PHYSICS

FOR IIT JEE ASPIRANTS OF CLASS 12 FOR PHYSICS

ELECTRO MAGNETIC INDUCTION

Solved Example

1. A reactangular loop of area $0.06m^2$ is placed in a uniform magnetic field of $0.3T$ with its plane (i) normal to the field (ii) inclined 30° to the field (iii) parallel to the field. Find the fliux linked with the coil in each case.

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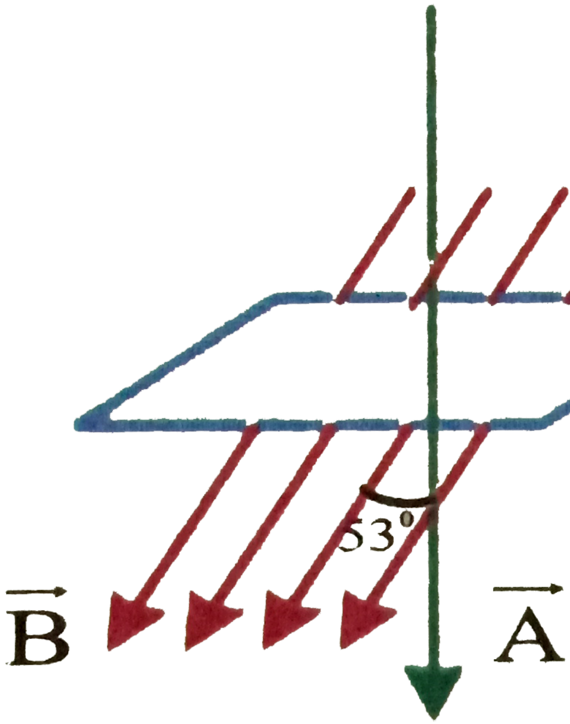
2. At a certain location in the northern hemisphere, the earth's magnetic field has magnitude of $42 \mu T$ and points downwards at 53° to the vertical. Calculate the flux through a horizontal surface of area $2.5 m^2$. $[\sin 53^\circ = 0.8]$



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3. The magnetic flux through a coil is varying according to the relation $\phi = (5t^3 + 4t^2 + 2t - 5)$ Wb. Calculate the induced current through the coil at $t = 2$ s if resistance of coil is 5 ohm.

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4. A circular coil opf 500 turns of wire has an enclosed area of $0.1m^2$ per turn. It is kept perpendicular to a magnetic field of induction $0.2T$ and rotated by 180° about a diameter perpendicular to the field in 0.1 sec. how much charge will pass when the coil is connected to a gavanometer with a combined resistance of $50 ohms$

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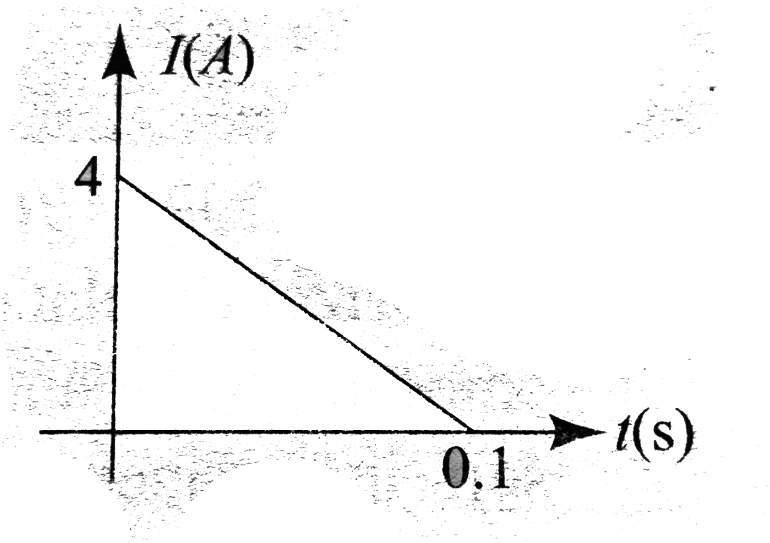
5. Some magnetic flux is changed from a coil of resitance 10Ω. As a result, an induced current is developed it, which varies with time as shown in Fig. 3.213. Find the magnitude of the change in flux through ythe coil in weber.



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6. A long solenoid with 1.5 turns per cm has a small loop of area $2.0cm^2$ placed inside the solenoid normal to its axis. If the current in the solenoid changes steadily from $2.0A$ to $4.0A$ in $1.0s$. The emf induced in the loop is

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

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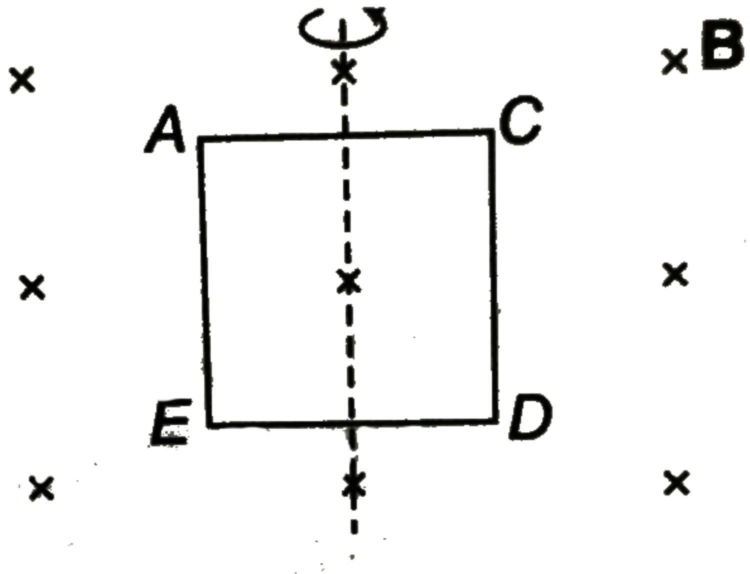
8. A square loop $ACDE$ of area $20cm^2$ resistance 5Ω is rotate in as magnetic field $B = 2T$ through 180° (a) in $0.01S$ and (b) in $0.02s$

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



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9. A rectangular loop of length $'l'$ and breadth $'b'$ is placed at a distance of x from an infinitely long wire carrying current $'i'$ such that the direction of current is parallel to breadth. If the loop moves away from the current wire in a direction perpendicular to it with a velocity $'v'$, the magnitude of the e.m.f. in the loop is: ($\mu_0 =$ permeability of free space)

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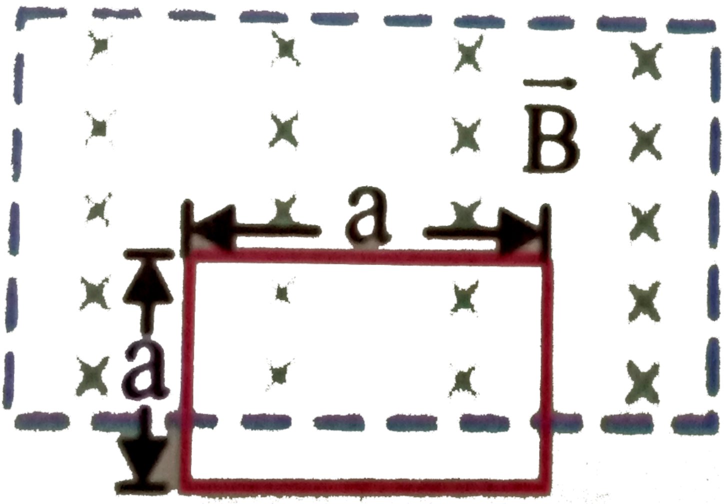
10. A horizontal magnetic field B is produced across a narrow gap between the two square iron pole pieces. A closed square loop of side a, mass m and resistance R is allowed to fall with the tope the lopp in the field. The loop attians a terminal velocity equal to :



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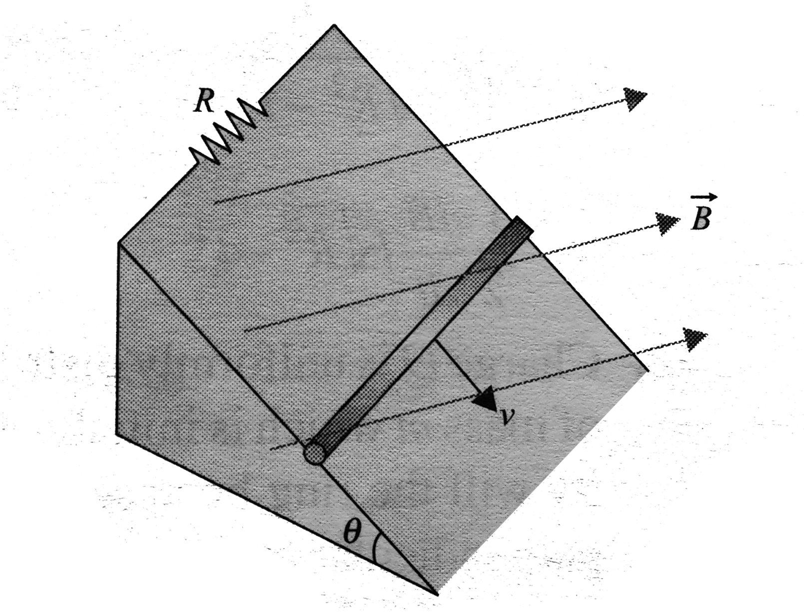
11. a conducting wire os mass m slides down two smooth conducting bars, set at an angle θ to the horizontal as shown in . The separatin between the bars is l. The system is located in the magnetic field B,

perpendicular to the plane of the sliding wire and bars. The constant velocity of the wire is



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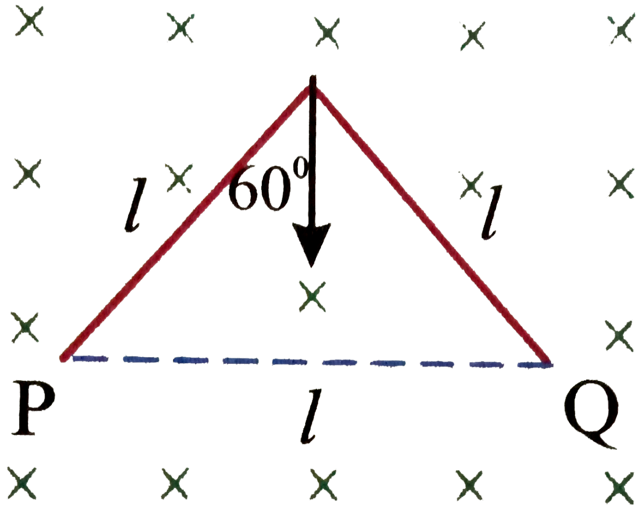
12. A wire of length $2l$ is bent at mid point so that the angle between two halves is 60°. If it moves as shown with a velocity v in a magnetic field B find the induced emf.



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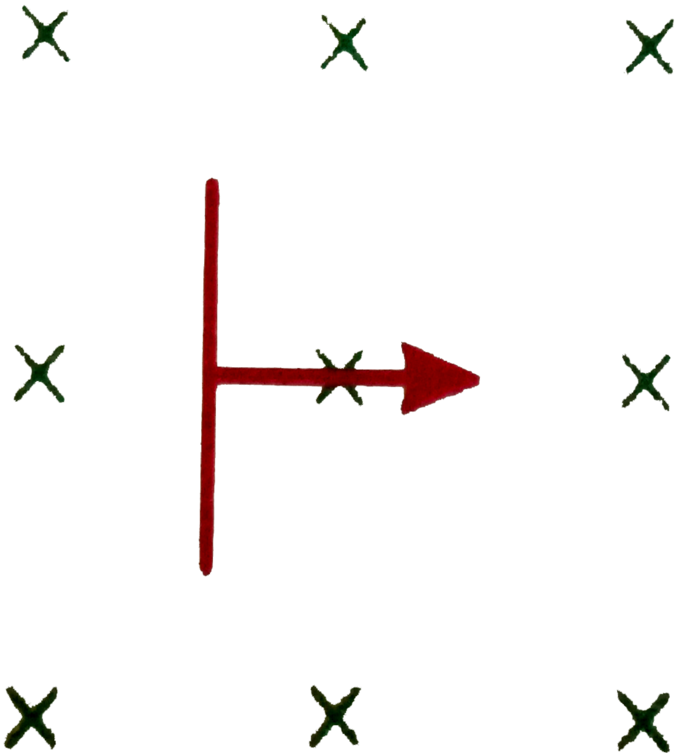
13. A conductor or length $0.1m$ is moving with a velocity of $4m/s$ in a uniform magnetic field of $2T$ as shwon in the figure. Find the emf induced?



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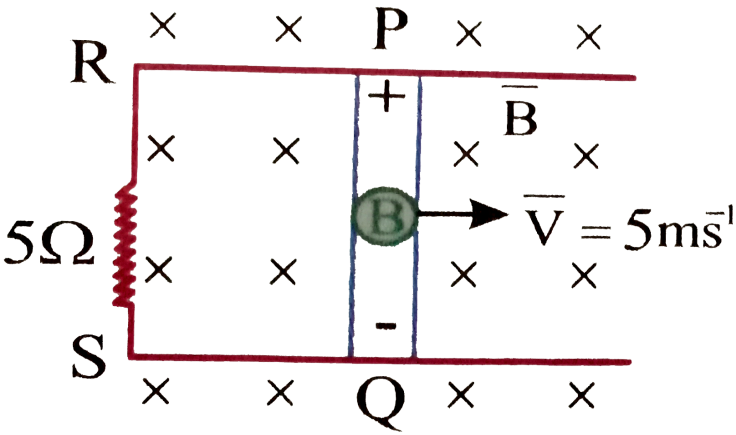
14. Figure shows a conducting rod PQ in contact with metal rails RP and SQ, which are $0.25m$ apart in a uniform magnetic field of flux density $0.4T$ acting perpendicular to the plane of the paper. Ends R and S are connected through a 5Ω resistance. What is the emf when the rod moves to the right with a velocity of $5ms^{-1}$? What is the magnitude and direction of the current through the 5Ω resistance? If the rod PQ moves to the left with the same speed, what will be the new current and its direction?



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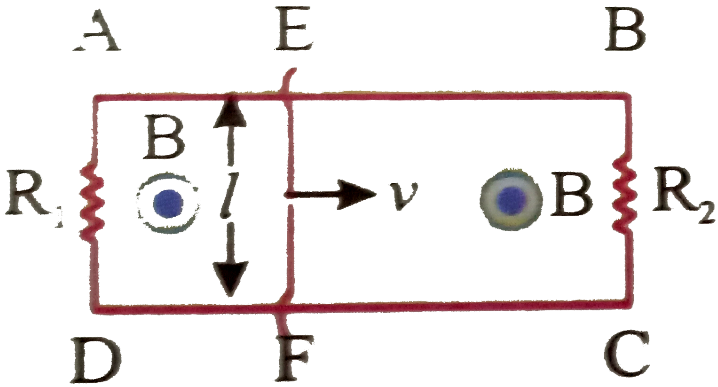
15. A loop $ABCD$ containing two resistors as shown in figure is placed in a uniform magnetic fielf B directed outwards to the plane of page. A sliding conductor EF of length l and of negligible resistance moves to th right with a uniform velocity v as shown in Fig. Determine the current

in each branch.



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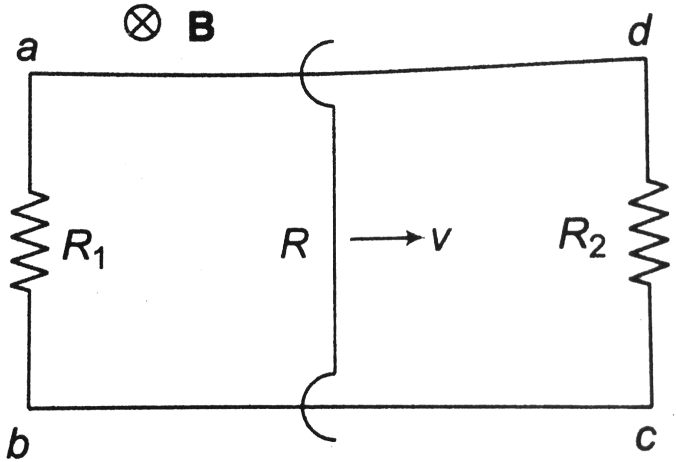
16. A rectangular loop with a sliding connector of length l is located in a uniform magnetic field perpendicular to the loop plane. The magnetic induction is equal to B. The connector has an electric resistance R, the sides ab and cd have resistances R_1 and R_2. Neglecting the self-inductance of the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



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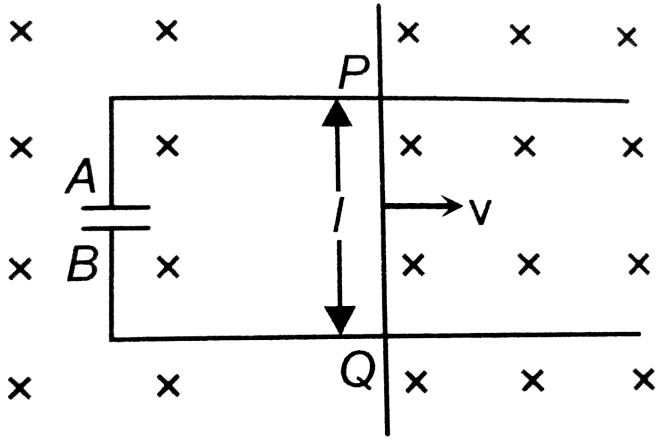
17. A conducting rod PQ of length $l = 1.0m$ is moving with a uniform speed $v2.0m/s$ in a uniform magnetic field $B = 4.0T$ directed into the paper.

A capacitor of capacity $C = 10\mu F$ is connected as shown in figure. Then



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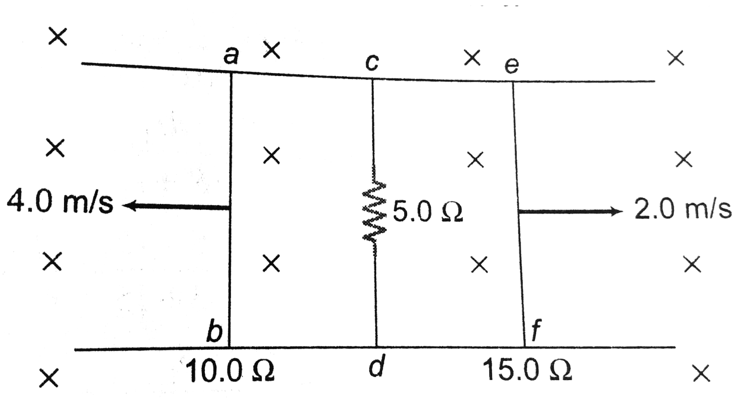
18. Two parallel rails with negligible resistance are $10.0cm$ apart. The are connected by a 5.0Ω resistor. The circuit also contains two metal rods having resistances of 10.0Ω and 15.0Ω along the rails. The rods are pulled away from the resistor at constant speeds $4.00\frac{m}{s}$ and $2.00m/s$ respectively. A uniform magnetic field of magnitude $0.01T$ is applied perpendicular to the, plane of the rails. Determine the current in the

5.0Ω resistor.



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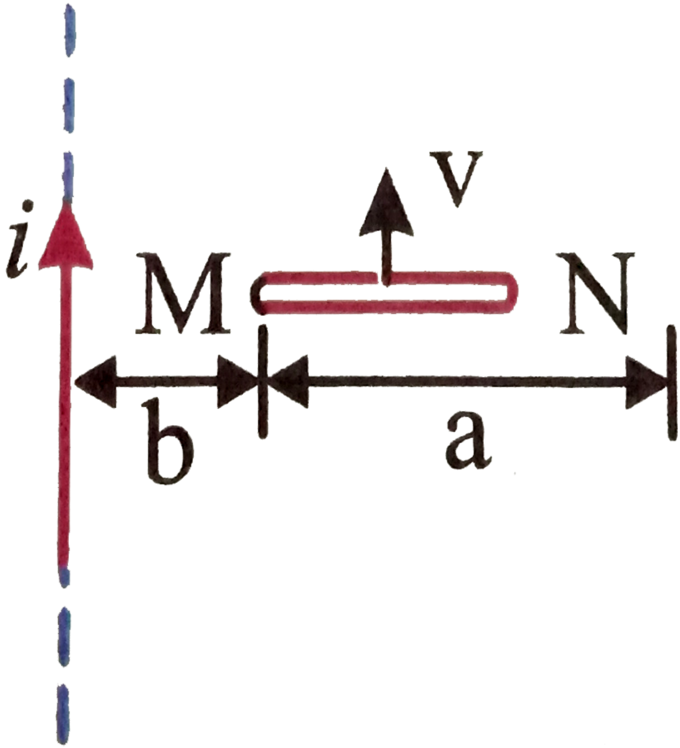
19. A conducting rod MN moves with a speed v parallel to a long straight wire which carries a constant current i, as shown in fig. The length of the rod is normal to the wire. Find the emf induced in the total length of the rod. State which end will be at a lower potential.



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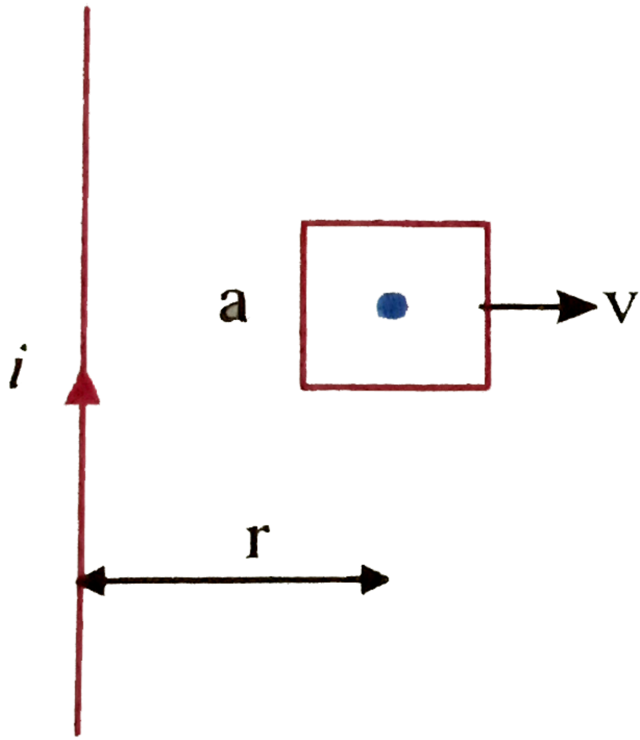
20. A square loop of side a is placed in the same plane as a long straight wire carrying a current i. The centre of the loop is at a distance r from wire where $r > > a$. The loop is moved away from the wire with a constant velocity v. The induced $e.m.f$ in the loop is



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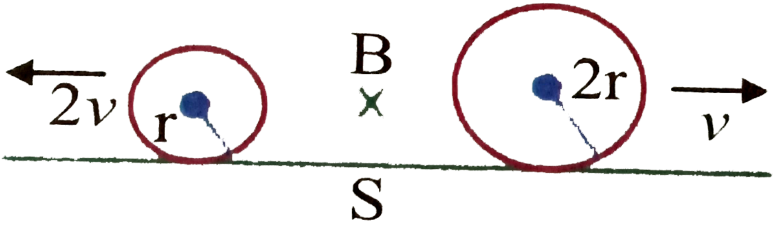
21. Two conducting rings of radii r and $2r$ move in apposite directions with velocities $2v$ and v respectively on a conducting surface S. There is a uniform magnetic field of magnitude B perpendicular to the plane of the rings. The potential difference between the highest points of the two rings is



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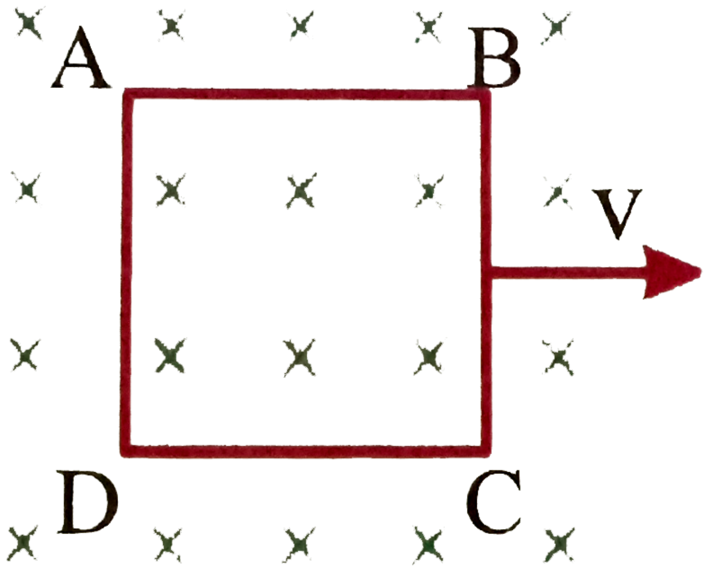
22. A metallic square loop $ABCD$ is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in the figure. Find

$a)$ In which sides of the loop electric field is induced.

$b)$ Net emf induced in the loop

$c)$ If one $'BC'$ is outside the field with remaining loop in the field and is being pulled ot a constant velocity then induced current in the loop.



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23. A copper rod of length $2m$ is rotated with a speed of $10rps$, in a uniform magnetic field of 1 tesla about a pivot at one end. The magnetic field is perpendicular to the plane of rotation. Find the emf induced across its ends

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24. A wheel with 10 metallic spokes each 0.5 m long is rotated with a speed of 120 rpm, in a plane normal to earth's magnetic field at the place. If the megnitude of the field is 0.40 gauss, what is the induced e.m.f. between the axle and rim of the wheel.

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25. A metal rod of resistance 20Ω is fixed along a diameter of a conducting ring of radius $0.1m$ and lies on $x-y$ plane. There is a magnetic field $\overrightarrow{B}=(50T)\overrightarrow{k}$. The ring rotates with an angular velocity $\omega=20rads^{-1}$ about its axis. An external resistance of 10Ω is connected across the center of the ring and rim. The current external resistance is

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26. A copper disc of radius $1m$ is rotated about its natural axis with an angular velocity $2\text{rad}/\text{sec}$ in a uniform magnetic field 5 telsa with its plane perpendicular to the field. Find the emf induced between the centre of the disc and its rim.

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

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28. 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

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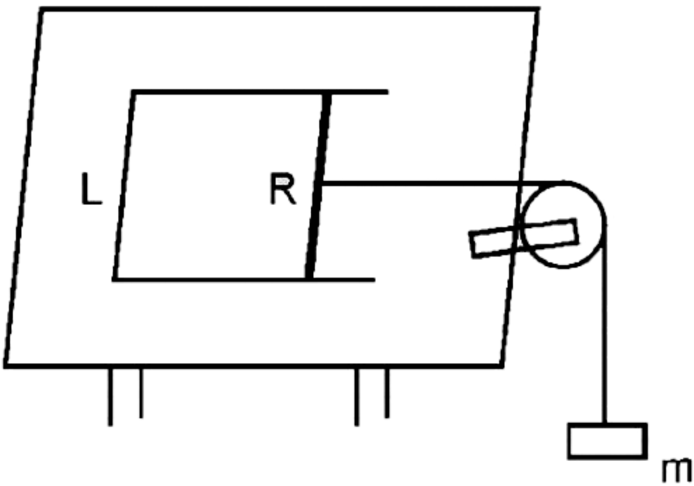
29. A pair of parallel horizontal conducting rails of negligible resistance shorted at one end is fixed on a table. The distance between the rails is L. A conducting massless rod of resistance R can slide on the rails frictionlessly. The rod is tied to a massless string which passes over a pulley fixed 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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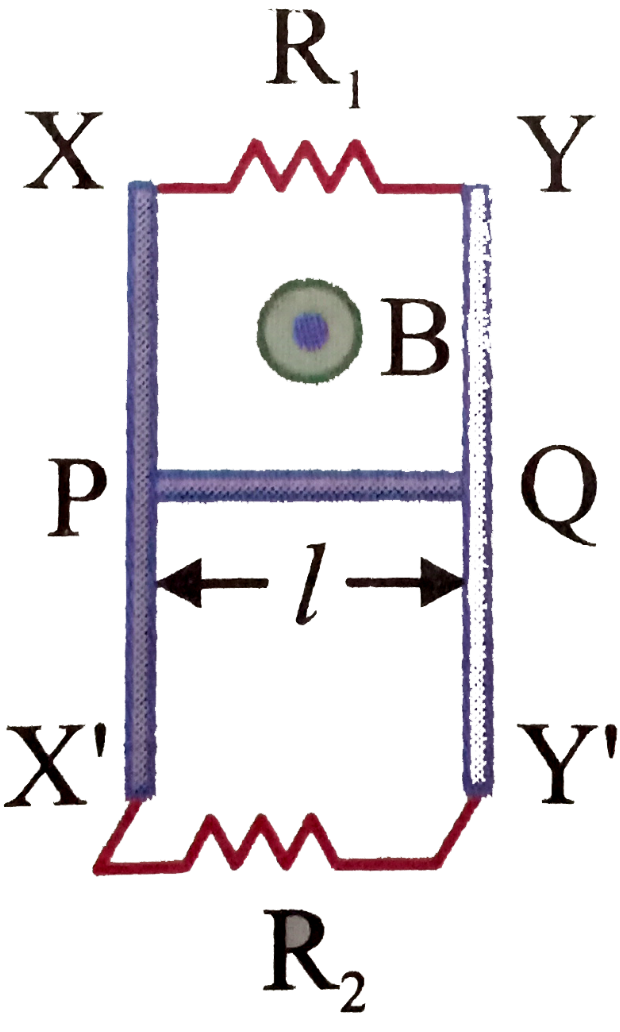
30. Two parallel vertical metallic bars XX^1 and YY^1, of negligible resistance and separated by a length $'l'$, are as shown in Fig. The ends of the bars are joined by resistance R_1 and R_2. A uniform magnetic field of induction B exsits in space normal to the plane of the bars. A horizontal metallic rod PQ of mass m starts falling vertically, making contact with the bars. It is oberved that in the steady state the powers dissipated in the resistance R_1 and R_2 and the terminal velocity attained by the rod PQ.



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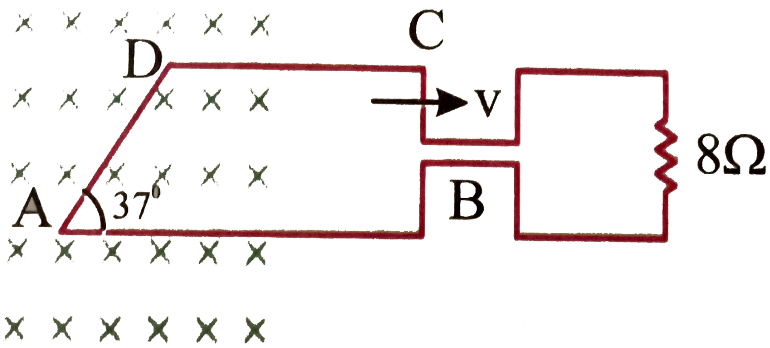
31. The loop $ABCD$ is moving with velocity $'v'$ towards right. The magnetic field is $4T$. The loop is connected to a resistance of 8Ω. If steady current of $2A$ flows in the loop then value of $'v'$ if loop has a resistance of 4Ω, is : (Given $AB = 30cm$, $AD = 30cm$)



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32. A square loop of side $12cm$ with its sides parallel to x and y- axes is moved with a velocity $8cm/s$ along positive x-direction in an environment containing magnetic field along $+ve$ z-direction. The field has a gradient of $10^{-3}\text{tesla}/\text{em}$ along $-ve$ x-direction (increasing along $-ve$ x-axis) and also decreases with time at the rate of $10^{-3}\text{tesla}/s$. The emf induced in the loop is

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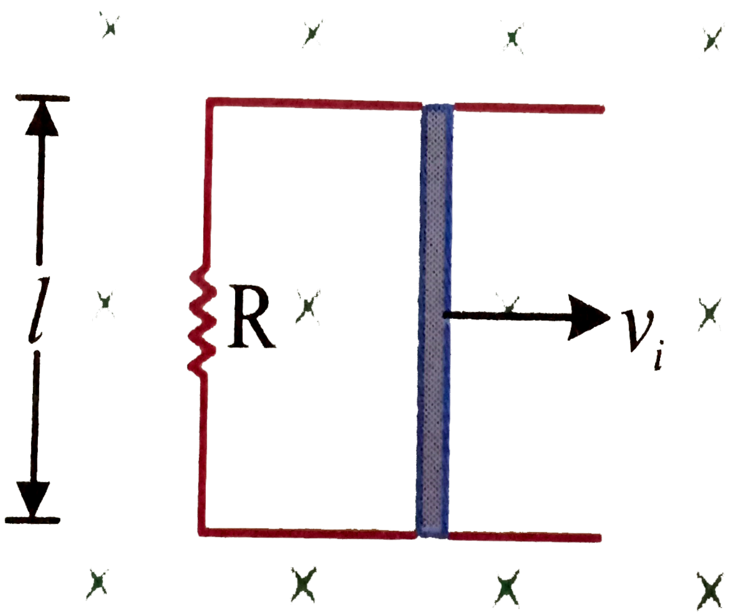
33. A bar of mass m and length l moves on two frictionless parallel rails in the presence of a uniform magnetic field directed into the plane of the paper. The bar is given and initial velocity v_i to the right and released. Find the velocity of bar, induced emf across the bar and the current in the circuit as a function of time



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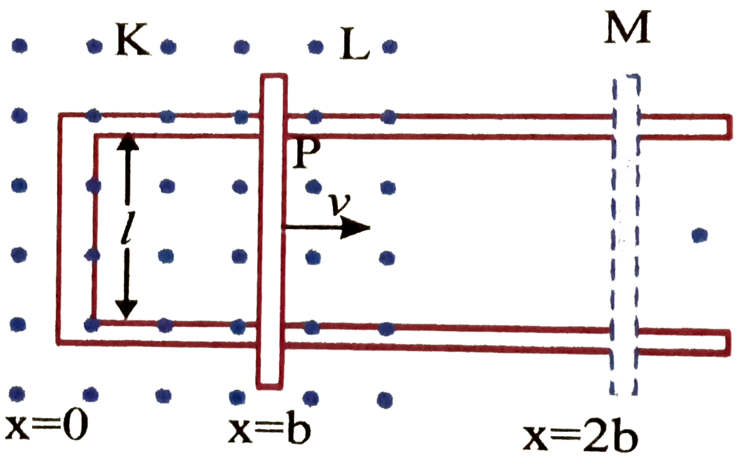
34. The arm PQ of the rectangular conductor is moved from $x = 0$, outwards in the uniform magnetic field which extends from $x = 0$ to $x = b$ and is zero for $x > b$ as shown. Only the arm PQ possess substantial ressitance r. Consider the situation when the arm PQ is pulled outwards from $x = 0$ to $x = 2b$, and is then moved back to $x = 0$ with constant speed v. Obtain expression for the flux, the induced emf, the force necessary to pull the arm and the power dissipated as Joule heat. Sketch the variation of these quantities with distance.



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35. Two different coils have self-inductances $L_1 = 8mH$ and $L_2 = 2mH$. The current in one coil is increased at a constant rate. The current in the second coil is also increased at the same constant rate. At a certain instant of time, the power given to the two coil is the same. At that time, the current, the induced voltage and the energy stored in the first coil are i_1, V_1 and W_1 respectively. Corresponding values for the second coil at the same instant are i_2, V_2 and W_2 respectively. Then:

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36. 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

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37. The self inductance of a coil having 200 turns is 10 mH. Compute the total flux linked with the coil. Also, determine the magnetic flux through the cross section of the coil, corresponding to current of 4 mA.

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38. A coil of inductane 0.2 henry is connected to 600 volt battery. At what rate, will the current in the coil graw when circuit is completed ?

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39. An inductor of 5 H inductance carries a steady current of 2 A. How can a 50 V self induced e.m.f. be made to appear in the inductor ?

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40. Two different coils have self inductane $L_1 = 16mH$ and $L_2 = 12mH$. At a certain instant, the current in the two coils is increasing at the same rate of power supplied to th two coils is the same. Find the ratio of $i)$ induced voltage $ii)$ current $iii)$ energy stored in the two coils at that instant.

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41. The newtwork shown is a part of the closed circuit in which the current is changing. At an instant, current in it is $5A$. Potential difference between the points A and B if the current is

(1) Increasing at $1A/\sec$

(2) Decreasing at $1A/\sec$

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42. Calculate the mutual inducatnce between two coils when a current of $2A$ changes to $6A$ in 2 seconds and induces an emf of $20mV$ in the secondary coil

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43. If the coefficient of mutual induction of the primary and secondary coils of an induction coil is $6H$ and a current of $5A$ is cut off in $1/5000$ second, calculate the emf induced in the secondary coil.

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44. A solenoid is of length $50cm$ and has a radius of $2cm$. It has 500 turns. Around its central section a coil of 50 turns is wound. Calculate the mutual inductance of the system.

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45. A solenoidal coil has 50 turns per centimetre along its length and a cross-sectional area of $4 \times 10^{-4} m^2$. 200 turns of another wire is wound round the first solenoid co-axially. The two coils are electrically insulated from each other. Calculate the mutual inductance between the two coils.

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46. Two circular coils, one of smaller radius r_1 and the other of very large radius r_2 are placed co-axially with centres coinciding. Obtain the mutual inductance of the arrangement.

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47. 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 coplanar and their centre coincide. What is the mutual inductance of the system ?

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48. A torodal solenoid with an air core has an average radius of 15 cm, area of cross-section `12 cm^(2) and 1200 turns. Obtain the self inductance of the toroid. Ignore field variations across the cross-section of the toroid.

(b) A second coil of 300 turns is wound closely on the toroid above. If the current in the primary coil is increased from zero to 2.0 A in 0.05 s, obtain the induced e.m.f. in the second coil.

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49. A boy pedals a stationary bicycle at one revolution per second. The pedals are attached to 100 turns coil of are $0.1m^2$ and placed in a uniform magnetic field of $0.1T$. What is the maximum voltage generated in the coil ?

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50. A coil of 800 turns $50cm^2$ area makes $10rps$ about an axis in its own plane in a magnetic field of 100 gauss perpendicular to the this axis. What is the instantaneous inducted emf in the coil ?

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51. A person peddles a stationary bicyle the pedals of the bicycle are attached to a 100 turn coil of area $0.10m^2$. The coil rotated at half a revolution per second and it is placed in a uniform magnetic field of

$0.01T$

perpendicular to the axis of rotation of the coil, What is the maximum voltage generated in the coil ?

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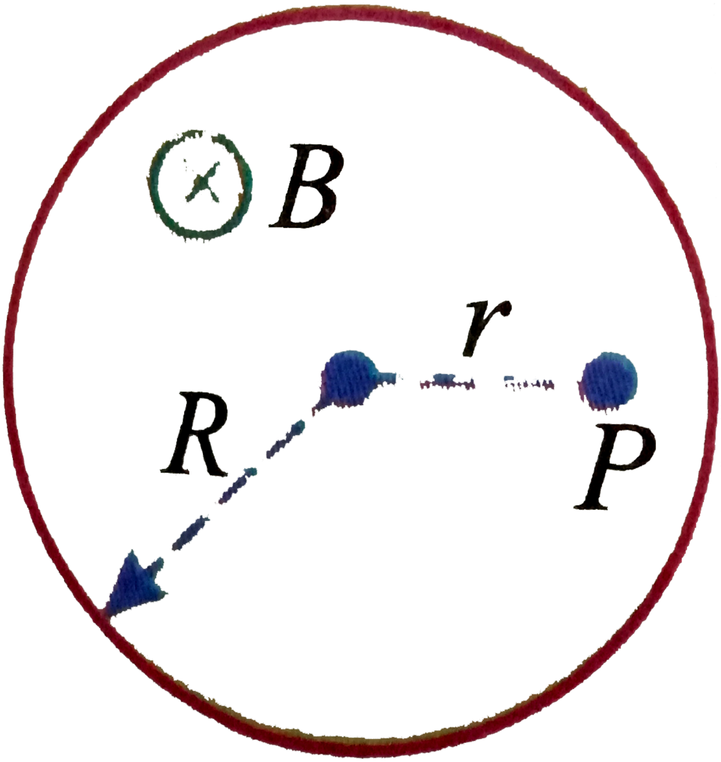
52. A uniform magentic field of induction B is confined in a cyclinderical region of radius R. If the field is incresing at a constant rate of

$\frac{dB}{dt} = \alpha T / s$, then the intensity of the electric field induced at point P, distant r from the axis as shown in the figure is proportional to :



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53. 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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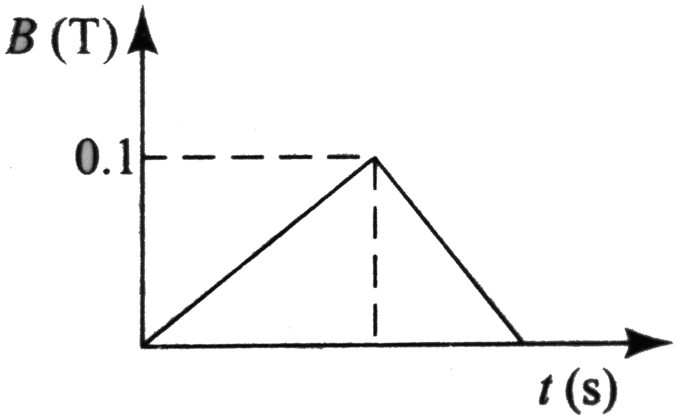
54. A closed loop of cross-sectional area $10^{-2}m^2$ which has inductance $L = 10mH$ and negligible resistance is placed in time- varying magnetic field. Figure shows the variation of B with time for the interval $4s$. The field is perpendicular to the plane of the loop (given at $t = 0$, $B = 0$, $I = 0$). The value of the maximum current induced in the loop is



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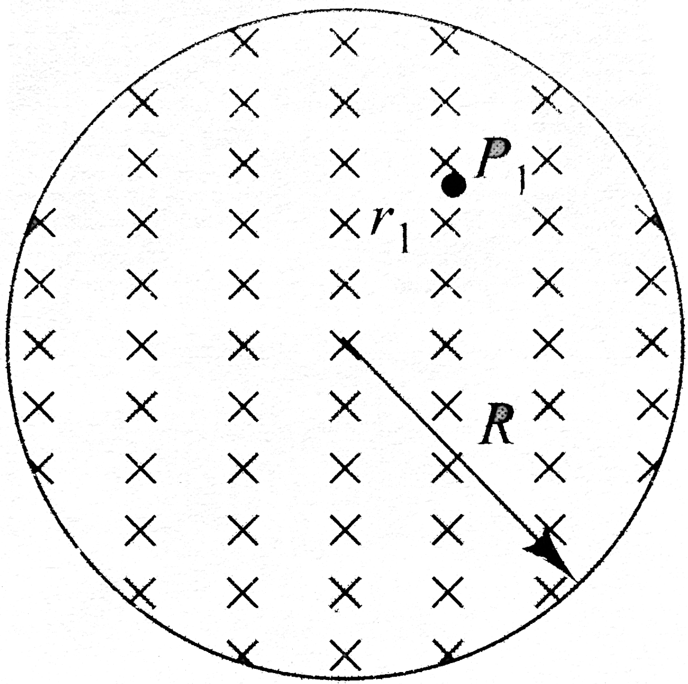
55. A magnetic field directed into the page changes with time according to $B = (0.0300t^2 + 1440)T$, where t is in seconds. The field has a circular cross section of radius $R = 2.50cm$. What are the magitude and direction of the electric field at point P_1 when $t = 3.00s$ and $r_1 = 0.0200m$?



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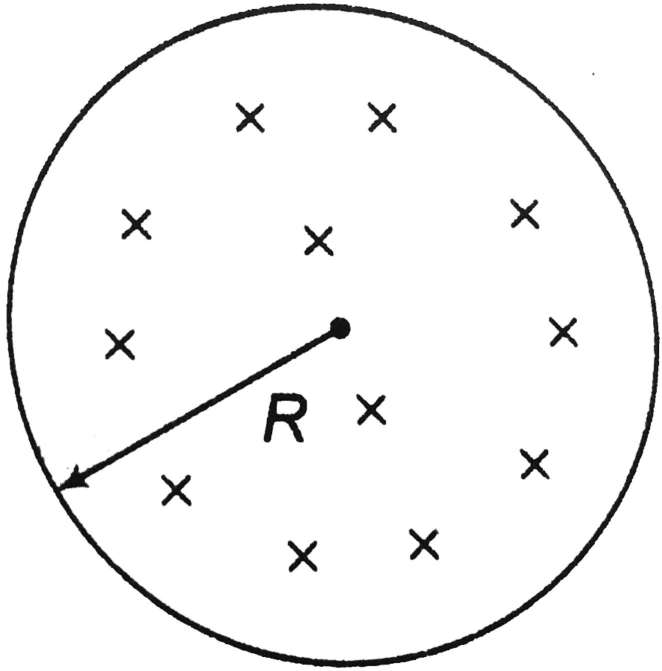
56. The magnetic field at all points within the cyllindrical region whose cross section is indicated in the accompanying Figure starts increasing at a constant rate α. T/s. find the magnitud of electric field as a function of r, the distance from the geometric centre of the region.



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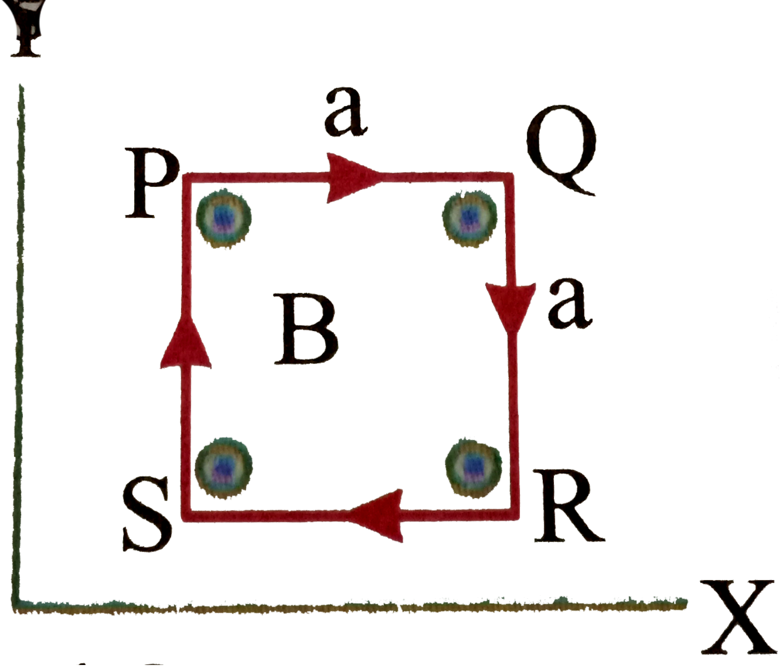
57. A wire is bent in the form of a square of side $'a'$ in a varying magnetic field $\overline{B} = \alpha B_0 t\hat{k}$. If the resistance per unit length is λ, then find the following.



$i)$ The direction of induction current

$ii)$ The current in the loop

$iii)$ Potential difference between P and Q

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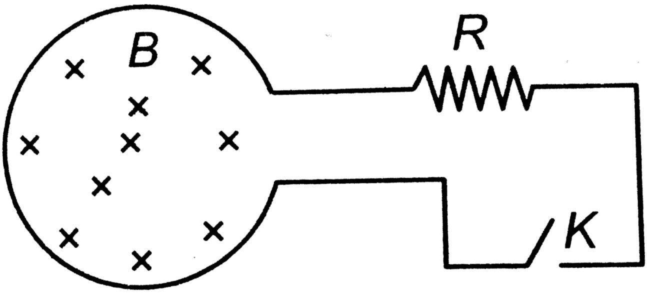
58. Shown in the figure is a circular loop of radius r and resistance R. A varible magnetic field of induction $B = B_0 e^{-t}$ is established inside the coil. If the key (K) is closed, the electrical power devloped right after closing the switch is equal to



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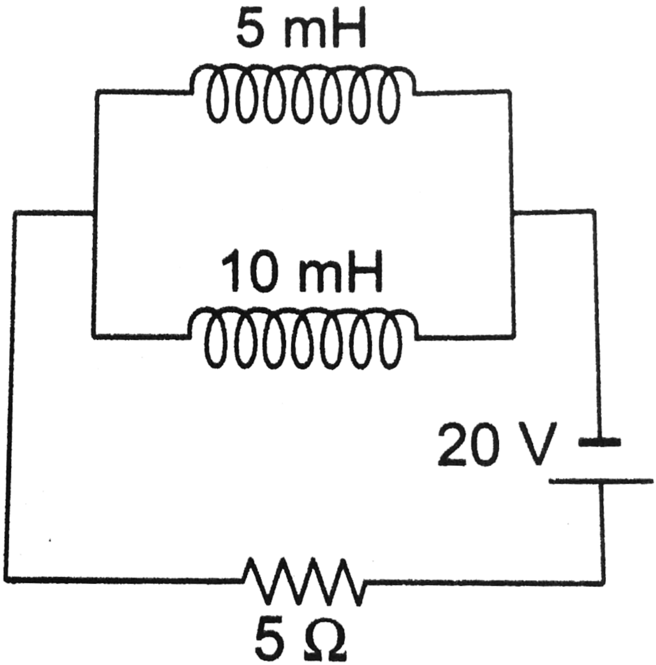
59. In the given circuit, find the current through the $5mH$ inductor in steady state.



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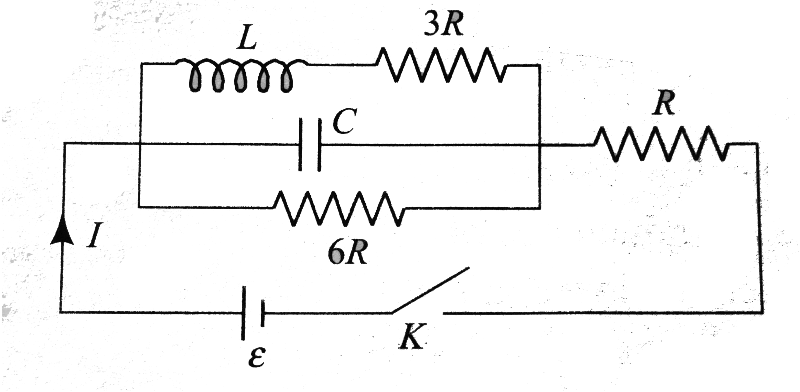
60. In the given circuit (Fig), key K is switched on the at $t = 0$. The ratio of current i through the cell at $t = 0$ to that at $t = \infty$ will be



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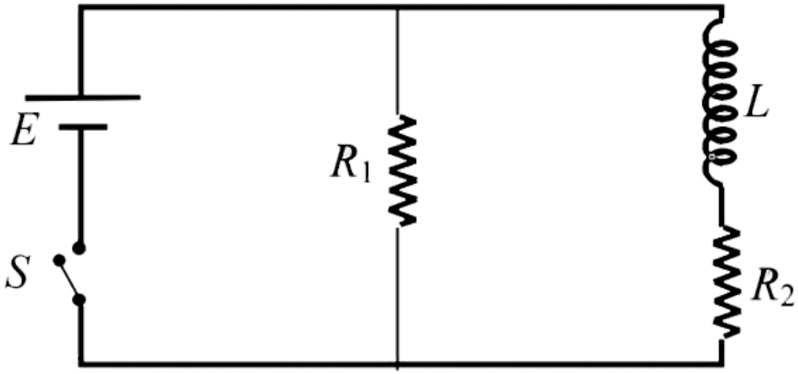
61. An inductor of inductance L=400 mH and resistor of resistance $R_1 = 2(\Omega)$ and $R_2 = 2(\Omega)$ are connected to a battery of emf E = 12 Vas shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at time t =0. What is the potential drop across L as 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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62. An inductor of $3H$ is connected to a battery of emf $6V$ through a resistance of 100Ω. Calculate the time constant. What will be the maximum value of current in the circuit ?

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63. A cell of $1.5V$ is connected across an inductor of $2mH$ in series with a 2Ω resistor. What is the rate of growth of current immediately after the cell is switched on.

Watch Video Solution

64. A coil having resistance 15Ω and inductance $10H$ is connected across a 90 Volt dc supply. Determine the value of current after $2\sec$, What is the energy stored in the magnetic field at that instant.

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65. Calculate the back $e.m.f$ of a $10H$, 200Ω coil $100ms$ after a $100V$ d.c supply is connected to it.

Watch Video Solution

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

a. at the instant of closing the switch and

b. after one time constant.

c. Find the steady state current in the circuit.

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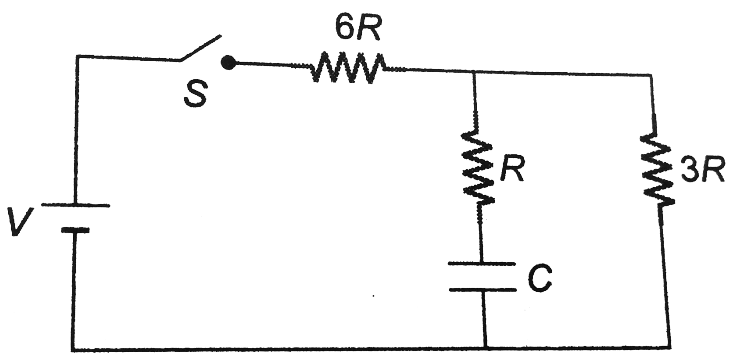
67. In the circuit shownin figure switch S is closed at time t=0. Find the current through different wire and charge stored on the capacitor at any time t.



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68. A parallel- plate capacitor, fileld with a dielectric of dielectric consatnt k, is charged to a potential V_0. It is now disconnected from the cell and the slab is removed. If it now discharges, with time constant τ, through a resistance then find time after which the potential difference across it will be V_0 ?

Watch Video Solution

69. A $4\mu F$ capacitor, a resistance of $2.5M\Omega$ is in series with $12V$ battery. Find the time after which the potential difference across the capacitor is 3 times the potential difference across the resistor. [Given In (2) = 0.693]

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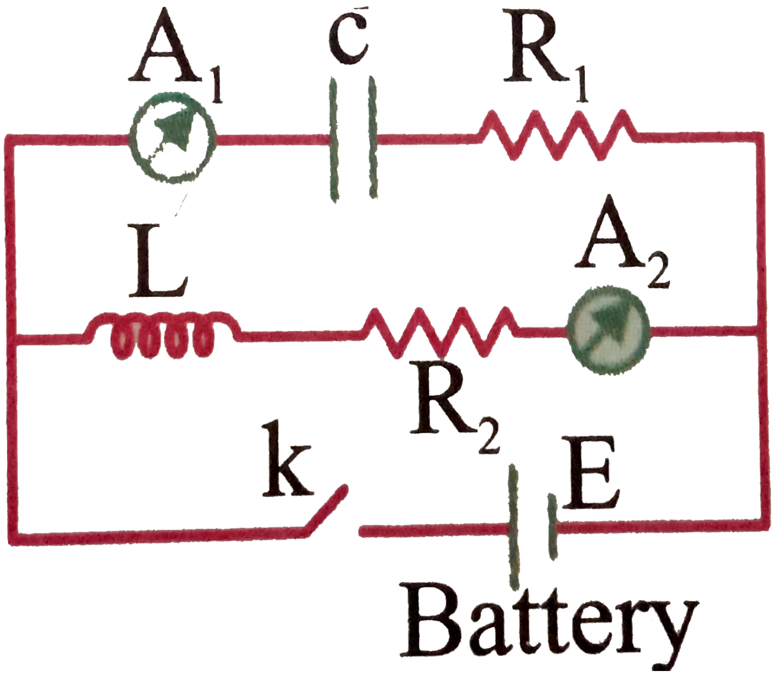
70. In a circuit inductance L and capacitance C are connected as shown in figure and A_1 and A_2 are ammeters. When key k is pressed to complete the circuit, then just after closing key k, the readig of A_1 and

A_2 will be:



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C.U.Q 1

1. When ever the flux linked with a coil changes, then

A. current is always induced

B. an emf and a current are always induced

C. and emf is incduced but a current is never induced

D. an emf is always induced and a current is induced, when the coil is a closed one

Answer: D

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2. Whenever the magnet flux linked with a coil changes, then is an induced emf in the circuit. This emf lasts

A. For a short time

B. For a long time

C. For ever

D. So long as the change in the flux takes place

Answer: D

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

A. Larger in case (i)

B. Smaller in case (i)

C. Equal in both

D. Larger or smaller depending upon the radius of the coil

Answer: A

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4. The laws of elctromagnetic induction have bee used in the construction of a

A. galvanometer

B. voltmeter

C. electric motor

D. electric generator

Answer: D

Watch Video Solution

5. When a rate of change of current in a circuit is unity, the induced emf is equal to

A. Total flux linked with the coil

B. induced charge

C. Number of turns in the circle

D. Coefficient of self induction

Answer: D

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6. A bar magnet is dropped along the axis of copper ring held horizontally. The acceleration of fall is

A. Equal to $'g'$ at the place

B. Less than $'g'$

C. More than $'g'$

D. Depends upon diameter of the ring and length of the magnet

Answer: B

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7. An annular circular brass disk of inner radius $'r'$ and outer radius $'R'$ is rotating about an axis passing through its centre and perpendicular to its plane with a uniform angular velocity $'\omega'$ in a uniform magnetic filed of induction $'B'$ normal to the plane of the disk. The induced emf between the inner and outer edge of the annular disk is

A. $\dfrac{B\omega(r^2+R^2)}{2}$

B. $\dfrac{B\omega(R^2-r^2)}{2}$

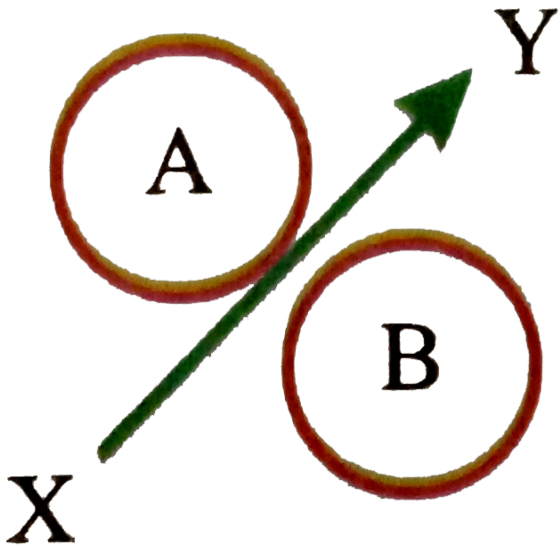
C. $\dfrac{B\omega(r-R)}{2}$

D. $\dfrac{B\omega(r+R)}{2}$

Answer: B

Watch Video Solution

8. Consider the situation shown in the figure. If the current I in the long straight conducting wire XY is increased at a steady rate then the induced $e.m.f.$'s in loop A and B will be



A. clockwise in A, anti clockwise in B

B. anti clockwise in A, clockwise in B

C. clockwise in both A and B

D. anti clockwise in both A and B

Answer: A

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9. The direction of the induced $e. m. f.$ is determined by

A. Fleming's left hand rule

B. Fleming's right hand rule

C. Maxwell's right hand screw rule

D. Ampere's rule of swimming

Answer: B

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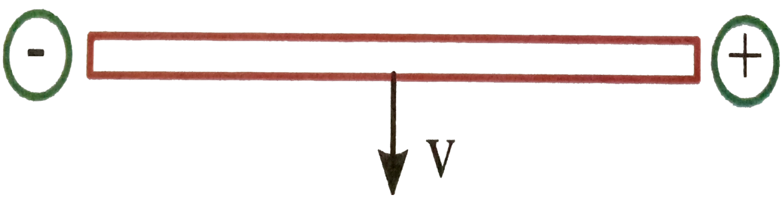
10. A wire moves with a velocity $''v''$ through a magnetic field and experiences an induced charge sepration as shown. Then the direction of the magnetic field is



A. in to the page

B. out of the page

C. towards the bottom of the page

D. towards the top of the page

Answer: A

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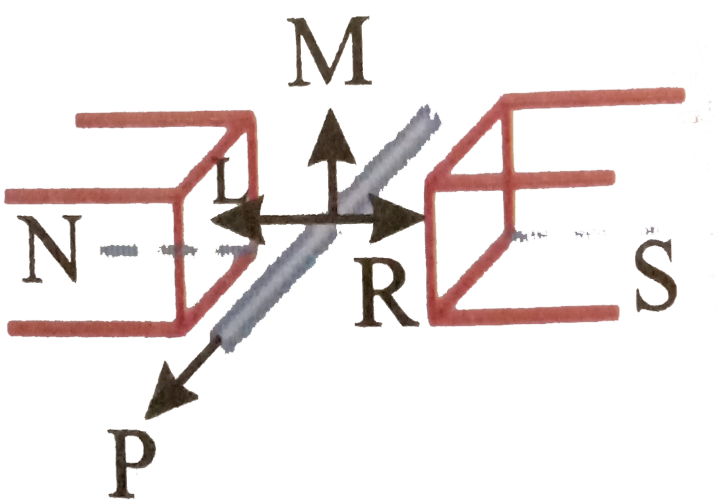
11. An electric potential difference will be incduced between the ends of the conductor shown in the figure, if the conductor moves in the direction shown by



A. P

B. R

C. L

D. M

Answer: D

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

A. an induced current form south-to-north direction

B. an induced current from north-to-south direction

C. no induced emf along the length of the conductor

D. an induced emf along the length of the conductor

Answer: C

Watch Video Solution

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

A. Current will increase in each loop

B. Current will decrease in each loop

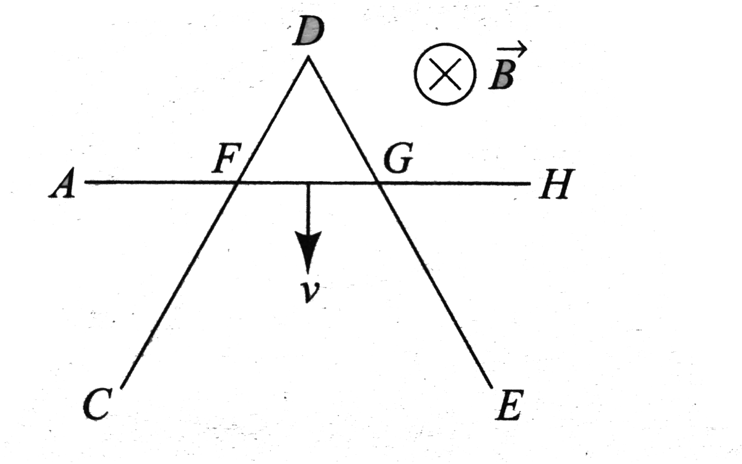
C. Current will remain same in each loop

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

Answer: B

Watch Video Solution

14. A long conducting wire AH is moved over a conducting triangular wire CDE with a constant velocity v in a uniform magnetic field $\overrightarrow{B}$ directed into the plane of the paper. Resistance per unit length of each wire is ρ. Then



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

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

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

D. a constant anticlockwise induced current will flow in the closed loop

Answer: D

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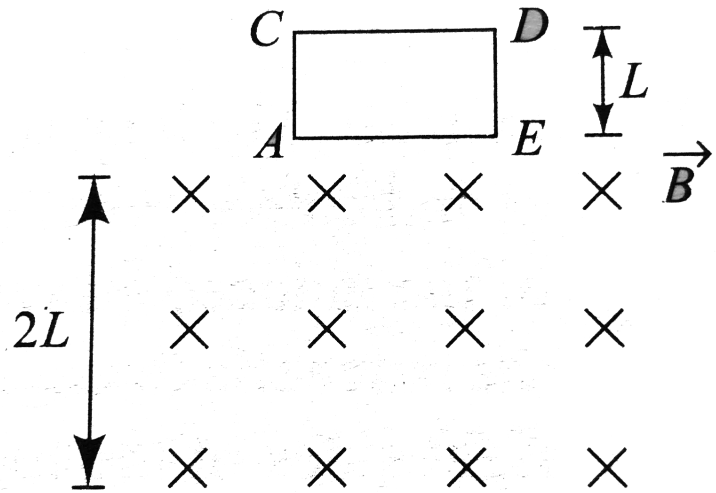
15. A square coil $ACDE$ with its plane vertically is released from rest in a horizontal uniform magnetic field $\vec{B}$ of length $2L$. The accelaration of the coilis



A. less than $'g'$ for all the time till the loop crosses the magnetic field completely

B. less than $'g'$ when it enters the field and greater than $'g'$ when it comes out of the field

C. $'g'$ all the time

D. less than $'g'$ whe it enters and comes out of the field but equal to $'g'$ when it is within the field

Answer: D

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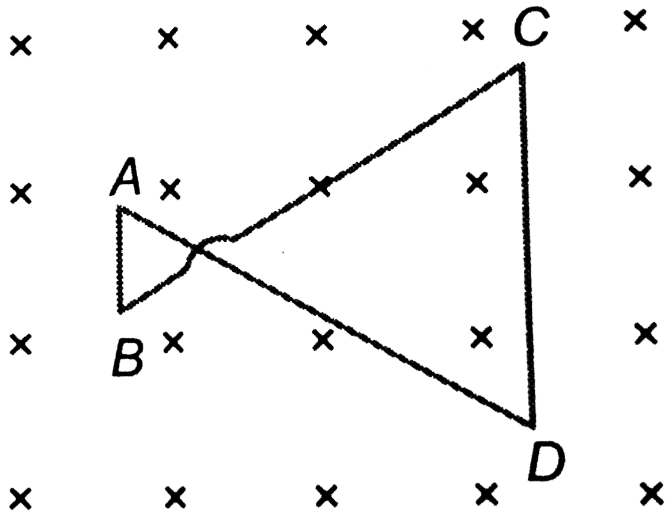
16. A conducting wire frame is placed in a magnetic field which is directed into the paper. The magnetic field is increasing at a constant rate. The direction of induced current in wire AB and CD are



A. B to A and D to C

B. A to B and C to D

C. A to B and D to C

D. B to A and C to D

Answer: A

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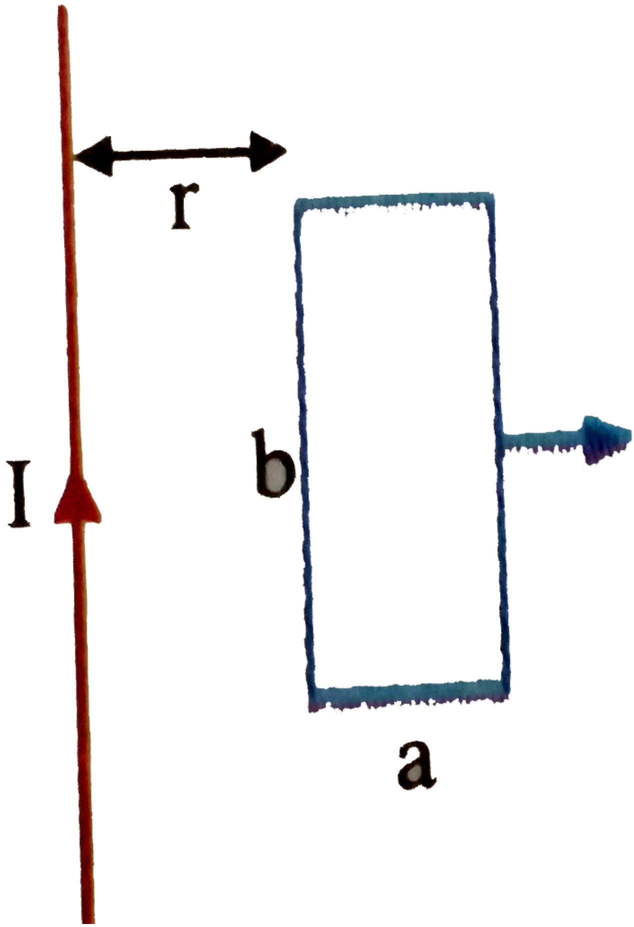
17. A rectangular loop of wire with dimensions shown in figure is coplanar with a long wier carrying current $'I'$. The distance between the wire and the left side of the loop is r. The loop is pulled to the right as indicated. What are the directions of the induced current in the loop and the magnetic forces on the left and right sides of the loop when the loop is pulled ?



A.

	Induced Current	Force on Left side	Force on Right side
a	Currentclockwise	To the left	To the left

B.

	Induced Current	Force on Left side	Force on Right side
b	Currentclockwise	To the right	To the left

C.

	Induced Current	Force on Left side	Force on Right side
c	Clockwise	To the right	To the left

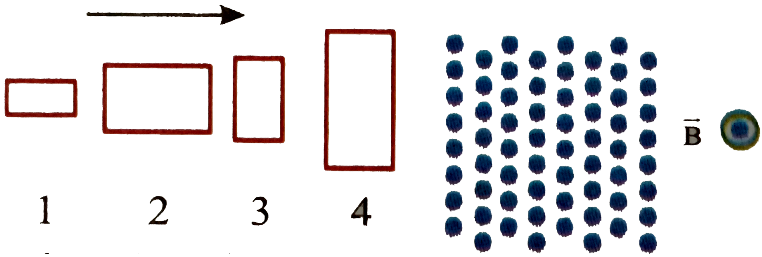
D.

	Induced Current	Force on Left side	Force on Right side
d	Clockwise	To the left	To the right

Answer: D

Watch Video Solution

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



A. 1 and 2 tie, then 3 and 4 tie

B. 3 and 4 tie, then 1 and 2 tie

C. $4, 3, 2, 1$

D. 4 then, 2 and 3 tie and then 1

Answer: C

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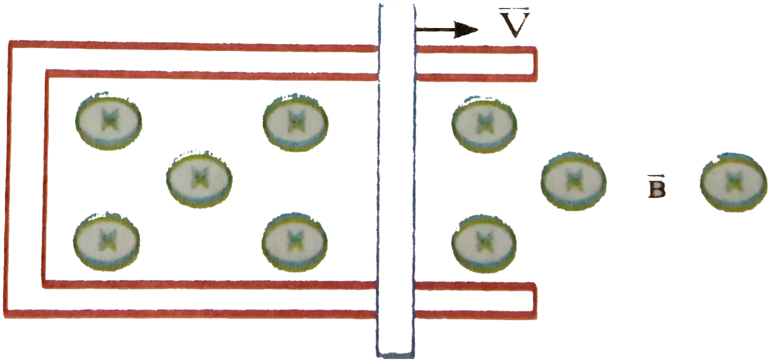
19. A rod lies acrossfrictionless rails in a uniform magnetic field $\overrightarrow{B}$ as shown in figure. The rod moves to the right with speed V. In order to make the induced emf in the circuit to be zero, the magnitude of the magnetic field should



A. not change

B. increase linearly with time

C. decrease linearly with time

D. decrease nonlinearly with time

Answer: D

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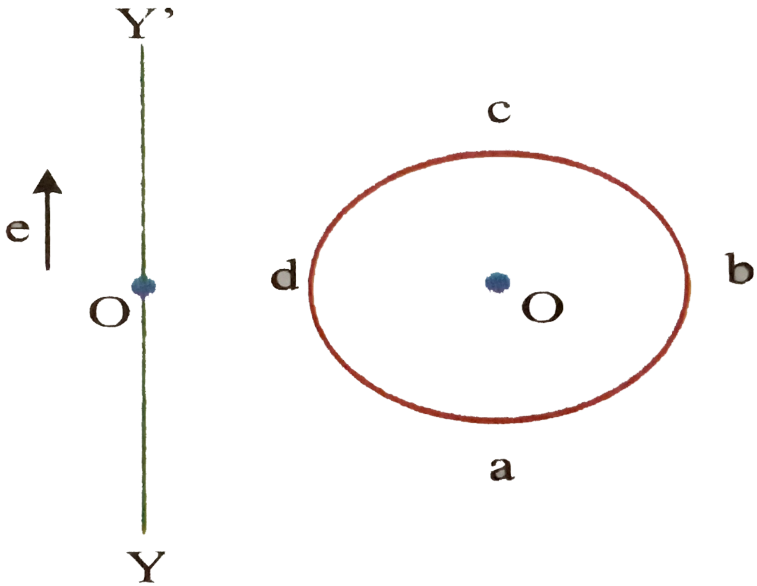
20. An electron moves on a straight line path YY' as shown in figure. A coil is kept on the right such that YY' is the plane of the coil. At the instant when the electron gets closest to the coil (neglect self-induction of the coil)



A. The current in the coil flows clockwise

B. The current in the coil flows anticlockwise

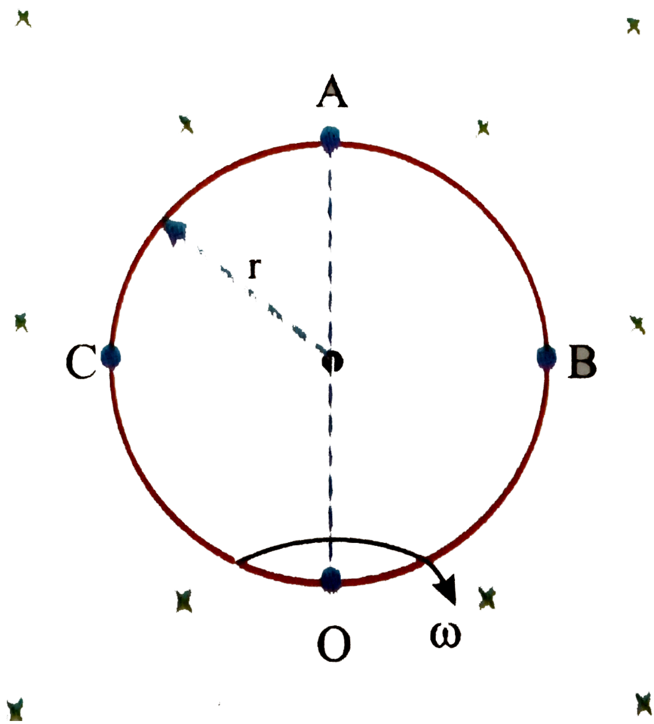
C. The current in the coil is zero

D. The current in the coil does not change the direction as the electron crosses point O

Answer: C

Watch Video Solution

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



A. point O will be at higher potential than A

B. the potential of point B and C will be different

C. the current in the ring will be zero

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

Answer: C

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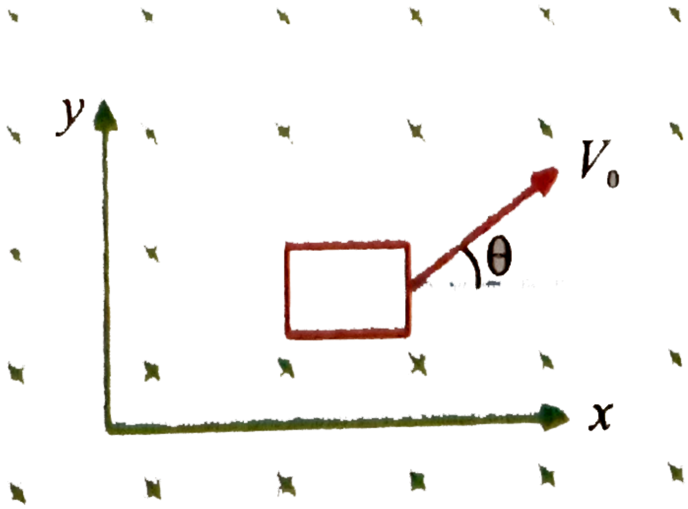
22. In the space shown a non-uniform magnetic field $\vec{B} = B_0(1+x)\left(-\hat{k}\right)$ tesla is present. A closed loop of small resistance, placed in the xy plane is given velocity V_0. The force due to magnetic field on the loop is



A. zero

B. Along $+x$ direction

C. along $-x$ direction

D. along $+y$ direction

Answer: C

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23. Two idential cycle wheels (geomettrically have different number of spokes connected from centre to rim. One if having 20 spokes and the other having only 10 (the rim and the spokes are resistanceless). One resistance of value R is connected between centre and rim. The current in R wil be

A. double in the first wheel than in the second wheel

B. four times in the first wheel than in the second wheel

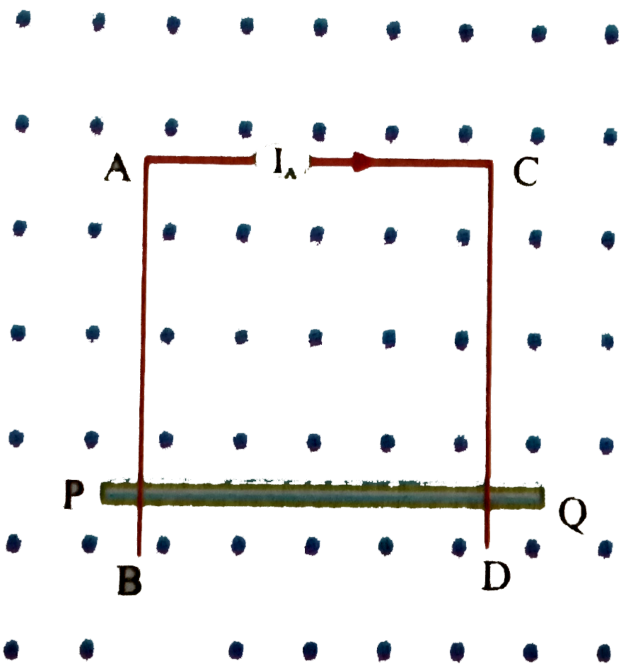
C. will be double in the second wheel than that of the first wheel

D. will be equal in both these wheels

Answer: D

Watch Video Solution

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



A. the rod PQ will move downward with constant acceleration

B. the rod PQ will move upward with constant acceleration

C. the rod will remain at rest

D. any of the above

Answer: D

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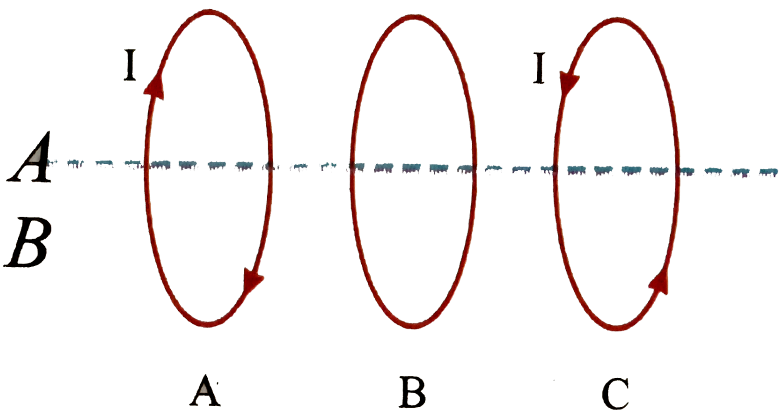
25. Three idential coils A, B and C carrying currents are placed coaxially with their planes parallel to one another. A and C carry current as shown in figure B is kept fixed while A and C both are moved towards B with the same speed. Initially, B is equally separated from A and C. The direction of the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



A. same as that in coil A

B. same as that in coil B

C. zero

D. none of these

Answer: C

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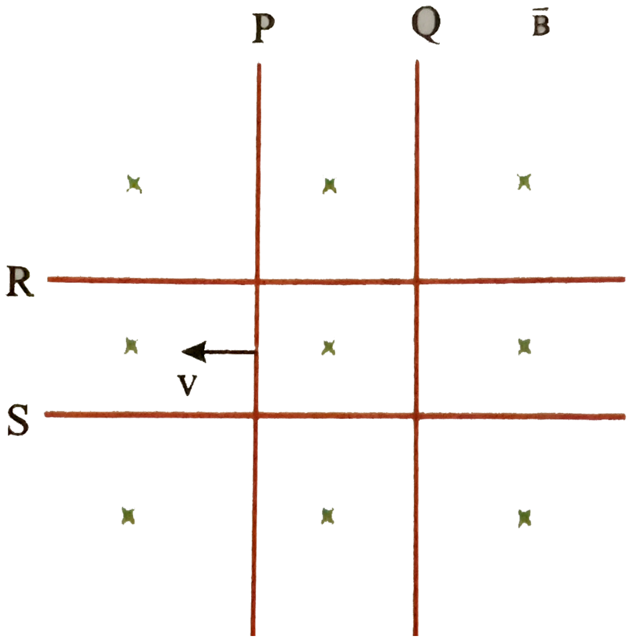
26. Two idential conductors P and Q are placed on two frictionless rails R and S in a uniform magnetic field directed into the plane. If P is moved in the direction shown in figure with a constant speed, then rod Q



A. will be attracted towards P

B. will be repelled away from P

C. will remain stationary

D. may be repelled away orattracted towards P

Answer: A

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27. An inductance stroes energy in the

A. eelctric field

B. magnetic field

C. resistance of the coil

D. electric and magnetic fields

Answer: B

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28. If $'N'$ is the number of turns in a coil, the value of self inductance varies as

A. N°

B. N

C. N^2

D. N^{-2}

Answer: C

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29. A series combination of L and R is connected to a battery of emf E having negligible internal resistance. The final value of current depeds upon

A. L and R only

B. E and L only

C. E and R only

D. L, R and E only

Answer: C

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

A. $L_1 + L_2$

B. $\frac{1}{2}(L_1 + L_2)$

C. $(L_1 \pm L_2)$

D. $\sqrt{L_1 L_2}$

Answer: D

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31. The coefficient of self inductance and the coefficient of mutual inductance have

A. same units but different dimensions

B. different units but same dimensions

C. different units and different dimansions

D. same units and same dimansions

Answer: D

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32. The mutual inductance between a pair of coils each of $'N'$ turns is $'M'$. If a current is $'I'$ in the first coil is brought to zero in a time t, then the avergae emf induced in the second coil is

A. MI/t

B. Mt/I

C. Mt/IN

D. It/MN

Answer: A

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33. A circuit contains two inductors of self-inductance L_1 and L_2 in series (Fig) If M is the mutual inductance, then the effective inductance of the circuit shows will be

A. $L_1 + L_2$

B. $L_1 + L_2 - 2M$

C. $L_1 + L_2 + M$

D. $L_1 + L_2 + 2M$

Answer: D

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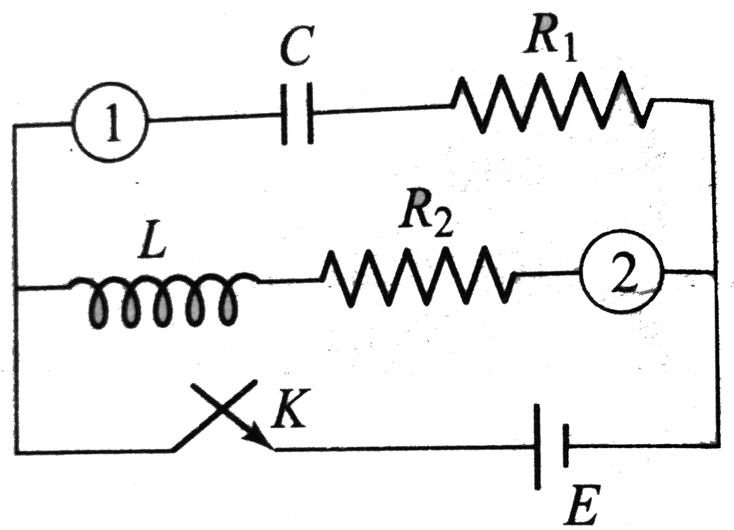
34. In the circuit of Fig. (1) and (2) are ammeters. Just after the key K is pressed to complete the circuit, the reading is



A. maximu in both (1) and (2)

B. zero in both (1) and (2)

C. zero in (1), maximu in (2)

D. maximum in (1), zero in (2)

Answer: D

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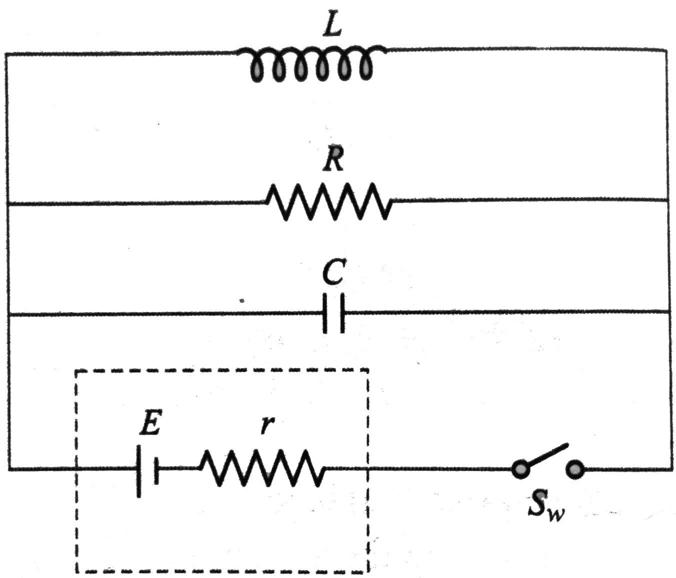
35. A pure inductor L, a capactior C and a resistance R are connected across a battery of emf E and internal resistance r as shows in Fig. Switch S_W is closed at $t = 0$, select the correct altermative (S).



A. current through resistance R is zero all the time

B. current through resistance R is zero at $t = 0$ and $t \to \infty$

C. maximum charge stored in the capacitor is CE

D. maximum energy stored in the indcutor is equal to the maximum energy stored in the capacitor

Answer: B

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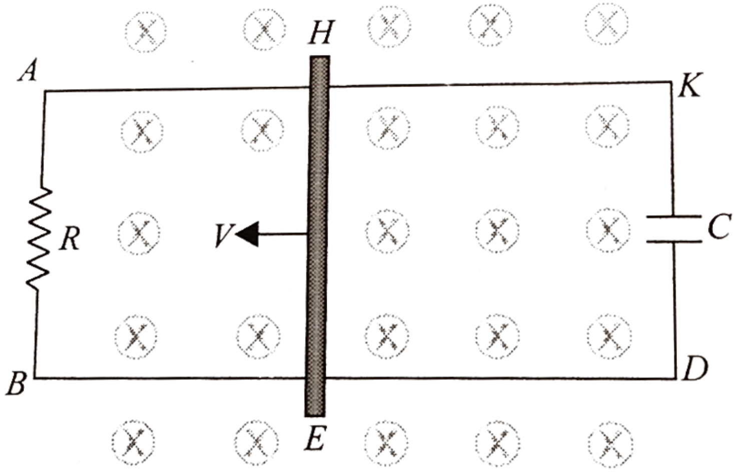
36. In the circuit shown in Fig. A conducting wire HE is moved with a constant speed v towards left. The complete circuit is placed in a uniform magnetic field $\vec{B}$ perpendicular to the plane of circuit inwards.

The current in HKDE is



A. clockwise

B. anticlockwise

C. alternating

D. zero

Answer: D

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37. In which of the following cases the emf is induced due to time varying magnetic feld (induced field emf)? Case I A magnet is moving along the axis of a conducting coil

Case II A loop having varying area (due to moving jumper) is placed in a magnetic field

case III The resistance of the coil is changing, which is connected to an ideal battery. case IV a current carrying wire is approaching a conducting ring.

A. I, II and III only

B. I, III and IV only

C. I, II and IV only

D. All the four

Answer: B

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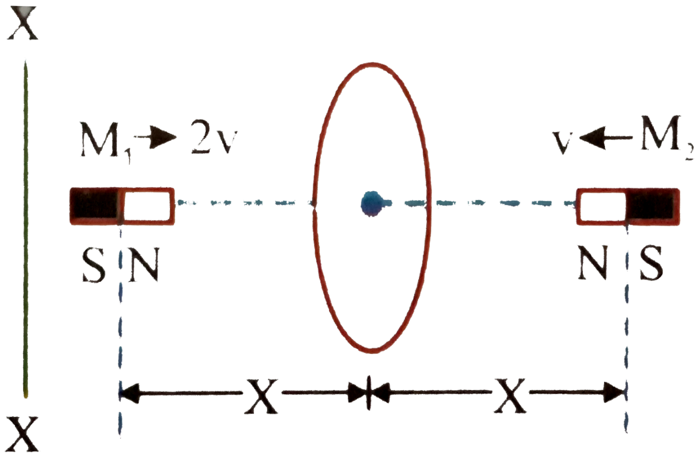
38. A closed conducting ring is placed in between two bar magnets as shown in the figure. The pole strenght of M_1 is double that of M_2. When the two bar magnets are at same distance from the centre of the ring, the bar magnet M_1 has given a velocity $2v$ while M_2 is given velocity v in the direction as shown in the figure.



The direction of induced current in the ring as seen from XX from this moment to the moment till bar magnets collide is

A. Always clockwise

B. always anticlockwise

C. first anti-clockwise, and then anticlockwise

D. first anti-clockwise, and then clockwise

Answer: B

Watch Video Solution

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

A. remains stationary

B. is attracted by the loop A

C. is repelled by the loop A

D. rotates about its CM, with CM fixed

Answer: C

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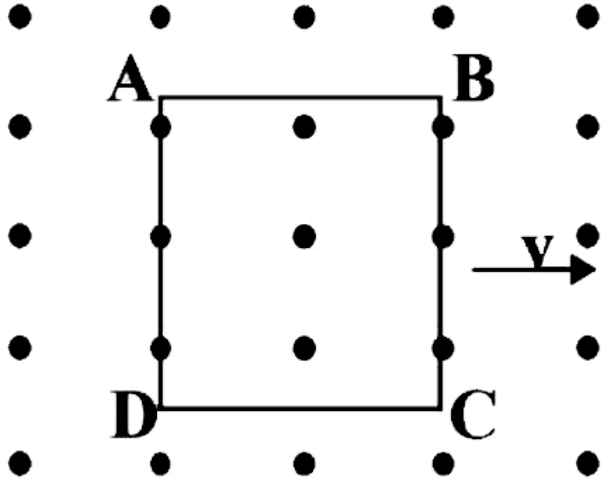
40. A metallic square loop ABCD is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in the figure. An electric field is induced



A. in AD, but not in BC

B. in BC, but not in AD

C. neither in AD nor in BC

D. in both AD and BC

Answer: D

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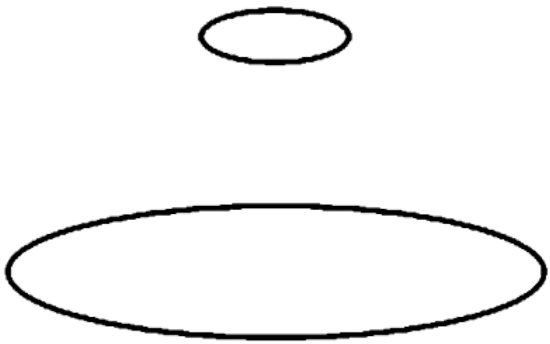
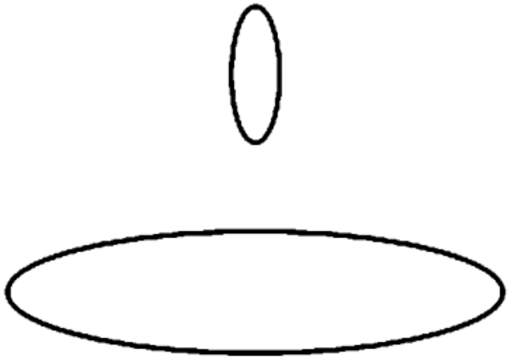
41. Two circular coils can be arranged in any of the three situation shown in the figure. Their mutual inductance will be



(a)

,



(b)

,

(c)

A. maximum in situation (A)

B. maximum in situation (B)

C. maximum in situation (C)

D. the same in all situations

Answer: A

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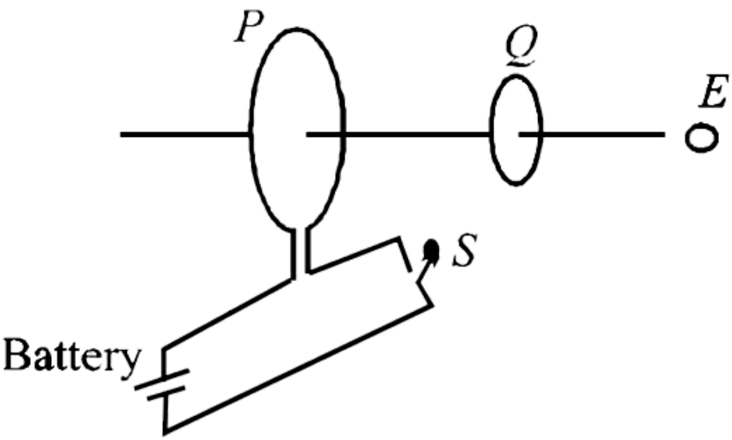
42. As shown in the figure, P and Q are two coaxial conducting loops separated by some distance. When the switch S is closed, a clockwise current I_P (as seen by E) and an induced current I_{Q1} flows in Q. The switch remains closed for a long time. when S is opened, a current I_{Q2} flows in Q. Then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



A. respectively clockwise and anticlockwise

B. both clockwise

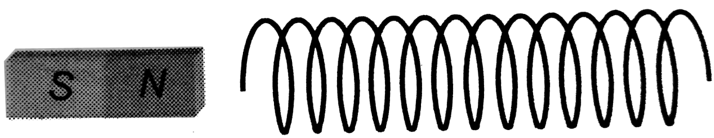
C. both anticlockwise

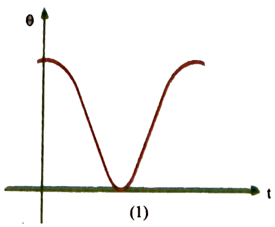
D. respectively anticlockwise and clockwise

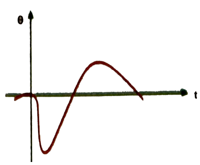
Answer: D

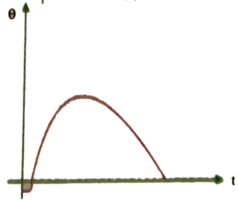
Watch Video Solution

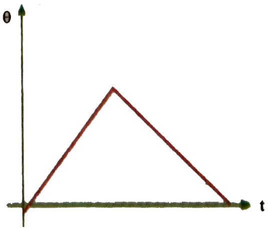
43. The variation of induced emf (E) with time (t) in a coil if a short bar magnet is moved along its axis with a constant velocity is best represent as



A. 

B. 

C. 

D. 

Answer: B

Watch Video Solution

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

A. clockwise of the $+ve$ z- axis

B. anticlockwise of the $+ve$ z-axis

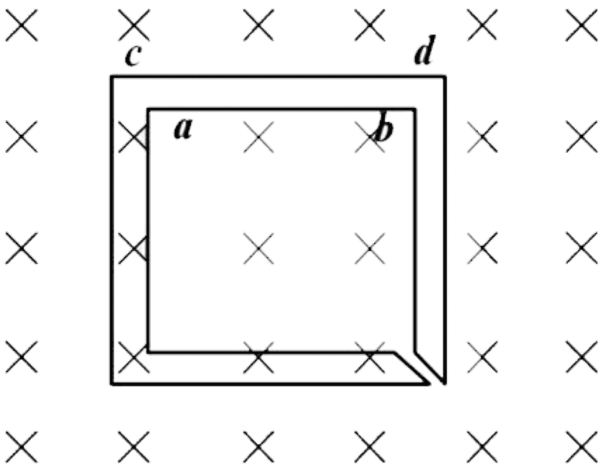
C. zero

D. along the magnetic field

Answer: C

Watch Video Solution

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



A. $I_1 > I_2$

B. $I_1 < I_2$

C. I_1 is in the direction ba and I_2 is in the direction cd

D. I_1 is in the direction ab and I_2 is in the direction dc

Answer: D

Watch Video Solution

46. A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to the magnetic lines of force. When a current is passed through the coil it starts oscillating, It is very difficult to stop. But if an aluminium plate is placed near to the coil, it stops. This is due to :

A. development of air current when the plate is placed

B. induction of electrical charge on the plate

C. shileding of magnetic lines of force as a aluminium is a paramagnetic material

D. electromagnetic induction in the aluminium plate giving rise to electromagnetic damping

Answer: D

Watch Video Solution

47. Which of the following units denotes the dimension $\frac{ML^2}{Q^2}$, where Q denotes the electric charge?

A. Wb/m^2

B. henry (H)

C. H/m^2

D. weber (Wb)

Answer: B

Watch Video Solution

48. 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. The potential difference between the centre of the rod and an end is

A. zero

B. $1/8\omega Bl^2$

C. $1/2\omega Bl^2$

D. $B\omega l^2$

Answer: B

Watch Video Solution

49. A rod of length l rotates with a uniform angular velocity omega about its perpendicular bisector. A uniform magnetic field B exists parallel to the axis of rotation. The potential difference between the two ends of the lrod is

A. zero

B. $1/2Bl^2\omega$

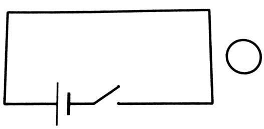
C. $Bl\omega^2$

D. $2Bl\omega^2$

Answer: A

Watch Video Solution

50. 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-pulse

B. a clockwise current-pulse

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

D. a clockwise current-pulse and then an anticlockwise current-pulse

Answer: D

Watch Video Solution

51. A bar magnet is released from rest along the axis of a very long, vertical copper tube. After some time the magnet.

A. will stop in the tube

B. will move with alomost contant speed

C. will move with an accelerating

D. will oscillate

Answer: B

Watch Video Solution

Assertion & Reason

1. Assertion: Magnetic flux is a vector quantity

Reason: Vlaue of magnetic flux can be positive, negative or zero

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: D

Watch Video Solution

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

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

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: D

Watch Video Solution

3. Assertion : When number of turns in a coil is doubled, coefficient of self-inductance of the coil becomes 4 times.

Reason : This is because $L \propto N^2$

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: A

Watch Video Solution

4. Assertion : The induced emf and current will be same in two identical loops of copper and aluminium, when rotated with same speed in the same magnetic field.

Reason : Mutual induction does not depends on the orientation of the coils

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: C

Watch Video Solution

5. Asseration: When two coils are wound on each other, the mutual induction between the coils is maximum.

Reason: Mutual induction does not depend on the orientation of the coils.

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: C

Watch Video Solution

6. Assertion: Only a charge in magnetic flux will maintain an induced current in the coil.

Reason: The presence of large magnetic flux through a coil maintains a current in the coil if the circuit is continuous.

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: C

Watch Video Solution

7. Assertion (A): Whenever the magnetic flux linked with a closed coil changes there will be an induced emf as well as an induced current.

Reason (R) : Accroding to Faraday, the induced emf is inversely proportional to the rate of change of magnetic flux linked with a coil.

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: C

Watch Video Solution

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

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

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: D

Watch Video Solution

9. Assertion: The probability of an electric bulb fusing is higher at the time of switching ON and OFF.

Reason: Inductive effects produce a surge at the time of switch OFF and switch ON.

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: A

Watch Video Solution

10. Assertion : L/R and CR both have same dimensions

Reason L/R and CR both have dimensions of time

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: A

Watch Video Solution

11. Assertion (A) : When a chraged condenser discharges through a resistor, the tiem taken for half the charge to be lost is always same, irrespective of the initial value of the charge.

Reason (R) : The rate of decay of charge in a CR circuit is a linear function of time.

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: C

Watch Video Solution

Level -I (C.W)

1. A field of strenght $5 \times 10^4 / \pi$ ampere turns / meter acts at right angles to the coil of 50 turns of area$10^{-2} m^2$. The coil is removed from the field in 0.1 second. Then the induced $e. m. f$ in the coil is

A. $0.1V$

B. $0.2V$

C. $1.96V$

D. $0.98V$

Answer: A

Watch Video Solution

2. A coil has $1,000$ turns and $500cm^2$ as its area. The plane of the coil is placed at right angles to a magnetic induction field of $2 \times 10^{-5} web/m^2$. The coil is rotated through 180° in 0.2 second. The average emf induced in the coil, in milli volts, is :

A. 5

B. 10

C. 15

D. 20

Answer: B

Watch Video Solution

3. A square loop of side $22cm$ is changed to a circle in time $0.4 \sec$ with its plane normal to a magnetic field $0.2T$. The emf induced is

A. $+6.6mv$

B. $-6.6mv$

C. $+13.2mv$

D. $-13.2mv$

Answer: B

Watch Video Solution

4. a coil of 1200 turns and mean area of $500cm^2$ is held perpendicular to a uniform magnetic field of induction $4 \times 10^{-4}T$. The resistance of the coil is 20 ohms. When the coil is rotated through 180° in the magnetic field in 0.1 seconds the average electric current (in mA) induced is :

A. 12

B. 24

C. 36

D. 48

Answer: B

Watch Video Solution

5. A closedc coil with a resitance R is placed in a magnetic field. The flux linked with the coil is ϕ. If the magnetic field is suddenly reversed in direction, the charge that flows through the coil will be

A. $\phi / 2R$

B. ϕ / R

C. $2\phi / R$

D. zero

Answer: C

Watch Video Solution

6. An aeroplane in which the distance between the tips of wings is $50m$ is flying horizontal with a speed of $360km/hr$ over a place where the verticle components of earth magnetic field is $2.0 \times 10^{-4} webr/m^2$. The potential different between the tips of wings would be

A. $0.1V$

B. $1.0V$

C. $0.2V$

D. $0.01V$

Answer: B

Watch Video Solution

7. The horizontal component of the earth's magnetic field at a place is $3 \times 10^{-4} T$ and the dip is $\tan^{-1}\left(\frac{4}{3}\right)$. A metal rod of length $0.25m$ placed in the north -south position and is moved at a constant speed of $10cm/s$ towards the east. The emf induced in the rod will be

A. zero

B. $1mV$

C. $5\mu V$

D. $10\mu V$

Answer: D

Watch Video Solution

8. A metal bar of length $1m$ falls from rest under the action of gravity remaining horizontal with its ends in east-west direction. The induced $e.m.f$ in it at the instant when it fallen for $10s$ is $\left(B_H = 1.7 \times 10^{-5}T \text{ and } g = 10ms^{-2}\right)$

A. $2.5mV$

B. $3.2mV$

C. $1.7mV$

D. $0.5mV$

Answer: C

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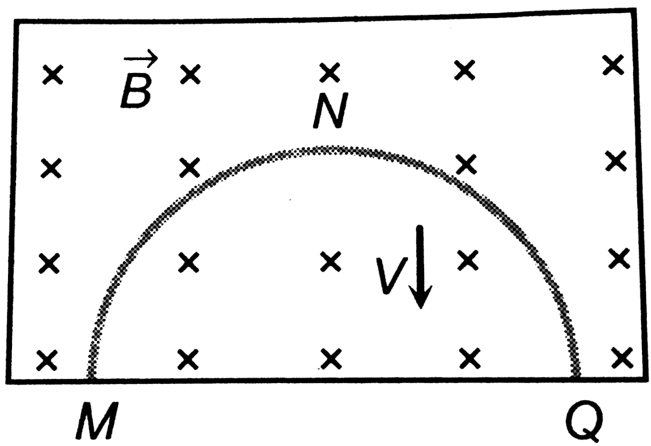
9. A thin semicircular conducting ring of radius R is falling with its plane verticle in a horizontal magnetic inducting B. At the position MNQ, the speed of the ring is V and the potential difference developed across the ring is



A. zero

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

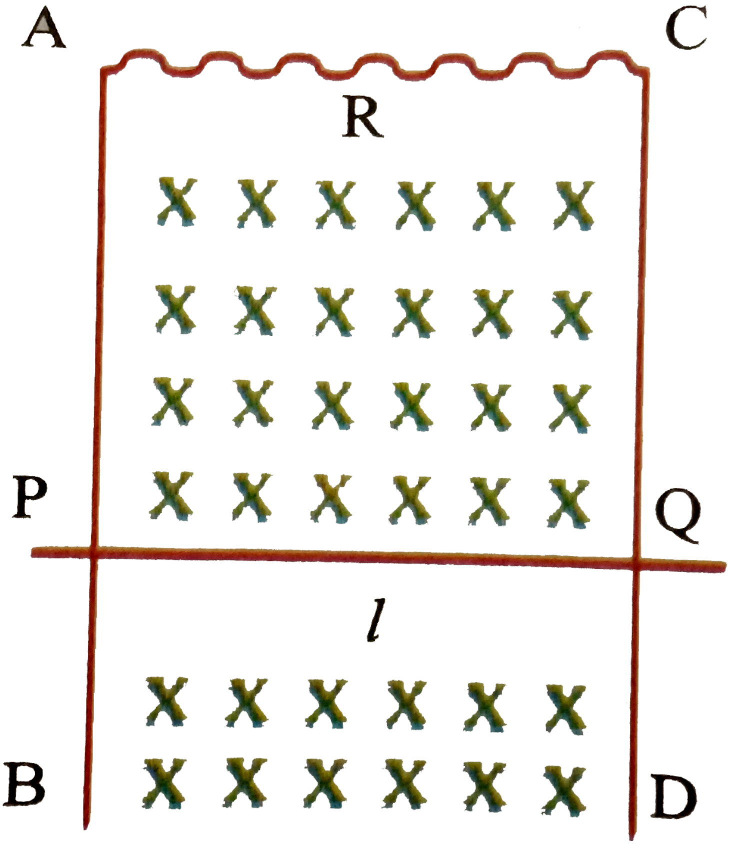
C. πRBV and Q is at higher potential

D. $2RBV$ and Q is at higher potential

Answer: D

Watch Video Solution

10. Two thick rods AB, CD are placed parallel to each other at a distance l. their ends are joined to a resistance R. A magnetic field of induction B is applied perpendicular to the plane contaning the rods. If the rods are vertical, the terminal uniform velocity of the rod PQ of mass m is given by



A. $\dfrac{mg.\ R}{B^2 l^2}$

B. $\dfrac{mg.\ R}{Bl}$

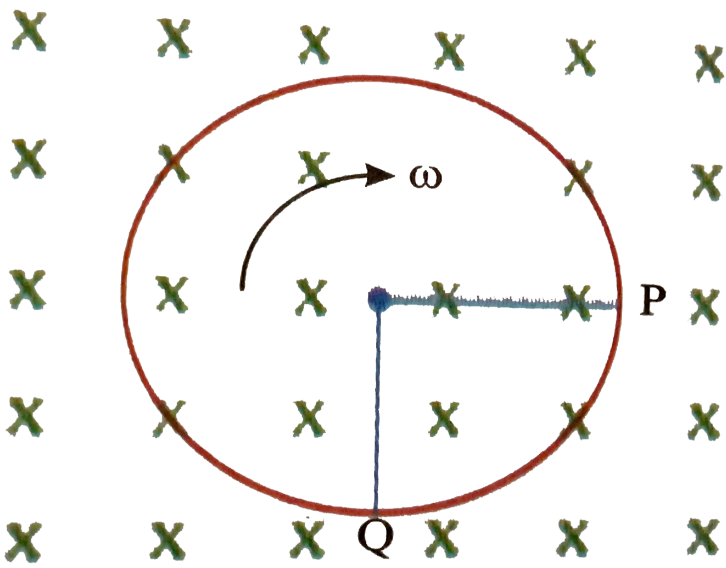
C. $\dfrac{mg}{BlR}$

D. $\dfrac{mgl}{BR}$

Answer: A

Watch Video Solution

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



A. $B\omega r^2$

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

C. $4B\omega r^2$

D. $\dfrac{\pi^2 r^2 B\omega}{8}$

Answer: A

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12. A cycle wheel with 64 spokes is rotating with N rotations per second at right angles to horizontal component of magnetic field. The induced $e.m.f$ generated between its axle and rim is E. If the number of spokes is reduced to 32 then the value of induced e.m.f. will be

A. E

B. $2E$

C. $E/2$

D. $E/4$

Answer: A

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13. A uniform circular metal disc of radius R is rotating about a vertical axis passing through its centre and perpendicular to its plane with constant frequency f. If B_H and B_V are horizontal and vertical components of the Earth's magnetic field respectively, then the induced e.m.f between its centre and the rim is

A. $\pi B_V f R^2$

B. $\pi B_H f R^2$

C. $2\pi B_V f R^2$

D. Zero

Answer: A

Watch Video Solution

14. a copper disc of diameter $20cm$ makes 1200 r.p.m. about its natural axis kept parallel to a uniform magnetic field of $10^{-2}T$. The potential difference between the centre and edge of the disc is

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

B. $62.8 \times 10^{-3}V$

C. $0.628 \times 10^{-3}V$

D. $0.628V$

Answer: A

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15. In an AC generator, a coil with N turns, all of the same area A and total resistance R, rotates with frequency (ω) in a magnetic field B. The maximum value of emf generated in the coils is

A. $NABR\omega$

B. NAB

C. $NABR$

D. $NAB\omega$

Answer: D

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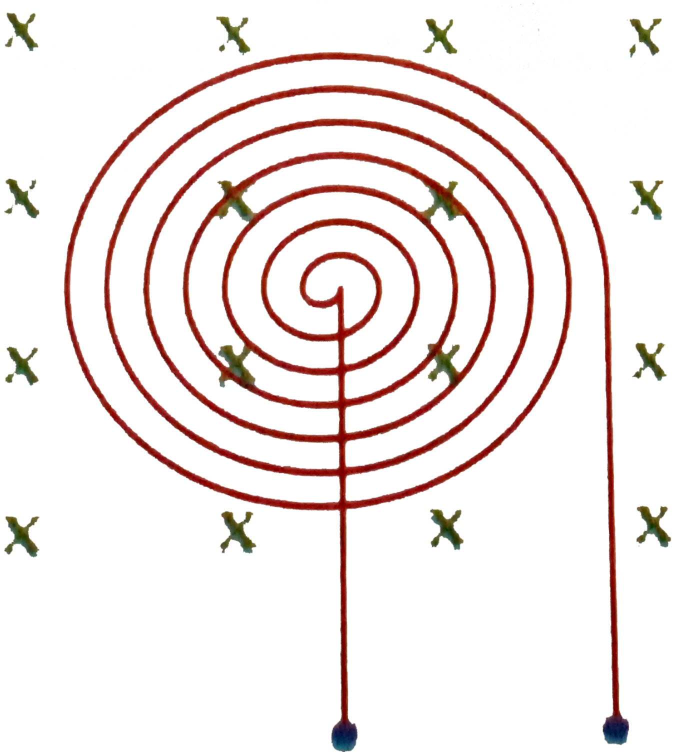
16. A flat circular coil having N turns (tightly wound D) is placed in a time varying magnetic field $B = B_0 \sin \omega t$. The outer radius of the coil is

R. Determine the maximum value of the induced emf in the circuit.



A. $\pi R^2 N B_0 \omega$

B. $3\pi R^2 N B_0 \omega$

C. $\dfrac{\pi R^2 N B_0}{\omega}$

D. $\dfrac{\pi R^2 N B_0 \omega}{3}$

Answer: A

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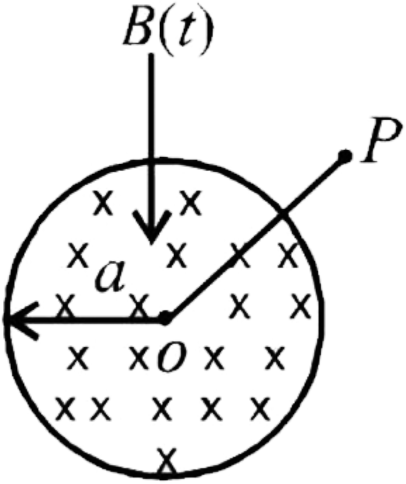
17. A uniform but time-varying magnetic field B(t) exists in a circular region of radius a and is directed into the plane of the paper, as shown. The magnitude of the induced electric field at point P at a distance r from the centre of the circular region



A. is zero

B. decreases as $1/r$

C. increases as r

D. decreases $1/r^2$

Answer: B

Watch Video Solution

18. A coil has self inductance of $0.01H$. The current through it is allowed to change at the rate of $1A$ in $10^{-2}s$. The induced emf is

A. $1V$

B. $2V$

C. $3V$

D. $4V$

Answer: A

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19. The average self-induced emf in a $25mH$ solenoid when the current in it falls from $0.2A$ to $0A$ in 0.01 second, is

A. $0.05V$

B. $0.5V$

C. $500V$

D. $50V$

Answer: B

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20. Two inductors each of inductance L are joined in parallel. Their equivalent inductance is

A. zero

B. $2L$

C. $L/2$

D. L

Answer: C

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21. A coil of 100 turns with a current of $5A$ produce a magnetic flux of $1\mu Wb$ and each turn of the coil. The coefficeint of self induction is

A. $10\mu H$

B. $20\mu H$

C. $30\mu H$

D. $40\mu H$

Answer: B

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22. In an inductance coil the current increases from zero to 6 ampere in 0.3 second by which an induced e.m.f. of 60 volt is produced in it. The value of coefficient of self-induction of coil is

A. 1 henry

B. 1.5 henry

C. 2 henry

D. 3 henry

Answer: D

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23. Two coils are at fixed location: When coil 1 has no corrent and the current in coil 2 increase at the rate of $15.0As^{-1}$, the emf in coil 1 is $25mV$, when coil 2 has no current and coil 1 has a current of $3.6A$, the flux linkange in coil 2 is

A. $16mWb$

B. $10mWb$

C. $4.00mWb$

D. $6.00mWb$

Answer: D

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24. A coil of inductance $0.20H$ is connected in series with a switch and a cell of emf $1.6V$. The total resistance of the circuit is 4.0Ω. What is the initial rate of growth of the current when the switch is closed?

A. $0.050As^{-1}$

B. $0.40As^{-1}$

C. $0.13As^{-1}$

D. $8.0As^{-1}$

Answer: D

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25. Two inductance coils made of difference metal wires are haivng the same inductance. But their tume constants are in ratio $1:2$. Then the ratio of their resistances is

A. $1:2$

B. $1:\sqrt{2}$

C. $\sqrt{2}:1$

D. $2:1$

Answer: D

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26. The time constant of an inductor is τ_1. When a pure resistor of $R\Omega$ is connected in series with it, the time constant is found to decrease to τ_2. The internal resistance of the inductor is

A. $\dfrac{R\tau_2}{\tau_1 - \tau_2}$

B. $\frac{R\tau_1}{\tau_1 - \tau_2}$

C. $\frac{R(\tau_1 - \tau_2)}{\tau_1}$

D. $\frac{R(\tau_1 - \tau_2)}{\tau_2}$

Answer: A

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Level-II (C.W)

1. A circular coil of $'n'$ turns is kept in a uniform magnetic fielf such that the plane of the coil is perpendicualr to the field. The magnetic flux associated with the coil is now ϕ. Now the coil is opened and made inot another circular coil od twice radius of the pervious coil and kept in the same field such that the plane of the coil is perpendicular to the field. The magnetic flux associated with this coil now is

A. ϕ

B. 2ϕ

C. $\frac{\phi}{4}$

D. $\frac{\phi}{2}$

Answer: B

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2. a physicist works in a laboratory where the magnetic field is $2T$. She wears a necklace enclosing of an area $100cm^2$ of field and having a resistance of 0.1Ω. Because of power failure, the field decays to $1T$ in millisecond. The electric charge circulated in the necklace assuming that the magnetic field is perpendicular to area covered by the necklace is

A. $0.01C$

B. $0.001C$

C. $0.1C$

D. $1.0C$

Answer: C

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3. Two parallel rails of a railway track insulated from each other and with the ground are connected to a millivoltmeter. The distance between the rails is one metre. A train is traveling with a velocity of $72 kmph$ along the track. The reading of the millivoltmetre (in mV) is : (Vertical component of the earth's magnetic induction is $2 \times 10^{-5} T$)

A. 144

B. 0.72

C. 0.4

D. 0.2

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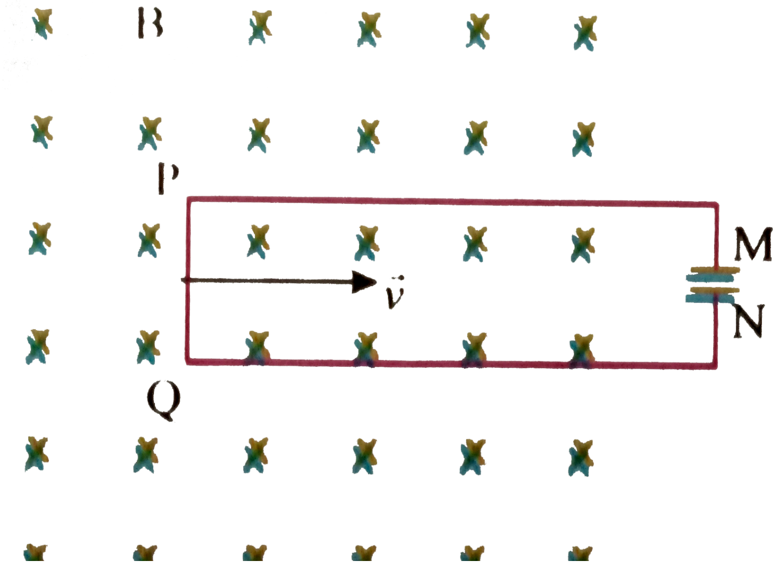
4. A rod PQ is connected to the capacitor plates. The rod is placed in a magnetic field (B) directed downwards perpendicular to the plane of the paper. If the rod is pulled out of magnetic field with velocity $\vec{v}$ as shown in Figure.



A. Plate M will be positively charged

B. Plate N will be positively charged

C. Both plates will be similarly charged

D. no charge will be collected on plates.

Answer: A

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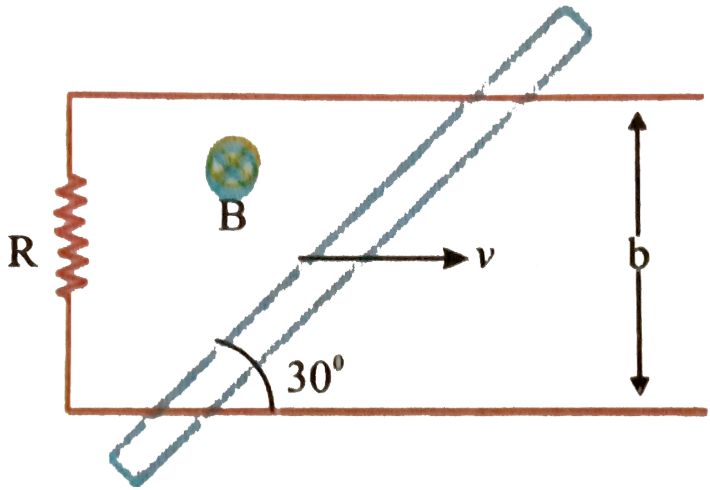
5. A wire is sliding as shown in Figure. The angle between the acceleration and the velocity of the wire is



A. 30°

B. 40°

C. 120°

D. 90°

Answer: C

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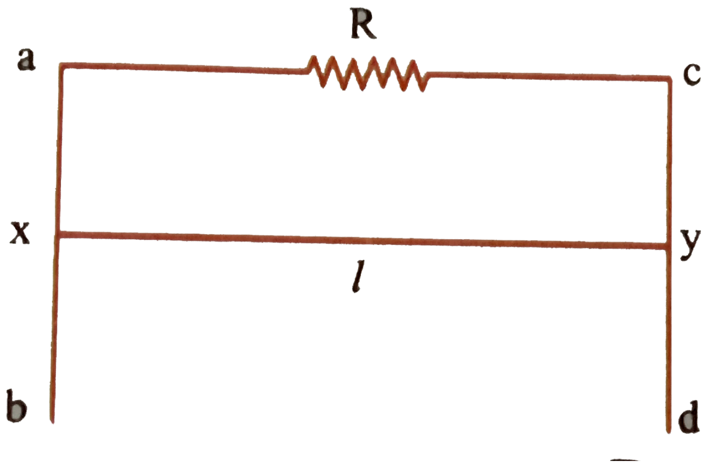
6. A conducting wire xy of lentgh l and mass m is sliding without friction on vertical conduction rails ab and cd as shown in figure. A uniform magnetic field B exists perpendicular to the plane of the rails, x moves with a constant velocity of



A. $\frac{mgR}{Bl}$

B. $\frac{mgR}{Bl^2}$

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

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

Answer: C

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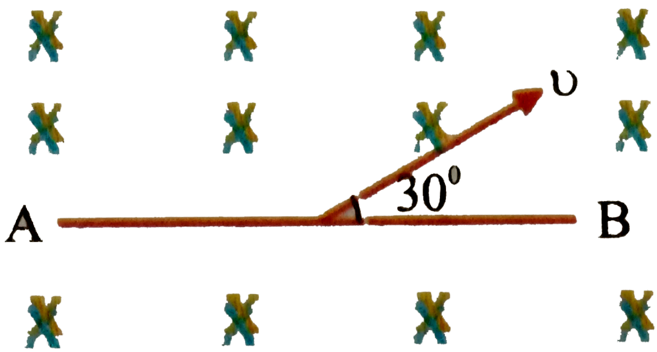
7. A conducitng rod AB of length $l = 1m$ moving at a velcity $v = 4m/s$ making an angle 30° with its length. A uniform magnetic field $B = 2T$ exists in a direction perpendicular to the plane of motion. Then :



A. $V_A - V_B = 8V$

B. $V_A - V_B = 4V$

C. $V_B - V_A = 8V$

D. $V_B - V_A = 4V$

Answer: B

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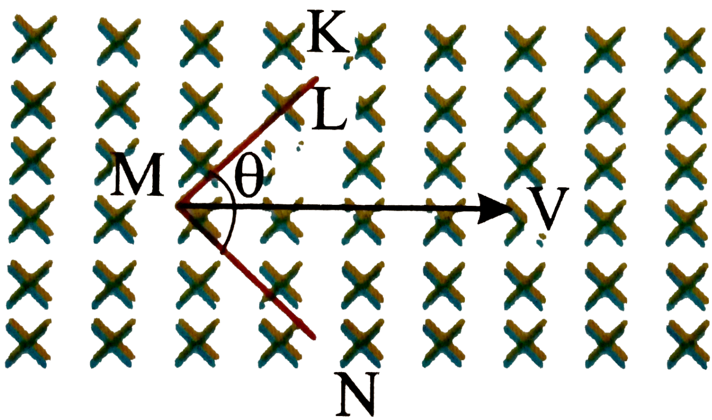
8. A wire KMN moves along the bisector of the angle θ with a constant velocity v in a uniform magnetic field B perpendicular to the plane of the paper and directed inward. Which of the following is correct?



A. Effective length of the wire is $2L\sin\frac{\theta}{2}$

B. $E.m.f$ induced between K and N is $2BLV\sin\frac{\theta}{2}$

C. The shape of KMN is immaterial, only the end points KN are important.

D. All the above

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

A. zero

B. 25volt

C. 20volt

D. 15volt

Answer: B

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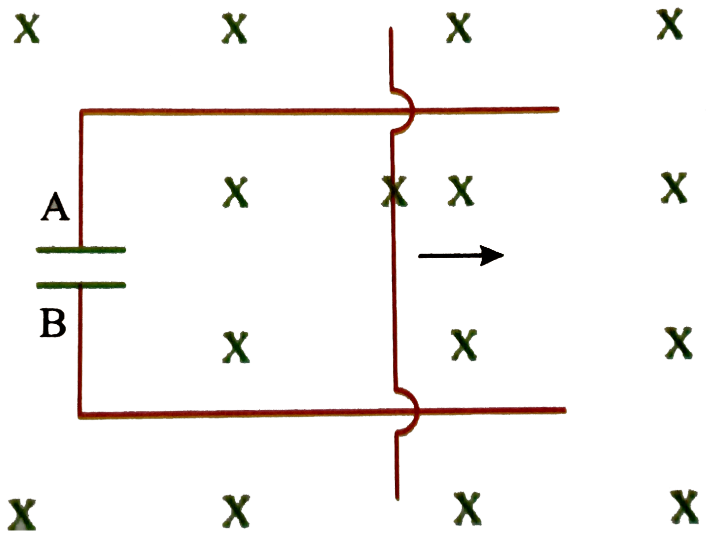
10. A conducting rod PQ of length $1m$ is moving with uniform velocity of $2m/s$ in a uniform magnetic field of $2T$ directed inot the plane of paper. A capacitor of capacity $c = 10\mu F$ is connected as shown. Then :



A. $q_A = +40\mu C, q_B = +40\mu C$

B. $q_A = +40\mu C, q_B = -40\mu C$

C. $q_A = -40\mu C, q_B = +40\mu C$

D. $q_A = q_B = 0$

Answer: A

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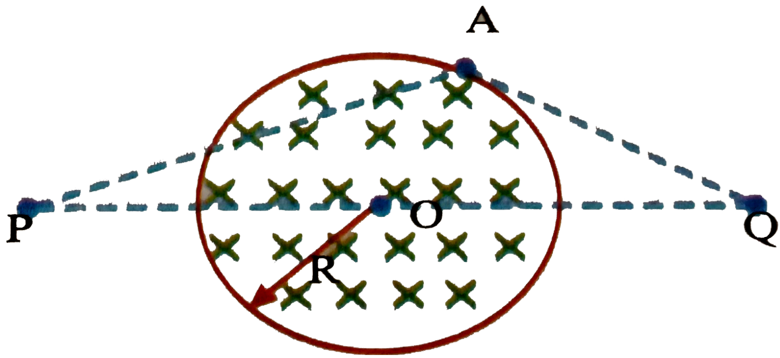
11. A time varying magnetic field is present in a cyclindrical region R as shown in the figure. A positive charge q is taken slowly from P to Q through POQ, the magnetic field varies with time as $B = B_0 t$ (where B_0 is a constant) are directed into the plane of the paper. If W is the workdone then $W =$



A. Zero

B. B_0

C. Infinite

D. $2B_0$

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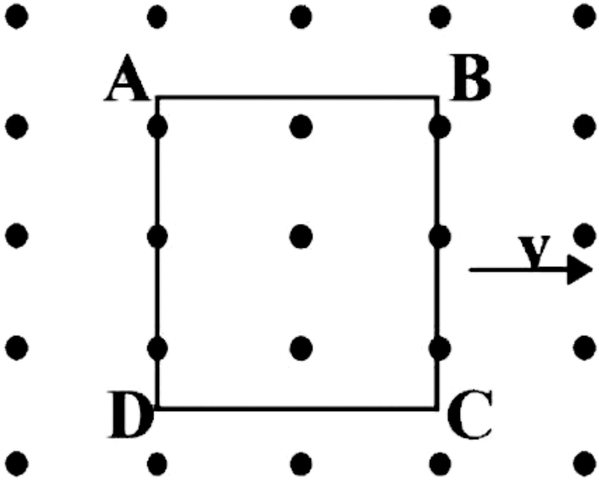
12. A metallic square loop ABCD is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in the figure. An electric field is induced



A. in AD, but not in BC

B. in BC, but not in AD

C. neither in AD nor in BC

D. in both AD and BC

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13. The flux linked with a coil is $0.8Wb$ when a 2 A current is flowing through it. If this current begins to increases at the rate of $400A/s$, the induced emf in the coil will be

A. $20V$

B. $40V$

C. $80V$

D. $160V$

Answer: D

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14. A solenoid of self inductance $1.2H$ is in series with a tangent galvanonmeter of reduction factor $0.9A$.They are connected to a battery and the tangent galvanometer shows a deflection of 53°. The energy stored in the magnetic field of the solenoid is $(\tan 53^\circ = 4/3)$

A. $0.864J$

B. $0.72J$

C. $0.173J$

D. $1.44J$

Answer: A

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15. There are two batteries $'A'$ and $'B'$ having same emf. A has no internal resistance and B has some internal restance. An inductance is connected first to $'A'$ and the energy in the uniform magnetic field setup inside is $'U'$. It is now disconnected from $'A'$ and reconnected to $'B'$. The energy stored in the uniform magnetic field will be

A. U

B. $> U$

C. $< U$

D. zero

Answer: C

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16. An emf induced in a secondary coil is $10000V$ when the current breaks in the primary. The mutual inductance is $5H$ and the current reaches to zero in $10^{-4}s$ in primary. The maximum current in the primary before the breaks is

A. $0.2A$

B. $0.3A$

C. $0.4A$

D. $0.5A$

Answer: A

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17. A mutual inductor consists of two coils X and Y as shown in Fig. in which one-quarter of the magnetic flux produced by X links with Y, giving a mutual inductance M. What will be the mutual inductance when Y is used as the primary?

A. $M/4$

B. $M/2$

C. M

D. $2M$

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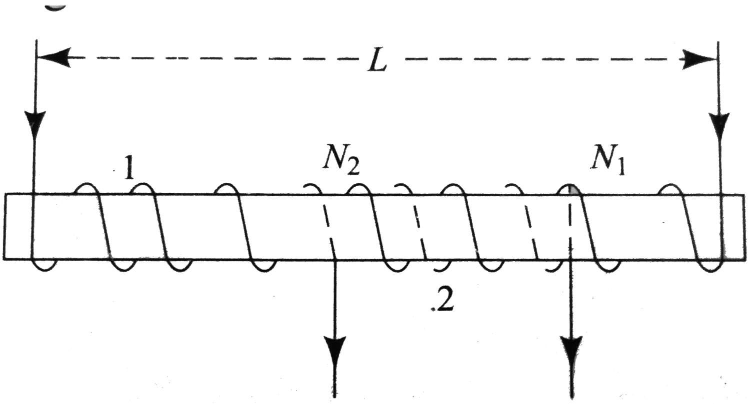
18. A long solenoid of length L, cross section A having N_1 turns has about its center a small coil of N_2 turns as shows in Fig The mutual inductance of two circuits is



A. $\frac{\mu_0 A(N_1 / N_2)}{L}$

B. $\frac{\mu_0 A(N_1 N_2)}{L}$

C. $\mu_0 A(N_1 N_2) L$

D. $\frac{\mu_0 A(N_1^2 N_2)}{L}$

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19. 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. r / R

B. r^2 / R

C. r^2 / R^2

D. r / R^2

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20. The coefficient of mutual inductance of two circuits A and B is $3mH$ and their respective resistances are 10Ω and 4Ω. How much current should change in $0.02s$ in circuit A, so that the induced current in B should be $0.0060A$?

A. $0.24A$

B. $1.6A$

C. $0.18A$

D. $0.16A$

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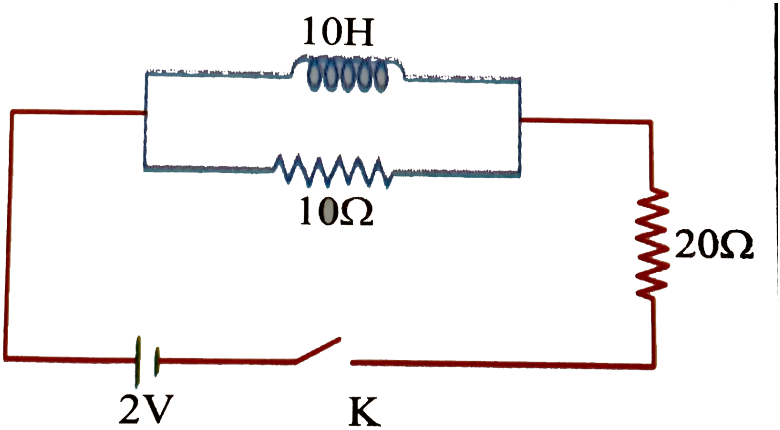
21. The key $'K'$ is switched on at $t=0$. Then the currents through battery at $t=0$ and $t=\infty$ are



A. $\frac{1}{15}A, \frac{1}{10}A$

B. $\frac{1}{10}A, \frac{1}{15}A$

C. $\frac{2}{15}A, \frac{1}{10}A$

D. $\frac{1}{15}A, \frac{2}{25}A$

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22. The current in an $L - R$ circuit builds upto $3/4th$ of its steady state value in $4\sec$. Then the time constant of this circuit is

A. $\frac{1}{\ln 2}\sec$

B. $\frac{3}{\ln 2}\sec$

C. $\frac{4}{\ln 2}\sec$

D. $\frac{2}{\ln 2}\sec$

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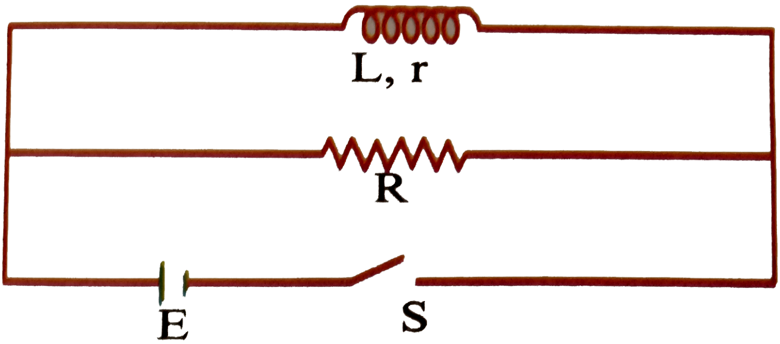
23. For the circuit shown, initially $'S'$ is closed for a long time so that steady has been reached. Then at $t = 0$, $'S'$ is opened, due to which the current decays to zero. The heat generated in inductor is.



A. zero

B. $\dfrac{E^2L}{2(R+r)}$

C. $\dfrac{E^2L}{2r(R+r)}$

D. $\dfrac{E^2R}{2r(R+r)}$

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

A. e

B. $\frac{1}{e-1}$

C. $1-\frac{1}{e}$

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

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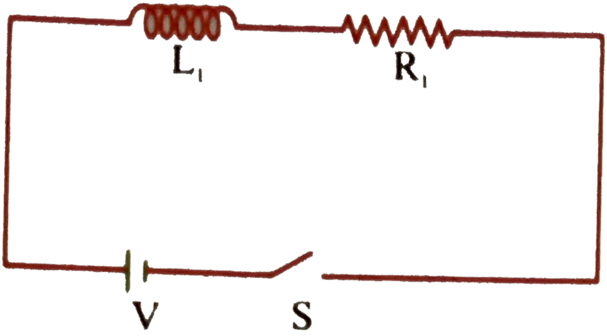
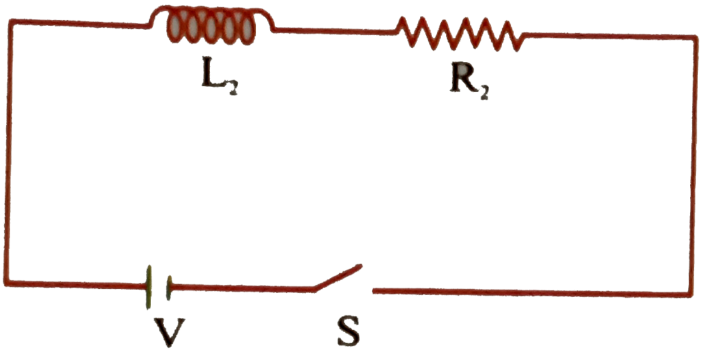
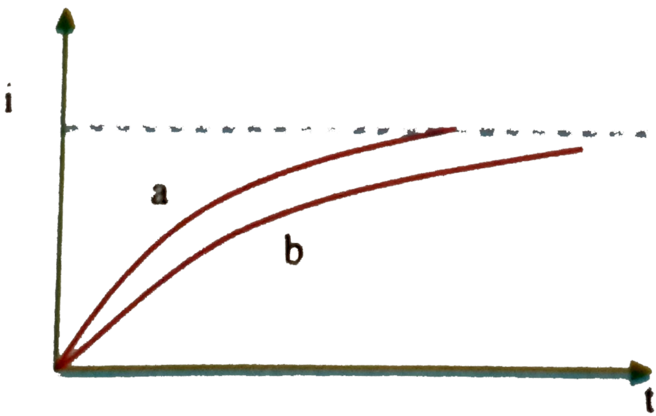
A)



B)



C)



25.

Current growth in two LR circuits (A) and (B) is as shown in figure (C). It follows that

A. $R_1 > R_2, L_1 < L_2$

B. $R_1 > R_2, L_1 = L_2$

C. $R_1 = R_2, L_1 < L_2$

D. $R_1 < R_2, L_1 > L_2$

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26. In an LR circuit, current at $t = 0$ is $20A$. After $2s$ it reduces to $18A$. The time constant of the circuit is :

A. $\ln\left(\frac{10}{9}\right)$

B. 2

C. $\frac{2}{\ln\left(\frac{10}{9}\right)}$

D. $2\ln\left(\frac{10}{9}\right)$

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27. A chock coil has an inductance of $4H$ and a resistance of 2Ω. It is connected to a battery of $12V$ and negaligible internal resistance. The time taken for the current to become $3.78A$ is nearly

A. $8s$

B. $.^{1} /_{2}$

C. $2s$

D. $4s$

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28. A coil of $40H$ inductance is connected in series with a resistance of 8 ohm and the combination is joined to the terminals of a $2V$ battery. The time constant of the circuit

A. 40

B. 20

C. 5

D. 0.2

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Level - III

1. A magnetic field in a certain region is given by $B = \left(40\hat{i} - 15\hat{k}\right) \times 10^{-4}T$. The magnetic flux passes through a loop of area $5.0cm^2$ is placed flat on xy plane is

A. $750nWb$

B. $-750nWb$

C. $360nWb$

D. $-360nWb$

Answer: B

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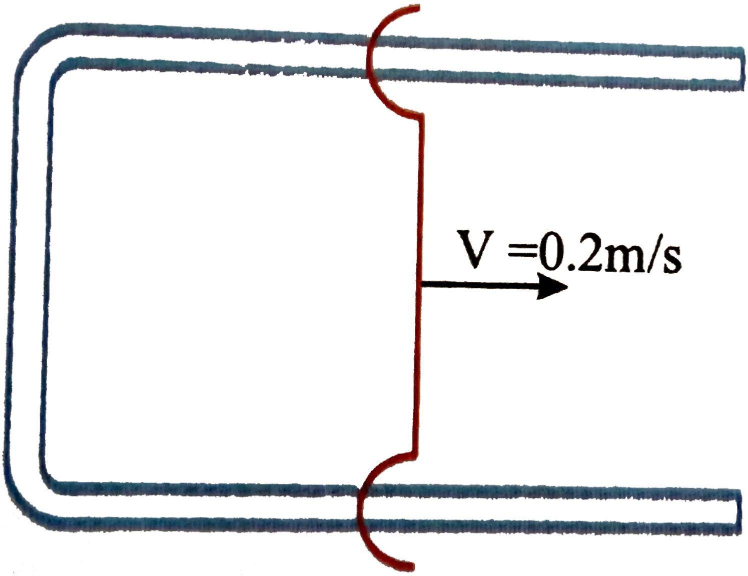
2. A straight conducting rod of length $30cm$ and having a resistance of 0.2 ohm is allowed to slide over two parallel thick metallic rails with uniform velocity of $0.2m/s$ as shown in the figure. The rails are situated in a horizontal plane if the horizontal component of earth's magnetic field is $0.3 \times 10^{-4}T$ and a steady current of $3\mu A$ is induced through the rod. The angle of dip will be:



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

B. $\tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$

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

D. $\tan^{-1}\left(\frac{1}{3}\right)$

Answer: D

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

A. $0.25mW$

B. $6.25mW$

C. $0.625mW$

D. $1W$

Answer: B

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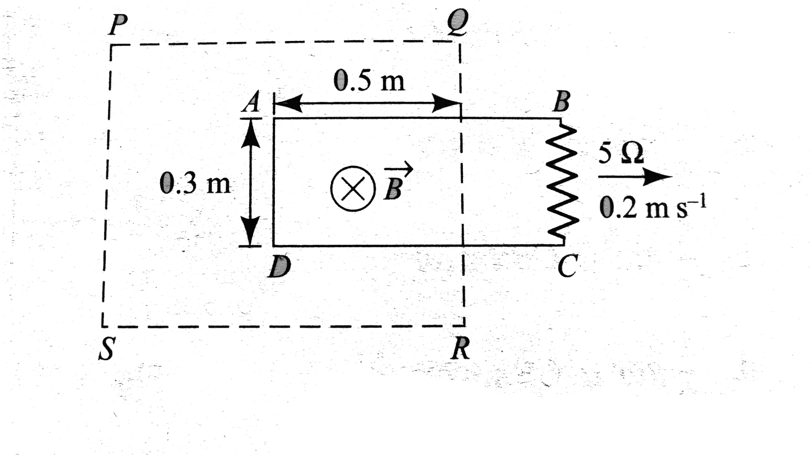
4. A circuit $ABCD$ is held perpendicular to the uinform magnetic field of $B = 5 \times 10^{-2}T$ extending over the region $PQRS$ and directed into the plane of the paper. The cicuit is moving out of the field at a uin form speed of $0.2ms^{-1}$ for $1.5s$. During this time, the current in the 5Ω

resistor is



A. $0.6mA$ from B to C

B. $0.9mA$ from B to C

C. $0.9mA$ from C to B

D. $0.6mA$ from C to B

Answer: A

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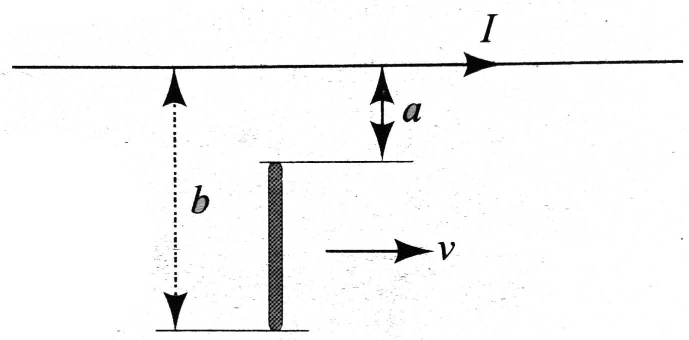
5. Shows a copper rod moving with velocity v parallel to a long straight wire carrying current $= 100A$. Calculate the induced emf in the rod, where $v = 5mS^{-1}$, $a = 1cm$, $b = 100cm$.



A. $0.23mV$

B. $0.46mV$

C. $0.16mV$

D. $0.32mV$

Answer: B

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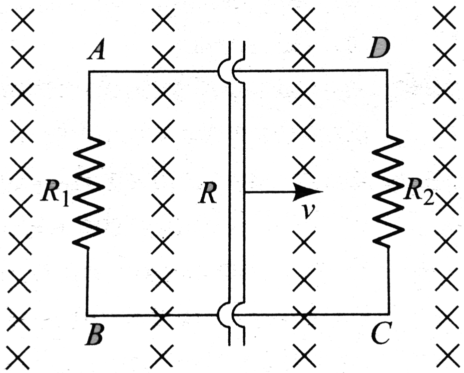
6. A rectangular loop with a sliding conductor of length l is located in a uniform magnetic field perpendicular to the plane of the loop . The magneitc inducetion is b. The resistances R_1 and R_2, respectively. Find the current through the conductor during its motion to the right with a constant velocity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



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

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

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

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

Answer: C

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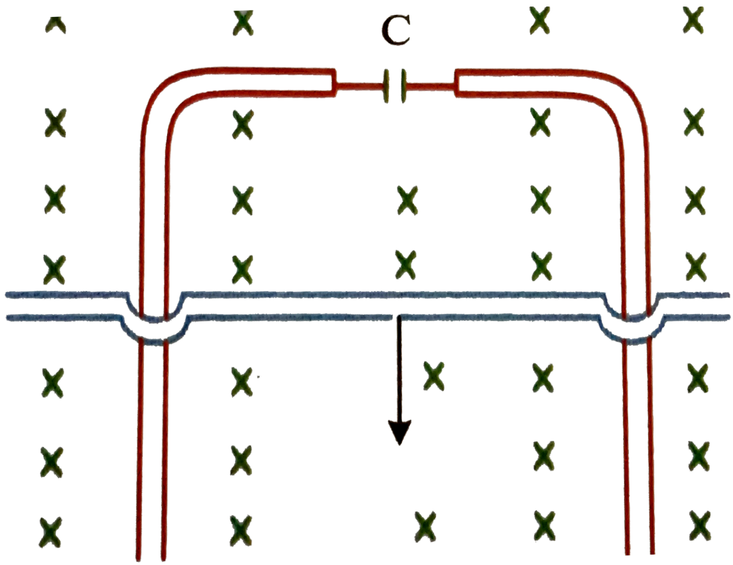
7. A conductor of length l and mass m can slide without any friction along the two vertical conductors connected at the top through a capacitor. A uniform magnetic field B is set up $\perp$ to the plane of paper. The acceleration of the conductor



A. is constant

B. Increases

C. decreases

D. cannot say

Answer: A

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8. A wheel has three spokes and is an uniform magnetic field perpendicular to its plane, with the axis of rotation of the wheel parallel to the magnetic field. When the wheel rotates with a uniform angualr velocity ω, the emf induced between the centre and rim of the wheel is $'e'$. If another wheel having same radius but with six spokes is kept in the same field and rotated with a uniform angular velocity $'\omega/2'$, the emf induced between the centre and the rim will be

A. e

B. $e/2$

C. $2e$

D. $e/4$

Answer: B

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9. A metal rod of length $1m$ is rotated about one of its ends in a plane at right angles to a uniform magnetic field pf induction $2.5 \times 10^{-3} Wbm^{-2}$. If it makes 1800 rpm, then the induced emf between its ends approximately is

A. $0.24V$

B. $0.12V$

C. $0.36V$

D. $0.48V$

Answer: A

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10. A bicycle si resting on its stand in the east-west direction and rear wheel is rotating at 100 revolution per minute. Length of each spoke is $30cm$, and vertical component of earth's magnetism is 1.5×10^{-5} tesla. If the emf induced in the spokes is $3\pi \times 10^{-6}V$, the angle of dip will be :

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

B. $\tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$

C. $\tan^{-1}\left(\sqrt{3}\right)$

D. $\tan^{-1}\left(\frac{1}{3}\right)$

Answer: A

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11. Find the linear speed the bicycle required to power its head light by a generator, whose rubber shaft presses against the wheel of cycle of radius $0.33m$, turns at an angular speed of 44 times as great as the angular speed of the tire itself. The coil consists of 75 turns, has an area of $2.6 \times 10^{-3} m^2$, and rotates in a $0.10T$ magnetic field. When the peak emf being generated is $6.0V$.

A. $2.5m/s$

B. $5m/s$

C. $2.3m/s$

D. $4.6m/s$

Answer: C

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12. The coil of an ac generator rotates at a frequency of $60Hz$ and develops an induced emf of $120V(rms)$. The coil has an area of $3.0 \times 10^{-3} m^2$ and consists of 500 turns. The magnitude of the magnetic field in which the coil rotates is

A. $0.30T$

B. $3.00T$

C. $0.03T$

D. $30T$

Answer: A

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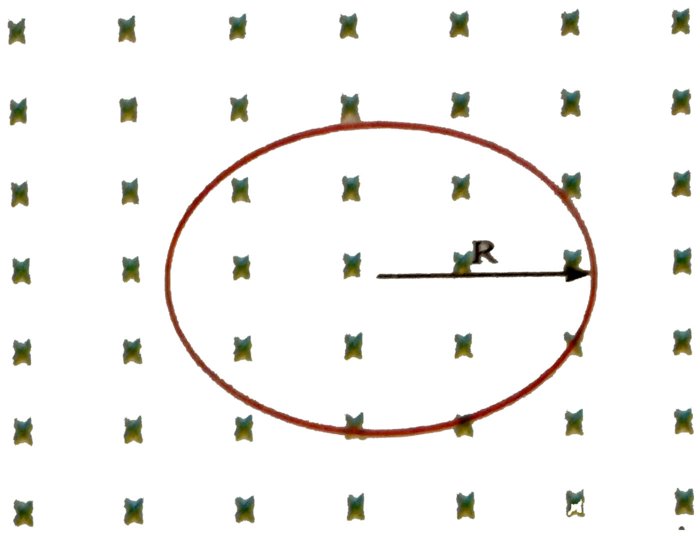
13. A conducting loop of radius R is present in a uniform magnetic field B perpendicular to the plane of ring. If radius R varies as a function of time t as $R = R_0 + t^2$. The emf induced in the loop is



A. $2\pi Bt(R_0 + t^2)$ Clockwise

B. $2\pi Bt(R_0 + t^2)$ Anticlockwise

C. $4\pi Bt(R_0 + t^2)$ Anticlockwise

D. $4\pi Bt(R_0 + t^2)$ Clockwise

Answer: C

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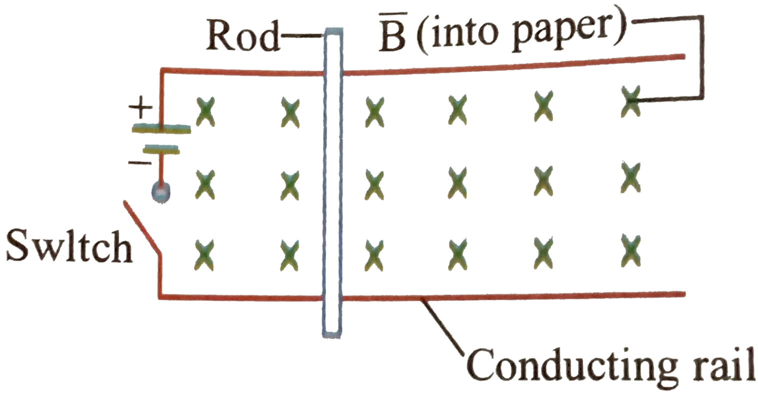
14. A conducting rod is free to slide along a pair of conducting rails, in a region where a uniform and constant (in time) magnetic field is directed into the plane of the paper, as the drawing illustrates. Initially the rod is at rest. There is no frictio between the rails and the rod. What happens to the rod after the switch is closed? If any induced emf devlops, be sure to account for its effect.



A. The rod accelerates to the right, its velocity increasing without limit.

B. The rod does not move.

C. The rod accelerates to the right for a while and then slows down and comes to a halt.

D. The rod accelerates to the right and eventually reaches a constant velocity at which it continues to move.

Answer: D

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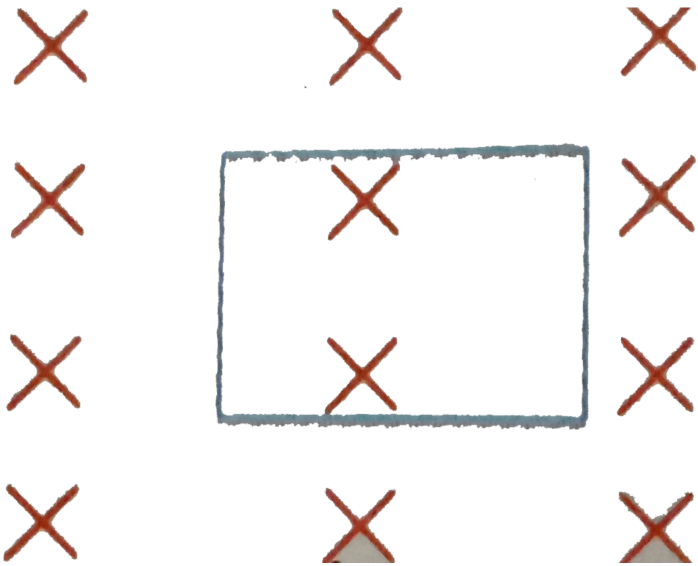
15. A specially uniform magnetic field of $0.080T$ is directed inot the plane of the page and perpendicular to it, as shown in the accompanying figure. A wire loop in the plane of the page has constant area $0.010m^2$. The magnitude of the magnetic field decreases at a constant rate of $3.0 \times 10^{-4} T/s$. The magnitude and direction of the induced emf is



A. $3.0 \times 10^{-6} V$ clockwise

B. $3.0 \times 10^{-6} V$ anticlockwise

C. $2.4 \times 10^{-5} V$ anticlockwise

D. $8.0 \times 10^{-4} V$ clockwise

Answer: A

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

A. $\frac{4\pi m}{\rho\sigma}\frac{dB}{dt}$

B. $\frac{m}{4\pi\rho\sigma}\frac{dB}{dt}$

C. $\frac{m}{\rho\sigma}\frac{dB}{dt}$

D. $\frac{2\pi m}{\rho\sigma}\frac{dB}{dt}$

Answer: B

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

A. $\frac{aT}{3R}$

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

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

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

Answer: D

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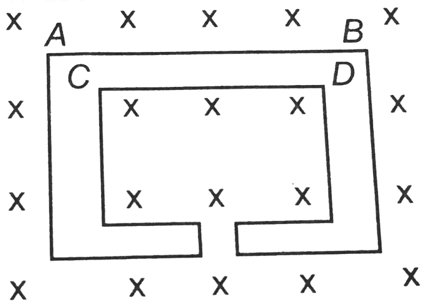
18. A wire is bent to form the double loop shown in figure. There is a uniform magnetic field directed into the plane of the loop. If the magnitude of this field is decreasing current will flow from:



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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19. Two coils have self-inductance $L_1 = 4mH$ and $L_2 = 1mH$ respectively. The currents in the two coils are increased at the same rate. At a certain instant of time both coils are given the same power. If I_1 and

I_2 are the currents in the two coils, at that instant of time respectively, then the value of (I_1 / I_2) is :

A. $1/8$

B. $1/4$

C. $1/2$

D. 1

Answer: B

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20. The length of a wire required to manufacture a solenoid of length l and self-induction L is (cross-sectional area is negligible)`

A. $\sqrt{\frac{2\pi Ll}{\mu_0}}$

B. $\sqrt{\frac{\mu_0 Ll}{4\pi}}$

C. $\sqrt{\frac{4\pi Ll}{\mu_0}}$

D. $\sqrt{\frac{\mu_0 Ll}{2\pi}}$

Answer: C

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21. The inductance L of a solenoid of length l, whose windings are made of material of density D and resistivity ρ, is (the winding resistance is R)

A. $\frac{\mu_0}{4\pi l}\frac{Rm}{\rho D}$

B. $\frac{\mu_0}{4\pi l}\frac{lm}{\rho D}$

C. $\frac{\mu_0}{4\pi l}\frac{R^2 m}{\rho D}$

D. $\frac{\mu_0}{2\pi R}\frac{lm}{\rho D}$

Answer: A

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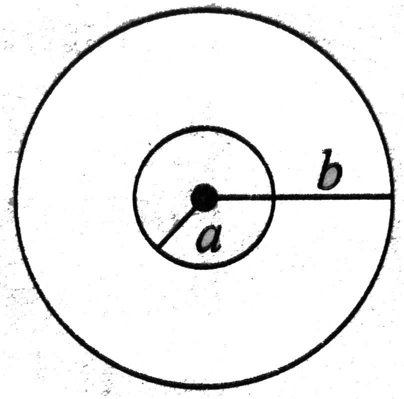
22. Two concentric and coplanar coils have radii a and $b(>>a)$ as shows in Fig. Resistance of the inner coil is R. Current in the outer coil is increased from 0 to i, then the total charge circulating the inner coil is



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

B. $\frac{\mu_0 i a b}{2R}$

C. $\frac{\mu_0 i a b}{2a} \frac{\pi b^2}{R}$

D. $\frac{\mu_0 i b}{2\pi R}$

Answer: A

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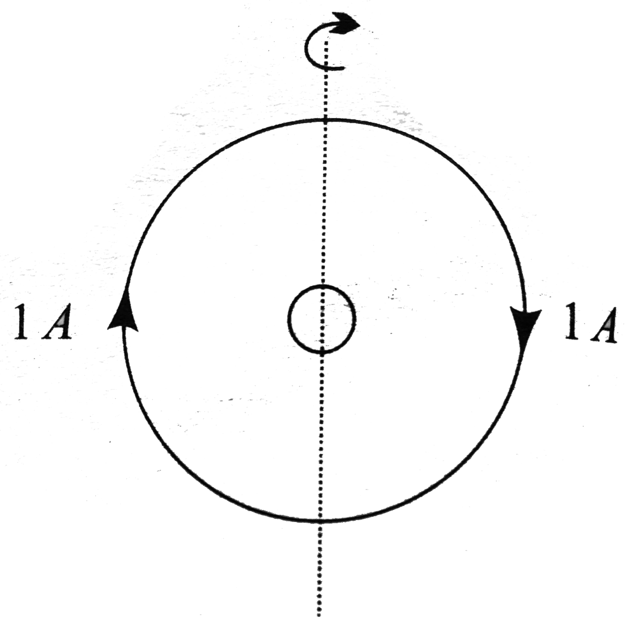
23. The linear loop has an area of $5 \times 10^{-4} m^2$ and a resistance oof 2Ω. The larger circular loop is fixed and has a radius of $0.1m$. Both the loops are concentric and coplanner. The smaller loop is rotated with an angular velocity $\omega rads^{-1}$ about its dismeter. The magnetic flux with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



A. $2\pi \times 10^{-6}$weber

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

C. $\pi \times 10^{-9} \cos \omega t$weber

D. zero

Answer: C

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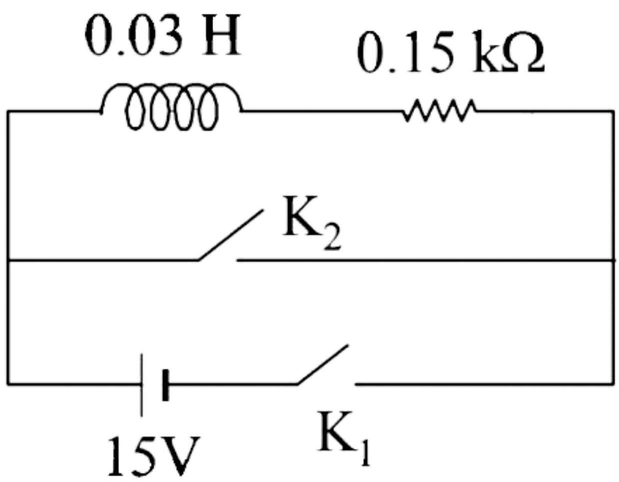
24. An inductor (L =0.03 H) and a resistor $(R = 0.15k(\Omega))$ are connected in series to a battery of 15 V EMF in a circuit shown below. The key K_1 is opened and Key K_2 is closed simultaneously. At t =1 ms, the current in the circuit will be $(e^5 = 150)$



A. $100mA$

B. $67mA$

C. $6.7mA$

D. $0.67mA$

Answer: D

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25. A coil of some internal resistance $'r'$ behaves line an inductance. When it is connected in series with a resistance R_1, the time constant is found to be τ_1. When it is connected in series with a resistance R_2, the time constant is found to be τ_2. The inductance of the coil is

A. $\dfrac{\tau_1\tau_2(R_1 - R_2)}{(\tau_2 - \tau_1)}$

B. $\dfrac{(\tau_2 - \tau_1)}{\tau_1\tau_2(R_1 - R_2)}$

C. $\dfrac{(R_1 - R_2)}{(\tau_2 - \tau_1)}$

D. $\dfrac{(\tau_2 - \tau_1)}{(R_1 - R_2)}$

Answer: A

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26. An inductance L and and a resistance R are connected in series to a battery of voltage V and negligible internal resistance through a switch. The switch is closed at $t = 0$. The charge that passes through the battery in one time constant is [e is base of natural logarithms]

A. $\frac{eR^2V}{L}$

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

C. $\frac{VL}{eR^2}$

D. $\frac{eL}{VR}$

Answer: C

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

A. $0.05s$

B. $0.1s$

C. $0.15s$

D. $0.03s$

Answer: B

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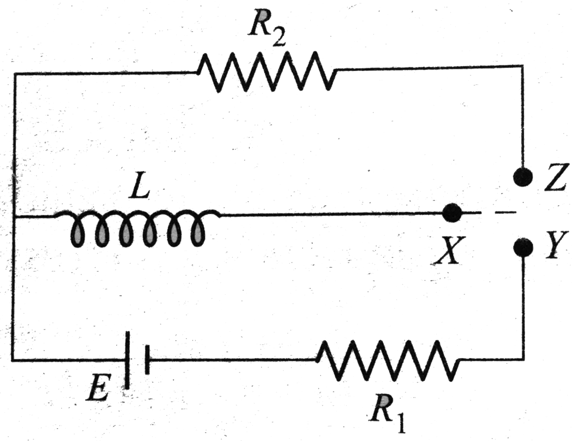
28. In the current shown Fig., X is joined to Y for a long time and then X is joined to Z. The total heat produced in R_2 is



A. $\dfrac{LE^2}{2R_1^2}$

B. $\dfrac{LE^2}{2R_2^2}$

C. $\dfrac{LE^2}{2R_1R_2}$

D. $\dfrac{LE^2R_2}{2R_1^3}$

Answer: A

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29. A condenser in series with a resistor is connected through a switch to a battery of negligible internal resistance and having an emf of $12V$.

One second after closing the switch, the condenser is found to have a potential difference of $6V$. The time constant of the system is

A. $2s$

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

C. $\log_e 2$

D. $\log_e\left(\frac{1}{2}\right)$

Answer: B

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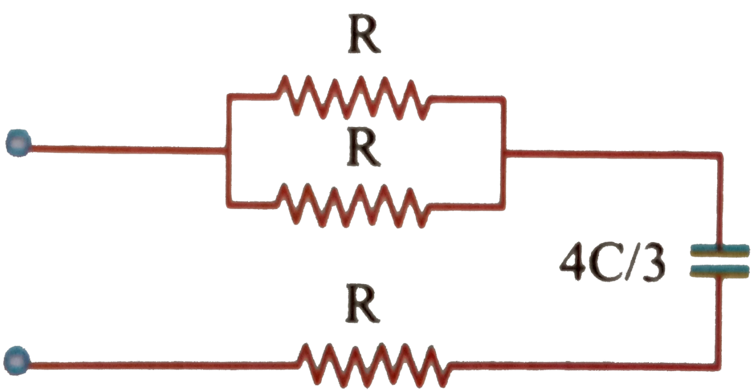
30. The time constant of the circuit shown is



A. RC

B. $2RC$

C. $3RC$

D. $4RC$

Answer: B

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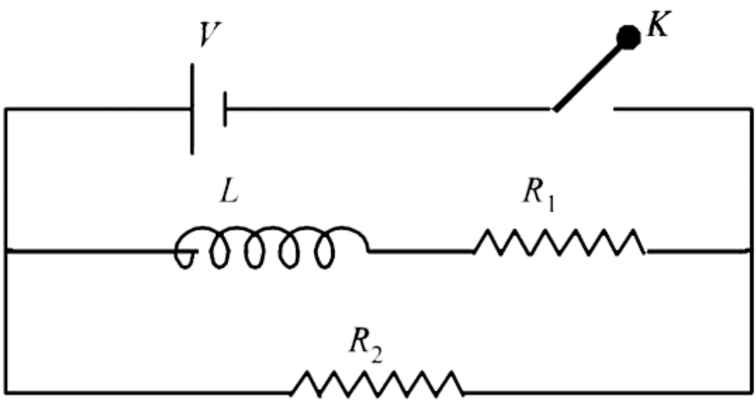
31. In the circuit shown below, the key K is closed at t =0. The current through the battery is



A. $\frac{VR_1R_2}{\sqrt{R_1^2 + R_2^2}}$ at t = 0 and $\frac{V}{R_2}$ at t = ∞

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

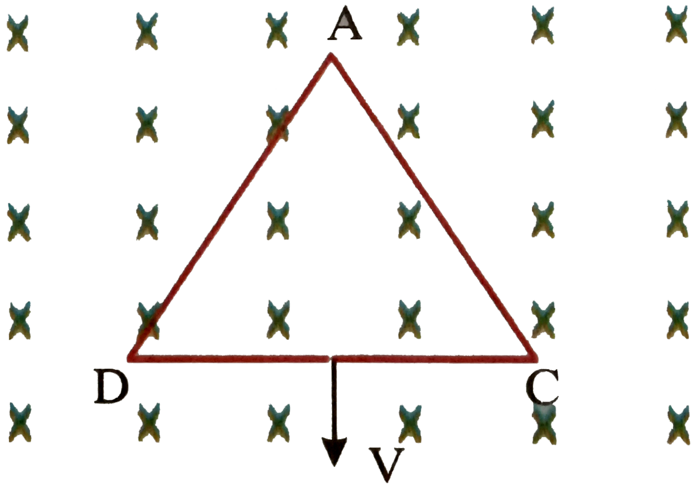
C. $\frac{V}{R_2}$ at t = 0 and $\frac{VR_1R_2}{\sqrt{R_1^2 + R_2^2}}$ at t = ∞

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

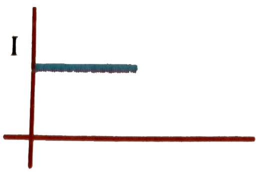
Answer: B

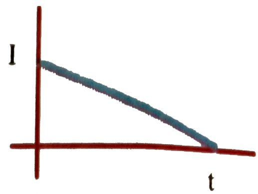
Watch Video Solution

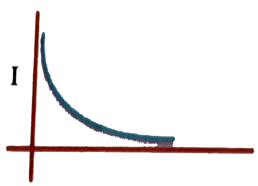
32. An equilateral triangular loop ADC having some resistance is pulled with a constant velocity v out of a uniform magnetic field directed inot the paper. At time $t = 0$, side DC of the loop at is at edge of the magnetic field.

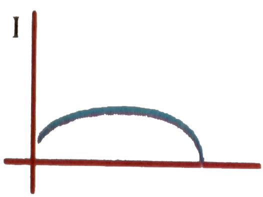


The induced current (i) versus time (t) graph will be as

A. 

B. 

C. 

D. 

Answer: B

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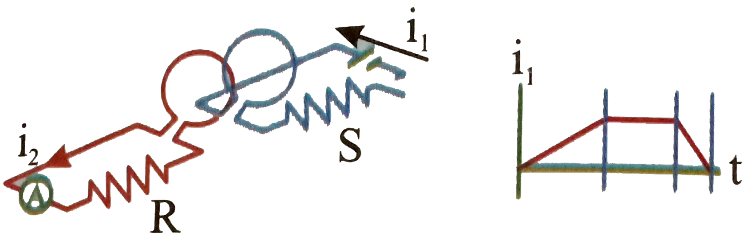
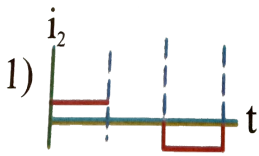
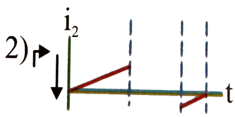
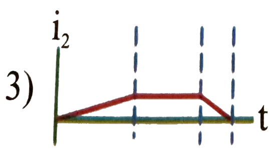
33. The current through the coil in figure (i) varies as shown in figure (ii).

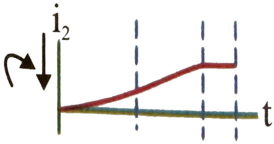
Which graph best shows the ammeter A reading as a function of time?



A. 

B. 

C. 

D. 

Answer: A

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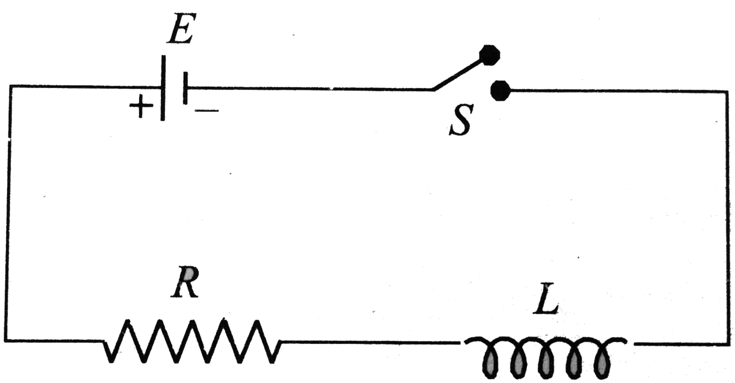
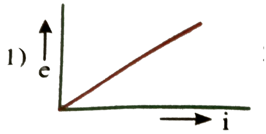
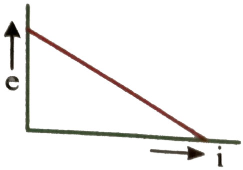
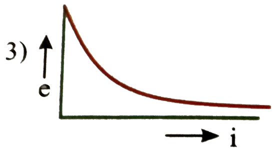
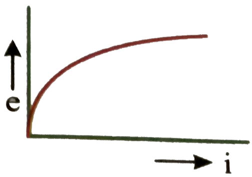
34. Switch S of the circuit shows in Fig. is closed at $t = 0$. If e denotes the induced emf in L and i the current flowing through the circuit at time t, then which of the following graphs correctly represents the variation of e with i?



A. 

B. 

C. 

D. 

Answer: B

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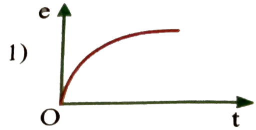
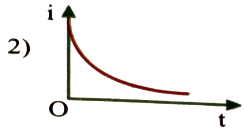
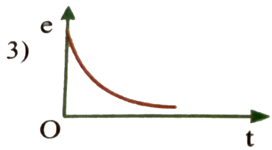
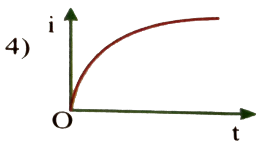
35. Switch S of the circuit shows in Fig is closed at $t = 0$. If e denotes the induced emf in L and I is the current flowing through the circuit at time t, which of the following graphs is//are correct?

A. 

B. 

C. 

D. 

Answer: C::D

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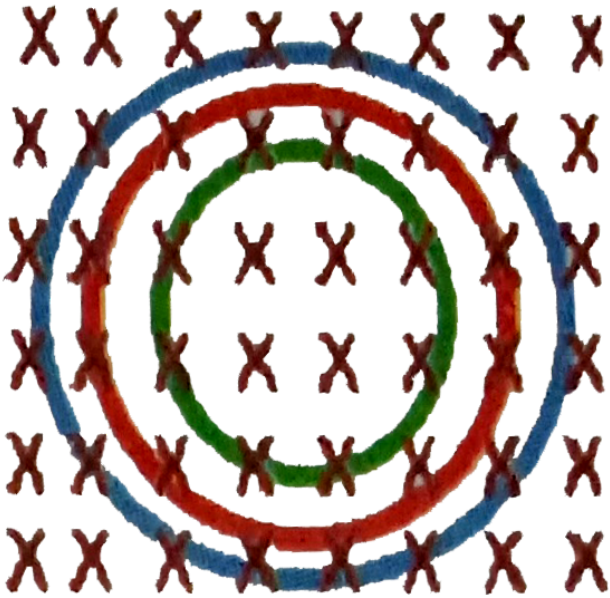
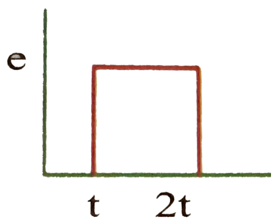
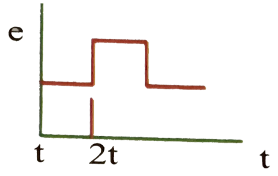
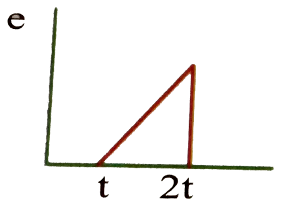
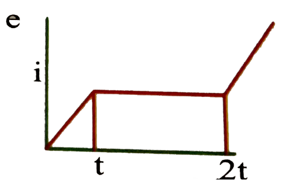
36. A flexible conducting wire in the form of a circle is kept in a uniform magnetic field with its plane normal to the field. Radius of that circle changes with time as shown. Then which of the following graphs represents the variation of induction emf with time $R = R_0, t < t_0, R = R_0 + t, t_0 < t < 2t_0$:



A. 

B. 

C. 

D. 

Answer: C

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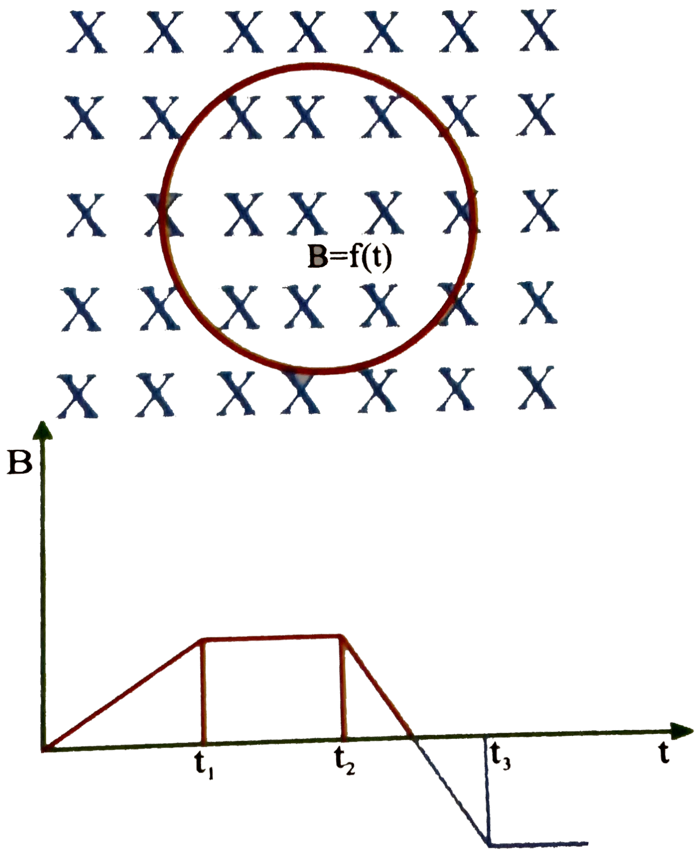
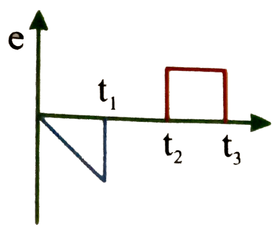
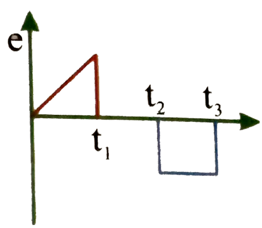
37. A wire loop is placed in a region of time varying magnetic field which oriented orthogonally to the plane of the loop as shown in figure. The graph shows the magnetic field variation as the function of time. Assume the positive emf is the ine which drives a current in the clockwise direction and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

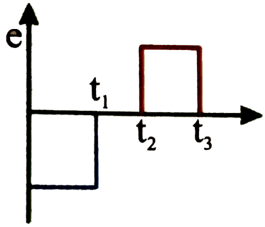


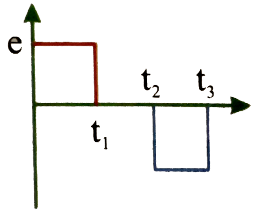


A.



B.

C. 

D. 

Answer: C

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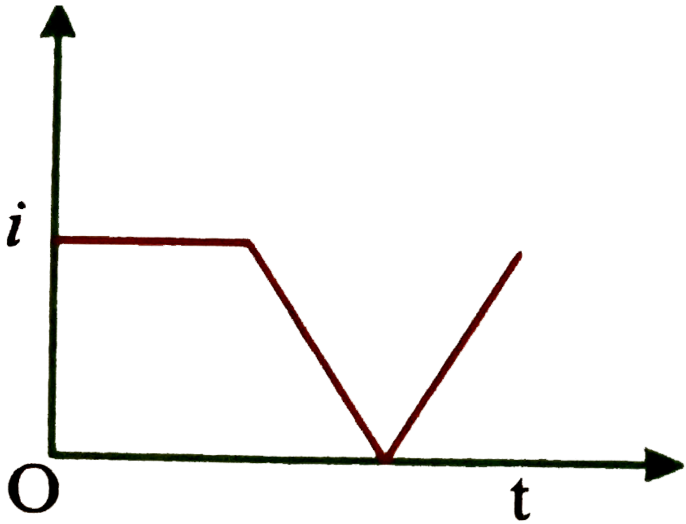
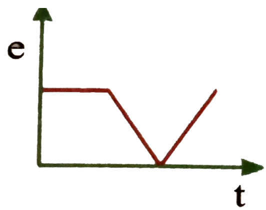
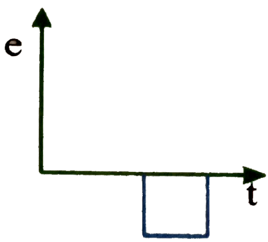
38. The current is an induction coil varies with time t, according to the graph shown in figure. Which of the following graphs shows the induced emf (e) in the coil with time.

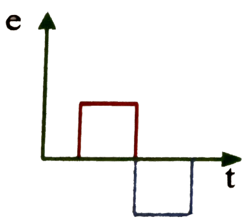




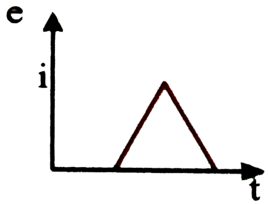
A.



B.



C.

D. 

Answer: C

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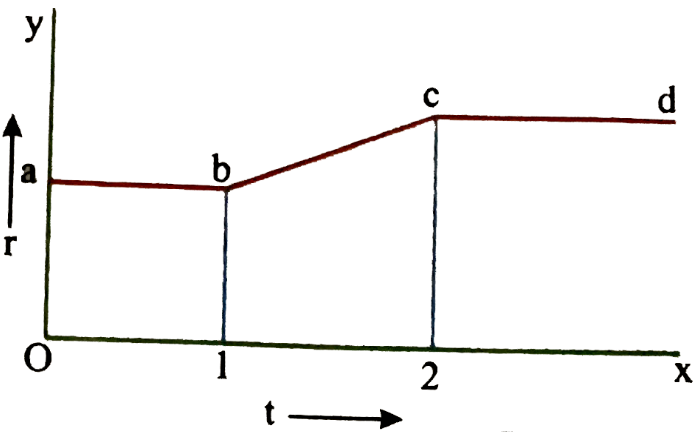
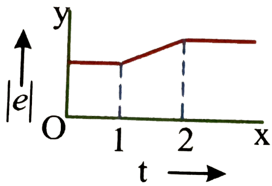
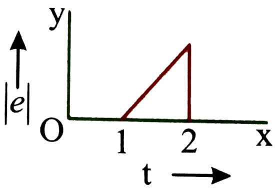
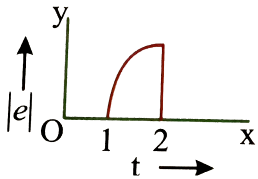
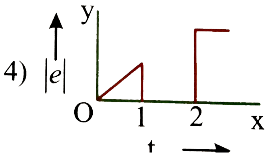
39. A flexible wire bent in the form of a circle is place in a uniform magnetic field perpendicularly to the plane of the coil. The radius of the coil changes as shown in Figure. The graph of magnetude of induced emf in the coil is represented by



A. 

B. 

C. 

D. 

Answer: B

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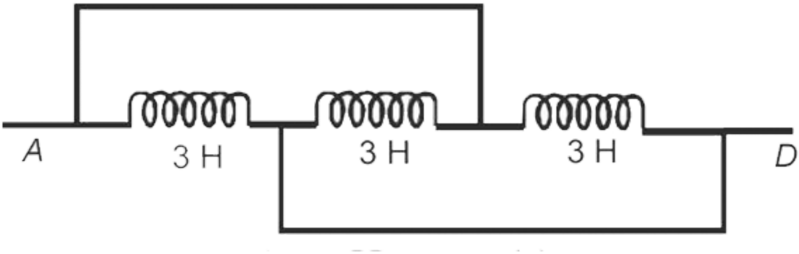
40. The inductance between A and D is



A. $3.66H$

B. $9H$

C. $0.66H$

D. $1H$

Answer: D

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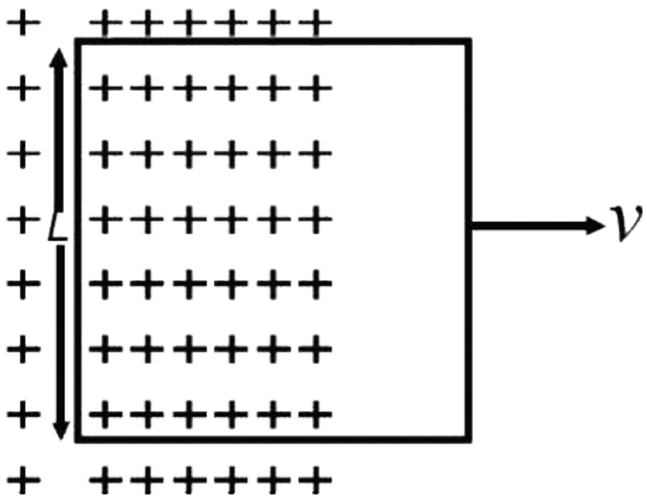
41. A conduting square loop of side L and resistnce R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnitude induction B constant in time and space, pointing perpendicular and into to plane at the loop exists every with half the loop outside the field, as shown in figure. The induced emf is



A. zero

B. RvB

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

D. vBL

Answer: D

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42. Two coil are placed close to each other. The mutual inductance of the pair of coils depends upon.

A. the current in the two coils

B. the rates at which currents are changing in the two coils

C. the relative position are orientation of the two coils.

D. the material of the wire of the coils.

Answer: D

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43. When the current changes from $+2A$ to $-2A$ in $0.05s$, and emf of $8B$ is induced in a coil. The coefficient of self-induction of the coil is

A. $0.1H$

B. $0.2H$

C. $0.4H$

D. $0.8H$

Answer: A

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44. 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. Q

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

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

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

Answer: D

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45. 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. $-\dfrac{W_2 - W_1}{5Rnt}$

B. $-\dfrac{n(W_2 - W_1)}{5Rt}$

C. $-\dfrac{W_2 - W_1}{Rnt}$

D. $-\dfrac{n(W_2 - W)_1}{Rt}$

Answer: B

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46. In a uniform magneitc field of induced B a wire in the form of a semicircle of radius r rotates about the diameter of hte circle with an angular frequency ω. The axis of rotation is perpendicular to hte field. If the total resistance of hte circuit is R, the mean power generated per period of rotation is

A. $\frac{B\pi r^2\omega}{2R}$

B. $\frac{\left(B\pi r^2\omega\right)^2}{8R}$

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

D. $\frac{(B\pi r\omega H_2)^2}{8R}$

Answer: B

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47. 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. $5 \mu V$

B. $50 \mu V$

C. $5 mV$

D. $50 mV$

Answer: B

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48. in a LCR circuit capacitance is chagned from C to 2C. For the resomat frequency to remain unchaged, the inductance should be chagned from L to

A. $4L$

B. $2L$

C. $L/2$

D. $L/4$

Answer: C

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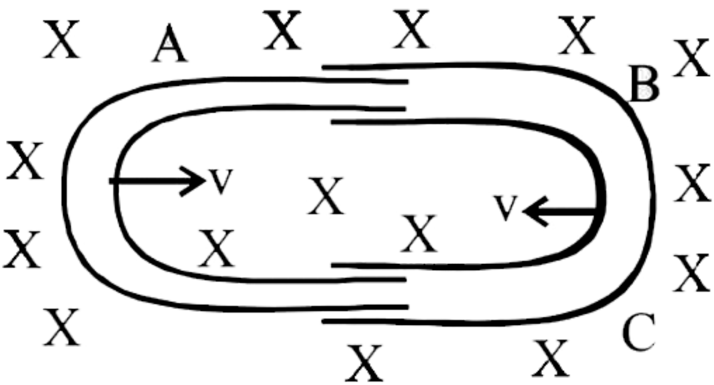
49. One conducting U tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube maoves towards the other at a constant speed v. Then the emf induced in the circuit in terms of B, l and v where l is the width of each tube will be



A. $2BlV$

B. zero

C. $-BlV$

D. BlV

Answer: A

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50. The self inductance of the motor of an electric fan is 10H. In order to impart maximum power at 50 Hz, it should be connected to a capacitance of

A. $2\mu F$

B. $1\mu F$

C. $8\mu F$

D. $4\mu F$

Answer: B

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

A. $0.3s$

B. $0.15s$

C. $0.1s$

D. $0.05s$

Answer: C

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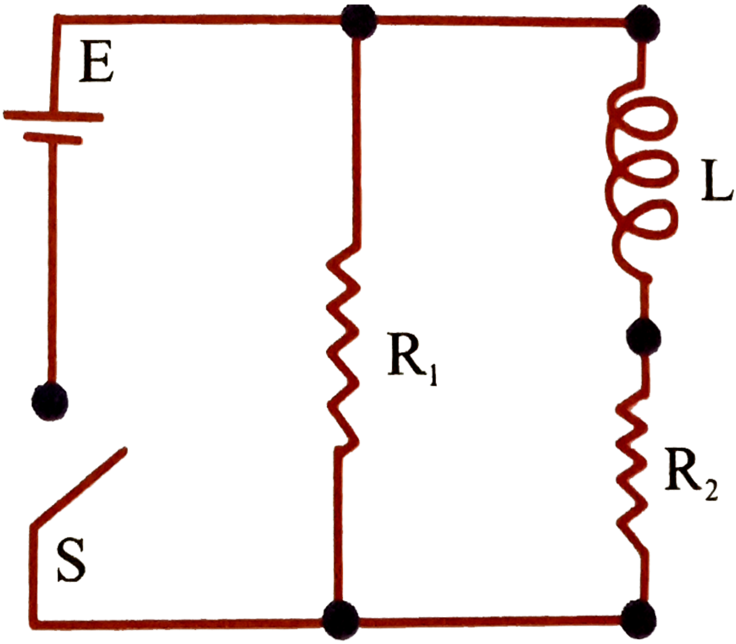
52. An inductor $(L = 100mH)$, a resistor $(R = 100\Omega)$, and a battery $(W = 100V)$ are initially connected in series as shown by the figure. After a long time the battery is disconnected after short circuiting the points A and B. The currents in the circuit $1mm$ after the short circuit is



A. $0.1A$

B. $1A$

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

D. eA

Answer: C

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53. The flux linked with a coil at any instant 't' is given by

$\phi = 10t^2 - 50t + 250$

The induced emf at $t = 3s$ is

A. $10V$

B. $190V$

C. $-190V$

D. $-10V$

Answer: D

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54. An ideal coil of 10H is connected in series with a resistance of $5(\Omega)$ and a battery of 5V. 2second after the connections is made, the current flowing in ampere in the circuit is

A. e

B. e^{-1}

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

D. $1 - e$

Answer: C

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

A. $4.78\pi \times 10^{-5} H$

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

C. $2.4\pi \times 10^{-5} H$

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

Answer: B

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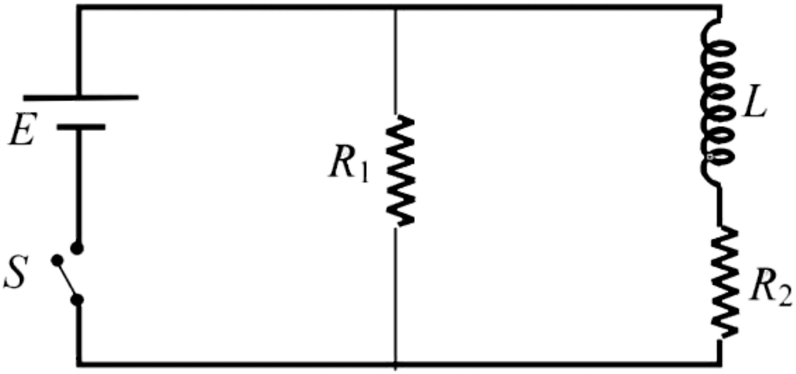
56. An inductor of inductance L=400 mH and resistor of resistance $R_1 = 2(\Omega)$ and $R_2 = 2(\Omega)$ are connected to a battery of emf E = 12 Vas shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at time t =0. What is the potential drop across L as 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. $6\left(1-e^{-t/0.2}\right)V$

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

Answer: D

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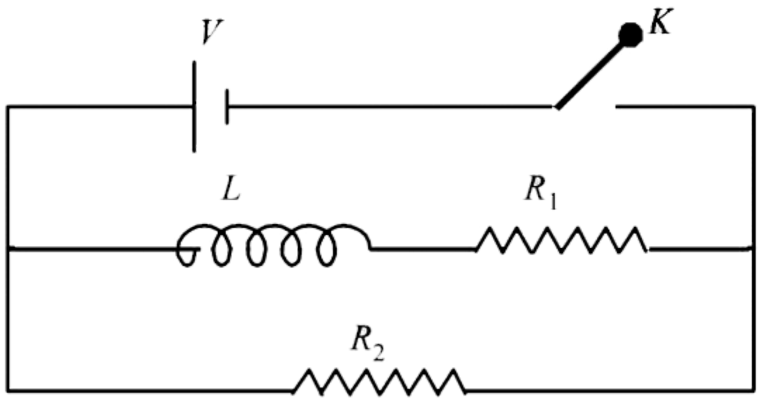
57. In the circuit shown below, the key K is closed at t =0. The current through the battery is



A. $\dfrac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at $t=0$ and $\dfrac{V}{R_2}$ at $t=\infty$

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

C. $\dfrac{V}{R_2}$ at $t=0$ and $\dfrac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at $t=\infty$

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

Answer: B

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58. A fully charged capacitor C with initial charge q_0 is connected to a coil of self inductance L at t=0. The time at which the energy is stored equally between the electric and the magnetic fields is

A. $\pi\sqrt{LC}$

B. $\frac{\pi}{4}\sqrt{LC}$

C. $2\pi\sqrt{LC}$

D. $\sqrt{LC}5$

Answer: B

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

A. $1mV$

B. $0.75mV$

C. $0.50mV$

D. $0.15mV$

Answer: D

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60. A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to the magnetic lines of force. When a current is passed through the coil it starts oscillating, It is very difficult to stop. But if an aluminium plate is placed near to the coil, it stops. This is due to :

A. developed of fair current when the plate is placed

B. induction of electrical charge on the plate

C. shileding of magnetic lines of force as a aluminium is a paramagnetic material

D. electronmagnetic induction in the aluminium plate giving rise to electromagnetic damping

Answer: D

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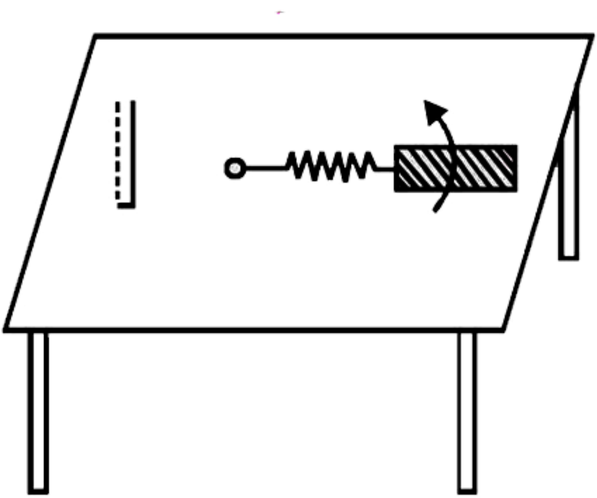
61. A metallic rod of length 'l' is tied to a string of length 2l and made to rotate with angular speed w on a horizontal table with one end of the string fixed. If there is a vertical magnetic field 'B' in the region, the e.m.f. Induced across the ends of the rod is



A. $\frac{3B\omega l^2}{2}$

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

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

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

Answer: C

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62. A circular loop of radius 0.3 cm lies parallel to amuch bigger circular loop of radius 20 cm. The centre of the small loop is on the axis of the bigger loop. The distance between their centres is 15 cm. If a current of 2.0 A flows through the smaller loop, then the flux linked with bigger loop is

A. 6×10^{-11}weber

B. 3.3×10^{-11}weber

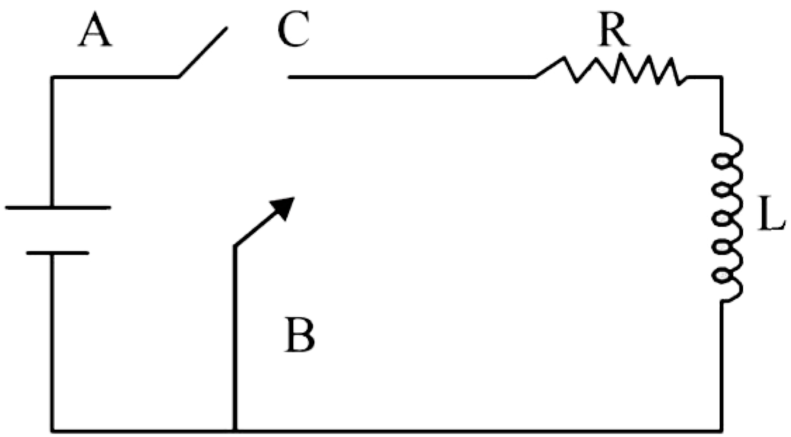
C. 6.6×10^{-9}weber

D. 9.1×10^{-11}weber

Answer: D

Watch Video Solution

63. In the circuit shown here, the point 'C' is kept connected to point 'A' till the current flowing through the circuit becomes constant. Afterward, suddenly, point 'C' is disconnected from point 'A' an connected to point 'B' at time t =0. Ratio of the voltage across resistance and the inductor at $t = L/R$ will be equal to:



A. -1

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

C. $\dfrac{e}{1-e}$

D. 1

Answer: D

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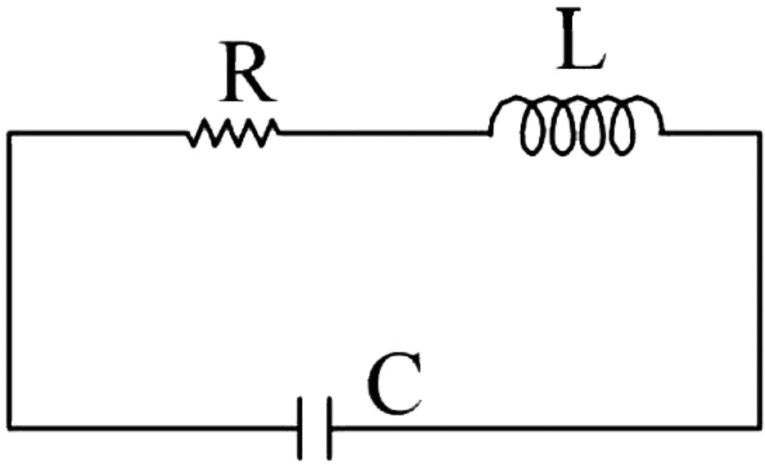
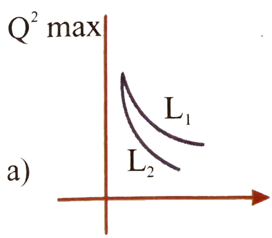
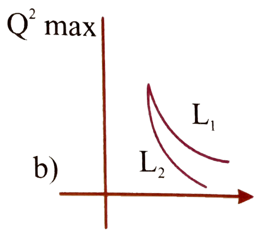
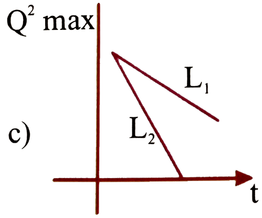
64. An LCR curcuit is equivalent to a damped pendulum. In an LCR circuit the capacitor is charged to (Q_0) and then connected to the L ans R as shown below.

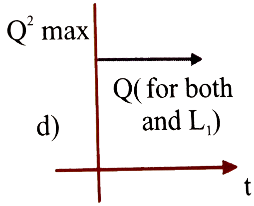


If a student plaots graphs of the square of maximum charge $\left(Q_{\max}^2\right)$ on the capacitor with time (t) for two different values L_1 and $L_2 (L_1 > L_2)$ of L then which of the following represents this graph correclty? (plots are schematic and not drawn to scale).

A. 

B. 

C. 

D. 

Answer: A

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NCERT Based Questions

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

A. $2B_0L^2Wb$

B. $3B_0L^2Wb$

C. $4B_0L^2Wb$

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

Answer: C

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2. A loop made of straight edegs has six corners at $A(0, 0, 0)$, $B(L, O, 0)C(L, L, 0)$, $D(0, L, 0)E(0, L, L)$ and $F(0, 0, L)$. Where L is in meter. A magnetic field $B = B_0\left(\hat{i} + \hat{k}\right)T$ is present in the region. The flux passing through the loop $ABCDEFA$ (in that order) is

A. B_0L^2Wb

B. $2B_0L^2Wb.$

C. $2B_0L^2Wb.$

D. $4B_0L^2Wb.$

Answer: B

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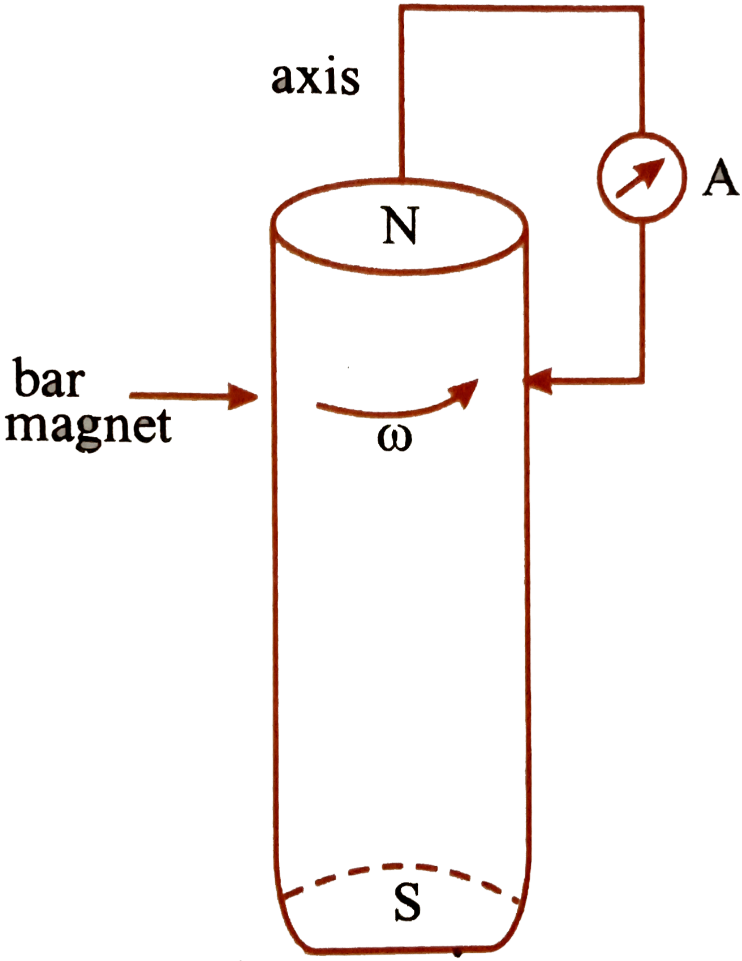
3. A cylindrical bar magnet is rotated about its axis (Figure). A wire is connect from the axis and is made to touch the cylindrical surface through a contact. Then



A. a direct current flows in the ammeter A.

B. no current flows through the ammeter A.

C. an alternating sinusoidal current flows through the ammeter A with a time period $T = \frac{2\pi}{\omega}$.

D. a time varying non-sinosoidal flows through the ammeter A.

Answer: B

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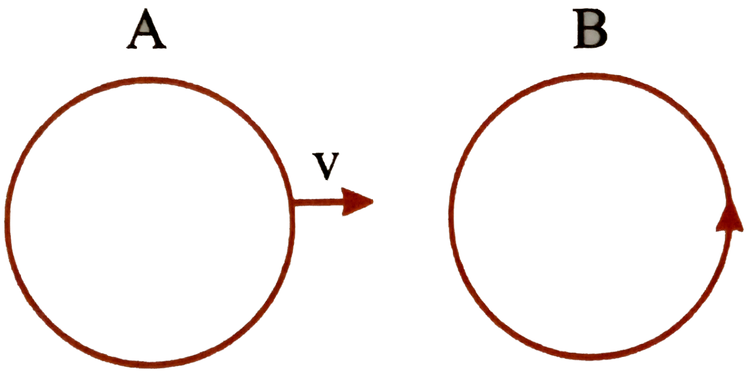
4. There are two coils A and B as shown in Figure. A current starts flowing in B as shown, when A is moved towards B and stops when A stops moving. The current in A is counterclockwise. B is kept stationary when A moves. We can infer that



A. there is a cosntant current in the clockwise direction in A.

B. there is a varying current in A.

C. there is no current in A.

D. there is a constant current in the counerclock-wise direction in A.

Answer: D

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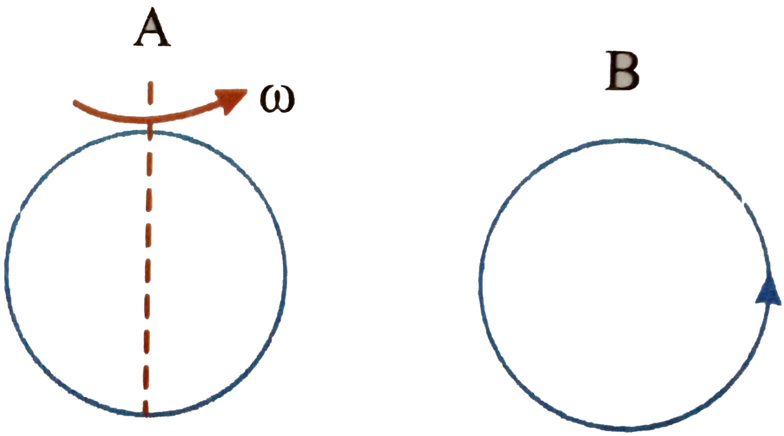
5. Same as problem 4 except the coil A is made to rotate about a vertical axis in the plane of the coil (Figure). No currents flows in B if A is at rest. The current in coil A, when the current in B (at $t = 0$) is counterclockwise and the coil A is as shown at this instant, $t = 0$, is



A. constant current clockwise.

B. varying current clockwise.

C. varying current counterclockwise.

D. constant current counterclockwise.

Answer: A

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

A. 1 and A increases

B. 1 decreases and A increases

C. 1 increases and A decreases

D. both 1 and A decreases

Answer: B

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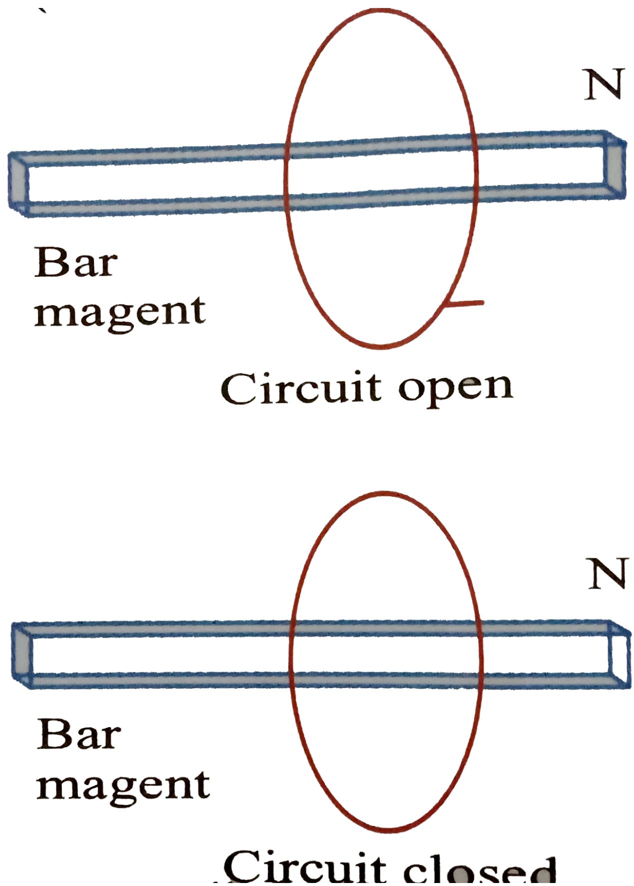
7. Consider a magnet surround by a wire with an on / of switch S (figure) if the switch is thrown from the off position (open circuit) to the on position the (closed circuit).



A. The current will flow in $C.W$ direction as seen from the left side

B. the current will flow in anti clock wise direction as seen from $L.H.S$

C. The current will not flow

D. Can not be decided.

Answer: C

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8. A wire in the form of a tightly would solenoid is connected to a DC source, and carries a current. If the coil is stretched so that there are gaps between successive elements of the spiral coil, then

A. No change in current

B. current will increase

C. Current will decrease

D. Flux through the coil will increase.

Answer: B

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9. A solenoid is connected to a battery so that a steady current flows through it. If an iron core is inserted into the solenoid, then

A. The current will not change

B. The current will increase

C. the current will decrease

D. the flux through the coil will decrease.

Answer: C

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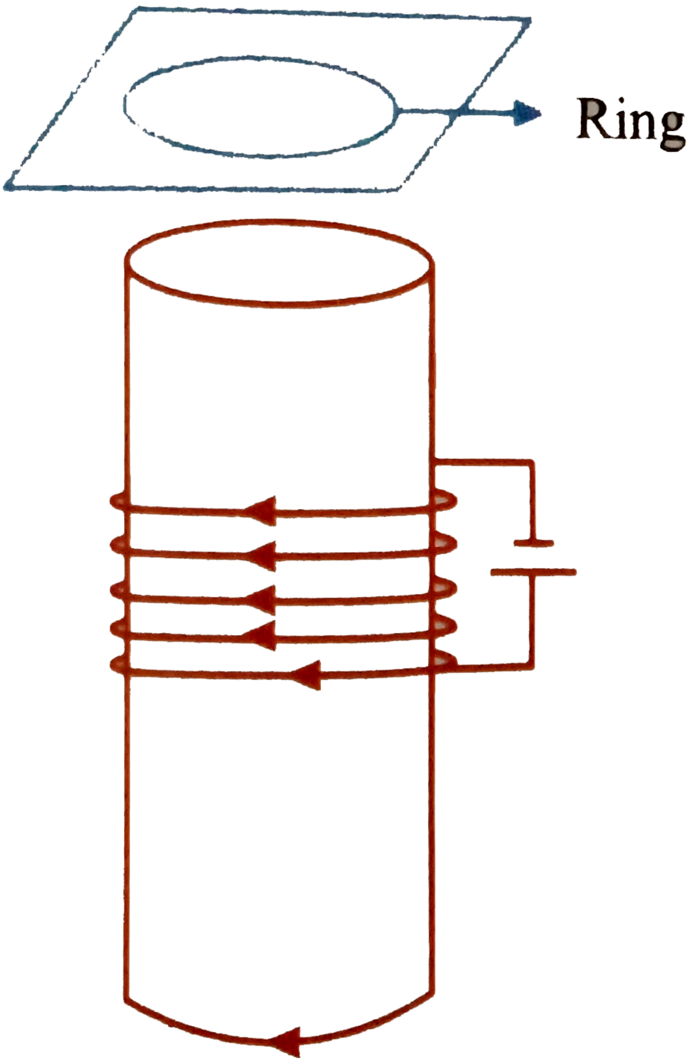
10. Consider a metal ring kept on top of a fixed solenoid (say on a carboard) The centre of the ring coincides with the axis of the solenoid.

If the current is suddenly switched on then



A. The metal ring is attracted

B. The metal ring is jumped up

C. No change in magnetic flux through the ring when switch is suddenly closed

D. Can not be decided.

Answer: B

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Single Answer Questions Level -V

1. A helicopter has metallic blades with a length pf $3m$ extending outward from a central hub and rotating at $2rev/s$. If the vertical component of the earht's magnetic field is $50\mu T$, then the emf induced between the blade tip and the centre hub is

A. $4.95V$

B. $2.83mV$

C. $5.66mV$

D. $11mV$

Answer: B

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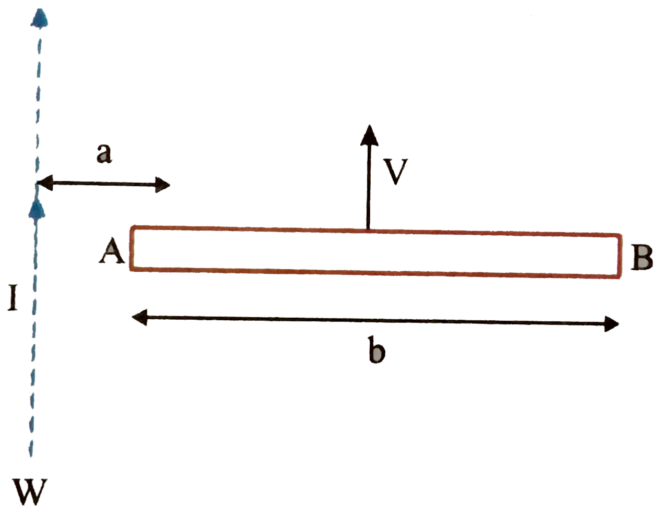
2. In the figure shown AB is a plastic rod moving with a constant velocity v, W is an infinite long wire carrying current I. The end of the rod which is at higher potential is



A. A

B. B

C. No emf will br induced in the rod

D. None of the above

Answer: C

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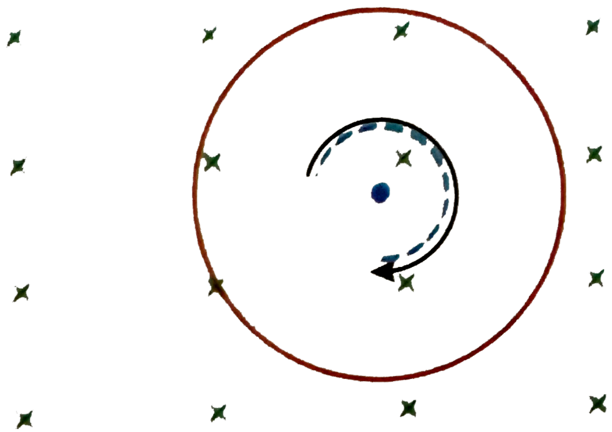
3. A non-conducting disk of radius R is rotating about its own axis with constant angular velocity ω in a perpendicular uniform magnetic field B as shown in figure. The emf induced between centre and rim of disk is



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

B. $B\omega R^2$

C. Zero

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

Answer: C

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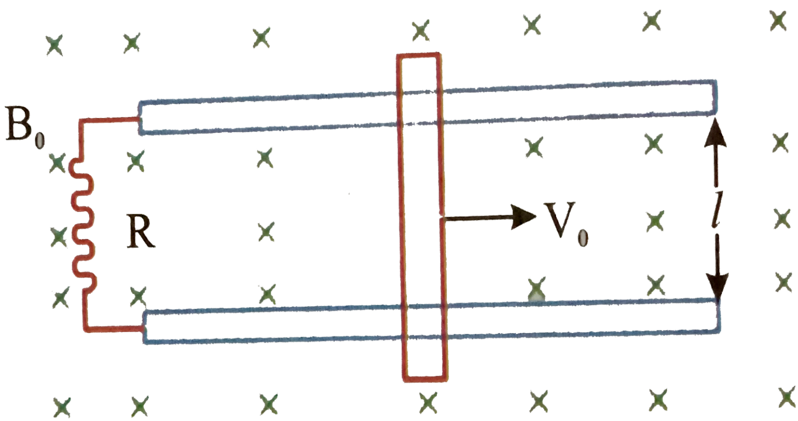
4. A conducting bar mass m and length l moves on two frictionless parallel conducting rails in the presence of a uniform magnetic field B_0 directed into the paper. The bar is given an initial velocity v_0 to the right and is released at $t = 0$. The velocity of the bar as a function of time is given by



A. $v_0 \times \frac{mRt}{B_0^2 l^2}$

B. $v_0 e^{-\frac{B_0^2 l^2 t}{mR}}$

C. $v_0 \times e^{\frac{-2B_0^2 l^2 t}{mR}}$

D. $v_0 e^{-\frac{B_0^2 l^2 t}{2mR}}$

Answer: B

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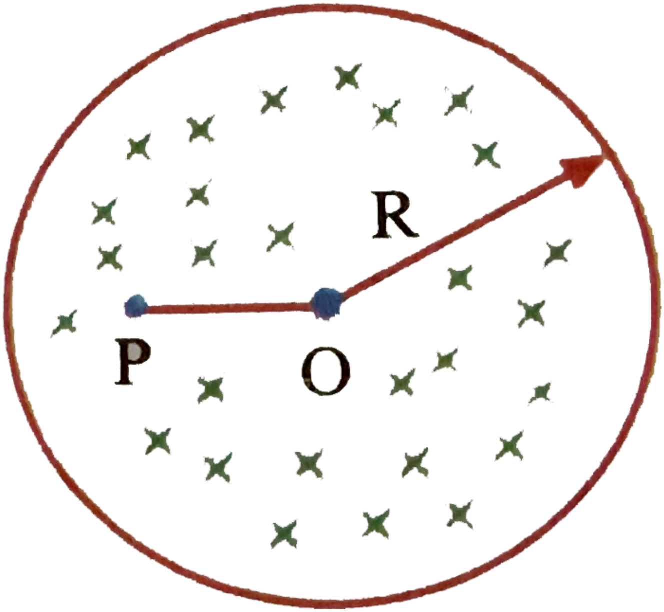
5. In a cylinder region of radius R, a uniform magnetic field is there which is increasing with time, according as $B = B_0 t^2$. A positive point charge q is released from rest at $P\left(OP = \frac{R}{2}\right)$ at $t = 0$ [the instant the field is switched on]



The force experienced by, the point charge at $t = 1s$, is $(R = 2m)$

A. qB_0, anti-clockwise

B. qB_0, clockwise

C. $2qB_0$, anti-clockwise

D. $2qB_0$, clockwise

Answer: C

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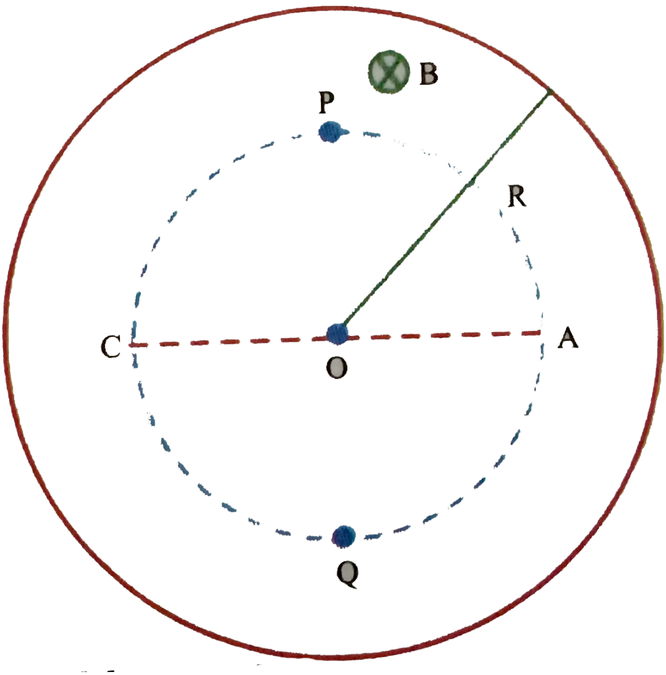
6. A uniform field B increasing with time exists in a cylindrical region of centre O and radius R. The direction of magnetic field is inwards the paper as shown. The work done by external agent in taking a unit positive charge slowly from A to C via paths APC, AOC and AQC be W_{APC}, Q_{AOC} and W_{AQC} respectively. Then-



A. $W_{APC} = W_{AOC} = W_{AQC}$

B. $W_{APC} > W_{AOC} > W_{AQC}$

C. $W_{APC} < W_{AOC} < W_{AQC}$

D. $W_{APC} = W_{AQC} < W_{AOC}$

Answer: B

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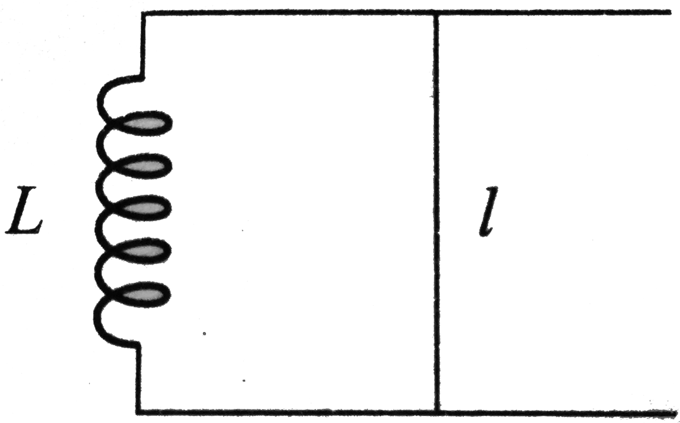
7. Two parallel resistanceless rails are connected by an inductor of inductance L at one end as shows in Fig. A magnetic field B exists in the space which is perpendicular to the plane of the rails. Now a conductor of length l and mass m is placed transverse on the rail and given an impulse J toward the rightward direction. Then choose the correct option (s).



A. Velocity of the conductor is half of the initial velocity after a displacement of the conductor

$$d = \sqrt{\frac{3J^2L}{4B^2l^2m}}$$

B. Velocity of the conductor is half of the initial velocity after a displacement of the conductor

$$d = \sqrt{\frac{3J^2L}{B^2l^2m}}$$

C. Current flowing trough the inductor at the instant when velocity of the conductor is half of the initial velocity $i = \sqrt{\frac{3J^2}{4Lm}}$

D. Current flowing trough the inductor at the instant when velocity of the conductor is half of the initial velocity $i = \sqrt{\frac{3J^2}{Lm}}$

Answer: A::C

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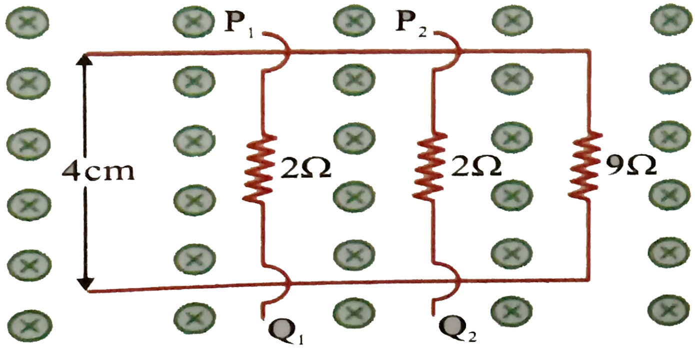
8. In the figure shown , the wires P_1Q_1 and P_2Q_2 are made to slide on the rails with same speed of $5cms^{-1}$. In this region a magnetic field of $1T$ exists. The electric current in the 9Ω resistance is :



A. Zero if both wires slide towards left

B. Zero if both wires slide in opposite directions

C. $0.2mA$ if both wires move towards left

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

Answer: B::C

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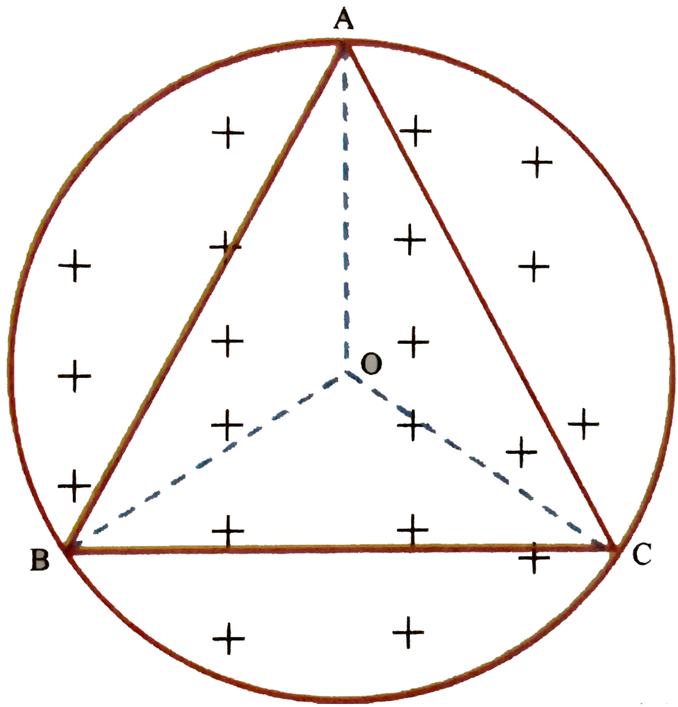
9. In the figure shown there exists a uniform time varying magnetic field $B = [(4T/s)t + 0.3T]$ in a cylinderical region of radius $4m$. An equilateral traingualr conducting loop is placed in the magnetic field with its centroide on the axis of the field and its plane perpendicular to the field.



A. $e.m.f.$ induced in any one rod is $16V$

B. $e.m.f.$ incduced in the complete ΔABC is $48\sqrt{3}V$

C. $e.m.f.$ induced in the complete ΔABC is $48V$

D. $e.m.f.$ induced in any one rod is $16\sqrt{3}V$

Answer: B::D

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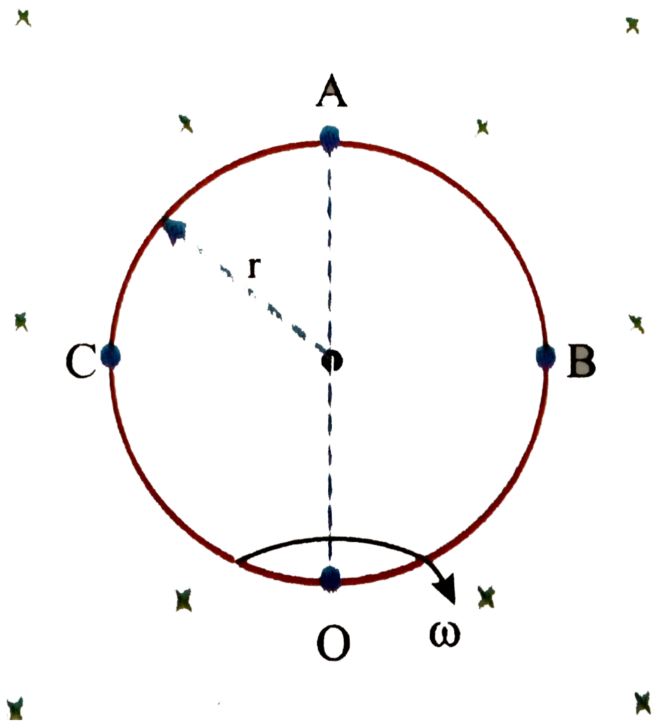
10. In figure, there is conducting ring having resistance R placed in the plane of paper in a uniform magnetic field B_0. If the rings is rotating in the plane of paper about an axis passing through point O and perpendicular to the plane of paper with constant angular speed ω in clockwise direction,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



A. Point A will be at higher potential than O.

B. The potential of point B and C will be same.

C. The current in ring will be zero.

D. The current in the ring will be $\frac{2B_0\omega. r^2}{R}$.

Answer: A::B::C

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

A. If $0 < n < 1$, $e \neq 0$ and $|e|$ decreases with time.

B. If $n = 1$, e is constant

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

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

Answer: A::B::C

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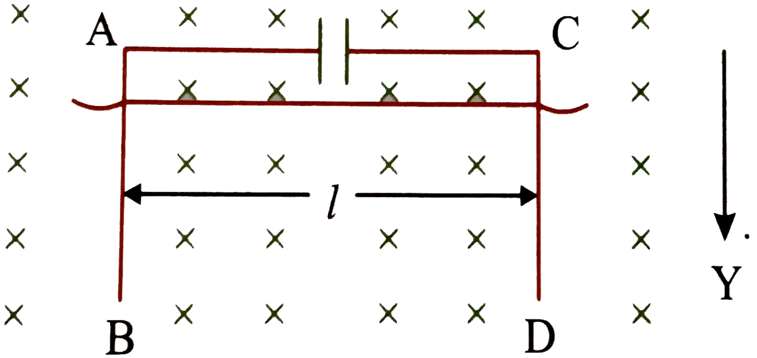
Comprehension Type Questions

1. A conductor of mass m and length l is sliding smoothly an two vertical conducting rails AB and CD as shown in figure. The top ends of two conducting rails are joined by a capacitor of capacitance C. The conductor is relased from rest when it is very close to AC i.e., $y = 0$. A uniform magnetic field B_0 perpendicular to plane of figure existing. Neglect the resistance of rails and connecting wires. Take acceleration due to gravity to be g.



Based on above information answer the following questions:

Mark the correct statement about the motion of conductor

A. It is falling down with constant acceleration g

B. It is falling down with constant acceleration but not equal to g

C. It is falling down with increasing acceleration

D. It is falling down with decreasing acceleration

Answer: B

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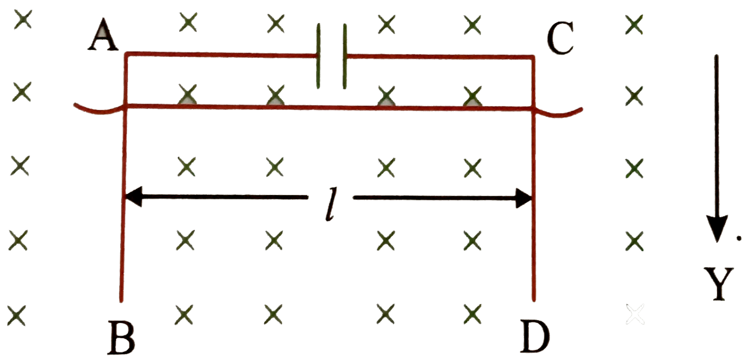
2. A conductor of mass m and length l is sliding smoothly an two vertical conducting rails AB and CD as shown in figure. The top ends of two conducting rails are joined by a capacitor of capacitance C. The conductor is relased from rest when it is very close to AC i.e., $y = 0$. A uniform magnetic field B_0 perpendicular to plane of figure existing. Neglect the resistance of rails and connecting wires. Take acceleration due to gravity to be g.



Based on above information answer the following questions:

Charge on the capacitor as a function of distance travelled y is given by

A. $CB_0l\sqrt{\dfrac{2mgy}{m + CB_0^2l^2}}$

B. $CB_0l\sqrt{\frac{m+CB_0^2l^2}{2mgy}}$

C. $CB_0le^{\frac{mgy}{m+CB_0^2l^2}}$

D. $CB_0l\sqrt{\frac{2mgy}{m+CB_0^2l^2}} \times e^{\frac{mgy}{m+CB_0^2l^2}}$

Answer: A

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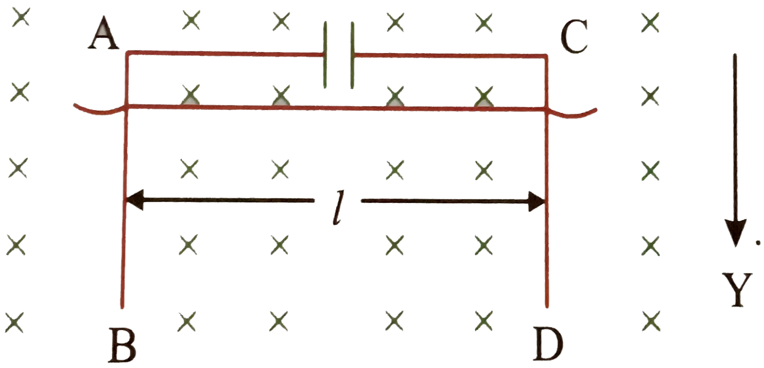
3. A conductor of mass m and length l is sliding smoothly an two vertical conducting rails AB and CD as shown in figure. The top ends of two conducting rails are joined by a capacitor of capacitance C. The conductor is relased from rest when it is very close to AC i.e., $y = 0$. A uniform magnetic field B_0 perpendicular to plane of figure existing. Neglect the resistance of rails and connecting wires. Take acceleration due to gravity to be g.



Based on above information answer the following questions:

Current in the circuit is

A. constant

B. increasing with time

C. decreasing with time

D. First increase, then reaches a maximum value, and then starts decreasing to attain a constant value finally

Answer: A

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4. A thin non-conducting ring mass m, radius a, carrying a charge q can rotate freely about its own axis which is vertical. At the initial moment the ring was at rest and no magnetic field was present. At instant $t = 0$, a uniform magnetic field is switched on which is vertically downwards and increase with time according to the law $B = B_0 t$. Neglecting magnetism induced due to totational motion of the ring. Now answer the following questions.

The angular acceleration of the ring and its direction of rotation as seen from above: if E is induced $e. m. f$

A. $\frac{Eq}{2ma}$, anticlockwise

B. $\frac{Eq}{ma}$, anticlockwise

C. $\frac{2Eq}{ma}$, clockwise

D. $\frac{Eq}{ma}$ clockwise

Answer: B

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5. A thin non-conducting ring mass m, radius a, carrying a charge q can rotate freely about its own axis which is vertical. At the initial moment the ring was at rest and no magnetic field was present. At instant $t = 0$, a uniform magnetic field is switched on which is vertically downwards and increase with time according to the law $B = B_0 t$. Neglecting magnetism induced due to totational motion of the ring. Now answer the following questions.

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

A. $\dfrac{E^2 q^2}{2m} t$

B. $\dfrac{E^2 q^2}{m} t$

C. $\dfrac{2E^2 q^2}{m} t$

D. $\dfrac{\sqrt{2} E^2 q^2}{m} t$

Answer: B

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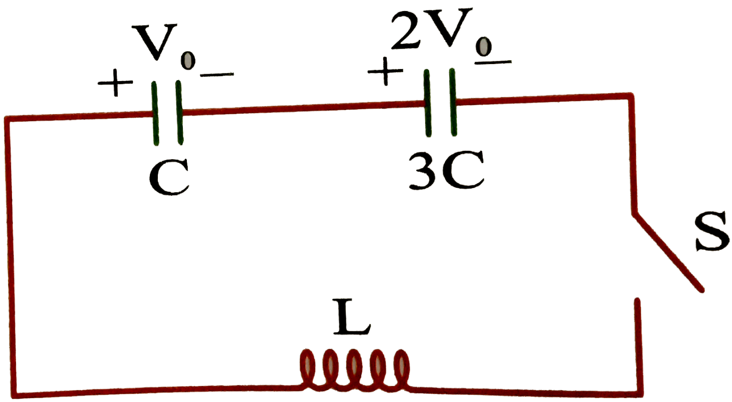
6. Two capacitors of capacitance C and $3C$ are charged to potential difference V_0 and $2V_0$ respectively, and connected to an inductor of inductance L as shown in figure. Initially the current in the inductor is zero. Now, the switch S is closed.



The maximum current in the indcutor is :

A. $\frac{3V_0}{2}\sqrt{\frac{3C}{L}}$

B. $V_0\sqrt{\frac{3C}{L}}$

C. $2V_0\sqrt{\frac{3C}{L}}$

D. $V_0\sqrt{\frac{C}{L}}$

Answer: A

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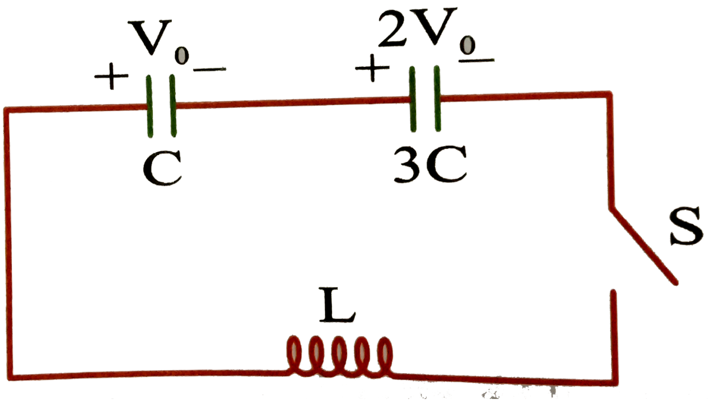
7. Two capacitors of capacitance C and $3C$ are charged to potential difference V_0 and $2V_0$ respectively, and connected to an inductor of inductance L as shown in figure. Initially the current in the inductor is zero. Now, the switch S is closed.



Potential difference across capacitor of capacitance C when the current in the cirucit is maximum is

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

B. $\frac{3V_0}{4}$

C. $\frac{5V_0}{4}$

D. $\frac{7V_0}{4}$

Answer: C

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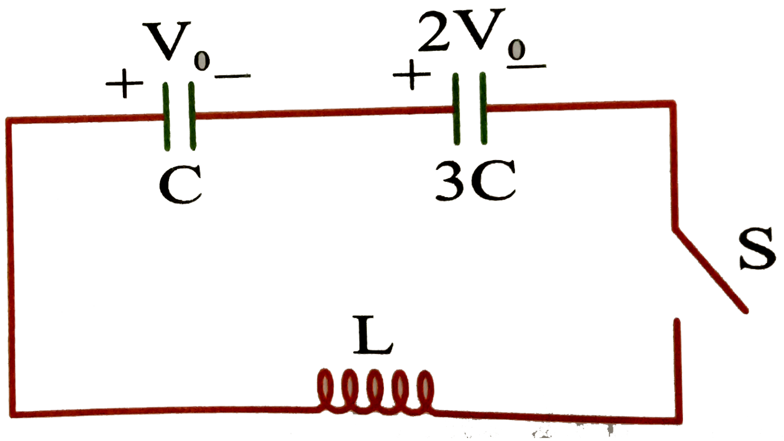
8. Two capacitors of capacitance C and $3C$ are charged to potential difference V_0 and $2V_0$ respectively, and connected to an inductor of inductance L as shown in figure. Initially the current in the inductor is zero. Now, the switch S is closed.



Potential difference across capacitor of capacitance $3C$ when the current in the cirucit is maximum is :

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

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

C. $\frac{5V_0}{4}$

D. $\frac{7V_0}{4}$

Answer: C

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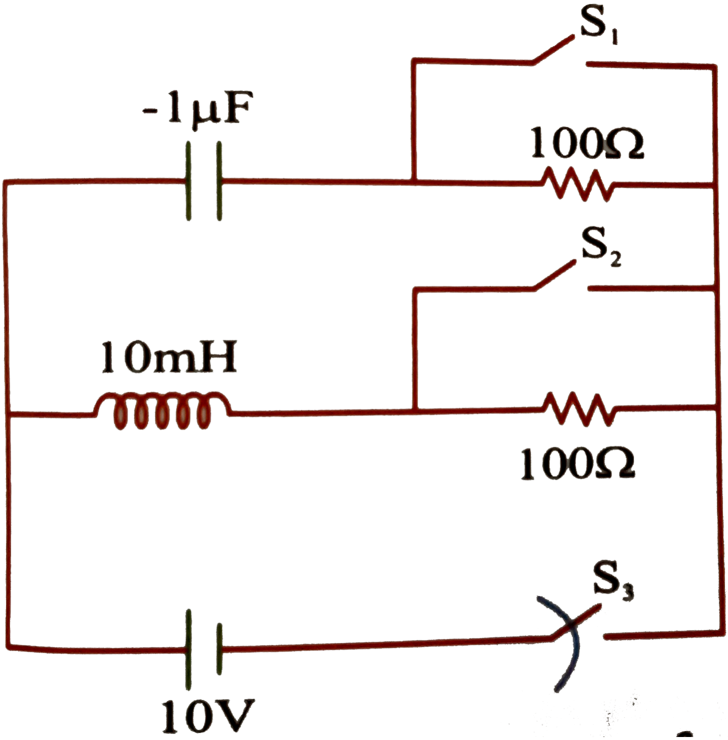
9. Switches S_1, S_2 remain open and switch S_3 remains closed for long time such that capacitor becomes fully charged and current in inductor coil becomes maximum, Now switches S_1, S_2 are simultaneously closed andS_3 in simultaneously opened at $t = 0$

Assume that battery and inductor coil are ideal



Charge (in μC) on capacitor as a function of time is :

A. $q = 10\sqrt{2}\sin\left[10^4 t + \frac{3\pi}{4}\right]$

B. $q = 10\sin\left[10^4 t + \frac{3\pi}{4}\right]$

C. $q = 10\sin\left[10^2 t + \frac{3\pi}{4}\right]$

D. $q = 10\sqrt{2}\sin\left[10^2 t + \frac{3\pi}{4}\right]$

Answer: A

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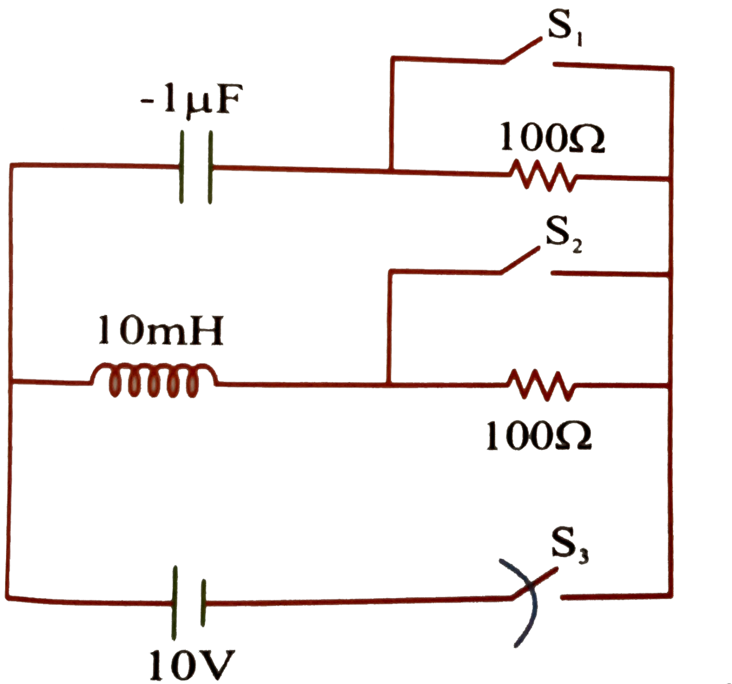
10. Switches S_1, S_2 remain open and switch S_3 remains closed for long time such that capacitor becomes fully charged and current in inductor coil becomes maximum, Now switches S_1, S_2 are simultaneously closed and S_3 in simultaneously opened at $t = 0$

Assume that battery and inductor coil are ideal



Maximum current in the inductor coil at any times $t > 0$

A. $\frac{1}{10}A$

B. $\frac{1}{5\sqrt{2}}A$

C. $\frac{1}{5}A$

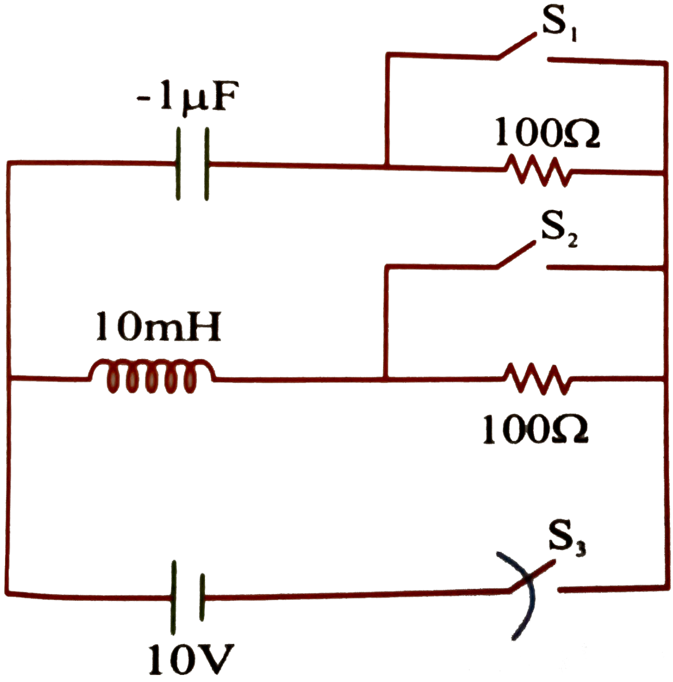
D. $1A$

Answer: A

Watch Video Solution

11. Switches S_1, S_2 remain open and switch S_3 remains closed for long time such that capacitor becomes fully charged and current in inductor coil becomes maximum, Now switches S_1, S_2 are simultaneously closed andS_3 in simultaneously opened at $t = 0$

Assume that battery and inductor coil are ideal



Find time $t > 0$, when energy store in inductor would have minimum for the first time ?

A. $\frac{\pi}{4} \times 10^{-4} s$

B. $\frac{\pi}{4} \times 10^{-4} s$

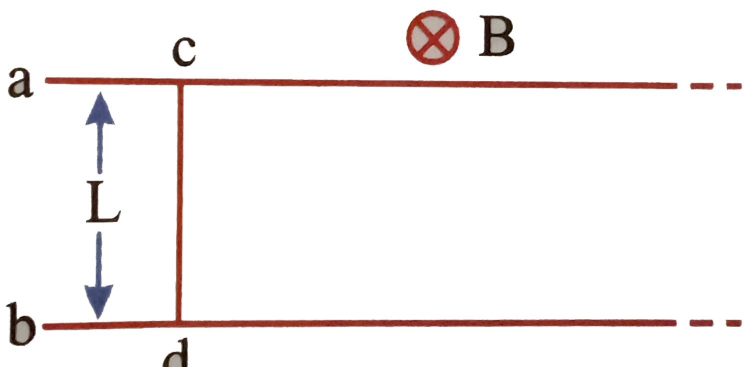
C. $\frac{3\pi}{4} \times 10^{-4} s$

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

Answer: C

Watch Video Solution

12. In the shown figure, there are two long fixed parallel conducting rails (having negligible resistance) and are separated by distance L. A uniform rod of resistance R and mass M is placed at rest on frictionless rails. Now at time $t = 0$, a capacitor having charge Q_0 and capacitance C is connected across rails at ends a and b such that current in rod (cd) is from c towards d and the rod is released. A uniform and constant magnetic field having magnitude B exists normal to plane of paper as shown. (Neglect acceleration due to gravity)



When the speed of rod is v, the charge on capacitor is :

A. $\left(Q_0 - \dfrac{RM}{LBC}v\right)$

B. $\left(Q_0 - \dfrac{M}{RC^2B}v\right)$

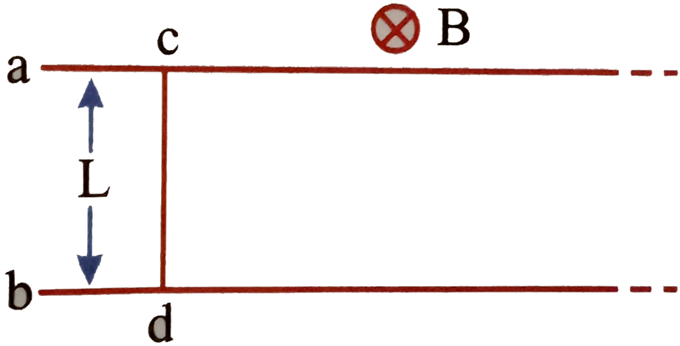
C. $\left(Q_0 - \frac{M}{LB}v\right)$

D. $\left(Q_0 - \frac{M}{RCB}v\right)$

Answer: C

Watch Video Solution

13. In the shown figure, there are two long fixed parallel conducting rails (having negligible resistance) and are separated by distance L. A uniform rod of resistance R and mass M is placed at rest on frictionless rails. Now at time $t = 0$, a capacitor having charge Q_0 and capacitance C is connected across rails at ends a and b such that current in rod (cd) is from c towards d and the rod is released. A uniform and constant magnetic field having magnitude B exists normal to plane of paper as shown. (Neglect acceleration due to gravity)



When the acceleration of rod is zero, the speed of rod is :

A. $\dfrac{Q_0R^2BC}{M+B^2L^2C^2}$

B. $\dfrac{Q_0LB}{M+B^2L^2C}$

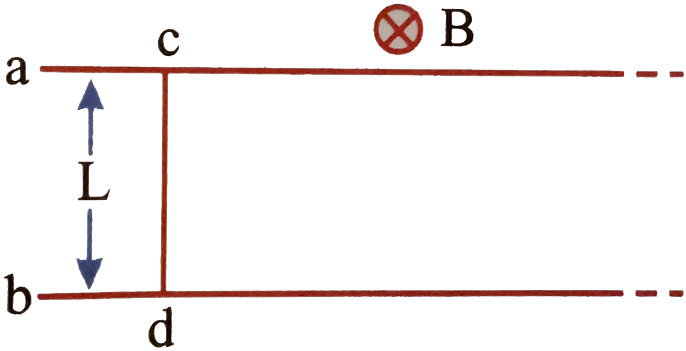
C. $\dfrac{Q_0LB}{M+B^2R^4C^4}$

D. $\dfrac{Q_0LB}{M+B^2L^2C^2}$

Answer: B

Watch Video Solution

14. In the shown figure, there are two long fixed parallel conducting rails (having negligible resistance) and are separated by distance L. A uniform rod of resistance R and mass M is placed at rest on frictionless rails. Now at time $t = 0$, a capacitor having charge Q_0 and capacitance C is connected across rails at ends a and b such that current in rod (cd) is from c towards d and the rod is released. A uniform and constant magnetic field having magnitude B exists normal to plane of paper as shown. (Neglect acceleration due to gravity)



When the acceleration of rod is zero, the charge on capacitor is:

A. $\dfrac{B^2L^2CQ_0}{M + B^2L^2C}$

B. $\dfrac{B^2R^4C^3Q_0}{M + B^2L^2C^2}$

C. $\dfrac{B^2R^4C^3Q_0}{M + B^2R^4C^4}$

D. $\dfrac{B^2L^2CQ_0}{M + B^2L^2C^2}$

Answer: A

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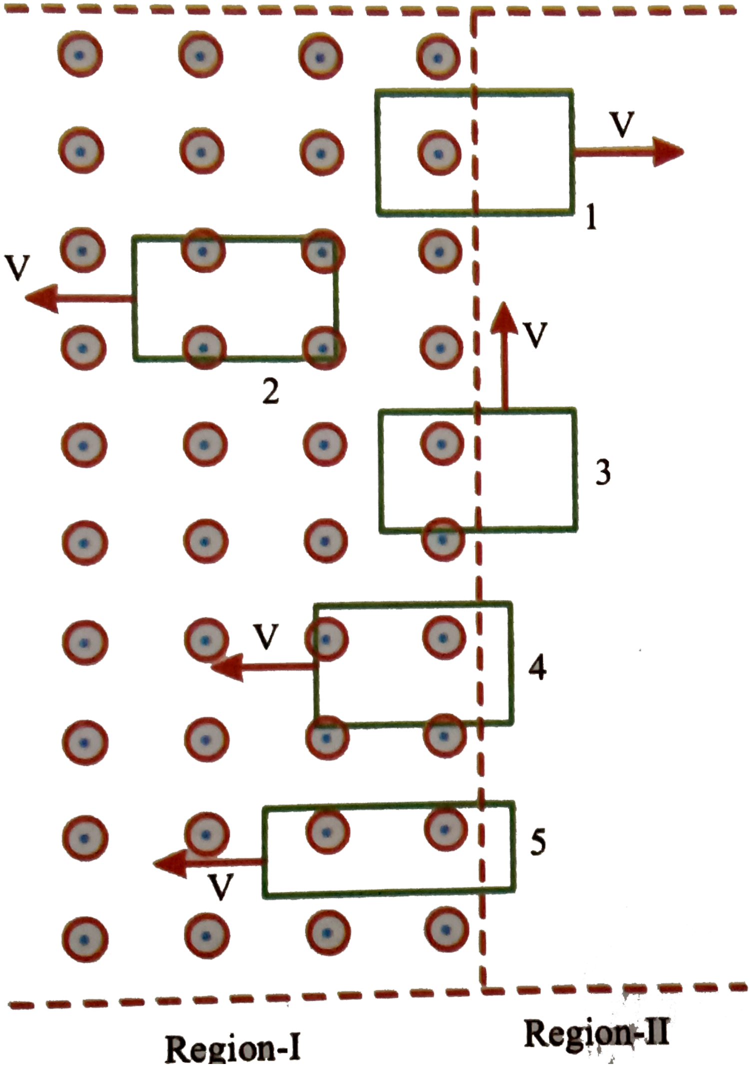
15. Six loops are formed of copper wire of the same cross-sectional area. Loops 1, 2, 3 and 4 are identical, loop 5 has the same area as the others but is longer. At the instant shown, all the loops are moving at the same speed in the directions indicated. A uniform and constant magnetic field points out of the page in region I, in region II there is no magnetic field. Ignore any interaction between the loops.



Then the number of loop or loops in which current is nonzero and in clockwise direction

A. no loop

B. one loop

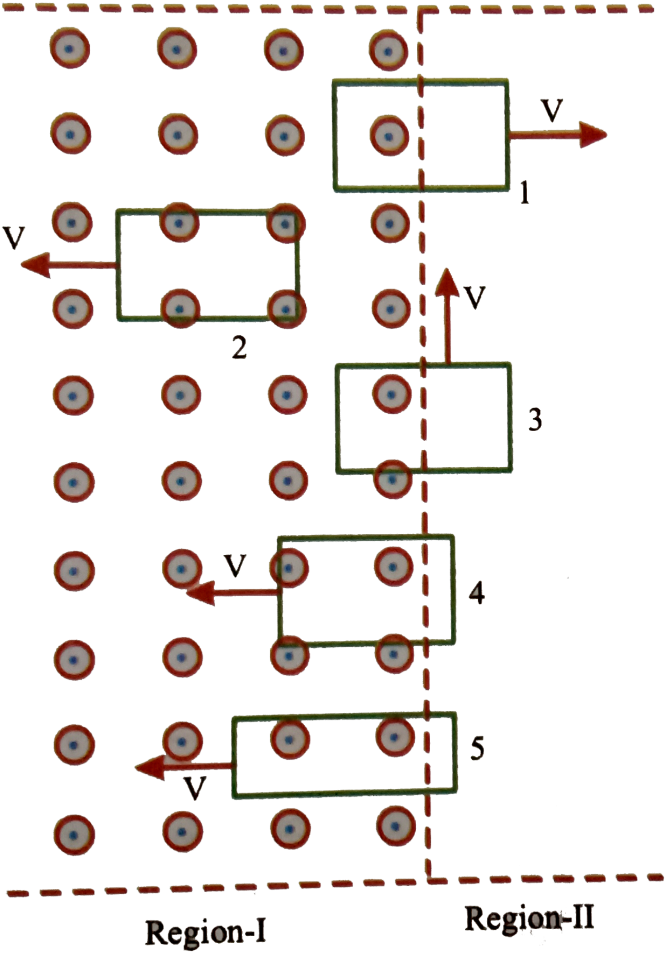
C. two loops

D. Three loops

Answer: C

Watch Video Solution

16. Six loops are formed of copper wire of the same cross-sectional area. Loops $1, 2, 3$ and 4 are identical, loop 5 has the same area as the others but is longer. At the instant shown, all the loops are moving at the same speed in the directions indicated. A uniform and constant magnetic field points out of the page in region I, in region II there is no magnetic field. Ignore any interaction between the loops.



The corretc order of magnitudes of current in the loops is

A. $I_5 > I_4 = I_1 > I_2 = I_3$

B. $I_4 > I_1 > I_5 > I_2 = I_3$

C. $I_5 = I_4 > I_1 > I_2 = I_3$

D. $I_4 = I_1 > I_5 > I_2 = I_3$

Answer: D

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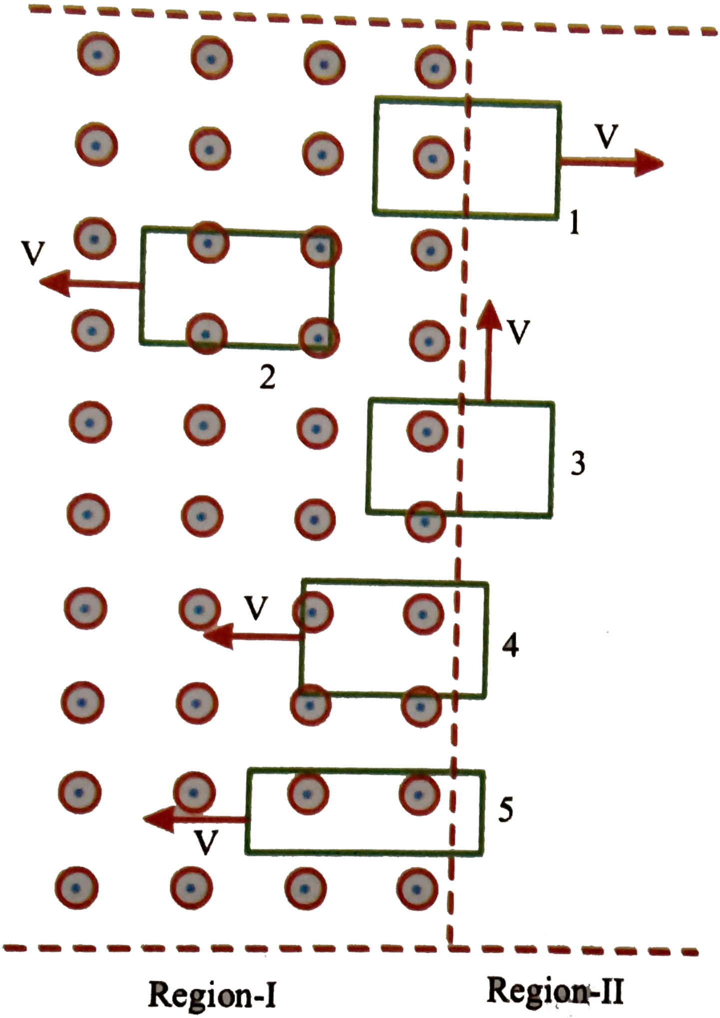
17. Six loops are formed of copper wire of the same cross-sectional area. Loops $1, 2, 3$ and 4 are identical, loop 5 has the same area as the others but is longer. At the instant shown, all the loops are moving at the same speed in the directions indicated. A uniform and constant magnetic field points out of the page in region I, in region II there is no magnetic field. Ignore any interaction between the loops.



The correct order of magnitudes of emf induced in the loop is

A. $E_5 > E_1 = E_4 > E_2 = E_3$

B. $E_1 = E_4 > E_5 > E_2 = E_3$

C. $E_1 > E_4 > E_5 > E_2 = E_3$

D. $E_4 > E_1 > E_5 > E_2 = E_3$

Answer: B

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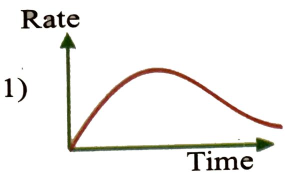
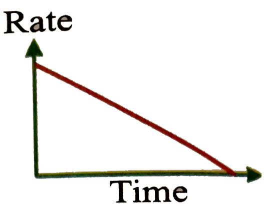
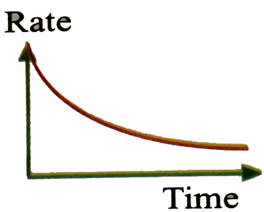
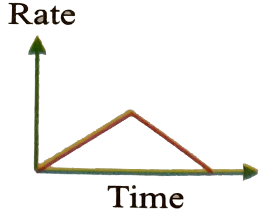
18. In an LR circuit connected to a battery, the rate at which energy is stored in the inductor is plotted against time during the growth of current in the circuit. Which of the following best represents the resulting curve?

A. 

B. 

C. 

D. 

Answer: A

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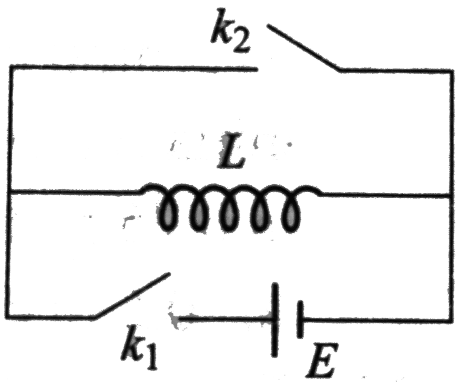
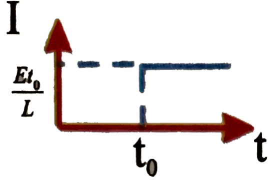
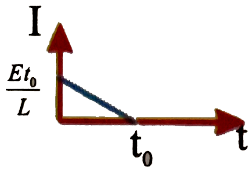
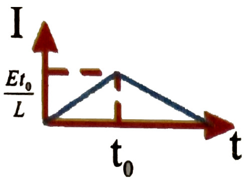
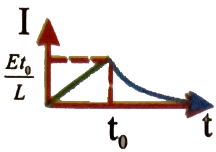
19. In the circuit shown in Fig. switch k_2 is open and switch k_1 is closed at $t = 0$. At time $t = t_0$, switch k_1 is open and switch k_2 is simultaneosuly closed. The variation of inductor current with time is



A. 

B. 

C. 

D. 

Answer: A

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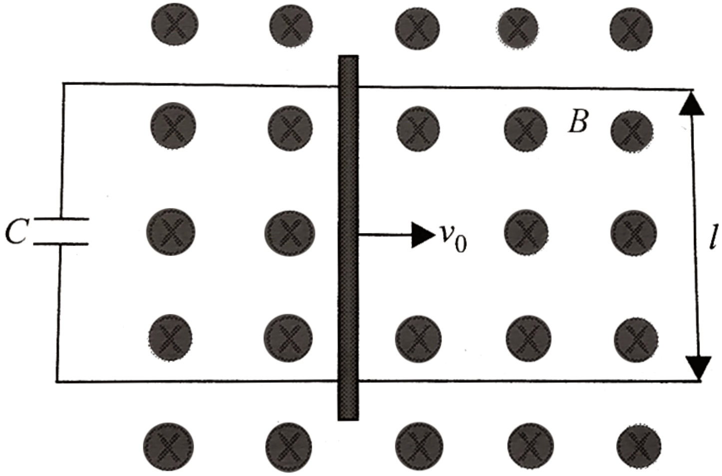
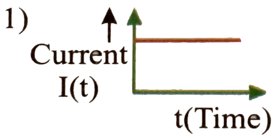
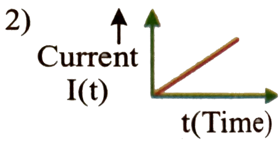
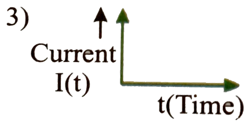
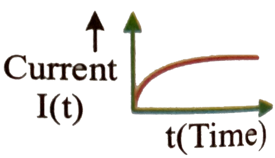
20. Two infinitely long conducting parallel rails are connected through a capacitor C as shown in Fig. A conductor of length l is moved with constant speed v_0. Which of the following graph truly depicts the variation of current through the conductor with time?



A.


B.


C.


D.


Answer: C

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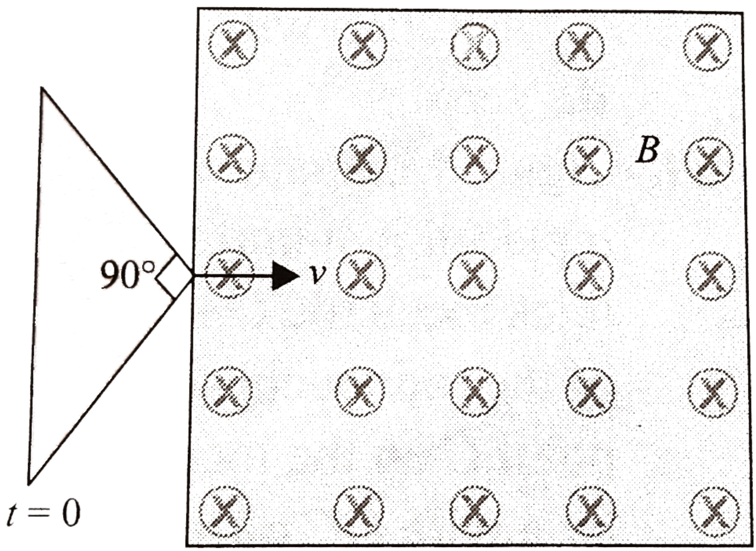
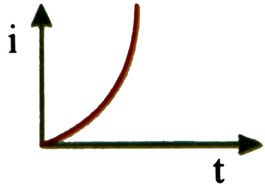
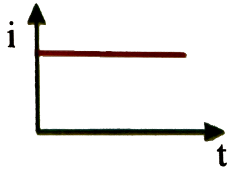
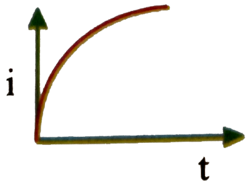
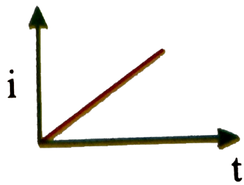
21. Figure shows an isosceles triangle wire frame with apex angle equal to $(\pi)/2$. The frame starts entering into the region of uniform magnetic field B with constant velocity v at t =0. The longest side of the frame is perpendicular to the direction of velocity. If i is the intantaneous current through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



A. 

B. 

C. 

D. 

Answer: D

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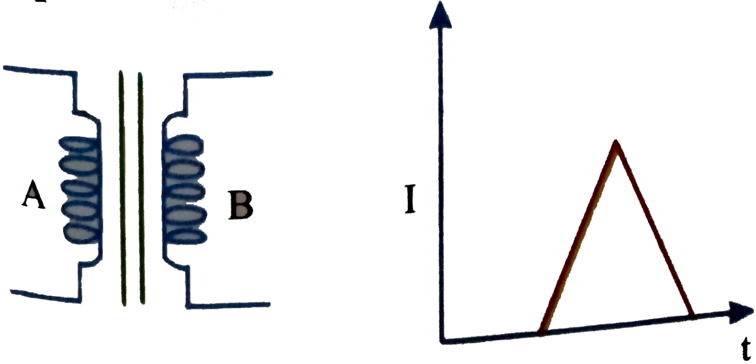
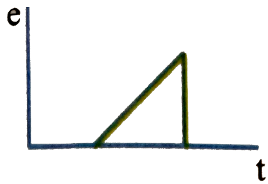
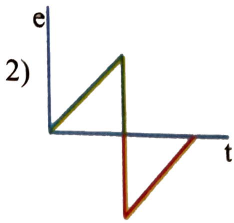
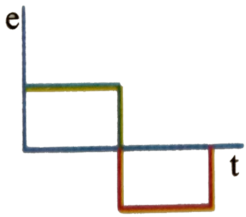
22. A and B are two coils placed closely as shown. The current in coil A varies as shown in the graph.

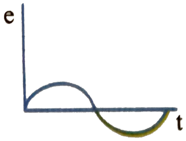


Then which of the following graphs gives the best respresent of variation of induction emf in coil B?

A. 

B. 

C. 

4) 

D.

Answer: C

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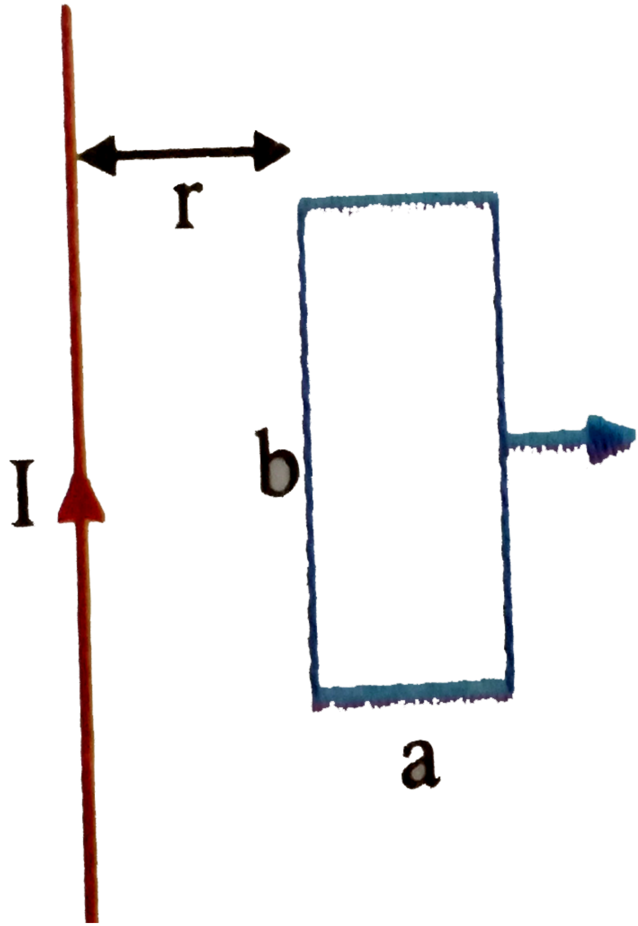
Single Answer Questions Level -VI

1. A rectangular loop of wire with dimensions shown in figure is coplanar with a long wire carrying current $'I'$. The distance between the wire and the left side of the loop is r. The loop is pulled to the right as indicated. What are the directions of the induced current in the loop and the magnetic forces on the left and right sides of the loop when the loop is pulled ?



A.

Induced current	Force on left side	Force om right side
Counterclockwise	To the left	To the left

B.

Induced current	Force on left side	Force om right side
Counterclockwise	To the right	To the left

C.

Induced current	Force on left side	Force om right side
Clockwise	To the right	To the left

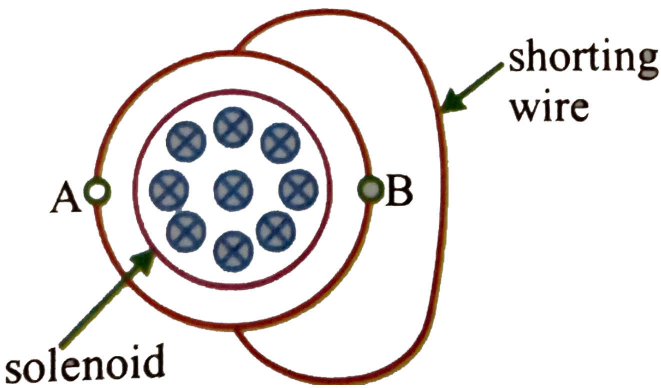
D.

Induced current	Force on left side	Force om right side
Clockwise	To the left	To the right

Answer: D

Watch Video Solution

2. A very long solenoid with its axis perpendicular to the page generates an inward magnetic field whose magnitude increases with time. This induces an emf in a conducting wire loop around the solenoid which lights two identical bulbs A and B connected in series along the wire. Now two points dimetrically opposite on the wire loop are shorted with another conducting wire (having zero resistance) lying to the right og bulb B in the plane of the page. After the shorting wire is inserted:



A. bulb A does not glow, and bulb B dims.

B. bublb A does not glow, and bulb B gets brighter.

C. bulb B does not glow, and bulb A dims.

D. bulb B does not glowm, and bulb A goes brighter.

Answer: D

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3. A coil having N turns is would tightly in the form of a spiral with inner and outer radii a and b respectively. When a current I passes through the coil, the magnetic field at the centre is.

A. $\frac{\mu_0 NI}{b}$

B. $\frac{2\mu_0 NI}{a}$

C. $\frac{\mu_0 NI}{2(b-a)} \ln \frac{b}{a}$

D. $\frac{\mu_0 IN}{(b-a)} \ln \frac{b}{a}$.

Answer: C

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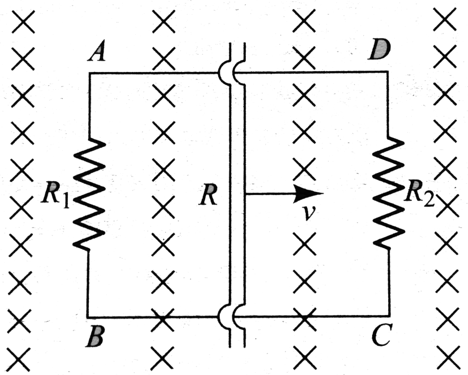
4. A rectangular loop with a sliding conductor of length l is located in a uniform magnetic field perpendicular to the plane of the loop . The magneitc inducetion is b. The resistances R_1 and R_2, respectively. Find the current through the conductor during its motion to the right with a constant velocity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



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

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

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

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

Answer: C

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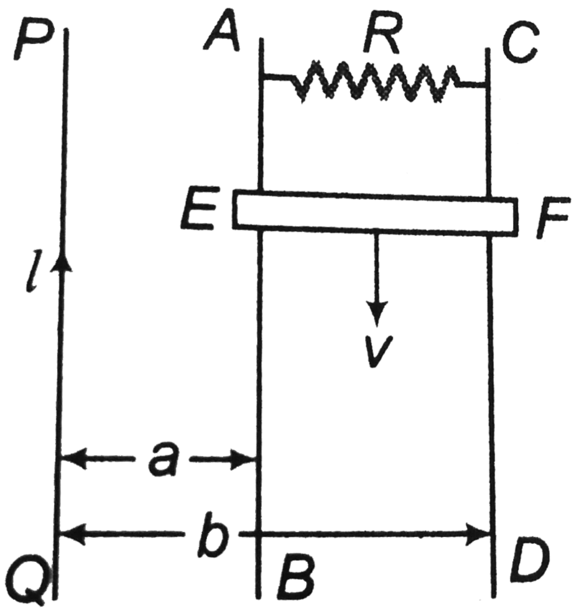
5. PQ is an infinite current carrying conductor. AB and CD are smooth conducting rods on which a conductor EF moves with constant velocity v as shown. The force needed to maintain constant speed of EF is



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

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

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

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

Answer: A

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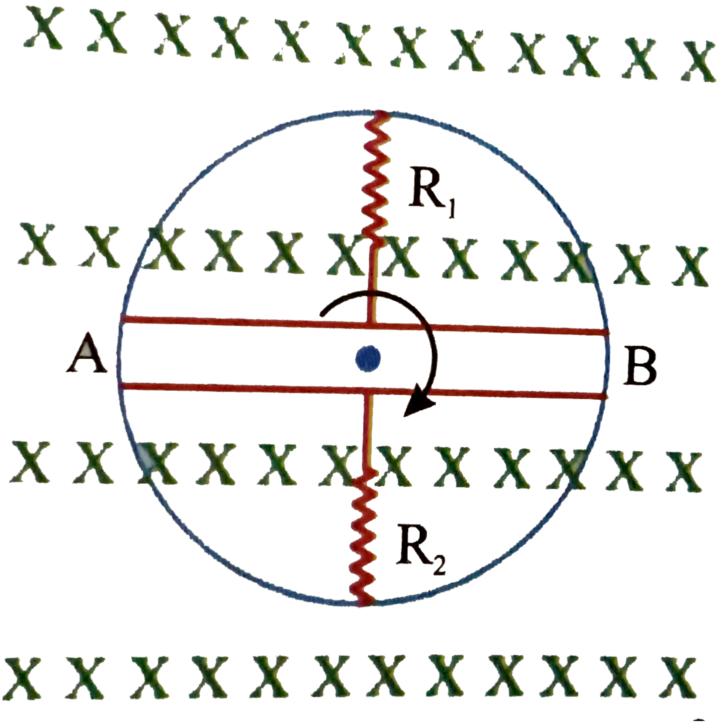
6. AB is a resistanceless conducting rod which forms a diameter of a conducting ring of radius r rotating in a uniform magnetic field B as shown in figure. The resistance R_1 and R_2 do not rotate. Then the

current through the resistor R_1 is



A. $\frac{B\omega r^2}{2R_1}$

B. $\frac{B\omega r^2}{2R_2}$

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

D. $\frac{B\omega r^2}{2(R_2+R_2)}$

Answer: A

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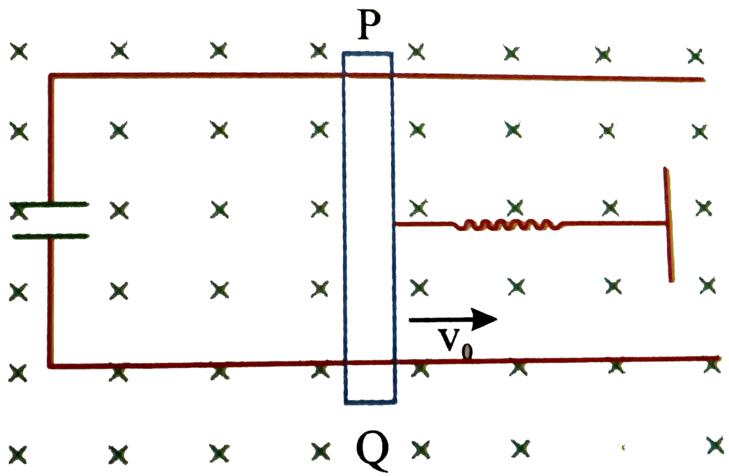
7. A conducting rod PQ of mass m and length l is placed on two long parallel (smooth and conducting) rails connected to a capacitor as shown. The rod PQ is connected to a non conducting spring of spring constant k, which is initially in relaxed state. The entire arrangement is placed in a magnetic feild perpendicular to the plane of figure.

Neglect the resistance of the rails and rod.

Now, the rod is imparted a velocity v_0 towards right, then acceleration of the rod as a function of its displacement x given by



A. $\dfrac{kx}{m}$

B. $\dfrac{kx}{m+B^2l^2C}$

C. $\dfrac{kx}{m - B^2 l^2 C}$

D. $\dfrac{kx}{B^2 l^2 C}$

Answer: C

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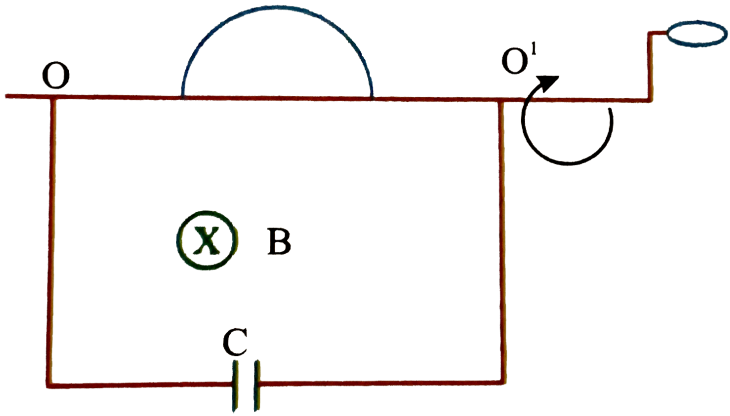
8. A copper rod is bent inot a semi-circle of radius a and at ends straight parts are bent along diameter of the semi-circle and are passed through fixed, smooth and conducting ring O and O' as shown in figure. A capacitor having capacitance C is connected to the rings. The system is located in a uniform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



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

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

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

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

Answer: B

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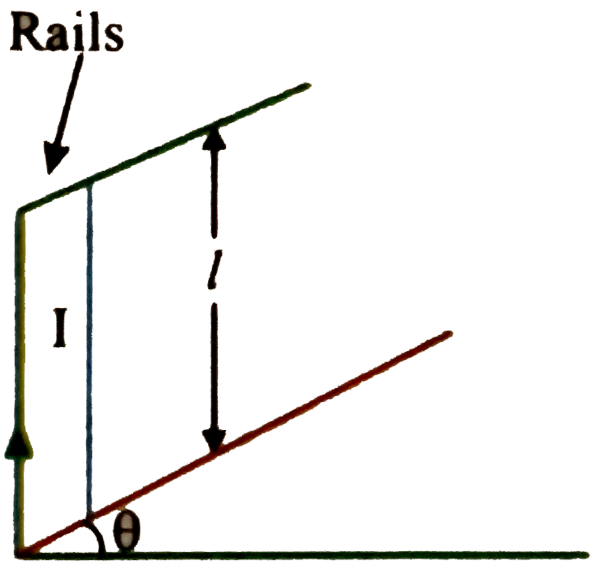
9. A conducting wire of length l and mass m is placed on two inclined rails as shown in figure. A current I is flowig in the wire in the direction shown When no magnetic field is present in the region, the wire is just on the verge of sliding. When a vertically upward magnetic field is switched on, the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



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

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

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

D. $\frac{1}{2}\left[\frac{IBl}{m}\frac{\cos 2\theta}{\cos\theta} - 2g\sin\theta\right]t^2$

Answer: D

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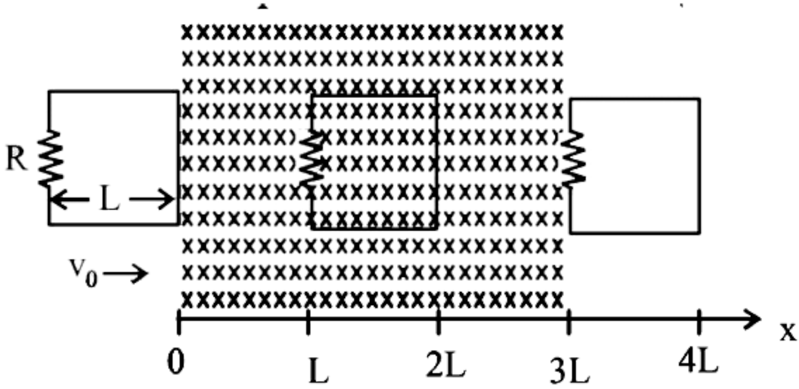
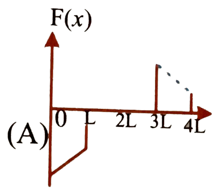
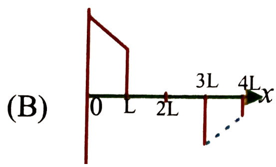
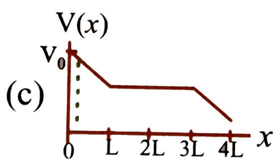
10. A rigid wire loop of square shape having side of length L and resistance R is moving along the x-axis with a constant velocity v_0 in the plane of the paper. At $t = 0$, the right edge of the loop enters a region of length 3L where there is a uniform magnetic field B_0 into the plane of the paper, as shown in the figure. For sufficiently large v_0 the loop eventually crosses the region. Let x be the location of the right edge of the loop. Let v(x), I(x) and F(x) represent the velocity of the loop, current in the loop, and force on the loop, respectively, as a function of x. Counter-clockwise current is taken as positive.

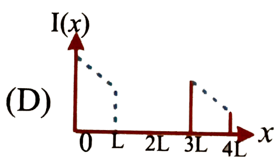


. Which of the following schematic plot(s) is (are) correct? (Ignore gravity)

A. 

B. 

C. 

D. 

Answer: C::D

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

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

B. $P_R < P_L$ for all times t

C. $P_R < P_L$ only near the starting of the circuit.

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

Answer: A::C

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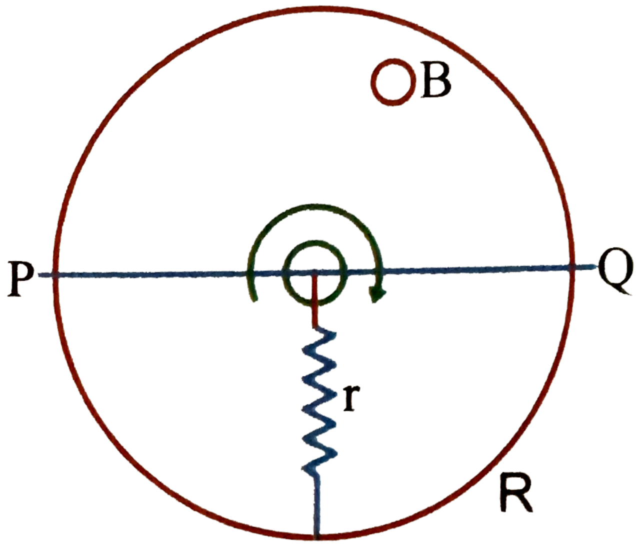
12. In the figure shown $'R'$ is a fixed conducting fixed ring of negligible resistance and radius $'a'$ PQ is a uniform rod of resistance r. It is hinged at the centre of the ring and rotated about this point in clockwise direction with a uniform angular velocity w. These is a uniform magnetic filled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



A. Current through $'r'$ is zero.

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

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

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

Answer: B::D

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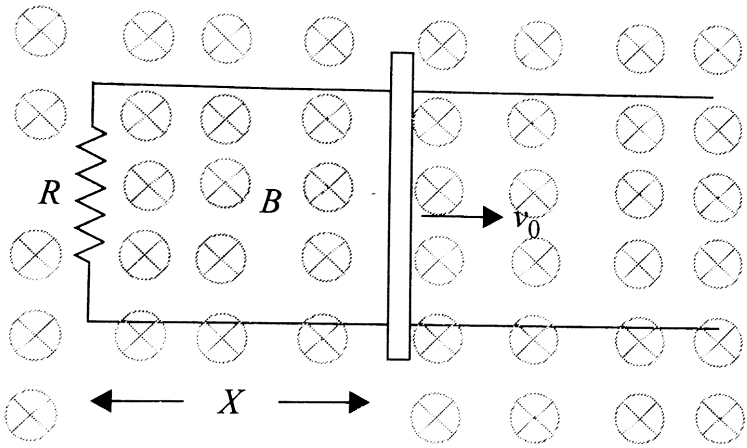
13. A conducting rod of length is moved at constant velocity v_0 on two parallel, conducting, smooth, fixed rails, that are placed in a uniform constant magnetic field B perpendicular to the plane for the rails as shown in Fig. A resistance R is connected between the two ends of the rails.

Then which of the following is/are correct:



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

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

C. Lenz's Law is not satisfied if the ropd is accelerated bt external force

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

Answer: A::B::D

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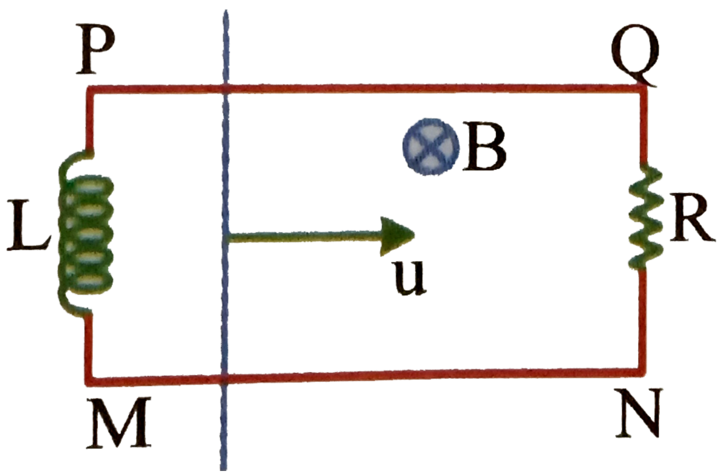
Integer type questions

1. In the figure, a conducting rod of length $l = 1$ meter and mass $m = 1kg$ moves with initial velocity $u = 5m/s$. On a fixed horizontal frame containing inductor $L = 2H$ and resistance $R = 1W$. PQ and MN are smooth, conducting wires. There is a uniform magnetic field of strength $B = 1T$. Initial there is no current in the inductor. Find the total charge in coulomb, flown through the inductor by the time velocity of rod becomes $v_f = 1m/s$ and the rod has travelled a distance $x = 3$ meter.



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2. A conducting rod length $1m$ moves with a speed of $2m/s$ parallel to a straight long wire carrying $4A$ current. Axis of rod is kept perpendicular to the wire with its near end at a distance of $1m$ from the wire. Magnitude of induced emf in rod is $N \times 10^{-7} \log 16 \text{volt}$. Find the value of N.

Watch Video Solution

Level-I(H.W)

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

A. $0.5A$

B. $5A$

C. $50A$

D. $5 \times 10^8 A$

Answer: B

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2. A magnetic flux of 500 microweber passing through a 200 turn coil is reversed in $20 \times 10^{-3} s$. The average induced emf in the coil (in volt) is

A. 2.5

B. 5.0

C. 7.5

D. 10.0

Answer: D

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3. A rectangular coil of 200 turns and area $100cm^2$ is kept perpendicular to a uniform magnetic field of induction 0.25 tesla. If the field is reversed in direction in 0.01 second, the average induced emf in the coil is

A. $10^6 V$

B. $10^4 V$

C. $10^2 V$

D. zero

Answer: C

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

A. $4V$

B. $3V$

C. $1.5V$

D. $2V$

Answer: B

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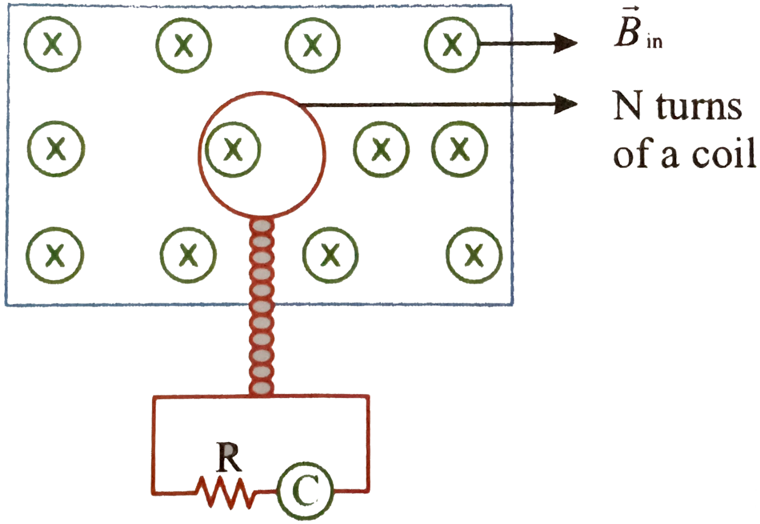
5. A flip coil consits of N turns of circular coils which lie in a uniform magnetic field. Plane of the coils is perpendicular to the magnetic field as shown in figure. The coil is connected to a current integrator which measures the total charge passing through it. The coil is turned through

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



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

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

C. $\dfrac{NBA}{\sqrt{2}A}$

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

Answer: D

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

A. zero

B. $2B_0lv_0$

C. B_0lv_0

D. $\sqrt{2}B_0lv_0$

Answer: A

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7. To measure the field $'B'$ between the poles of an electronmagnet, a small test loop of area $1cm^2$, resistance 10Ω and 20 turns is pulled out of it. A galvanometer shows that a total charge $2\mu C$ passed through the loop. The value of $'B'$ is

A. $0.001T$

B. $0.01T$

C. $0.1T$

D. $1.0T$

Answer: B

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8. 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. $\frac{AB}{R}$

C. ABR

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

Answer: B

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9. 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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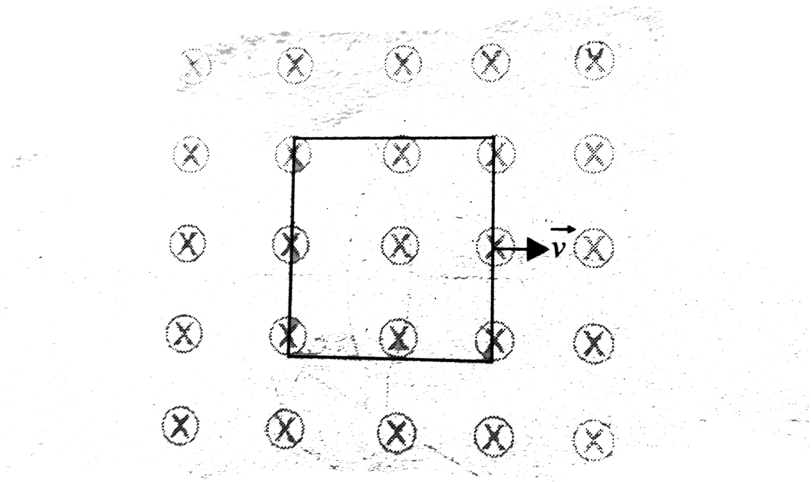
10. Conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B, constant in time and space, pointing perpendicular and into the plane of the loop exists everywhere.

The current induced in the loop is



A. BLv/R clock wise

B. BLv/R anticlock wise

C. $2BLv/R$ anticlock wise

D. zero

Answer: D

Watch Video Solution

11. A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant, uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. Select the correct statements(s) from the following

A. The entire rod is at the same electric potential

B. There is an electric field in the rod

C. The electric potential is highest at the centre of the rod and decrease towards its ends

D. The electric potential is lowest at the centre of the rod and increases towards its ends

Answer: B

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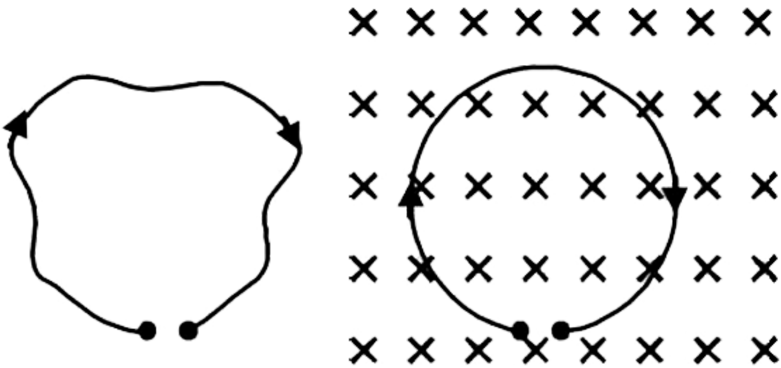
12. A thin wire of length L is connected to two adjacent fixed points and carries a current I in the clockwise direction , as shown in the figure. When the system is put in a uniform magnetic field of strength B going into the plane of the paper , the wire takes the shape of a circle . The tension in the wire is



A. IBL

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

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

D. $\frac{IBL}{4\pi}$

Answer: C

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13. A coil has an inductance of $0.05H$ and 100 turns and $0.02A$ current is passed through it. Flux linked with coil is

A. $10^{-2}Wb$

B. $10^{-3}Wb$

C. $10^{-4}Wb$

D. $10^{-5}Wb$

Answer: D

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14. A current of $2A$ is increasing at a rate of $4A/s$ through a coil of inductance $2H$. The energy stored in the inductor per unit time is

A. $2W$

B. $1W$

C. $16W$

D. $4W$

Answer: C

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15. The current decays from $5A$ to $2A$ in $0.01s$ in a coil. The emf induced in a coil nearby it is $30V$. The mutual inductance between the coils is

A. $1.0H$

B. $0.1H$

C. $0.001H$

D. $10H$

Answer: B

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16. A varying current in a coil change from $10A$ to $0A$ in $0.5 \sec$. If the average emf induced in the coil is $220V$, the self inductance of the coil is

A. $5H$

B. $6H$

C. $11H$

D. $12H$

Answer: C

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17. An air cored solenoid is of length 0.3 m, area of cross section $1.2 \times 10^{-3} m^2$ and has 2500 turns. Around its central section, a coil of 350 turns is wound. The solenoid and the coil are electrically insulated from eachother. Calculate the e.m.f. induced in the coil if the initial current of 3 A in the solenoid is reversed in 0.25 s.

A. $0.1056V$

B. $1.056V$

C. $10.56V$

D. $0.01056V$

Answer: A

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18. A solenoid of length 50 cm with 20 turns per cm and area of cross section 40 cm^2 comletely surrounds another co-axial solenoid of the same length, area of cross seciton $25cm^2$ with 25 turns per cm. Calculate the mutual inductance of the system.

A. $9.7mH$

B. $7.9mH$

C. $8.9mH$

D. $6.8mH$

Answer: B

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19. The current in a coil is changed from $5A$ to $10A$ in $10^{-2}s$. An emf of $50mV$ is induced in coil near by it. The mutual inductance of two coils is

A. $100\mu H$

B. $200\mu H$

C. $300\mu H$

D. $400\mu H$

Answer: A

Watch Video Solution

20. 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 coplanar and their centre coincide. What is the mutual inductance of the system ?

A. l/L

B. l^2/L

C. L/l

D. L^2/l

Answer: B

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21. A coil is connected to a battery of $12V$ emf and negligible resistance. The current in the solenoid grows to 63% of its final steady state value in $0.3s$. If the final steady state current is $0.6A$, the inductance of the solenoid is

A. $0.6H$

B. $6.0H$

C. $0.015H$

D. $0.15H$

Answer: B

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22. A coil of inductance $8.4mH$ and resistance $6\ \Omega$ is connected to a $12V$ battery. The current in the coil is $1.0A$ at approximately the time.

A. $500s$

B. $20s$

C. $35s$

D. $1ms$

Answer: D

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23. An ideal coil of 10H is connected in series with a resistance of $5(\Omega)$ and a battery of 5V. 2second after the connections is made, the current flowing in ampere in the circuit is

A. $(I - e)$

B. e

C. e^{-1}

D. $(I - e^{-1})$

Answer: D

Watch Video Solution

Level-II (H.W)

1. A coil of 30 turns of wire each of $10cm^2$ area is placed with its plance perpendicular to a magnetic field of $0.1T$. When the coil is suddenly withdraw from the field, a galvanometer connected in series with the coil indicated that a $10\mu C$ charge passes around the circuit. The combined resistance of the coil and galvanometer is

A. 3Ω

B. 30Ω

C. 300Ω

D. 3000Ω

Answer: C

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2. A square coil of side $0.5m$ has movable sides. It si placed such that its plance is perpendiuclar to uniform magnetic field of induction $0.2T$. If all the sides are allowed to move with a speed of $0.1 m/s$ for 4 sec outwards, average induced emf is

A. Zero

B. $0.01 V$

C. $0.028 V$

D. $0.072 V$

Answer: D

Watch Video Solution

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

A. 0

B. $25 V$

C. $20V$

D. $15V$

Answer: B

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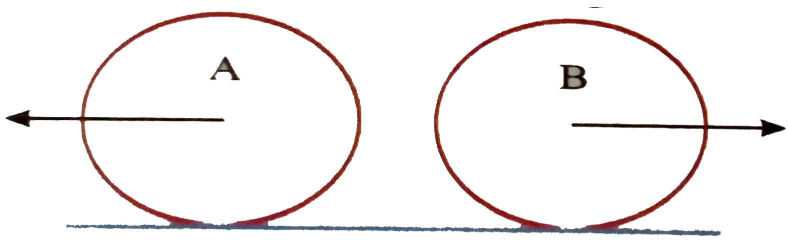
4. Two identical conducting rings A and B of radius R are rolling over a horizontal conducting plane with same speed v but in opposite direction. A constant magnetic field B is present pointing into the plane of paper. Then the potential difference between the highest points of the two rings is



A. 0

B. $2BvR$

C. $4BvR$

D. none of these

Answer: C

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

A. $E \propto t^2$

B. $E \propto t$

C. $E \propto \sqrt{t}$

D. E is constant

Answer: D

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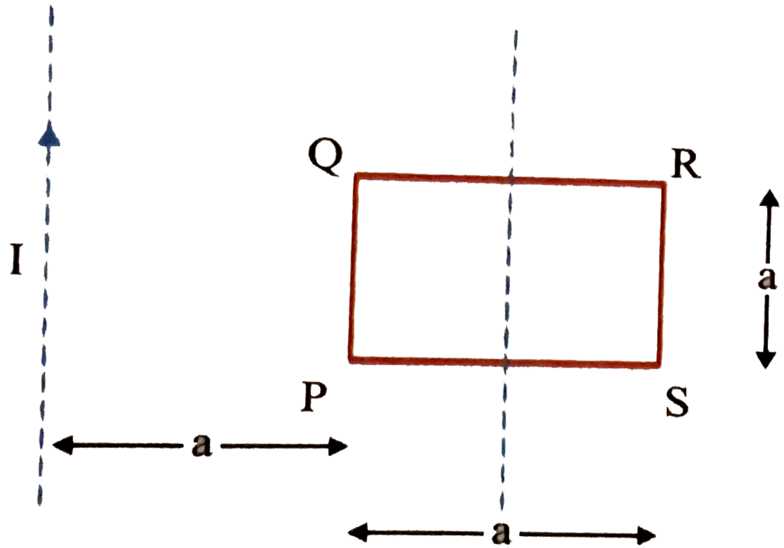
6. A square loop $PQRS$ of side $'a'$ and resistance $'r'$ is placed near an infinitely long wire carrying a constant current I. The sides PQ and RS are parallel to the wire. The wire and the loop are in the same plane. The loop is rotated by 180° about an axis parallel to the long wire and passing through the mid points of the side QR and PS. The total amont of charge which passes through any point of the loop during rotation is:



A. $\frac{\mu_0 Ia}{2\pi r} ln2$

B. $\frac{\mu_0 Ia}{\pi r} ln2$

C. $\frac{\mu_0 Ia^2}{2\pi r}$

D. $\frac{\mu_0 ia}{2\pi r}$

Answer: B

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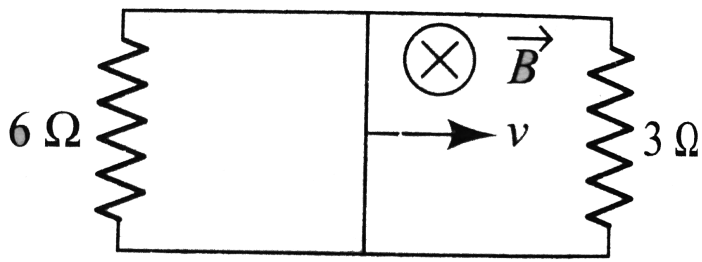
7. A rectangular loop with a sliding connector of length $l = 1.0m$ is situated in a uniform magnetic field $B = 2T$ perpendicular to the plane of loop. Resistance of connector is $r = 2\Omega$. Two resistances of 6Ω and 3Ω are connected as shown in . The external force required to keep the connetor moving with a constant velocity $v = 2ms^{-1}$ is



A. $6N$

B. $4N$

C. $2N$

D. $1N$

Answer: B

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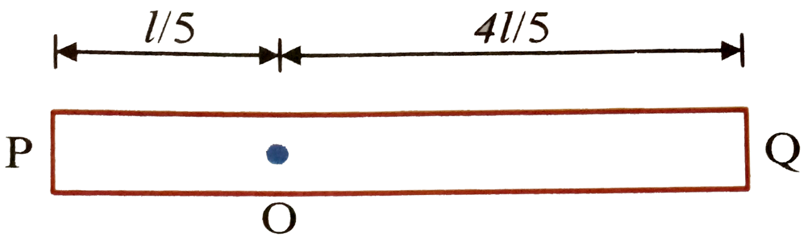
8. A straight rod of length l si rotating about axis passing through O is shown. A uniform magnetic field B exists parallel to the axis of rotation. $E.m.f$ induced between P and Q is:



A. $\frac{8}{25}B\omega l^2$

B. $\frac{3}{10}B\omega l^2$

C. $\frac{7}{25}B\omega l$

D. zero

Answer: B

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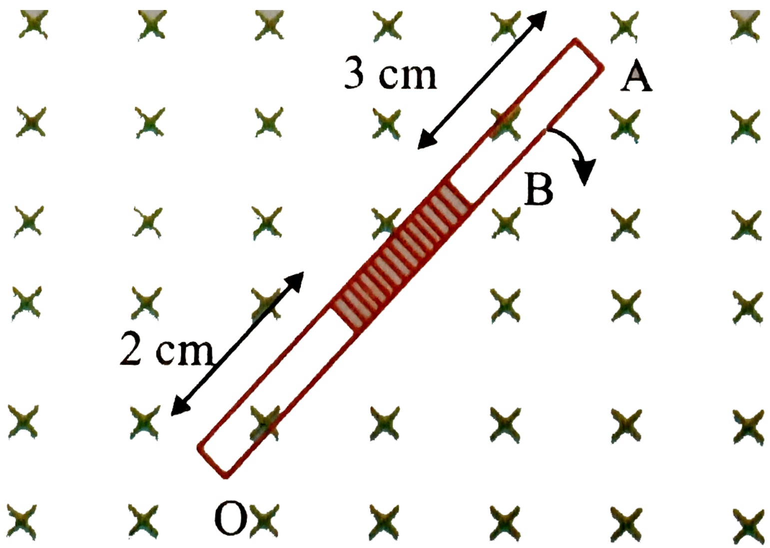
9. A rod of length $10cm$ made up of conducting and non-conducting material (shaded part is non-conducting). The rod is rotated with constant angular velocity $10rad/s$ about point O, in constant magnetic field of $2T$ as shown in the figure. The induced emf between the point A and B of rod will be:



A. $0.029V$

B. $0.1V$

C. 0.051

D. $0.064V$

Answer: C

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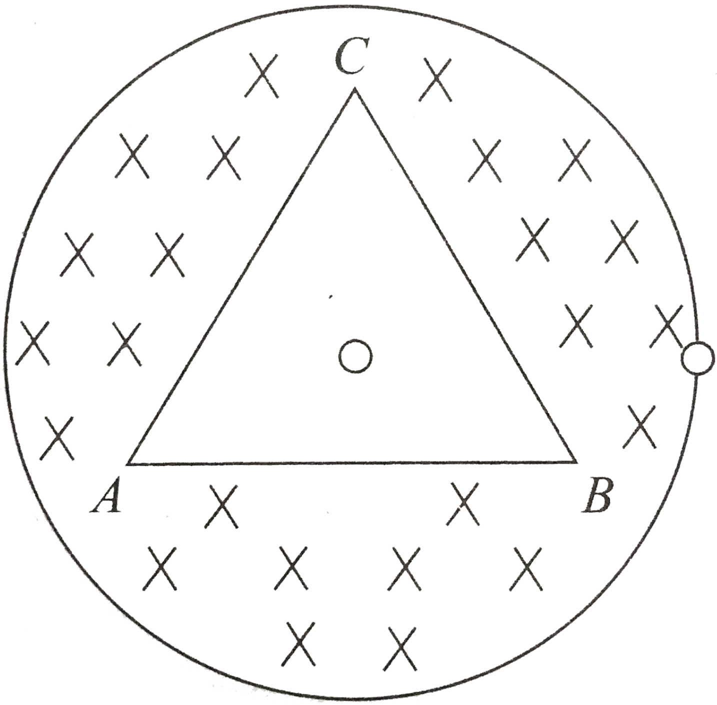
10. A triangular wire frame (each side =2m) is placed in a region of time variant magnetic field $dB/dt = (\sqrt{3})T/s$. The magnetic field is perpendicular to the plane of the triangle and its centre coincides with the centre of triangle. The base of the triangle AB has a resistance $1(\Omega)$ while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



A. $0.4V$

B. $0.6V$

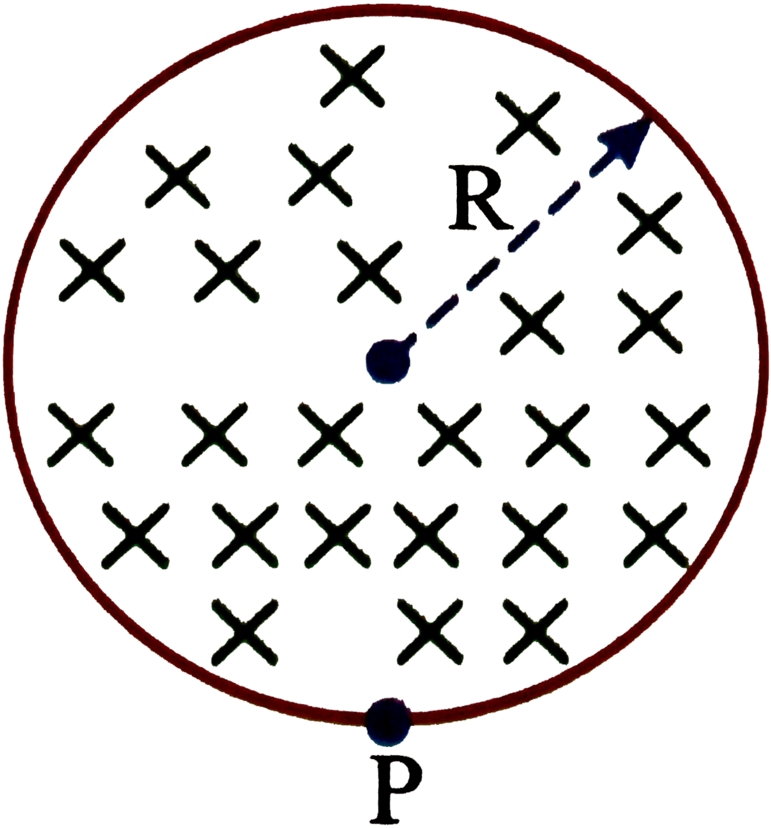
C. $1.2V$

D. None

Answer: B

Watch Video Solution

11. A uniform magnetic field of induction B is confined to a cyclindrical region of radius R. The magnetic field is increasing at a constant rate of dB/dt (tesla / second). A charge q of mass m, placed at the point P on the periphery of the fixed experiences an acceleration :



A. $\frac{1}{2}\frac{eR}{m}\frac{dB}{dt}$ towards left

B. $\frac{1}{2}\frac{eR}{m}\frac{dB}{dt}$ towards right

C. $\frac{eR}{m}\frac{dB}{dt}$ towards left

D. zero

Answer: A

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12. The e.m.f. induced in a secondary coil is $20000V$ when the current breaks in the primary coil. The mutual inductance is $5H$ and the current reaches to zero in 10^{-4} sec in the primary. The maximu current in the primary before it breaks is

A. $0.1A$

B. $0.4A$

C. $0.\ 6A$

D. $0.8A$

Answer: B

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13. 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/L

C. L^2/l

D. l^2/L

Answer: D

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14. A straight solenoid of length $1m$ has 5000 turns in the primary and 200 turns in the secondary coil. If the area of cross section is $4cm^2$, the mutual inductance will be

A. $503H$

B. $503mH$

C. $503\mu H$

D. $5.03H$

Answer: C

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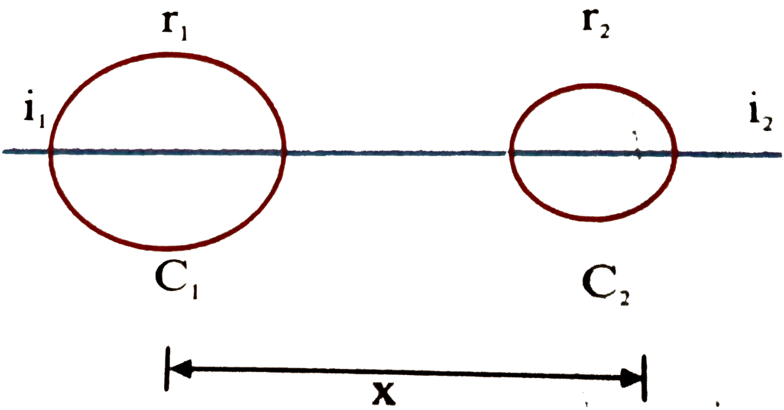
15. Two coaxial circular loops of radius $0.5m$ and $5 \times 10^{-2}m$ are separated by a distance $0.5m$ and carry currents $2A$ and $1A$ respectively.

The force between the loops due to mutual induction is



A. $2.09 \times 10^{-8} N$

B. $1.06 \times 10^{-6} N$

C. $4.18 \times 10^{-8} N$

D. $8.3 \times 10^{-5} N$

Answer: A

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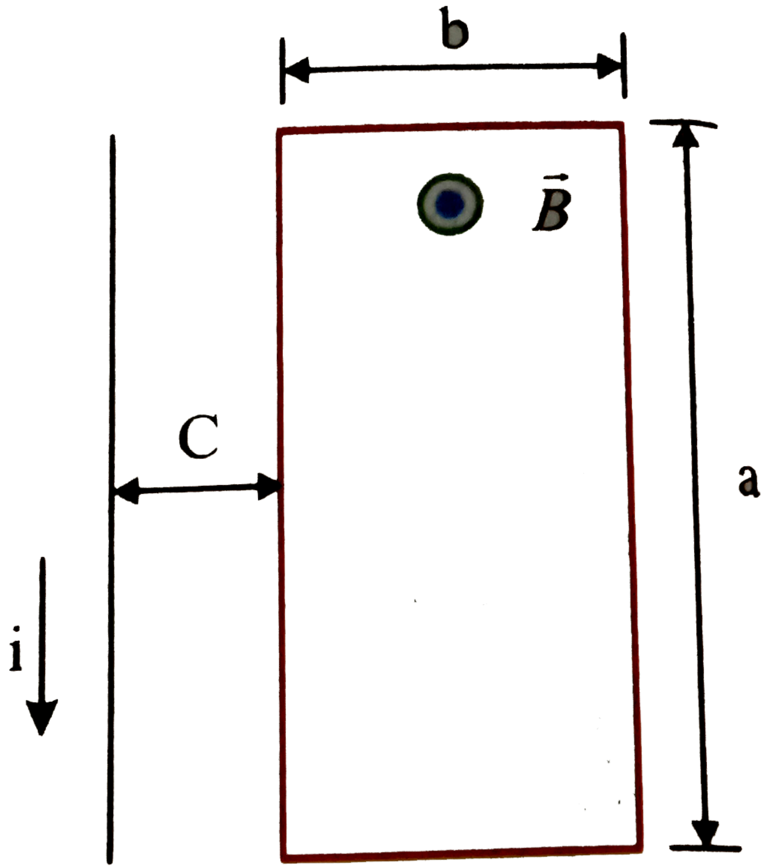
16. The mutual inductance between the rectangular loop and the long straight wire as shown in figure is M.



A. $M =$ zero

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

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

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

Answer: D

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17. An infinite long straight conducting cylinderical shell of radius a is surrounded by a thin coaxial infinite conducing cylinderical shell of radius b. Assuming current flows uniformly through the cylinderical shell returns through the outer shell, the inductance per unit length for this arrangement is

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

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

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

D. $\frac{\mu_0}{4\pi}\ln\left(\frac{b}{a}\right)$

Answer: C

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18. A μF capacitor is charged by a $400V$ supply through $0.1M\Omega$ resistance. The time taken by the capacitor to develop a potential difference of $300V$ is : (Given $\log_{10} 4 = 0.602$)

A. $2.2 \sec$

B. $1.1 \sec$

C. $0.55 \sec$

D. $0.48secs$

Answer: D

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19. A resistance with an inductor of $8H$ has the same time constant as it has with a condenser of capacitor $2\mu F$. The value of the resistance expressed in ohms is

A. 500

B. 250

C. 4000

D. 2000

Answer: B

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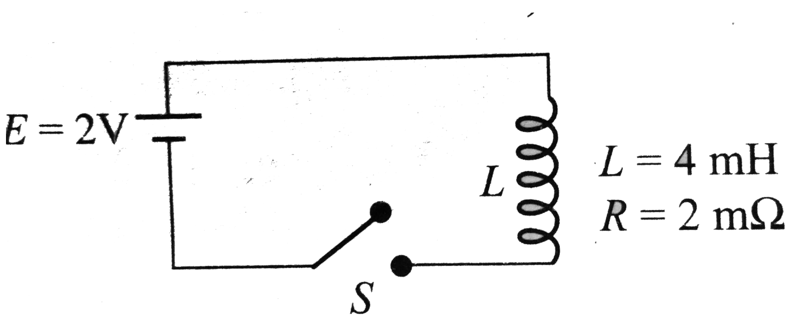
20. The cell in the circuit shows in Fig is ideal. The coil has an inductance of $4mH$ and a resistance of $2m\Omega$. The switch is closed at $t=0$. The amount of energy stored in the inductor at $t=2s$ is (take $e=3$)



A. $\frac{4}{3} J$

B. $\frac{8}{9} \times 10^3 J$

C. $\frac{8}{3} \times 10^{-3} J$

D. $2 \times 10^3 J$

Answer: B

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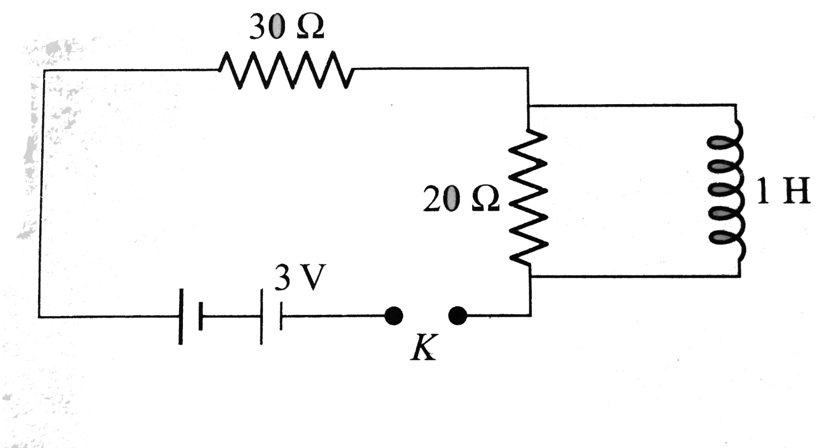
21. In the Fig., the final current through 30Ω resistance when circuit is completed is



A. $3A$

B. $0.1A$

C. $5A$

D. $0.5A$

Answer: B

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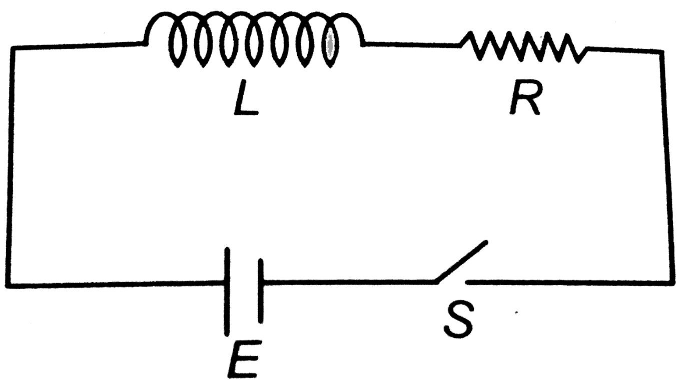
22. In the circuit shown in figure switch S is closed at time $t = 0$. The charge which passes through the battery in one time constant is



A. $\frac{eR^2E}{L}$

B. $E = \left(\frac{L}{R}\right)$

C. $\frac{EL}{eR^2}$

D. $\frac{eL}{ER}$

Answer: C

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23. A coil of wire having inductance and resistance has a conducting ring placed coaxially within it. The coil is connected to a battery at time t=0, so that a time-dependent current $1_1(t)$ starts following through the coil. If $I_2(t)$ is the current induced in the ring, and B (t) is the magnetic field at the axis of the coil due to $I_1(t)$ then as a function of time $(t > 0)$, the product $I_2(t)B(t)$

A. increases with time

B. decreases with time

C. does not vary with time

D. passes through a maximum

Answer: D

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