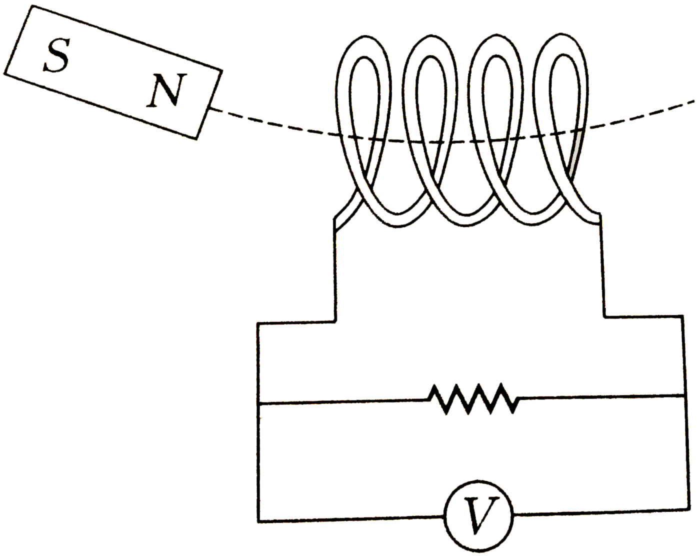
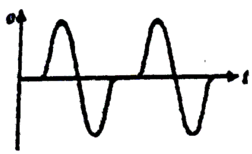
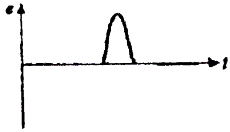
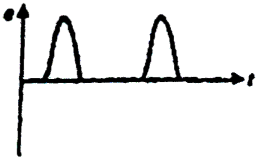
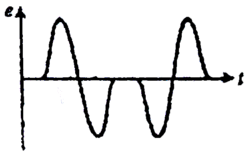
20. A magnet is made to oscillate with a particular frequency, passimg through a coil as shown in figure. The time variation of the magnitude of emf generated across the coil during one cycle



A. 

B. 

C. 

D. 

Answer: a

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21. Which materials have negative value of magnetic susceptibility?

A. Non magnetic

B. Para magnetic

C. Dimagnetic

D. Ferromagnetic

Answer: C

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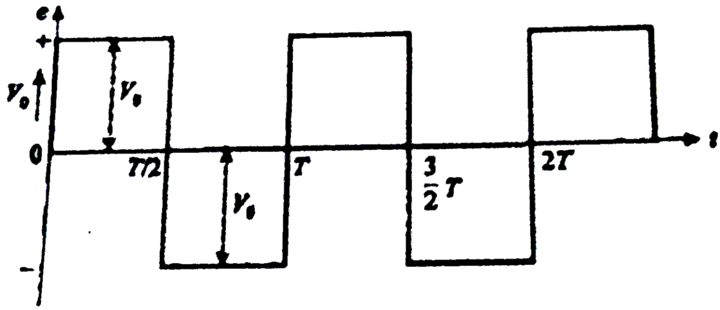
22. The average and RMS value of voltage for square wave shown in figure-5.254 having peak value V_0

are:



A. $\frac{V_0}{\sqrt{2}}, \sqrt{2}V_0$

B. $\sqrt{2}V_0, \frac{V_0}{\sqrt{2}}\Big)$

C. V_0, V_0

D. Zero,V_0

Answer: A

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23. 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: C

Watch Video Solution

24. In ac circuit when ac ammeter is connected it reads i current if a student used dc ammeter in place of ac ammeter the reading in the dc ammeter will be:

A. $\frac{i}{\sqrt{2}}$

B. $\sqrt{2i}$

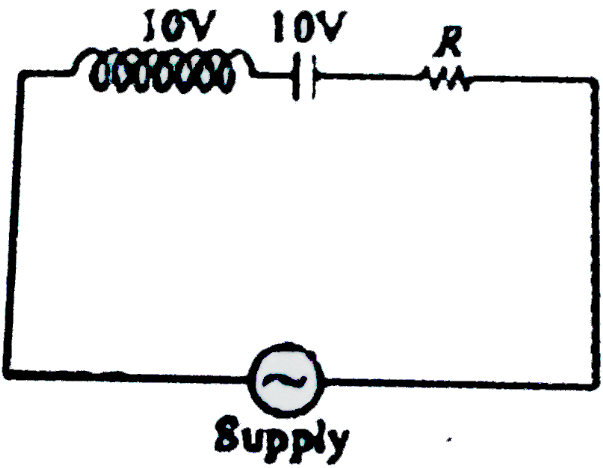
C. 0.637i

D. Zero

Answer: D

Watch Video Solution

25. If v alue of R is changed in the series RLC circuit shown in figure-5.255, then:



A. voltage across L remains same

B. voltage across C remains same

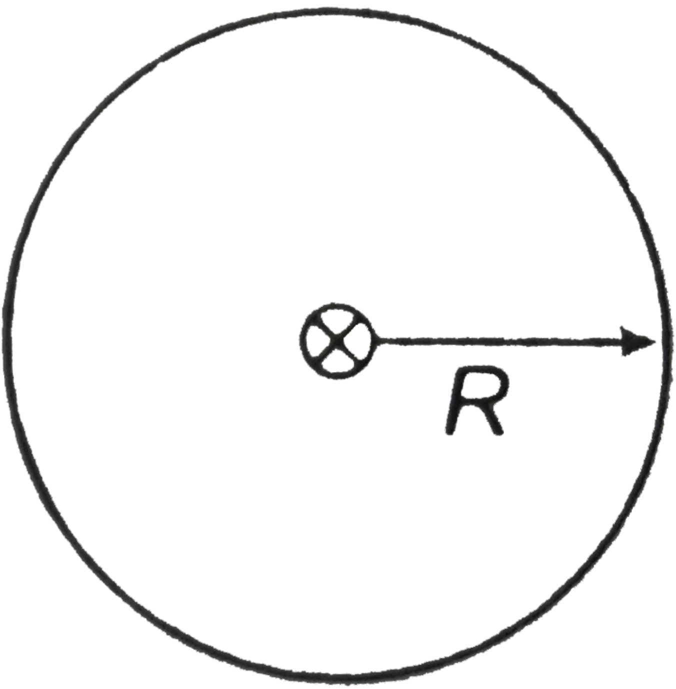
C. voltage across LC combination remains same

D. voltage across LC combination changes

Answer: C

Watch Video Solution

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

Watch Video Solution

27. Which of the following material is ferromagnetic

A. Bismuth

B. Nickel

C. Quartz

D. Aluminium

Answer: C

Watch Video Solution

28. In series RLC AC circuit, at resonance, the current is:

A. Always in phase with the genrator voltage.

B. Always lags the generator voltage

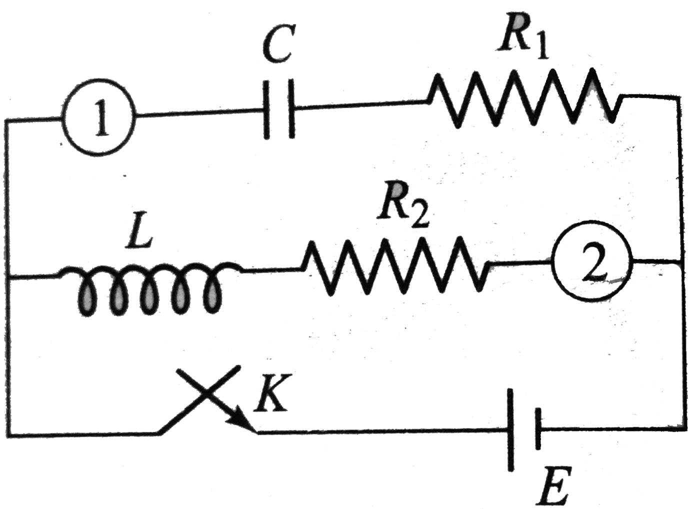
C. Always leads the generator voltage

D. May lead or lag behind the generator voltage.

Answer: B

Watch Video Solution

29. In the circuit of Fig. (1) and (2) are ammeters. Just after the key K is pressed to complete the circuit, the reading is



A. Maximum in both 1 and 2

B. Zero in both 1 and 2

C. Zero in 1, minimum in 2

D. Maximum in 1,zero in 2

Answer: D

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30. The value of current in two series LCR circuits at resonance is same when connected across a sinusodial voltage source. Then:

A. Both circuits must be having same value of capacitance and inductor

B. In both circuits ratio of L and C will be same

C. For both the circuits X_L / X_C must be same at that frequency

D. Both circuits must have same impedance at all frequencies .

Answer: C

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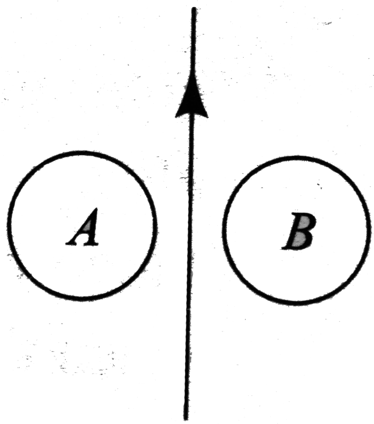
31. A and B two metallic rings placed at opposite sides of an infinitely long straight conducting wire as shown in Fig. 3.157. If current in the wire is slowly decreased, the direction of the induced current will be



A. Clockwise in A and anticlockwise in B

B. Anticlockwise in A and clockwise in B

C. Clockwise in both A and B

D. Anticlockwise in both A & B

Answer: C

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32. The area of B-H hysteresis curve is an indication of:

A. The permeability of the substance

B. The susceptibility of the substance

C. The retentivity of the substance

D. The enrgy dissipated per cycle per unit volume of the substance

Answer: D

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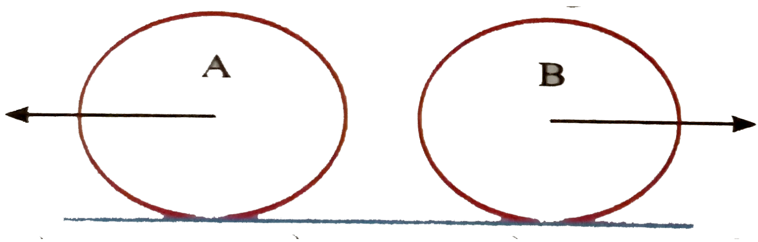
33. Two identical conducting rings A and B of radius R are rolling over a horizontal conducting plane with same speed v but in opposite direction. A constant magnetic field B is present pointing into the plane of paper. Then the potential difference between the highest points of the two rings is



A. Zero

B. 2BvR

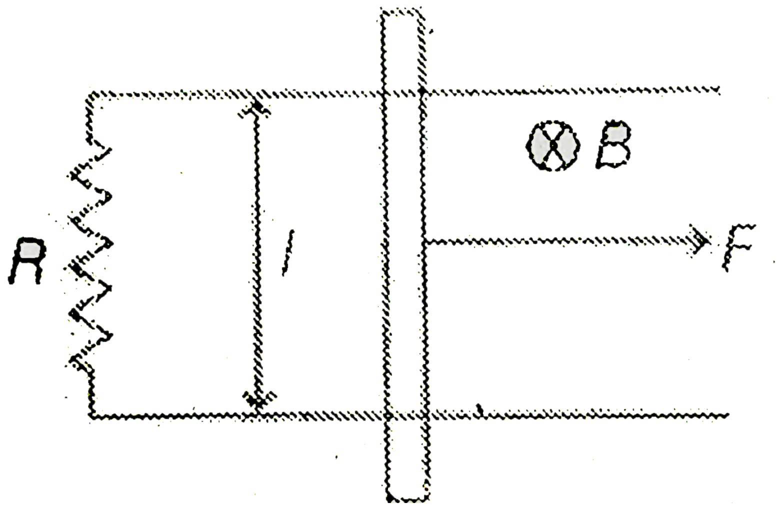
C. 4BvR

D. None of these

Answer: C

Watch Video Solution

34. A constant force is being applied on a road of length 'l' kept at rest on two parallel conducting rails connected at ends by resistance R in uniform magnitic field B shown.



A. The power delivered by force wil be constant with time

B. The power delivered by force will be increasing first and then will decrease

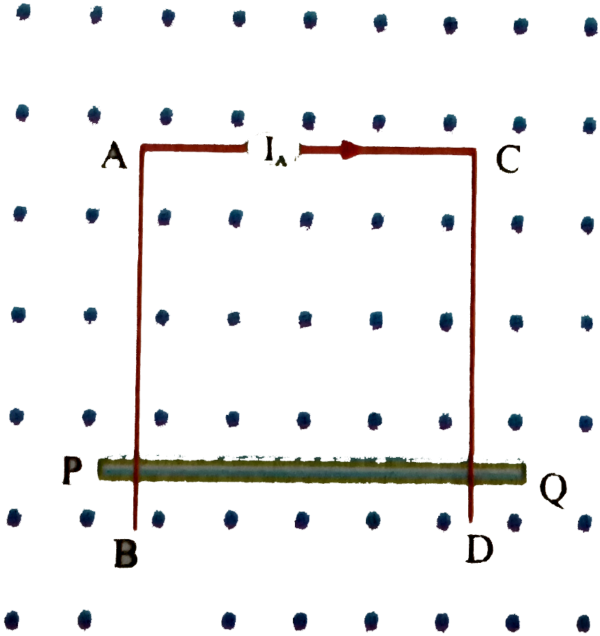
C. The rate of power delivered by the external force will be increasing continously

D. The rate of power delivered by external force will be decreasing continously.

Answer: B

Watch Video Solution

35. AB and CD are fixed conducting smooth rails placed in a vertical plane and joined by a constant current source at its upper end. PQ is a conducting rod which is free to slide on the rails. A horizontal uniform magnetic field exists in space as shown in figure. If the rod PQ is released from rest then,



A. The rod PQ will move downward with constant acceleration

B. The rod PQ will move upward with constnat acceleration

C. The rod will move downward with decreasing accelration and finally acquire a constant velocity

D. Either A or B.

Answer: D

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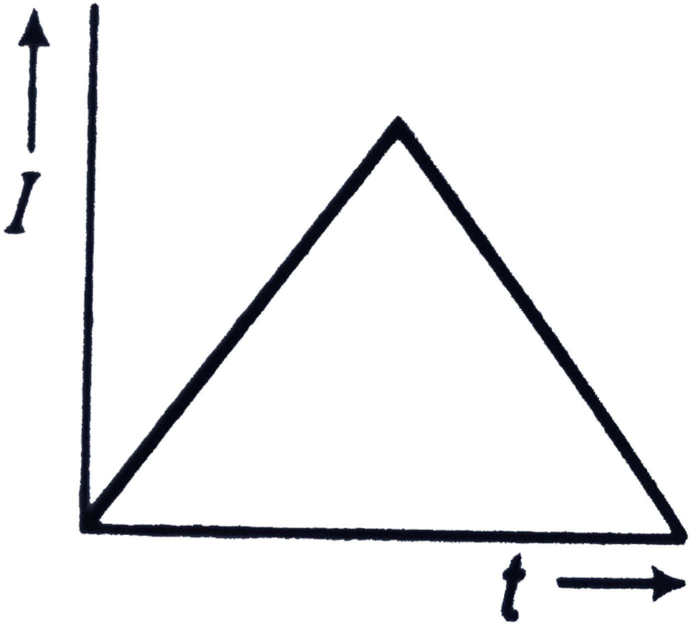
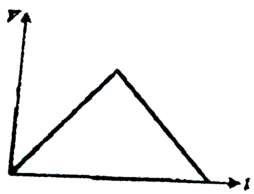
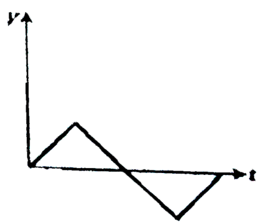
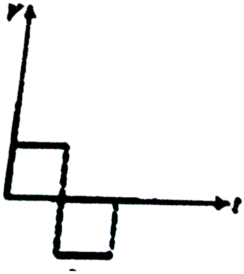
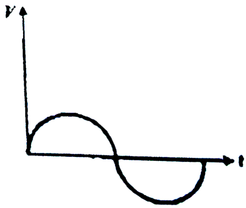
36. An alternating current I in an inductance coil varies with time t according to the graph as shown: Which one of the following graph gives the variation of voltage with time?



A. 

B. 

C. 

D. 

Answer: D

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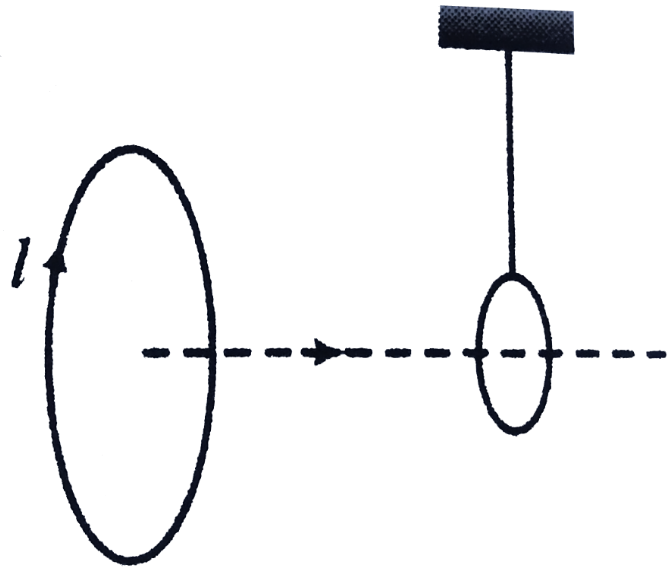
37. A small circular loop is suspended from an insulating thread. Another coaxial circular loop carrying a current I and having radius much larger than the first loop starts moving towards the smaller loop. The smaler loop will



A. Be attracted towards the bigger loop

B. Be repelled by the bigger loop

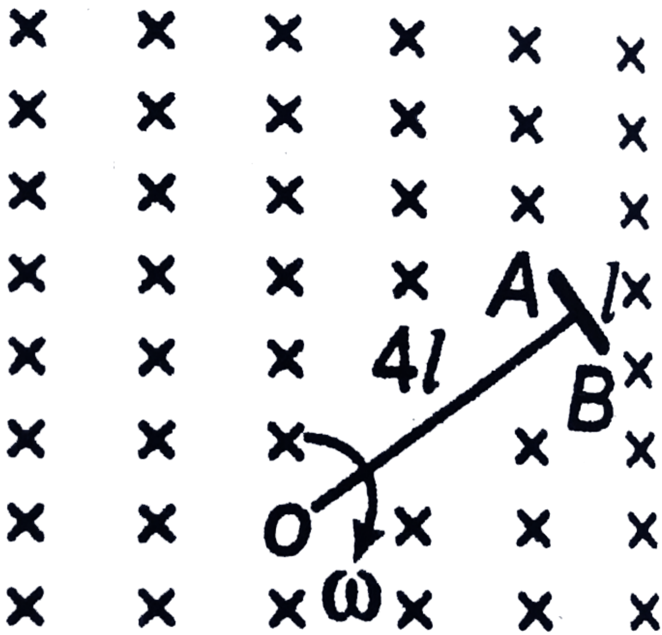
C. Expreince no force

D. All of the above

Answer: D

Watch Video Solution

38. 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. $2B\omega^2$

D. $B\omega^2$

Answer: A

Watch Video Solution

39. The permanent magnetic moment of the atoms of a material is not zero. The material

A. Diamagnetic

B. Paramagnetic

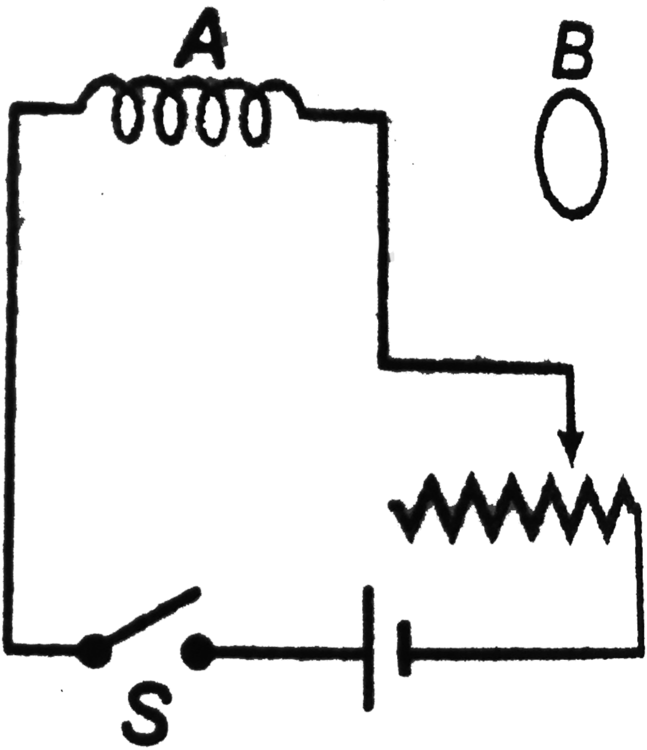
C. Ferromagnetic

D. Antiferromagnetic

Answer: A

Watch Video Solution

40. 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 A

B. Is repelled by A

C. Is initially repelled and then attracted

D. Is initially and then repelled

Answer: A

Watch Video Solution

41. Magnetic permeability is maximum for

A. Paramagnetic substances

B. Ferromagnetic Substances

C. Diamagnetic substances

D. Non-magnetic substances

Answer: A

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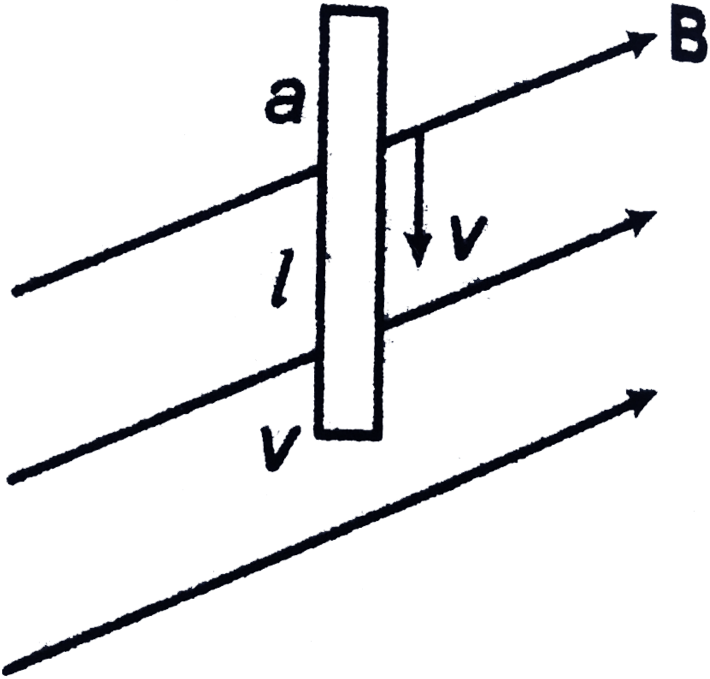
42. A conducting rod of length l falls verticaly under gravity in a region of uniform magnetic field B. The field vectors are inclined at an angle θ with the horizontal as shown in figure. If the instantaneous velocity of the rod is v, the induced emf in the rod ab is



A. Blv

B. Blv $\cos\theta$

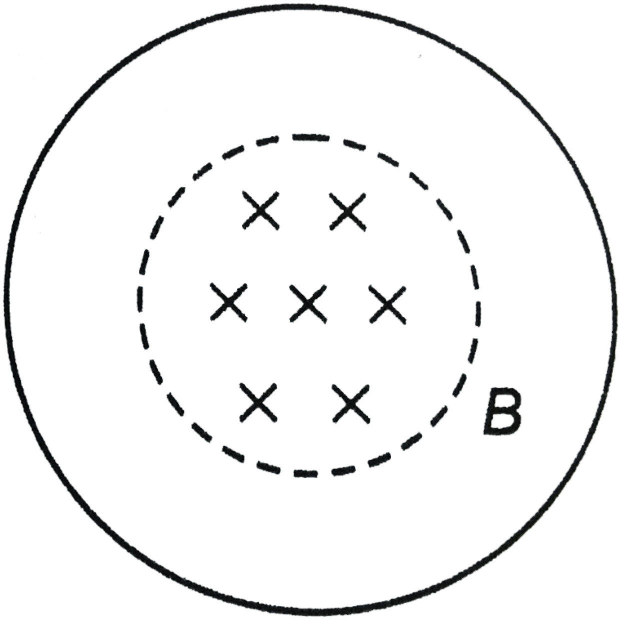
C. Blc $\sin\theta$

D. Zero

Answer: A

Watch Video Solution

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

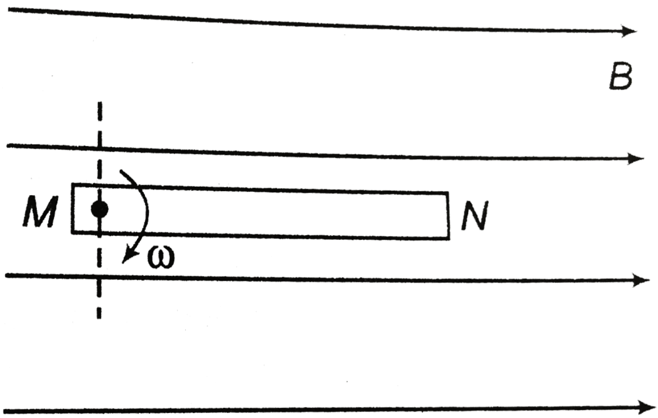
C. Zero in 1, minimum in 2

D.

Answer: A

Watch Video Solution

44. 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 $\frac{1}{2}B\omega,^2$

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

Answer: A

Watch Video Solution

45. At Curie point, a ferromagnetic material transforms into:

A. Diamagnetic

B. Paramagnetic

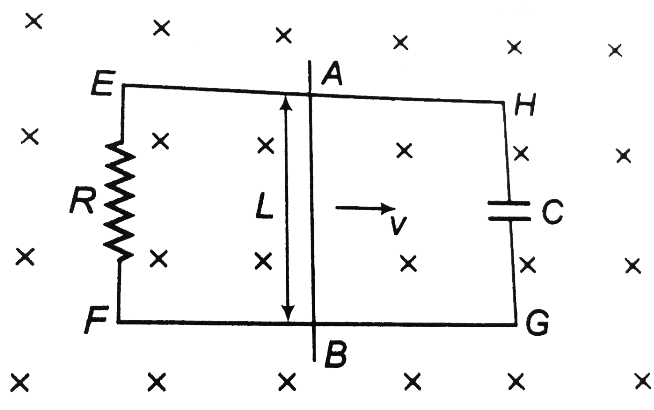
C. Ferromagnetic

D. Antiferromagnetic

Answer: A

Watch Video Solution

46. 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. Statement i and iii are correct

B. Statemetn ii and iv are correct

C. Statement i,iii and iv are correct

D. None of these

Answer: A

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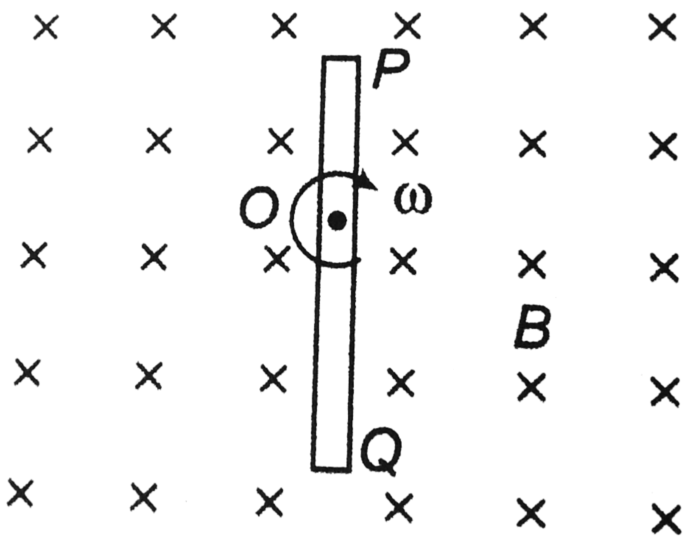
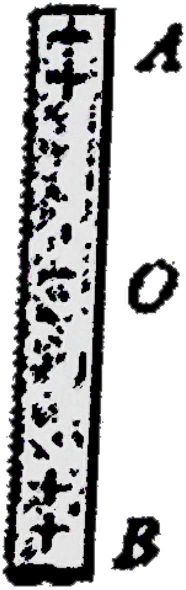
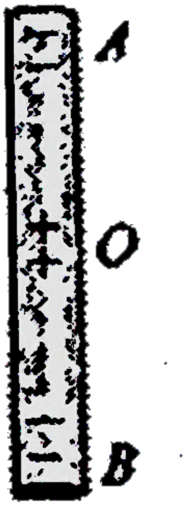
47. A rod is rotating with a constant angular velocity ω about point O (its centre) in a magnetic field B as shown. Which of the folloiwng figure correctly shows the distribution of charge inside the rod?

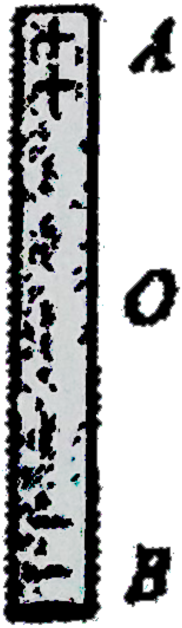


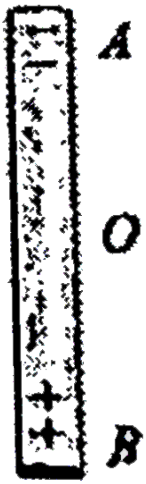


A.



B.

C. 

D. 

Answer: A

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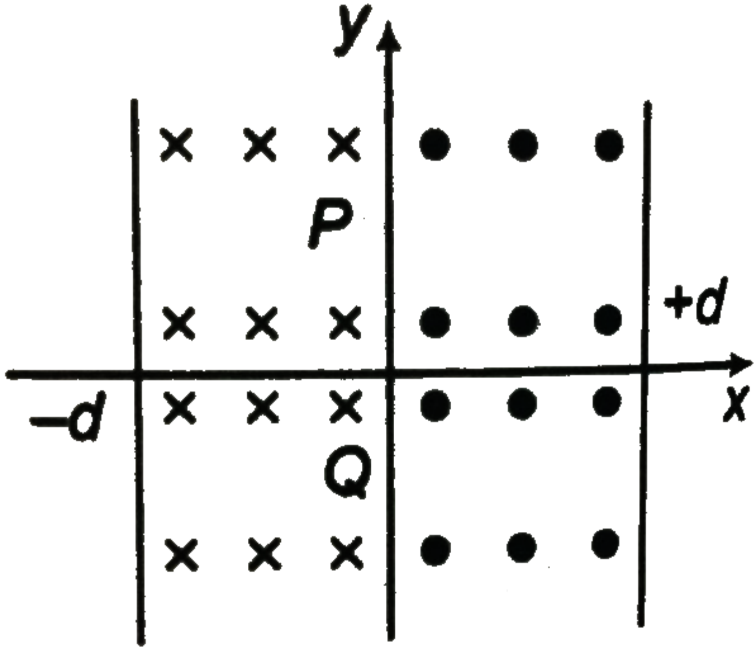
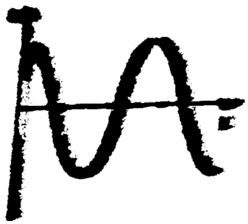
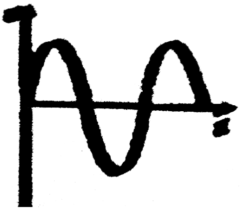
48. A straight conductig rod PQ is executing SHM in xy-plane from $x = -d$ to $x = +d$. Its mean position is $x = 0$ and its length is along y-axis. There exists a uniform magnetic field B from $x = -d$ to $x = 0$ pointing inward normal to the paper andfrom $x = 0$ to $x = +d$ there exists another uniform 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. 

B. 

C. 

D. 

Answer: A

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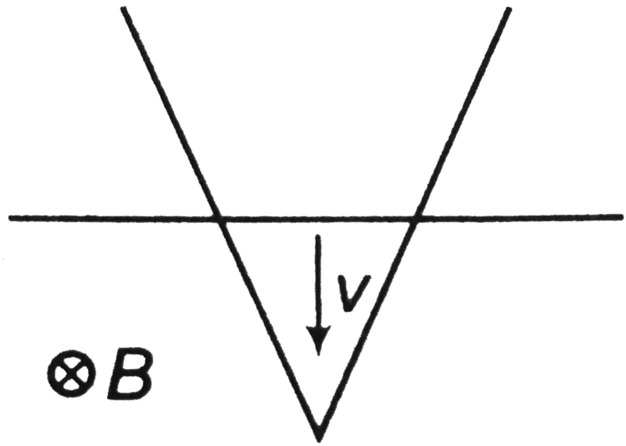
49. A wire is bent in the form of a V shape and placed in a horizontal plane.There exists a uniform magnetic field B perpendicular to the plane of the wire. A uniform conducting rod starts sliding over the V shaped wire with a constant speed v as shown in the figure. If the wire no resistance, the current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



A. Increase with time

B. Decrease with time

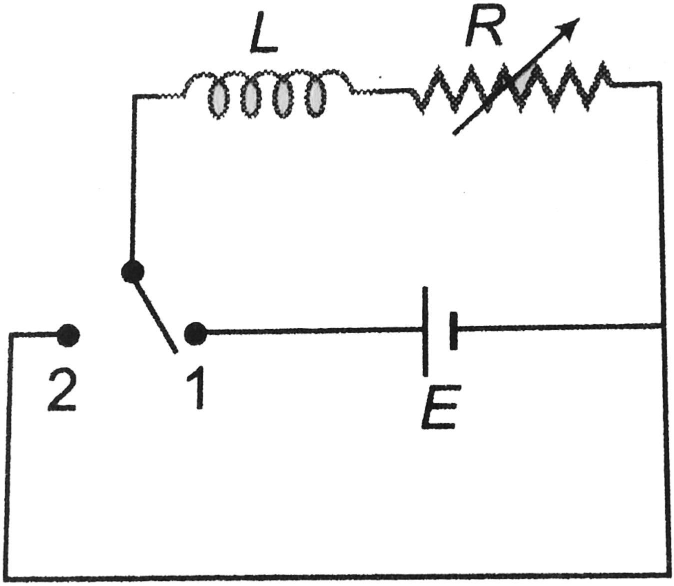
C. Remain constant

D. Always be zero

Answer: A

Watch Video Solution

50. 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 a constant rate

B. Should be increased at a cosntant rate

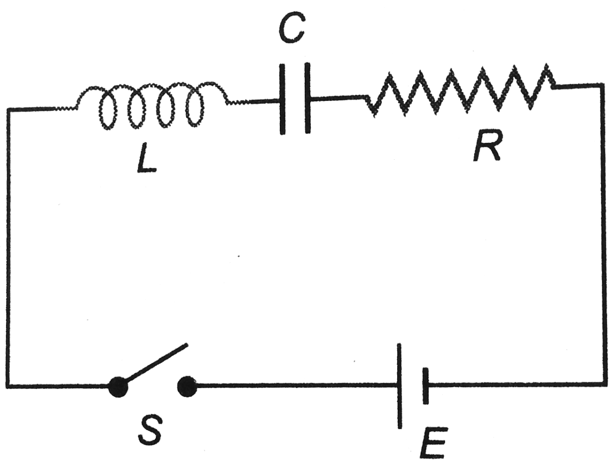
C. should be maintained constant

D. Not possible

Answer: A

Watch Video Solution

51. When the switch S is closed at $t = 0$, indentify 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: A

Watch Video Solution

52. If a diamagnetic solution is poured into a U-tube and one aem of this U-tube placed between the poles of a strong magnet with the meniscus in a line with the field, then the level of the solution will

A. will rise

B. will fall

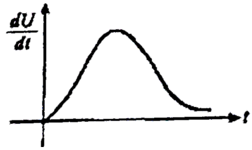
C. will oscillateat constant amplitude

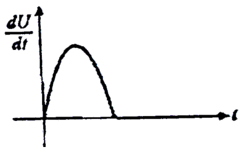
D. remain as it is

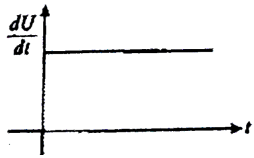
Answer: A

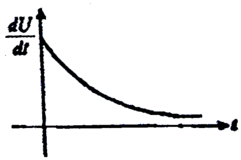
Watch Video Solution

53. Rate of increment of energy in an inductor with time in series RL circuit getting charged with battery of EMF Eis best represented by:

A. 

B. 

C. 

D. 

Answer: A

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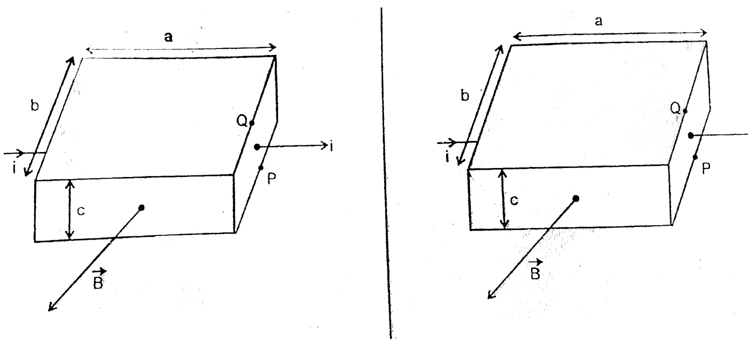
54. A current flows through a rectangular conductor in the presence of uniform magnetic field B pointing out of the page as shown. Then the potential difference $V_P - V_Q$ is equal to (assume charge carriers in the conductor to be positively charged moving with a drift velocity of v)



A. Bvb

B. $-Bvb$

C. Bvc

D. $-Bvc$

Answer: A

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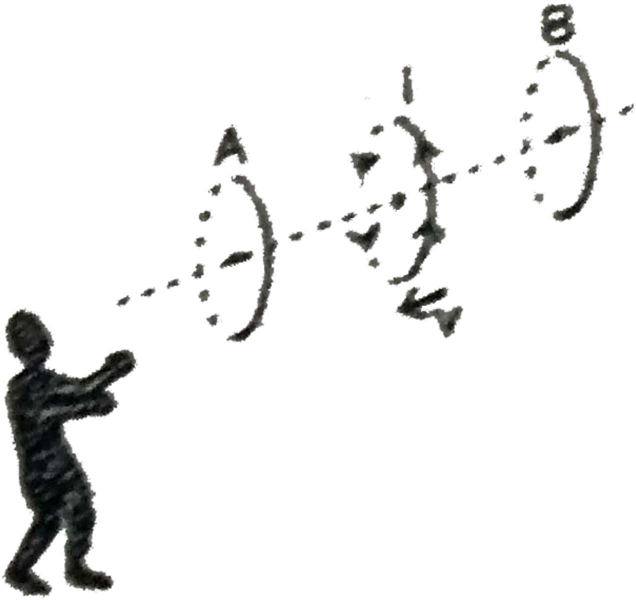
55. Three coaxial circular wire loops and a stationary observer are positioned as shown in figure. From the observers point of veiw, a current I flows counter clockwise in the middle loop, which is moving towards the observer with a velocity v. Loops A and B are stationary. This same observer would notice that.



A. Clockwise currents are induced in loops A and B.

B. Counter clockwise currents are induced in loops A and B

C. A clockwise current is induced in loop A, but a counter clockwise current is induced in loop B.

D. A counter clockwise current is induced in loop A, but a clockwise current is induced in loop B.

Answer: A

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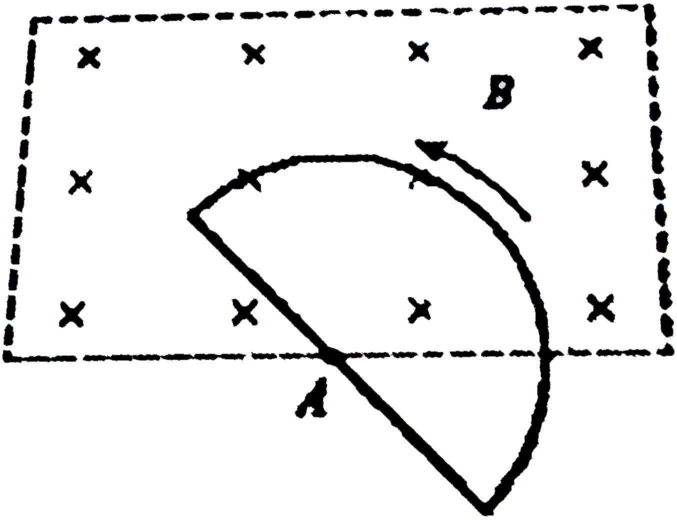
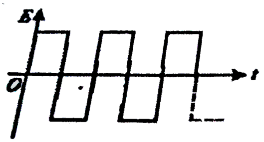
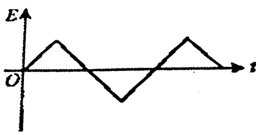
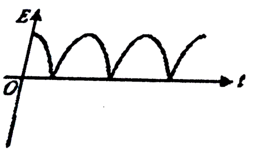
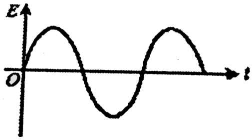
56. A uniform and constant magnetic field B is directed perpendicularly into the plane of the page everywhere within a rectangular region as shown in figure-5.277. A wire circuit in the shape of a semicircle is rotated at uniform angular speed in counter clockwise direction in the plane of the page about an axis passing through point A. The axis A is perpendicular to straight line portion of the circuit. Which of the following graphs best approximates the EMF E induced in the the page at the edge of the field and directed through the centre of the circuit as a function of time I ?



A. 

B. 

C. 

D. 

Answer: A

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57. 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. Remain same

C. Doubled

D. Quadrupled

Answer: A

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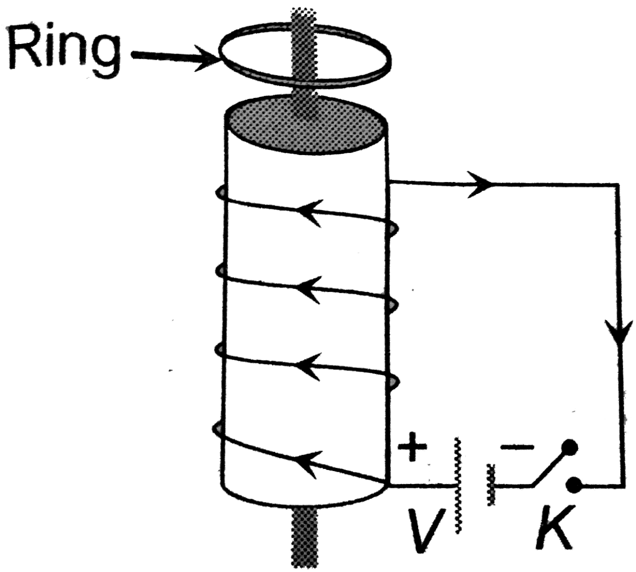
58. A conducting ring is placed around the core of an electromagnet as shown in fig. qhen key K is pressed, the ring



A. Remain stationary

B. Is attracted towards the electromagnet

C. Jumps out of the core

D. None of the above

Answer: A

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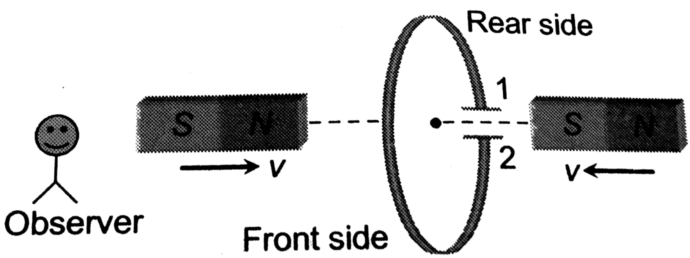
59. The north and south poles of two indential magnets approach a coil, containing a condenser,with equal speeds from opposite sides. Then



A. Plate I will be negative and plate 2 positive

B. Plats I will be positive and plate 2 negative

C. Both the plates will be positve

D. Both the plates will be negative

Answer: A

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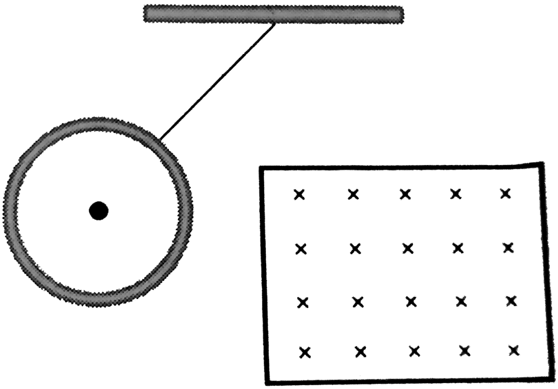
60. A metalic ring connected to a rod oscillates freely like a pendulum. If now a magnetic field is applied in horizontal diection so that the pendulum now swings through the field, the pendulum will



A. Keep oscillating with the old time period

B. Keep oscillating with a smaller time period

C. Keep oscillating with a larger time period

D. Come to rest very soon.

Answer: A

Watch Video Solution

61. The frequency of ac mains in India is

A. 30 Hz

B. 50Hz

C. 60Hz

D. 120Hz

Answer: A

Watch Video Solution

62. A bulb and a capacitor are connected in series to a source of alternating current. If its frequency is increased, while keeping the voltage of the source constant, then

A. Bulb will give more intense light

B. Bulb will give less intense light

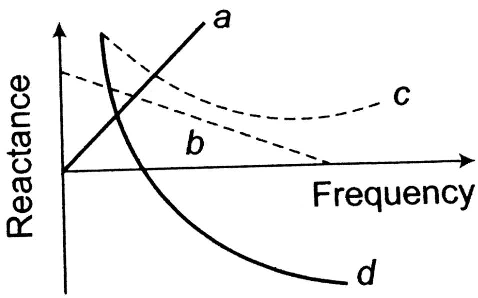
C. Bulb will give light of same intensity as before

D. Bulb will stop radiating light

Answer: A

Watch Video Solution

63. Which of the following plots may represent the reactance of a series LC combination?



A. a

B. b

C. c

D. d

Answer: A

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Numerical MCQs

1. 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: B

Watch Video Solution

2. The potential differences V and the current i flowing through an instrument in an AC circuit of frequency f are given by $V = 5\cos\omega t$ and $I = 2\sin\omega t$ amperes (where $\omega = 2\pi f$). The power dissipated in the instrument is

A. Zero

B. 10W

C. 5W

D. 2.5W

Answer: D

Watch Video Solution

3. In a step up transformer, the turn ratio is 3 : 2. A battery of EMF 4.5V is connected across the primary windings of transformer. The voltage developed in the secondary would be:

A. 4.5V

B. 30V

C. 1.5V

D. Zero

Answer: A

Watch Video Solution

4. 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

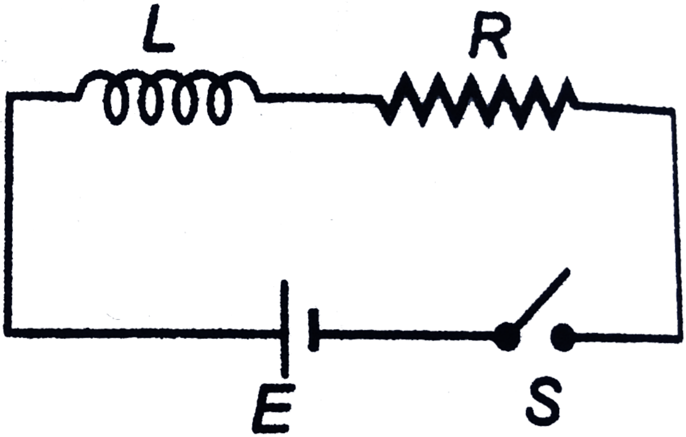
C. $1/2$

D. 0

Answer: B

Watch Video Solution

5. 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: C

Watch Video Solution

6. In an AC circuit, V and I are given by $V = 100\sin(100t)vo < s, I = 100\sin\left(100t + \frac{\pi}{3}\right)mA$. The power dissipated in circuit is

A. 104W

B. 10W

C. 2.5W

D. 5W

Answer: D

Watch Video Solution

7. The ratio of secondary to the primary turns in a transformer is $3:2$. If the power output be P, then the input power neglecting all loses must be equal to

A. 5P

B. $\sqrt{5}P$

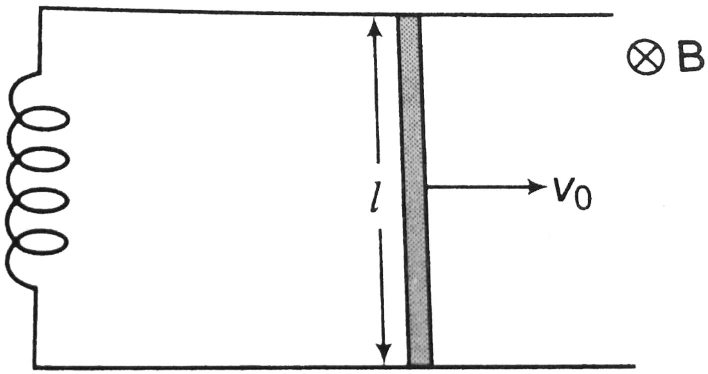
C. P/5

D. None of these

Answer: B

Watch Video Solution

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



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

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

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

D. None of these

Answer: A

Watch Video Solution

9. A 40Ω electric heater is connected to a $200V, 50Hz$ main supply. The peak value of electric current flowing in the circuit is approx.

A. 2.5A

B. 5.0A

C. 7A

D. 10A

Answer: D

Watch Video Solution

10. A transformer is used to light a $100W$ and $110V$ lamp from a $220V$ mains. If the main current is $0.5A$, the Efficiency of the transformer is approximately:

A. 0.11

B. 0.5

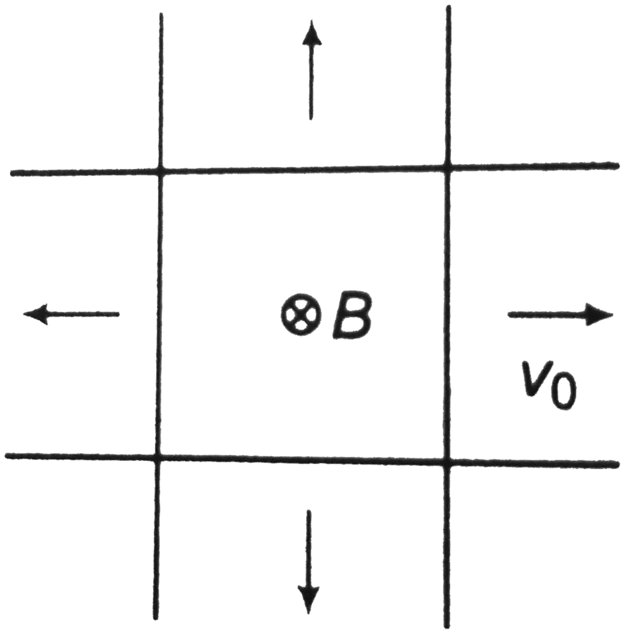
C. 0.8

D. 0.9

Answer: B

Watch Video Solution

11. 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 witha constant velocity v_0 at $t = 0$. Then, induced current in the loop at any time is $(\lambda$ is resistance per unit length of the conductors)



A. $\dfrac{aBv_0}{\lambda(a+v_0 l)}$

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

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

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

Answer: C

Watch Video Solution

12. An alternating voltage is connected in series with a resistance R and inductance L if the potential drop across the resistance is $200V$ and across the inductance is $150V$, then the applied voltage is

A. 350V

B. 25V

C. 500V

D. 300V

Answer: A

Watch Video Solution

13. 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. 0.25m Wb

B. 25mWb

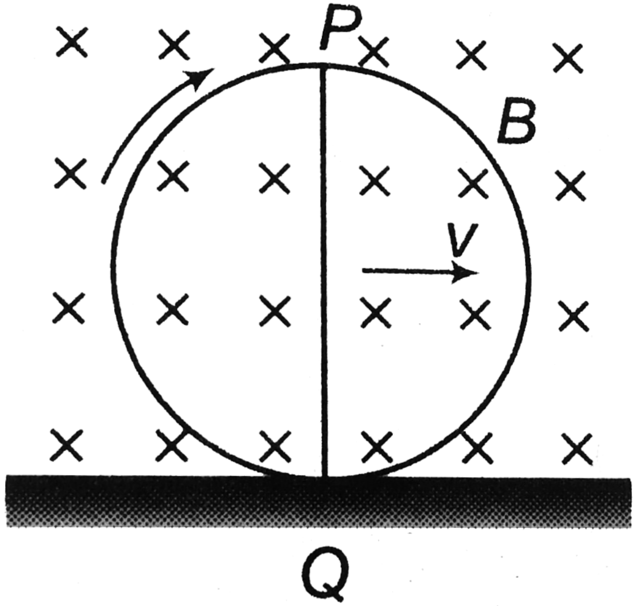
C. 50mWb

D. 15mWb

Answer: D

Watch Video Solution

14. 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. 3Bvl2

D. Zero

Answer: C

Watch Video Solution

15. An inductive circuit a resistance of $10 ohm$ and an inductance of 2.0 henry. If an AC voltage of 120 volt and frequency of $60 Hz$ is applied to this circuit, the current in the circuit would be nearly

A. 0.32A

B. 0.016A

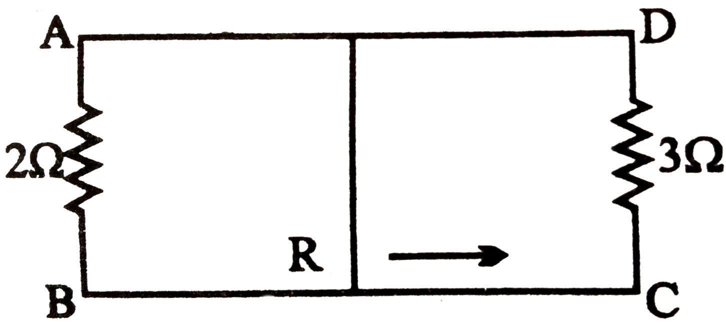
C. 0.48A

D. 0.80A

Answer: B

Watch Video Solution

16. 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. $\frac{1}{220}A$

B. $\frac{1}{110}A$

C. $\frac{1}{440}A$

D. $\frac{1}{55}A$

Answer: A

Watch Video Solution

17. A 20volts AC is applied to a circuit consisting of a resistance and a coil with negligible resistance. If the voltage across the resistance is $12V$, the voltage across the coil is

A. 16V

B. 10V

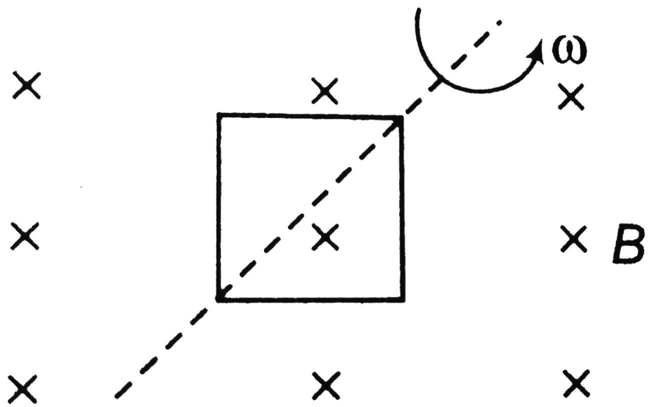
C. 8V

D. 6V

Answer: A

Watch Video Solution

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

D. $b^2 B\omega$

Answer: A

Watch Video Solution

19. A resistance of 300Ω and an inductance of $\frac{1}{\pi}$ henry are connected in series to an AC voltage of 20volts and $200Hz$ frequency. The phase angle between the voltage and current is

A. $\frac{\tan^{-1}(4)}{3}$

B. $\frac{\tan^{-1}(3)}{4}$

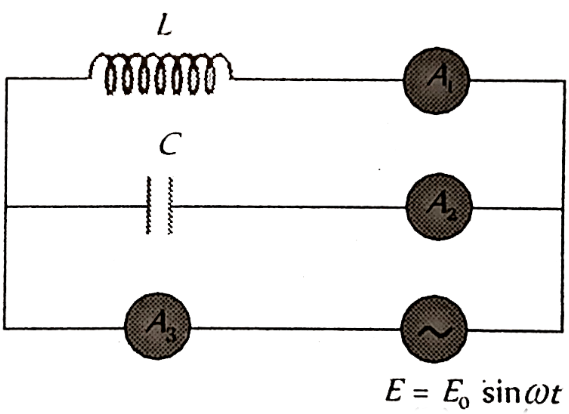
C. $\frac{\tan^{-1}(3)}{2}$

D. $\frac{\tan^{-1}(2)}{5}$

Answer: D

Watch Video Solution

20. An inductor L and a capacitor C are connected in the circuit as shown in the figure. The frequency of the power supply is equal to the resonant frequency of the circuit. Which ammeter will read zero ampere



A. A_1

B. A_2

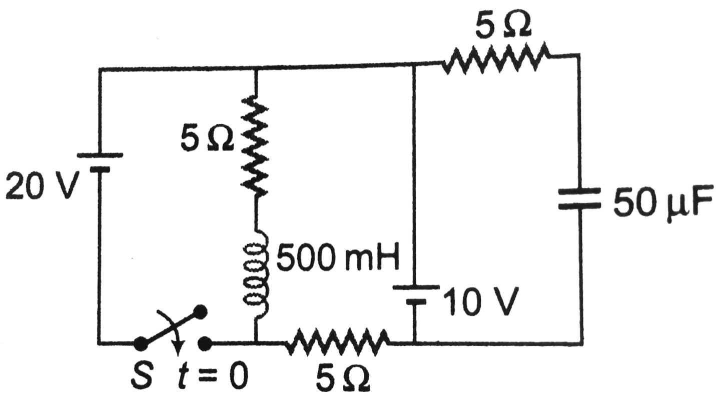
C. A_3

D. None of these

Answer: D

Watch Video Solution

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



A. 2Wb

B. 1.5Wb

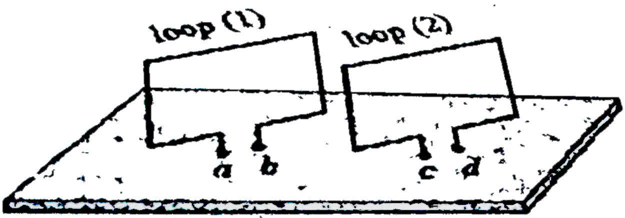
C. 0Wb

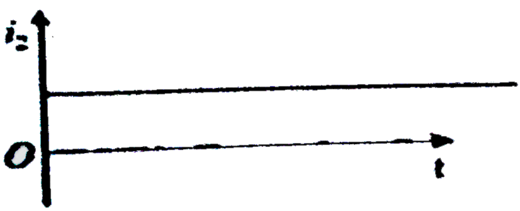
D. None of the above

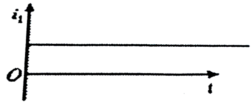
Answer: A

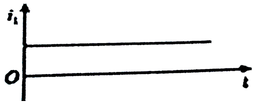
Watch Video Solution

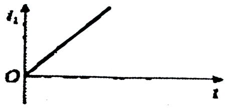
22. An electric current i_1 can flow in either direction through loop-1 and induced current i_2 in loop-2. Positive i_2 is when current is from 'a' to 'b' in loop-1 and positive i_2 is when the current is from 'c' to 'd' in loop-2. In an experiment, the graph of induced current i_2 against time 'r' is shown in figure-5.291. which one of the following graphs options for current i_1 could have caused i_2 o behave as shown:

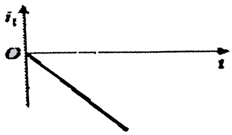




A. 

B. 

C. 

D. 

Answer: B

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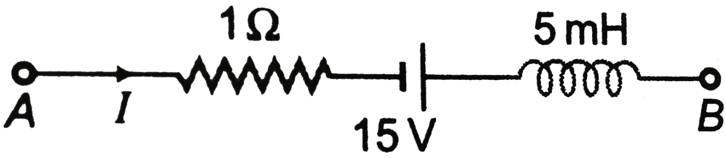
23. The network shown in the figure is a part of complete circuit. What is the potential difference

$V_B - V_A$ 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: B

Watch Video Solution

24. A simple LR circuit is connected to a battery at time $t = 0$. The energy stored in the inductor reaches half its maximum value at time

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

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

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

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

Answer: C

Watch Video Solution

25. A 120 volt AC source is connected across a pure inductor of inductance 0.70 henry. If the frequency of the source is $60Hz$, the current passing through the inductor is

A. 4.55A

B. 0.355A

C. 0.455A

D. 3.55A

Answer: A

Watch Video Solution

26. Two coils X and Y are placed in a circuit such that a current change of 3A in coil X causes the change in magnetic flux by 1.2Wb in coil Y. The value of mutual inductance of the coil is:

A. 0.2H

B. 0.4H

C. 0.6H

D. 3.6H

Answer: A

Watch Video Solution

27. 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. $\frac{\mu_0 / qv}{2nd}$

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

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

D. $\frac{\mu_1 iqvl}{4\pi a}$

Answer: C

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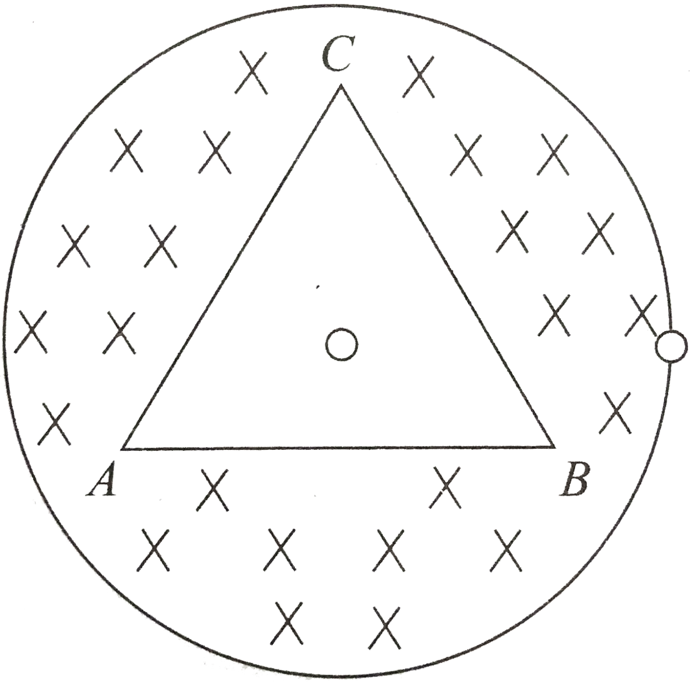
28. A triangular wire frame (each side =2m) is placed in a region of time variant magnetic field $dB/dt = (\sqrt{3})T/s.$ The magnetic field is perpendicular to the plane of the triangle and its centre coincides with the centre of triangle. The base of the triangle AB has a resistance $1(\Omega)$ while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



A. 0.4V

B. 0.6V

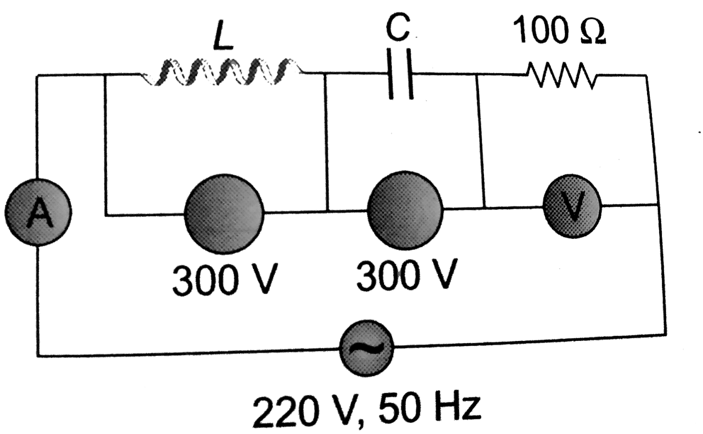
C. 1.2V

D. None

Answer: B

Watch Video Solution

29. In the circuit shown below, what will be the reading of the voltmeter and ammeter?



A. 800V,2A

B. 300V,2A

C. 220V,2.2A

D. 100V,2A

Answer: B

Watch Video Solution

30. A galvanometer is connected to the secondary coil. The galvanometer shows an instantaneous maximum deflection of 7 divisions when current is started in the primary coil of the solenoid. Now if the primary coil is rotated through 180°, then the new instantaneous maximum deflection will be:

A. 7units

B. 14units

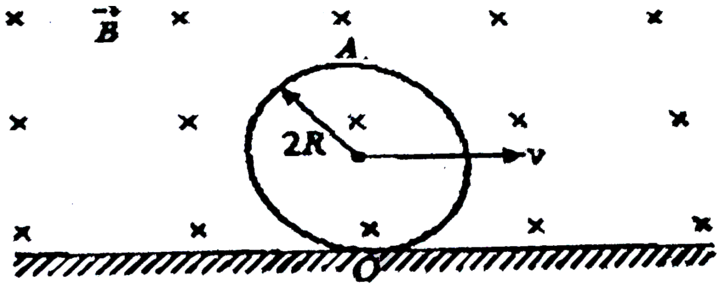
C. 0 units

D. 21units

Answer: B

Watch Video Solution

31. A conducting ring of radius 2R rolls on a smooth horizontal conducting surface as shown in figure-5.295. A uniform horizontal magnetic field B is perpendicular to the plane of the ring. The potential of A with respect to O is:



A. 2 BvR

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

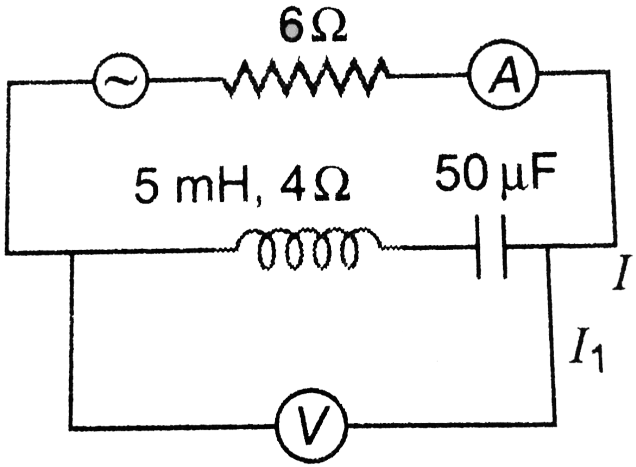
C. 8BvR

D. 4BvR

Answer: D

Watch Video Solution

32. In the circuit shown in figureure the AC source gives a voltage $V = 20\cos(2000t)$. Neglecting source resistance, the voltmeter and and ammeter readings will be



A. 0V,0.47A

B. 1.68V,0.47A

C. 0V,1.4A

D. 5.6V,1.4A

Answer: A

Watch Video Solution

33. A coil of area $100cm^2$ having 50turns is perpendicular to a magnetic field of intensity 0.02T. The resistance of the coil is 2Ω. If t is removed from magnetic field in is the charge flown through the coil is:

A. 5C

B. 0.5C

C. 0.05C

D. 0.005C

Answer: B

Watch Video Solution

34. 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. $\frac{T}{In\frac{1}{\beta}}$

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

D. $TIn\beta$

Answer: C

Watch Video Solution

35. A force of 10N is required to move a conducting loop through a non-uniform magnetic field to 2m/s. The rate of production of internal energy in loop is:

A. 25W

B. 5W

C. 10W

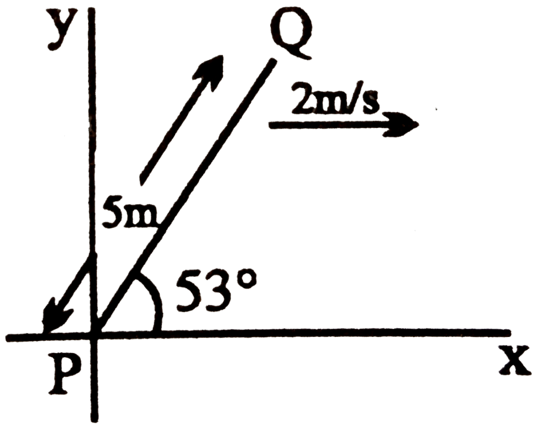
D. 20W

Answer: C

Watch Video Solution

36. A conducting rod PQ of length $5m$ oriented as shown in figure is moving with velocity $(2m/s)\hat{i}$ without any rotation in a uniform magnetic field

$\left(3\hat{j}+4\hat{k}\right)$ Tesla. Emf induced in the rod is



A. 32volt

B. 40volt

C. 50volt

D. None

Answer: D

Watch Video Solution

37. A telephone wire of length $200 km$ has a capacitance of $0.014 \mu F per km$. If it carries an AC of frequency $5 kHz$ what should be the value of an inductor required to be connected in series so that impedence of the circuit is minimum ?

A. 0.35mH

B. 35mH

C. 3.5mH

D. Zero

Answer: B

Watch Video Solution

38. 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. Pt

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

C. $\frac{P\tau}{It2}$

D. $P\tau In2)$

Answer: D

Watch Video Solution

39. An aeroplane is flying horizontally with a velocity of 360Km/hr. The distance between the tips of wings is 50m. If the vertical component of earth's magnetic field is $4 \times 10^{-4} T$, induced EMF across the wings is:

A. Zero

B. $2 \mu V$

C. $2 mV$

D. 2V

Answer: C

Watch Video Solution

40. In a certain circuit current changes with time according to $i = 2\sqrt{t}$ RMS value of current between t=2s to t=4s will be

A. 3A

B. $3\sqrt{3}A$

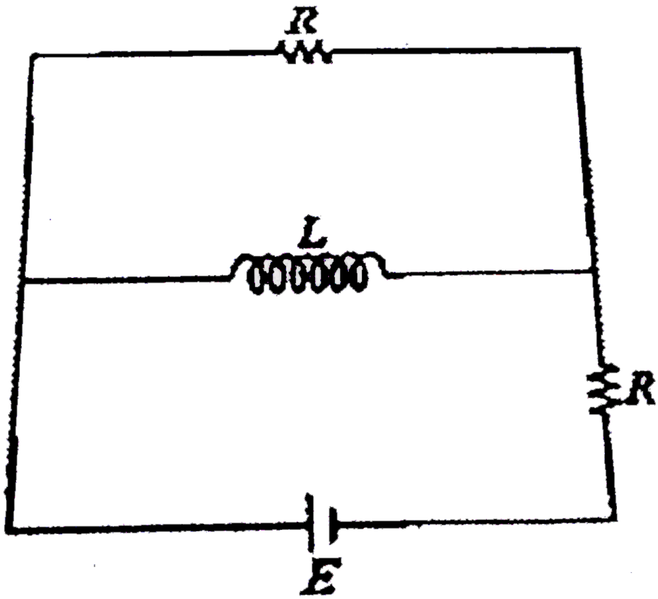
C. $2\sqrt{3}A$

D. $\left(2-\sqrt{2}\right)A$

Answer: A

Watch Video Solution

41. The figure-5.298 shows a specific RL circuit, the time constant for this circuit is:



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

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

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

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

Answer: B

Watch Video Solution

42. 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. 4C

B. 628C

C. 3.14C

D. 25.12C

Answer: C

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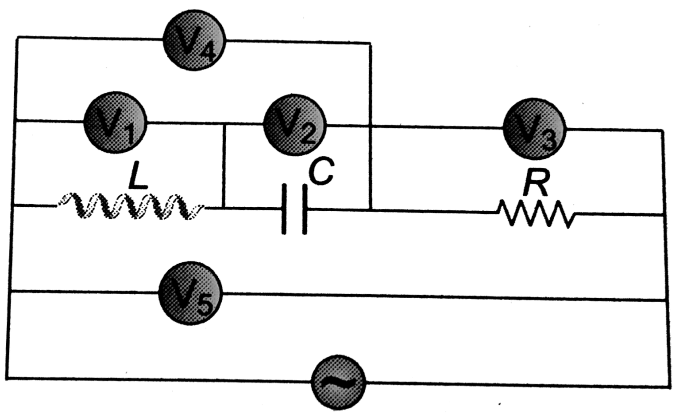
43. In the adjoining AC circuit the voltmeter whose reading will be zero at resonance is



A. V_1

B. V_2

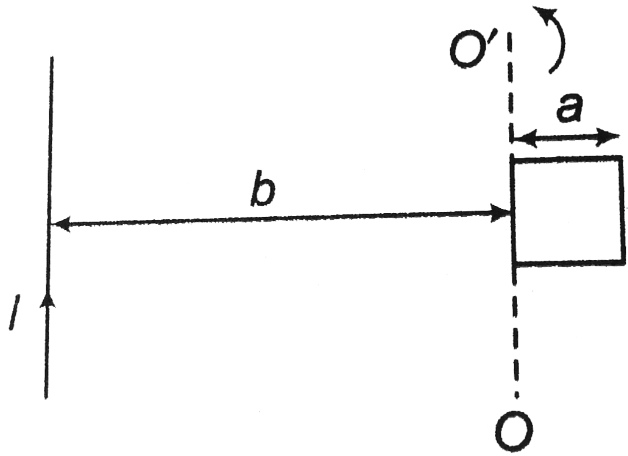
C. V_3

D. V_4

Answer: B

Watch Video Solution

44. 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. $\dfrac{\mu_0 la}{2\pi R} In\left(\dfrac{2a+b}{b}\right)$

B. $\dfrac{\mu_0 la}{2\pi R} In\left(\dfrac{b}{b^2-a^2}\right)$

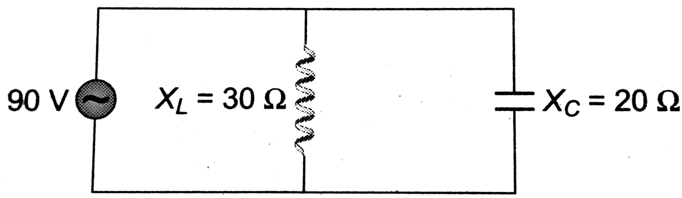
C. $\dfrac{\mu_0 la}{2\pi R} In\left(\dfrac{a+2b}{b}\right)$

D. None of these

Answer: A

Watch Video Solution

45. In the adjoining figure the impedence of the circuit will be



A. 120Ω

B. 50Ω

C. 60Ω

D. 90Ω

Answer: A

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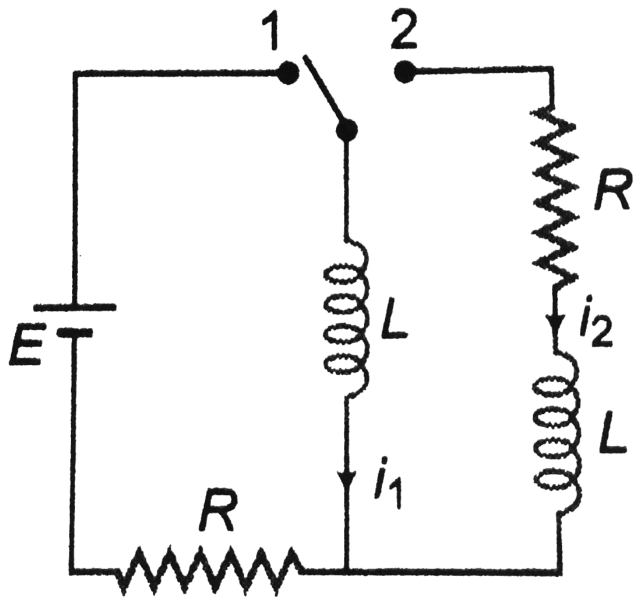
46. In figure, the switch is in the position 1 for long time, then the switch is shifted to position 2 at $t = 0$. At this instant the value of i_1 and i_2 are



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

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

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

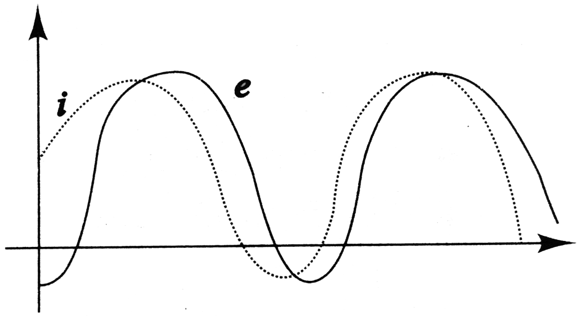
D. None of these'

Answer: A

Watch Video Solution

47. When an ac source of emf$e = E_0 \sin(100t)$ is connected across a circuit, the phase difference between emf e and currnet I in the circuit is observed to be $(\pi)/(4)$ as shown in fig. If the circuit consists possibly only of R-C or R-C of L-R series, find the relationship find the relationship

between the two elements.



A. $R = 1k\Omega, C = 10\mu F$

B. $R = 1k\Omega, C = 1\mu F$

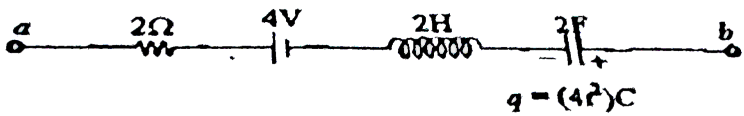
C. $R = 1k\Omega, C = 10H$

D. $R = 1k\Omega, L = 1H$

Answer: A

Watch Video Solution

48. In the part of a circuit branch shown in figure-5.304 the potential difference V_{ab} at t=1s is:



A. 30V

B. $-30V$

C. 20V

D. $-20V$

Answer: D

Watch Video Solution

49. 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. 0.58V

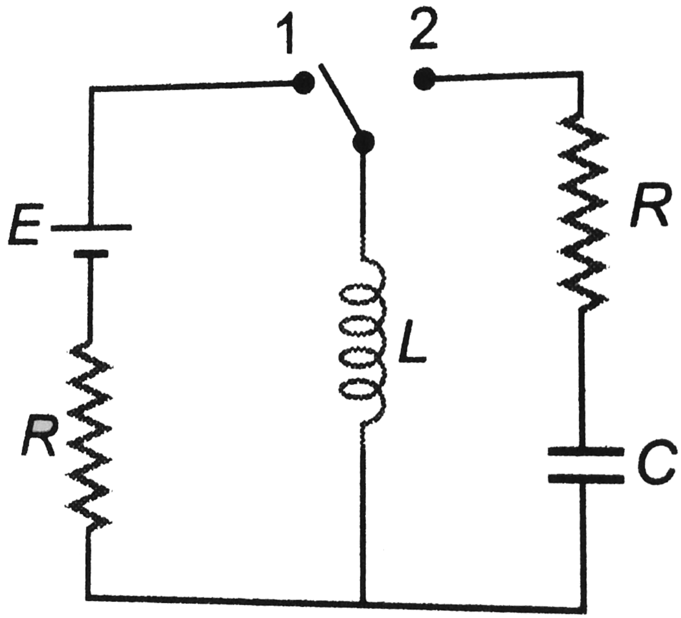
C. 0.29V

D. 5.8V

Answer: A

Watch Video Solution

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

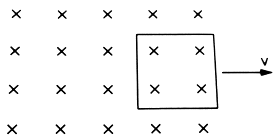
C. $\frac{E}{R}$

D. None of these

Answer: B

Watch Video Solution

51. Shows a square loop having 100 turns, an area of $2.5 \times 10^{-3} m^2$ and a resistance of 100Ω. The magnetic field has a magnitude B =0.40 T. Find the work done in pulling the loop out of the field, slowly and uniformly is 1.0 s.



A. Zero

B. 1mJ

C. $1\mu J$

D. 0.1mJ

Answer: B

Watch Video Solution

52. 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. $2\pi V$

B. $5\pi V$

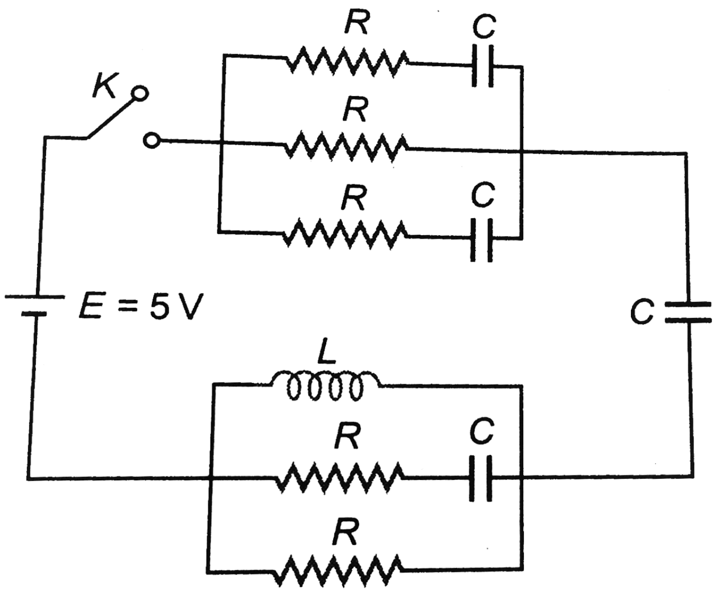
C. πV

D. $4\pi V$

Answer: B

Watch Video Solution

53. 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

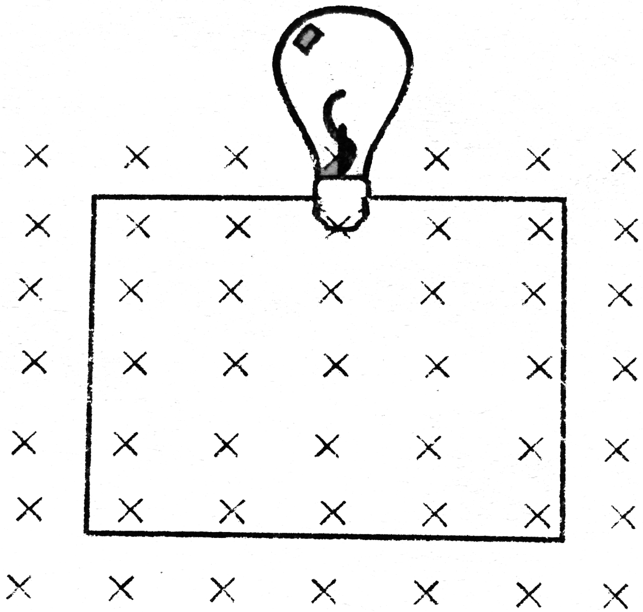
D. 2A

Answer: A

Watch Video Solution

54. A square wire loop of $10.0cm$ side lies at right angles to a uniform magnetic field of $7T$. A $10V$ light bulb is in a series with the loop as shown in Fig. 3.125. The magnetic field decreasing steadily to zero over a time interval Δt. For what value of Δt

(im ms), the bulb will shine with full brightness?



A. 20ms

B. 0.02ms

C. 2ms

D. 0.2ms

Answer: C

Watch Video Solution

55. 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 is

A. 20+20r

B. 20

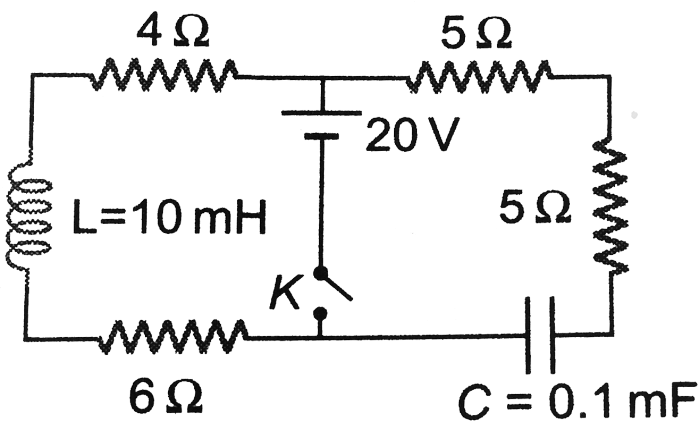
C. 20r

D. Zero

Answer: C

Watch Video Solution

56. 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

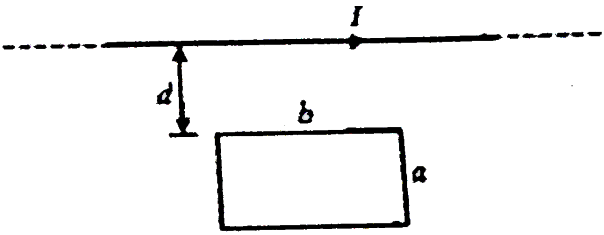
C. 4A

D. Zero

Answer: C

Watch Video Solution

57. A long straight wire is parallel to one edge of a rectangular loop as shown in figure-5.310. if the current in the long wire varies with time as $I = I_0 e^{-tr}$, what will be the induced emf in the loop at t=τ?



A. $\frac{\mu_0 bI}{\pi\tau} In\left(\frac{d+a}{d}\right)$

B. $\frac{\mu_0 bI}{2\pi\tau} In\left(\frac{d+a}{d}\right)$

C. $\frac{2\mu_0 bI}{\pi\tau} In\left(\frac{d+a}{d}\right)$

D. $\frac{\mu_0 bI}{\pi\tau} In\left(\frac{d}{d+a}\right)$

Answer: C

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58. 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. $100In2\Omega$

B. $100(1 - In2)\Omega$

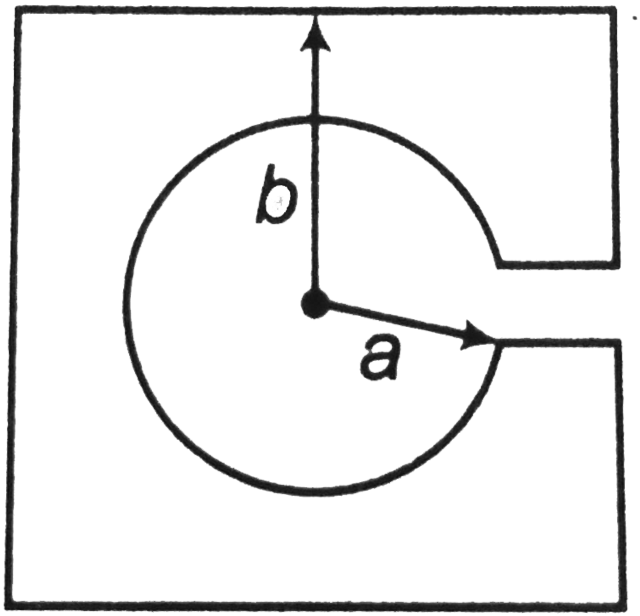
C. $100In4\Omega$

D. $100(1 - In4)$

Answer: C

Watch Video Solution

59. 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. Cockwise $\frac{B_0(\pi a^2 - b^2)}{R}$

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

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

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

Answer: C

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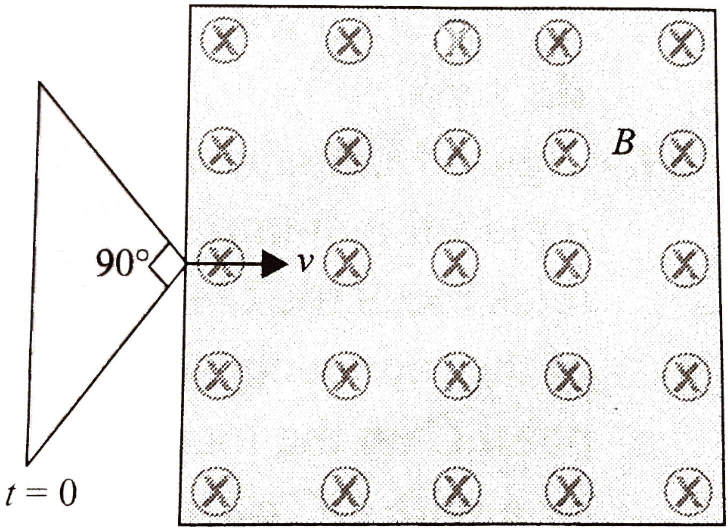
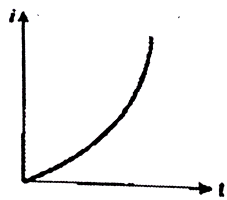
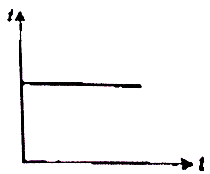
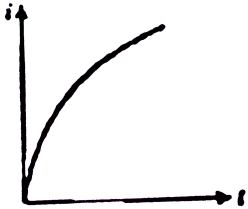
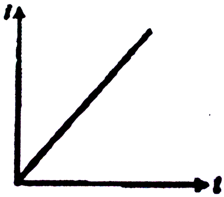
60. Figure shows an isosceles triangle wire frame with apex angle equal to $(\pi)/2$. The frame starts entering into the region of uniform magnetic field B with constant velocity v at t =0. The longest side of the frame is perpendicular to the direction of velocity. If i is the intantaneous current through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



A. 

B. 

C. 

D. 

Answer: A

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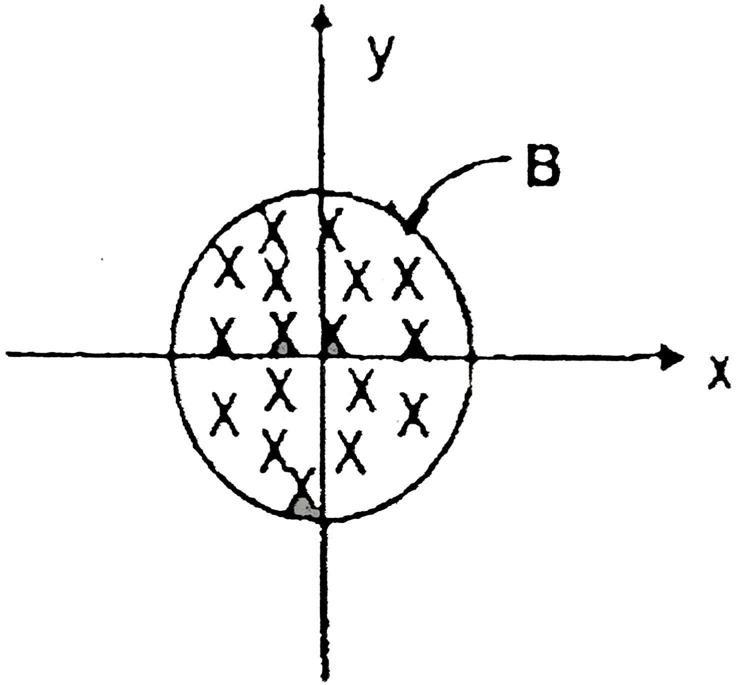
Advance MCQs

1. A loop is kept so that its center lies at the origin of the coordinate system. A magnetic field has the induction B pointing along Z axis as shown in the figure



A. No EMF and current will be induced in the loop if it rotates about Z-axis

B. EMF is induced but no current flow sif the loop is a fiber when it rotates about Y-axis.

C. EMF is indued and induced current flows in the loop if the loop is made of copper $\&$ is rotated about Y-axis.

D. If the loop moves along Z-axis with constant velocity, no current flows in it.

Answer: A::B::C

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2. For a RLC series circuit , phasors of current i and applied voltage V $= V_0 \sin \omega t$ are shown in diagram at t=0, which of the following is/are CORRECT?

A. At $= \dfrac{\pi}{2\omega}$, instantaneous power supplied by source is negative.

B. From $0 < t < \dfrac{2\pi}{3\omega}$, average power supplied by source is positive.

C. At $t = \dfrac{5\pi}{6\omega}$, instantaneous power supplied by source is negative.

D. If ω is increased slightly, angle between the two phasors decreases.

Answer: A::C

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3. 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. $i_1 l i_2 = 1/4$

B. $i_1 / i_2 = 4$

C. $w_2 / w_1 = 4$

D. $v_2 / v_1 = 1/4$

Answer: A

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4. Mutual inductance of two coils can be increased by

A. The number of turns of each coil

B. The shape of each coil

C. Current through each coil.

D. Separation between the coils.

Answer: A::C::D

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5. Which of the following statements is/are correct?

A. Self-induced emf may tend to decrease the current

B. Self-induced emf may tend to increse the current

C. Self-induced emf triesto keep the current constnat

D. None of these

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

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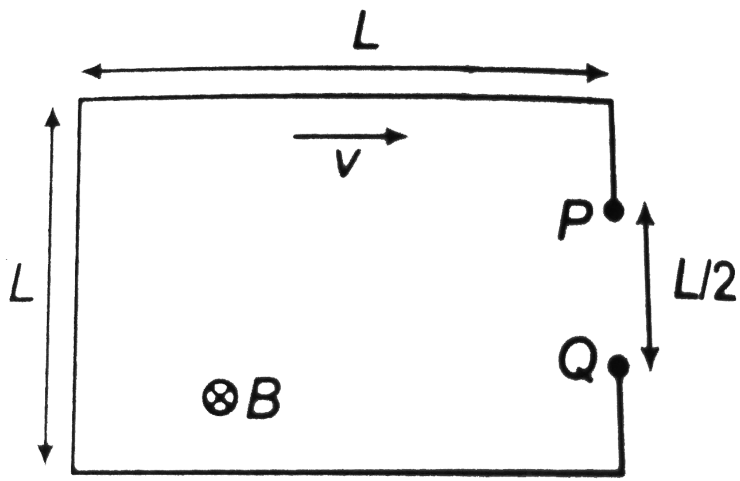
6. The loop shown moves with a velocity v in a uniform magnetic field of magnitude B, directed into the paper. The potential differene between point P and Q is e. Then



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::D

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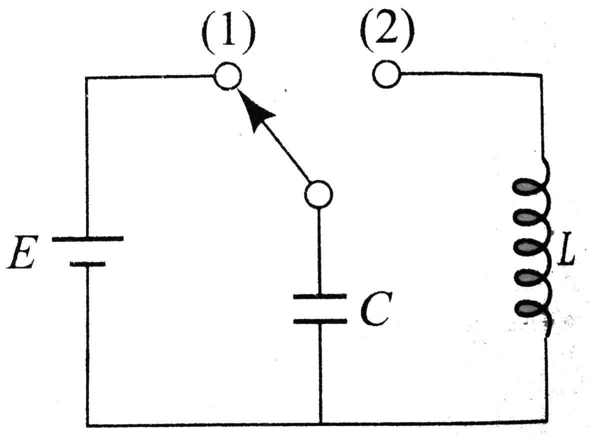
7. In the following electrical network at $t < 0$, key is placed on (1) till the capacitor got fully charged. Key is placed on (2) at $t = 0$. Time when the energy in both the capacitor and inductor will be same for the first time is



A. $\dfrac{\pi\sqrt{LC}}{r}$

B. $\dfrac{\pi\sqrt{LC}}{2}$

C. $\dfrac{5\pi\sqrt{LC}}{4}$

D. $\dfrac{5\pi\sqrt{LC}}{2}$

Answer: B::C

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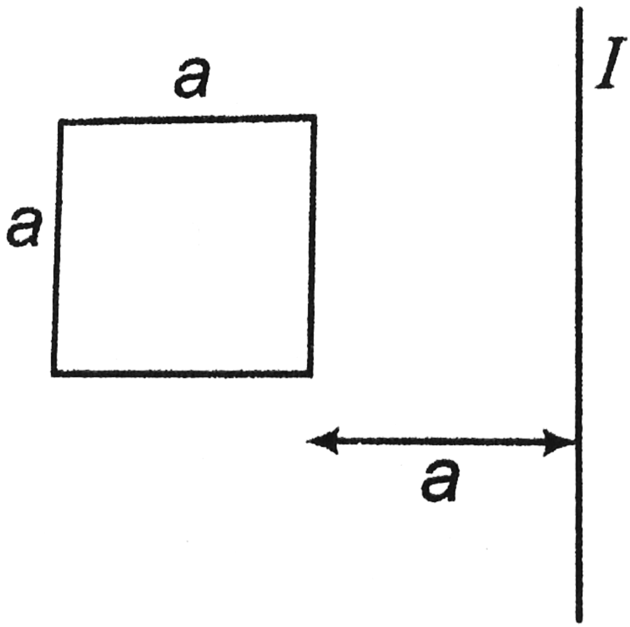
8. An infinitely longg wire is placed near a square loop as shown in figure. Choose the correct options.



A. The mutual inductance between the two is $\frac{\mu_0 a}{2\pi} In(2)$

B. The mutual inductance between the two is

$$\frac{\mu_0 a^2}{2\pi} In(2)$$

C. If a constant 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 condition, induced current in the loop is anticlockwise.

Answer: A::B

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9. A circuit is set up by connecting L=100mH, C $= 5\mu F$ and R $= 100\Omega$ in series. An alternating emf of 150` sqrt(2)V,(500)/(pi) Hz is applied across this series combination. Which of the following is correct:

A. the impedance of the circuit is 141.1 Ω

B. the average power dissipated across resistance 225W

C. the average power dissipated across inductor is zero

D. the average power dissipated across capacitor is zero

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10. Choose the CORRECT statements:

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::B::D

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11. For an LCR series circuit with an aac source of angular frequency ω.

A. Circuit will be capacitive if $\omega > \frac{1}{\sqrt{LC}}$

B. Circuit will be inductive if $\omega = \frac{1}{\sqrt{LC}}$

C. Power factor of circuit will by unity if $\omega L = \frac{1}{\omega C}$

D. Current will be leading if $\omega > \frac{1}{\sqrt{LC}}$

reactance equals inductive reactance.

Answer: C::D

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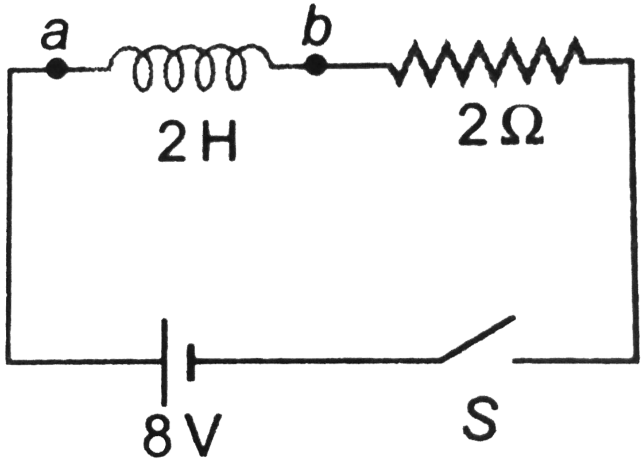
12. In the circuit shown in figure, circuit is closed at time $t = 0$. At time $t = \ln(2)$ second



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

B. Rate of heat dissipated across resistance is

8J/s

C. Rate of heat dissipated across resistance is

16J/s

D. $V_a - V_b = 4V$

Answer: A::C

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13. Choose the CORRECT statement(s) in the following:

A. Diamagnetism exist in all materials

B. Diamagnetism is the result of partial alignment of permanent magnetic moment in the material

C. The magnetic field due to induced magnetic moment is opposite to the applied field.

D. The magnetising field intensity is always zero in free space.

Answer: A::B::C

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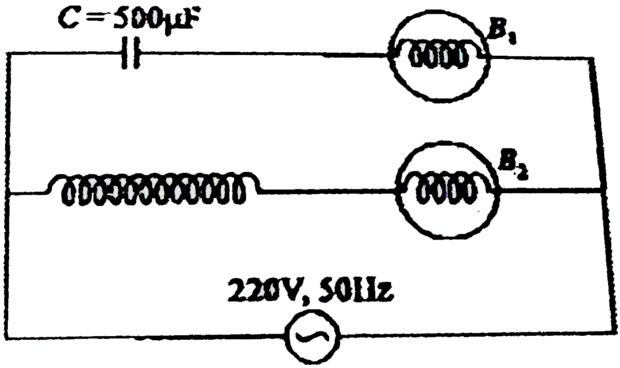
14. In the circuit shown in figure-5.318, if both the bulbs B_1 and B_2 are identical:



A. their brightness will be same

B. B_2 will be brighter than B_1

C. as frequency of supply voltage is increased the brightness of bulb B_1 will increase and that of B_2 will decrease

D. Only B_2 will glow because the capacitor has infinite impednace

Answer: C

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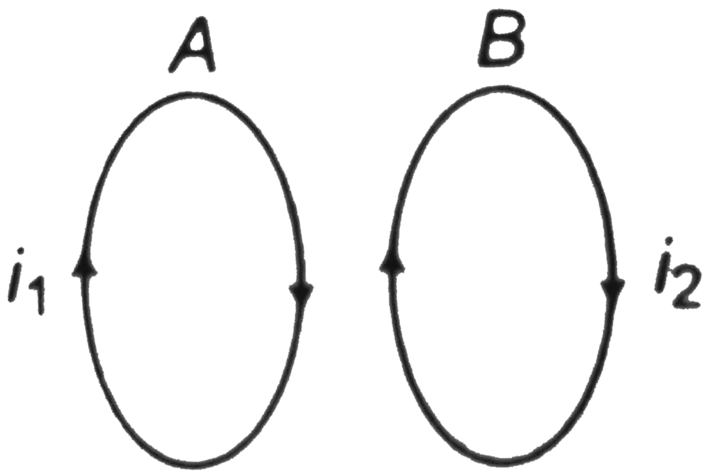
15. Two circular coils are placed adjacent to each other. Their planes are parallel and currents through them i_1 and i_2 are in same direction. Choose the correct options.



A. What A is brought near B_2 current i_2 will increase

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: B::C::D

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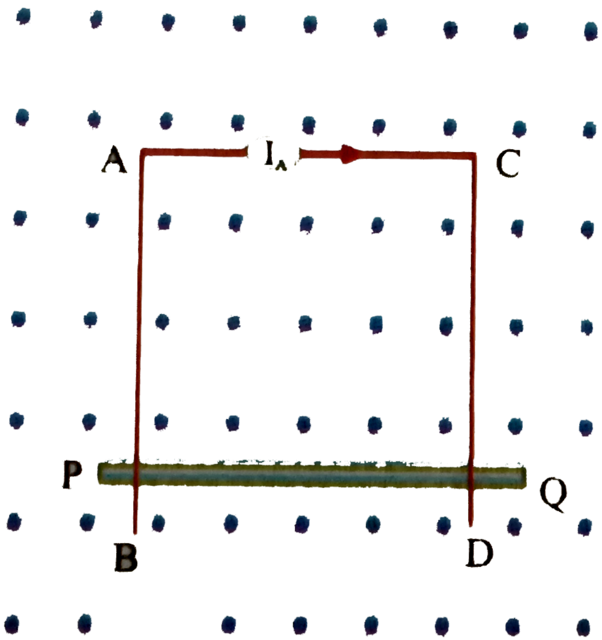
16. AB and CD are fixed conducting smooth rails placed in a vertical plane and joined by a constant current source at its upper end. PQ is a conducting rod which is free to slide on the rails. A horizontal uniform magnetic field exists in space as shown in figure. If the rod PQ is released from rest then,



A. The rod PQ may move downward with constant acceleration

B. The rod PQ may move upward with constnat acceleration

C. The rod will move downward with decreasing acceleration and finally acquire a constant velocity

D. The rod will move upward with decreasing acceleration and finally acquire a constant velocity.

Answer: A::D

Watch Video Solution

17. 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

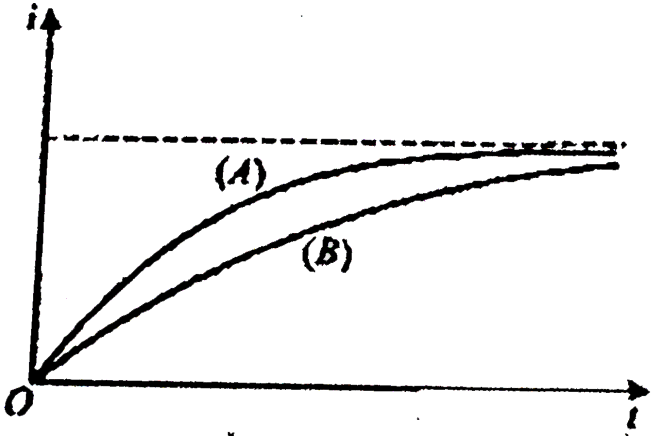
C. 2C charge will flow in the coil in above period

D. Heat produced in the col in the above period can't be determined form the given data.

Answer: A::B::C

Watch Video Solution

18. A circuit consisting of a constant EMF E, a self-inductance L and a resistance R in sereis is closed at time $t = 0$. The relation between the current i in the circuit and the time t is as shown by the curve. A in the figure-5.321. when one or more of parameters E,R and L are changed, the curve B is obtained. Then it is possible that:



A. E and R are kept constant and L is increased

B. E and R are kept constant and L is decreased

C. E and R are both halved and L is kept constant

D. E and L are kept constant and R is decreased.

Answer: A::C

Watch Video Solution

19. In LC oscillations of a capacitor with an initial charge q_0 is connected in parallel.

A. Time period of oscillations is $\frac{2\pi}{\sqrt{LC}}$

B. $Ma\xi\mu mcurrent \in \circ uitis$(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 $\frac{q_0}{2C}$

Answer: B,C

Watch Video Solution

20. A solenoid is connedted to a source of constant EMF for a long time. A sof iron piece is inserted into it. Then :

A. Self-inductance of the solenoid gets increased

B. Flux linked with the solenoid increases , hence steady state current gets decreased.

C. Energy stored in the solenoid increases, hence steady state current gets decreased.

D. Magnetic moment of the solenoid gets increased.

Answer: A::D

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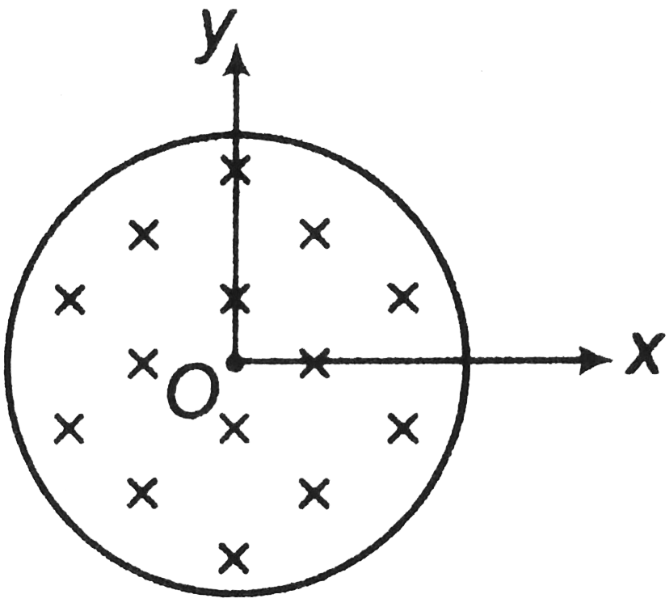
21. Magnetic field in cylindrical region of radius R in inward direction is as shown in figure.



A. An electron will experience no force kept at (2P,0,0) if magnetic field increase 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: A::B::C

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22. Two identical coaxial circular loops carry a current i each circulating int the same direction. If the loops approch each other the current in

A. the current in each will tend to increase

B. the current in each will tend to decrease

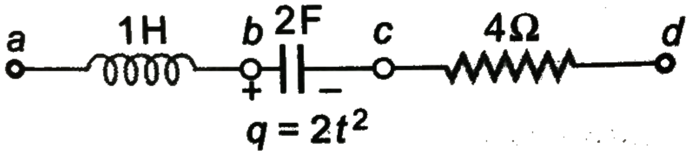
C. both may repel each other

D. both may attract each other

Answer: A::D

Watch Video Solution

23. 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. $V_a - V_d = 20V$

Answer: A::B::D

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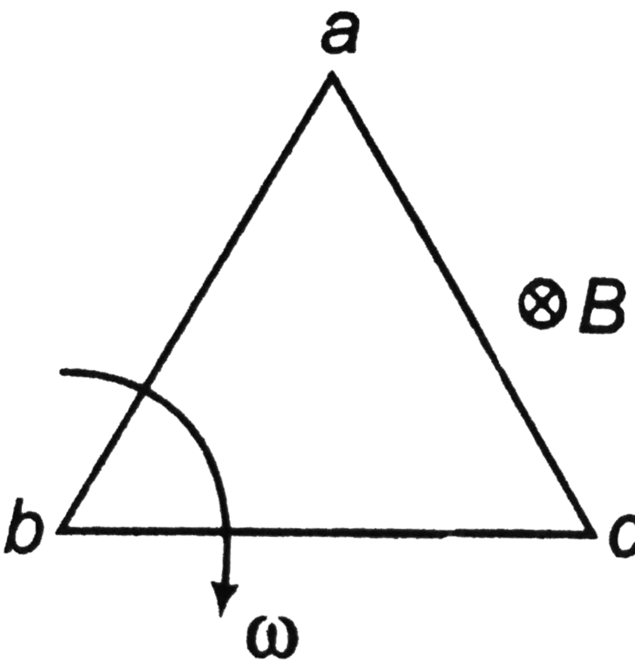
24. An equilateral triangular conducting frame is rotated with angular velocity ω in a uniform magnetic field B as shown. Side of triangle is l. choose the correct options



A. $V_a - V_c = 0$

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

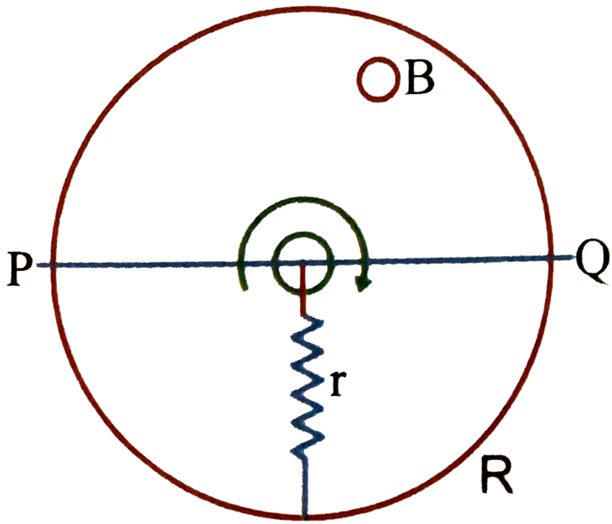
C. $V_a - V_b = \frac{B\omega l^2}{2}$

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

Answer: B::C

Watch Video Solution

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



A. Current through 'r' is zero

B. Current through 'r' is $\dfrac{2B\omega a^2}{5r}$

C. Direction of current in external 'r' is from centre to circumference

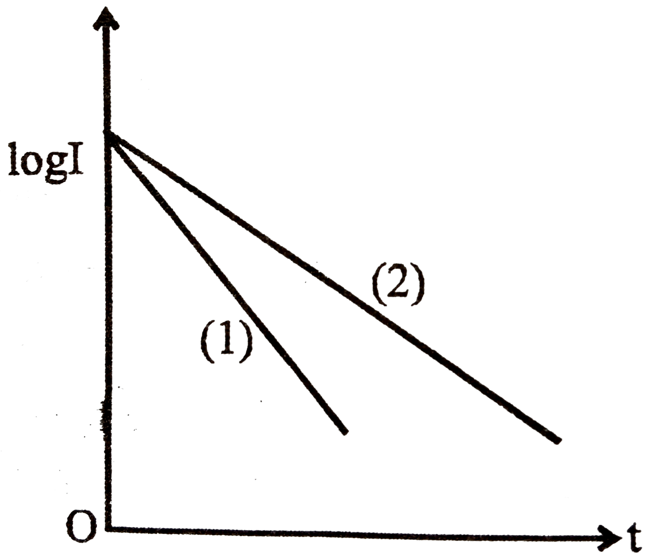
D. Direction of current in external 'r' is from circumference to centre.

Answer: B::C

Watch Video Solution

26. A capacitor of capacity C is charged to a steady potential difference V and connected in series with an opne key and a pure resistor 'R'. At time $t = 0$, the key si closed. If $I =$ current at time t, a plot of

$\log I$ against 't' is as shown in (1) in the graph. Later one of the parametrs i.e. V, R or C is charged keeping the other two constant, and graph (2) is recored. then-



A. C is reduced

B. C is increased

C. R is reduced

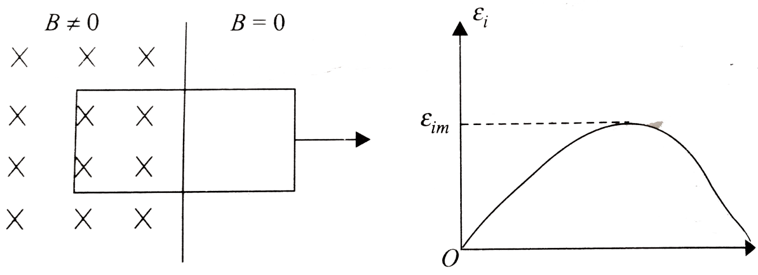
D. R is increased

Answer: A::B::C

Watch Video Solution

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

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



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

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

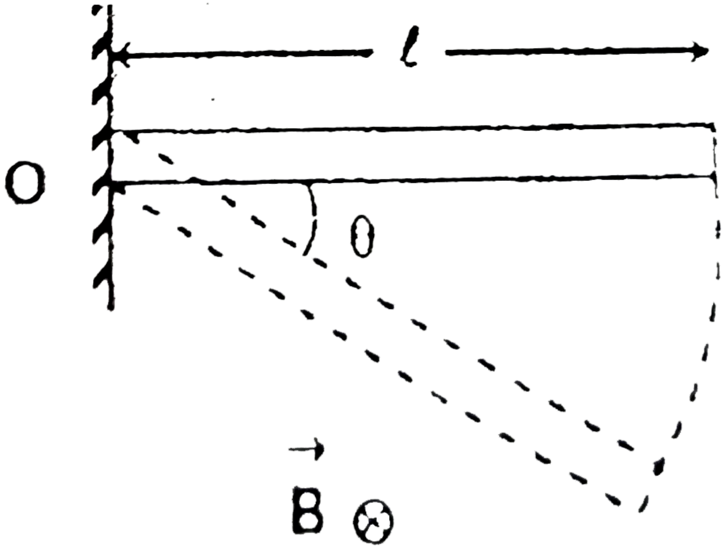
C. The total area under the curve $(e_1 vs l)$ is independent of rate of removal of coil from the field.

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

Answer: A::B::C

Watch Video Solution

28. A conducting rod of length l is hinged at point O. It is free to rotate in vertical plane. There exists a uniform magnetic field $\overrightarrow{B}$ in horizontal direction. The rod is released from position shown in the figure. Potential difference between two ends of the rod is proportional to



A. $l^{3/2}$

B. l^2

C. $\sin\theta$

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

Answer: B::C

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

A. All the points on the ring are at the same potential

B. The EMF induced in the ring is $\pi a^2 \alpha$

C. Electric field intensity E at any point on the ring is zero

D. $E = \frac{1}{2} a\alpha$.

Answer: A::B::C

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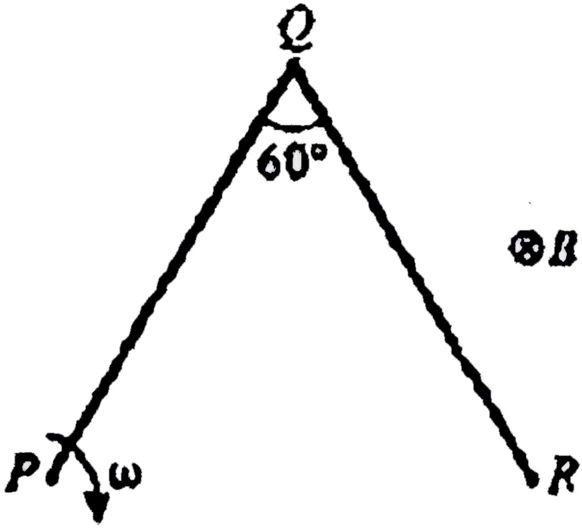
30. A bent rod PQR with PQ=QR=1 shown in figure-5.329 is rotating about its end P with a constant angular speed ω in a region of transverse magnetic field of induction B:



A. EMF induced across the rod is $B\omega l^2/2$

B. EMF induced across the rod is $B\omega^2 l/2$

C. Potential difference between points Q and R

on the rod is $B\omega^2/2$

D. Potential difference between points Q and R on the rod is zero

Answer: A::D

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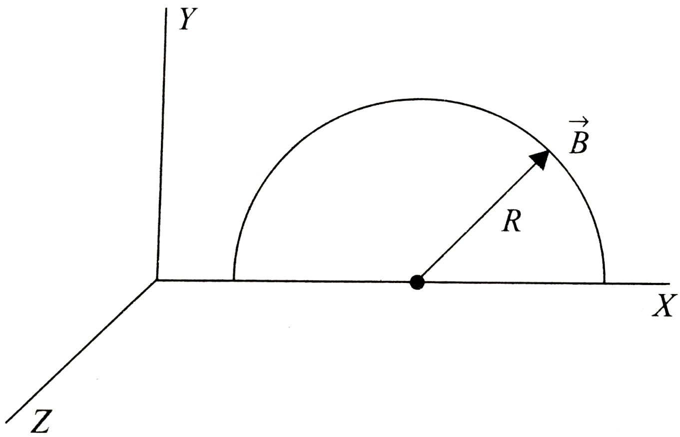
31. A semicircle conducting ring of radius R is placed in the xy plane, as shown in Fig. A uniform magnetic field is set up along the x-axis. No emf, will be induced in the ring if



A. It moves along the x-axis

B. It moves along the y-axis

C. It moves along the z-axis

D. It remains stationary

Answer: A

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

A. the south pole faces the ring and the magnet moves towardsit

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

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

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

Answer: A

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33. An ideal inductor, (having initial current zero) a resistor and an ideal battery are connected in series at time $t = 0$. At any time t, the battery supplies energy at the rate P_B, the resistor dissipates energy at the rate P_R and the inductor stores energy at the rate P_L.

A. $P_B = P_g + P_L$ for all times t

B. $P_B < P_L$ for all times t

C. $P_L < P_g$ in steady state

D. $P_B > P_L$ only near the starting of the circuit.

Answer: A

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Others

1. A coil inductance L and resistance R is connected to a constant voltage source. How soon will the coil current attains $\eta(\eta < 1)$ fraction of the steady state value?

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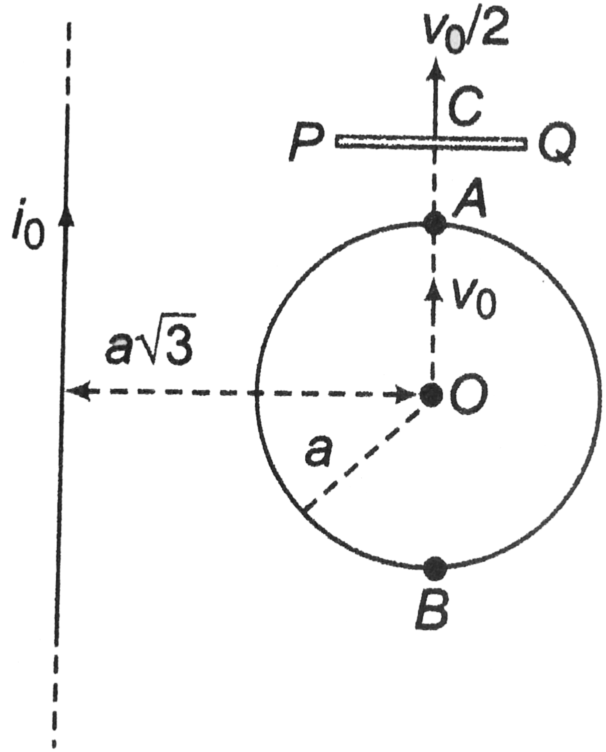
2. A conducting circular loop of radius a and resistance per unit length R is moving with a constant velocity v_0 , parallel to an infinite conducting wire carrying current i_0. A conducting rod of length $2a$ is approaching the centre of the loop with a constant velocity $\frac{v_0}{2}$ along the direction 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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3. A metal disc of radius $R = 25cm$ rotates with a constant angular velocity ω = 130 rad s^{-1} about its axis. Find the potential difference between the center and rim of the disc if

(a) the external magnetic field is absent,

(b) the external uniform megnetic field $B = 5.0$mT directed perpendicular to the disc.

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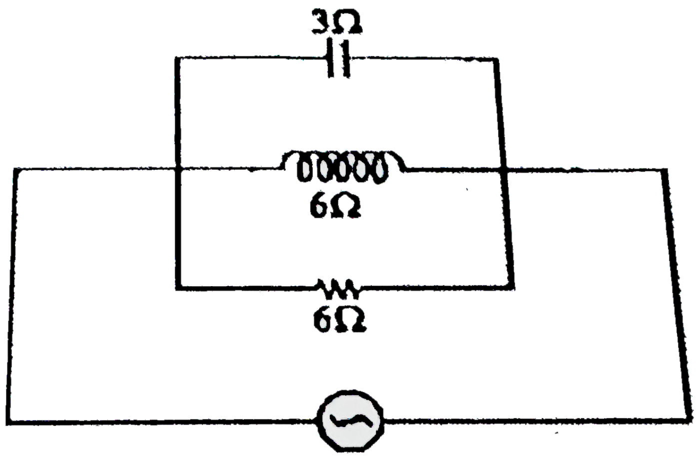
4. Find out impedance of given circuit.



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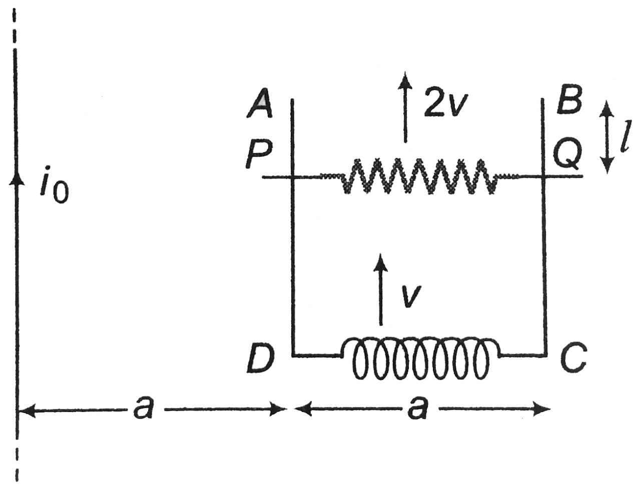
5. U-frame $ABCD$ and a sliding rod PQ of resistance R, start moving with velocities v and $2v$

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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6. Radio receiver receives a message at 300m band, If the available inductance is lmH, then calculate required capacitance.

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7. An inductor-coil , a capacitor and an AC source of rms voltage $24V$ are connected in series. When the frequency of the source is varied, a maximum rms current of $6.0A$ is observed. If this inductor coil is connected to a battery of $emf 12V$ and internal resistance 4.0Ω, what will be the current?

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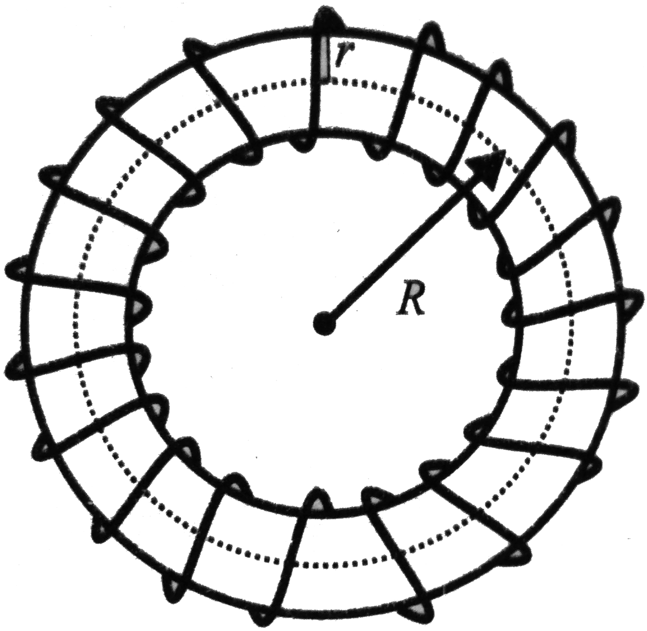
8. A toroid is wound over a circular core. Radius of each turn is r and radius of toroid is $R(>>r)$. The coefficient of self-inductance of the toroid is given by



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9. 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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10. An electromagnetic wave of wavelength 300 metere canbe transmitted by a transmission centre. A condenser of capacity 2.5 μF is available.

Calculate the inductance of the required coil for a resonant circuit. Use $\pi^2 = 10$.

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11. A coil of 5 turns has dimentsion $9cm \times 7cm$. It rotate at the rate of 15π rad/s in a uniform magnetic filed shose flux denxity is 0.8T. What maximum EMF is induced in the coil? What is the EMF 1/90s after it reaches the value zero?

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12. A circuit containing 0.1H inductor and a $500\mu F$ capacitor in series is connected to a 230V, $100/\pi$ Hz supply. The resistacne of the circuit is negligible.

(a) Obtain the current amplitude and rrns values.

(b) Obtain the rrns value of potential drops across each element. (c) What is the average power transferred to the inductor? (d) What is the average power transferred to the capacitor? (e) What is the total average power absorbed by the circuit? ['Average' implies average over one cycle.]

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13. In a LC circuit parallel combination of inductance of 0.01H and a capacitor of $1\mu F$ is connected to a variable frequency alternating current source. Draw a rough sketch of the current variation as the frequency is changed from 1kHz to 3kHz.

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14. In a series LCR circuit, at the frequencies f_1 and f_2 of AC source, the current amplitude falls to $\frac{1}{\sqrt{2}}$ of the current amplitude at resonance. Then the value of $f_2 - f_1$ is

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15. A coil of 1.60 turns of cross-sectional area $250cm^2$ rotates at an angular velocity of 300rad/s about an axis parallel to the plane of the coil in a uniform magnetic field of 0.6 weber/mere.^{2} . What is the maximum EMF induced in the coil. If the coil is connected to a resistance of 2Ω, what is the maximum torque that has to be delivered to maintain its motion.

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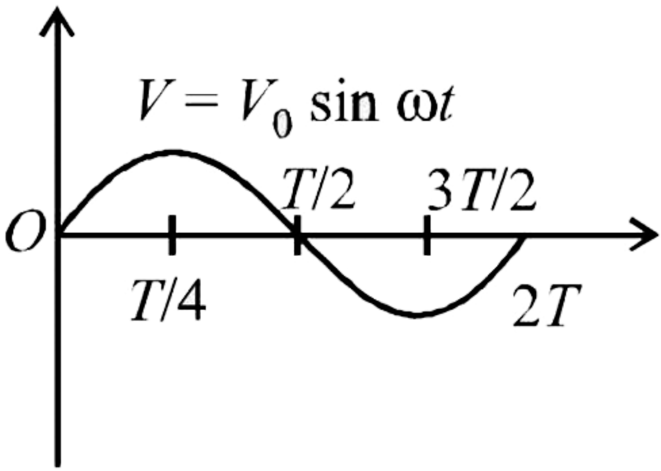
16. In a series L-R circuit $(L = 35mH$ and $R = 11\Omega)$, a variable emf source $(V = V_0 \sin \omega t)$ of $V_{rms} = 220V$ and frequency 50 Hz is applied. Find the current amplitude in the circuit and phase of current with respect to voltage. Draw current-time graph on given graph $\left(\pi = \frac{22}{7}\right)$.



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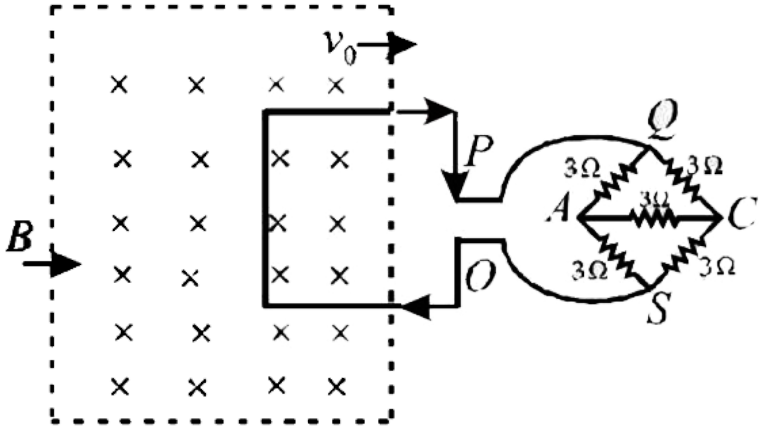
17. A square metal wire loop of side 10 cm and resistance 1 ohm is moved with a constant velocity (v_0) in a uniform magnetic field of induction $B = 2weber\,/\,m^2$ as shown in the figure. The magnetic field lines are perpendicular to the plane to the loop (directed into the paper). The loop is connected to a network of resistors each of value 3 ohms. The resistances of hte lead wire OS and PQ are negligible. What should be the speed of the loop so as to have a steady current of 1 milliampere in the loop? Given the direction of current in the loop.



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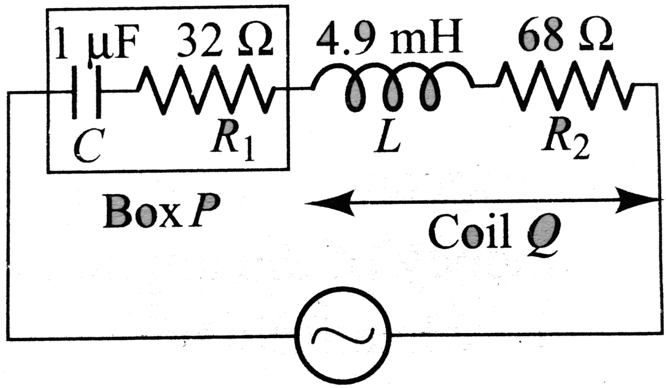
18. A box P and a coil Q are connected in series with an ac source of variable frequency. The emf of the source is constant at 10 V. Box P xontains a capacitance of 32Ω. Coil Q has a self inductance of 4.9 mH and a resistance of 68Ω in series. The frequency is adjusted so that maximum current flows in P and Q.



The voltage across P is

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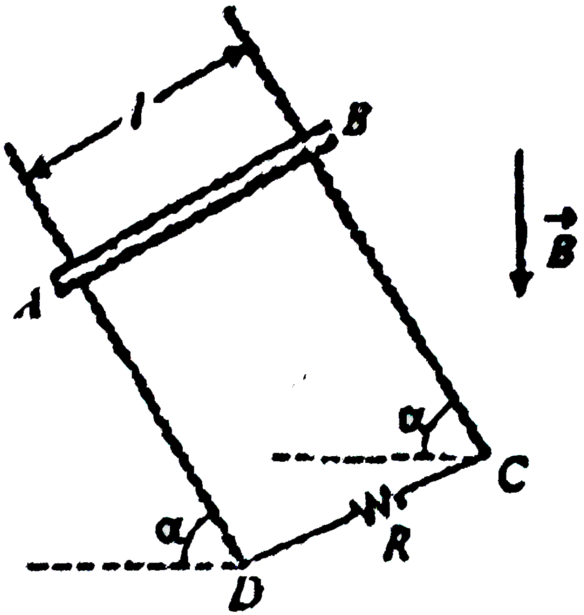
19. Two parallel conducting rails separated by a distance l are fixed on a plane surface, inclined at an angle α to the horizontal as shown in figure-5.336.

Rails are connected at the bottom by a resistance R. A copper rod of mass in slides without friction on the rails due to gravity. A uniform vertical field B exists throughout the region. Find the steady state velocity of the rod. Show that the rate at which thermal energy is produced in the circuit is equal to the rate at which rod is losing gravitational potential energy. What will happen if the direction of B is reversed?



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20. A small town with a demand of 800 kW of electric power at 220 V is situated 15 km away from an electric plant generating power at 440 V. The resistance of the two line wires carrying power is 0.5Ω per km. The town gets power from the lines through a 4000-220 V step down transformer at a substation in the town.

Estimate the line power loss in the form of heat.

(b) How much power must the plant supply. assuming there is negligible power loss due to leakage?

(c) Characterize the step up transformer at the plant.

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21. A magnetising field of $1500A/m$ produces a flux of $2 \cdot 4 \times 10^{-5}$ weber in a bar of iron of cross-sectional area $0 \cdot 5cm^2$. Calculate the permeability and susceptibility of the iron bar used.

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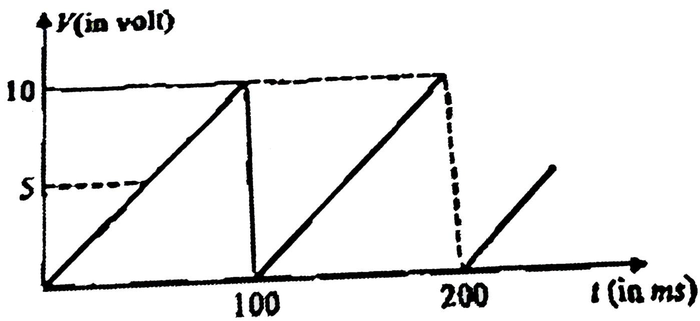
22. A periodic voltage wave form has been shown in figure-5.337.



Determine (a) Frequency of the wave form (b) Average value of the voltage

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23. A long solenoid having 200 turns per centimeter carries a current of $1.5A$. At the center of the solenoid a coil is placed of 100 turns of cross-sectional area $3.14 \times 10^{-4} m^2$ having its axis parallel to the field produced by the solenoid. When the direction of current in the solenoid is reversed within $0.05s$, the induced emf in the coil is

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24. An iron rod of $0 \cdot 2cm^2$ cross-sectional area is subjected to a magnetising field of $1200Am^{-1}$. The suscaptibility of iron is 599. Find the permeability and the magnetic flux produced.

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25. When 10V,DC is applied across a coil current through it is 2.5A, if 10V,50Hz A.C. is supplied current reduces to 2A. Calculate reactance of the cell.

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26. A long cylinderivcal coil of inductance L_1 is wound on a bobibs of diameter d_1. The magnetic induction is the coil connected to a current source is B_1. After rewinding the coil aaa babbin of diameterd_2 its inductance become L_2. Find the magnetic induction B_2 of the field in the new coil connected to the same current source assuming that the length of wire is much larger than that of coil.

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27. An airplane with a 20 wingspread is flying at 250m/s straight south parallel to the earth's surface. The earths magnetic field has a horizontal component of $2 \times 10^{-3} Wb/m^2$ and the dip angle is 60°. Calculate the induced e.m.f. between the plane tips.

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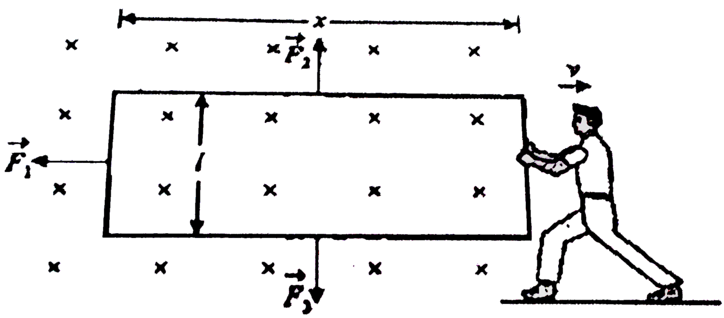
28. A rectangular loop of wire is placed in a uniform magnetic field B acting normally to the plane of the loop. If a man attempt to pull it out ofthefield with velocityv as shown in figure-5.338, calculate the power required for this purpose.



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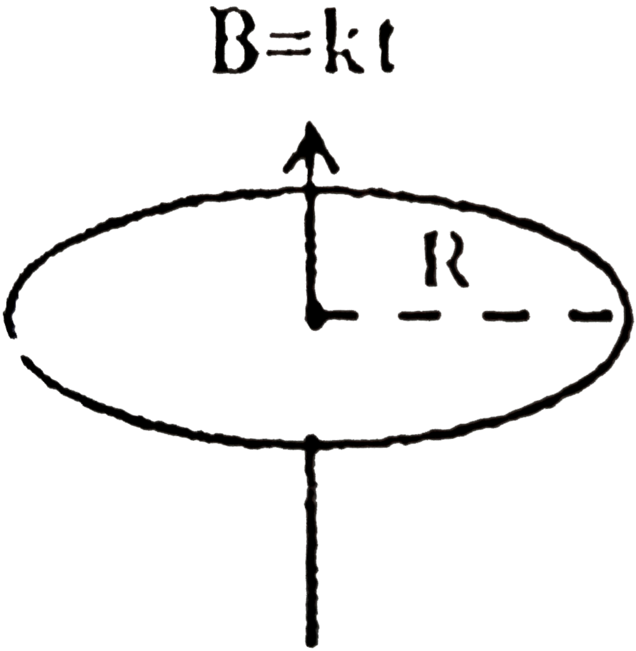
29. A thin non conducting horizontal disc of mass m having total charge q distributed uniformly over its surface, can rotate freely about its own axis. Initially when the disc is stationery a magnetic field B directed perpendicular to the plane is switched on at $t = 0$. Find the angular velocity ω acquired by disc as a function of time, if $B = kt$, where t is time.



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30. Calculate (a) resistance or (b) inductance required in series to operate a lamp (60V,10W) from asourceof(I00V, 50 Hz)

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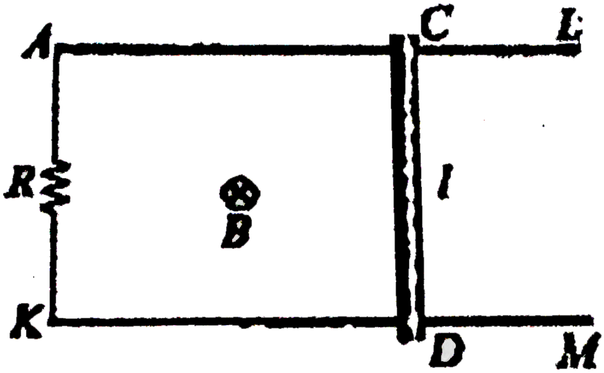
31. Two parallel wires AL and KM placed at a distance l are connected by a resistor R and placed in a magnetic field B which is perpendicular to the plane containing the wire as shown in figure-5.340. Another wire CD now connects the two wires perpendicularly and made to slide with velocity v. Calculate the workdone needed to slide the wire CD.

Neglect the resistance of all the wires.



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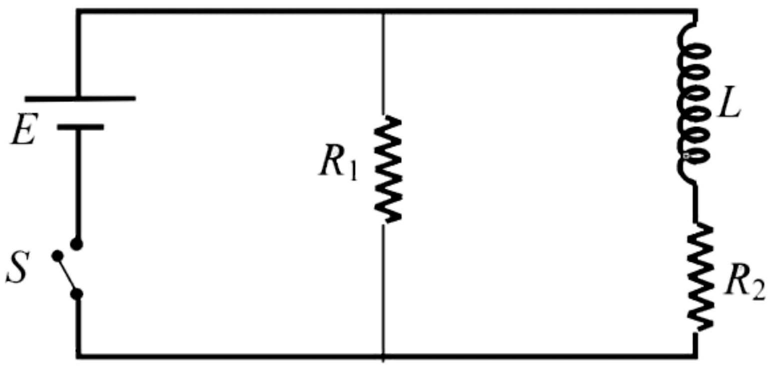
32. An inductor of inductance L=400 mH and resistor of resistance $R_1 = 2(\Omega)$ and $R_2 = 2(\Omega)$ are connected to a battery of emf E = 12 Vas shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at time t =0.

What is the potential drop across L as a function of time? After the steady state is reached, the switch is opened. What is the direction and the magnitude of current through R_1 as a function of time?



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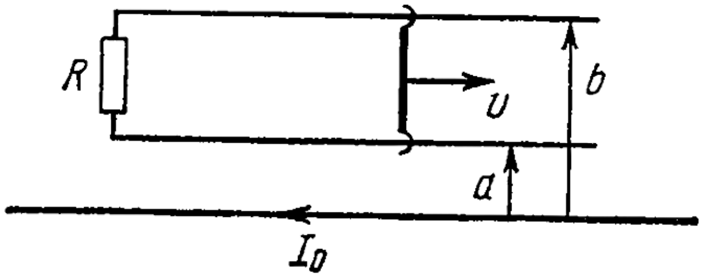
33. A long straight wire carries a current I_0. At distances a and b from it there are two other wires, parallel to the former one, which are interconnected by a resistance R (Fig). A connector slides without friction along the wires with a constant velocity v. Assuming the resistances of the wires, the conductor, the sliding contacts, and the self-inductance of the frame to be negligable, find:

(a) the magnitude and the direction of the current induced in the connector,

(b) the force required to maintain the connector's velocity constant.



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34. An $L-C$ circuit consists of an inductor with $L=0.0900H$ and a capacitor of $C=4x10-4F$. 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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35. A circuit has a coil of resistance 60 ohm and inductance 3 henry. It is connected in series with a capacitor of $4\mu F$ and $A.C$ supply voltage of $200V$ and 50 cycle/sec

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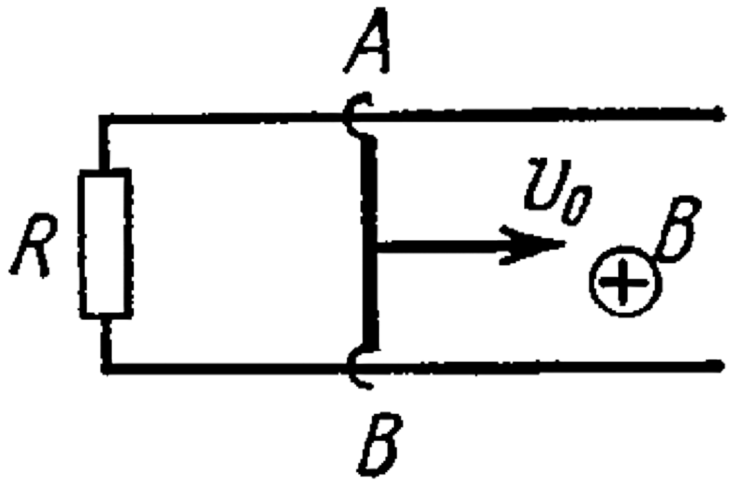
36. A conductor rod AB of mass m slides without friction over two long conducting rails separated by a distance (Fig) At the left end the raidls are interconnected by a resistance R. The system is located in a unifrom magnetic fileld perpendicular to the plane of the loop. At the moment $t = 0$ the rod AB starts moving to the right with an initial velocity v_0. Neglecting the resistances of the rails and the rod AB, as wellas the self -indcuctance, find:

(a) the distance covered by the rod until it comes to a standsill,

(b) the amount of heat generated in the resitance R during this process.



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37. 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.

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38. A vertical copper disc of diameter $20cm$ makes 10 revolution per second about a horizontal axis passing through its center. A uniform magnetic field

$10^{-2}T$ acts perpendicular to the plane of the disc. Calculate the potential difference between its center and rim in volts.

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39. A current of 10 A is flowing in a long straight wire situated near a rectangular circuit whose two sides oflength 0.2m are parallel to the wire. One of them is at a distance of0.05m and the other at a distance of 0. IOm from the wire. The wire is in the plane of the rectangle. Find the magnetic flux through the rectangular circuit. If the current decays uniformly to zero in 0.02s, fmd the EMF induced in the circuit and indicate the direction in which the induced current flows.

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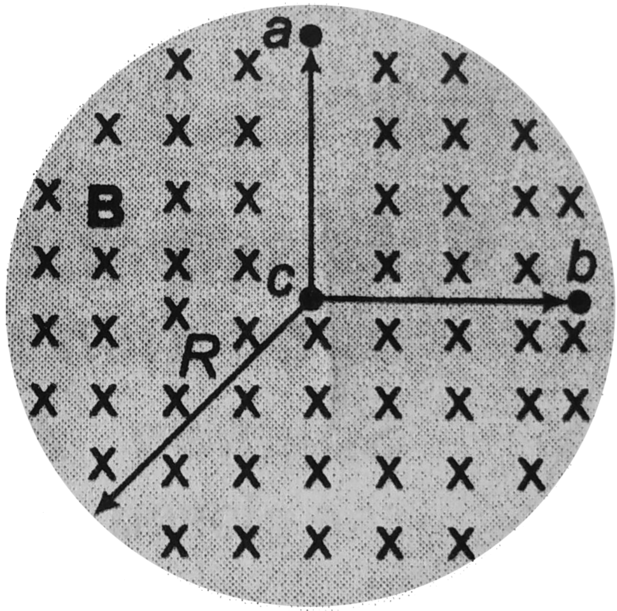
40. The magnetic field B at all points within a circular region of the radius R is uniform space and directed into the plane of the page in figure. If the magnetic field is increasing at a rate dB/dt what are the magnitude and direction of the force on as stationary positive point charge q located at 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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41. The rails ofa railway track are I.Sm apart and assumed to be insulated from one another. Calculate the EMF that will exist between the rails if a train is passing at 100 km/hr. Assume the horizontal component of earth's magnetic field is $0.36 \times 10^{-4} T$ and $\tan\theta = 1.036$ where θ is the angle of dip.

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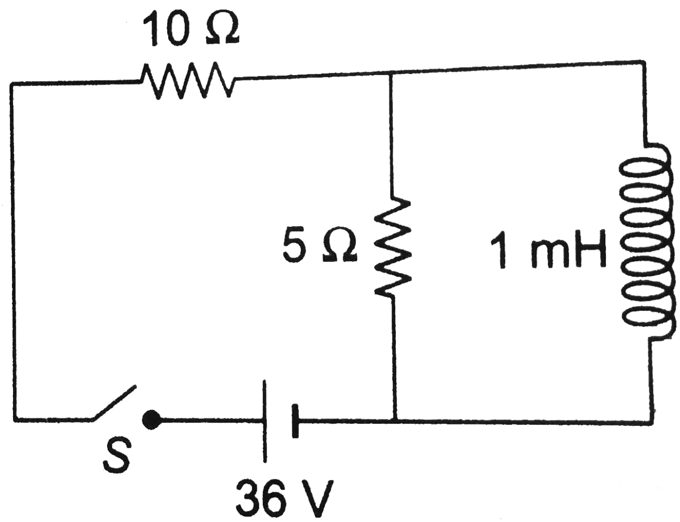
42. In the circuit arrangement shown in figure, the switch S is closed at $t = 0$. Find the current in the inductance as a function of time? Does the current through 10Ω resistor vary with time or remains constant.



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43. A closed coil having 50turns, area $300cm^2$ and resitance 40Ω is h eld at right angles to uniform field of induction 0.02T. If it is then turned through an angle of 30° about an axis at right angles to the field, find the charge flown through the coil.

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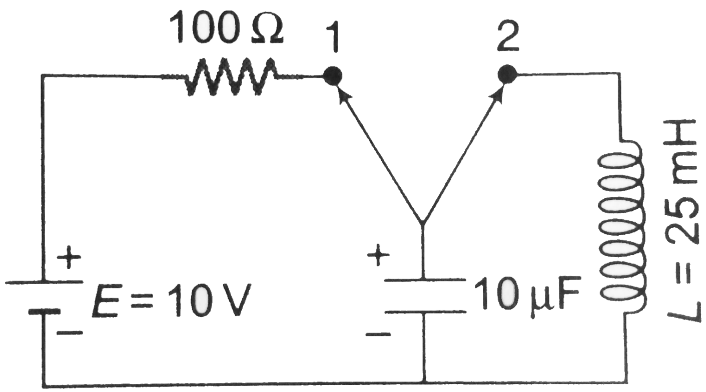
44. Initially, the capacitor is charged to a potential of $5V$ and then connected to position 1 with the shown polarity for $1s$. After $1s$ it is connected across the inductor at position 2



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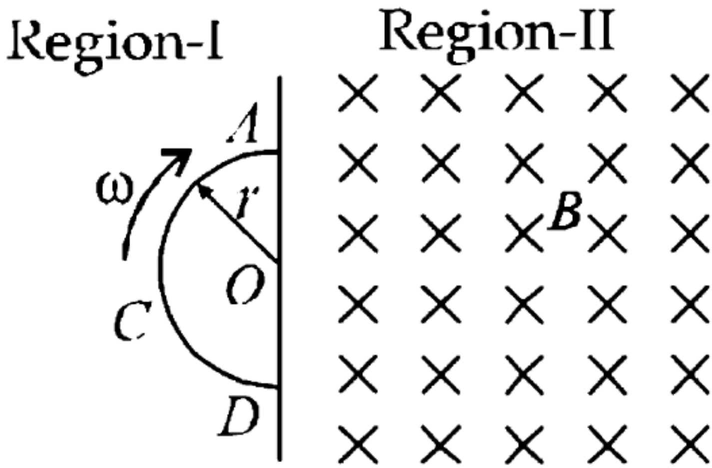
45. Space is divided by the line AD into two regions. Region I is field free and the Region II has a unifrom magnetic field B direction into the plane of the paper. ACD is a simicircular conducting loop of radius r with center at O, hte plane of the loop being in the plane of the paper. The loop is now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



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

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

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

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46. An inductance of $2.0H$, a capacitance of $18\mu F$ and a resistance of $10k\Omega$ are connected to an AC source of $20V$ with adjustable frequency. (a) What frequency should be chosen to maximise the current in the circuit? (b) What is the value of this maximum current?

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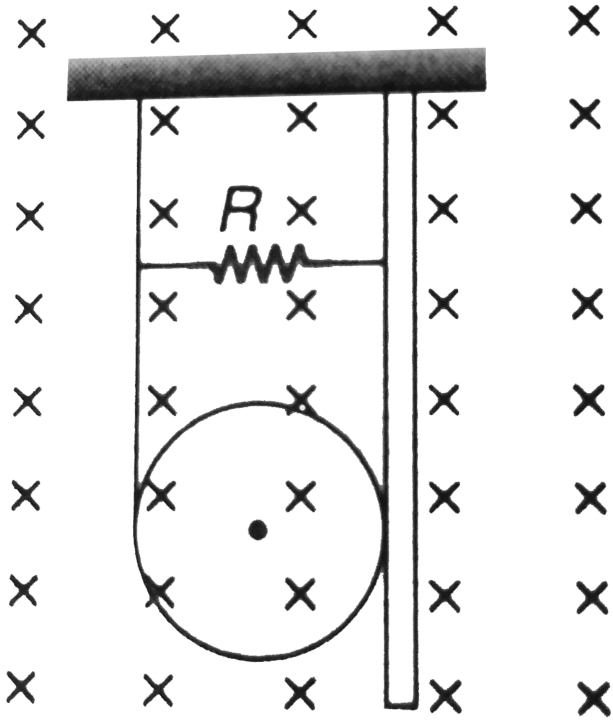
47. A conducting light string is wound on the rim of a metal ring of radius r and mass m. The free end of the string is fixed to the ceiling. A vertical infinite smooth conducting plane is always tangent to the ring as shown in the figure. A uniform magnetic field Bis applied perpendicular to the plane 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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48. A stiffw ire bent into a semicircle of radius R is rotated at a frequency Jin a uniform magnetic field B. Calculate the amplitude and frequency of the induced voltage. If this circuit has negligible resistance and the internal resistance of the ammeter is 100Ω, calculate the amplitude of induced current.

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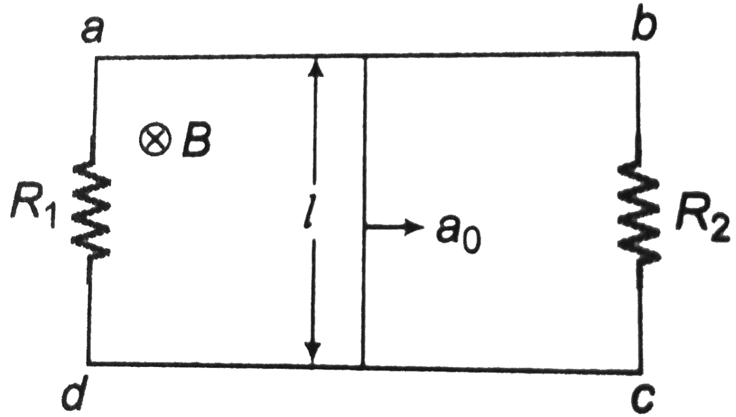
49. A rectangular loop with a sliding conductor of length l is located in a uniform magnetic field perpendicular to the plane of loop. The magnetic induction perpendicular to the plane of loop Is equal to B. The part ad and be has electric resistance R_1 and R_2, respectively. The conductor starts moving 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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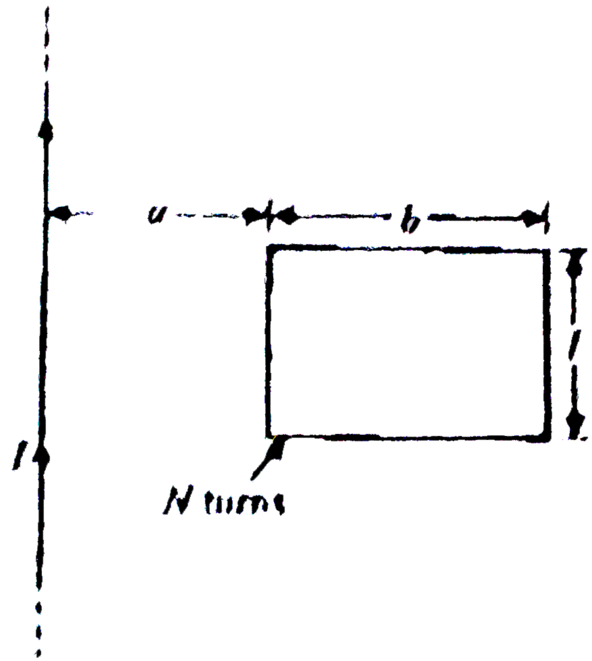
50. A long straight wire carries a current $I = I_0 \sin(\omega t + \partial)$ and lies in the plane of a rectangular loop of N turns of wire as shwon in figure-5.351. The quantities $l_0 \omega$ and ∂ are all constants. Determine the EMF induced in the loop by the magnetic field due to the current in the straight wire. Assume $I_0 = 50A, \omega = 200\pi / s, N = 100, a = b = 5cmcm$

and l=20cm.



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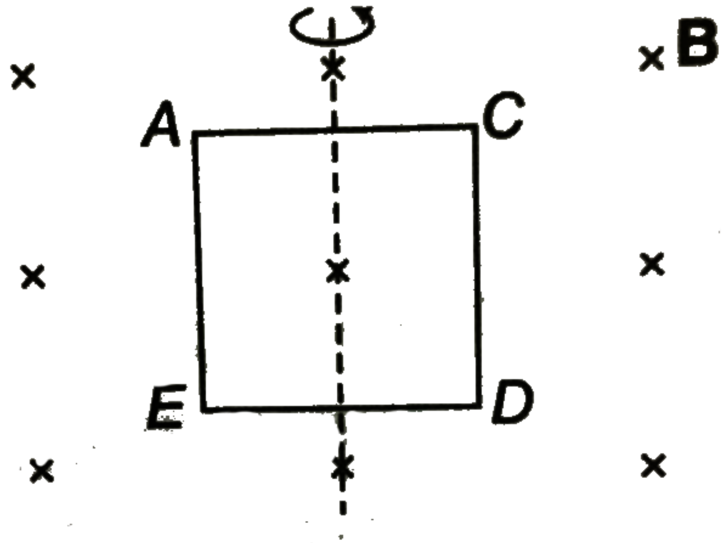
51. A square loop $ACDE$ of area $20cm^2$ resistance 5Ω is rotate in as magnetic field $B = 2T$ through 180° (a) in $0.01S$ and (b) in $0.02s$

Find the magnitudes of averasge values of e i and

$\triangle\ q$ in both the cases.



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52. Two long parallel wires of zero resistance are

connected to each other by a battery of $1.0V$. The

separation between the wires is $0.5m$. A metallic bar, which is perpendicular to the wire and of resistance 10Ω moves on these wire when a magnetic field of 0.02 tesla is acting perpendicular to the plane containing the wire and the wires. Find the velocity of the bar as a function of time if the mass of the bar is $0.002kg$. Find also the steady-state velocity of the bar.

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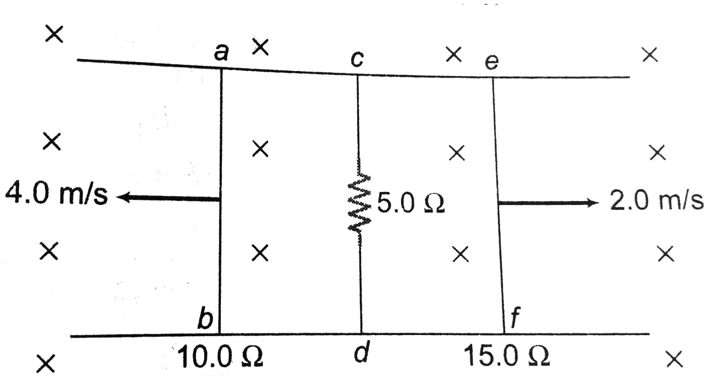
53. Two parallel rails with negligible resistance are $10.0cm$ apart. The are connected by a 5.0Ω resistor. The circuit also contains two metal rods having resistances of 10.0Ω and 15.0Ω along the rails. The rods are pulled away from the resistor at constant speeds $4.00\frac{m}{s}$ and $2.00m/s$ respectively. 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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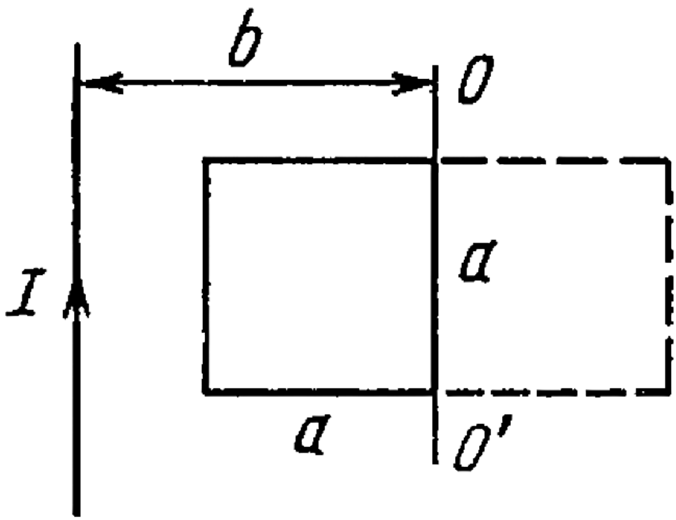
54. A square wire frame with side a and a straight conductor carrying constant current I are located in the same plane (Fig). The inductance and the resitance of the frame are equal to L and R respectively. The frame was turned throgh 180° about the axis OO'separated fromt the current carrying conductor by a distance b. FInd the electric charge having flown through the frame.



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55. 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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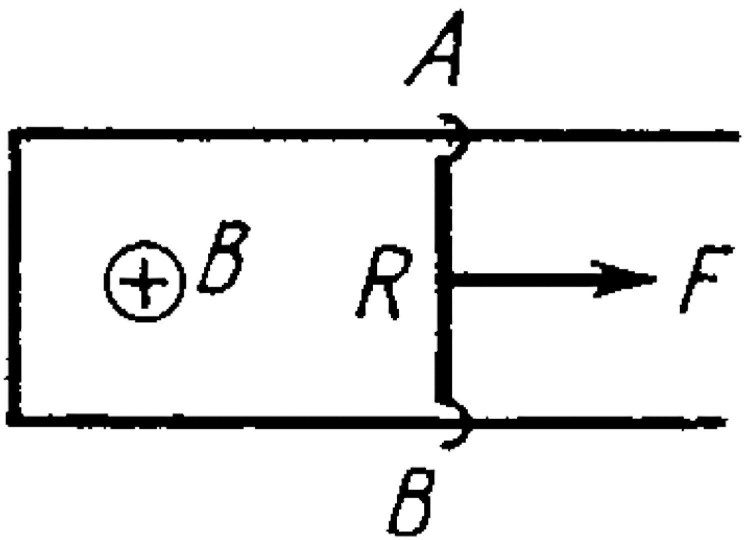
56. A connector AB can slide without frictiion along a II-shaped conductor located in a horizontal plane (Fig). The connector has a length l, mass m and resistance R. The whole system is located in a unifrom magnetic field of induction B

directed vertically. At the moment $t = 0$ a constant horizontal force F starts acting on the connector shifting it translationwise to the right. Find how th e velocity o fhte connector varies with time t. The inductance of the loop and the resistance of the II-shaped conductor conductor are assumed to be negligible



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57. 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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58. When an alternating voltage of $220V$ is applied across a device P, a current of $0.25A$ flows through the circuit and it leads the applied voltage by a angle $\frac{\pi}{2}$ radian. When the same voltage source is connected across another device Q, the same current is observed in the circuit but in phase with the applied voltage. What is the current when the same source is connected across a series combination of P and Q?

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59. 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 turn of solenoid 1?

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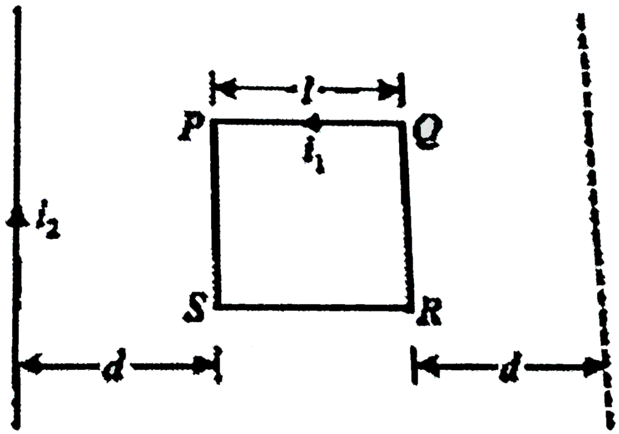
60. A square frame PQRS of each side l, with a steady current i_1 is near a long straight conductor carrying a current i_2. The frame and the conductor are in one plane, with the length of the conductor parallel to the side PS and QR of the square frame as shown in figure-5.357. Calculate the workdone in moving the conductor from position P_1 to P_2.



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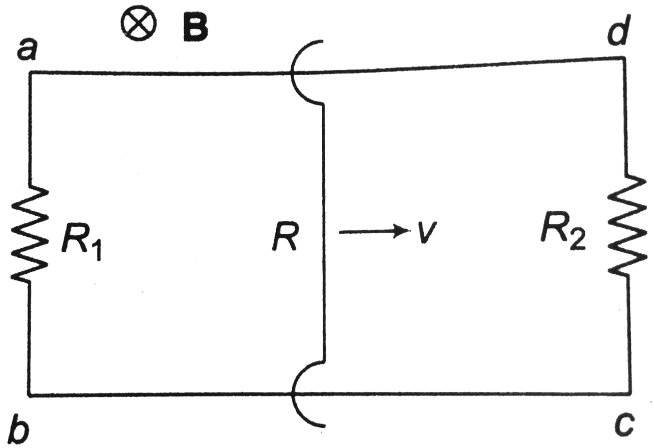
61. A rectangular loop with a sliding connector of length l is located in a uniform magnetic field perpendicular to the loop plane. The magnetic induction is equal to B. The connector has an electric resistance R, the sides ab and cd have resistances R_1 and R_2. Neglecting the self-inductance of the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



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62. 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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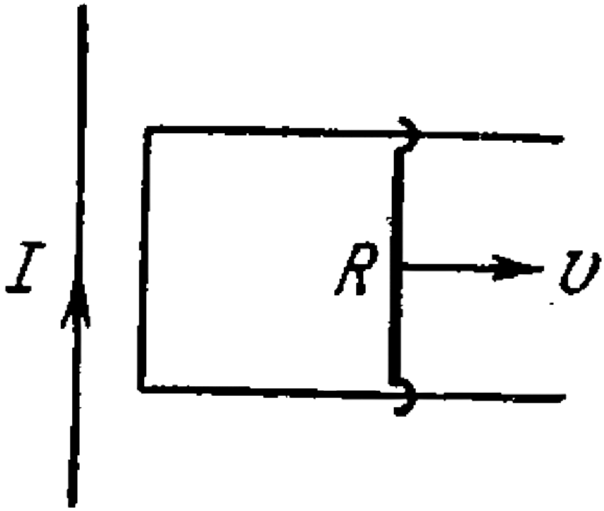
63. A long straight wire carrying a current I and a II- shaped conductor with siding connector are located in the same plane as shown in Fig. The connector of length l and resistance R sides to the right with a current induced in the loop as a function of separation r between the connector and the stragiht wire. The resistance of the II-

shaped conductor and the self-induced of the loop are assumed to be negligible.



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64. A 20 volts 5 watt lamp (amp to be treated as a resistor) is used on AC mains of 200 volts and $\frac{50}{\pi}\sqrt{11}c.\ p.\ s.$ Calculate the (i) capacitance of the capacitor, or inductance of the inductor, to be put in series to run the lamp. (i) How much pure resistance should be included in place of the above device so that the lamp can run on its rated voltage. (ii) which is more economical (the capacitor, the inductor or the resistor).

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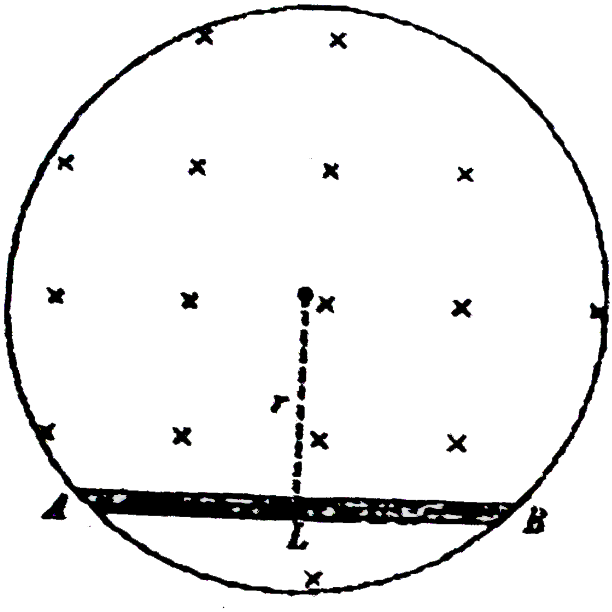
65. A rod AB of length L is placed in a cylindrical region time varying magnetic field as shown in figure-5.360 , with the rate of increasing magnetic induction C T/s. find the potential difference across ends of rod due to induced electric field in the region.



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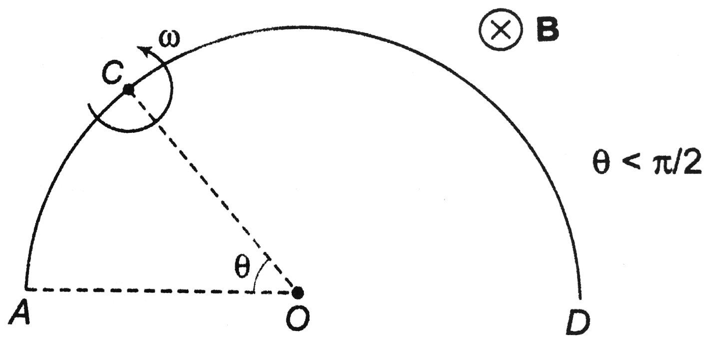
66. A uniform wire of resistance per unit length λ is bent into semicircle of radius a. The wire rotates with angular velocity ω in a vertical plane about a

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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67. 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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68. On a smooth horizontal table a disc is placed with non conducting ring with uniformly distributed charge q fixed on its circumference. Both disc and ring are of mass m and radius r. If a uniform magnetic field of induction B which is symmetric with centre of disc is switched on in vertically downward direction, find the angular speed attained by disc due to this.

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69. 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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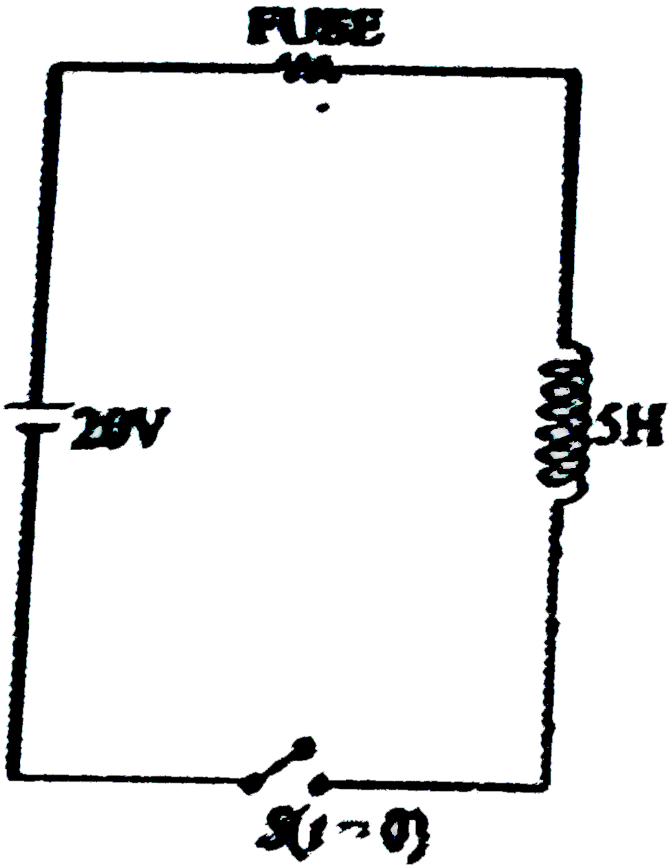
70. Figure-5.362 shows a circuit in which an inductor of 5H is a=connected to a 20V battery and a fuse of rating 30A. Neglect any resitance in the circuit, if switch is closed at t=0 find the time after which fuse will blow up.



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71. 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 $830 A / s$.

(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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72. A small coil of radius r is placed at the centre of another coaxial coil of radius $R(R > > r)$ find the coeffcient for this pair of coils.

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