PHYSICS

BOOKS - CP SINGH PHYSICS (HINGLISH)

ELECTROMAGNETIC INDUCTION

EXAMPLE

1. A long solenoid of radius $3cm$, length $100cm$ carries a current of $4A$. The total

number of truns is 300 . Assuming ideal solenoid, find the flux passing through a circular surface having centre on axis of solenoid,

(a) of radius $2cm$ and is perprndicular of the axis of solenoid (i) inside and (ii) at the end of solenoid

(b) of radius $4cm$ and is perprndicular of the axis of solenoid

(c) of radius greater than $3cm$ and angle between normal to area and axis of solenoid is $60^\circ C$

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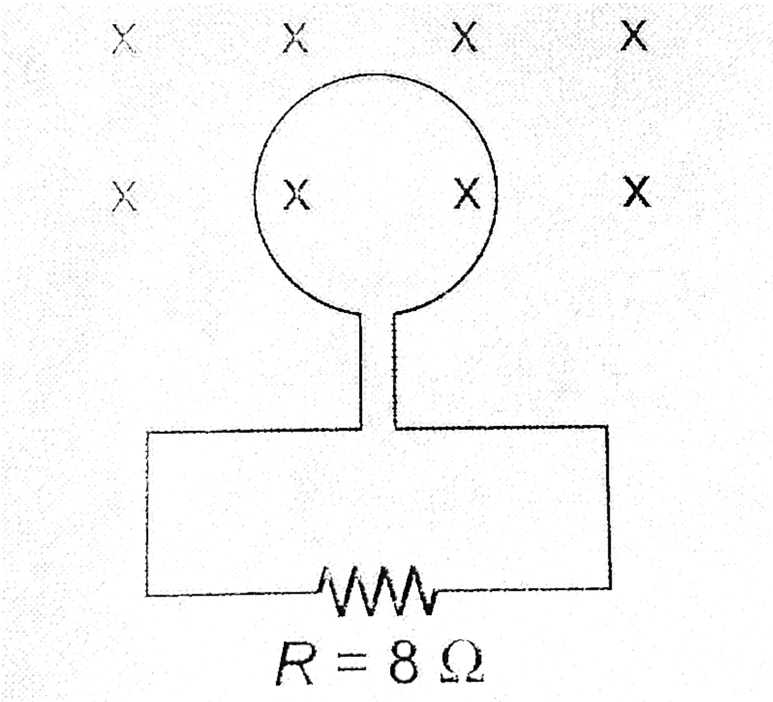
2. The magnetic flux passing prependicular to the plane of the coil directed into the paper is varying according to the relation

$\phi = 6t^2 + 8t + I0$, where ϕ is in weber and t in second.

(a) What is the magnitude of emf induced in the loop when $t = 2\,\mathrm{sec}$?

(b) What is the magnitude and direction of current at $t = 2\,\text{sec}$?



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3. A wire of length l in the from of a circular loop lies in a plane normal to a magnetic firld

B_0 . If this wire is converted into a square loop in time t_0 , find the average induced emf.

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4. A coil of area $500 cm^2$ 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 indued e.m.f.

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5. 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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6. A coil of area A lies in a uniform magnetic field B with its plane perpednicular to the field. In this position the normal to the coil makes an angle 0° with a field. The coil rotates at a uniform rate about its diameter to complete one rotation in time T . Find the average induced e.m.f. in the coil during the interval when coil rotates from:

(a) 0° to 90°

(b) 90° to $I80^\circ$

(c) $I80^\circ$ to 270°

(d) 270° to 360°

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7. A conducting loop of area A is placed in a magnetic field which varies sinusoidally with time as $B = B_0 \sin$

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

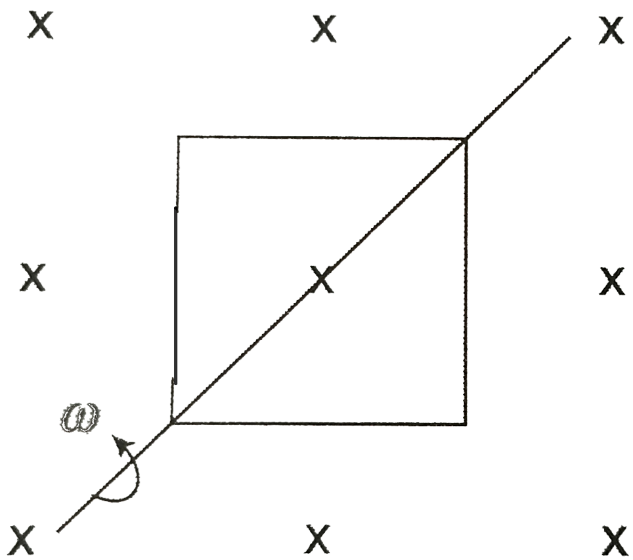
(a) the emf induced ion the coil as a function of time t

(b) the maximum emf induced

(c) the average emf induced in the loop over a long period (d) the average of the squares of emf induced over a long period

(e) if resistance of loop is R , amount of change flow in time $t = 0$ to $t = 2T$

(f) heat produced in time $t = 0$ to $= 4T$



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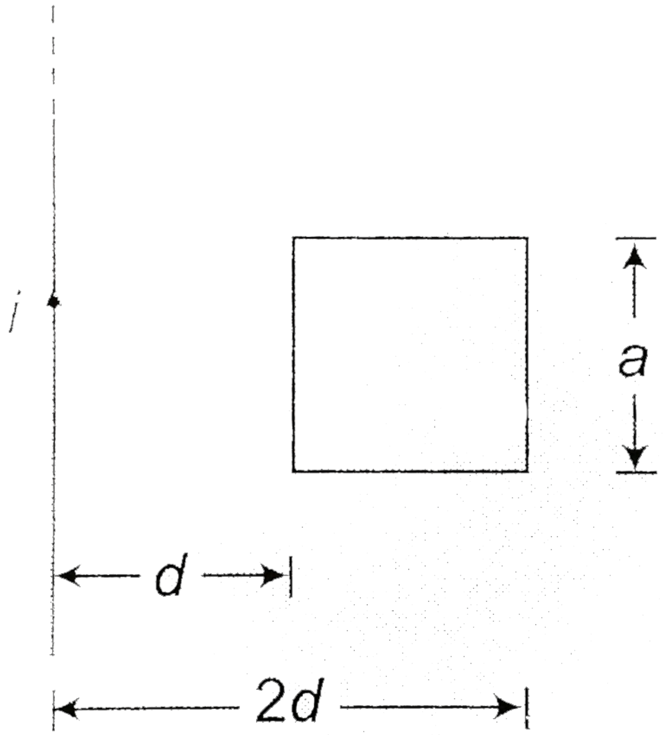
9. A current i_0 is flowing in a long straigh wire situation near a rectangular loop as shown. If the current in the loop as shown . If the current decays iniformly to zero in time t_0 find the emf include in the circuit and determine direction of induced current in the loop .



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10. The magnetic flux passing through a metal ring varies with time t according to $\phi_B = 6t^3 - I8t^2$, t is in second. The resistance of the ring is 3Ω . Determine the maximum current induced in the ring during the interval from $t = 0$ to $t = 2\,\sec$.

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11. 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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12. Two straight conducting rails from a right angle where their end are joined. A conducting bar polaced over the rails starts at vertex at the time $t = 0$ and moves with a constant velocity v to the right as shown in the figure. Calculate

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

the emf around the triangle at that time

(c) in what manner does the emf around the triangle vary with time

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13. A current $i = \alpha t$, where t is time is flowing in a long wire. A smaller circular loop of radius a has its plane parallel to the wire and is placed at distance d from the wire. If resistance per unit length of loop is λ , find the magnitude and direction of the current in the loop.

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14. A very small circular loop of area $5 \times I0^{-4} m^2$, resistance 2Ω and negligible inductance is initially coplanar and concentric with a much larger fixed circular loop of radius $0. Im$. A constant current of IA 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 limked with the smaller loop, (b) indced emf (c) induced current in the smaller loop, as a function of time.

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15. A very small circular loop of radius r is initially coplanar and concentric with a much larger circular loop of radius $R(\; > \; > r)$. A constant current i is passed in the larger loop which is kept fixed in space and the small loop is rotated with angular velocity ω about a diameter. The resistance of the small loop is R_0 and the inductance is negligible.

(a) Find the current in the small loop as a function of time.

(b) Calculate how much troque must be exerted on the small loop to rotate it.

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16. The magnetic field in the cylindrical region shown in figure increases at a constant rate of

$20.0 mT/\sec$. Each side of the square loop abcd and defa has a length of $I.00 cm$ and a resistance of 4.00Ω . Find the cuurent (magnitude and sense) in the wire ad if:

(a) the switch S_I is closed but S_2 is open

(b) S_I is but S_2 is closed

(c) both S_I and S_2 are open and

(d) both S_I and S_2 are closed

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17. A uniform magnetic field B exists in a direction perpendicular to the palne of a square frame made of copper wire. The wire has a total length of $40cm$. The magnetic field changes with time at a steady rate $(dB/dt) = 0.02T/\sec$. Find the current induced in the frame. Resistance of wire $= I0\Omega$

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18. A coil formed by wrapping 50 truns of wire in the shape of square is positioned in a magnetic field so that the normal to plane of the coil makes an angle of 60° , with the direction of the field. When the magnetic field is increased uniformly from $200\mu T$ to $600\mu T$ in $0.4 \sec$, an emf of magnitude $I00mV$ is induced in the coil. What is the total length of the wire ?

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19. 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 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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20. A circular coil of radius 2.00 cm has 50 turns. A uniform magnetic field B= 0.200 T exists in the space is a direction parallel to the axis of the loop. The coil is now rotated about a diameter through an angle of 60.0°. The operation takes 0.100 s. (a) find the average emf induced in the coil. (b) if the coil is a closed one(with the two ends joined together) and has a resistance of 4.00Ω. calculate the net charge crossing a cross- section of the wire of the coil.

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21. A closed coil having 100 turns is rotated in a uniform magnetic field $B = 4.0 \times 10^{-4}$ T about a diameter which is perpendicular to the field. The angular velocity of rotation is 300 revolutions per minute. The area of the coil is $25cm^2$ and its resistance is 4.0Ω. Find (a) the average emf developed in the half a turn form a position where the coil is perpendicular to the magnetic field, (b) the average emf in a full turn and (c) the net charge displaced in part (a).

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22. 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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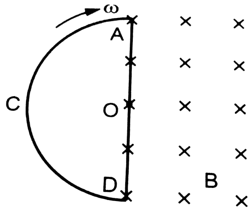
23. The magnetic field B shown in is directed into the plane of the paper. ACDA is a semicircular conducting loop of radius r with the centre at O. The loop is now made ot rotate clockwise with a constant angular velocity ω about on axis passing through O and perpendicular to the plane of the paper. The resistance of the loop is R. Obtain an expression for the magnitude of the induced current in the loop. Plot a graph between the induced current i and ωt, for two periods of rotation.



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24. The figure shows a square loop wire with sides of length $l = 2cm$. A magnetic field position points into the page and its magnitude is given by $B = 4t^2 yT, t$ is in second and y is in metre. Determine the emf induced around the square at $t = 2.5 \sec$.

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25. A Square frame with side a and a straigh conductor carrying a constant current I and located in the same plane. The inductance and the resistance of the frame are equal to L and R respectivaly. The frame was truned through $I80^\circ$ about the axis OO' separated from the current carrying conductor by a distance b . Find the electric charge having flown through the frame.

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26. A square loop of edge a has N turns and a total resistance R . The loop moves with constant velocity v through a region of constant magnetic field B . The loop enters in magnetic field at $t = 0$. Discuss the vartion of (a) Flux passing through the loop (b) the induced emf and (c) the external force acting on the loop a function of position of the loop in the field.

27. A short bar magnet is pulled rapidly through a conductind cooil along its axis with uniform velocity, with its north pole entering the coil first. Sketch vartition of (a) flux, (b) induced current and (c) power dissipated in coil with time.

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28. Two concentric coplanar circular loops made of wire, with resistance per unit length λ

, have radii r_I and $r_2(r_2 > > r_I)$. A potential difference $(\alpha + \beta t)$ is applied to the larger loop, where t is time. Calculate current in the smaller loop.

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29. Two infinitely long solenoids (shown in cross-section) pass through a circuit as shown in the figure. The magnitude of $\vec{B}$ inside each is the same and is increasesing at the rate of $I00T / \sec$. What is the current in each resistor ?

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30. A plane loop is shaped ion the from as shown in the figure with radii a and b and is placed in a uniform time varying magnetic field $B = B_0 \sin \omega t$. Find the amplitude of the current induced in the loop if its resistance per unit length is equal to λ . The inductance of the loop negligible.

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31. A π shaped metal frame is located in a uniform magnetic field perpendicular to the plane of the conductor and varying with time at the rate $(dB/dt) = 0.I0T/\sec$. A conducting connector starts moving with an acceleration $a = I0cm/\sec^2$ along the parallel bars of the frame. The lenght o0f the connector is equal to $l = 20cm$. Find the emf induced in the loop $t = 2\sec$ after the beginnig of the motion, if at the moment

$t = 0$ the loop area and the magnetic induction are equal to zero. The inductance of the loop is to be neglected.

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32. A metallic meter stick moves with a velocity of $2m / \sec$ in a diretion perpendicular to its length and perpendicular to a uniform magnetic firld of magnitude $0.2T$. The emf induced between the ends of the stick

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33. The two rails of a railway track, insulataed form each other and from the ground, are connected to a millivoltmeter. What will be the reading of the millivoltmeter when a train travels on the track at a speed of $180 kmh^{-1}$? The vertical component of earth's magnetic field is0.2×10^{-4} and the rails are separted by 1m.

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34. The horizontal component of the earth's magnetic field at a place is $3.0X10^{-4}T$ and the dip is 53°. A metal rod of length 25cm is placed in the north - south direction and is moved at a constant speed of 10cm s^(-1) towards east. Calculate the emf induced in the rod.

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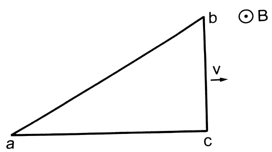
35. A right angled triangle abc, made from a metallic wire, moves at a uniform speed v in its plane as shown in . A uniform magnetic field B exists in the perpendicular direction. Find the emf induced (a) in the loop abc, (b) in the segment bc, (c) in the segment ac and (d) in the segment ab.



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36. A copper wire bent in the shape of a semicircle of radius r translates in its plane with a constant velocity v. A uniform magnetic field B exists in the direction perpendicular to the plane of the wire. Find the emf induced between the ends of the wire if (a) the velocity is perpendicular ot the diameter joining free ends, (b) the velocity is parallel to this diameter.

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37. A circular copper ring of raidus r translates in its plane with a constant velocity v. A uniform magnetic field b exists in the speace in a direction perpendicular ot the plane o fhte ring. Consider different pairs of diametrically opposite points on the ring. (a) Between which pair of points is the emf? (b) Between which pair of points is the emf minimum? What is the value of this minimum emf?

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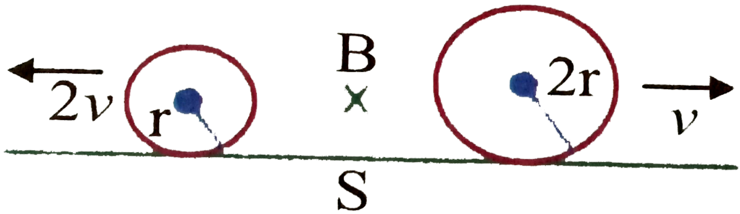
38. Two conducting rings of radii r and $2r$ move in apposite directions with velocities $2v$ and v respectively on a conducting surface S. There is a uniform magnetic field of magnitude B perpendicular to the plane of the rings. The potential difference between the highest points of the two rings is



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39. A wire bent as a parabola $y = ax^2$ is located in a uniformed magnetic field of induaction B , the vector B being perpendicular to the plane $x - y$. At moment $t = 0$ a connector starts sliding translationwise from the parabola apex with a constant acceleration ω . Find the emf of electromagnetic induction in the loop thus formed as a function of y

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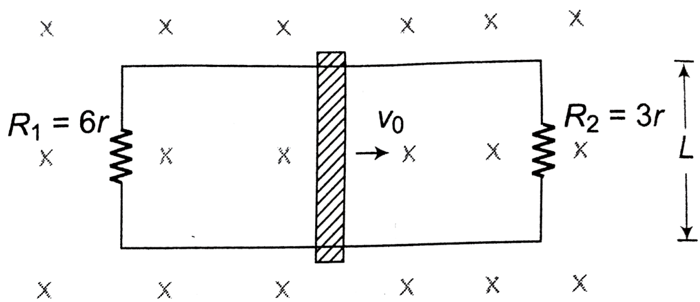
40. A uniform rod of mas m is moving with constant velocity v_0 in a perpendicular uniform magnetic field B as shown. The resistance of rod is r . The current flowing through rod, R_I and R_2 will be



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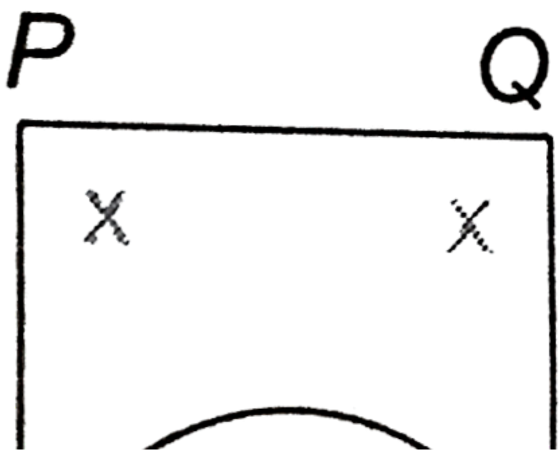
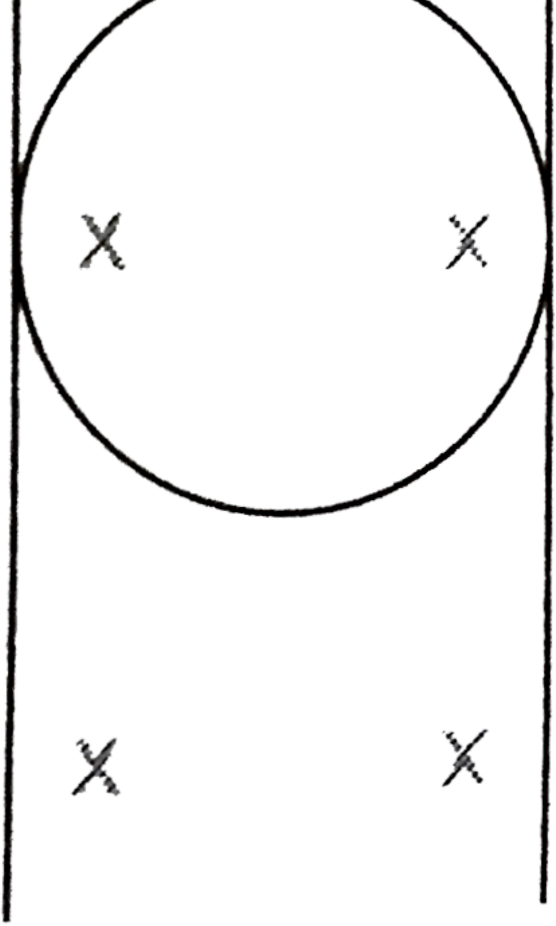
41. A vertical ring of radius r and resistance on R falls vertically. It is in contact with two vertical rails which are joined at the top. The rails are without friction and resistance. There is a horizontal uniform, magnetic field of magnitude B perpendicular to the plane of the ring and the rails.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





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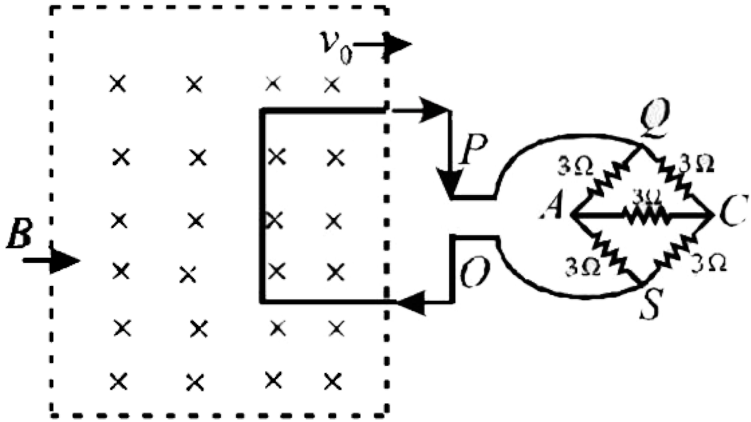
42. A square metal wire loop of side 10 cm and resistance 1 ohm is moved with a constant velocity (v_0) in a uniform magnetic field of induction $B = 2weber/m^2$ as shown in the figure. The magnetic field lines are perpendicular to the plane to the loop (directed into the paper). The loop is connected 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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43. an electric circuit is component of the three conducting rods MO , ON and PQ , as shown in the figure. The resistence of the rods per unit length is λ . The rod PQ slide, as shown in the figure, at a constant velocity v , keeping its tilt angle relative to ON and MO fixed at 45° . At each instance the circuit is closed. The whole system is embedded in a uniform magnetic field B , which is directe dperpendicularly into th epage. Compute the time-dependent induced electric current

44. Figure shown a square loop of side l being moved towards right at a constant speed v . The front edge enters th emagnetic field B at $t = 0$. The width of field is $3l$. Sketch induced emf versus time graph.

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45. In the previous problem, fin dthe total heat produced in the loop.

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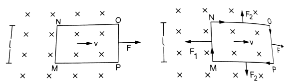
46. Show a rectangular loop MNOP being pullled out of a magnetic field with a uniform velocity v by applying an external force F. The length MN is equal to l and the total resistance of the loop is R. Find(a) the current in the loop,(b) the magnetic force on the loop, (c) the external force F needed to magnetic the velocity, (d) the power delivered by the external force and (e) the thermal power developed in the loop.



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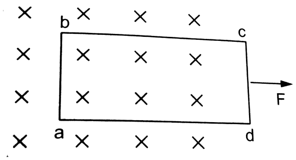
47. A rectanguar frame of wire abcd has dimensions $32cm \times 8.0cm$ and a total resistance of 2.0Ω. It is pulled out of a magentic field $B = 0.020T$ by applying a force of 3.2×10^{-5} N . It is found that the frame moves with constant speed. Find (a) this constant speed, (b) the emf induced in the loop, (c) the potential difference between the points c and d.



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48. In the figure shown the four rods have λ resistance per unit length. The arrangement is kept in a magnetic filed of constant magnitude B and directed perpendicular to the plane of the figure and direction inwards. Intially the sides as shown from a square. Now each wire starts moving with constant velocity v towards opposite wire. Find as a function of time:

(a) induced emf in the circuit

(b) induced current in the circuit with direction

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49. Figure shows a wire ab of length L and resistance R which can slide on a smooth pair

of rails. I_g is current generator which supplies a constant current i in the circuit. If the wire ab slide at a speed v towards right, find the potential difference below a and b

(b) The current generator I_g show in the figure sends a constant current i through the circiut. The wire ab has a length L and mass m and can slide on the smooth horizontal rails connect to I_g . The entire system lies in a vertical magnetic field B . Find the velocity of the wire as a function of time.

(c) The system containing the rails and the wire of the previous part is kept vertically in a uniform horizontal magnetic field B that is perpendicular to the plane of the rails (figure). If is found that the wire stays in equilibrium. If th ewire ab is replaced by another wire of double its mass, how long will lit take in falling through a distance equal to its length?

The current generator I_g shown in figure sends a constant current i through the circuit. The wire cd is fixed and wire ab is made to slide on the smooth, thick rails with a constant velocity v toward right. Each of these wires has resistance r . Find the current through the wire cd .

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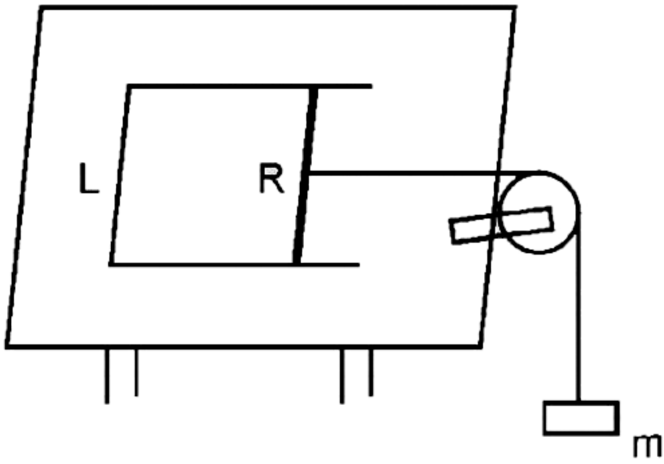
50. A pair of parallel horizontal conducting rails of negligible resistance shorted at one end is fixed on a table. The distance between the rails is L. A conducting massless rod of resistance R can slide on the rails frictionlessly. The rod is tied to a massless string which

passes over a pulley fixed to the edge of the table, A mass m, tied to the other end of the string hanges vertically. A constant magnetic field B exists perpendicular to the table. If the system is released from rest, calculate.

(i) the terminal velocity achieved by the rod, and

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



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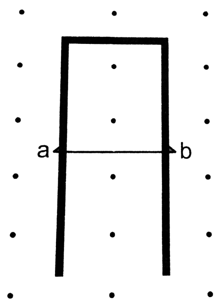
51. A conducting wire ab of length l, resistance r and mass m starts sliding at t = 0 down a smooth, vertical, thick pair of connected rails as shown in . A uniform magnetic field B exists in the space in a diraction perpendicular to the plane of the rails. (a) Write the induced emf in the loop at an instant t when the speed of the wire is v. (b) what would be the magnitude and direction of the induced current in the wire? (c) Find the downward acceleration of the wire at this instant. (d) After sufficient time, the wire starts moving with a constant velocity. Find this velocity `v_m. (e) Find the velocity of the wire as a function of time. (f) Find the displacement of the wire as a functong of time. (g) Show that the rate of heat developed inte wire is equal to the rate at which the gravitational potential energy is decreased after steady state is reached.



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52. A metal bar with length L, mass m and resistance R is polaced on frictionless metal rails that are inclined at an angle ϕ above the

horizontal. The rails have negiligible resistance. There is a uniform magnetic field of nagnitude B direction download in the figure. The bar is released from rest and slide down the rails.

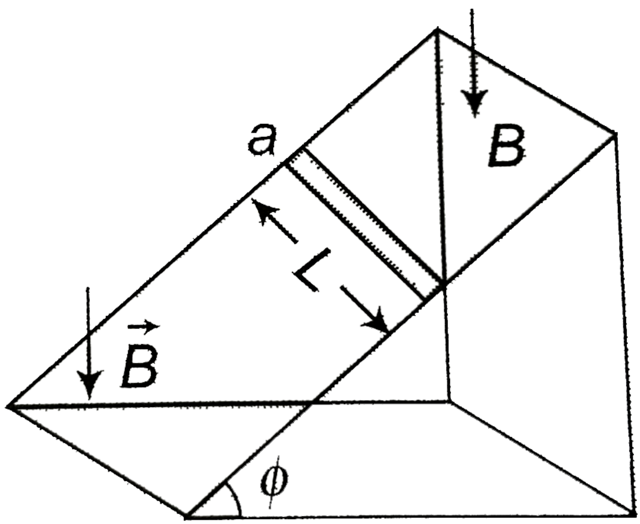
(a) Is the direction of the current induced in the bar from a and b or b to a ?

(b) What is the terminal speed of the bar ?

What is the induced current in the bar when the terminal speed has been reached ?

(d) After the terminal speed has been reached, at what rate is electrical energy being converted to thermal energy in the resistance of the bar ?

(e) After the terminal speed has been reached, at what rate is work being done on the bar by gravity? Compare your answer to that in part (d).



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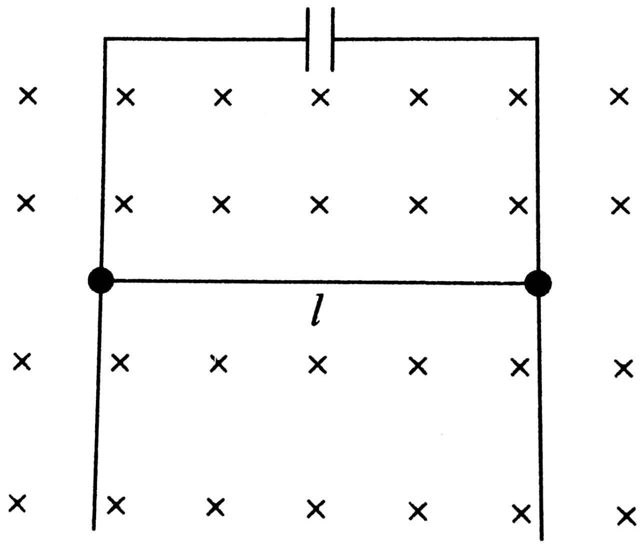
53. Two metal bars are fixed vertically and are connected on the top by a capacitor C. A sliding conductor of length land mass m slides with its ends in contact with the bars. The arrangement is placed in a uniform horizontal magnetic field directed normal to the plane of the figure. The conductor is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



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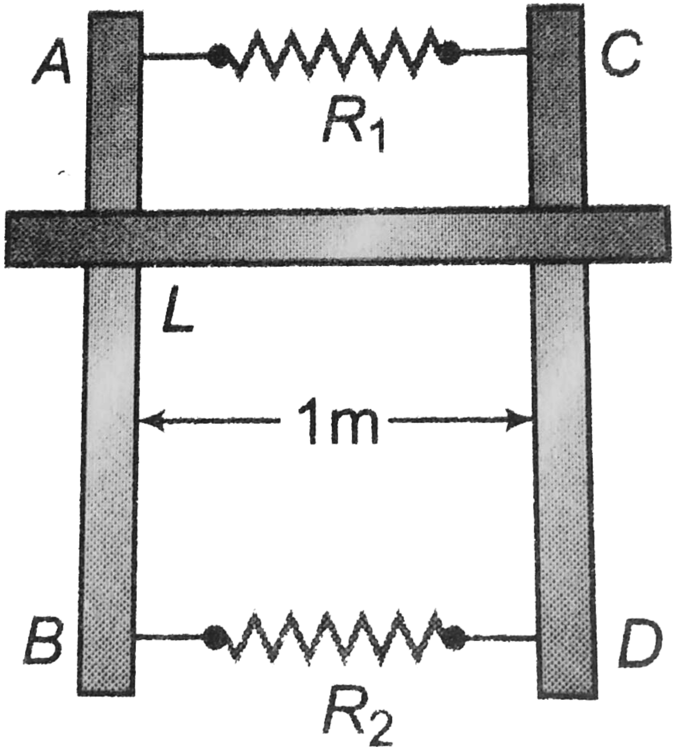
54. Two parallel vertical metallic rails AB and CD are separated by $1m$. They are connected at the two ends by resistances R_1 and R_2 as shown in the figure. A horizontal metallic bar l of mass $0.2 kg$ slides without friction, vertically down the rails under the action of gravity. There is a uniform horizontal magnetic field of $0.6 T$ perpendicular to the plane of the rails. It is observed that when the terminal velocity is attained, the powers dissipated in R_1 and R_2 are $0.76 W$ and $1.2 W$ respectively $(g = 9.8 m/s^2)$



The terminal velocity fo the bar L will be

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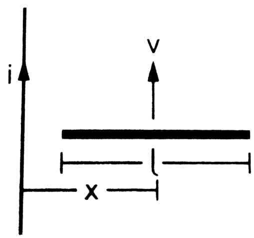
55. shows a straight, long wire carrying a current I and a rod of length l coplanar with the wire and perpendicular to it. The rod moves with a constant velocity v in a direction parallel to the wire. The distance of the wire from the centre of the rod is x. Find the motional emf induced in the rod.



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

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57. (a) A metal rod of length L rotates about an end with a uniform angular velocity ω . A uniform magnetic field B exists in the direction of the axis of rotation. Calculate the emf induced between the ends of the rod. Neglect the centripetal force acting on the free electrons as they move in circular paths.

(b) A rod of length L rotates with a small but uniform angular velocity ω about its perpendicular bisector. A uniform magnetic field B exists parallel to the axis of rotation. Find the potential difference (i) between the centre of rod and one end and (ii) between the two ends of the rod.

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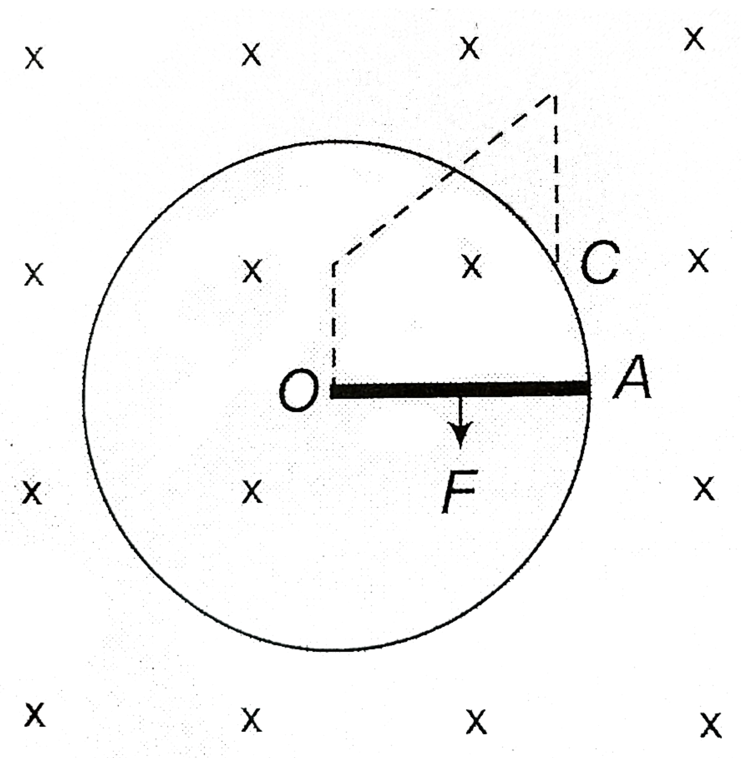
58. Figure shows a conducting circular loop of radius a placed in a uniform, perpendicular magnetic field B. A thick metal rod OA is pivoted at the centre O . The other end of the rod toucher the loop are connected by a wire OC of resistance R. A force is applied at the middle point of the rod OA perpendicularly, so that the rod rotates clockwise at a uniform angular velocity ω . Find the force.

(b) Consider the situation shown in the figure of the previous problem. Suppose the wire connecting O and C has zero resistance but the circular loop has a resistance R uniformly distributed along its lenght. The rod OA is made to rotate with a uniform angular speed ω as shown in the figure. Find the current in the rod when $\angle AOC = 90^{\circ}$.



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59. A vertical copper disc of diameter $20cm$ makes 10 revolution per second about a horizontal axis passing through its centre. A uniforjm magnetic field $10^{-2}T$ acts perpendicular to the plane of the disc. Calculate the potential defference between its centre and rim in volts.

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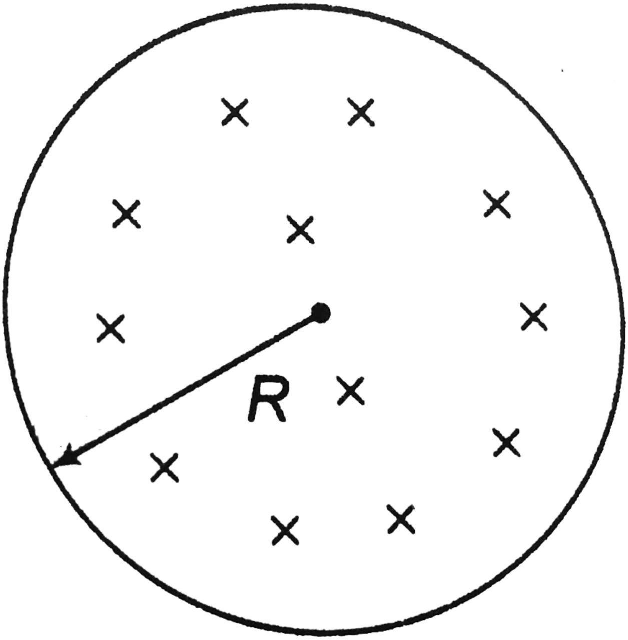
60. The magnetic field at all points within the cyllindrical region whose cross section is indicated in the accompanying Figure starts increasing at a constant rate $\alpha . T/s$. find the magnitud of electric field as a function of r, the distance from the geometric centre of the region.



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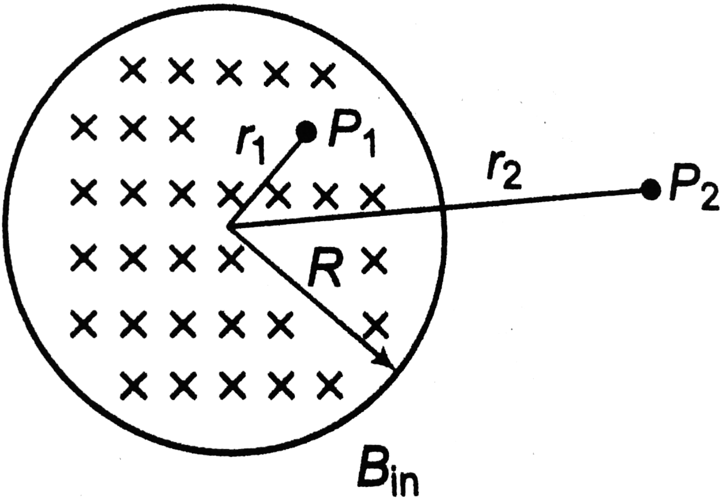
61. The current in an ideal, long solenoid is varies at a uniform rate of $0.01 A s^{-1}$. The solenoid has 2000 turns/m and its radius 6.0 cm. (a) Consider a circle of radius 1.0 cm inside the solenoid with its axis coinciding with the axis of the solenoid. write the change in the magnetic flux through this circle in 2.0 seconds. (b) find the electric field induced at a point on the circumference of hte circle. (c) find the electric field induced at a piont outside the solenoid at a distance 8.0cm from its axis.

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



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

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

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63. A thin non conducting ring of mass m, radius a carrying a charge q can rotate freely about its own axis which is vertical. At the initial moment, the ring was at rest in horizontal position and no magnetic field was present. At instant $t = 0$, a uniform magnetic field is switched on which is vertically downward and increases with time according to the law $B = B_0 t$. Neglecting magnetism induced due to rotational motion of ring.

Angular acceleration of ring is

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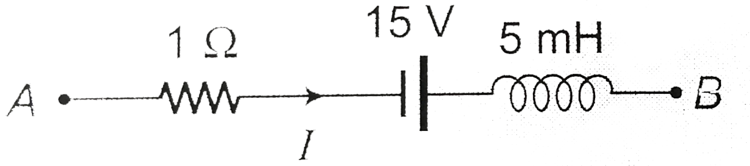
64. (a) When the current in a coil changes from $8A$ to $2A$ in $3 \times 10^{-2} s$, the emf induced in the coil is $2V$. The self-induced of coil in mH

(b) A $12V$ battery conneted to a 6Ω . $10H$ coil through a switch drives a constant current in the circuit. The switch is suddenly opened. Assuming that it took 1msec to open the switch, calculate the average emf induced across the coil.

(c) The equivalent inductance of two inductored in series. What is the value of inductances of the individual inductors?

(d) If $i = 5A$ and decreasing at a rate of 10^3 (A/sec), find $V_B - B_A$.



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65. Calculate the self-inductance of a coil of 100 turns, if a current of $2A$ gives rise to magnetic flux of $50\mu Wb$ through the coil. Also calculate the magentic energy stored in the medium surrounding the coil for the above value of current.

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66. A $50cm$ long solenoid having 500 turns and radius $2cm$ is wound on an iron core of relative permeability 800 . What will be the average emf induced in the solenoid if the current in it changes from 0 to $2A$ in 0.05 sec?

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67. 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 dimater of the solenoid is assumed to be considerably less than its length. Given desity of copper p_0 and resistivility p .

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68. A supereconducting round ring of radius a and inductance L was located in a uniform in a uniform magnetic field of induction B . The ring plane was parallel to the vector B and the current in the ring was equal to zero, then the ring was turned through 90° so that its plane became perpendicular to the field. Find

(a) the current induced in the ring after the turn

(b) the work performed during the turn.

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

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70. Two different coils have self-inductances $L_1 = 8mH$ and $L_2 = 2mH$ At a certain instance the current in thw two coils is increasing at the same constant rate and the power supplied to the coils is the same. Find the ratio of (a) induced voltage (b) current (c) energy stored i the two coils at that instant.

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71. A uniformly wound solenoid coil of self inductance $1.8 \times 10^{-4} H$ and resistance 6Ω is broken up into two identical coils. These identical coils are then connected in parallel across a $12V$ battery of negligible resistance. The time constant and steady state current will be

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72. The current in a coil of self-inductance $4H$ is given by $i = 4\sin t^2$. Find the amount of energy spent during the period when the current changes from 0 to $4A$.

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73. The current in an inductor is given by $i = \alpha + \beta t$, where t is time. The self-induced emf in it is V . Find

(a) the self-inductance

(b) the energy stored in the inductor and the power supplied to it at time $t = t_0$

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74. A long wire carrying current i_0 is planced near a small cube of edge a at distance $d(d > > a)$. Find the magnetic energy stored in the loop.

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75. Consider a small cube of volume $1mm^3$ at the centre of a circular loop of radius 10 cm carrying a current of 4 A. Find the magnetic energy stored inside the cube.

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76. A long wire carries a current of uniform density. Let i be the total current carried by the wire. Show that the magnetic energy per unit length stored within the wire equals

$\frac{\mu_0 t^2}{16\pi}$. Note that it does not depend on the wire diameter.

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77. A small circular loop of radius a is placed inside a large square loop of edge $L(>>a)$. The loops are coplanar and concentric. Find mutual inductance.

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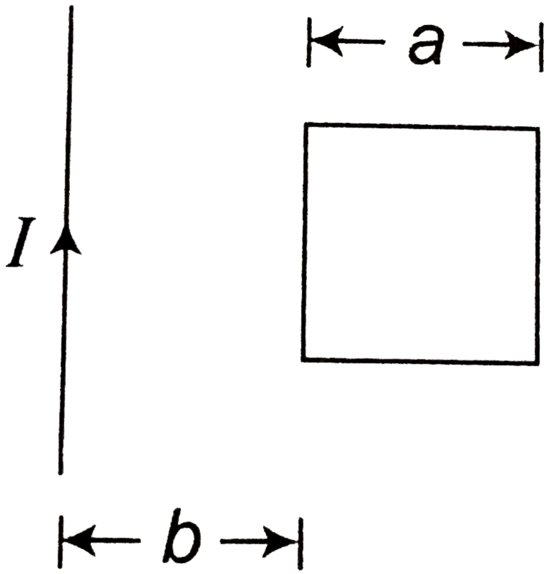
78. The coefficient of mutual inductance



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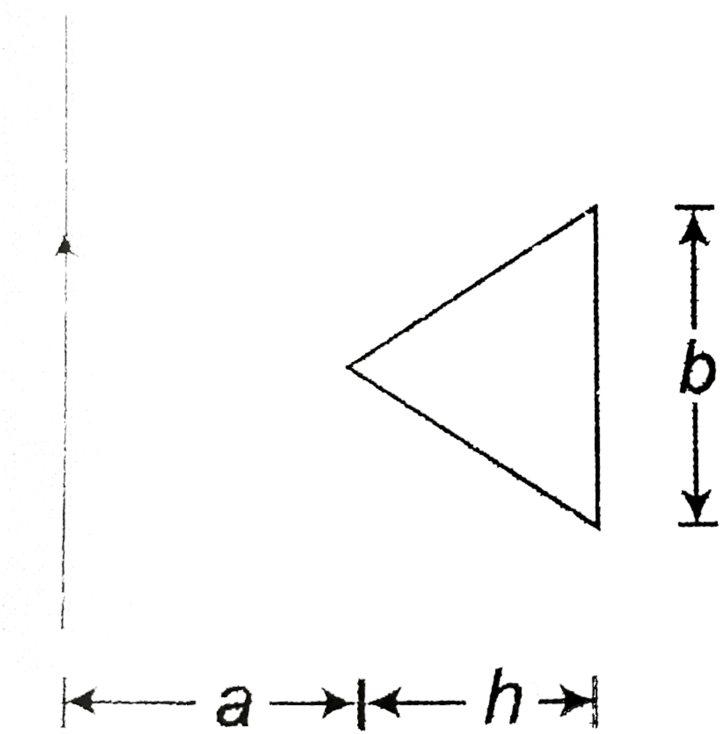
79. As shown in the figure, a long wire is placed near a triangular coil. Calculate the mutual inductance of the combination.



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80. 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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81. 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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82. A circular coil P of 100 turns and radius $2cm$ is placed coaxially at the centre 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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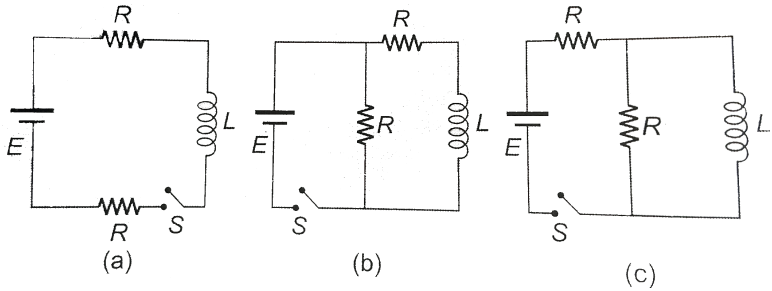
83. Find the steady-state value of current in the circuits.



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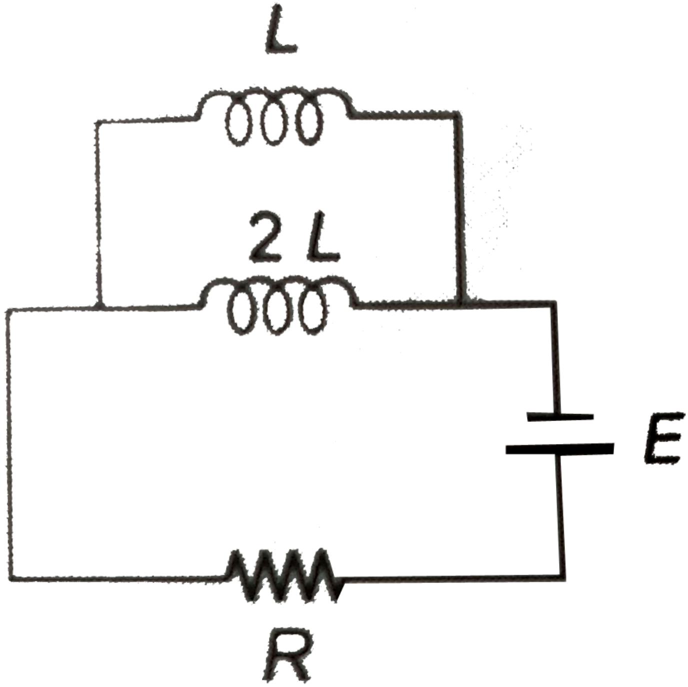
84. Find current in R , L and $2L$ in steady state.



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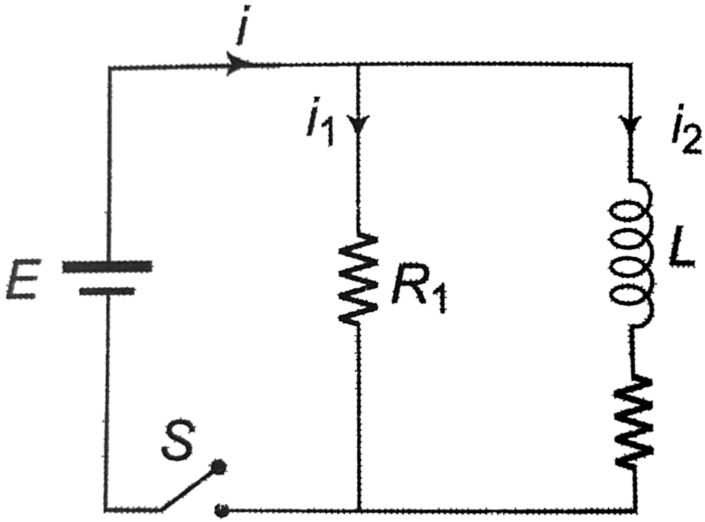
85. Consider the circuit shown in the figure. If $E = 20V$, $R_1 = 4\Omega$, $R_2 = 12\Omega$ and $L = 5H$. Find current i , i_1 , i_2 , P.d. across R_2 and L

(a) just after closing the switch $(t = 0)$

(b) after a long time $(t = \infty)$



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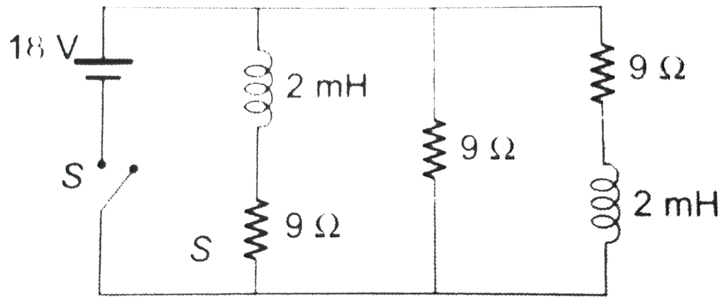
86. Find current through the battery

(a) just after the switch is closed

(b) long after the switch has been closed



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

a. at the instant of closing the switch and

b. after one time constant.

c. Find the steady state current in the circuit.

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89. A solenoid having inductance 4.0 H and resistance 10Ω is connected to a 4.0 V battery at t = 0. Find (a) the time constant, (b) the time elapsed before the current reached 0.63 of its steady state value, (c) the power delivered by the battery at this instant and (d) the power dissipated in Joule heating at this instant.

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90. At $t = 0$, switch S is closed, calculate

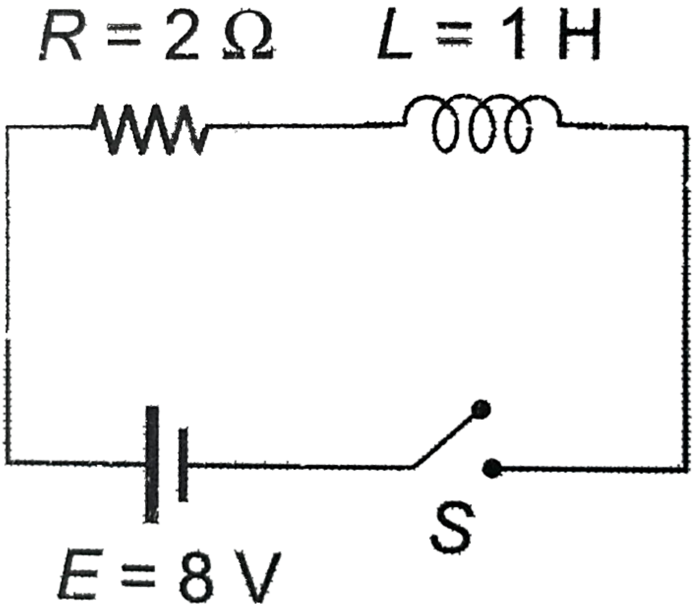
(a) initial rate of increase of current i.e. $\frac{di}{dt}$ at $t = 0$

(b) $\frac{di}{dt}$ at time when current in the circiut is $1A$

(c) current at $t = 0.5 \sec$

(d) rate at which energy of magnetic field is incresing, rate of heat produced in resistance and rate at which energy is supplied by battery when $i = 1A$

(e) energy stored in inductor in steady state



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91. A coil having an inductance L and a resistance R is connected to a battery of emf

E . Find the time taken for the magnetic energy stored in the circuit to change from one fourth of the steady-state value.

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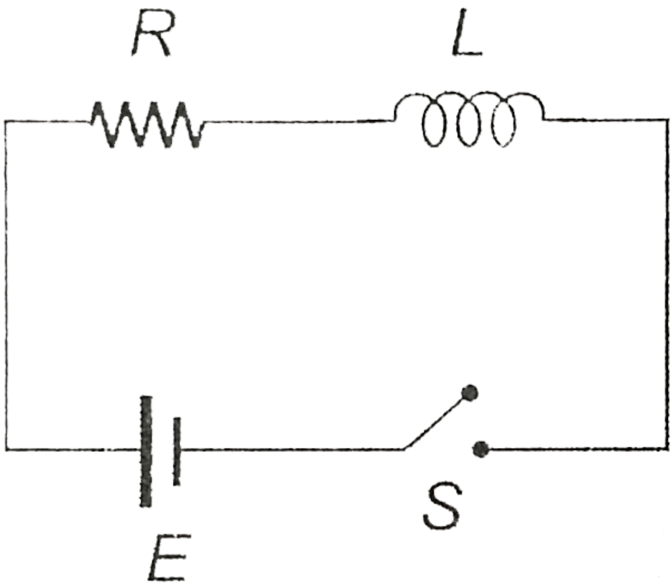
92. At $t = 0$, switch S closed. Find the ratio of the rate at which magnetic energy stored in the coil to the rate at which energy is supplied by the battery at time $t = \tau = L/R$.



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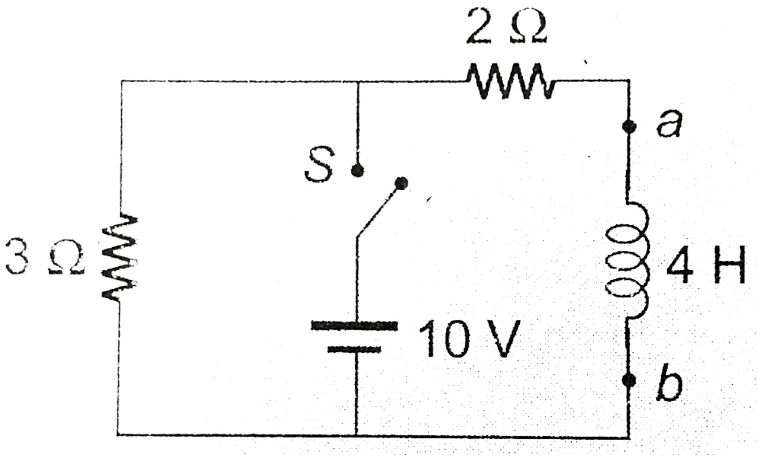
93. The switch is closed for a long time and then opned at time $t = 0$. Find the initial voltage across L after $t = o$, which end is at

higher potential a or b ?



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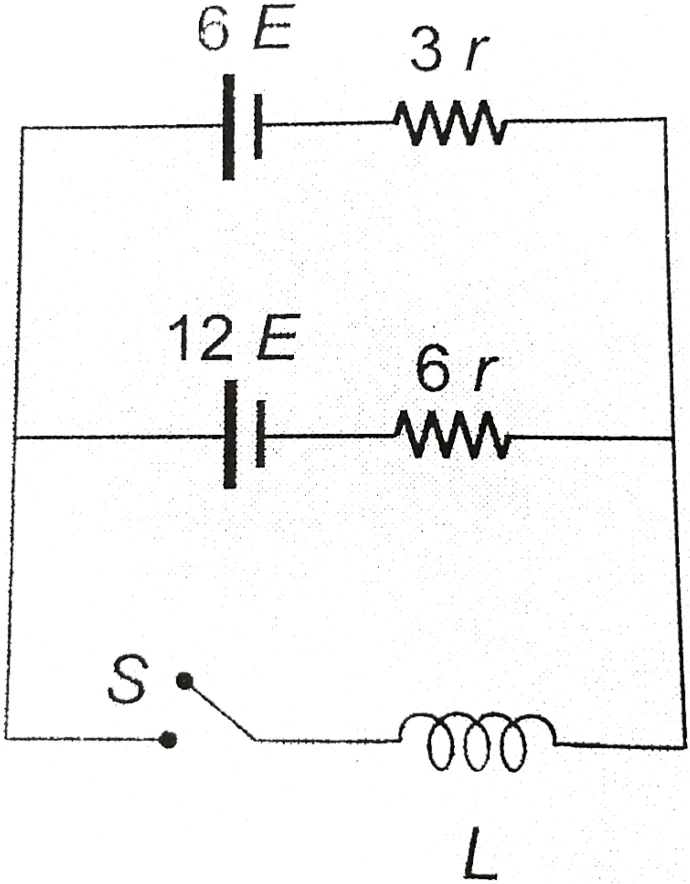
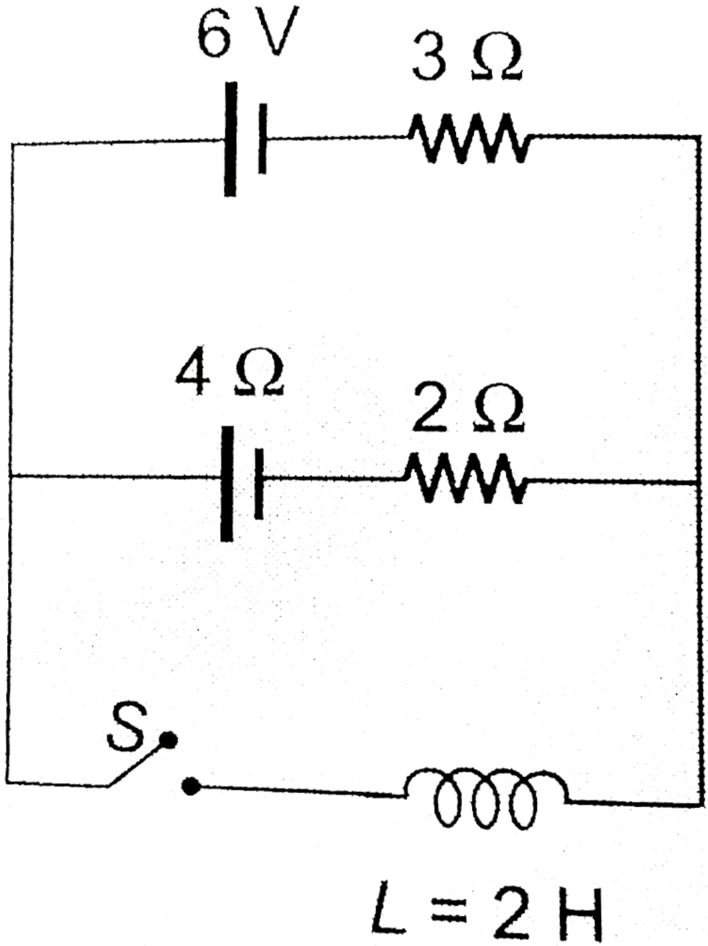
94. The switch S is closed at time $t=0$. Find the current through the inductor as a function of time t



(a)



(b) 1

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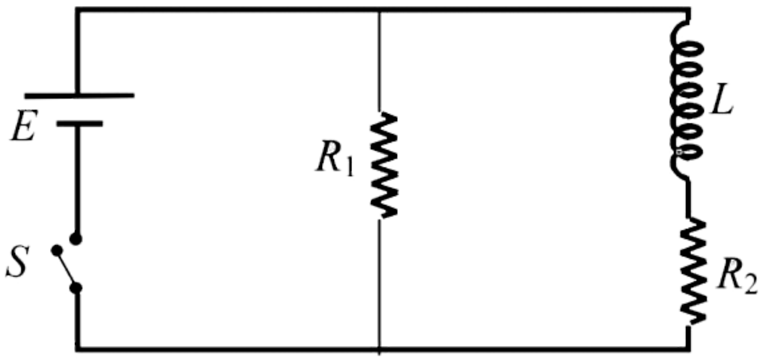
95. An inductor of inductance L=400 mH and resistor of resistance $R_1 = 2(\Omega)$ and $R_2 = 2(\Omega)$ are connected to a battery of emf E = 12 Vas shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at time t =0. What is the potential drop across L as 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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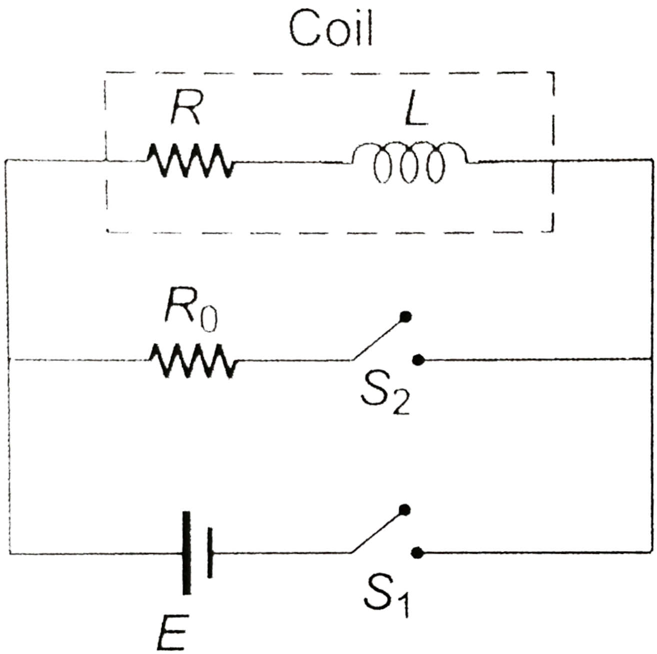
96. Initally switch S_1 is closed, after a long time, S_1 is opened and S_2 is closed. Find the heat produced in coil after long time.



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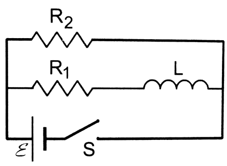
97. Consider the circuit shown in .(a) find the current through the battery a long time after the switch S is closed. (b) Suppose the switc is again opened at t = 0. What is the time cosstant of the discharging circuit? (c) Find t current through the inductor after one time constant.



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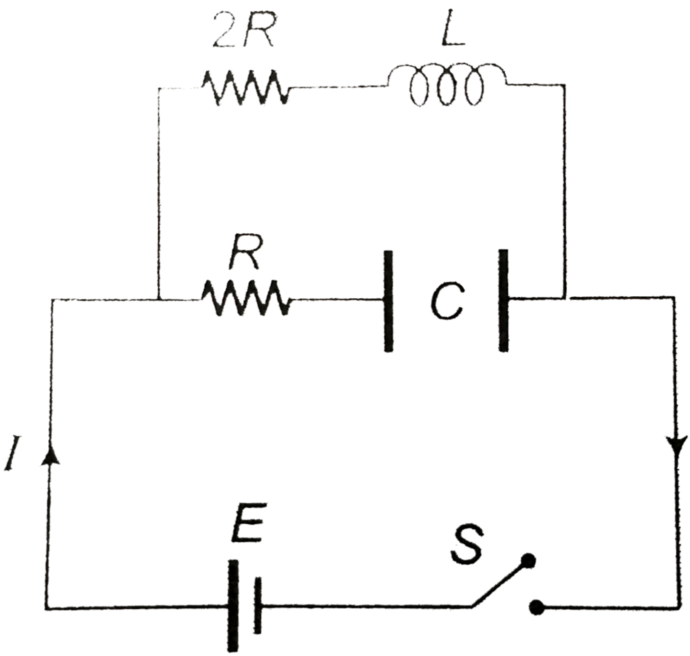
98. In the circuit diagram shown, intially there is no energy in the inductor and the capacitor.

The switch is closed at $t = 0$. Find the current I as a function of time t.



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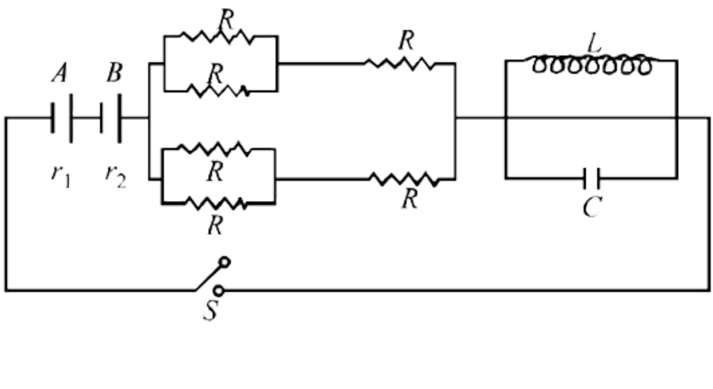
99. In the figure both cells A and B are of equal emf. Find R for which potential difference across battery A will be zero, long time after the switch is closed. Internal resistance of batteries A and B (r_1) and (r_2) respectively $(r_1 > r_2)$.



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100. A capacitor of capacity $2\mu F$ is changed to a potential different of $12V$. It is then connected across an inductor of inductance $0.6mH$ What is the current in the circuit at a time when the potential difference across the capacitor is $6.0V$?

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101. 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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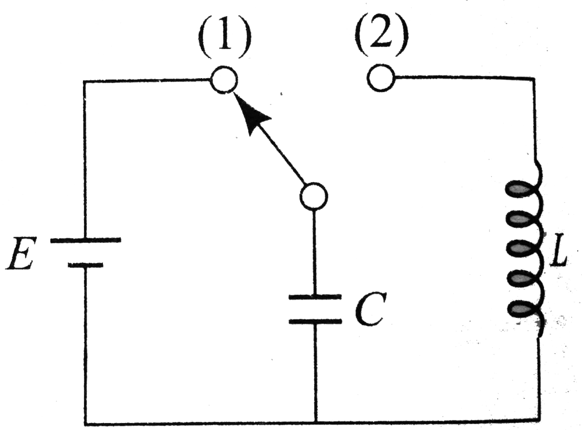
102. In the following electrical network at $t < 0$, key is placed on (1) till the capacitor got fully charged. Key is placed on (2) at $t = 0$. Time when the energy in both the capacitor and inductor will be same for the first time is



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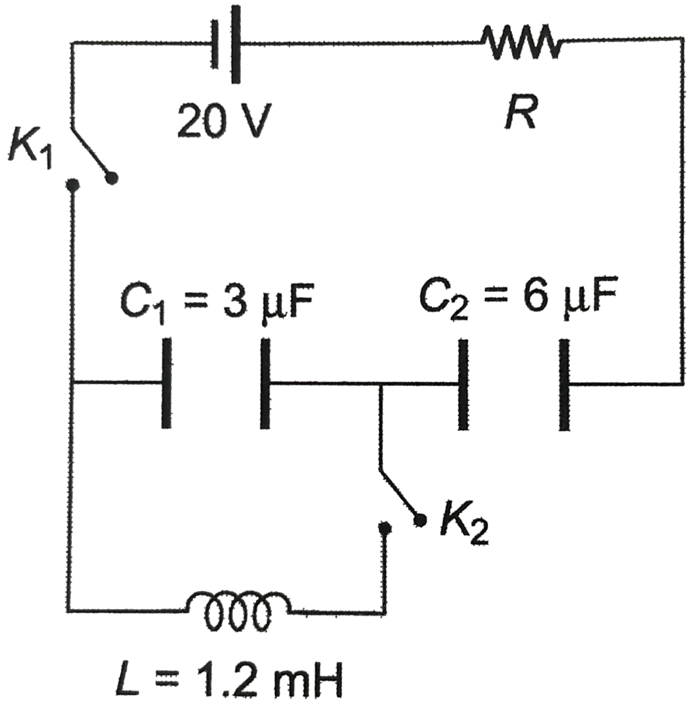
103. A circuit containing capacitors C_1 and C_2 shown in the figure is in the steady state with key K_1 cloesed. At the instant $t = 0$, K_1 is opened and K_2 is closed.

(a) Find the angular frequency of oscillation of the LC circuit.

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

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



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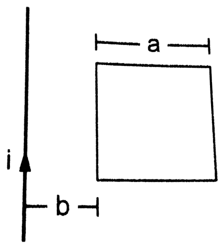
104. Shows a square frame of wire having a total resistance r placed coplanarly with a long, straight wire. The wire carries a current I given by $i = i_0 \sin \omega t$. Find(a) the flux of the magnetic field through the square frame, (b) the emf induced in the frame and (c) the heat developd in the frame in the time interval 0 to $\frac{20\pi}{\omega}$.



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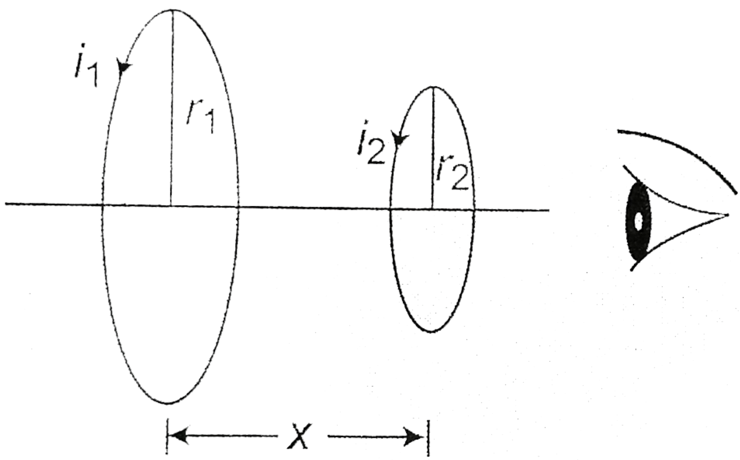
105. Two coaxial circular loops of raadii r_1 and r_2 are separated by a distance x and carry currents i_1 and i_2 respectively. Calculate the mutual inductance. What is the force between the loops ?



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106. 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 ans 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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107. Consider the situation shown in the figure. The wire PQ has mass m , resistance r and can slide On the smooth, horizontal parallel rails separated by a distance l . The resistance of the rais is negiligible. A uniform magnetic field B exists in the reactangular region and a resistance R connects the rail outside the field region. At $t = 0$, the wire PQ is pushed toward right with a speed v_0 . Find

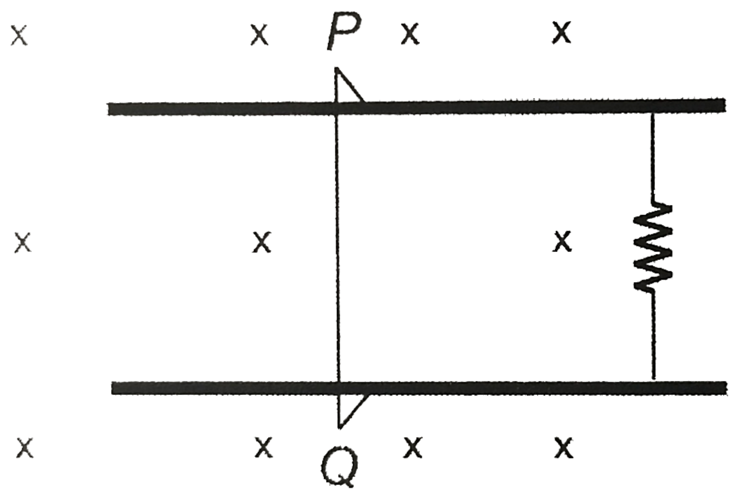
(a) the current in the loop at an instant when the speed of the wire PQ is v

(b) the acceleration of the wire as this instant

(c) the velocity v as a function of x

(d) the maximum distance the wire will move

(e) the velocity as a function of time



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108. 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 toi the wire and of resistance 10Ω moves on these wire when a magnetic field of 0.02 tesla is acting p endicular 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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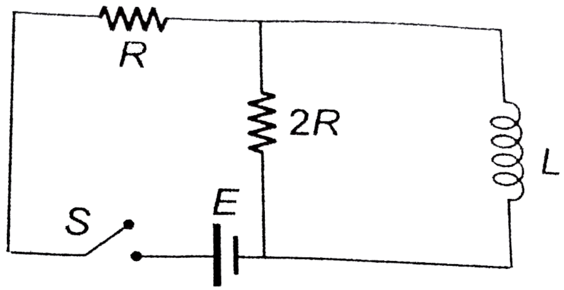
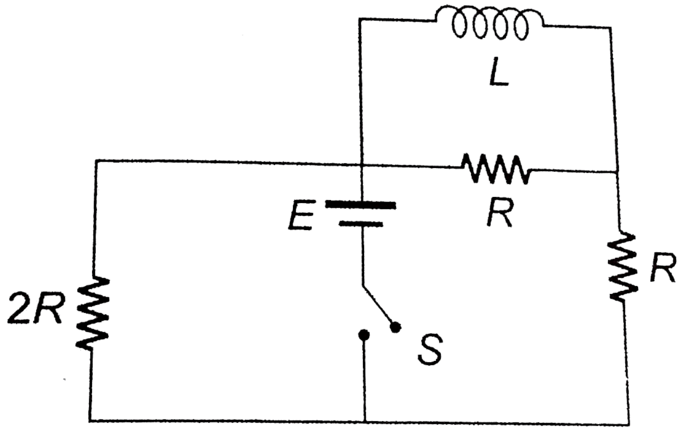
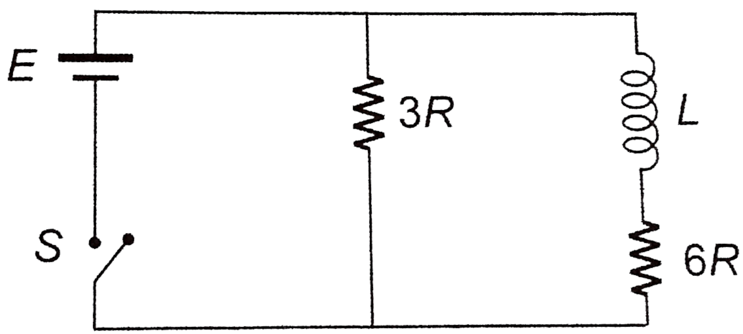
109. At $t = 0$, switch S is closed. Find time constant of the circuit and current through inductor as a function of time t .







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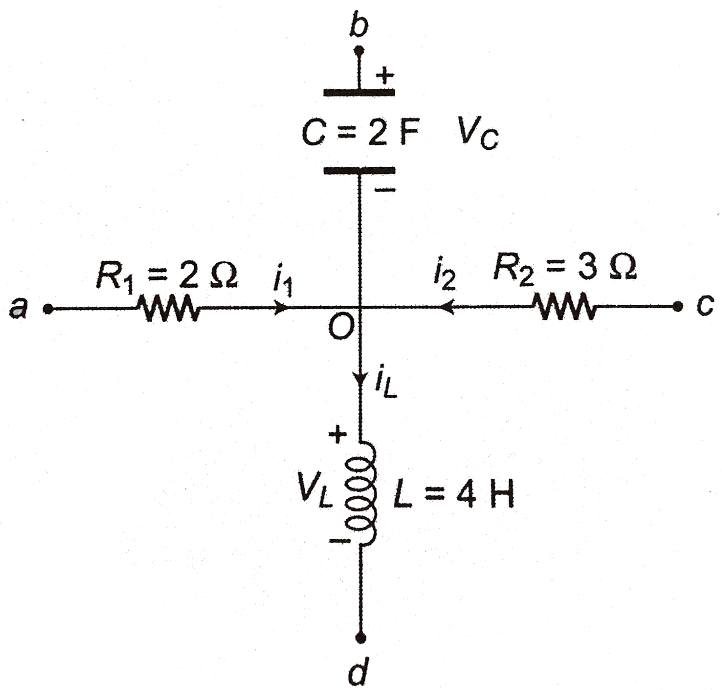
110. In the figure shown, $i_1 = 10e^{2t} A$, $i_2 = 4A$

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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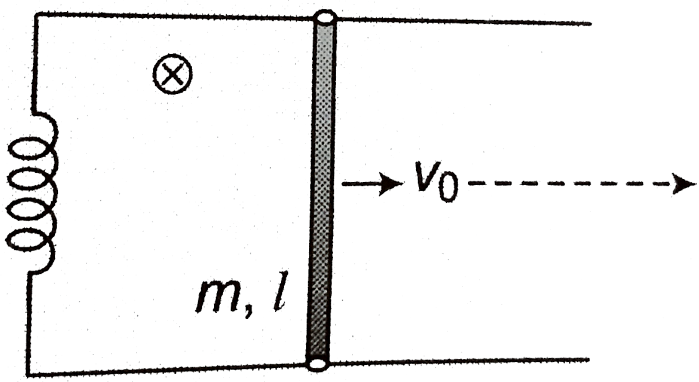
111. A loop is formed by two parallel conductors connected by a solenoid with inductance L and a conducting rod of mass m which can freely (without friction) slide over the conductors. The conductors are located in a horizontal plane in a uniform vertical magnet field B . the distance between the conductors is l . At the moment $t = 0$, the rod is imparted an initial velocity v_0 directed to the right. Find the law of its motion $x(t)$ if the electric resistance of the loop is negligible.



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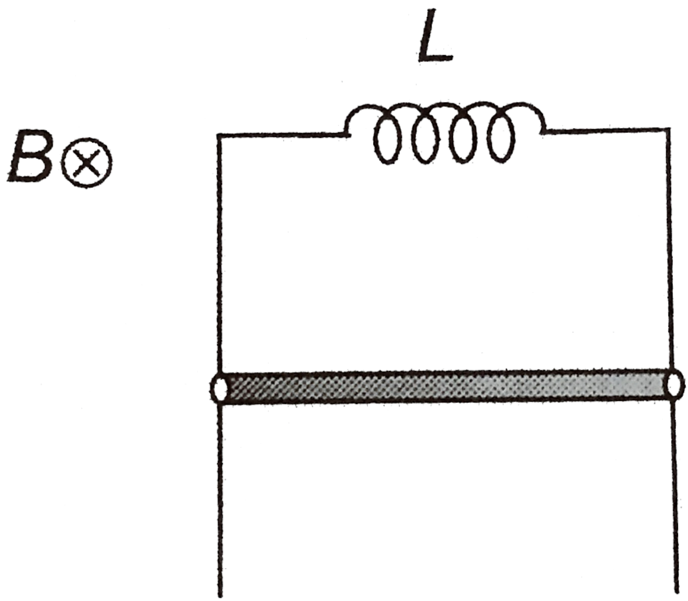
112. A coil of inductance L connects the upper ends of two vertical copper bars separated by a distance l . A horizontal conducting connector of mass m starts falling with zero initial velocity along the bars without losing contact with them. The whole system is located in a uniform magnetic field B perpendicular to the plane of the bars. Find the law of motion $x(t)$ of the connector.



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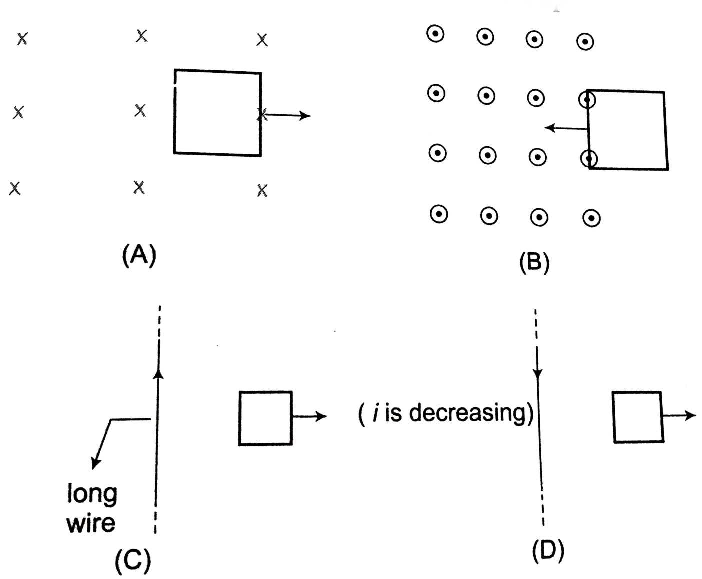
EXERCISES

1. The direction of induced current in the loop



A. clockwise, clockwise clockwise, anticlockwise

B. clockwise, clockwise, anticlockwise, clockwise,

C. clockwise, anticlockwise, clockwise, clockwise,

D. anticlockwise, clockwise, clockwise, clockwise,

Answer: A

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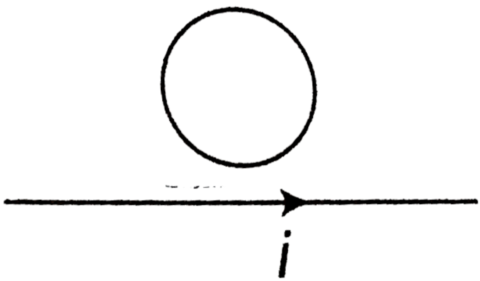
2. A current-carrying wire is placed, below a coil in its plane, with current flowing as shown. If the current increases



A. no current will be inducd in the coil

B. an anticlockwise current will be induce inm the coil

C. a clockwise current will be induced in the coil

D. the current induced in the coil will be first anticlockwise and the clockwise

Answer: C

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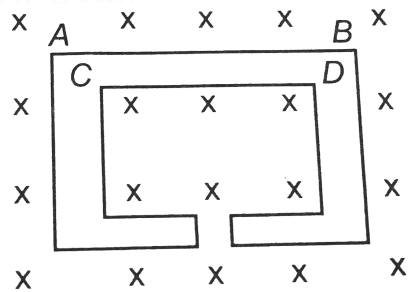
3. A wire is bent to form the double loop shown in figure. There is a uniform magnetic field directed into the plane of the loop. If the magnitude of this field is decreasing current will flow from:



A. A to B and C to D

B. B to A and D to C

C. A to B and D to C

D. B to A and C to D

Answer: C

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

A. clockwise

B. zero

C. counter clockwise

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

Answer: C

Watch Video Solution

5. 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. (i), (iii)

B. (ii), (iii)

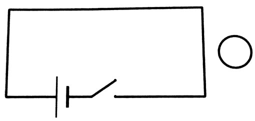
C. (i), (ii)

D. (ii), (iv)

Answer: B

Watch Video Solution

6. Consider the situation shown in . if the switch is closed and after some time it is opened again, the closed loop will show



A. an anticlockwise current-pules

B. a clockwise current-pules

C. an anticlockwise current-pules and then a clockwise current-pules

D. a clockwise current-pules and thenj an anticlockwise current-pules

Answer: D

Watch Video Solution

7. Solve the previous question if the closed loop is completely enclosed in the circuit containing the switch.

A. an anticlockwise current-pules

B. a clockwise current-pules

C. an anticlockwise current-pules and then a clockwise current-pules

D. a clockwise current-pules and thenj an anticlockwise current-pules

Answer: C

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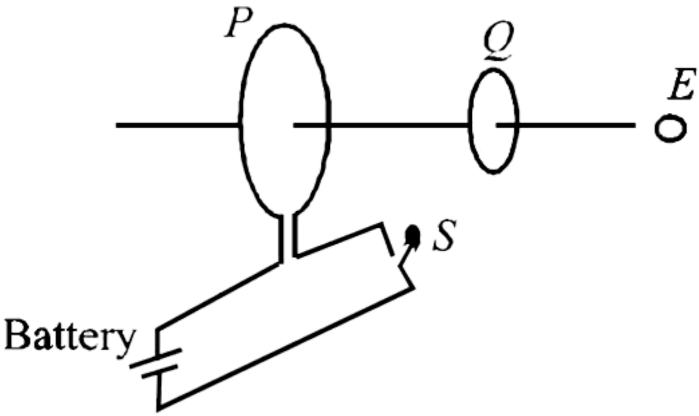
8. As shown in the figure, P and Q are two coaxial conducting loops separated by some distance. When the switch S is closed, a clockwise current I_P (as seen by E) and an induced current I_{Q1} flows in Q. The switch remains closed for a long time. when S is opened, a current I_{Q2} flows in Q. Then the direction IQ_1 and IQ_2 (as seen by E) are



A. respectively clockwise and anticlockwise

B. both clockwise

C. both anticlockwise

D. respectively anticlockwise and clockwise

Answer: D

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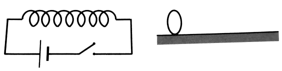
9. shows a horizontal solenoid connected to a battery and a switch. A coper ring is placed on a frictionless track, the axis of the ring being along the axis of the solenoid. As the switch is closed, the ring will



A. remain stationary

B. move towards the solenoid

C. move away from the solenoid

D. move towards the solenoid or away from it depending on which terminal $(+ve \text{ or } -ve)$ of the battery is conneted to the left end of the solenoid

Answer: C

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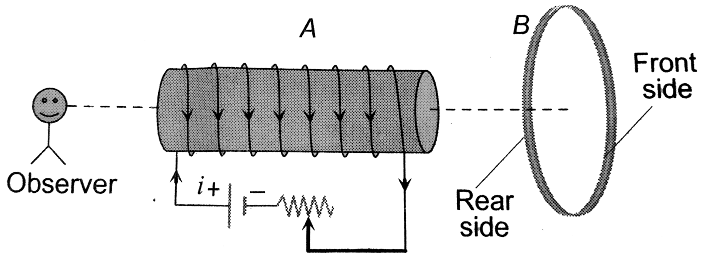
10. An aluminium ring B faces an electromagnet A. The current I through A

can be altered



A. whether l increases or decreases, B will not experinence any force

B. if l decreases, A will repel B

C. if l increases, A will attract B

D. if l increases, A will repel B

Answer: D

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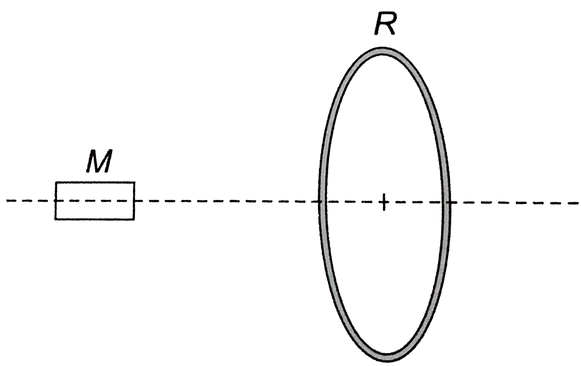
11. A conduting ring R is placed on the axis of a bar magnet M . The plane of R is perpendicular to this axis. M can move along this axis



A. M will repel R when moving towards R

B. M will attract R when moving towards R

C. M will repel R when moving towards as well as away from R

D. M will attract R when moving towards as well as away from R

Answer: A

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

A. attract each other

B. repel each other

C. do not exert any force on each other

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

Answer: A

Watch Video Solution

13. 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. each decreases

B. each increases

C. each remain the same

D. one increases whereas that in the other decreases

Answer: A

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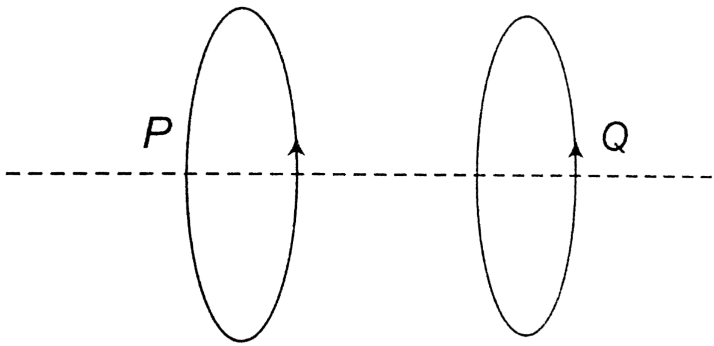
14. Two circular coil P and Q are arranged coaxially as shown. The sign conenntion adopted is that the currents are taken as positive when they flow in the direction of the arrows. Choose the correct statement.



A. If P carries a steady position current and it is moved towarrd Q , a positive current is induced in Q

B. If P carries a steady position current and is moved towarrd P , a negitive current is induced in Q

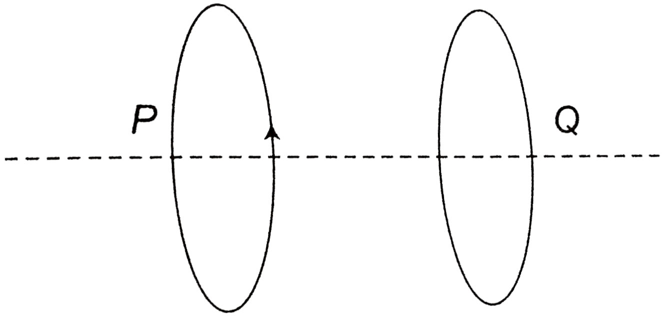
C. If both the coils carry positive currents, the coil repel each other

D. If a positive current flowing in P is switched off, a negitive current is induced momentarily in Q

Answer: B

Watch Video Solution

15. Two circular loops P and Q are placed with their planes paraller to each other. A current is flowing through P. If this current is increasesed, then



A. the loop will attract each other

B. the loops will repel each other

C. the loops will neither attract nor repel each other

D. loop Q will strat rotating

Answer: B

Watch Video Solution

16. A small, conducting circular loop is placed inside a long solenoid carrying a current. The plane of the loop contains the axis of the solenoid. If the current in the solenoid is varied, the current induced in the loop is

A. cliockwise

B. anticlockwise

C. zero

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

Answer: C

Watch Video Solution

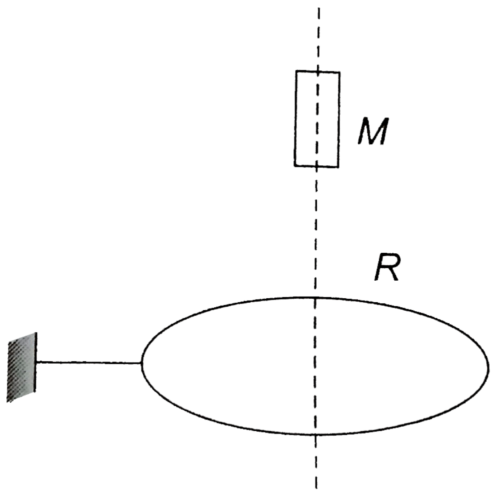
17. A small magnet M is allowed to fall through a fixed horizontal conducting ring R. Let g be the acceleration of M will be

(i) $< g$ when it is above R and moving towards R

(ii) $> g$ when it is above R and moving towards R

(iii) $< g$ when it is below R and moving away from R

(iv) $> g$ when it is below R and moving away from R



A. (i), (iii)

B. (ii), (iv)

C. (i), (ii)

D. (ii), (iii)

Answer: A

Watch Video Solution

18. In the previous question, the directions of the current flowing in the ring, when M is above R and below R will be

A. the same in all cases

B. opposite in all cases

C. the same only if N-pole of M move toward R when M is above R

D. the same only if S-pole of M move toward R when M is above R

Answer: B

Watch Video Solution

19. A copper ring having a cut such as not to from a complete loop is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet is

A. g

B. $< g$

C. $> g$

D. none

Answer: A

Watch Video Solution

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

A. change

B. mass

C. momentum

D. energy

Answer: D

Watch Video Solution

21. A coducting circular loop of area $1mm^2$ is placed coplanarly with a long, straight wire at a distance of 20 cm from if. The straight wire carries an electric current which changes from 10A to zero is 0.1 s. Find the average emf induced in the loop in 0.1 s.

A. $10^{-10}V$

B. $10^{-11}V$

C. $10^{-12}V$

D. $10^{-13}V$

Answer: A

Watch Video Solution

22. A rectangular coil of single trun, having area A , rotates in a uniform magnetic field B with an angular velocity ω about an axis prependicular to the field. If initially the plane of the coil is perpendicular to the field, then the average induced emf when it has rotate through 90° is

A. $\frac{\omega BA}{\pi}$

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

C. $\frac{\omega BA}{4\pi}$

D. $\frac{2\omega BA}{4\pi}$

Answer: D

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23. A conducting square loop having edges of length2.0 cm is rotated through 180° about a diagonal in 0.20s. A magnetic field B exists in the region which si perpendicular to the loop in its initial position. If the average induced emf during the rotation is 20 mV, find the magnitude of the magnetic field.

A. $2T$

B. $3T$

C. $5T$

D. $6T$

Answer: C

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

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

B. zero

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

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

Answer: A

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

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

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

C. ABR

D. $\frac{B^2A}{R^2}$

Answer: B

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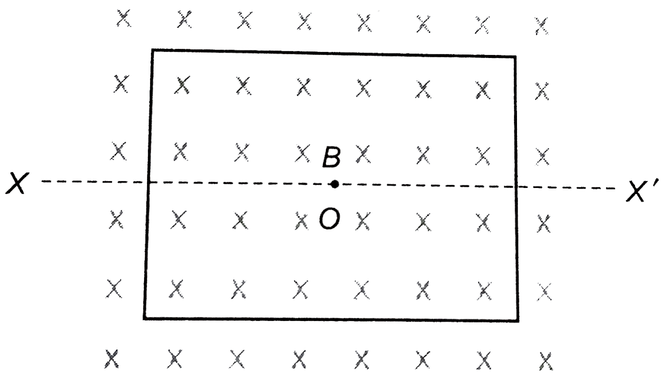
26. A rectangular coil is placed in a region having a uniform magnetic field B perpendicular to the plane of the coil. An emf will not be induced ion the coil if the



A. magnetic field is increased uniformly

B. magnetic field is switched off

C. coil is rotated about the axis XX'

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

Answer: D

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27. A cylindrical bar amgnet is kept along the axis of a circular coil. If the magnet is rotated about its axis, then

A. a current will be induced in the coil

B. no current will be induced in the coil

C. only an emf will be induced in the coil

D. both a current and an emf will be induced in the coil

Answer: B

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28. A long slenoid of radius 2 cm has 100 turns/cm and carries a current of 5A. A coil of radius 1 cm having 100 turns and a total resistance of 20 Ω is placed inside the solenoid coaxially. The coil is connected to a galvanometer. If the current in the solenoid is reversed in direction, find the charge flown through the galvanometer.

A. $2 \times 10^{-4} C$

B. $3 \times 10^{-4} C$

C. $2 \times 10^{-5} C$

D. $4 \times 10^{-4} C$

Answer: A

Watch Video Solution

29. A conducting loop of cross-area A and resistance R is placed perpendicular to a magnetic field B . The loop is withdrawn completely from the field. The change, which flows through any cross-section of the wire in the process

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

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

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

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

Answer: B

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30. A square- shaped copper coil has edges of length 50cm and contains 50 turns. It is placed perpendicular to 1.0 T magnetic field. It is removed form the magnetic field in 0.25 s and restored in its joriginal place in the next 0.25 s. Find the magnitude of the average emf induced in the loop during (a) its removal, (b) its restoration and (c) its motion.

A. $50V$

B. $55V$

C. $60V$

D. $45V$

Answer: B

31. Suppose the resistance of the coil in the previous problem is 25Ω. Assume that the coil moves with uniform velocity during its removal and restoration. Find the thermal energy developed in the coil during (a) its removal, (b) its restoration and (c) its motion.

A. $45J$

B. $50J$

C. $55J$

D. $60J$

Answer: B

Watch Video Solution

32. A conducting circular loop is placed in a uniform magnetic field $0.04T$ with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at $2mm/\sec$. The induced emf in the loop when the radius is $2cm$ is

A. $3.2\pi\mu V$

B. $4.8\pi\mu V$

C. $0.8\pi\mu V$

D. $1.6\pi\mu V$

Answer: A

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33. A wire loop is rotated in a uniform magnetic field about an an axis perpendicular to the field. The direction of the current induced in the loop reverses once each

A. quarter revolution

B. half revolution

C. full revolution

D. two revolutions

Answer: B

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34. A short-circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to the current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be

A. halved

B. the same

C. doubled

D. quadrupled

Answer: D

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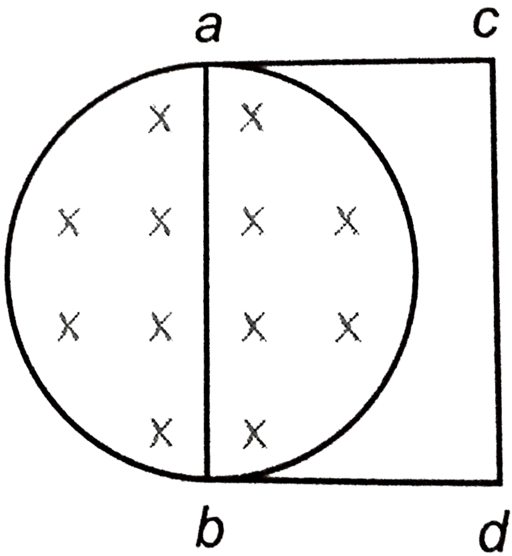
35. A uniform magnetic field B exists in a cylindrical region of radius $I0cm$ as shown in figure. A uniform wire or length $80cm$ and resistance 44.0Ω is bent into a square frame and is placed with one side along a diameter of the cylindrical region. if the magnetic field increases at a constant rate of $0.0I0T/\sec$, the current induced in the frame



A. $3.9 \times 10^{-5} A$

B. $4.0 \times 10^{-5} A$

C. $4.1 \times 10^{-5} A$

D. $3.9 \times 10^{-4} A$

Answer: A

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36. A circular coil of radius $2.00cm$ has 50 turns. A uniform magnetic field $B = 0.2T$ exists in the space in a direction parallel to the axis of rthe loop. The coil is now rotated about a diameter through an angle of 60° . The operation takes $0.Is$. The average emf induced in the coil is

A. $6.28 \times 10^{-2} V$

B. $6.28 \times 10^{-3} V$

C. $62.8 \times 10^{-2} V$

D. $628 \times 10^{-2} V$

Answer: A

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37. A circular coil of one turn of radius $5.0 cm$ is rotated about a diameter with a constant angular speed of 80 revolutions per minute. A uniform magnetic field $B = 0.0IT$ exists in a direction perpendicular to the axis of rotation, the maximum emf induced, the average emf induced in the coil over a long period and the average of the squares of emf induced over a long period is

A. $6.4 \times 10^{-4} V, zero, 2.2 \times 10^{-7} V^2$

B. $6.6 \times 10^{-4} V, zero, 2.0 \times 10^{-7} V^2$

C. $6.8 \times 10^{-4} V, zero, 2.5 \times 10^{-7} V^2$

D. $6.4 \times 10^{-4} V, zero, 2.0 \times 10^{-6} V^2$

Answer: B

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

A. more in first case/More in first case

B. more in first case/More in first case

C. less in first case/More in second case

D. less in equal case/More in both case

Answer: B

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39. The flux linked with a circuit is given by $\phi = t^3 + 3t - 7$. The graph between time (x-axis) and induced emf (y-axis) will be

A. straight line through origin

B. straight line with positive intercept

C. stairght line with negative intercept

D. parabola not through the origin

Answer: D

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40. The magnetic flux (ϕ) linked with a coil depends on time t as $\phi = at^n$, where a and n are constants. The emf induced in coil is e.

(i) If $0 < n < I, e = 0$

(ii) If $0 < n < I, een0$ and $|e|$ decreases with time

(iii) If $n > I, e$ is constant

(iv) If $n < I, |e|$ increases with time

A. $(i), (iii)$

B. $(ii), (iii), (iv)$

C. $(i), (ii)$

D. $(ii), (iv)$

Answer: D

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41. A rectangular, a square , a circular and an elliptical loop, all in the $(x - y)$ plane, are moving out of a uniform magnetic field with a contant velocity $\vec{v} = v\hat{i}$. The magnetic field is directed along the negative z-axis direction. The induced emf, during the passege of these loops , out of the field region, will not remain constant for

A. the rectangular, circular and elliptical loops

B. the circular and the elliptical loops

C. only the elliptical loop

D. any of the four loops

Answer: B

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42. A magnetic field of $2 \times 10^{-2} T$ acts at right angles to a coil of area $100 cm^2$ with 50 turns. The average emf induced in the coil is $0.1 V$, when it is removed from the field in time t. The value of t is

A. $0.1 \sec$

B. $0.01 \sec$

C. $1 \sec$

D. $20 \sec$

Answer: A

Watch Video Solution

43. Faraday's law are consequence of conservation

A. energy

B. energy and magnetic field

C. charge

D. magnetic field

Answer: A

Watch Video Solution

44. A coil having n turns and resistance $R\Omega$ is connected with a galvanometer of resistance $4R\Omega$. This combination is moved in time t seconds from a magnetic field W_1 weber to W_2 weber. The induced current in the circuit is

A. $-\frac{W_2W_1}{5Rnt}$

B. $-\frac{n(W_2W_1)}{5Rt}$

C. $-\dfrac{W_2W_1}{Rnt}$

D. $-\dfrac{n(W_2W_1)}{Rt}$

Answer: B

Watch Video Solution

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

A. current is induced in the loop in the anticlockwise direction

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

C. Altrenating current is induced in the loop

D. no current is induced in the loop

Answer: A

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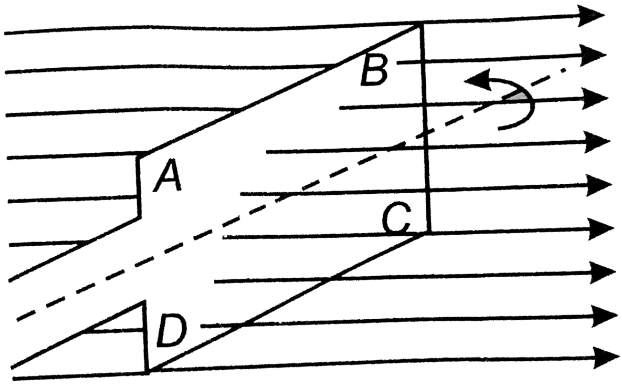
46. A rectangular coil ABCD is rotated anticlockwise with a uniform angular velocity about the axis shown In the fig. the axis of rotation of the coil as well as the magnetic field B are horizontally.the induced emf in the coilwould be minimum when the plane of the coil



A. the plane of the coil is horizontal

B. the plane of the coil makes an angular of 45° with the magnetic field

C. the plane of the coil is at right angles to the magnetic field

D. the plane of the coil makes an angle of 30° with the magnetic field

Answer: A

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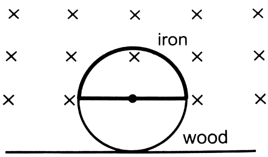
47. shows a circular wheel of radius 10.0 cm whose upper half, shown dark in the figure, is made of iron and the lower half of wood. The two junctions are joined by an iron rod. A uniform magnetic field B of magnitude $2.00X10^{-4}T$ exists in the space above the central line as suggested by the figure. The wheel is set into pure rolling on the horizontal surface. The wheel is set into pure rolling on the horizontal surface. If it takes 2.00 seconds for the iron part to come down and the wooden part to go up, find the average emf induced during this period.



A. $1.57 \times 10^{-6} V$

B. $1.5 \times 10^{-5} V$

C. $15.7 \times 10^{-6} V$

D. $1.55 \times 10^{-6} V$

Answer: D

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48. An induced emf is produced when a magnet is plunged into a coil. The magnitude of the induced emf is independent of

A. the strength of the magnetic

B. the speed with which the magnetic is moved

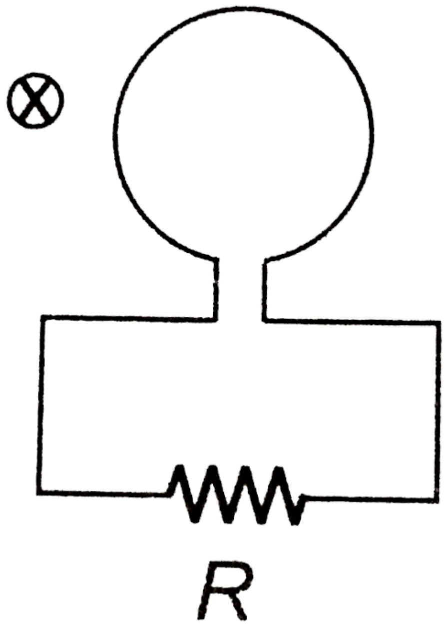
C. the resistivity of the wire of the coil

D. the number of turns in the coil

Answer: C

Watch Video Solution

49. In the figure the flux through the loop perpendicular to the plane of the coil and direciton into the paper varying according to the relation $\phi = 6t^2 + 7t + I$ where ϕ is in milliweber and t is in loop at $t = 2s$ and direction of induced current through R are



A. $39mV$, right to left

B. $39mV$, left to right

C. $31mV$ right to left

D. $31mV$, left to right

Answer: D

Watch Video Solution

50. A metallic meter stick moves with a velocity of $2m/\sec$ in a diretion perpendicular to its length and perpendicular to a uniform magnetic firld of magnitude $0.2T$. The emf induced between the ends of the stick

A. $0.2V$

B. $0.4V$

C. $0.5V$

D. $0.6V$

Answer: B

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

A. P

B. Q

C. L

D. M

Answer: D

Watch Video Solution

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

A. $2Blv$

B. Blv

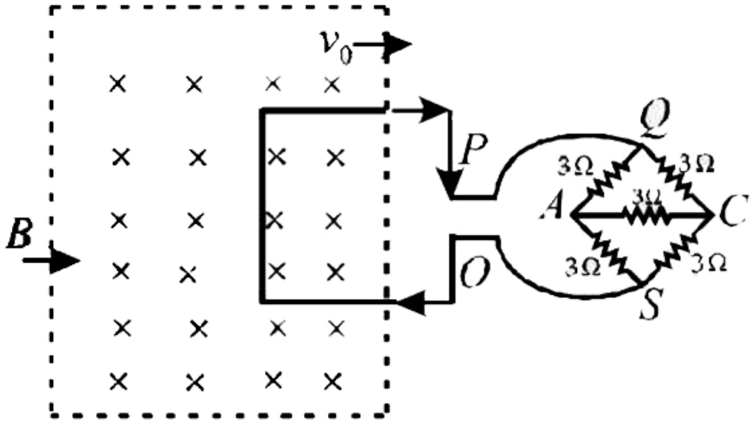
C. $0.5Blv$

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

Answer: B

Watch Video Solution

53. 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.



A. $0.5cm / \sec$

B. $1cm / \sec$

C. $2cm / \sec$

D. $4cm / \sec$

Answer: C

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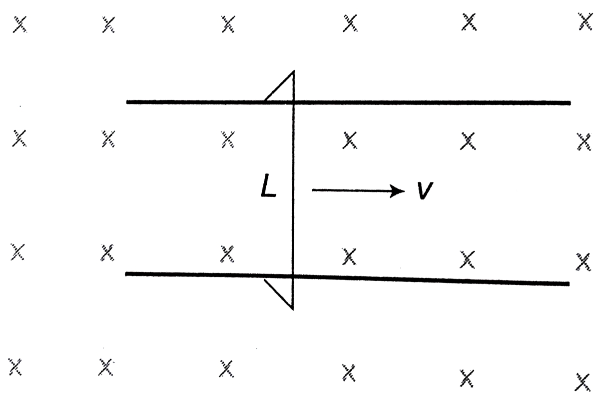
54. Figure shows a wire sliding on two parallel, conducting rails placed at a separation L . A magnetic field B exists in a direction perpendicular to the plane of the rails. What force is necessary to keep the wire moving at a constant velocity V ?



A. BvL

B. Bv^2L

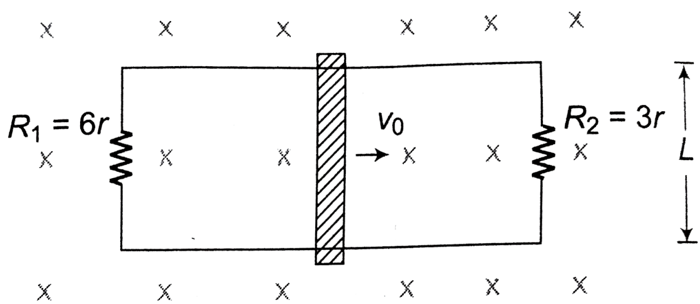
C. zero

D. B^2v^2L/R

Answer: C

Watch Video Solution

55. A uniform rod of mas m is moving with constant velocity v_0 in a perpendicular uniform magnetic field B as shown. The resistance of rod is r . The current flowing through rod, R_I and R_2 will be



A. $\dfrac{Bv_0L}{3r}, \dfrac{2}{3} \cdot \dfrac{Bv_0L}{3r}, \dfrac{1}{3} \cdot \dfrac{Bv_0L}{3r}$

B. $\dfrac{Bv_0L}{3r}, \dfrac{1}{3} \cdot \dfrac{Bv_0L}{3r}, \dfrac{2}{3} \cdot \dfrac{Bv_0L}{3r}$

C. $\dfrac{Bv_0L}{3r}, \dfrac{1}{3} \cdot \dfrac{Bv_0L}{3r}, \dfrac{1}{3} \cdot \dfrac{Bv_0L}{3r}$

D. $\dfrac{Bv_0L}{3r}, \dfrac{Bv_0L}{3r}, \dfrac{Bv_0L}{3r}$

Answer: B

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56. A conductor PQ , with $PQ = r$, moves with a velocity v in a uniform magnetic field of induced B . The emf induced in the rod is

A. $\left(\overrightarrow{v} \times \overrightarrow{B}\right). \overrightarrow{r}$

B. $\overrightarrow{v} . \left(\overrightarrow{r} \times \overrightarrow{B}\right)$

C. $\overrightarrow{B} . \left(\overrightarrow{r} \times \overrightarrow{v}\right)$

D. $\left|\overrightarrow{r} \times \left(\overrightarrow{v} \times \overrightarrow{B}\right)\right|$

Answer: A

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57. The wings of an aeroplane are $I0m$ apart. The plane is moving horizontally towards the north with a velocity of $200m/\sec$ at a place where the vertical component of earth's magnetic field is $0.5 \times I0^{-4}T$. The induced emf set up between the tips of the wings is

A. $0.1V$

B. $0.15V$

C. $1V$

D. $1.5V$

Answer: A

Watch Video Solution

58. The two rails of a railway track, insulated from each other and the ground, are connected to a milli voltmeter. What is the reading of the milli voltmeter when a train travels at a speed of $180km/hours$ along the track, given that the vertical components of earth's magnitic field is $0.2 \times 10^{-4} weber / m^2$

& the rails are separated by 1 meter?

A. $1mV$

B. $2mV$

C. $3mV$

D. $4mV$

Answer: A

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

A. zero

B. $B_0 lv$

C. $B_0 lv \sin \delta$

D. $B_0 lv \cos \delta$

Answer: C

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60. In the precious question, if the conductor lies east-west and the moves vertical up with a speed v . The emf induced emf is

A. zero

B. $B_0 l v$

C. $B_0 l v \sin \delta$

D. $B_0 l v \cos \delta$

Answer: D

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61. The two ends of a horizontal conducting rod of length l are joined to a voltmeter. The whole arrangement moves with a horizontal velocity v, the direction of motion being perpendicular to the rod. The vertical component of the earth's magnetic field is B. The voltmeter reading is

A. $Bl v$ only if the rod moves eastward

B. $Bl v$ only if the rod moves westward

C. $Bl v$ only if the rod moves in any way

D. zero

Answer: C

Watch Video Solution

62. A player with 3 meter long iron rod runs toward east with a speed of $30 km / hr$. Horizontal component of eath's magnetic field is $4 \times 10^{-5} Wb/m^2$. If he runs with the rod in horizontal and vertical position, then the potential difference induced between the two ends of the rod in the two cases will be

A. zero in vertical position, $1 \times 10^{-3} V$ in horizontal position

B. $1 \times 10^{-3} V$ in vertical position, zero in horizontal position

C. zero in both positions

D. $1 \times 10^{-3} V$ in both positions

Answer: B

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63. The magnitude of the earth's magnetic field at the north pole is B_0 . A horizontal conductor of length l moves with a velocity v . The direction of v is perpendicular to the conductor. The induced emf is

(i) zero, if v is vertical

(ii) $B_0 l v$, if v is vertical

(iii) zero, if v is horizontal

(iv) $B_0 l v$, if v is horizontal

A. $(i), (iii)$

B. $(ii), (iv)$

C. $(i), (iv)$

D. $(ii), (iii)$

Answer: C

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64. A wire of length 10cm translates in a direction making an angle of 60° with its length. The plane of motion is perpendicular ot a uniform magnetic field of 1.0 T that exists in the space. Find the emf induced between the ends of the rod if the speed of translation of $20 cms^{-1}$.

A. $1.7 \times 10^{-3} V$

B. $17 \times 10^{-3} V$

C. $0.17 \times 10^{-3} V$

D. $1.7 \times 10^{-4} V$

Answer: B

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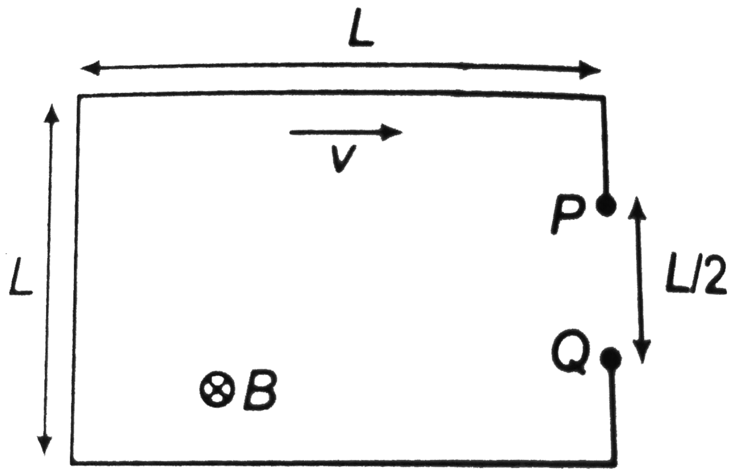
65. The loop shown moves with a velocity v in a uniform magnetic field of magnitude B, directed into the paper. The potential differene between point P and Q is e. Then



A. $(ii),(iii)$

B. $(i),(iv)$

C. $(i),(iii)$

D. $(ii),(iv)$

Answer: C

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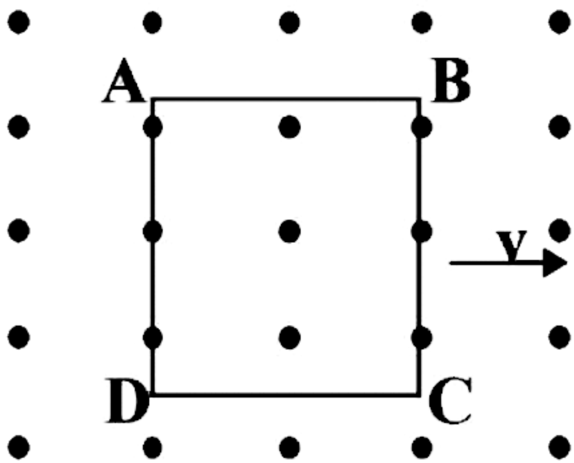
66. A metallic square loop ABCD is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in the figure. An electric field is induced



A. in AD , but not in BC

B. in BC , but not in AD

C. neither in AD not in BC

D. in both AC and BD

Answer: D

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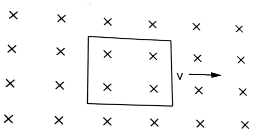
67. A conducting square loop of side l and resistance R moves in its plane with a uniform velocity v perpendicular ot one of its sides. A uniform and constant magnetic field B exists along the perpendicualr ot the plane of the loop as shown in . The current induced in the loop is



A. $\dfrac{Blv}{R}$, clockwise

B. $\dfrac{Blv}{R}$, anticlockwise

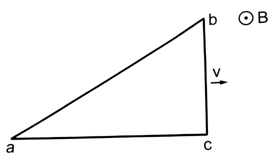
C. $\dfrac{2Blv}{R}$, anticlockwise

D. zero

Answer: D

Watch Video Solution

68. A right angled triangle abc, made from a metallic wire, moves at a uniform speed v in its plane as shown in . A uniform magnetic field B exists in the perpendicular direction. Find the emf induced (a) in the loop abc, (b) in the segment bc, (c) in the segment ac and (d) in the segment ab.



A. zero: $vB(bc), +ve$ at c , zero, $vB(bc), +ve$ at a

B. $vB(bc), +ve$ at c , zero, $vB(bc), +ve$ at a

C. zero, zero $vB(bc), +ve$ at c , $vB(bc), +ve$ at a

D. $vB(bc), +ve$ at c , $vB(bc), +ve$ at a , zero, zero

Answer: A

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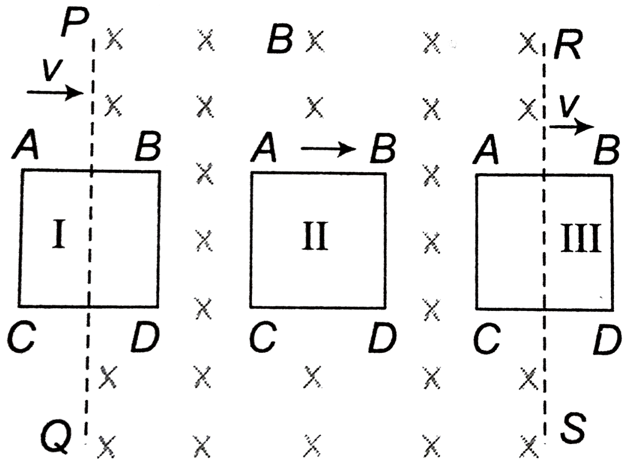
69. A square loop $ABCD$ of edge a moves to the right with a velocity v parallel to AB . There is a uniform magnetic field of magnitude B , direction into the paper, in the region between PQ and RS only. I, II and III are three ppositions of the loop.

(i) The emf induced in the loop has magnitude B a v in all three position

(iii) Induced emf is anticlockwise in position II

(iv) The induced emf is clockwise in position III



A. $(i), (iii)$

B. $(ii), (iii), (iv)$

C. $(i), (ii)$

D. $(iii), (iv)$

Answer: B

Watch Video Solution

70. In the previous question, in position I of the loop

(i) The induced emf will increases linearly as the loop enters the field

(ii) The induced emf will increase from 0 to Bav shaply as edge BD crosses PQ

(iii) The induced emf will have a constant value Ba^2v

(iv) The loop will experince a force to the left after entering the field partially

A. $(i), (iii)$

B. $(ii), (iii), (iv)$

C. $(i), (ii)$

D. $(ii), (iv)$

Answer: D

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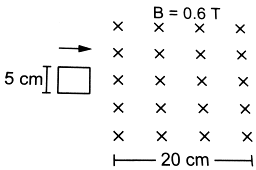
71. Shown a square loop of side 5 cm beign moved towards right at a constant speed of 1 cm/s. the front edge enters the 20 cm wide magnetic field at $t = 0$. Find the emf induced in the loop at

$(a)t = 2s$, $(b)t = 10s$, $(c)t = 22s(d)t = 30s$.



A. $3 \times 10^{-4}V$

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

C. $2.5 \times 10^{-4}V$

D. $3.5 \times 10^{-4}V$

Answer: A

Watch Video Solution

72. Find the total heat produced in the loop of the previous problem during the interval 0 to 30 s if the resistance of the loop is 4.5Ω.

A. $2.5 \times 10^4 J$

B. $2.0 \times 10^4 J$

C. $3.0 \times 10^4 J$

D. $3.5 \times 10^4 J$

Answer: B

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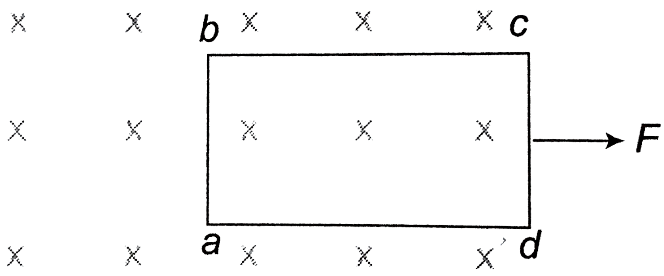
73. A rectangular frame of wire $abcd$ has dimensions $1m \times 0.5m$ and a total resistance of 30Ω. It is pulled out of a magnetic field $B = 2T$ by applying a force of $1N$. It is found that the frame moves with constant speed.

(i) The constant speed is $30m/\sec$

(ii) The emf induced in loop is 30 volt

(iii) The p.d. between a and b is $25V$

(iv) The p.d. between c and d is $5V$.



A. (i), (ii), (iii)

B. (ii), (iii), (iv)

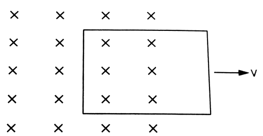
C. (i), (ii), (iii)

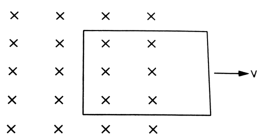
D. all

Answer: D

Watch Video Solution

74. shows a conducting loop being pulled out of a magnetic field with a speed v. Which of lthe four plots shown in may represent the power delivered by the pulling agent as a function of the speed v ?





A. A to B and C to D

B. B to A and D to C

C. c

D. d

Answer: B

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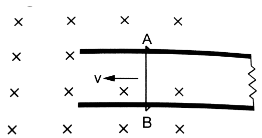
75. Consider the situation shown in . The wire AB is slid on the fixed rails rails with a constant velocity. If the wire AB is replaced by a semicircular wire, the magnitude of the induced current will



A. increase

B. remain the same

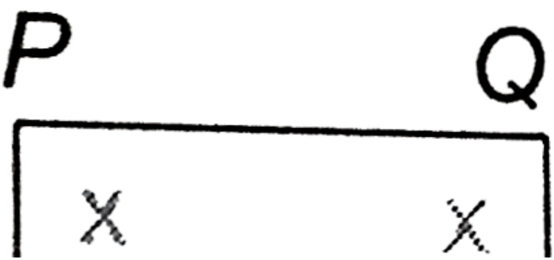
C. decreaes

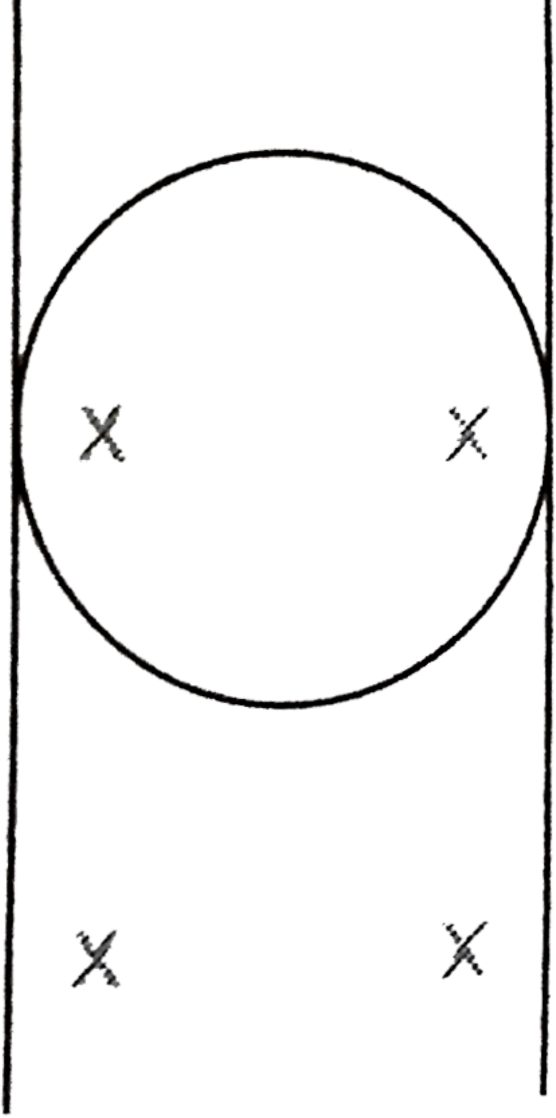
D. increase of decrease depending on whether the semicircular bulges towards the resistance or away from it

Answer: B

Watch Video Solution

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





A. zero

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

C. $\frac{4Brv}{R}$

D. $\frac{8Brv}{R}$

Answer: D

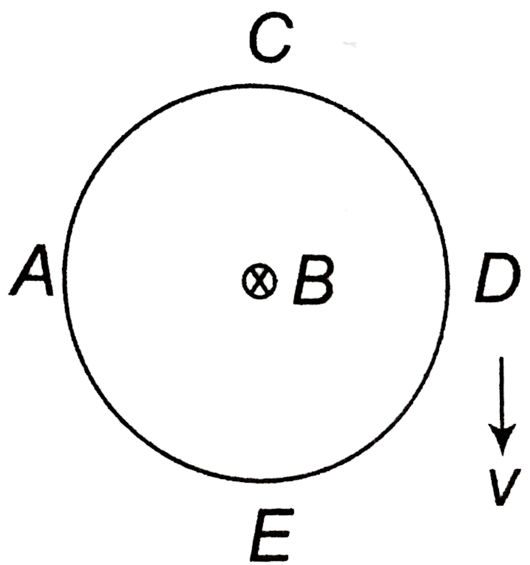
Watch Video Solution

77. A vertical conduction ring of radius R falls vertically in a horizontal magnetic field of magnitude B with constant speed v . The direction of B is perpendicular to the plane of the ring. When the speed of the ring is v, (i) A and D are at different potential

(ii) A and D are at the same potential

(iii) C and E are at the same potential

(iv) The potential difference between A and D is $2BRv$, with D a higher potential



A. $(i), (iii)$

B. $(ii), (iv)$

C. $(i), (iii),)iv)$

D. $(ii), (iii)$

Answer: C

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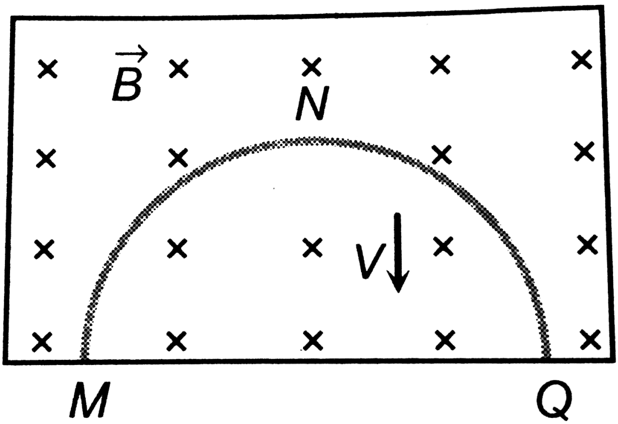
78. A thin semicircular conducting ring of radius R is falling with its plane verticle in a horizontal magnetic inducting B. At the position MNQ, the speed of the ring is V and the potential difference developed across the ring is



A. zero

B. $1/2Bv\pi R^2$, and M is at a higher potential

C. πRBv , and Q is at a higher potential

D. $2RBv$, and Q is at a higher potential

Answer: D

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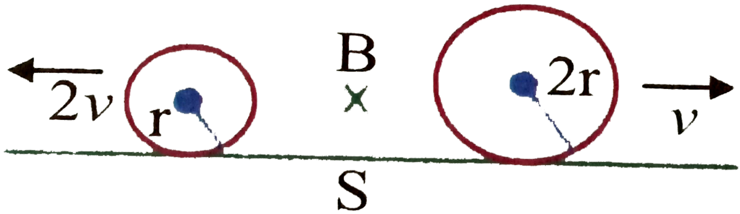
79. Two conducting rings of radii r and $2r$ move in apposite directions with velocities $2v$ and v respectively on a conducting surface S. There is a uniform magnetic field of magnitude B perpendicular to the plane of the rings. The potential difference between the highest points of the two rings is



A. zero

B. $2rvB$

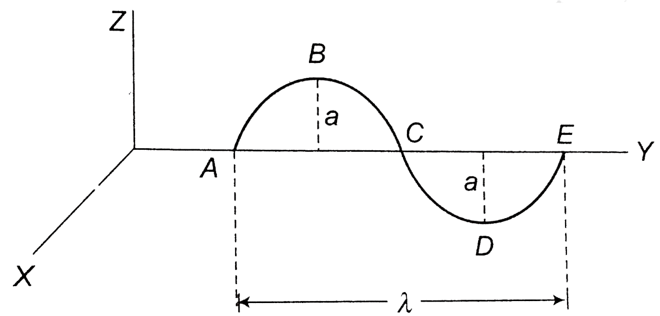
C. $4rvBr$

D. $10rvB$

Answer: D

Watch Video Solution

80. The conductor $ABCDE$ has the shape shown. It is lies in the YZ plane, with A and E on the $y$axis. When it moves with a velocity v in a magnetic field B , an emf e is induced between A and E . (Choose the incorrect option)



A. $e0$, if v is the y-direction and B is in the x-direction

B. $e = 2B\lambda v$, if v is in the y-direction and B is in the x-direction

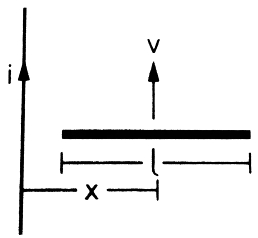
C. $e = B\lambda v$, if v in the z-direction and B is in the x-direction

D. $e = B\lambda v$, if v is in the x-direction and B is in the z-direction

Answer: B

View Text Solution

81. shows a straight, long wire carrying a current I and a rod of length l coplanar with the wire and perpendicular to it. The rod moves with a constant velocity v in a direction parallel to the wire. The distance of the wire from the centre of the rod is x. Find the motional emf induced in the rod.



A. $\frac{\mu_0 i v}{2\pi} 1n\left(1+\frac{L}{2a}\right), A$

B. $\frac{\mu_0 iv}{\pi} 1n\left(1+\frac{L}{2a}\right), B$

C. $\frac{\mu_0 iv}{2\pi} 1n\left(1+\frac{L}{a}\right), A$

D. $\frac{\mu_0 iv}{\pi} 1n\left(1+\frac{L}{2a}\right), B$

Answer: C

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82. The magnetic field in a region is given by $\vec{B} = \vec{k}\frac{B_0}{L}y$ where L is a fixed length. A conducting rod of length L lies along the Y - axis between the origin and the point (0,L, 0).

If the rod moves with a velocity $v = v_0$ in x direction, find the emf induced between the ends of the rod.

A. $\frac{Bv_0L}{4}$

B. $\frac{Bv_0L}{2}$

C. $\frac{3Bv_0L}{4}$

D. Bv_0L

Answer: B

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

A. both A and B are ture

B. A is true but B is false

C. B is true but A is false

D. both A and B are false

Answer: A

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84. A conducting loop is placed in a uniform magnetic field with its plane perpendicular to the field with its plane perpendicular to the field. An emf is induced in the loop if

(i) it is traslated

(ii) it is rotated about its axis

(iii) it is rotated about a diameter

it is deformed

A. $(i), (ii)$

B. $(ii), (iii)$

C. $(iii), (iv)$

D. $(i), , (v)$

Answer: C

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85. A magnet is moving towards a coil along its axis and the emf induced in the coil is ε . If the coil also strats moving towards the magnet with the same speed, the induced emf will be

A. $\varepsilon/2$

B. ε

C. 2ε

D. 4ε

Answer: C

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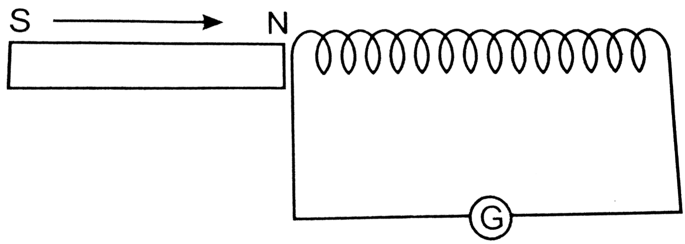
86. As shown in the figure, a magnetic is moved with a a fast speed towards a coil at rest. Due to this, induced electromotive force, induced charge in the coil are E, I and Q respectively. If the speed of magnetic is doubled, the incorrect statement is



A. E increases

B. I increases

C. Q increases

D. Q remains unchanged

Answer: C

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87. A metal rod length l rotates about on end with a uniform angular velocity ω. A uniform magnetic field $\vec{B}$ exists in the direction of the axis of rotation. Calculate the emf induced between the ends of the rod. Neglect the centripetal force acting on the free electrons as they money in circular paths.

A. $\dfrac{B\omega L^2}{4}$

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

C. $\frac{3B\omega L^2}{4}$

D. $B\omega L^2$

Answer: B

Watch Video Solution

88. if rod is rotated about an axis passing through its mid-point , the potential difference between the ends of rod is

A. $\frac{B\omega L^2}{4}$

B. $\frac{B\omega L^2}{2}$

C. $\frac{3B\omega L^2}{4}$

D. zero

Answer: D

View Text Solution

89. A metal conductor of length 1m rotates vertically about one of its ends at angular velocity 5 radians per second. If the horizontal component of earth's magnetic field is

$0.2 \times 10^{-4} T$, then the emf developed between the two ends of hte conductor is

A. $5 mV$

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

C. $50 mV$

D. $50 \mu V$

Answer: D

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90. A metal rod of resistance R is fixed along a diameter o fa conducting ring of radius r . There is a magnetic field of magnitude B perpendicular to the plane of the loop. The ring spins with an angular velocity ω about its axis. The centre of the ring is joined to its rim by an external wire W . The ring and W have no resistance. The current in W is

A. zero

B. $\dfrac{Br^2\omega}{2R}$

C. $\dfrac{Br^2\omega}{R}$

D. $\frac{2Br^2\omega}{R}$

Answer: D

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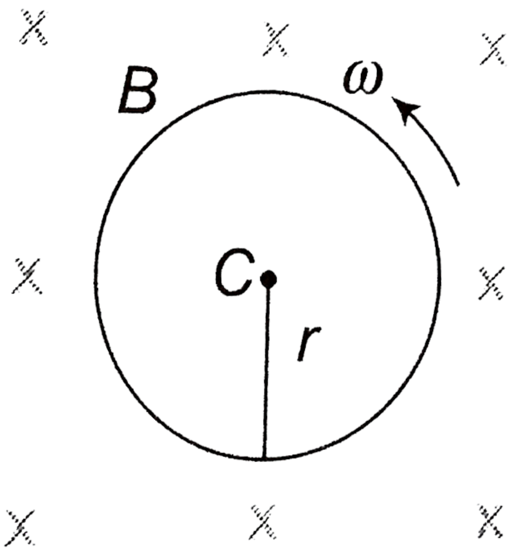
91. A conducting disc of radius r spins about its axis an angular velocity ω . There is a uniform magnetic field of magnitude B perpendicular to the plane of the disc C is the centre of the disc.

(i) No emf is induced in the disc

(ii) The potential difference between C and the rim is $1/2Br^2\omega$

C is at a higher potential than the rim

(iv) Current flows between C and the rim



A. $(i), (iii)$

B. $(ii), (iii)$

C. $(ii), (iv)$

D. none

Answer: B

Watch Video Solution

92. Three indential rings move with same speed on a horizontal magnetic field normal to plane of rings. The first (a) slips without rolling, the second(b) rolls without slipping and the third rolls with slipping:

A. The same emf is induced in all three rings

B. No emf is induced in all three rings

C. In each ring all points are at the same

D. B develops the maximum induced emf, and A the least

Answer: A

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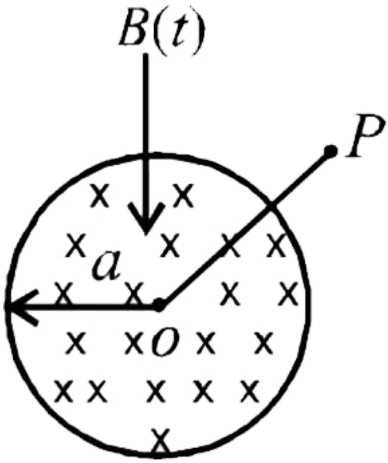
93. A uniform but time-varying magnetic field B(t) exists in a circular region of radius a and is directed into the plane of the paper, as shown. The magnitude of the induced electric field at point P at a distance r from the centre of the circular region



A. zero

B. decreases as $/r$

C. increases as r

D. decreases as $1/r^2$

Answer: B

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94. The inductance of a coil is proportional to

A. its length

B. the number of turns

C. the resistance of the coil

D. the square of the number of turns

Answer: D

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95. When the number of turns and the length of the solenoid are doubled keeping the area of cross-section same, the inductance

A. remains the same

B. is halved

C. is doubled

D. becomes four times

Answer: C

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

A. 1.0 henry

B. 4.0 henry

C. 2.5 henry

D. 2.0 henry

Answer: A

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97. A coil is wound as a transformer of rectangular cross section. If all the linear dimension of the transformer are increased by a factor 2 and the number of turns per unit length of the coil remain the same, the self-inductance increased by a factor of

A. 4

B. 8

C. 12

D. 16

Answer: B

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98. A long solenoid of N turns has a self-induced L and area of cross-section A. When a current i flows through the solenoid, magnetic field inside it has magnitude B . The current i is equal to

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

B. $BANL$

C. $\frac{BN}{AL}$

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

Answer: A

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

A. $(i), (iii)$

B. $(ii), (iii)$

C. $(ii), (iv)$

D. all

Answer: D

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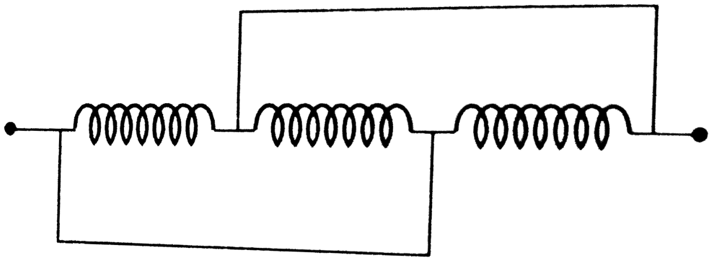
100. Pure inductance of $3.0H$ is connected as shown below. The equivalent inductance of the circuit is



A. $1H$

B. $2H$

C. $3H$

D. $9H$

Answer: A

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101. 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 ?

A. $4, 6$

B. $3, 7$

C. $2, 8$

D. $1, 9$

Answer: A

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102. When the current in a coil changes from $8A$ to $2A$ in $3 \times 10^{-2} s$, th eemf induced in the coil is $2V$. The self-induced of coil in mH

A. 10

B. 20

C. 30

D. 40

Answer: A

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103. A current of $2A$ flowing through a coil of 100 truns give rise to a nagnetic flux of $5 \times 10^{-5} Wb$ per turn. Magnetic energy associated with cooil is

A. $5J$

B. $0.5J$

C. $0.05J$

D. $0.005J$

Answer: D

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

A. $(i), (ii), (iii)$

B. $(i), (iii), (iv)$

C. $(i), (ii), (iv)$

D. all

Answer: A

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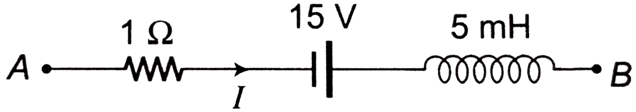
105. If $I = 5A$ and decreasing at a rate of $10^2 (A / \sec)$, then $V_B - V_A$



A. $5V$

B. $10V$

C. $15V$

D. $20V$

Answer: C

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106. In the previous question, if the direction of I is reversed, $V_B - V_A$ will be

A. $20V$

B. $15V$

C. $10V$

D. $5V$

Answer: D

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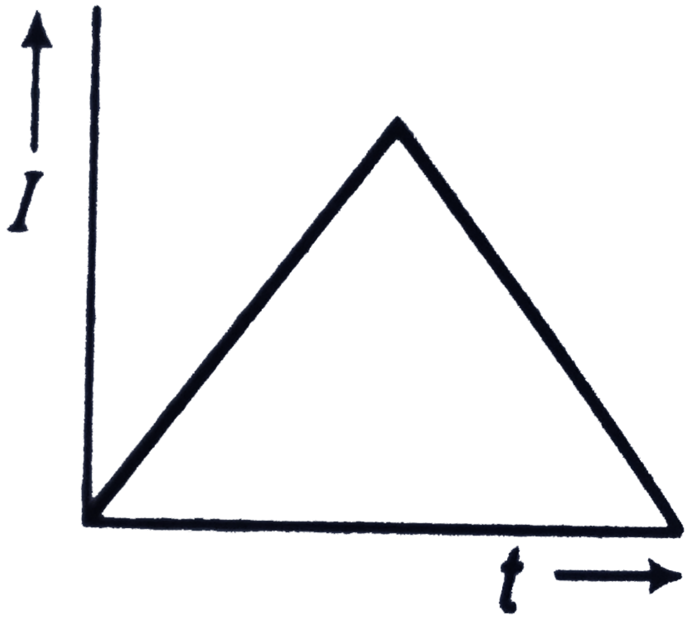
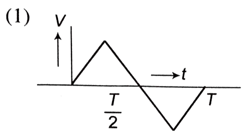
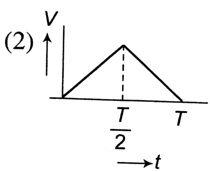
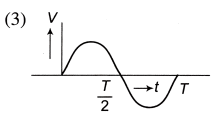
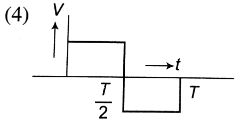
107. An alternating current I in an inductance coil varies with time t according to the graph as shown: Which one of the following graph gives the variation of voltage with time?



A. 

B. 

C. 

D. 

Answer: D

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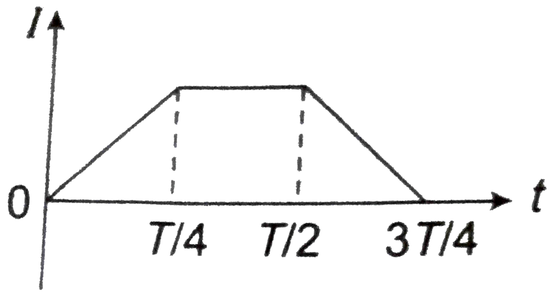
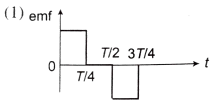
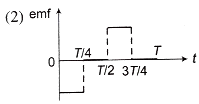
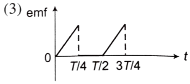
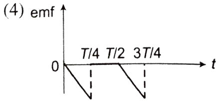
108. The current i in a coil varies with time as shown in the figure. The variation of induced emf with time would be



A. 

B. 

C. 

D. 

Answer: B

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

A. $30mH, 30\Omega$

B. $30mH, 60\Omega$

C. $60mH, 30\Omega$

D. $30mH, 60\Omega$

Answer: C

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110. A uniformly wound solenoid coil of self inductance $1.8 \times 10^{-4} H$ and resistance 6Ω is broken up into two identical coils. These identical coils are then connected in parallel across a $12V$ battery of negligible resistance.

The time constant and steady state current will be

A. $10\mu \sec, 6A$

B. $10\mu \sec, 8A$

C. $30\mu \sec, 6A$

D. $30\mu \sec, 8A$

Answer: D

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

A. 0.1 sec

B. 0.2 sec

C. 0.3 sec

D. 0.4 sec

Answer: B

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112. Two solenoids have identical geometrical construction but one is made of thick wire and the other of thin wire. Which of the following quantities are different for the two solenoids?

A. $(i), (ii)$

B. $(iii), (iv)$

C. $(ii), (iv)$

D. all

Answer: D

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113. Two conducting circular loops of radii R_1 and R_2 are placed in the same plane with their centres coincidingt. Find the mutual inductane between them assuming $R_2 < < R_1$.

A. $\frac{\mu_0 \pi R_2^2}{2R_1}$

B. $\frac{\mu_0 \pi R_1^2}{2R_2}$

C. $\frac{\mu_0 \pi R_2^2}{R_1}$

D. $\frac{\mu_0 \pi R_1^2}{R_1}$

Answer: A

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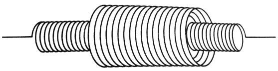
114. A solenoid S_1 is placed inside another solenoid S_2 as shown in The radii of he inner and the outer solenoids are r_1 and r_2 respectively and the numbers of turns per unit length are n_1 and n_2 respectively. Consider a length l of each solenoid. Calculate the mutual inductance betwwen them.



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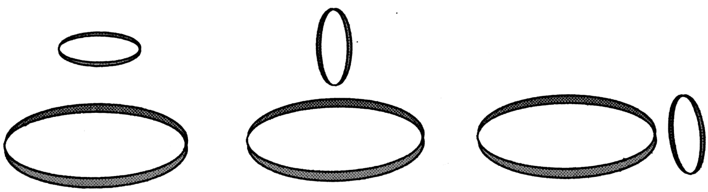
115. Two circular coils can be arranged in any of the three situation shown in the figure. Their mutual inductance will be



A. maximum in situation (a)

B. maximum in situation (b)

C. maximum in situation (c)

D. the same in all situations

Answer: A

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116. A small square loop of wire of side l is placed inside a large square loop of wire of side $L(L > > l)$. The loops are co-planer and their centres coincide. The mutual inductance of the system is proportional to

A. l / L

B. l^2 / L

C. L / l

D. L^2 / l

Answer: B

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117. A small coil of radius r is placed at the centre of a large coil of radius R, where $R > > r$. The two coils are coplanar. The mutual inductance between the coils is proportional to

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

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

C. $\frac{r^2}{R^2}$

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

Answer: B

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118. Two coils are placed closed to each other. The mutual inductance between them assuming $R_2 < < R_1$

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119. The number of turns of primary and secondary coils of a transformer are 5 and 10 respectively and the mutual inductance of the tranformar is 25 henry. Now the number of turns in the primary and secondary of the transformar are made 10 and 5 respectivaly. The mutual inductance of the transformar in henry will be

A. 6.25

B. 12.5

C. 25

D. 50

Answer: C

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

A. $4mH$

B. $16mH$

C. $10mH$

D. $6mH$

Answer: A

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121. Two coaxial solenoids are made by winding thin insulated wire over a pipe of cross-sectional area $A = 10cm^2$ and length =20cm. If one of the solenoid has 300 turns and the other 400 turns, their mutual indcutance is

A. $4.8\pi \times 10^{-4}H$

B. $4.8\pi \times 10^{-5}H$

C. $2.4\pi \times 10^{-4} H$

D. $4.8\pi \times 10^{4} H$

Answer: C

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

A. 2π

B. 5π

C. π

D. 4π

Answer: B

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123. The mutual inductance between two coils is 2.5 H. If the current in one coil is changed at the rate of $1 A s^{-1}$, what will be the emf induced in the other coil?

A. $2.5 V$

B. $10 V$

C. $5 V$

D. $20 V$

Answer: A

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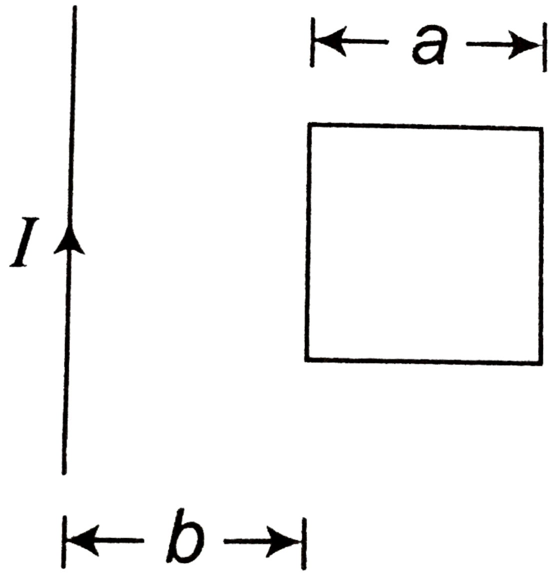
124. The coefficient of mutual inductance



A. $\frac{\mu_0 a}{2\pi} \ln\left(1+\frac{a}{2b}\right)$

B. $\frac{\mu_0 a}{\pi} \ln\left(1+\frac{b}{2a}\right)$

C. $\frac{\mu_0 a}{2\pi} \ln\left(1+\frac{a}{b}\right)$

D. $\frac{\mu_0 a}{2\pi} \ln\left(1+\frac{b}{a}\right)$

Answer: C

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125. An inductor of 2 henry and a resistance of 10 ohms are connected in series with a battery of 5 volts. The initial rate of change of current is

A. $0.5amp/\sec$

B. $2.0amp/\sec$

C. $2.5amp/\sec$

D. $0.25amp/\sec$

Answer: C

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126. A coil o finductanc e$8.4mH$ and resistance 6Ω is connected to a $12V$ battery. The current in the coil is 1.0A` in the time (approx .)

A. $500\sec$

B. $20\sec$

C. $35 m \sec$

D. $1 m \sec$

Answer: D

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

A. e^{-1}

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

C. $(1 - e)$

D. e

Answer: B

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128. An e.m.f. of 15 volt is applied in a circuit containing 5 henry inductance and 10 ohm resistance. The ratio of the current at time $t = \infty$ and at $t = 1$ second is

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

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

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

D. e^{-1}

Answer: B

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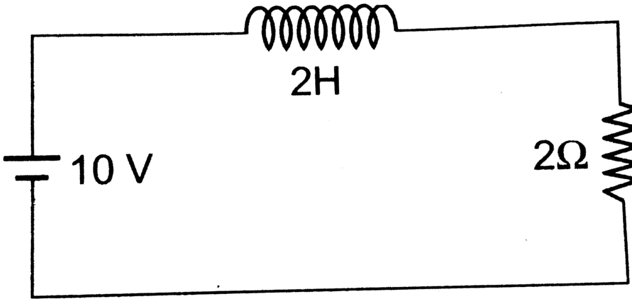
129. In the figure magnetic energy stored in the coil is



A. zero

B. infinite

C. 25 joules

D. none of the above

Answer: C

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130. The time constant of an LR circuit respresents the time in which the current in the circuit

A. reaches a value equal to about 37% of its final value

B. reaches a value equal to about 63% of its final value

C. attains a constant value

D. attains 50% of the constant value

Answer: B

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

A. R/L

B. R/L

C. L/R

D. $1/LR$

Answer: C

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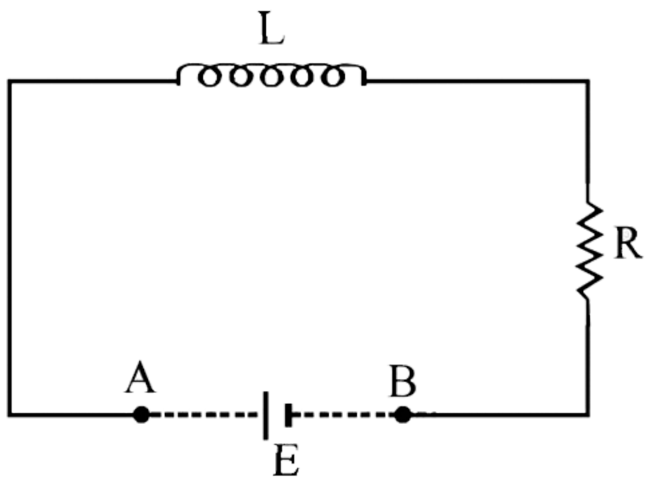
132. An inductor $(L = 100mH)$, a resistor $(R = 100(\Omega))$ and a battery $(E = 100V)$ are initially connected in series as shown in the figure. After a long time the battery is disconnected after short circuiting the point A and B. The current in the circuit 1 ms after the short circuit is



A. eA

B. $0.1A$

C. $1A$

D. $1/eA$

Answer: D

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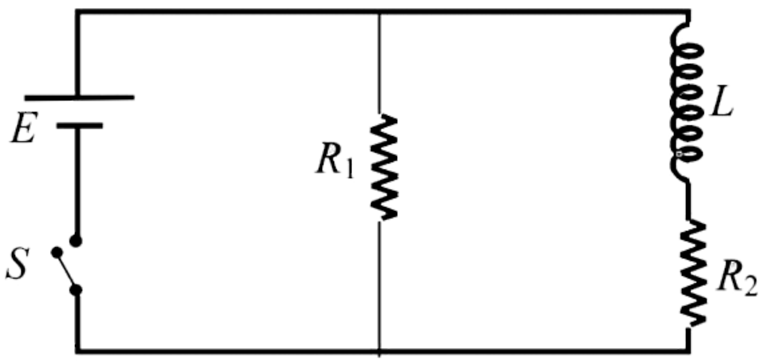
133. An inductor of inductance L=400 mH and resistor of resistance $R_1 = 2(\Omega)$ and $R_2 = 2(\Omega)$ are connected to a battery of emf E = 12 Vas shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at time t =0.

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?



A. $6e^{-5t}V$

B. $\frac{12}{t}e^{3t}V$

C. $6\left(1-\frac{e^{-t}}{0.2}\right)V$

D. $12e^{-5t}V$

Answer: D

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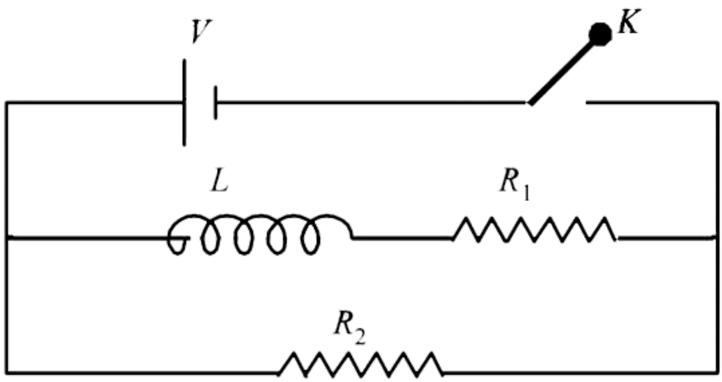
134. In the circuit shown below, the key K is closed at t =0. The current through the battery is



A. $\dfrac{V(R_1 + R_2)}{R_1 R_2}$ at $t = 0$ and $\dfrac{V}{R_2}$ at $t = \infty$

B. $\dfrac{V(R_1 + R_2)}{\sqrt{R_1^2 R_2^2}}$ at $t = 0$ and $\dfrac{V}{R_2}$ at $t = \infty$

C. $\frac{V}{R_2}$ at $t=0$ and $\frac{V(R_1+R_2)}{R_1R_2}$ at $t=\infty$

D. $\frac{V}{R_2}$ at $t=0$ and $\frac{V(R_1+R_2)}{R_1R_2}$ at $t=\infty$

Answer: C

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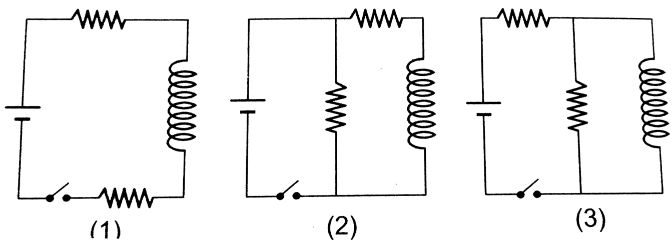
135. The figure shows theree cirrcuit with idential batteries, inductors, and resistors. Rank the circuit according to the current through the battery (i) just after the switch is closed and (ii) a long time later, greatest first



A. $(i) i_2 > i_3 > i_1 (i_1 = 0) (ii) i_2 > i_3 > i_1$

B. $(i) i_2 > i_3 > i_1 (i_1 \neq 0) (ii) i_2 > i_3 > i_1$

C. $(i) i_2 > i_3 > i_1 (i_1 = 0) (ii) i_2 > i_3 > i_1$

D. $(i) i_2 > i_3 > i_1 (i_1 \neq 0) (ii) i_2 > i_3 > i_1$

Answer: A

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

A. intensity of the bulb remains the same

B. intensity of the bulb decreases

C. intensity of the bulb increases

D. the bulb cease to glow

Answer: B

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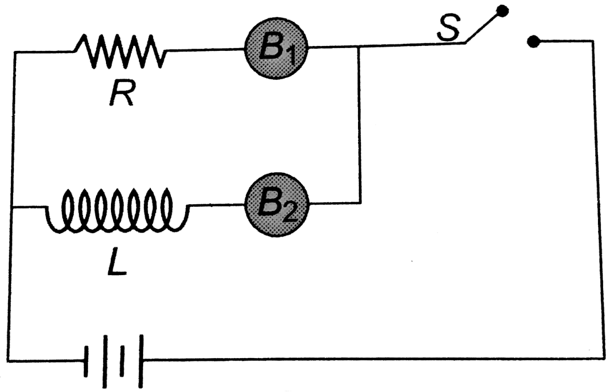
137. The adjoining figure shows two bulbs B_1 and B_2 resistor R and an inductor and L. When the switch S is turned off



A. bo th B_1 and B_2 die out promptly

B. bo th B_1 and B_2 die out with some delay

C. B_1 dies out promptly but B_2 with some delay

D. B_2 dies out promptly but but B_1 with some delay

Answer: C

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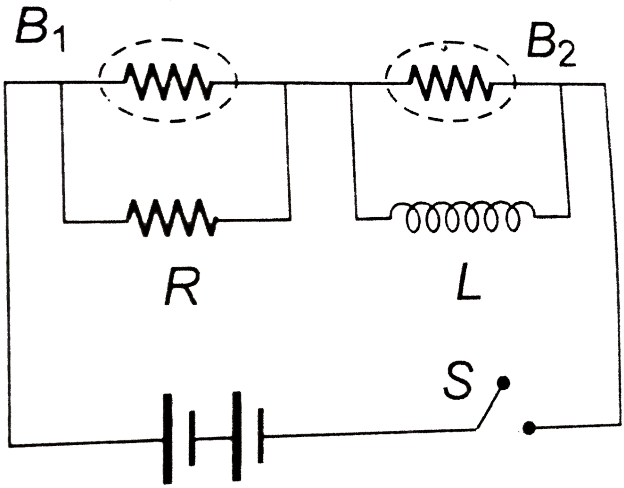
138. If the switch in the following circuit is turned off, then



A. the bulb B_1 will go out immediately whereas B_2 after sometimes

B. the bulb B_2 will go out immediately whereas B_1 after sometimes

C. both B_1 and B_2 will go immediately

D. both B_1 and B_2 will go out after sometimes

Answer: D

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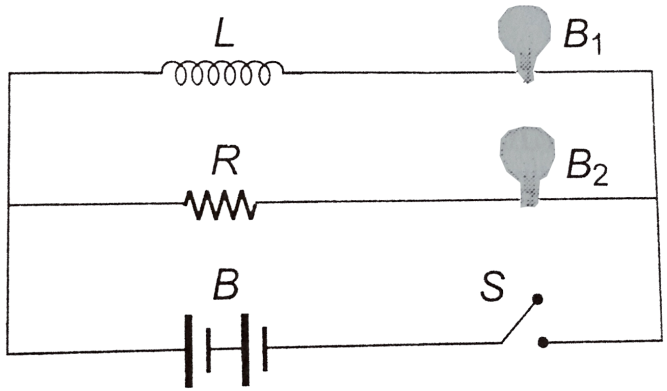
139. An inductor L , a resistanece R and two identical bulbs, B_1 and B_2 are connected to a battery through a switch S as shown in the figure. The resistance R is the samem as that of the coil that makes L .Which of the following statement gives the correct description of the happenings when the switch S is closed



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

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

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

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

Answer: C

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140. A capacitor is fully changed with a battery. Then the battery is removed and a coil is connected with the capacitor in parallel, current varies as

A. increase monotoically

B. decreases monotonically

C. zero

D. oscillates indefinitely

Answer: D

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

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

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

C. $\frac{Q}{\sqrt{3}}$

D. $\frac{Q}{3}$

Answer: B

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