PHYSICS

BOOKS - AAKASH SERIES

ELECTROMAGNETIC INDUCTION

Problem

1. A rectangular loop of area 0.06 m2 is placed in a 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 flux linked with the coil in each case.

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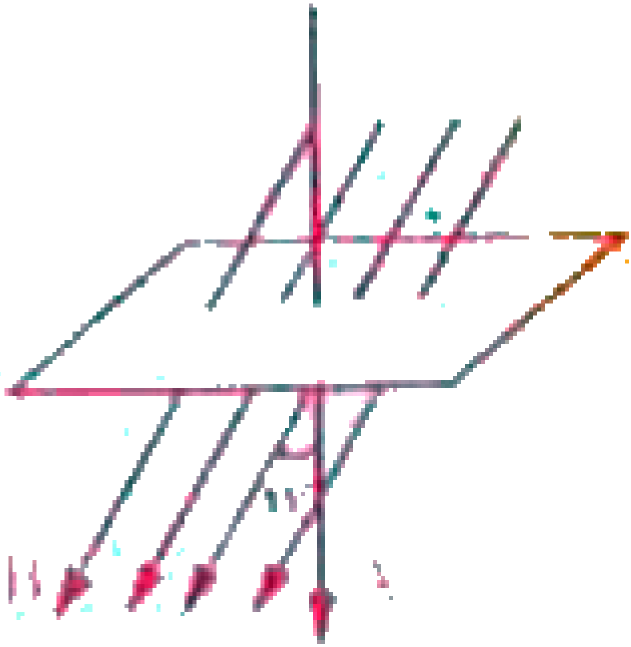
2. At a certain location in the northern hemisphere, the earth.s magnetic field has a magnitude of $42\mu T$ and points downwards at 53° to the vertical. Calculate the flux through a horizontal surface of area 2.5 m^2. [$\sin 53^\circ$ = 0.8]



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3. The magnetic flux through a coil perpendicular to its plane is varying according to the relation $\phi_B = \left(5t^3 + 4t^2 + 2t - 5\right)$ weber. Calculate the induced current through the coil at t = 2 second. The resistance of the coil is 5 Ω.

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

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

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6. A long solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 2.0 A to 4.0 A in 0.1 s, what is the induced emf in the loop while the current is changing?

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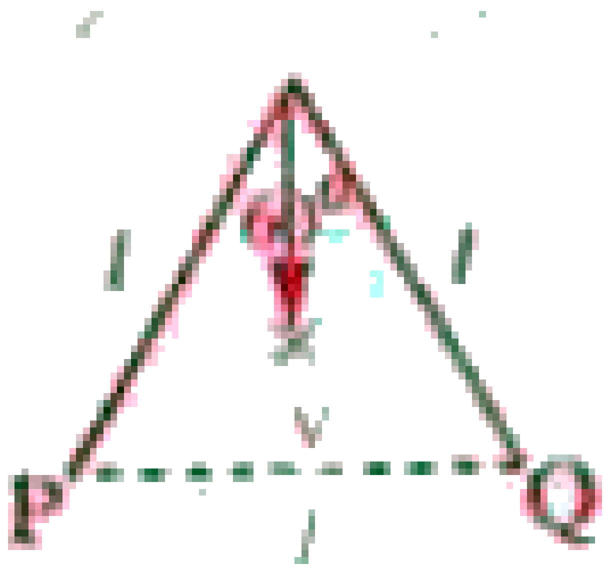
7. A wire of length 21 is bent al mid point so that the angle between two halves is 60°. If it moves as shown with a velocity v in a magnetic field B find the induced emf



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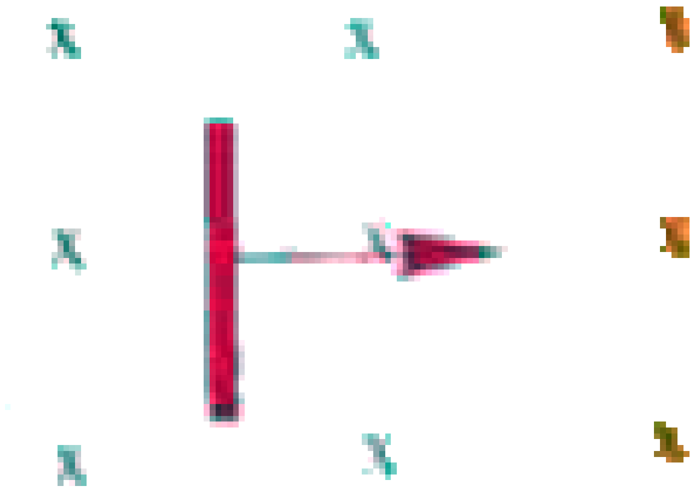
8. A conductor of length 0.1m is moving with a velocity of 4m/ s in a uniform magnetic field of 2T as shown in the figure. Find the emf induced ?



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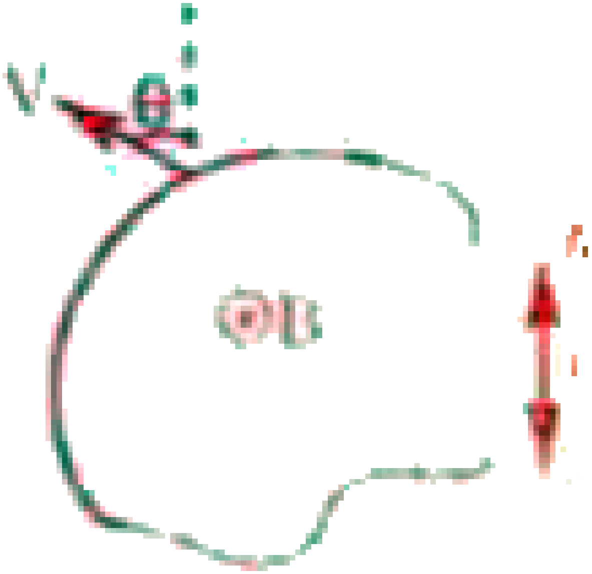
9. Figure shows an irregular shaped wire AB moving with velocity v, as shown. Find the emf induced in the wire



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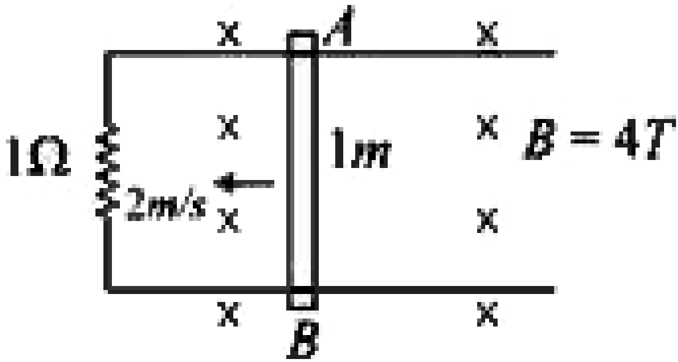
10. Two fixed long parallel horizontal rails, a distance 1 m apart are joined at one end by a resistance 1Ω. A rod AB of negligible resistance slides towards the resistance. A magnetic field of magnitude 4T perpendicular to the plane of rails exists. Find the current flowing (in Ampere) in the resistance, at an instant when the velocity of the rod is 2 m/s.



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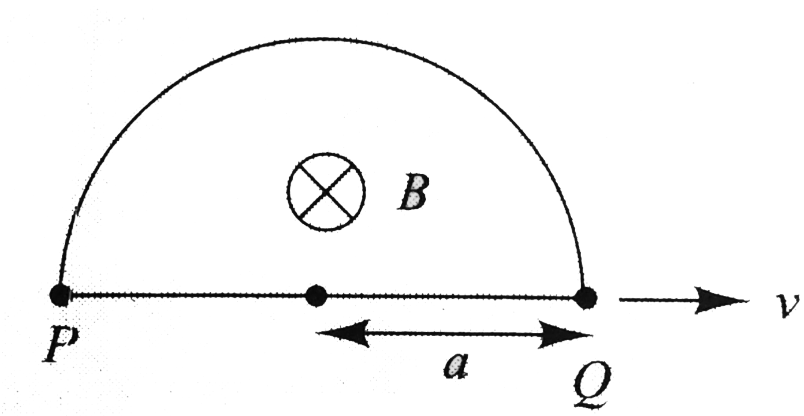
11. Find the emf across the points P and Q which are diametrically opposite points of a semicircular closed loop moving in a magnetic filed as shown in figure



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12. A current I is flowing in a straight conductor of length L. The magnetic induction at a point distant $\frac{L}{4}$ from its centre will be

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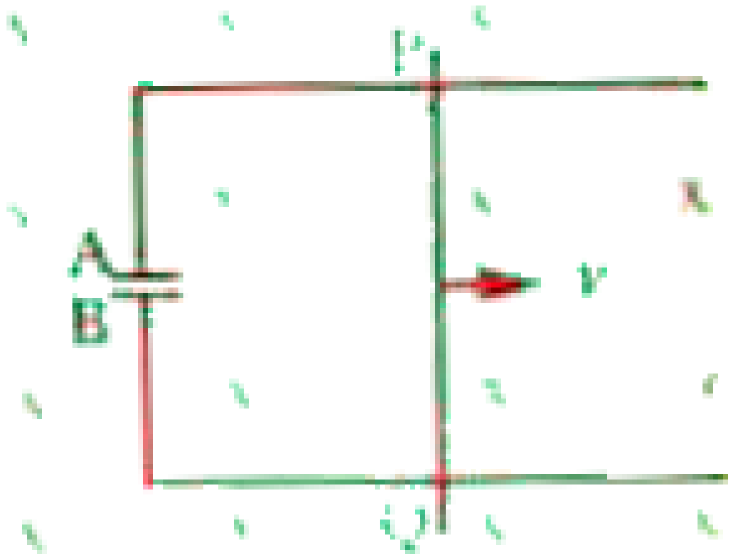
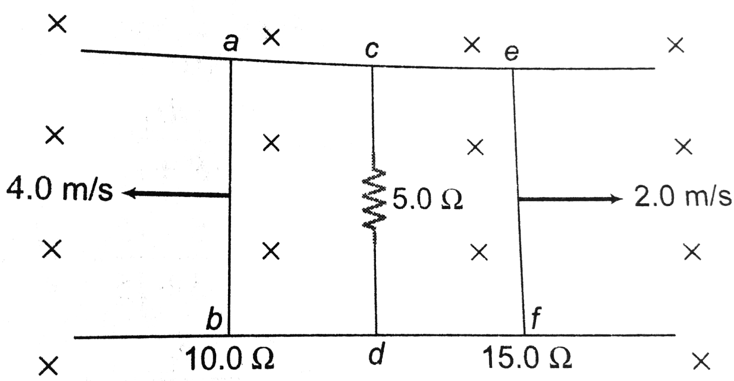
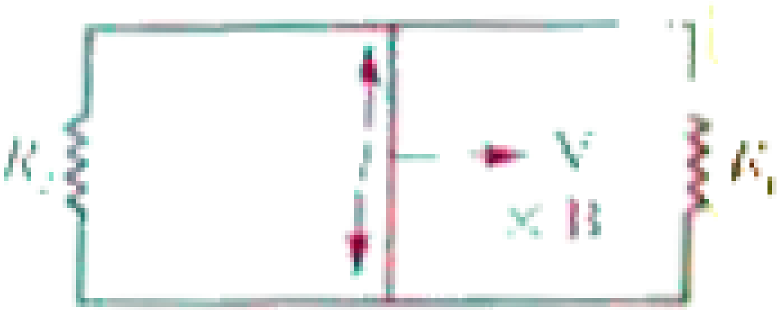
13. A conducting rod PQ of length L = 1.0m is moving with a uniform speed v = 2.0 m/s in a uniform B magnetic field B = 4.0 T directed into the paper. A capacitor of capacity $C = 10\mu F$ is connected as shown in the figure. Then what are the charges on the plates A and B of the capacitor



14. 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.



15. A rectangular loop with a slide wire of length l is kept in a uniform magnetic field as shown in the figure. The resistance of slider is R. Neglecting self inductance of the loop find the current in the wonnector during its motion with a velocity v.



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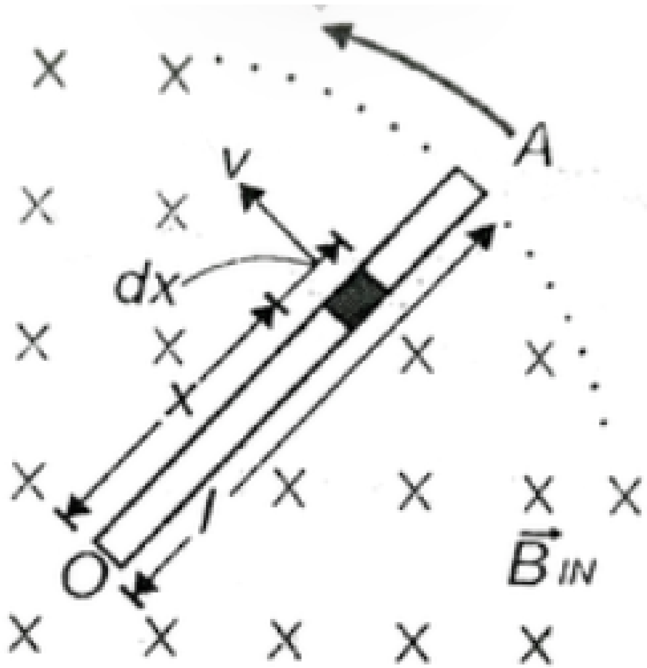
16. A conducting rod OA of length l is rotated about its end O with an angular velocity ω in a uniform magnetic field directed perpendicualr to the rotation. Find the emf induced in the rod, between it's ends.



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17. A squre loop of side a is placed in the same plane as a long stainght wire carrying a current i. The centre of the loop si sat a distance r from the wire where $r > > a$. The loop is moved away from the wire with a constant velocity v. The induced emf in the loop is

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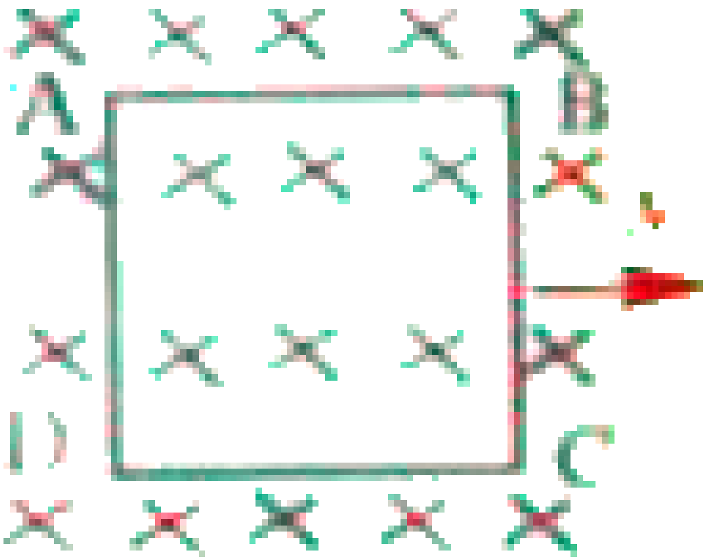
18. A metallic square loop ABCD is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in the figure, Find

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

b) Net emf induced in the loop.

c) If one side .BC. is outside the field with remaining loop in the field and is being pulled on D with a constant velocity then induced current in the loop.



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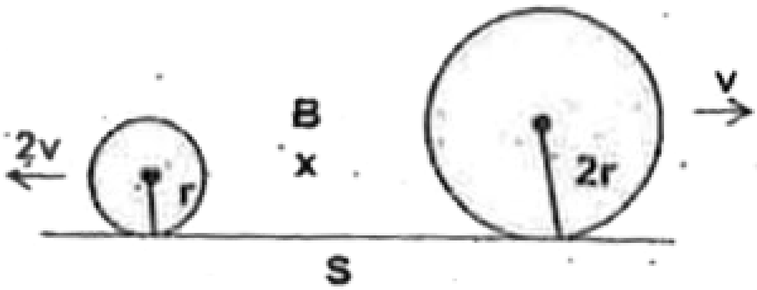
19. Two conducting rings of radii r and 2r move in opposite directions with velocities 2v and v respectively on a conducting surface s. there is a uniform magneitc field of magnitude B perpendicular to the plane rings. The potential difference between the highest points of the two rings is



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

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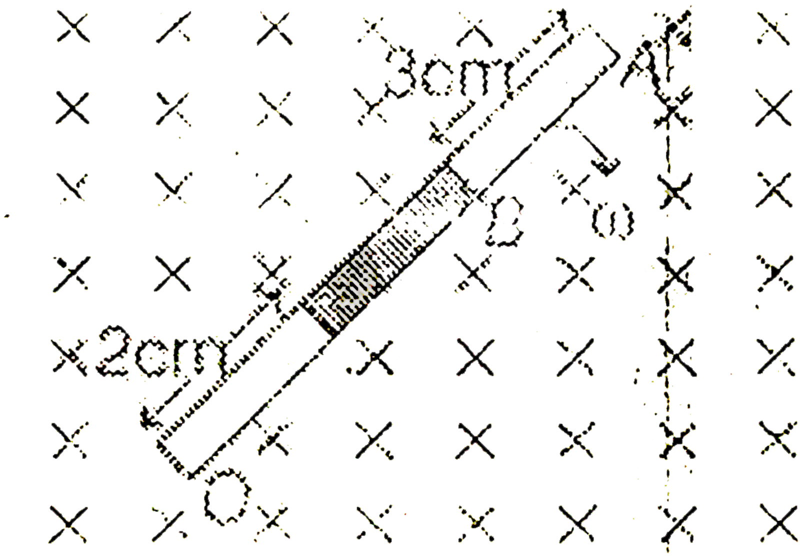
21. A rod of length 10cm made up of conducting an non-conducting). The road is roatate with constant angular velocity 10rad/s about point O, is constant magnetic field of 2T as shown in the figure. The induced emf between the points A and B of rod will be



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22. A wheel with 10 metallic spokes each 0.5 m long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of earth's magnetic field H_E at a place. If H_E = 0.4 G at the place, what is the induced emf between the axle and the rim of the wheel? Note that 1 G = 10^{-4} T.

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

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

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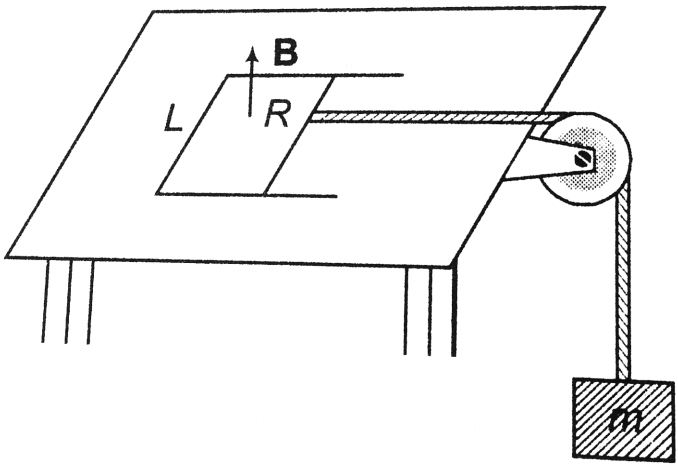
25. A pair of parallel horizontal conducting rails of negligible resistance shorted at one end is fixed on a table. The distance between the rails is L. A conducting massless rod of resistance R can slide on the rails frictionlessly. The rod is tied to a massless string which passes over a pulley fixed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



a. the terminal velocity achieved by the rod and

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

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26. Two resistors of resistance R_1 and R_2 having $R_1 > R_2$ are connected in parallel. For equivalent resistance R, the correct statement is

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27. 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, then the electrical power dissipated would be

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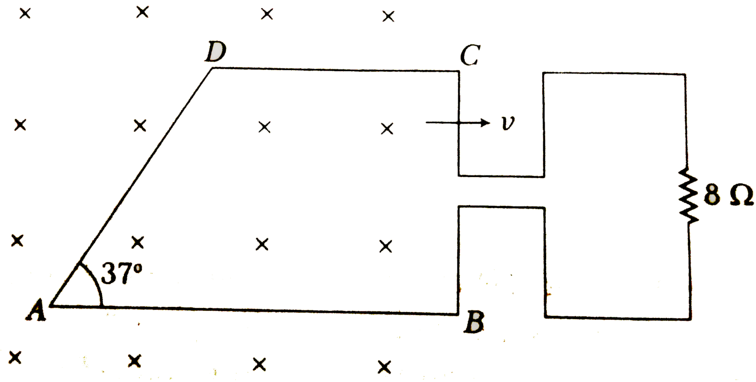
28. The loop ABCD is moving with velocity v towards right. The magnetic field is 4 T. The loop is connected to a resistance of 8Ω. If steady current of 2 A flows in the loop, then value of v, if loop has resistance of 4Ω, is

(Given, AB = 30 cm, $\sin 37^{\circ} = \frac{3}{5}$)



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29. A square loop of side 12 cm with its sides parallel to X and Y axes is moved with a velocity of 8 cm s^{-1} in the positive x-direction in an environment containing a magnetic field in the positive z-direction. The field is neither uniform in space nor constant in time. It has a gradient of $10^{-3} T cm^{-1}$ along the negative x-direction (that is it increases by $10^{-3} T cm^{-1}$ as one moves in the negative x-direction), and it is decreasing in time at the rate of $10^{-3} T s^{-1}$. Determine the direction and magnitude of the induced current in the loop if its resistance is 4.50 $m\Omega$.

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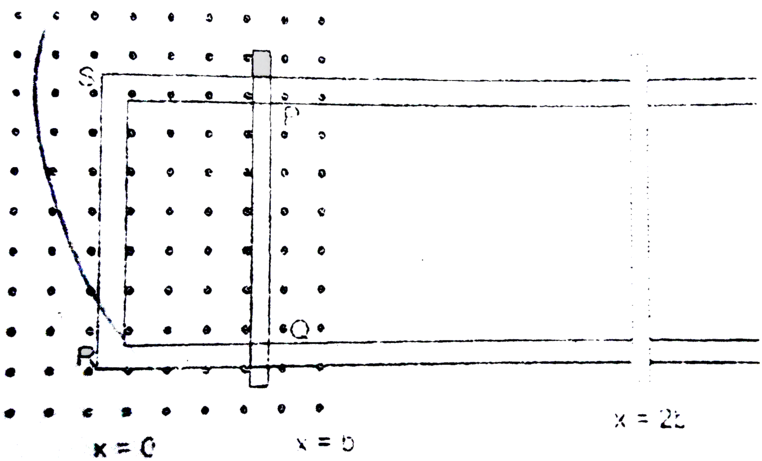
30. State Faraday's law of electromagnetic induction.

Figure shows a rectangular conductor $PQRS$ in which the conductor PQ is free to move in a uniform magnetic field B perpendicular to the plane of the paper.The field extends from $x=0$ to $x=b$ and is zero for $x>b$.Assume that only the arm PQ posses resistance r.When the arm PQ is pulled outward from $x=0$ with constant speed v, obtain the expressions for the flux and the induced emf. sketch the variations of these quantities with distance $0 \le x \le 2b$.



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31. A proton is moving along the negative direction of X-axis in a magnetic field directed along the positive direction of Y-axis. The proton will be deflected along the negative direction of

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32. Two concentric circular coils, one of small radius r_1 and the other of large radius r_2, such that $r_1 > > r_2$, are placed co-axially with centres coinciding. Obtain the mutual inductance of the arrangement.

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

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34. The self-inductance of a coil having 200 turns is 10 milli henry. Calculate the magnetic flux through the cross-section of the coil corresponding to current of 4 milliampere. Also determine the total flux linked with each turn.

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35. An inductor of 5 H inductance carries a steady current of 2A. How can a 50 V self-induced emf be made to appear in the inductor ?

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36. Two different coils have self- inductances $L_1 = 16$ mH and $L_2 = 12$ mH. At a certain instant, the current in the two coils is increasing at the same rate and power supplied to the 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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37. A current I is flowing in a straight conductor of length L. The magnetic induction at a point distant $\frac{L}{4}$ from its centre will be

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

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

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40. A solenoid is of length 50 cm 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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41. An air cored solenoid is of length 0.3m, area of cross section is $1.2 \times 10^{-3} m^2$ and has 2500 turns. Around its central section, a coil of 350 turns is wound. The solenoid and the coil are electrically insulated from each other. Calculate the emf induced in the coil if the initial current of 3A in the solenoid is reversed in 0.25s.

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

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43. For a toroid N = 500, radius = 40 cm, and area of cross section $= 10cm^2$. Find inductance

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44. 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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45. A solenoid of length 50cm with 20 turns per centimetre and area of cross-section 40cm? completely surrounds another coaxial solenoid of the same length, area of cross-section $25cm^2$ with 25 turns per centimetre. Calculate the mutual inductance of the system.

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

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

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48. A person peddles a stationary bicycle the pedals of the bicycle are attached to a 100 turn coil of area 0.10 m^2. The coil rotates at half a revolution per second and it is placed in a uniform magnetic field of 0.01

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

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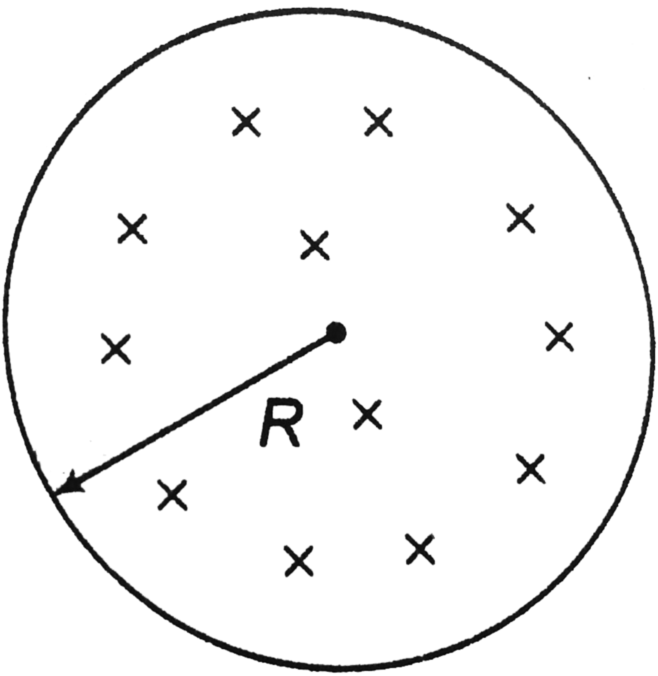
49. The magnetic field at all points within the cylindrical region whose cross section is indicated in the accompanying Figure starts increasing at a constant rate $\alpha . T / s$. find the magnitud of electric field as a function of r, the distance from the geometric centre of the region.



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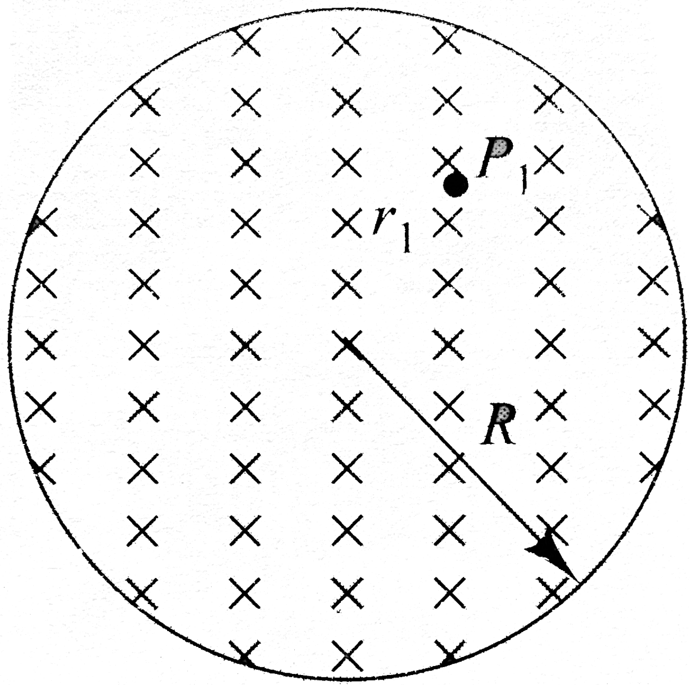
50. A magnetic field directed into the page changes with time according to $B = (0.0300t^2 + 1440)T$, where t is in seconds. The field has a circular cross section of radius $R = 2.50cm$. What are the magnitude and direction of the electric field at point P_1 when $t = 3.00s$ and $r_1 = 0.0200m$?



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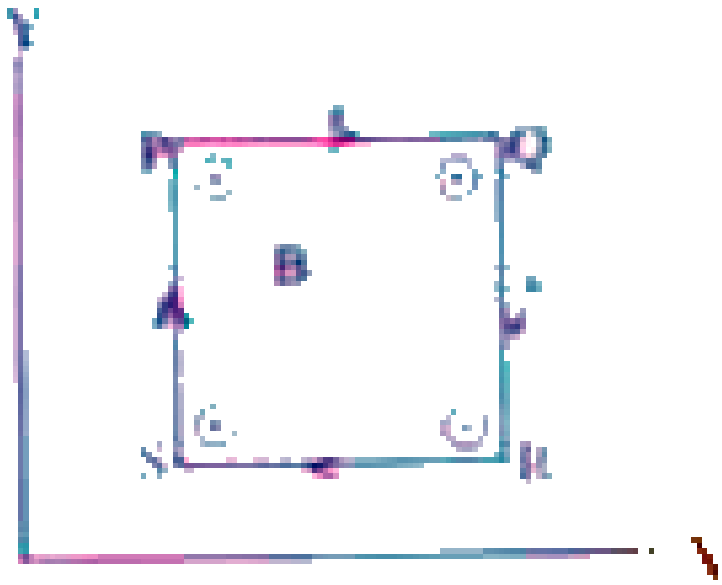
51. A wire is bent in the form of a square of side la in a varying magnetic field $B = \propto B_0 t\hat{k}$. If the resistance per unit length is λ. then find the following:

(i) The direction of induced current

(ii) The current in the loop

(iii) Potential difference between P and Q



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52. Shown in the figure is a circular loop of radius, r and resistance R. A variable magnetic field of induction $B = e^{-t}$ is established inside the coil. If the key (K) is closed at t=0 , the electrical power developed at the instant is equal to

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53. An inductor of 3H is connected to a battery of emf 6V through a resistance of 100 Ω. Calculate the time constant. What will be the maximum value of current in the circuit ?

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

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

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56. An inductor of 10mH is connected to a 18V battery through a resistor of 10kΩ and a switch After a long time, when the maximum current is set up in the circuit, the current is switched off. Calculate the cur- rent in the circuit after 2 μs.

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57. Calculate the back e.m.f of a 10H, 200 Ω coil 100 ms after a 100Vdc supply is connected to it.

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58. The time constant of a certain inductive coil was found to be 2.5 ms. With a resistance of 80Ω added in series, a new time constant of 0.5 ms was obtained. Find the inductance and resistance of the coil.

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59. When a coil joined to a cell, the current through the coil grows with a time constant τ. After what time, the current will reach 10% of its steady-state value?

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60. A cell of emf ε and internal resistance r is charged by a current I, then

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61. 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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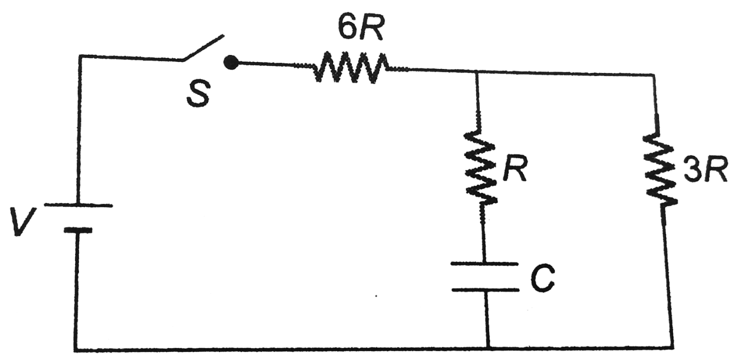
62. In the circuit shownin figure switch S is closed at time t=0. Find the current through different wire and charge stored on the capacitor at any time t.



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63. A parallel - plate capacitor, filled with a dielectric of dielectric constant 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?

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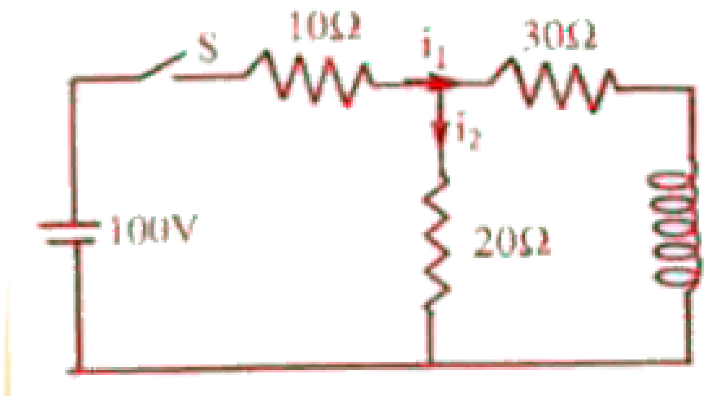
64. Find the values of i_1 and i_2



i) immediately after the switch S is closed.

ii) long time later, with S closed

ii) immediately after S is reopende

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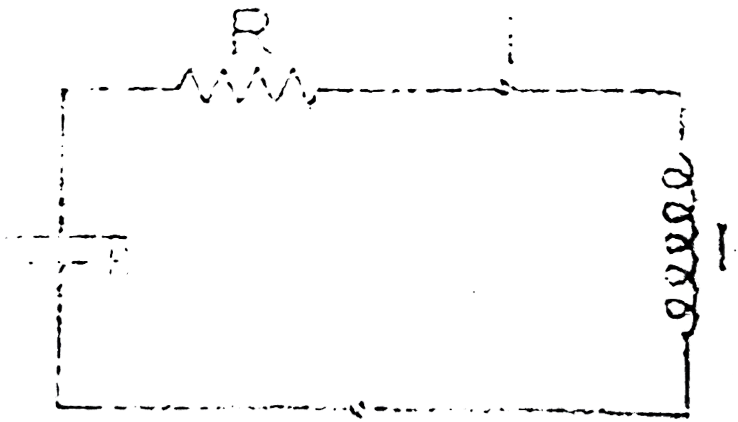
65. Suppose the EMF of the battery, the circuit shown varies with time t so the current is given by $i(t) = 3 + 5t$, where i is the amperes $\&t$ is in seconds.Take $R = 4\Omega, L = 6H\&$ find an expression for the battery EMF as a funtion of time.



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66. A $4\mu F$ capacitor and a resistance of $2.5M\Omega$ are series 12 V battery. Find the time after with the potential difference across the capacitor is 3 times the potential difference across the resistance [Given $\ln(2) = 0.693$]

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67. 3 A coil of inductance 8.4 mH and resistance 6 Omega is connected to a 12 V battery The current in the coil is 1.0 A at approximately the time

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68. In a circuit inductance L and capacitance C are connected as shown in figures. A_1 and A_2 are ammeeters. When key K is pressed to complete the circuit, then just after closing key(K), the reading of current wil be

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69. A rectangular loop of area 0.06 m^2 is placed in a magnetic field of 0.3T with its plane inclined 30° to the field. Find the flux linked with the coil .

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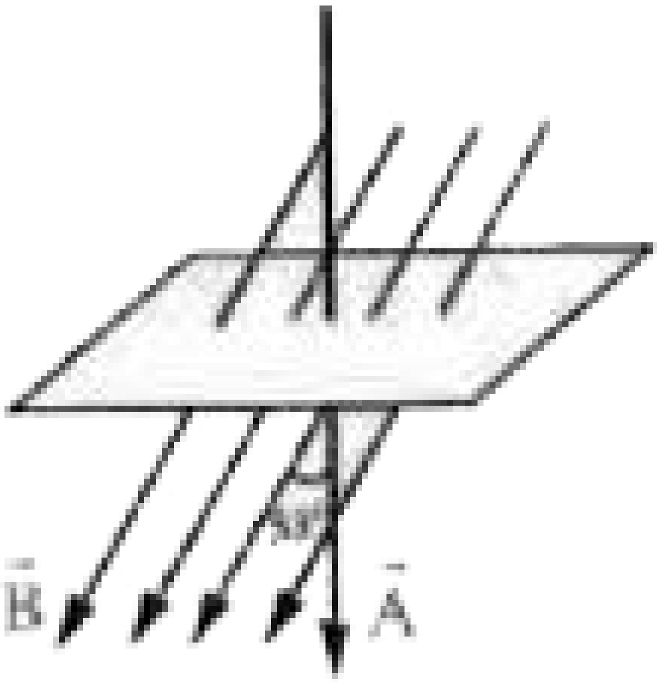
70. At a certain location in the northern hemisphere, the earth.s magnetic field has a magnitude of $42\mu T$ and points downwards at 53° to the vertical. Calculate the flux through a horizontal surface of area $2.5m^2$. $[\sin 53^\circ = 0.8]$



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

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74. A long solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 2.0 A to 4.0 A in 0.1 s, what is the induced emf in the loop while the current is changing?

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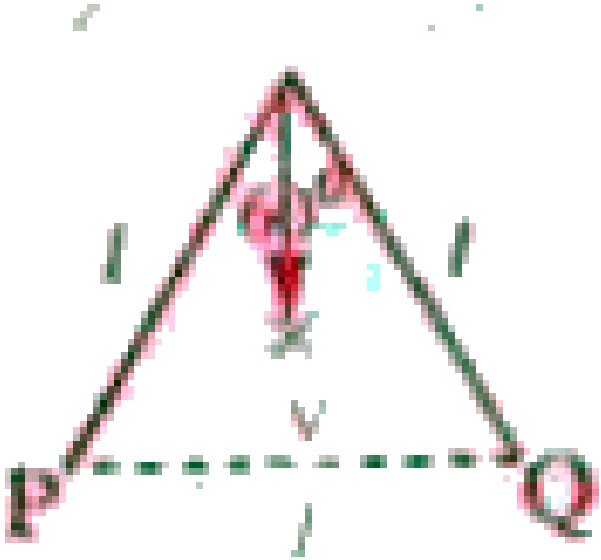

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76. A conductor of length 0.1m is moving with a velocity of 4m/s in a uniform magnetic field of 2T as shown in the figure. Find the emf induced

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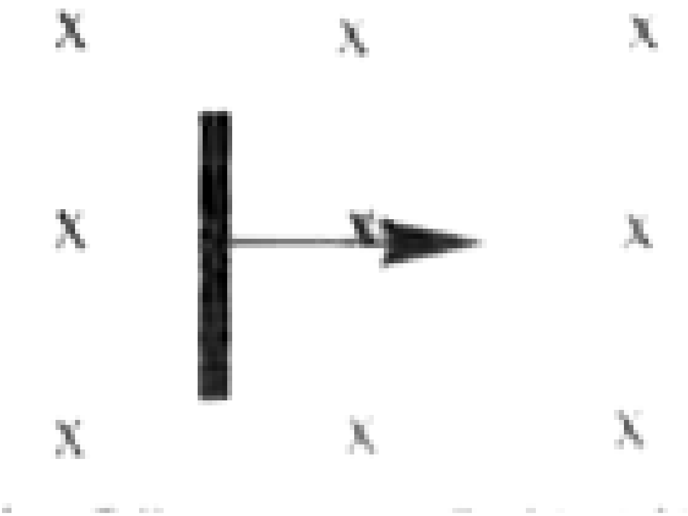

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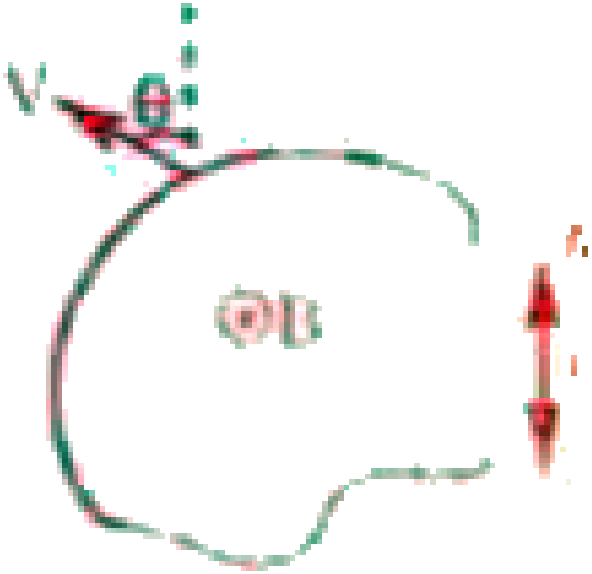

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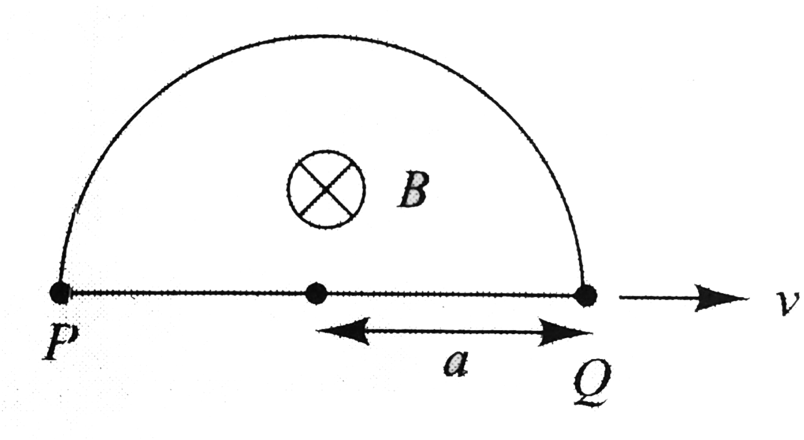
78. Find the emf across the points P and Q which are diametrically opposite points of a semicircular closed loop moving in a magnetic filed as shown in figure



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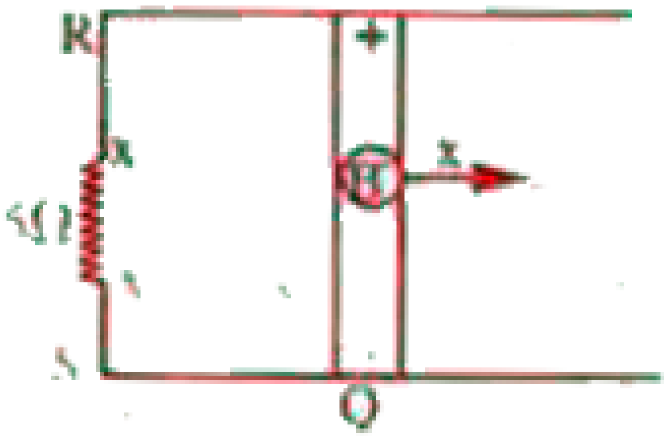
79. Figure shows a conducting rod PQ in contact with metal rails RP and SQ which are 0.257 apart in i uniform magnetic field of flux density 0.4T acting perpendicular to the plane of the paper. Ends R and S are connected through a 5 Ω resistance. What is the emf when the rod moves to the right with a velocity of 5 ms^{-1}? What is the magnitude and direction of the current through the 5 Ω 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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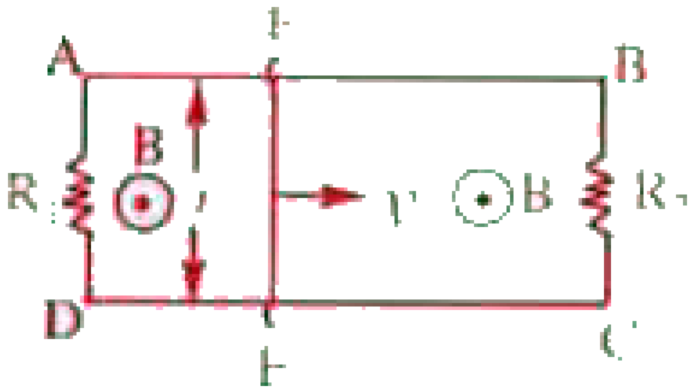
80. A loop ABCD containing two resistors as shown in figure is placed in a uniform magnetic field B directed outward to the plane of page. Asliding conductor EF of length l and of negligible resistance moves to the right with a uniform velocity v as shown in Fig. Determine the current in each branch.



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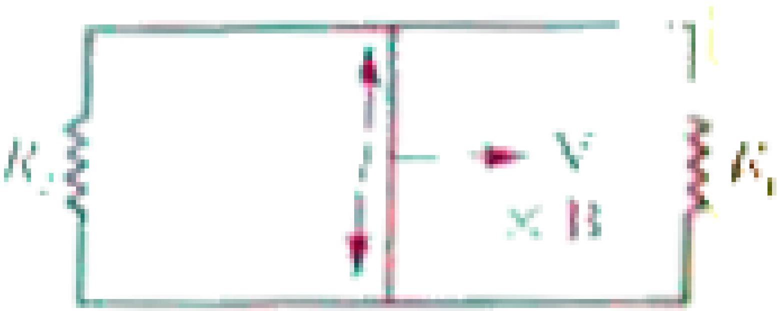
81. A rectangular loop with a slide wire of length l is kept in a uniform magnetic field as shown in the figure. The resistance of slider is R. Neglecting self inductance of the loop find the current in the wonnector during its motion with a velocity v.



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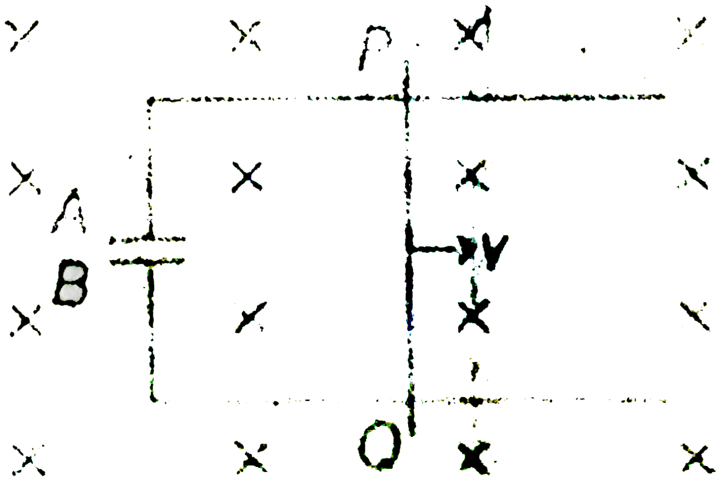
82. A conductivity rod PQ of length L=1.0m is moving with a uniform spped v=2.0m/e in a uniform magneitc field B=4.0T directed into the paper. A capacitor of capacity $C = 10\mu F$ is connected as shown in figure Then



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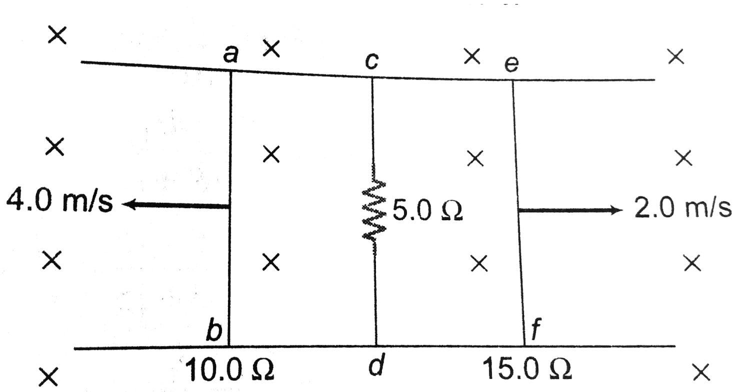
83. Two parallel rails with negligible resistance are $10.0cm$ apart. The are connected by a 5.0Ω resistor. The circuit also contains two metal rods having resistances of 10.0Ω and 15.0Ω along the rails. The rods are pulled away from the resistor at constant speeds $4.00\frac{m}{s}$ and $2.00m/s$ respectively. 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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84. 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.

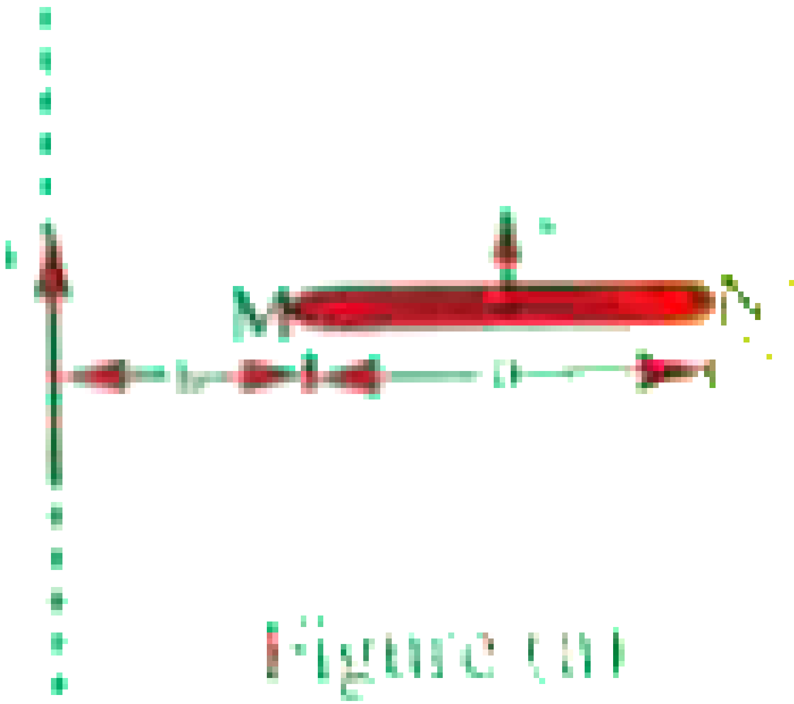

Figure (a)

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85. A squre loop of side a is placed in the same plane as a long staight wire carrying a current i. The centre of the loop si sat a distance r from the wire where $r > > a$. The loop is moved away from the wire with a constant velocity v. The induced emf in the loop is

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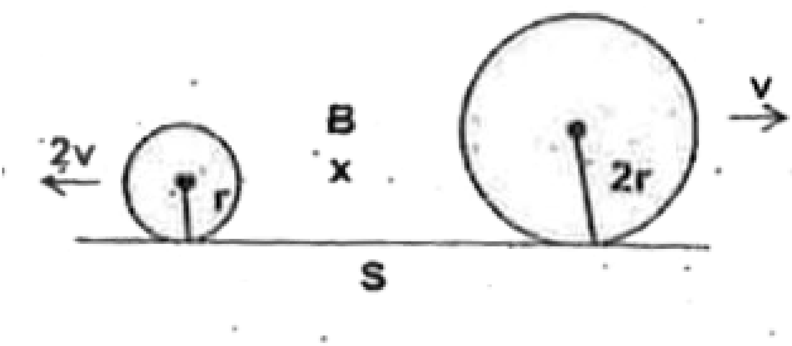
86. Two conducting rings of radii r and 2r move in opposite directions with velocities 2v and v respectively on a conducting surface s. there is a uniform magneitc field of magnitude B perpendicular to the plane rings. The potential difference between the highest points of the two rings is



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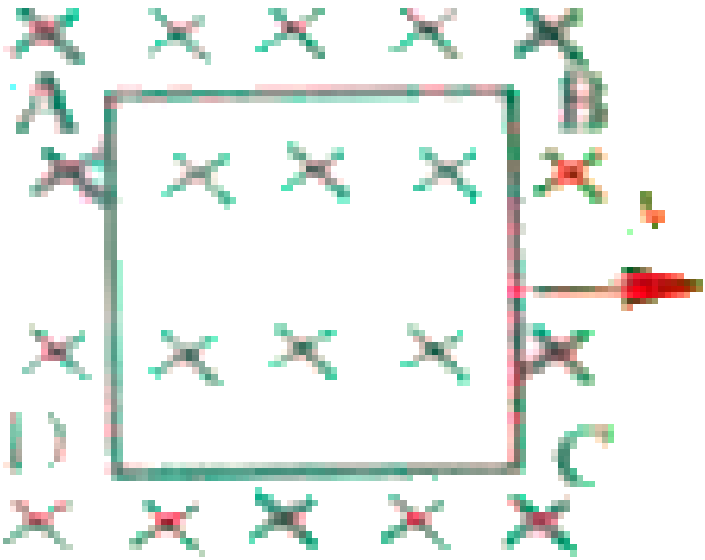
87. A metallic square loop ABCD is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in the figure, Find

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

b) Net emf induced in the loop.

c) If one side .BC. is outside the field with remaining loop in the field and is being pulled on D with a constant velocity then induced current in the loop.



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88. A copper rod of length 2m is rotated with a speed of 10 rps, 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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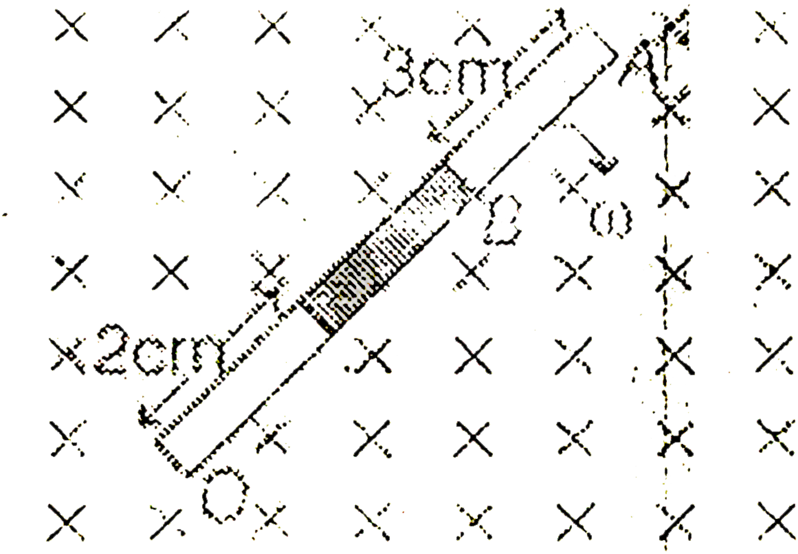
89. A rod of length 10cm made up of conducting an non-conducting). The road is roatate with constant angular velocity 10rad/s about point O, is constant magnetic field of 2T as shown in the figure. The induced emf between the points A and B of rod will be



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90. A wheel with 10 metallic spokes each 0.5 m long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of earth's magnetic field H_E at a place. If H_E = 0.4 G at the place, what is the induced emf between the axle and the rim of the wheel? Note that 1 G = 10^{-4} T.

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

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

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93. 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, then the electrical power dissipated would be

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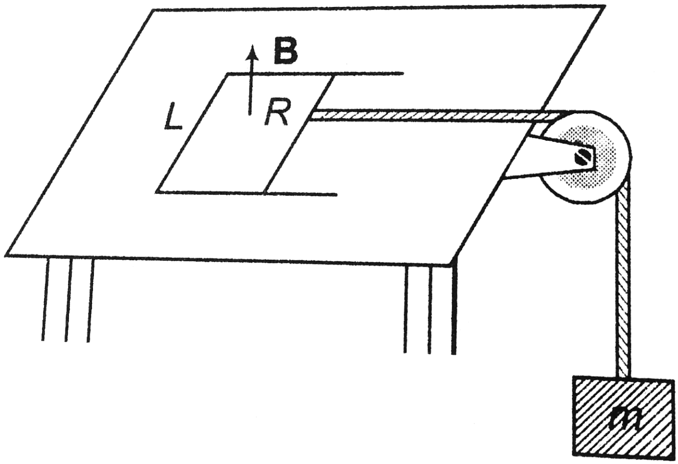
94. A pair of parallel horizontal conducting rails of negligible resistance shorted at one end is fixed on a table. The distance between the rails is L. A conducting massless rod of resistance R can slide on the rails frictionlessly. The rod is tied to a massless string which passes over a pulley fixed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



a. the terminal velocity achieved by the rod and

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

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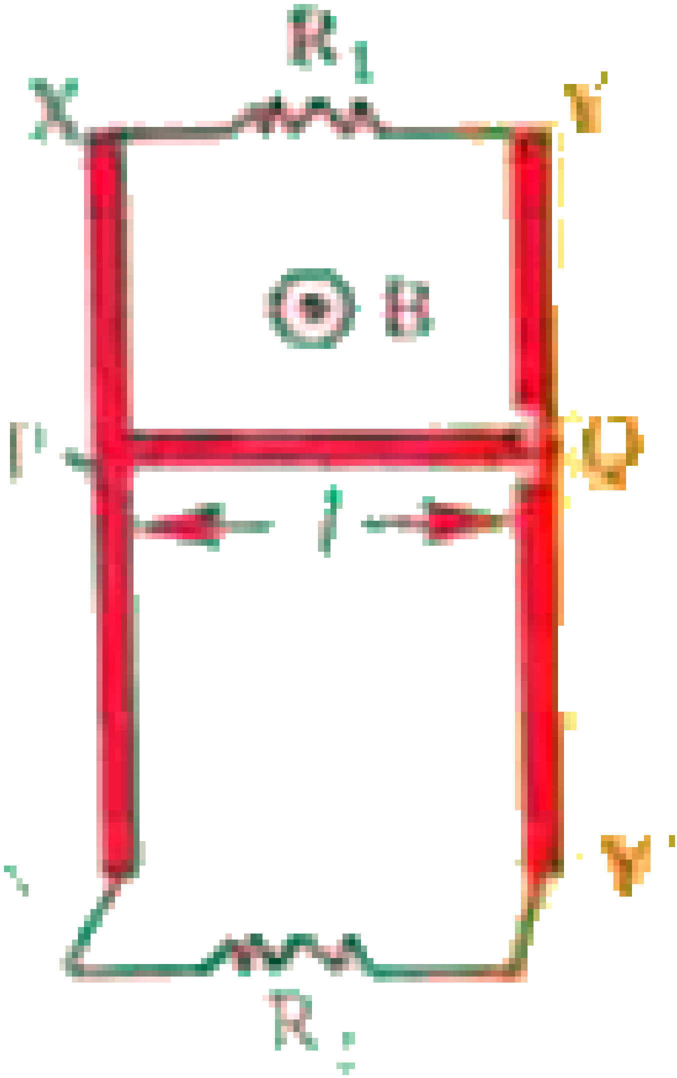
95. Two parallel vertical metallic bars XX.and YY., of negligible resistance and separated by a length .l., are as shown in Fig. The ends of the bars are joined by resistance R_1 and R_2. A uniform magnetic field of induction B exists in space normal to the plane of the bars. A horizontal metallic rod PQ of mass m starts falling vertically, making contact with the bars. It is observed that in the steady state the powers dissipated in the resistance

R_1 and R_2 are P_1 and P_2 respectively. Find an expression for R_1, R_2 and the terminal velocity attained by the rod PQ



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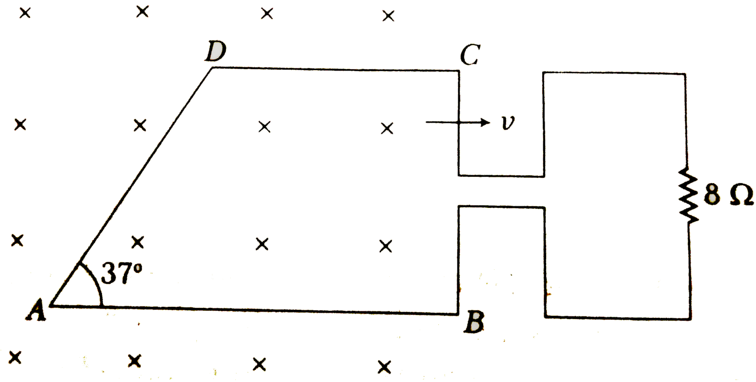
96. The loop ABCD is moving with velocity v towards right. The magnetic field is 4 T. The loop is connected to a resistance of 8Ω. If steady current of 2 A flows in the loop, then value of v, if loop has resistance of 4Ω, is (Given, AB = 30 cm, $\sin 37^{\circ} = \frac{3}{5}$)



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97. A square loop of side 12 cm with its sides parallel to X and Y axes is moved with a velocity of 8 cm s^{-1} in the positive x-direction in an environment containing a magnetic field in the positive z-direction. The field is neither uniform in space nor constant in time. It has a gradient of $10^{-3} T cm^{-1}$ along the negative x-direction (that is it increases by $10^{-3} T cm^{-1}$ as one moves in the negative x-direction), and it is decreasing in time at the rate of $10^{-3}Ts^{-1}$. Determine the direction and magnitude of the induced current in the loop if its resistance is 4.50 $m\Omega$.

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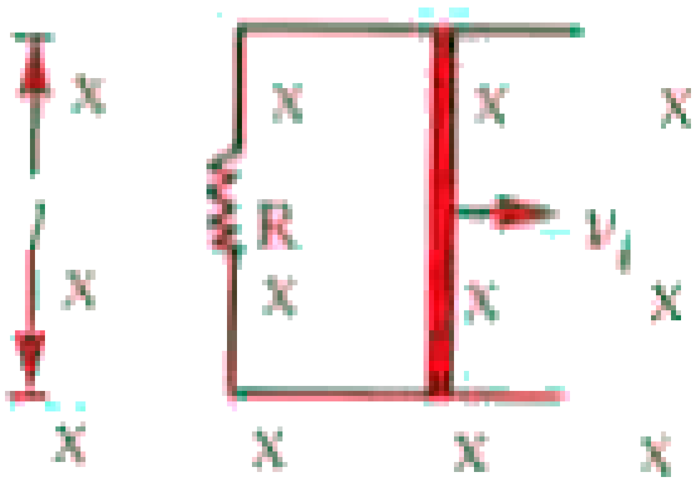
98. A bar of mass mand length l moves on two frictionless parallel rails in the presence of a uniform magnetic field directed into the plane of the paper. The bar is given an initial velocity v_i to the right and released. Find the velocity of bar, induced emfacross the bar und the current in the circuit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



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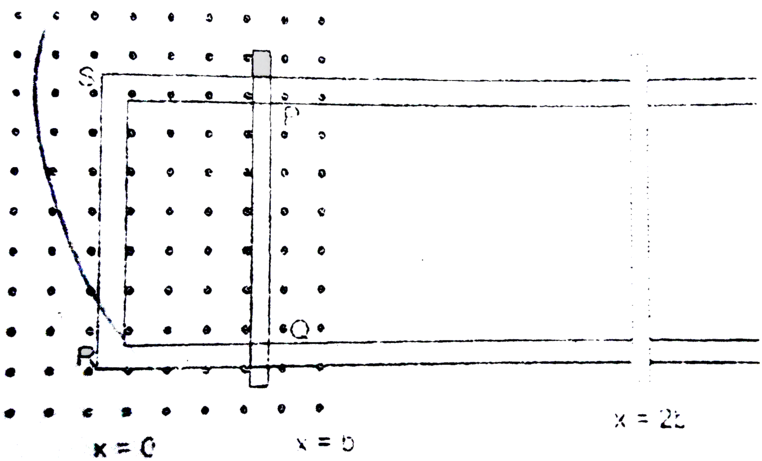
99. State Faraday's law of electromagnetic induction.

Figure shows a rectangular conductor $PQRS$ in which the conductor PQ is free to move in a uniform magnetic field B perpendicular to the plane of the paper.The field extends from $x = 0$ to $x = b$ and is zero for $x > b$.Assume that only the arm PQ posses resistance r.When the arm PQ is pulled outward from $x = 0$ with constant speed v, obtain the expressions for the flux and the induced emf. sketch the variations of these quantities with distance $0 \leq x \leq 2b$.



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100. Two concentric circular coils, one of small radius r_1 and the other of large radius r_2, such that $r_1 > \; > r_2$, are placed co-axially with centres coinciding. Obtain the mutual inductance of the arrangement.

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101. A small square loop of wire of side l is placed inside a large square loop of wire of side $L(> \; > l)$. The loops aer coplanar and their centres coincide. What is the mutual inductance of the system?

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102. The self-inductance of a coil having 200 turns is 10 milli henry. Calculate the magnetic flux through the cross-section of the coil corresponding to current of 4 milliampere. Also determine the total flux linked with each turn.

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

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104. An inductor of 5 H inductance carries a steady current of 2A. How can a 50 V self-induced emf be made to appear in the inductor ?

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105. Two different coils have self- inductances $L_1 = 16$ mH and $L_2 = 12$ mH. At a certain instant, the current in the two coils is increasing at the same rate and power supplied to the 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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106. The network shown is a part of the closed circuit 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 1 $A/\sec$ 2) decreasing at 1$A/\sec$

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

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

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109. A solenoid is of length 50 cm 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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110. An air cored solenoid is of length 0.3m, area of cross section is $1.2 \times 10^{-3} m^2$ and has 2500 turns. Around its central section, a coil of 350 turns is wound. The solenoid and the coil are electrically insulated from each other. Calculate the emf induced in the coil if the initial current of 3A in the solenoid is reversed in 0.25s.

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111. A solenoid of length 50cm with 20 turns per centimetre and area of cross-section 40cm? completely surrounds another coaxial solenoid of

the same length, area of cross-section $25 cm^2$ with 25 turns per centimetre. Calculate the mutual inductance of the system.

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112. 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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113. (a) A toroidal solenoid with an air core has an average radius of 0.15m, area of cross section $12 \times 10^{-4} m^2$ and 1200 turns. Obtain the self inductance of the toroid. Ignore field variation 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 emf in the secondary coil.

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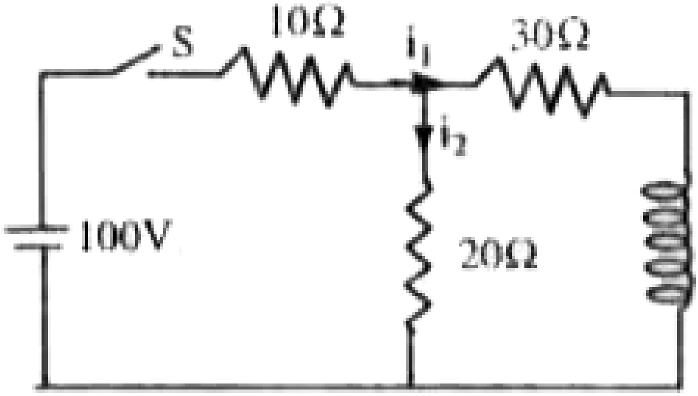
114. Find the values of i_1 and i_2



i) immediately after the switch S is closed.

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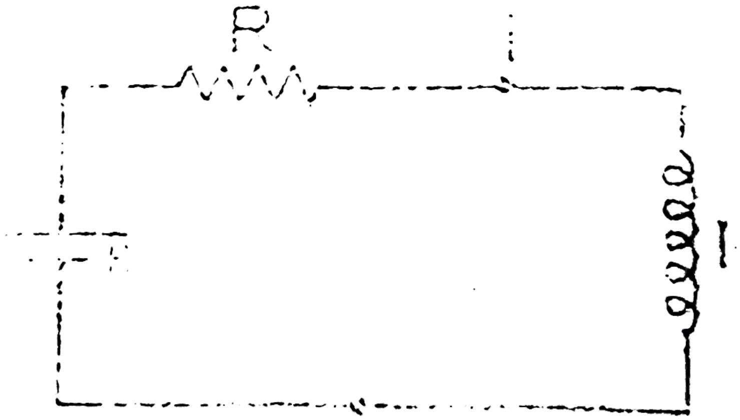
115. Suppose the EMF of the battery, the circuit shown varies with time t so the current is given by $i(t) = 3 + 5t$, where i is the amperes $\&t$ is in seconds.Take $R = 4\Omega$, $L = 6H\&$ find an expression for the battery

EMF as a funtion of time.



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

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

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118. A person peddles a stationary bicycle the pedals of the bicycle are attached to a 100 turn coil of area 0.10 m^2. The coil rotates at half a revolution per second and it is placed in a uniform magnetic field of 0.01 T perpendicular to the axis of rotation of the coil, What is the maximum voltage generated in the coil ?

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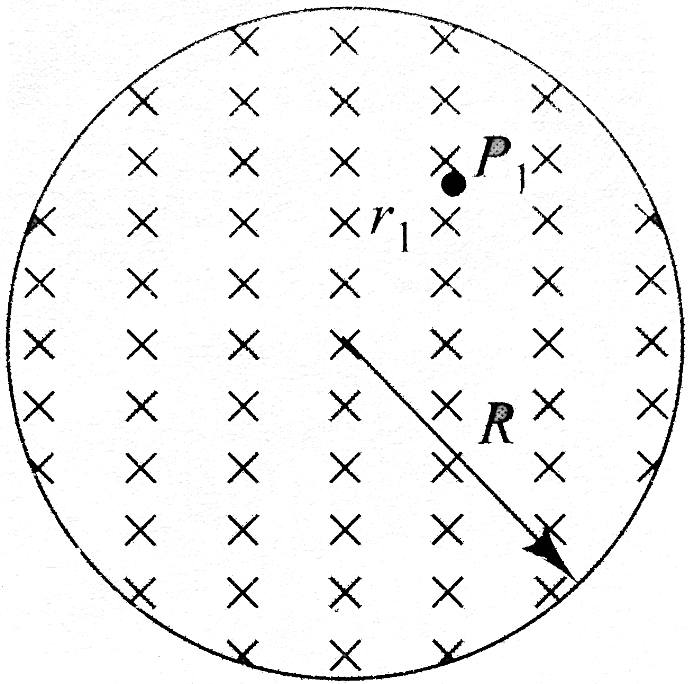
119. A magnetic field directed into the page changes with time according to $B = \left(0.0300t^2 + 1440\right)T$, where t is in seconds. The field has a circular cross section of radius $R = 2.50cm$. What are the magitude and direction of the electric field at point P_1 when $t = 3.00s$ and

$r_1 = 0.0200m$?



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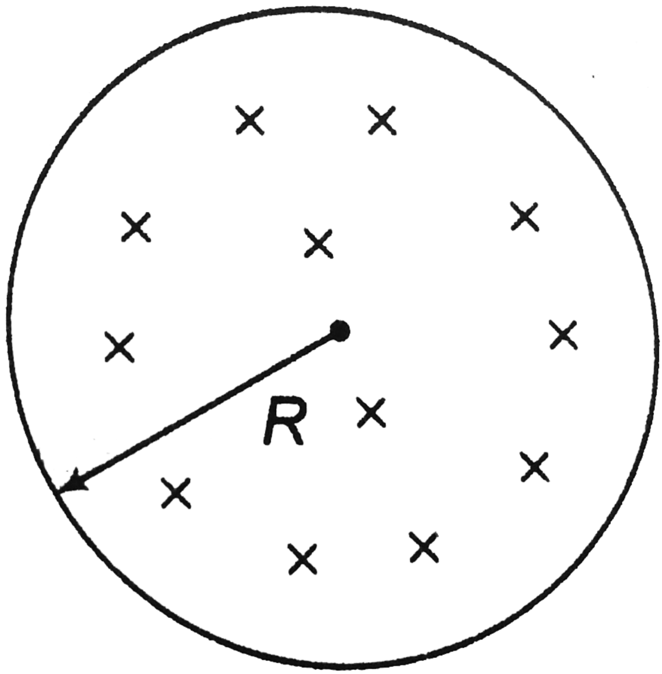
120. The magnetic field at all points within the cyllindrical region whose cross section is indicated in the accompanying Figure starts increasing at a constant rate $\alpha . T/s$. find the magnitud of electric field as a function of

r, the distance from the geometric centre of the region.



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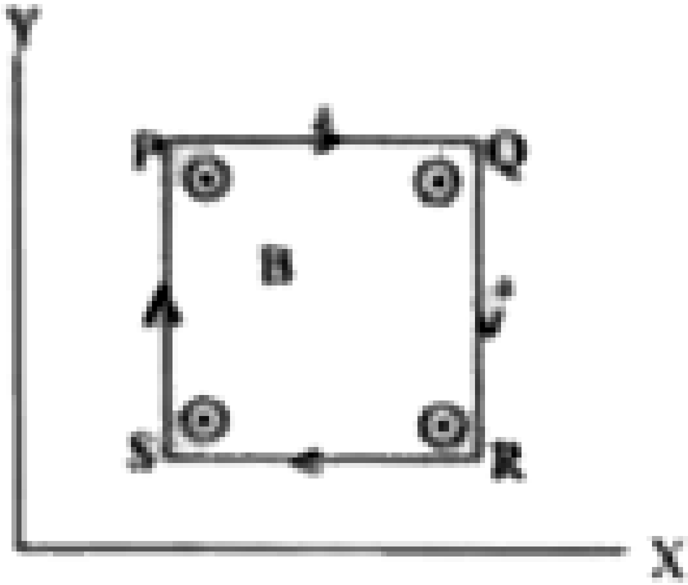
121. A wire is bent in the form of a square of side .a. in a varying magnetic field $\vec{B} = '\alpha' B_0 t\hat{k}$. If the resistance per unit length is λ , then find the following.



(i) The direction of induced current (ii) The current in the loop (iii) Potential difference between P and Q

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122. Shown in the figure is a circular loop of radius, r and resistance R. A variable magnetic field of induction $B = e^{-t}$ is established inside the coil. If the key (K) is closed at t=0 , the electrical power developed at the instant is equal to

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123. An inductor of 3H is connected to a battery of emf 6V through a resistance of 100 Ω. Calculate the time constant. What will be the maximum value of current in the circuit ?

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

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

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126. An inductor of 10mH is connected to a 18V battery through a resistor of $10k\Omega$ and a switch After a long time, when the maximum current is set up in the circuit, the current is switched off. Calculate the cur- rent in the circuit after 2 μs.

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127. Calculate the back e.m.f of a 10H, 200 Ω coil 100 ms after a 100Vdc supply is connected to it.

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128. The time constant of a certain inductive coil was found to be 2.5 ms. With a resistance of 80Ω added in series, a new time constant of 0.5 ms was obtained. Find the inductance and resistance of the coil.

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129. When a coil joined to a cell, the current through the coil grows with a time constant τ. After what time, the current will reach 10% of its steady-state value?

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130. At t=0, an inductor of zero resistance is joined to a cell of emf ε through a resistance. The current increases with a time constant τ. After what time will the potential difference across the coil be equal to that across the resistance ?

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

a. at the instant of closing the switch and

b. after one time constant.

c. Find the steady state current in the circuit.

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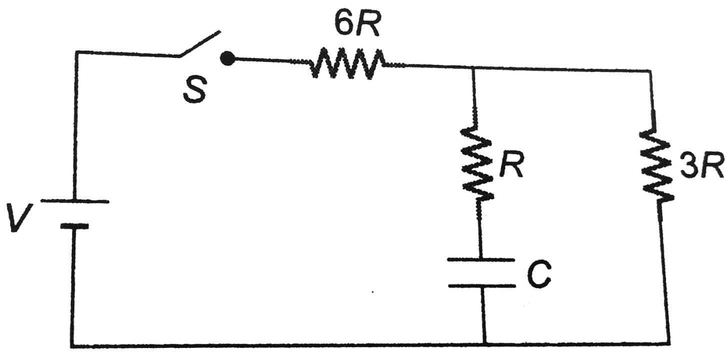
132. In the circuit shownin figure switch S is closed at time t=0. Find the current through different wire and charge stored on the capacitor at any time t.



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133. A parallel - plate capacitor, filled with a dielectric of dielectric constant 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?

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134. A $4\mu F$ capacitor and a resistance of $2.5 M\Omega$ are series 12 V battery. Find the time after with the potential difference across the capacitor is 3 times the potential difference across the resistance [Given $\ln(2) = 0.693$]

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135. 3 A coil of inductance 8.4 mH and resistance 6 Omega is connected to a 12 V battery The current in the coil is 1.0 A at approximately the time

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136. In a circuit inductance L and capacitance C are connected as shown in figures. A_1 and A_2 are ammeeters. When key K is pressed to complete the circuit, then just after closing key(K), the reading of current wil be

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Exercise Ia

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

A. A current will be induced in the coil

B. No current will be induced in the coil

C. Only e.m.f will be induced in the coil

D. Both e.m.f and current will be induced in the coil

Answer: B

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2. A magnet is brought towards a coil (i) speedly (ii) slowly, then induced emf/induced charge will be respectively

A. More in first case/More in first case

B. More in first case/Equal in both case

C. Less in first case/More in second case

D. Less in first case/Equal in both case

Answer: B

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3. If the flux of magnetic induction through each turn of a coil of resistance R and having N turns changes from ϕ_1 to ϕ_2 then the magnitude of the charge that passes through the coil is

A. $\dfrac{\phi_2 - \phi_1}{R}$

B. $\dfrac{N(\phi_2 - \phi_1)}{R}$

C. $\dfrac{\phi_2 - \phi_1}{NR}$

D. $\dfrac{NR}{\phi_2 - \phi_1}$

Answer: B

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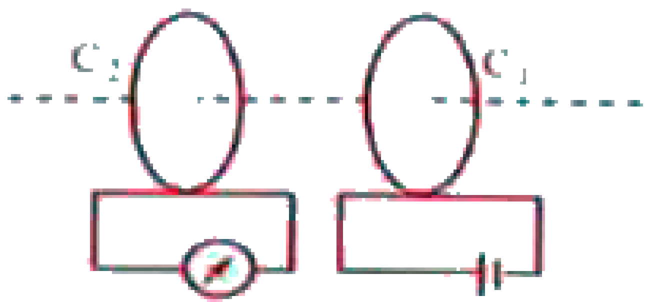
4. Two coils C_1 and C_2 are kept coaxially as shown the coil C_1 is connected to a battery and the coil C_2 is connected to a galvanometer. The deflection in galvanometer can be increased by



A. inserting a soft iron rod in coil C_1.

B. increasing relative speed between coils

C. connecting powerful battery to the coil C_1

D. all the above

Answer: D

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5. A closed iron ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of he ring. The acceleration of the falling is

A. Equal to gravity

B. Less than gravity

C. More than gravity

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

Answer: B

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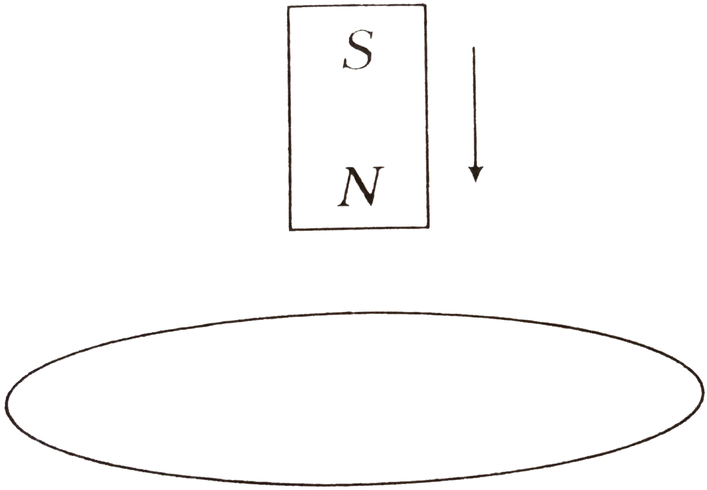
6. The north pole of a magnet is brought near a metallic ring as shown in the figure. The direction of induced current in the ring will be



A. First clockwise then anti clockwise

B. In clockwise direction

C. In anti clockwise direction

D. First anti clockwise then clockwise

Answer: C

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7. Two similar circular loops carry equal currents in the same direction. On moving the coils further apart, the electric current will

A. Increase

B. Decrease

C. Remain uncharged

D. The information is incomplete

Answer: A

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8. As shown in the figure, à magnet is moved with a fast speed towards a coil at rest. Due to this induced emf, induced current and induced charge in the coll is E, I and Q respectively. If the speed of the magnet is doubled, the incorrect statement is

A. E increases

B. I increases

C. Q remains same

D. Q increases

Answer: D

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

A. Clockwise

B. Zero

C. Counter clock wise

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

Answer: C

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10. A magnet is dropped dwon an infinitely long vertical copper tube,

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

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

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

D. The magnet moves with continuously increasing velocity and acceleration.

Answer: A

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

A. Clockwise of the +ve z axis

B. Anti clockwise of the +ve z axis

C. Zero

D. Along the magnetic field

Answer: C

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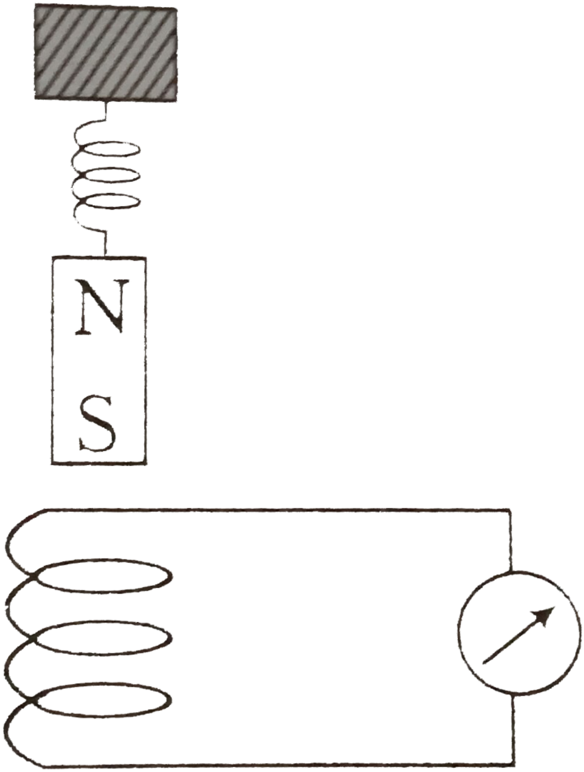
12. A magnet N-S is suspended from a spring and while at oscillates, the magnet moves in and out of the coil C. The coil is connected to a galvanometer G.



Then, as the magnet oscillates,

A. G shows deflection to the left and right with constant amplitude

B. G shows deflection on one side

C. G shows no deflection

D. G shows deflection to the left and right but the amplitude steadily decreases.

Answer: D

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13. When the current through a solenoid increases at a constant rate, then the induced current

A. Is constant and is in the direction of the instaneous current

B. Is constant and is opposite to the direction of the instaneous current

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

D. Increases with time and opposite to the direction of the instaneous current

Answer: B

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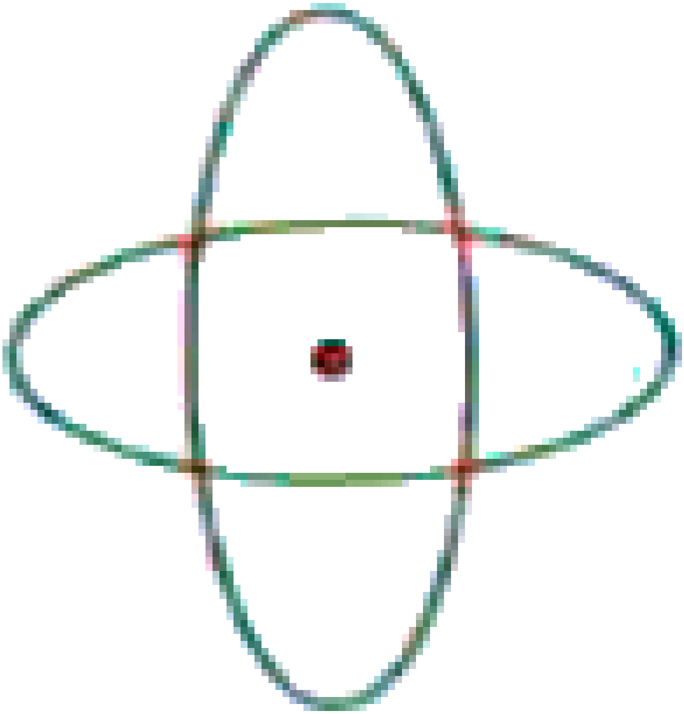
14. Two coils of wires A and B are mutually at right angles to each other as shown in the figure. If the current in one coil is changed, then in the other coil



A. No current will be induced.

B. Current will be induced in clockwise direction.

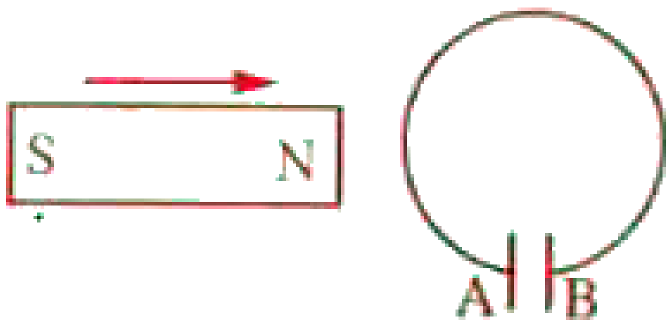
C. Current will be induced in anti-clockwise direction.

D. Current will be induced depending on increasing or decreasing current.

Answer: A

Watch Video Solution

15. In the given figure, the north pole of a magnet is brought towards a closed loop containing a condenser. Positive charge will be produced on



A. Plate A

B. Plate B

C. Both on plate A and plate B

D. Neither on plate A nor plate B

Answer: A

Watch Video Solution

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

A. Remains stationary

B. Is attracted by the loop A

C. Is repelled by the loop A

D. Rotates about its centre of mass with centre of mass fixed

Answer: C

Watch Video Solution

17. A closed loop moves normal to a constant electric field between the plates of capacitor with plane of loop is normal to the field. When the loop is partially outside the plates of capacitor, the induced current in the loop

A. depends on speed of loop

B. depends on size of loop

C. depends of intensity of electric field

D. zero

Answer: D

Watch Video Solution

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

A. Directly proportional to I

B. Directly proportional R

C. Inversely proportional to R

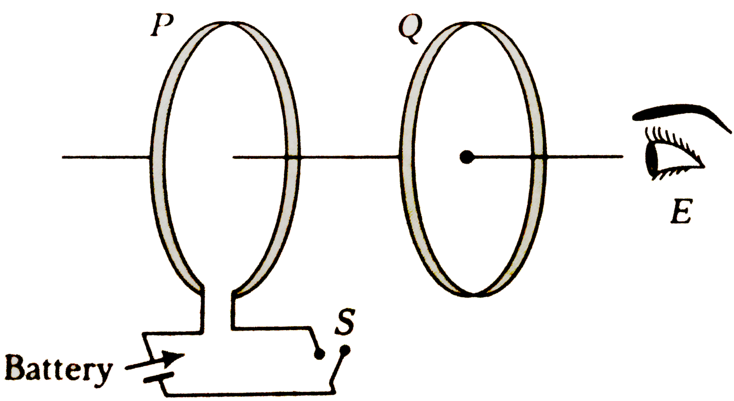
D. Zero

Answer: D

Watch Video Solution

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

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



A. respectively clockwise and Anti-clockwise

B. both clockwise

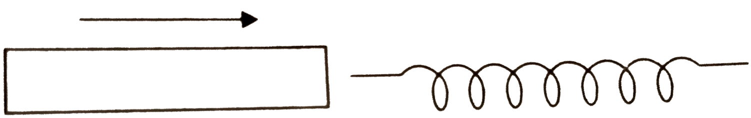
C. both Anti-clockwise

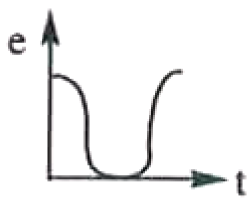
D. respectively anti-clockwise and clockwise

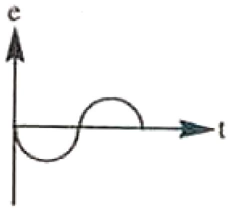
Answer: D

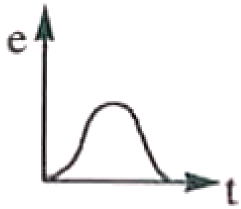
Watch Video Solution

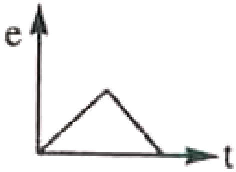
20. The variation of induced emf (ε) with time (t) in a coil if a short bar magnet is moved along its axis with a constant velocity is best represented as



A. 

B. 

C. 

D. 

Answer: B

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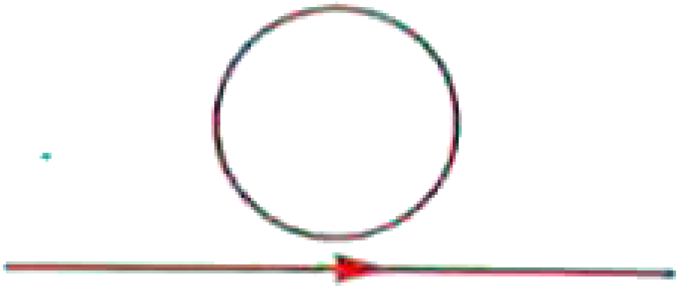
21. A current carrying wire is placed below a coil in its plane, with current flowing as shown. If the current increases.



A. No current will be induced in the coil

B. An anti clockwise current will be induced in the coil

C. A clockwise current will be induced in the coil

D. The current induced in the coil will be first anti clockwise and then clockwise

Answer: C

Watch Video Solution

22. A wire loop is rotated in magneitc field. The frequency of change of direction of the induced e.m.f. is.

(1.) Once per revolution

(2.) twice per revolution

(3.) four times per revoution

(4.) six time per revolution

A. Once per revolution

B. Twice per revolution

C. Four times per revolution

D. Six times per revolution

Answer: B

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23. A coil is rotated in a uniform magnetic field about an axis perpendicular to the field. The emf induced in the coil would be maximum when the plane of coil is :

A. parallel to the field

B. perpendicular to the field

C. at 45° to the field

D. none of these

Answer: A

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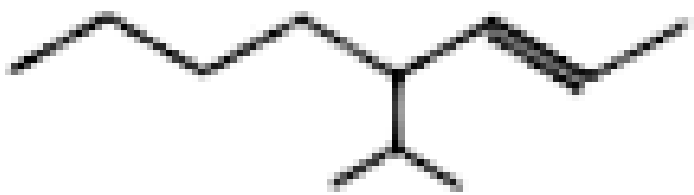
24. Write down the IUPAC name of the following :



A. its acceleration becomes greater than g

B. its acceleration becomes less than g

C. its acceleration remains equal to g

D. none of these

Answer: C

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25. The north of a bar magnet is moved towards a coil along the axis passing through the centre of the coil and perpendicular to the plane of the coil. The direction of the induced current in the coil when viewed in the direction of the motion of the magnet is

A. Clockwise

B. Anti - clockwise

C. No current in the coil

D. Either clockwise or anti - clockwise

Answer: B

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26. Two identical coaxial circular loops carry a current I each ciculating in the same direction. If the loops approach each other

A. The current in each increases

B. The current in one increases and current in the other decrease

C. The current in each decreases

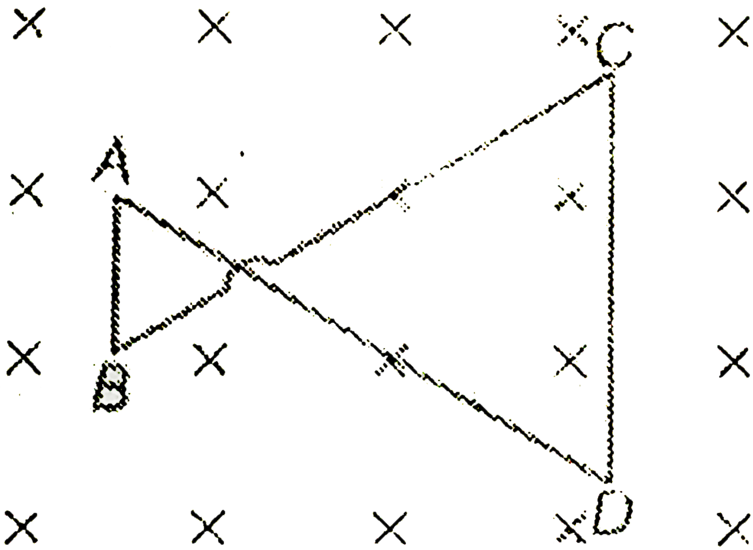
D. The current in each remains same

Answer: C

Watch Video Solution

27. A conducting wire frame is placed is placed in a magnetic field which is directed into the paper. The magnetic field is increasing at a costant rae.

The directions of induced currents in wires AB and CD are



A. 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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28. In an experiment, a magnet with its magnetic moment along the axis of circular coil and directed towards the coil, is withdrawn away from the coil and parallel to itself. The current in the coil, as seen by the withdrawing magnet, is

A. zero

B. clockwise

C. anti clockwisc

D. first .a. then .b.

Answer: B

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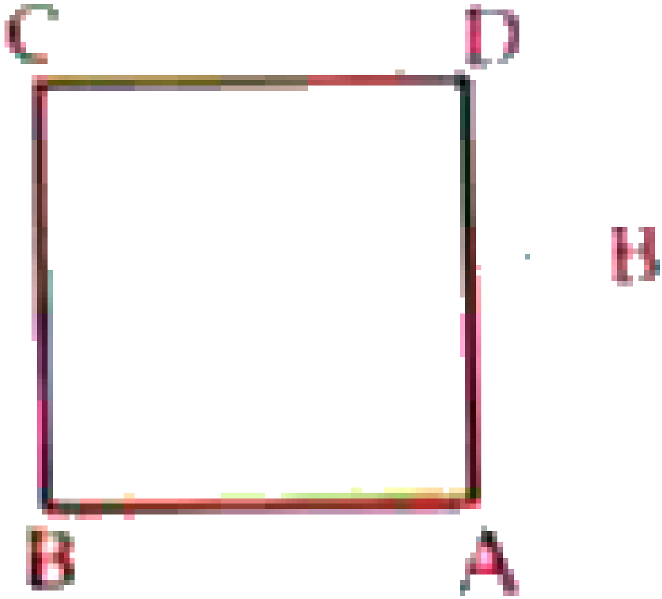
29. A conducting wire frame is placed in a magnetic field which is directed into the paper. The magnetic field is increasing at a constant rate. The directions of induced currents in wires AB and CD are



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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30. If a current of 0.5 apere flows through a metallic wire for 2 hour then how many electrons flow through the wire ?

A. a current is induced in anticlockwise direction and $a > g$

B. a current is induced in the clockwise direction and $a < g$

C. a current is induced in anticlockwise direction and $a < g$

D. no current is induced in the loop and a = g

Answer: B

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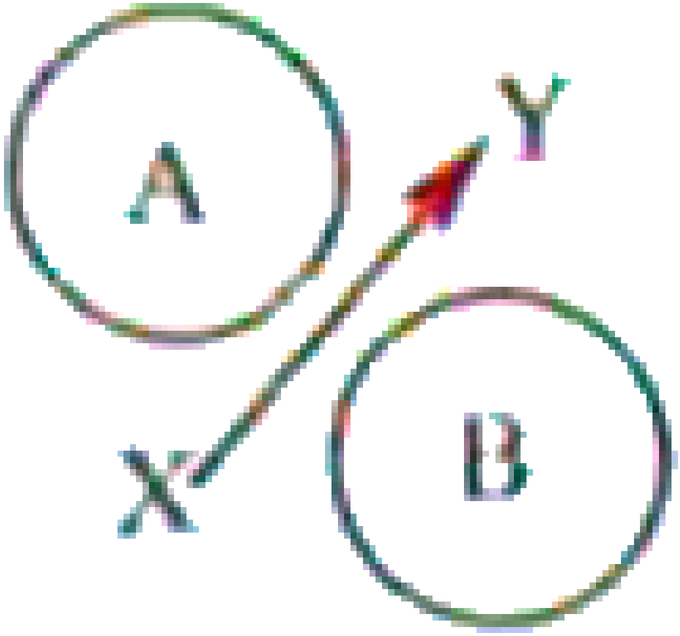
31. Consider the situation shown in the figure, If the current I in the long straight conducting wire XY is increased at a steady rate then the induced e.m.f..s in loops A and B wil be



A. clock wise in A, anti clockwise in B

B. anti clock wise 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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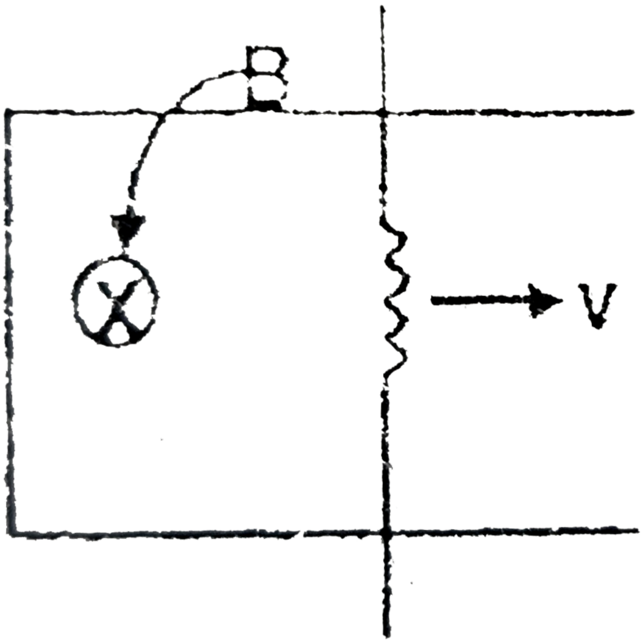
32. A conducting bar is pulled with a constant speed v on a smooth conducting rail. The region has a steady magnetic field of induction B as shown in the figure. If the speed of the bar is doubled then the rate of heat dissipation will



A. Constant

B. Quarter of the initial value

C. Four fold

D. Doubled

Answer: C

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33. 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. l and A increase

B. l decreases and A increase

C. l increases and a decrease

D. both l and A decrease

Answer: B

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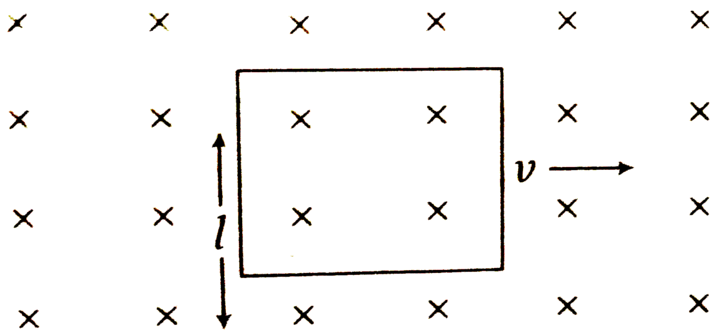
34. A conducting square loop of side l and resistance R is moving out of the plane with a uniform velocity v perpendicular to one of its sides. A uniform and constant magnetic field B exists along the perpendicular to the plane of the loop as shown in figure.



The current induced in the loop is

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

B. $\frac{Blv}{R}$ anti clockwise

C. $\frac{2Blv}{R}$ anti clockwise

D. zero

Answer: D

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

A. in AD but not in BC

B. in BC but not in AD

C. neither in AD nor in BC

D. in both AD and BC

Answer: D

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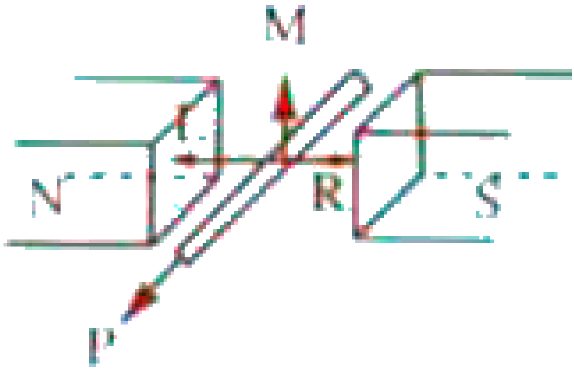
36. An electric potential difference will be induced between the ends of the conductor shown in the figure, if the conductor moves in the direction shown by



A. P

B. R

C. L

D. M

Answer: D

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37. A vertical rod of length l is moved with constant velocity v towards east. The vertical component of earth magnetic field is B and angle of dip is θ. The induced e.m.f. in the rod is

A. $Blv\sin\theta$

B. $Blv\tan\theta$

C. $Blv\cot\theta$

D. $Blv\cos\theta$

Answer: C

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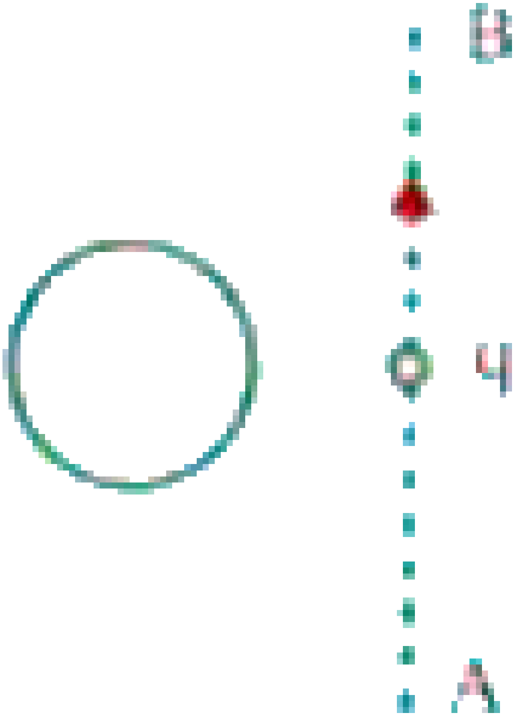
38. A positive charge q moves along the line AB, which lies in the same plane as a circular loop of conducing wire as shown in the figure. The direction of current induced in the loop is



A. Clockwise

B. First anticlockwise then clockwise

C. First clockwise then anticlockwise

D. No current is induced

Answer: C

Watch Video Solution

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

A. Keep oscillating with the old time period

B. Keep oscillating with a smaller time period

C. Oscillates with increasing time period and come to rest

D. Come to rest very soon

Answer: C

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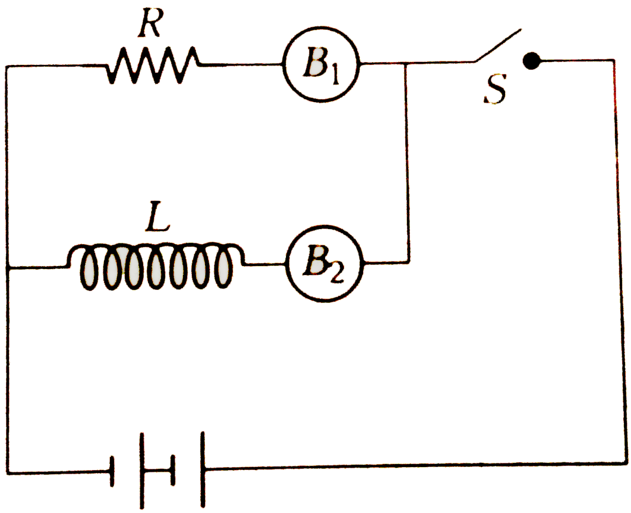
40. Figure shows tow bulbs B_1 and B_2 resistor R and inductor L, when the switch S is turned off



A. Both B_1 and B_2 die out promptly

B. Both B_1 and B_2 die out with some delay

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

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

Answer: B

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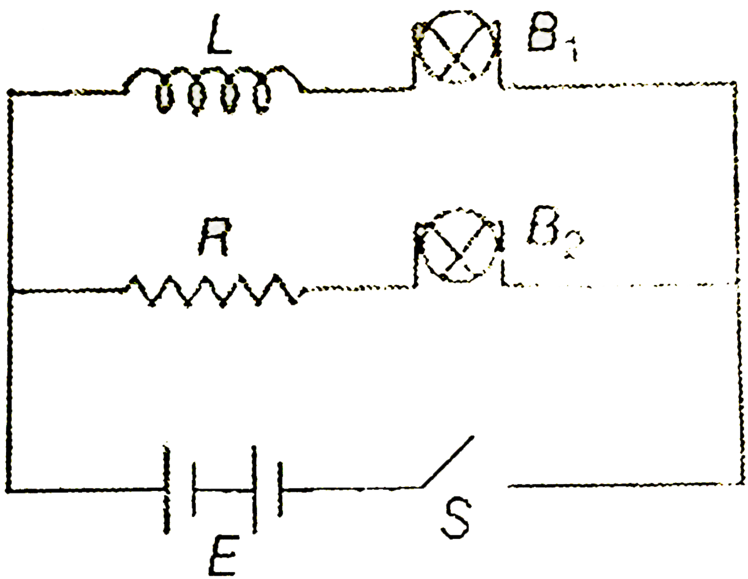
41. An inductor L, a resistanc eR and two identical bulbs B_1 and B_2 are connected to a battery through a switch S as shown in the figure . The resistance of coil having inductance L is also R. Which of the following statement gives the corrrect description of the happenings when the switch S is closed?



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

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

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

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

Answer: A

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42. If the number of turns per unit length of a coil of solenoid is doubled, the self-inductance of the solenoid will

A. Be nine times

B. Remain constant

C. Be halved

D. Be doubled

Answer: A

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

A. Increase

B. decrease

C. remains same

D. first increase then decrease

Answer: B

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44. A coil of self-inductance L is connected in series with a bulb B and an AC source. Brightness of the bulb decreases when

A. Frequency of the AC source is decreased

B. Number of turns in the coil is reduced

C. A capacitance of reactance $X_C = X_L$ is included in the same circuit

D. An iron rod is inserted in the coil

Answer: D

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45. The coefficient of mutual inductance of two coils depends on

A. the currents in the two coils.

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

C. relative position and orientation of the two coils.

D. the materials of the wires of the coils.

Answer: C

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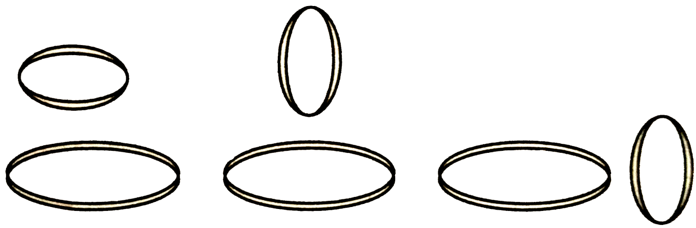
46. Two circular coils can be arranged in any of three situations as shown in the figure. Their mutual inductance will be



(i) (ii) (iii)

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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47. When the plane of the armature of an ac. generator is parallel to the field , in which it is rotating

A. both the flux linked and induced emf in the coil area zero

B. the flux linked with it is zero, while induced emf is maximum

C. flux linked is maximum while induced emf is zero

D. both the flux and emf have their respective maximum values.

Answer: B

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48. A coil of self-inductance L is placed in an external magnetic field (no current flows in the coil). The total magnetic flux linked with the coil is ϕ. The magnetic field energy stored in the coil is

A. Zero

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

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

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

Answer: B

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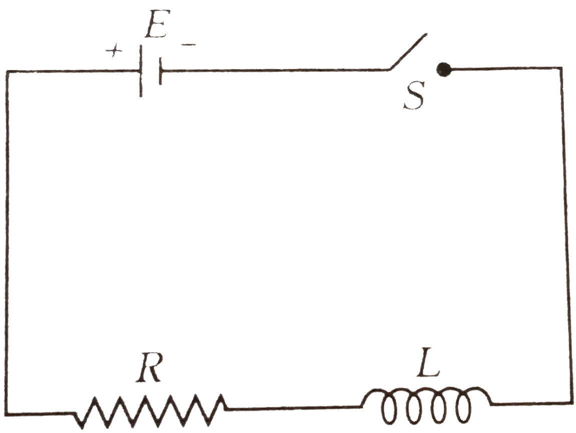
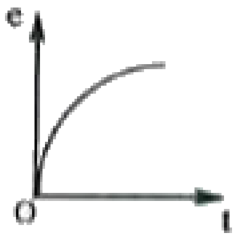
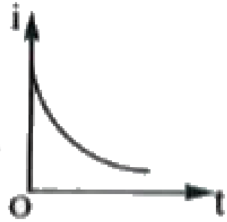
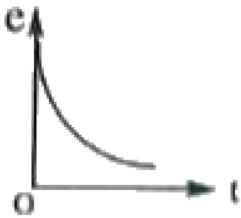
49. Switch S of the circuit shown in figure is closed at t = 0.

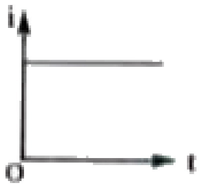


If emf in L is e and i is the current flowing through the circuit at time t, which of the following graphs is corrent?

A. 

B. 

C. 

D. 

Answer: C

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50. The magnetic energy stored in a long solenoid of area of cross-section A in a small region of length L is

A. $\dfrac{B^2 AL}{2\mu_0^2}$

B. $\dfrac{AL}{2\mu_0}$

C. $\dfrac{1}{2}\mu_0 B^2 AL$

D. $\dfrac{B^2 AL}{2\mu_0}$

Answer: D

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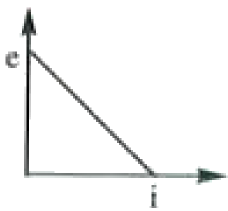
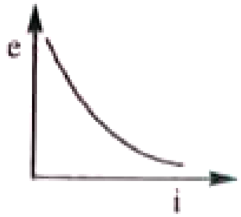
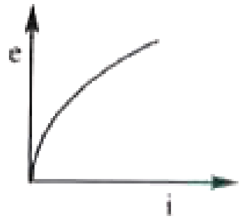
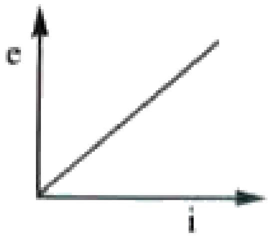
51. In an L-R circuit connected to a battery of constant emf E, switch is closed at time t=0. If e denotes the induced emf across inductor and I the current in the circuit at any time t. Then which of the following graphs shown the variation of e with i?



A.

B. 

C. 

D. 

Answer: A

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52. Two identical capacitors A and B are charged to the same potential and then made to discharge through resistances R_A and R_B respectively, with $R_A > R_B$.

A. A will require greater time than B to discharge

B. More heat will be produced in A than in B.

C. More heat will be produced in B than in A.

D. A will require less time than B to discharge completely

Answer: A

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53. Consider the situation shown in figure . 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 an anticlockwise current pulse

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

Answer: D

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54. In the pure inductive circuit, the curves between frequency f and reciprocal of inductive reactance $1/X_L$ is

A. at the time of switching on due to high resistance

B. at the time of switching off due to high resistance

C. at the time of switching off due to low resistance

D. at the time of switching on due to low resistance

Answer: B

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55. The heat developed in a system is proportional to the current through it.

A. a, c only

B. c, d only

C. a, c, d

D. d only

Answer: B

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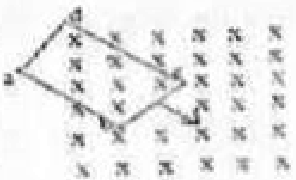
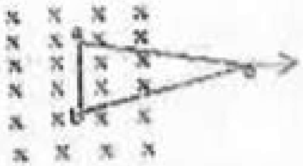
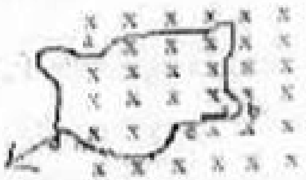
56. Match the items of column I with those of Column II and choose the correct option from the codes given below.

Column – I (planar loops of different shapes	Column – II (direction of induced current)
A) 	1) b a c d
B) 	2) c d a b c
C) 	3) b c d a b

A. A - 3, B - 1, C-2

B. A - 2, B- 1, C-3

C. A - 1, B-2, C-3

D. A - 1, B - 3, C-2

Answer: B

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57. Consider the following statements

A) If time constant is small the condenser discharges slowly.

B) For small values of inductance the rate of decay of current will be large

A. Both are correct

B. Only A is correct

C. Only B is correct

D. Both are wrong

Answer: C

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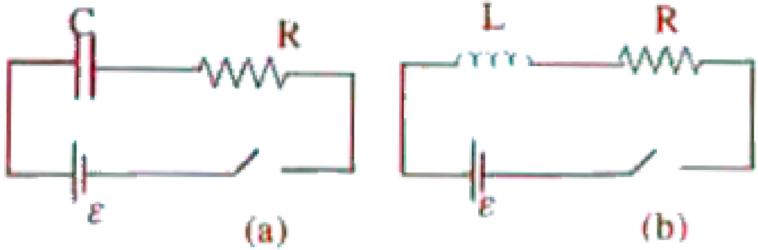
58. The switches in (a) and (b) are closed at t = 0 and re opened after a long time at $t = t_0$



a) The charge on C just at t =0 is ε^{C}.

b) The charge on C long after t = 0 is ε^{C}.

c) The current in L just before t = 0 is $\frac{\varepsilon}{R}$

d) The current in L long after t = 0 is $\frac{\varepsilon}{R}$

A. a, c are true

B. b, d are true

C. only d is true

D. only a is true

Answer: A

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Exercise Ib

1. A : Total induced emf in a loop is not confined to any particular point but it is distributed around the loop in direct proportion to the resistances of its parts.

R: In general when there is no change in magnetic flux, no induced emf is produced.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: B

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2. (A): Unlike electrostatic field the lines of induced field from closed loop.

(R): Electrostatic field is conservative unlike induced fields.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: A

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3. A: The mutual Induction between the two coils infinitely apart is zero. R: If the mutual induction between the two coils is zero, it means that their self inductances are also zero.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: C

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4. A: An inductor is called the inertia of an electric circuit.

R: An inductor tends to keep the flux constant.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: A

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5. A: At any instant, if the current through an inductor is zero, then the induced emf will also be zero.

R: In one time constant, the current flows to 37 percent of its maximum value in a series LR circuit.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: D

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6. A: There may be an induced emf in a loop without induced current.

R: Induced current depends on the resistance of the loop as well.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: A

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7. A: When the magnetic flux through a loop is maximum, induced emf is maximum.

R: When the magnetic flux through a loop is minimum, induced emf is minimum.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: D

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8. A: When a conducting loop is kept stationary in a non-uniform magnetic field an emf is induced.

R: As per Faraday's law, whenever flux changes, an emf is induced.

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

B. Both A and R are true but 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. A: When an electric motor is started, a variable resistance (that decreases with time) is used in series. This resistance is known as motor slarter,

R: The back-emf in the beginning, when motor starts, is very small.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: A

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10. A current I is flowing in a straight conductor of length L. The magnetic induction at a point distant $\frac{L}{4}$ from its centre will be

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

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

C. A is true but R is false

D. Both A and R are false

Answer: B

Watch Video Solution

11. A: Electrical power through transmission lines is transmitted at high voltage.

R: At high voltage theft of power is checked.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: C

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12. (A): The electric field induced due to changing magnetic field is non-conservative.

(R): The line integral of the electric field along a closed loop is always zero.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: C

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13. (A): In equation $F = q(E + v \times B)$ when v = 0, any force on the charge must arise from the electric field term E alone

(R): To explain, the existence of induced emf or induced current in static conductor kept in time - varying magnetic field, we must assume that a time - varying magnetic field generates an electric field

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

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

C. A is true but R is false

D. Both A and R are false

Answer: B

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14. A: The induced current flows so as to oppose the cause producing it.

R: Lenz's law is based on energy conservation.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: A

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15. (A): Only a change in magnetic flux will maintain an induced current in the coil.

(R): 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

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

C. A is true but R is false

D. Both A and R are false

Answer: C

Watch Video Solution

16. (A): If changing current is flowing through a machine of iron eddy currents are produced

(R): Change in magnetic flux through an area causes eddy currents

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

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

C. A is true but R is false

D. Both A and R are false

Answer: A

Watch Video Solution

17. Assertion : The possibility of an electric bulb fusing is higher at the time of switching on and off.

Reason : Inductive effects produce a sugar at the time of switch - off and switch - on .

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

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

C. A is true but R is false

D. Both A and R are false

Answer: A

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18. Assertion : An emf $\overrightarrow{E}$ is induced in a closed loop where magnetic flux is varied. The induced $\overrightarrow{E}$ is not a conservative field.

Reason : The line intergral $\overrightarrow{E}\,.\,\overrightarrow{dl}$ around the closed loop is non-zero.

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

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

C. A is true but R is false

D. Both A and R are false

Answer: A

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Exercise Ii

1. A coil of 100 turns and area square centimetre is placed in a magnetic field B = 0.2 T . The normal to the plane of the coil makes an angle of 60° with the direction of the magnetic field . The magnetic flux linked with the coil is :

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

A. - 900 nwb

B. - 700 nwb

C. - 200 nwb

D. - 800 nwb

Answer: A

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3. A magentic field of 2×10^{-2} T acts at right angles to a coil of area $100 cm^2$, with 50 turns .The average emf induced in the coils is 0.1 V, when it is removed from the fields in t second . The value of t is

A. 0.1s

B. 0.01s

C. 1s

D. 20s

Answer: A

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4. 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

C. 7.5

D. 10

Answer: D

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5. The magnetic flux linked with a coil (in Wb) is given by the equation $\phi = 5t^2 + 3t + 16$. The magnetic of induced emf in the coil at fourth second will be

A. 145 V

B. 43 V

C. 10 V

D. 108 V

Answer: B

Watch Video Solution

6. A rectangular coil of 20 turns and area of cross-section 25sq. Cm has a resistance of 100Ω. If a magnetic field which is perpendicular to the plane of coil changes at a rate of 1000 tesla per second, the current in the coil is

A. 1 amp

B. 0.5 amp

C. 5 amp

D. 50 amp

Answer: B

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

that flows during this period is

A. 2.5×10^{-6} C

B. 2×10^{-6} C

C. 10^{-6} C

D. 8×10^{-6} C

Answer: A

Watch Video Solution

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

A. 6.55 T

B. 5.66 T

C. 0.655 T

D. 0.566 T

Answer: D

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9. A magnetic field of 5×10^{-5} T is produced at a perpendicular distance of 0.2 m from a long straight wire carrying electric current. If the permeability of free space is $4\pi \times 10^{-7} Tm / A$, the current passing through the wire in A is

A. 0.2 A

B. 0 A

C. 4 A

D. 50 A

Answer: B

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10. The number of turns in the coil of an AC generator is 5000 and the area of the coil is $0.25m^2$. The coil is rotated at the rate of 100 cycles/s in a magnetic field of 0.2Wm^{-2}. The peak value of the emf generated is nearly

A. 786 kV

B. 440 kV

C. 220 kV

D. 157.1 kV

Answer: D

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11. A circular coil of area 8 m^2 and number of turns 20 is placed in a magnetic field of 2T with its plane perpendicular to it. It is rotated with an angular velocity of 20 rev/s about its natural axis. The emf induced is

A. 400V

B. 800 πV

C. zero

D. 400 π V

Answer: C

Watch Video Solution

12. A coil having 500 square loops each of side 10 cm is plance normal to a magnetic flux which increases at the rate of $1.0Ts^{-1}$. The induced emf in volts is

A. 0.1

B. 0.5

C. 1

D. 5

Answer: D

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13. The Wing span of an aeroplane is 20 metre . It is flying in a field , where the vertical component of magnetic field of earth is 5×10^{-5} tesla , with vertical component of magnetic field of earth is 5×10^{-5} tesla , with velocity 360 km/h .The potential difference produced between the blades will be :

A. 0.10 V

B. 0.15 V

C. 0.20 V

D. 0.30V

Answer: A

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14. A small piece of metal wire is dragged across the gap between the pole pieces of a magnet in 0.4 sec. If magnetic flux between the pole pieces is known to be 8×10^{-4}Wb, then induced emf in the wire, is

A. 4×10^{-3} V

B. 8×10^{-3} V

C. 2×10^{-3} V

D. 6×10^{-3} V

Answer: C

Watch Video Solution

15. A copper disc of radius 0.1 m is rotated about its natural axis with 10 rps in a uniform magnetic field of 0.1 T with its plane perpendicular to the field, The emf induced across the radius of the disc is

A. $\pi \times 10$V

B. $2\pi \times 10$ V

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

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

Answer: C

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16. A wheel with 10 metallic spokes each 0.5 m long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of earth's magnetic field H_E at a place. If H_E = 0.4 G at the place, what is the induced emf between the axle and the rim of the wheel? Note that 1 G = 10^{-4} T.

A. 1.256×10^{-3} V

B. 6.28×10^{-4} V

C. 1.256×10^{-4} V

D. 6.28×10^{-5} V

Answer: D

Watch Video Solution

17. An E.M.F of 5 V is produced in an inductor, when the current changes at a steady rate from 3A to 2A in 1 millisecond, the value of self inductance is

A. Zero

B. 5H

C. 5000H

D. 5 mH

Answer: D

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18. A coil has a self-inductance of 0.05 henry. Find magnitude of the emf induced in it when the current flowing through it is changing at the rate $100As^{-1}$

A. 10 Wb

B. 20 Wb

C. 10 μ Wb

D. 20 μ Wb

Answer: C

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19. A long solenoid has 1000 truns. When a current of 4A flows through it, the magnetic flux linked with each trun of the solenoid is 4×10^{-3} Wb. The self -niducatance of the soleniod is

A. 4H

B. 3H

C. 2H

D. 1H

Answer: D

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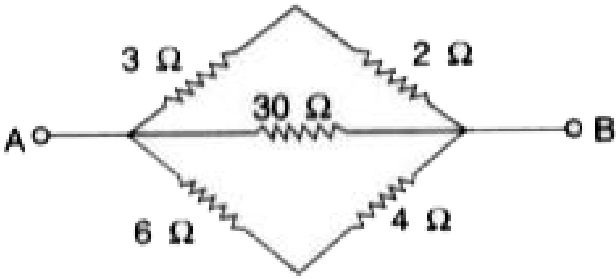
20. Calculate the equivalent resistance between the points A and B in Fig.



A. 2H

B. 6H

C. $8/3$H

D. $4/9$H

Answer: A

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21. If a change in current of 0.01 A in one coil produces a change in magnetic flux of 1.2×10^{-2} Wb in the other coil , then the mutual inductance of the two coils in henries is :

A. 0

B. 0.5

C. 2

D. 3

Answer: C

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22. The current in a coil is changed from 5A to 10A in 10^{-2}s. Then, an emf of 50mV is induced in a coil near by it. Calculate mutual inductance of two coils.

A. 100 μ H

B. 50 μ H

C. 20 μ H

D. 60 μ H

Answer: A

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23. Two coaxial solenods are made by winding thin insulated wire over a pipe of cross sectional area A = $10cm^2$ and length = 20 cm. If one of the solenoids has 300 turns and the other 400 turns, their mutual inductance is $\left(\mu_0 = 4\pi \times 10^{-7} TmA^{-1}\right)$

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

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

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

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

Answer: D

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24. To emf induced in a secondary coil is 20000 V , when the current breaks in the primary coil . The mutual inductance is 5 H and current in the primary before it breaks is :

A. 1A

B. 0.2A

C. 0.3A

D. 0.4A

Answer: D

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

A. 10 mH

B. 6 mH

C. 4 mH

D. 16 mH

Answer: C

Watch Video Solution

26. Two coaxial solenods are made by winding thin insulated wire over a pipe of cross sectional area A = $10cm^2$ and length = 20 cm. If one of the solenoids has 300 turns and the other 400 turns, their mutual inductance is $\left(\mu_0 = 4\pi \times 10^{-7} TmA^{-1}\right)$

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

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

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

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

Answer: D

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27. A 50 mh coil carries a current of 2 A. the energy stored in joules is

A. 1

B. 0.1

C. 0.05

D. 0.5

Answer: B

Watch Video Solution

28. A condenser of capacity 1 μ F and a resistance 0.5 mega-ohm are connected in series with a DC supply of 2 V. The time constant of circuit is

A. 2 s

B. 1 s

C. 0.5 s

D. 0.25 s

Answer: C

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29. An ideal coil of 10 H is joined in series with a resistance of 5Ω and a battery of 5 V. 2 s after joining, the current flowing in ampere in the circuit will be

A. e^{-1}

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

C. (1-e)

D. e

Answer: B

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30. A capacitor is connected to a 12 V battery through a resistance of (10Ω).It is found that the potential difference across the capacitor rises to 4.0 V in 1(mu)s. find the capacitance of the capacitor.

A. $0.36\mu F$

B. $0.69\mu F$

C. $\frac{1}{0.36}\mu F$

D. $\frac{1}{0.696}\mu F$

Answer: D

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31. A coil of self inductance 2.5 H and resistance 20Ω is connected to a battery of emf 120 V having internal resistance of 5Ω. Find :

The time constant of the circuit

A. 0.2 sec, 10A

B. 2 sec, 10A

C. 3 sec, 20A

D. 4 sec, 20A

Answer: A

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32. A 8 μ F capacitor is charged by a 400 V supply through 0.1 M Ω 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. 0.48 sec

Answer: D

Watch Video Solution

Exercise Iii

1. A aquare of side L meters lies in the xy-plane in a region, where the magnetic field is given 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. $2B_0L^2$Wb

B. $3B_0L^2$Wb

C. $4B_0L^2$Wb

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

Answer:

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2. A rectangular coil of area A rotates in a uniform magnetic field B with angular velocity about an axis perpendicular to the field, initially the plane of coil is perpendicular to the field,then the avarage induced e.m.f. after rotating by 90° is

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

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

C. $\frac{\omega B A}{4\pi}$

D. $\frac{2\omega B A}{\pi}$

Answer:

Watch Video Solution

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

A. BR/A

B. AB/R

C. ABR

D. $2BA/R$

Answer:

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4. A square loop of side .a. lying in a perpendicular magnetic field to its plane is changed to a circle. If change occurs in .t. seconds in magnetic field B tesla, the induced emf is

A. $\frac{4}{\pi}\frac{Ba^2}{t}$

B. $\frac{Ba^2}{t}$

C. $\frac{Ba^2}{t}\left[\frac{4}{\pi}-1\right]$

D. zero

Answer:

Watch Video Solution

5. A very small circular loop of area $5 \times 10^{-4} m^2$ resistance 2 ohm and negligible self inductance initially coplaner and concentric with a much larger fixed circular loop of radius 0.1 m. A constant current of 1.0 A is passed through the bigger loop. The smaller loop is rotated with constant angular velocity ω rad /sec about it's diameter. Calculate the

(a) induced emf and

(b) the iduced current through the smaller loop as a function of time.

A. $\frac{\pi\omega}{8}\cos\omega t$

B. $\frac{\pi\omega}{2}\sin\omega t$

C. $\pi\omega^2\sin\omega t$

D. $\pi\omega\sin\omega t$

Answer:

Watch Video Solution

6. A conducting circular loop is in a perpendicular magnetic field of induction 10^{-2}T If the radius of the loop starts shrinking at a uniform rate of 1 mm/s, then the e.m.f. induced in the loop at the instant when its radius is 10 cm will be

A. 1 μ V

B. 2 μ V

C. $\pi\mu$ V

D. $2\pi\mu$ V

Answer:

Watch Video Solution

7. A square coil of side 0.5 m has movable sides. It is placed such that its plane is perpendicular to uniform magnetic field of induction 0.2 T. If all the sides are allowed to move with a speed of 0.1 ms^{-1} for 4 sec outwards, average induced emf is

A. Zero

B. 0.01V

C. 0.028V

D. 0.072V

Answer:

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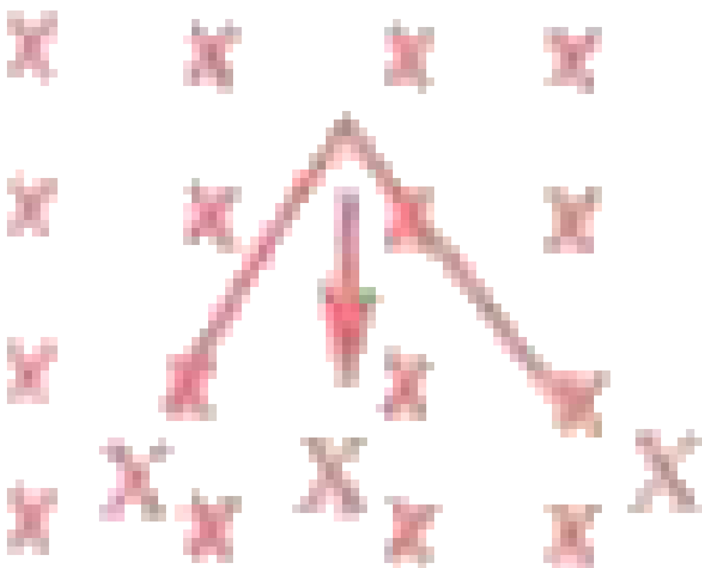
8. A wire of length .2l. is bent at midpoint so that angle between the two halves is 60°. If it moves as shown with velocity .V. in a magnetic field .B.. The induced emf with be



A. Blv, P at high potential and Q at low potential

B. 2Blv, P at high potential and Q at low potential

C. Blv, Q at high potential and P at low potential

D. 2Blv, from Q at high potential and P at low potential

Answer:

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9. A vertically ring of radius r and resistance R falls vertically. It is in conect with two vertical rails which are joined at the top. The rails are without friction and resistance. There is a horizontal uniform magnetic field of magnitude B the speed of the ring is v, the current in the top horizontal of the rail section is

A. zero

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

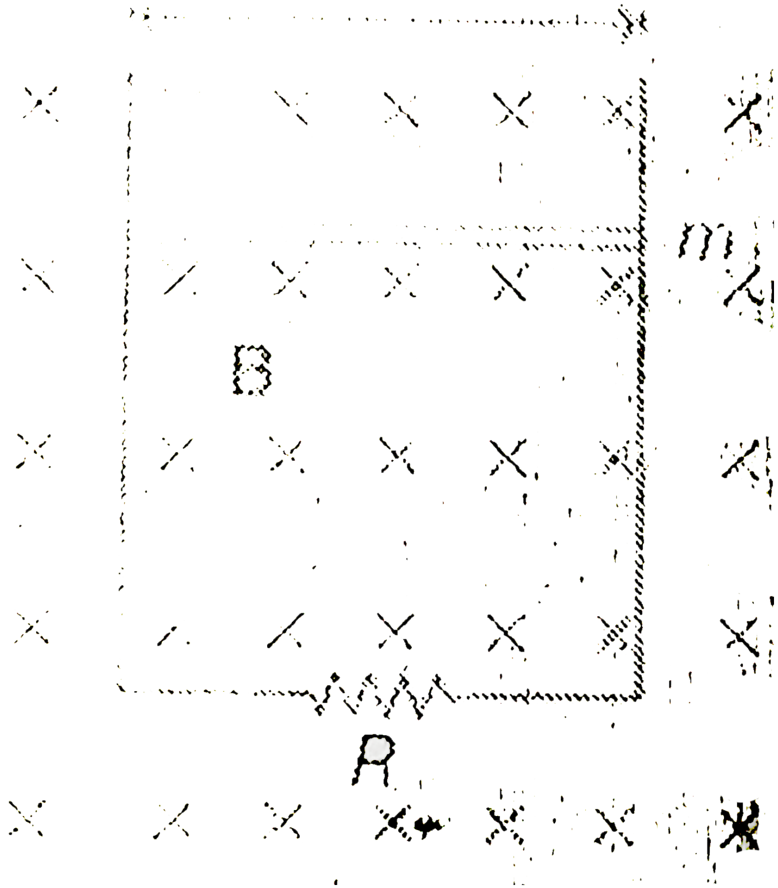
C. $\dfrac{4Brv}{R}$

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

Answer:

Watch Video Solution

10. A horizontal wire is freee to slide on the vertical rails of a conducting frame as shown in figure. The wire has a mass m and length l. The wire has a mass m and length l. Resistance of the cirucuit is R. If a uniform magnetic field B is directed perpendicular to the frame, then terminal speed of the wire as it fails under the force of gravity is



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

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

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

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

Answer:

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

A. Zero

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

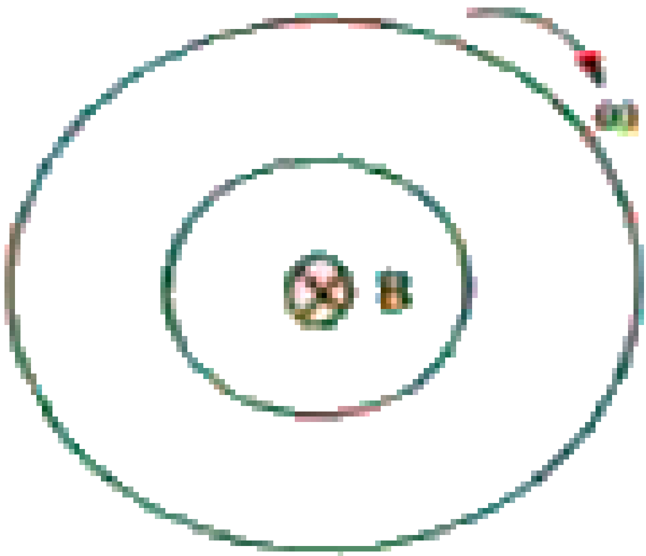
C. $\dfrac{2Br^2\omega}{R}$

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

Answer:

Watch Video Solution

12. An annular disc of copper with inner and outer radii r and R is rotating with a uniform angular speed w in a region where a uniform magnetic field B exists as shown. Then net emf induced between the inner edge and outer edge of the disc is



A. Zero

B. $\frac{1}{2} Bw(R-r)^2$

C. $\frac{1}{2} Bwr^2$

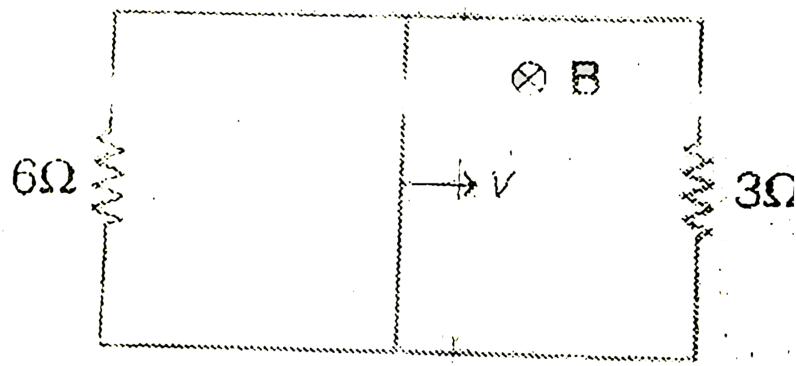
D. $\frac{1}{2} Bw\left(R^2-r^2\right)$

Answer:

Watch Video Solution

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

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



A. 6N

B. 4N

C. 2N

D. 1N

Answer:

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14. A squre loop of side a is placed in the same plane as a long stainght wire carrying a current i. The centre of the loop si sat a distance r from the wire where $r > \; > a$. The loop is moved away from the wire with a constant velocity v. The induced emf in the loop is

A. $\frac{\mu_0}{4\pi}iv$

B. $\frac{\mu_0}{2\pi}\frac{iv}{a}$

C. $\frac{\mu_0}{4\pi}\frac{iv}{a}$

D. $\frac{\mu_0}{2\pi}iv$

Answer:

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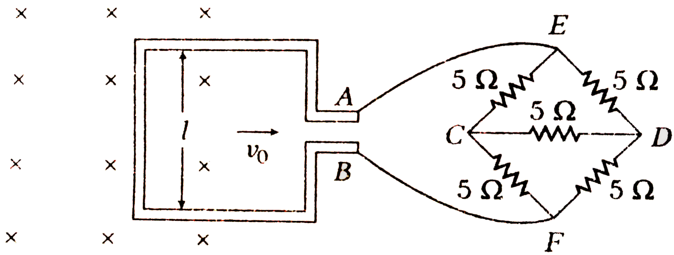
15. A square metal wire loop of side 20 cm and resistance 2Ω is moved with a constant velcoity v_0 in a uniform magnetic field of induction B = 1 Wb/m^2 as shown in the figure. The magnetic field lines are perpendicular to the plane of the loop. The loop is connected to a network of resistance each of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



A. $0.02m/s$

B. $2m/s$

C. $20m/s$

D. $200m/s$

Answer:

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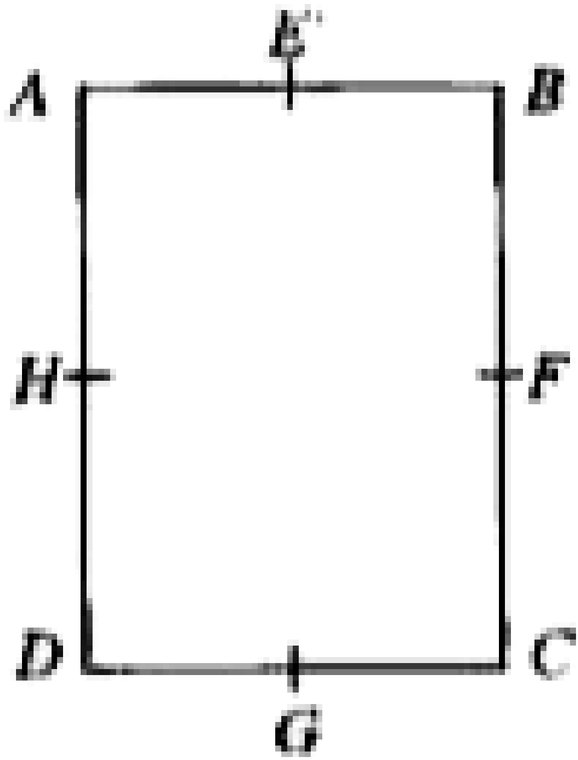
16. IN a retangle ABCD (BC = 2AB). The moment of inertia along which aixs will be minimum



A. $\dfrac{\mu_0 iav}{2\pi x}$

B. $\dfrac{\mu_0 iav}{2\pi(x+a)}$

C. 1/(2 x-a)[2x+a]`

D. $\dfrac{\mu_0 ia^2 v}{2\pi x(x+a)}$

Answer:

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17. A rectangulare loop of length l and breadth b is placed at distance of x from 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, then magnitude of the emf in the loop is (μ_0= permeability of free space)

A. $\dfrac{m_0 iv}{2\pi x}\left(\dfrac{l+b}{b}\right)$

B. $\dfrac{m_0 iv}{2\pi^2 x}\log\left(\dfrac{b}{l}\right)$

C. $\dfrac{m_0 ilbv}{2\pi x(1+x)}$

D. $\dfrac{m_0 ilbv}{2\pi}\log\left(\dfrac{x+l}{x}\right)$

Answer:

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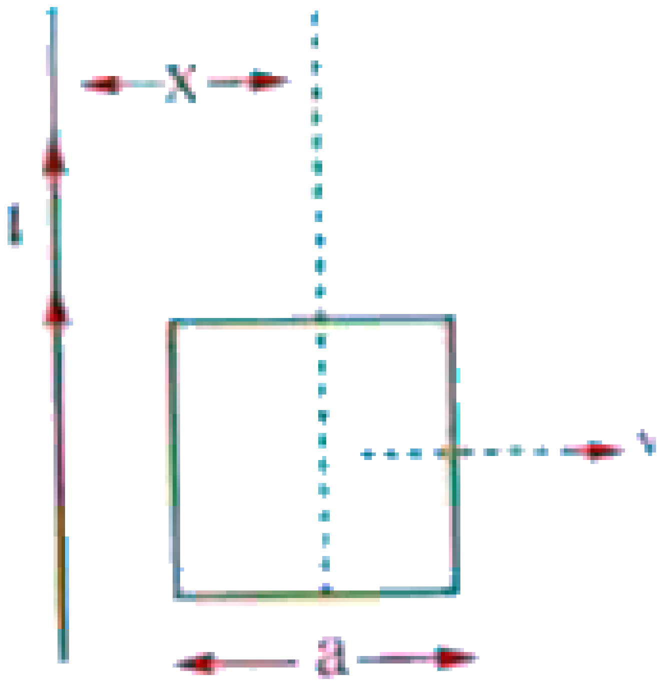
18. A conducting square frame of side .a. and a long straight wire carrying currnet I are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity .V.. The emf induced inthe frame will be proportional to



A. $\dfrac{1}{(2x+a)^2}$

B. $\dfrac{1}{(2x-a)(2x+a)}$

C. $\dfrac{1}{x^2}$

D. $\dfrac{1}{(2x-a)^2}$

Answer:

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19. If current is decreasing at a rate of 1000 As^{-1} p.d. between A and B is

A. 5V

B. 6V

C. 7V

D. 8V

Answer:

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20. A coil is wound on a rectangular frame. Keeping the number of turns per unit length constant, if the linear dimensions of the coil are doubled then the coefficient of self induction of the coil will become.

A. 4 times

B. 12 times

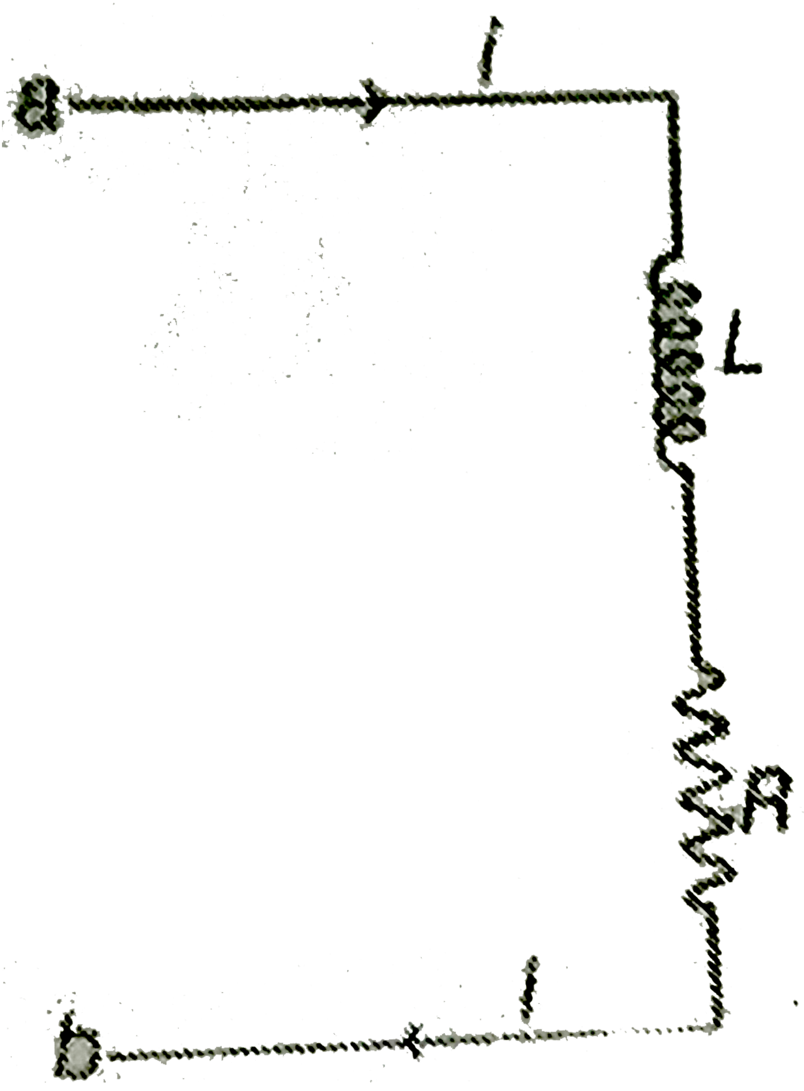
C. 16 times

D. 8 times

Answer:

Watch Video Solution

21. When the current in the portion of the circuit shown in the figure is 2A and increasing at the rae of 1A/s, the measured potential difference $V_{ab} = 8V$. However when the current is 2A and decreasing at the rate of 1A/s, the measured potential difference $V_{ab} = 4V$. The values of R and L are



A. 3 ohm and 2 henry respectively

B. 2 ohm and 3 henry respectively

C. 10 ohm and 6 henry respectively

D. 6 ohm and 1 henry respectively

Answer:

Watch Video Solution

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

A. l / L

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

C. L / l

D. $\frac{L^2}{l}$

Answer:

Watch Video Solution

23. The coefficient of mutual induction between two coils is 4H. If the current in the primary reduces from 5A to zero in 10^{-3} second then the induced e.m.f in the secondary coil will be

A. 10^4V

B. $25 \times 10^3 V$

C. 2×10^4V

D. 15×10^3V

Answer:

Watch Video Solution

24. A 50 Hz AC current of crest value 1 A flows through the primary of a transformer. If the mutual inductance between the promary and secondary be 0.5 H, the creast voltage induced in the secondary is

A. 125 V

B. 100 V

C. 157 V

D. 50 V

Answer:

Watch Video Solution

25. 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 $\frac{I_1}{I_2}$ is

A. $1/8$

B. $1/4$

C. $1/2$

D. 1

Answer:

Watch Video Solution

26. 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, then the electrical power dissipated would be

A. halved

B. the same

C. doubled

D. quadrupled

Answer:

Watch Video Solution

27. Shown in the figure is a circular loop of radius, r and resistance R. A variable magnetic field of induction $B = e^{-t}$ is established inside the coil. If the key (K) is closed at t=0 , the electrical power developed at the instant is equal to

A. $\dfrac{B_0^2 \pi r^2}{R}$

B. $\dfrac{B_0^2 \pi r^2}{R}$

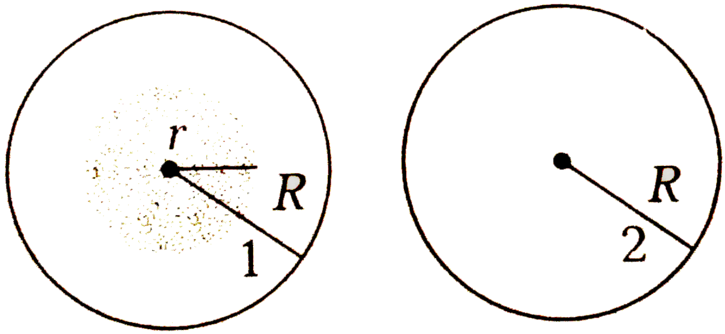
C. $\dfrac{B_0^2 \pi^2 r^4 R}{5}$

D. $\dfrac{B_0^2 \pi^2 r^4}{R}$

Answer:

Watch Video Solution

28. A uniform magnetic field is restricted within a region of radius r. The magnetic field changes with time at a rate $\frac{dB}{dt}$. Loop 1 of radius R $>$ r encloses the region r and loop 2 of radius R is outside the region of magnetic field as shown in figure. Then, the emf generated is



Zero in loop 1 and zero in loop 2

− d B d t π r 2 in loop 1 and − d B d t π 2 in loop 2

− d B d t π R 2 in loop 1 and zero in loop 2

− d B d t π r 2 in loop 1 and zero in loop 2

A. Zero in loop 1 and zero in loop 2

B. $-\frac{d\overrightarrow{B}}{dt}\pi r^2$ in loop 1 and $-\frac{d\overrightarrow{B}}{dt}\pi r^2$ in loop 2

C. $-\frac{d\overrightarrow{B}}{dt}\pi R^2$ in loop 1 and zero in loop 2

D. $-\frac{d\overrightarrow{B}}{dt}\pi r^2$ in loop 1 and zero in loop 2

Answer:

Watch Video Solution

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

A. $\frac{a^2\tau^3}{4R}$

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

C. $\frac{a^2\tau^3}{6R}$

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

Answer:

Watch Video Solution

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

A. A current will be induced in the coil

B. No current will be induced in the coil

C. Only e.m.f will be induced in the coil

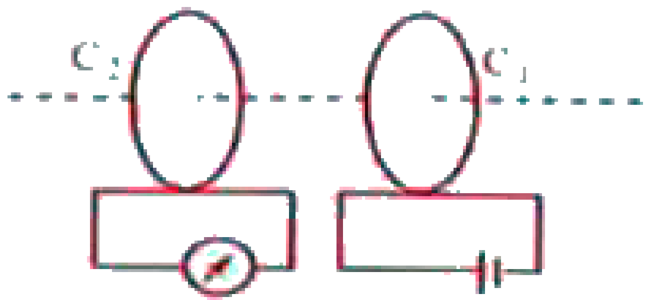
D. Both e.m.f and current will be induced in the coil

Answer: B

Watch Video Solution

2. Two coils C_1 and C_2 are kept coaxially as shown the coil C_1 is connected to a battery and the coil C_2 is connected to a galvanometer.

The deflection in galvanometer can be increased by



A. inserting a soft iron rod in coil C_1

B. increasing relative speed between coils.

C. connecting powerful battery to the coil C_1

D. all the above

Answer: D

Watch Video Solution

3. A copper ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet while it is passing through the ring is

A. Equal to that due to gravity

B. Less than that due to gravity

C. More than that due to gravity

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

Answer: B

Watch Video Solution

4. A magnet is brought towards a coil (i) speedly (ii) slowly, then induced emf/induced charge will be respectively

A. More in first case/ More in first case

B. More in first case/ Equal in both case

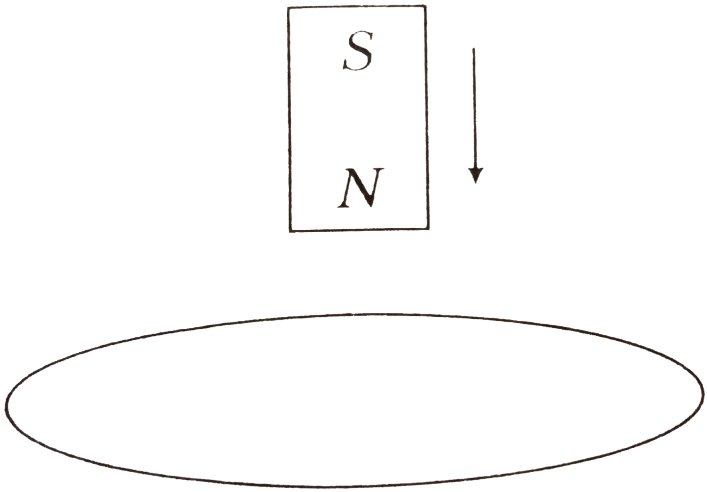
C. Less in first case/ More in second case

D. Less in first case/ Equal in both case

Answer: B

Watch Video Solution

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



A. First clockwise then anti clockwise

B. In clockwise direction

C. In anti clockwise direction

D. First anti clockwise then clockwise

Answer: C

Watch Video Solution

Watch Video Solution

6. Two similar circular loops carry equal currents in the same direction. On moving the coils further apart, the electric current will

A. Increase

B. Decrease

C. Remain uncharged

D. The information is incomplete

Answer: A

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7. As shown in the figure, à magnet is moved with a fast speed towards a coil at rest. Due to this induced emf, induced current and induced charge in the coll is E, I and Q respectively. If the speed of the magnet is doubled, the incorrect statement is

A. E increases

B. I increases

C. Q remains same

D. Q increases

Answer: D

Watch Video Solution

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

A. Clockwise

B. Zero

C. Counter clock wise

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

Answer: C

Watch Video Solution

9. A magnet is dropped dwon an infinitely long vertical copper tube,

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

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

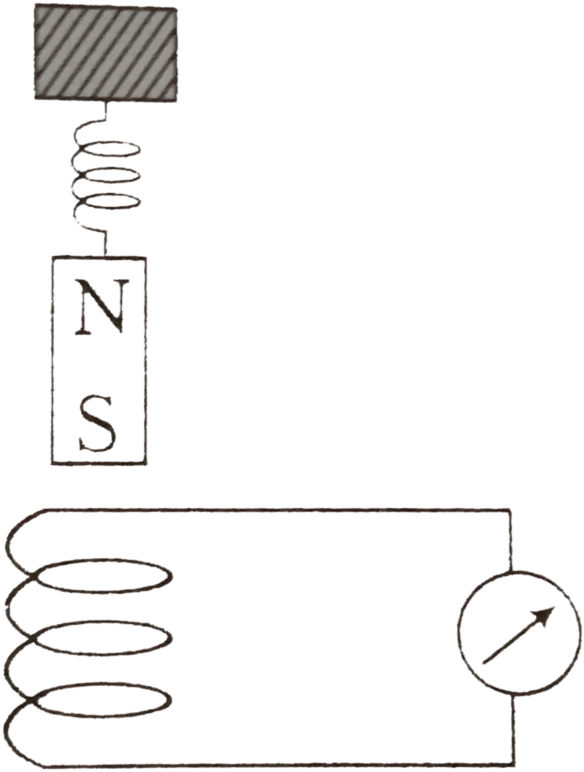
C. The magnet moves with continuously increasing velocity but constant accelerating

D. The magnet moves with continuously increasing velocity and acceleration.

Answer: A

Watch Video Solution

10. A magnet N-S is suspended from a spring and while at oscillates, the magnet moves in and out of the coil C. The coil is connected to a galvanometer G.



Then, as the magnet oscillates,

A. G shows deflection to the left and right with constant amplitude

B. G shows deflection on one side

C. G shows no deflection

D. G shows deflection to the left and right but the amplitude steadily decreases.

Answer: D

Watch Video Solution

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

A. Clockwise of the +ve z axis

B. Anti clockwise of the +ve z axis

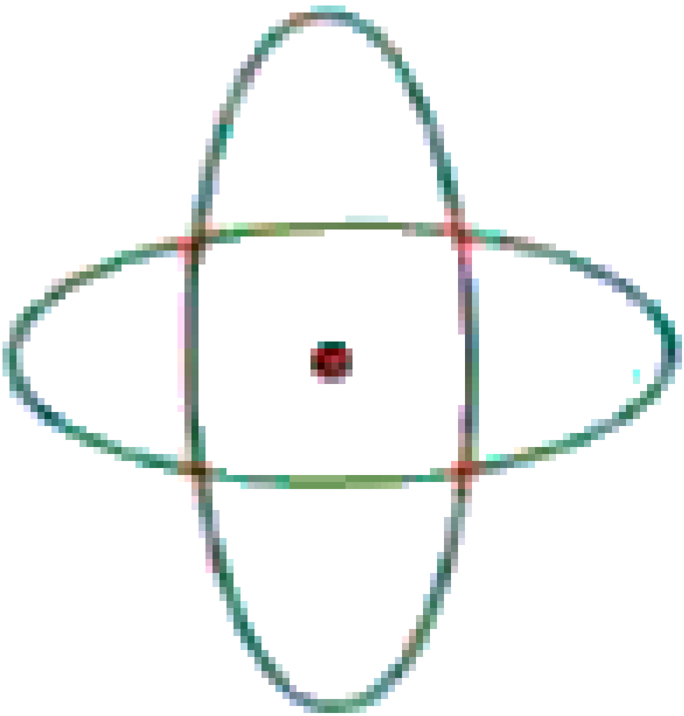
C. Zero

D. Along the magnetic field

Answer: C

Watch Video Solution

12. Two coils of wires A and B are mutually at right angles to each other as shown in the figure. If the current in one coil is changed, then in the other coil



A. No current will be induced

B. Current will be induced in clockwise direction

C. Current will be induced in anti-clockwise direction.

D. Current will be induced depending on increasing or decreasing current.

Answer: A

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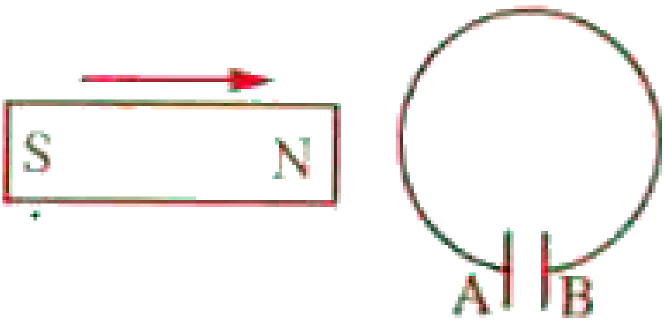
13. In the given figure, the north pole of a magnet is brought towards a closed loop containing a condenser. Positive charge will be produced on



A. Plate A

B. Plate B

C. Both on plate A and plate B

D. Neither on plate A nor plate B

Answer: A

Watch Video Solution

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

A. Remains stationary

B. Is attracted by the loop

C. Is repelled by the loop A

D. Rotates about its centre of mass with centre of mass fixed

Answer: C

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

A. Directly proportional to I

B. Directly proportional R

C. Inversely proportional to R

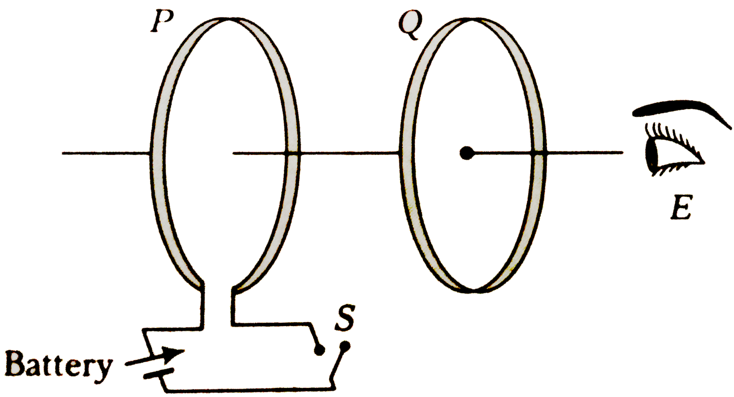
D. Zero

Answer: D

Watch Video Solution

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

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



A. respectively clockwise and Anti-clockwise

B. both clockwise

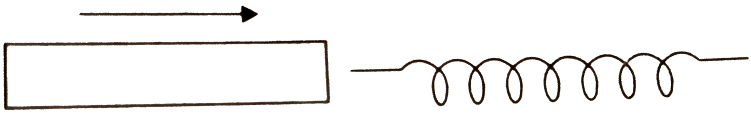
C. both Anti-clockwise

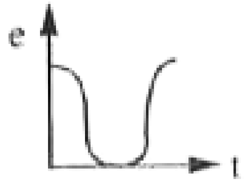
D. respectively anti-clockwise and clockwise

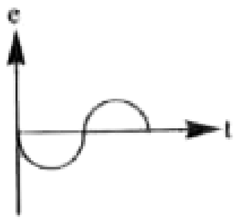
Answer: D

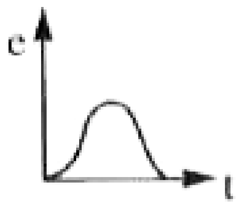
Watch Video Solution

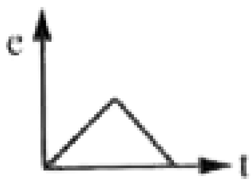
17. The variation of induced emf (ε) with time (t) in a coil if a short bar magnet is moved along its axis with a constant velocity is best represented as



A. 

B. 

C. 

D. 

Answer: B

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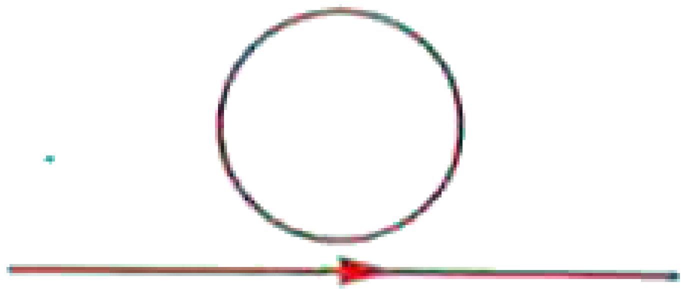
18. A current carrying wire is placed below a coil in its plane, with current flowing as shown. If the current increases.



A. No current will be induced in the coil

B. An anti clockwise current will be induced in the coil

C. A clockwise current will be induced in the coil

D. The current induced in the coil will be first anti clockwise and then clockwise

Answer: C

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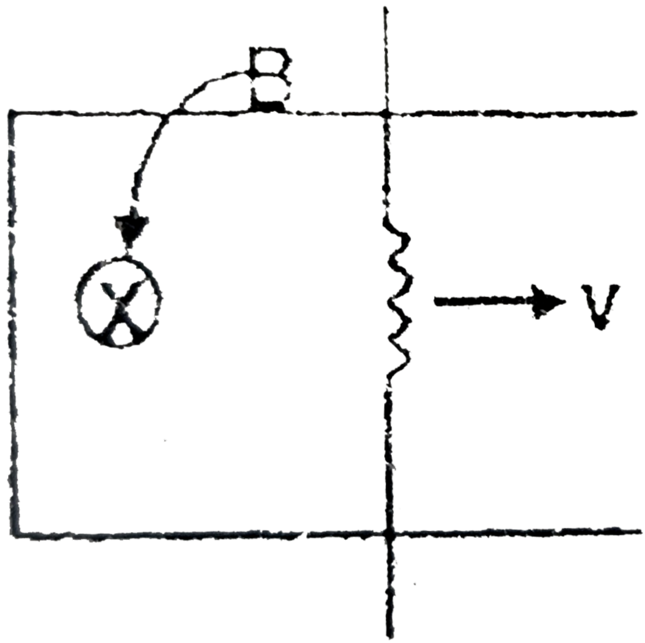
19. A conducting bar is pulled with a constant speed v on a smooth conducting rail. The region has a steady magnetic field of induction B as shown in the figure. If the speed of the bar is doubled then the rate of heat dissipation will



A. Constant

B. Quarter of the initial value

C. Four fold

D. Doubled

Answer: C

Watch Video Solution

20. A coil is rotated in a uniform magnetic field about an axis perpendicular to the field. The emf induced in the coil would be maximum when the plane of coil is :

A. parallel to the field

B. perpendicular to the field

C. at 45° to the field

D. None of these

Answer: A

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21. A magnet with its north pole pointing down wards along the axis of an open ring as illustrated. As the magnet reaches close to the centre of the ring

A. its acceleration becomes greater than g

B. its acceleration becomes less than g

C. its acceleration remains equal to g

D. none of these

Answer: C

Watch Video Solution

22. The north of a bar magnet is moved towards a coil along the axis passing through the centre of the coil and perpendicular to the plane of the coil. The direction of the induced current in the coil when viewed in the direction of the motion of the magnet is

A. Clockwise

B. Anti - clockwise

C. No current in the coil

D. Either clockwise or anti-clockwise

Answer: B

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

A. in AD but not in BC

B. in BC but not in AD

C. neither in AD nor in BC

D. in both AD and BC

Answer: D

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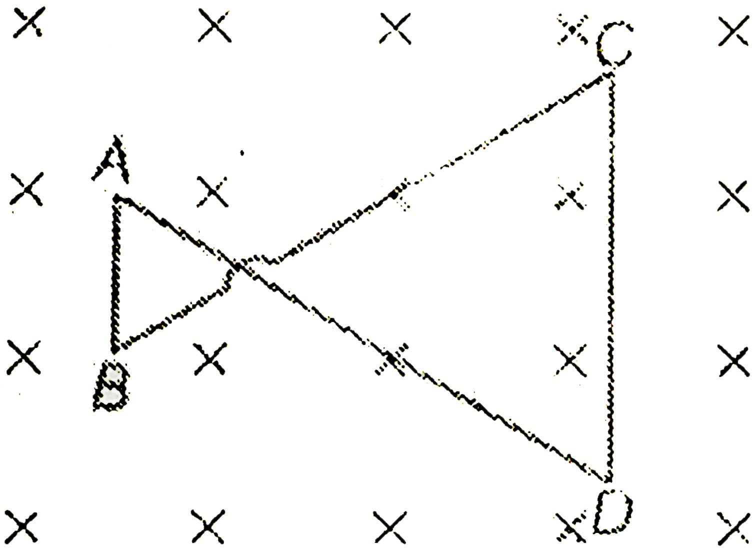
24. A conducting wire frame is placed is placed in a magnetic field which is directed into the paper. The magnetic field is increasing at a costant rae. The directions of induced currents in wires AB and CD are



A. 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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25. A metallic ring is connected to a rod oscillates freely like a pendulum. If now a magnetic field is applied in horizontal direction so that the pendulum now swings through the field, the pendulum will

A. Keep oscillating with the old time period

B. Keep oscillating with a smaller time period

C. Oscillates with increasing time period and come to rest

D. Come to rest very soon

Answer: C

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26. In an experiment, a magnet with its magnetic moment along the axis of circular coil and directed towards the coil, is withdrawn away from the

coil and parallel to itself. The current in the coil, as seen by the withdrawing magnet, is

A. zero

B. clockwise

C. anti clockwise

D. first .a. then .b.

Answer: B

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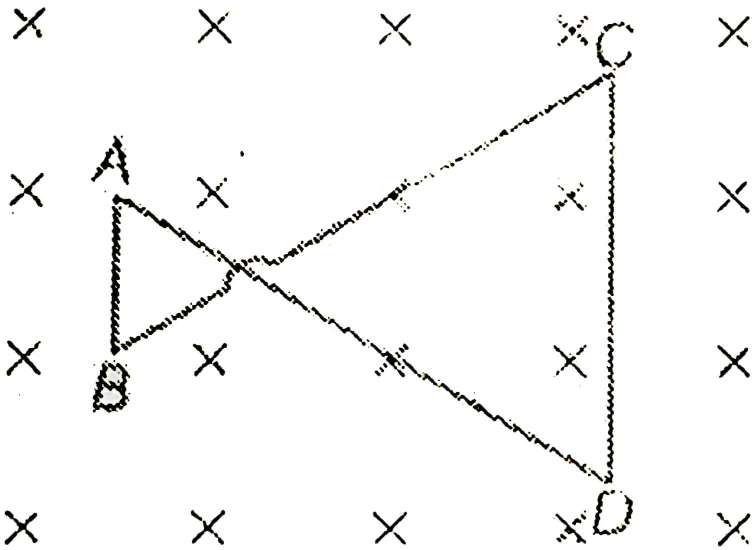
Exercise I Self And Mutual Induction

1. A conducting wire frame is placed is placed in a magnetic field which is directed into the paper. The magnetic field is increasing at a costant rae.

The directions of induced currents in wires AB and CD are



A. B to A and D to C

B. A to B and C to D

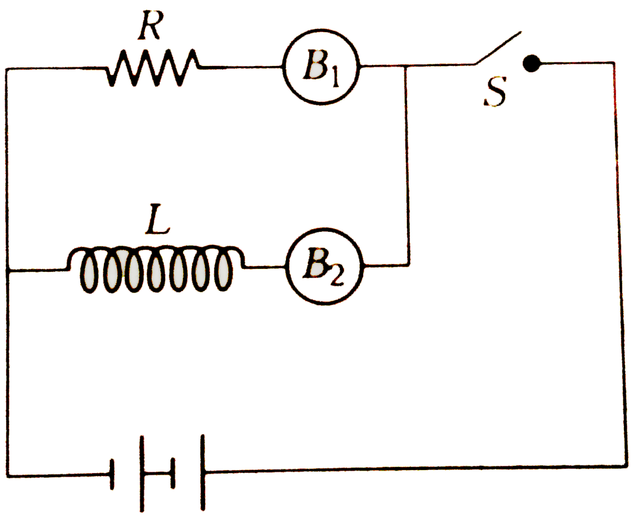
C. A to B and D to C

D. B to A and C to D

Answer: A

Watch Video Solution

2. Figure shows tow bulbs B_1 and B_2 resistor R and inductor L, when the switch S is turned off



A. Both B_1 and B_2 die out promptly

B. Both B_1 and B_2 die out with some delay

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

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

Answer: C

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3. The coefficient of mutual inductance of two coils depends on

A. the currents in the two coils.

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

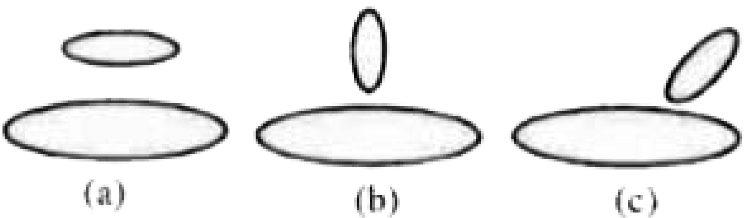
C. relative position and orientation of the two coils.

D. the materials of the wires of the coils.

Answer: C

Watch Video Solution

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



A. maximum in situation (a)

B. maximum in situation (b)

C. maximum in situation (c)

D. the same in all situations

Answer: A

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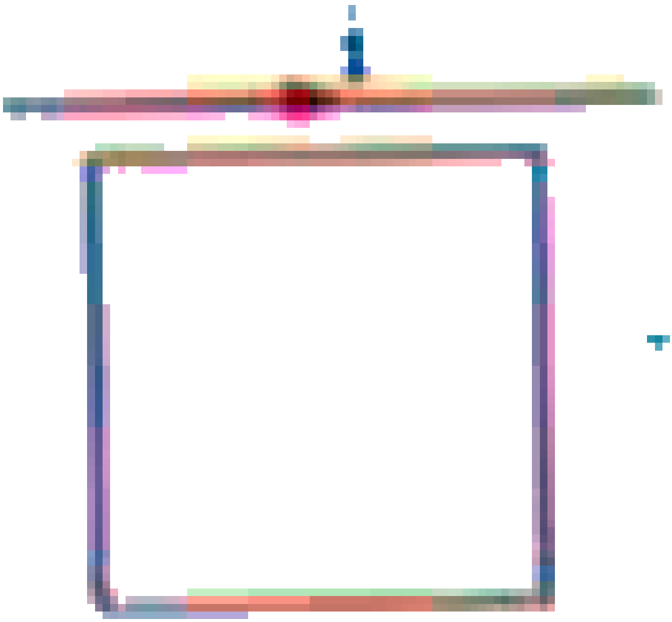
5. Current i flows through a long wire. A square loop made of conducting wire held below the wire in the same vertical plane is released and allowed to fall under gravity. If acceleration of the loop is a, then :



A. a current is induced in anticlockwise direction and a gt g

B. a current is induced in the clockwise direction and a lt g

C. a current is induced in anticlockwise direction and a lt g

D. no current is induced in the loop and a = g

Answer: B

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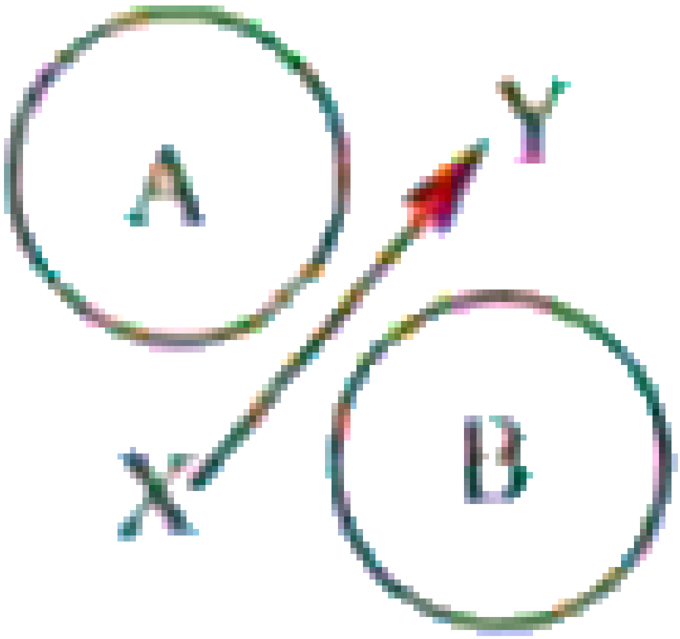
6. Consider the situation shown in the figure, If the current I in the long straight conducting wire XY is increased at a steady rate then the induced e.m.f..s in loops A and B wil be



A. clock wise in A, anti clockwise in B

B. anti clock wise 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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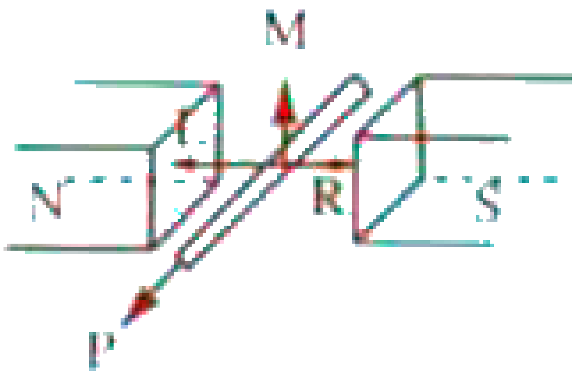
7. An electric potential difference will be induced between the ends of the conductor shown in the figure, if the conductor moves in the direction shown by



A. P

B. R

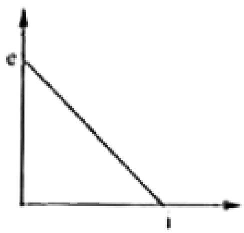
C. L

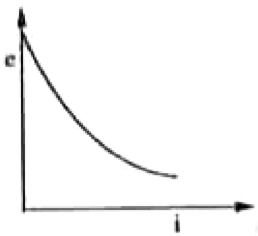
D. M

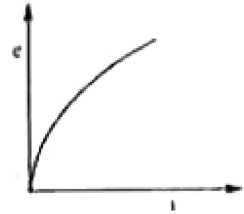
Answer: D

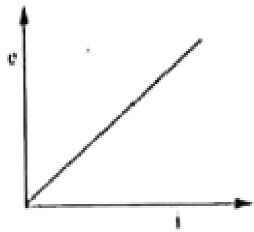
Watch Video Solution

8. In an L-R circuit connected to a battery of constant emf E, switch is closed at time t=0. If e denotes the induced emf across inductor and I the current in the circuit at any time t. Then which of the following graphs shown the variation of e with i?

A. 

B. 

C. 

D. 

Answer: A

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9. Two identical capacitors A and B are charged to the same potential and then made to discharge through resistances R_A and R_B respectively, with $R_A > R_B$.

A. A will require greater time than B to discharge completely.

B. More heat will be produced in A than in B.

C. More heat will be produced in B than in A.

D. A will require less time than B to discharge completely

Answer: A

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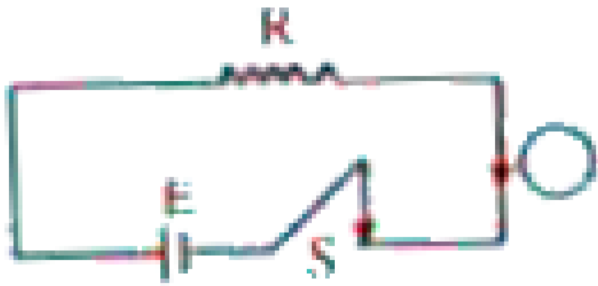
10. The switch S in the adjoined circuit is closed and then opened. The closed loop will show



A. an anticlockwise current pulse

B. a clockwise current pulse

C. an anticlockwise current pulse and then an anticlockwise current pulse

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

Answer: D

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11. The induced emf in a L-R circuit is maximum:

A. at the time of switching on due to high resistance

B. at the time of switching off due to high resistance

C. at the time of switching off due to low resistance

D. at the time of switching on due to low resistance

Answer: B

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12. Self inductance coefficient of a system can be increased by

increasing the current through it

b) decreasing the current through it

c) inserting an iron core

d) increasing the number of turns

A. a, c only

B. c, d only

C. a, c, d

D. d only

Answer: B

Watch Video Solution

13. A) It is possible to have mutual inductance with out self-inductance B) If the current in an inductor is doubled, the stored energy in it is quadrupled C) One can have an inductance without a resistance

A. A & B are false

B. B & C are false

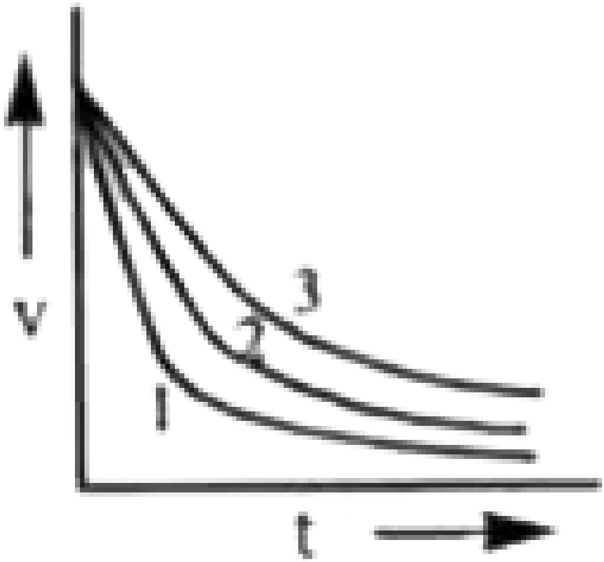
C. A & C are false

D. All are false

Answer: C

Watch Video Solution

14. Three identical capacitors A, B and C are charged to the same potential and then made to discharge through three resistances R_A, R_B and R_C, where $R_A > R_B > R_C$. Their potential differences (V) are plotted against time t, giving the curves 1, 2 and 3. Find the correlations between A, B, C and 1, 2, 3.



A. Only a is correct

B. Only a, b are correct

C. Only b, c, d are correct

D. a, b, c, d are correct

Answer: C

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15. Consider the following statements

A) If time constant is small the condenser discharges slowly.

B) For small values of inductance the rate of decay of current will be large

A. Both are correct

B. Only A is correct

C. Only B is correct

D. Both are wrong

Answer: C

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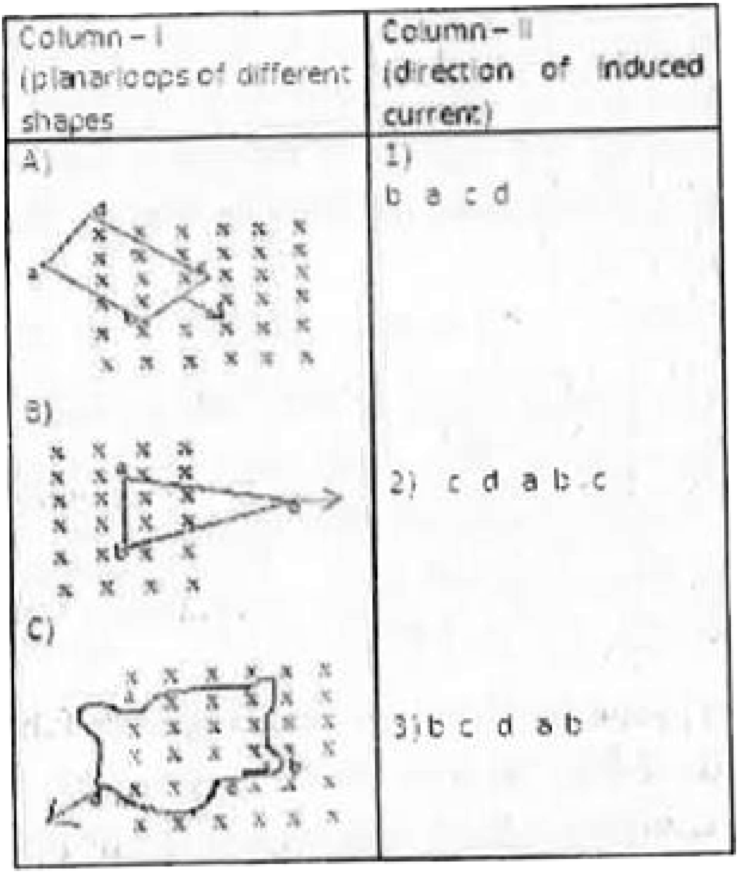
16. Match the items of column I with those of Column II and choose the correct option from the codes given below.



Column – I (planar loops of different shapes	Column – II (direction of induced current)
A)	1) b a c d
B)	2) c d a b c
C)	3) b c d a b

Watch Video Solution

Exercise I Assertion And Reason

1. Assertion : It is more difficult to push a magnet into a coil with more loops.

Reason : Emf induced in the current loop resists the motion of the magnet.

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 and .R. is false

D. .A. is false and .R. is true

Answer: A

Watch Video Solution

2. (A): When a conducting wire loop which is inside a uniform magnetic field directed perpendicular to its planes is moving with uniform velocity, an e.m.f is induced in it.

(R) : When magnetic flux linked with a conducting wire loop changes with time an e.m.f is induced in the coil.

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

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

C. C) .A. is true and .R. is false

D. D) .A. is false and .R. is true

Answer: D

Watch Video Solution

3. 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 Induced emf is proportional to rate of change of magnetic field while induced current depends on resistance of wire.

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 and .R. is false

D. .A. is false and .R. is true

Answer: D

Watch Video Solution

4. Assertion : Inductance coils are made of copper.

Reason : Induced current is more in wire having less resistance.

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 and .R. is false

D. .A. is false and .R. is true

Answer: A

Watch Video Solution

5. (A) : Self-inductance is called the inertia of electricity.

(R) : Self-inductance is the phenomenon, according to which an opposing induced e.m.f. is produced in a coil as a result of change in current or magnetic flux linked with the coil.

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

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

C. C) .A. is true and .R. is false

D. D) .A. is false and .R. is true

Answer: B

Watch Video Solution

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

Reason : Mutual induction is indendent of 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 and .R. is false

D. .A. is false and .R. is true

Answer: C

Watch Video Solution

7. (A): An aircraft flies along the meridian, the potential at the ends of its wings will be the same.

(R) : Whenever there is change in the magnetic flux e.m.f. induces.

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 and .R. is false

D. .A. is false and .R. is true

Answer: D

Watch Video Solution

8. Assertion : In the phenomenon of mutual induction, self induction of each of the coil persiste.

Reason : Self induction arises when strength of current in one coil changes. In mutual induction, current is changing in both the individual 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 and .R. is false

D. .A. is false and .R. is true

Answer: A

Watch Video Solution

9. (A): When number of turns in a coil doubled, coefficient of self inductance of the coil becomes four times.

(R): Coefficient of self inductance is proportional to the square of number of turns.

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 and .R. is false

D. .A. is false and .R. is true

Answer: A

Watch Video Solution

10. (A): An induced current develop in a conductor moved in a direction parallel to the magnetic field. (R): An induced current is developed when the number of magnetic lines of force associated with conductor is changed.

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 and .R. is false

D. .A. is false and .R. is true

Answer: D

Watch Video Solution

11. (A): An induced emf is generated when magnet is withdrawn from the solenoid.

(R) : The relative motion between magnet and solenoid induces emf.

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 and .R. is false

D. .A. is false and .R. is true

Answer: A

Watch Video Solution

12. (A): The working of dynamo is based on the principle of self induction.

(R) : Self induction of a coil is numerically equal to the magnetic flux linked with the coil, when a unit current flow through it.

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 and .R. is false

D. .A. is false and .R. is true

Answer: D

Watch Video Solution

13. (A): A dynamo converts mechanical energy into electrical energy.

(R): The dynamo is based on the principle of electromagnetic induction.

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 and .R. is false

D. .A. is false and .R. is true

Answer: A

Watch Video Solution

14. (A): A bar magnet is dropped into a long vertical copper tube. Even taking air resistance as negligible, the magnet attains a constant terminal velocity. If the tube is heated, the terminal velocity gets increased.

(R) : The terminal velocity depends on eddy current produced in bar magnet.

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 and .R. is false

D. .A. is false and .R. is true

Answer: B

Watch Video Solution

Exercise Ii Magnetic Flux Faraday S Law Lenz S Law Ac Generator

1. A coil of 100 turns and area square centimetre is placed in a magnetic field B = 0.2 T . The normal to the plane of the coil makes an angle of 60° with the direction of the magnetic field . The magnetic flux linked with the coil is :

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

B. $5 \times 10^{-5} Wb$

C. $10^{-2} Wb$

D. $10^{-4} Wb$

Answer: A

Watch Video Solution

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

A. 0.1s

B. 0.01s

C. 1s

D. 20s

Answer: A

Watch Video Solution

3. 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

C. 7.5

D. 10

Answer: D

Watch Video Solution

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

A. $-900 nwb$

B. $-700nwb$

C. $-200nwb$

D. $-800nwb$

Answer: A

Watch Video Solution

5. A rectangular coil of 20 turns and area of cross-section 25sq. Cm has a resistance of 100Ω. If a magnetic field which is perpendicular to the plane of coil changes at a rate of 1000 tesla per second, the current in the coil is

A. 1amp

B. 0.5amp

C. 5amp

D. 50amp

Answer: B

Watch Video Solution

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

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

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

C. $10^{-6}C$

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

Answer: A

Watch Video Solution

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

A. 6.55 T

B. 5.66 T

C. 0.655 T

D. 0.566T

Answer: D

Watch Video Solution

8. The number of turns in the coil of an AC generator is 5000 and the area of the coil is $0.25m^2$. The coil is rotated at the rate of 100 cycles/s in a magnetic field of $0.2\mathrm{Wm}^{-2}$. The peak value of the emf generated is nearly

A. 786 kV

B. 440 kV

C. 220 kV

D. 157.1 kV

Answer: D

Watch Video Solution

9. A circular coil of area $8m^2$ and number of turns 20 is placed in a magnetic field of 2T with its plane perpendicular to it. It is rotated with an angular velocity of 20rev/s about its natural axis. The emf induced is

A. 400V

B. $800\pi V$

C. 0

D. $400\pi V$

Answer: C

Watch Video Solution

10. A coil having 500 square loops each of side 10 cm is placed normal to a magnetic flux which increases at the rate of 1.0 tesla/second. The induced e.m.f. in volts is

A. 0.1

B. 0.5

C. 1

D. 5

Answer: D

Watch Video Solution

Exercise Ii Motional Emf

1. The Wing span of an aeroplane is 20 metre . It is flying in a field , where the vertical component of magnetic field of earth is 5×10^{-5} tesla , with vertical component of magnetic field of earth is 5×10^{-5} tesla , with velocity 360 km/h .The potential difference produced between the blades will be :

A. 0.10V

B. 0.15V

C. 0.20V

D. 0.30V

Answer: A

Watch Video Solution

2. A copper disc of the radius 0.1 m is rotated about its centre with 20 revolutions per second in a uniform magnetic field of 0.1 T with its plane perpendicular to the field. The emf induced across the radius of the disc is-

A. $\pi \times 10V$

B. $2\pi \times 10V$

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

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

Answer: C

Watch Video Solution

3. A wheel with 10 metallic spokes each 0.5 m long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of earth's magnetic field H_E at a place. If H_E = 0.4 G at the place, what is the induced emf between the axle and the rim of the wheel? Note that 1 G = 10^{-4} T.

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

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

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

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

Answer: D

Watch Video Solution

Exercise Ii Self Inductance And Mutual Inductance

1. An E.M.F of 5 V is produced in an inductor, when the current changes at a steady rate from 3A to 2A in 1 millisecond, the value of self inductance is

A. 0

B. 5H

C. 5000H

D. 5mH

Answer: D

Watch Video Solution

2. If a change in current of 0.01 A in one coil produces a change in magnetic flux of 1.2×10^{-2} Wb in the other coil , then the mutual inductance of the two coils in henries is :

A. 0

B. 0.5

C. 2

D. 3

Answer: C

Watch Video Solution

3. A coil has an inductance 0.05 H and 100 turns. Calculate the flux linked with it when 0.02A current is passed through it.

A. 10 Wb

B. 20 Wb

C. $10\mu Wb$

D. $20\mu Wb$

Answer: C

Watch Video Solution

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

A. 1V

B. 2V

C. 1.5V

D. 2.5V

Answer: A

Watch Video Solution

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

A. $100\mu H$

B. $50\mu H$

C. $20\mu H$

D. $60\mu H$

Answer: A

Watch Video Solution

6. A 50 mh coil carries a current of 2 A. the energy stored in joules is

A. 1

B. 0.1

C. 0.05

D. 0.5

Answer: B

Watch Video Solution

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

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

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

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

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

Answer: D

Watch Video Solution

8. To emf induced in a secondary coil is 20000 V , when the current breaks in the primary coil . The mutual inductance is 5 H and current in the primary before it breaks is :

A. 1A

B. 0.2A

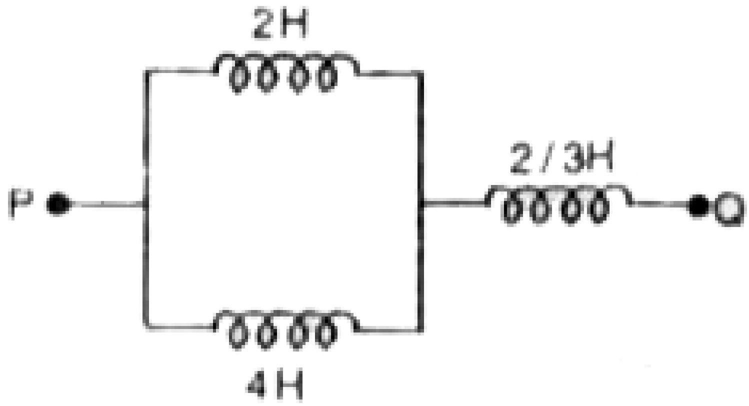
C. 0.3A

D. 0.4A

Answer: D

Watch Video Solution

9. The equivalent inductance between points P and Q in figure is :



A. 2H

B. 6H

C. 8/3H

D. 4/9H

Answer: A

Watch Video Solution

Exercise Ii Dc Circuits

1. A condenser of capacity 1 μ F and a resistance 0.5 mega-ohm are connected in series with a DC supply of 2 V. The time constant of circuit is

A. 2s

B. 1s

C. 0.5s

D. 0.25s

Answer: C

Watch Video Solution

2. An ideal coil of 10 H is joined in series with a resistance of 5Ω and a battery of 5 V. 2 s after joining, the current flowing in ampere in the circuit will be

A. e^{-1}

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

C. $(1 - e)$

D. e

Answer: B

Watch Video Solution

3. A capacitor is charged from a battery through a resistance of 1 M Ω. If it takes 1 sec for the charge to reach one-half of its final value then capacity of capacitor is

A. $0.3\mu F$

B. $0.69\mu F$

C. $\frac{1}{0.36}\mu F$

D. $\frac{1}{0.696}\mu F$

Answer: D

Watch Video Solution

4. A coil with self inductance of 2.4H and resistance 12Ω is suddenly switched across a 120V direct current supply of negligible internal resistance. Determine (i) the time constant of the coil and (ii) the final steady current

A. 0.2 sec, 10A

B. 2 sec, 10A

C. 3 sec, 20A

D. 4 sec, 20A

Answer: A

Watch Video Solution

5. A 8 μ F capacitor is charged by a 400 V supply through 0.1 M Ω 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. 0.48 sec

Answer: B

Watch Video Solution

Practice Exercise Magnetic Flux Faraday S Law Lenz S Law Ac Generator

1. 1. A coil of area $2cm^2$ with turns 500 is placed in a magnetic field of 0.5 T with its plane parallel to field. The flux linked with the coil is

A. 50mWb

B. Zero

C. 25mWb

D. 5mWb

Answer: B

Watch Video Solution

2. A coil having an area $2m^2$ is placed in a magnetic field which changes from 1 Wbm^{-2} to $4\ \mathrm{Wbm}^{-2}$ in an interval of 2 s. The emf induced in the coil will be

A. 4V

B. 3V

C. 1.5V

D. 2V

Answer: B

Watch Video Solution

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

A. 5

B. 10

C. 15

D. 20

Answer: B

Watch Video Solution

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

A. $3A_0B_0/t$

B. $4A_0B_0/t$

C. $3B_0/A_0t$

D. $4B_0/A_0t$

Answer: A

Watch Video Solution

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

A. 0.5

B. 1

C. 1.5

D. 2

Answer: B

Watch Video Solution

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

A. 1 mA

B. 2 mA

C. $2\sqrt{2}mA$

D. 4mA

Answer: B

Watch Video Solution

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

A. 0.2C

B. 0.4C

C. 2C

D. 4C

Answer: B

Watch Video Solution

8. A rectangular coil of 300 turns has an average area of 25 cm $\times$ 10 cm . The coil rotates with a speed of 50 cps in a uniform magnetic field of strength 4×10^{-2} T about an axis perpendicular of the field . The peak value of the induced e.m.f is (in volt) :

A. 3000π

B. 300π

C. 30π

D. 3π

Answer: C

Watch Video Solution

9. A rectangular coil of dimensions 4 cm x 5 cm with number of turns 20 is placed with its plane perpendicular to a uniform magnetic field of 5 T. If it is moved with a speed of 2 m/s in the field parallel to its length, the e.m.f induced is

A. 0.4V

B. 0.5V

C. 0

D. 0.1V

Answer: C

Watch Video Solution

10. A 50 turns circular coil has a radius of 3 cm, it is kept in a magnetic field acting normal to the area of the coil. The magnetic field B increased from 0.10 tesla to 0.35 tesla in 2 milliseconds. The average induced e.m.f in the coil is

A. 1.77 volts

B. 17.7 volts

C. 177 volts

D. 0.177 volts

Answer: B

Watch Video Solution

Practice Exercise Motional Emf

1. Two rails of a railway track, insulated from each other and the ground, are connected to a millivoltmetre. What is the reading of the millivoltmetre when a train travels at a speed of 20 ms^{-1} along the track? Given that the vertical component of earth's magnetic field is $0.2 \times 10^{-4} \mathrm{Wbm}^{-2}$ and the rails are separated by 1 m

A. 10^{-2}V

B. 10^{-4} V

C. 10^{-3} V

D. 1 V

Answer: C

Watch Video Solution

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

A. 30V

B. 40V

C. 60V

D. 600V

Answer: C

Watch Video Solution

3. A wheel having metal spokes of 1m long between its axle and rim is rotating in a magnetic field of flux density $5 \times 10^{-5} T$ normal to the plane of the wheel. An e.m.f of 22/7 mV is produced between the rim and the axle of the wheel. The rate of rotation of the wheel in revolutions per seconds is

A. 10

B. 20

C. 30

D. 4

Answer: B

Watch Video Solution

4. A horizontal straight wire 10m long extending from east to west is falling with a speed of 5.0m/s at right angles to the horizontal component of earths magnetic field `0.3xx10^(-4) tesla. The emf induced across the ends of wire is

A. 1.5 mV with higher potential at eastern end

B. 1.5 mV with higher potential at western end

C. 0.75 mV with higher potential at eastern end

D. zero

Answer: A

Watch Video Solution

Practice Exercise Self Inductance And Mutual Inductance

1. Current in a coil increases from 0 to 1 ampere in 0.1 second. If self inductance of the coil is 5 millihenry, magnitude of induced emf is

A. 5V

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

C. 0.5V

D. $5 \times 10^{-2} V$

Answer: D

Watch Video Solution

2. Coefficient of mutual induction between 2 coils is 0.4 H. If a current of 4A in the primary is cut off in 1/15000 second, the emf induced in the secondary is

A. 24 KV

B. 15KV

C. 30 KV

D. 10 KV

Answer: A

Watch Video Solution

3. If a current of 10 A changes in one second through a coil, and the induced emf is 20 V, then the self-inductance of the coil is

A. 100H

B. 250H

C. 300H

D. 50H

Answer: B

Watch Video Solution

4. The current decays from 5A to 2A in 0.01s in a coil. The emf induced in a coil nearby it is 30V. Calculate the mutual inductance of the coil.

A. 0.1H

B. 0.2H

C. 0.5H

D. 0.01H

Answer: A

Watch Video Solution

5. Energy stored in a coil of self-inductance 40mH carrying a steady current of 2 A is

A. 0.8 J

B. 8J

C. 0.08J

D. 80J

Answer: C

Watch Video Solution

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

A. 0.4H

B. 0.8H

C. 0.1H

D. 0.2H

Answer: C

Watch Video Solution

7. The magnetic field along the axis of an air cored solenoid is B. The magnetic field energy density is

A. $\frac{1}{2}\frac{B^2}{\mu_0}$

B. $\frac{1}{2}\mu_0 B^2$

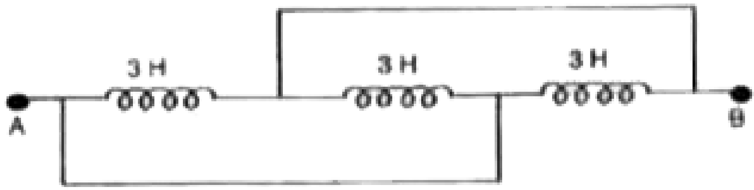
C. $\frac{1}{2}\mu_0 B$

D. $\frac{B}{2\mu_0}$

Answer: A

Watch Video Solution

8. Three pure inductances each of 3H are connected as shown in figure. The equivalent inductance between points A and B is



A. 1H

B. 2H

C. 3H

D. 9H

Answer: A

Watch Video Solution

9. A coil of 40 henry inductance is connected in series with a resistance of 8 ohm and the combination is joined to the terminals of a 2 volt battery. The time constant of the circuit is :-

A. 40s

B. 20s

C. 8s

D. 5s

Answer: D

Watch Video Solution

10. A coil of self inductance 50 henry is joined t the terminals of a battery of e.m.f 2 volts through the circuit . If the battery is now disconnected , the time in which the currents will decay to 1/e of its steady value is :

A. 500s

B. 50s

C. 5s

D. 15s

Answer: C

Watch Video Solution

11. A potential difference of 6V is applied to a coil of inductance 0.5H and a resistance of 4 ohm connected in series. The time taken for the current to reach half the maximum value is (in seconds)

A. $\frac{\log_e 2}{8}$

B. $\frac{\log_e 2}{4}$

C. $\frac{\log_e 4}{8}$

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

Answer: A

Watch Video Solution

12. A constant voltage of 25 V is applied to a series L-R circuit at t = 0, by closing a switch. What is the potential difference across the resistor and the inductor at time t = 0?

A. 0 V, 25 V

B. 12.5 V, 12.5 V

C. 10 V, 15 V

D. 25 V, 0 V

Answer: A

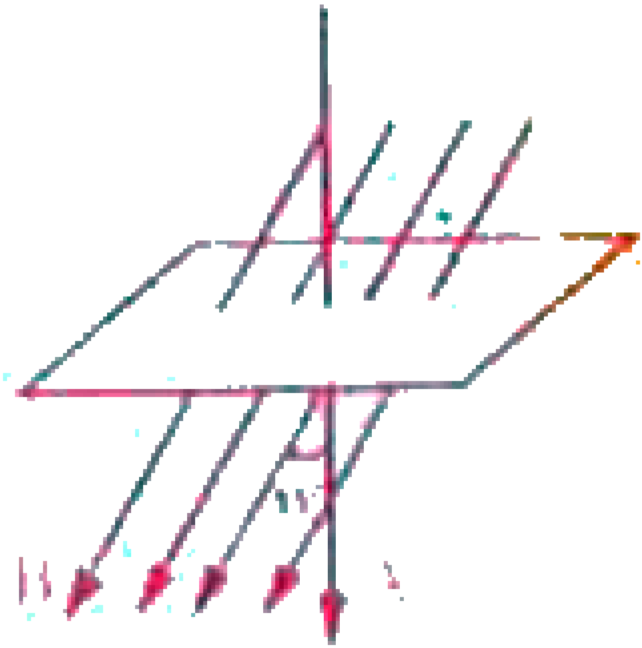
Watch Video Solution

Example

1. A rectangular loop of area 0.06 m2 is placed in a 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 flux linked with the coil in each case.

Watch Video Solution

2. At a certain location in the northern hemisphere, the earth.s magnetic field has a 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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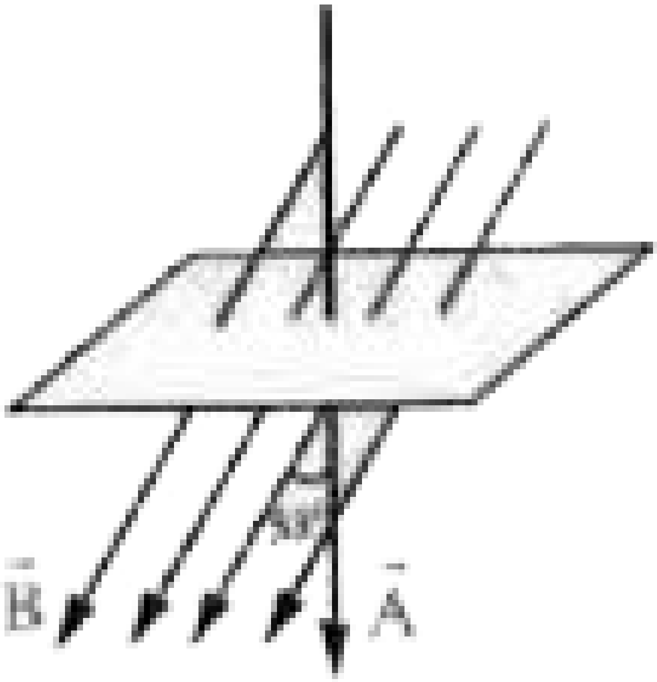
3. At a certain location in the northern hemisphere, the earth.s magnetic field has a magnitude of $42\mu T$ and points downwards at 53° to the vertical. Calculate the flux through a horizontal surface of area $2.5m^2$. $[\sin 53^\circ = 0.8]$



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4. The flux of magnetic field through a closed conducting loop of resistance 0.4Ω changes with time according to the equation

$\Phi = 0.20t^2 + 0.40t + 0.60$ where t is time in seconds.Find (i)the induced emf at $t = 2s$.(ii)the average induced emf in $t = 0$ to $t = 5s$.(iii)charge passed through the loop in $t = 0$ to $t = 5s$ (iv)average current.In time interval $t = 0$ to $t = 5s$ (v) heat produced in $t = 0$ to $t = 5s$

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5. The magnetic flux through a coil perpendicular to its plane is varying according to the relation $\phi_B = (5t^3 + 4t^2 + 2t - 5)$ weber. Calculate the induced current through the coil at t = 2 second. The resistance of the coil is 5 Ω.

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

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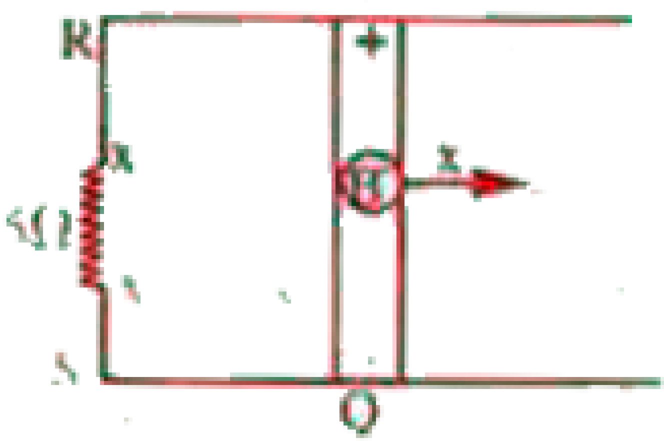
7. Figure shows a conducting rod PQ in contact with metal rails RP and SQ which are 0.257 apart in i uniform magnetic field of flux density 0.4T acting perpendicular to the plane of the paper. Ends R and S are connected through a 5 Ω resistance. What is the emf when the rod moves to the right with a velocity of 5 ms^{-1}? What is the magnitude and direction of the current through the 5 Ω 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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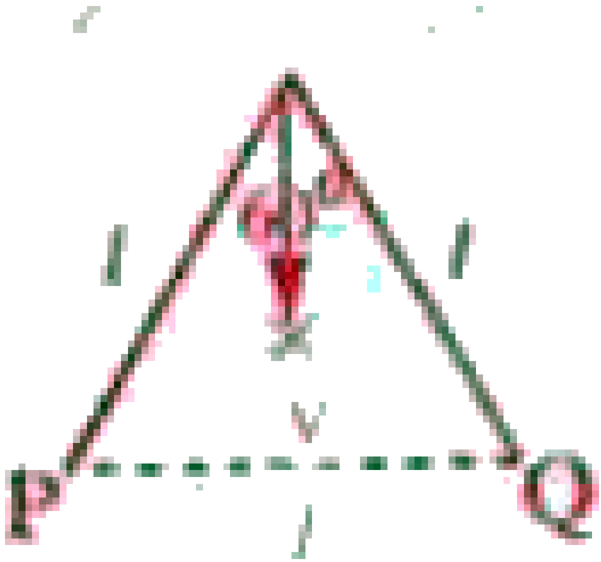
8. A wire of length 21 is bent al mid point so that the angle between two halves is 60°. If it moves as shown with a velocity v in a magnetic field B find the induced emf



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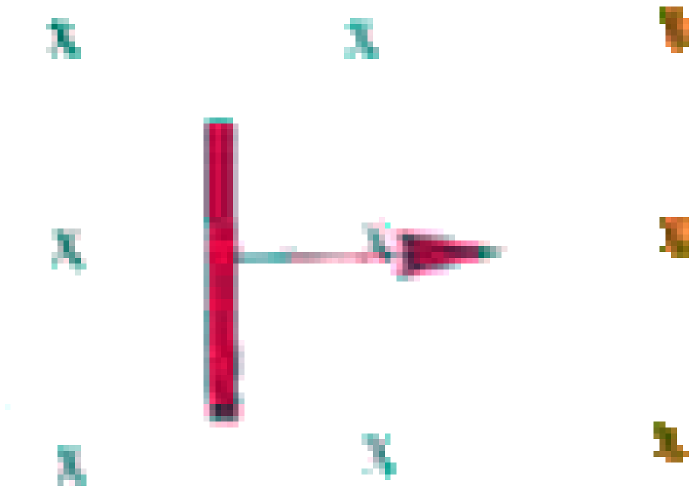
9. A conductor of length 0.1m is moving with a velocity of 4m/ s in a uniform magnetic field of 2T as shown in the figure. Find the emf induced

?



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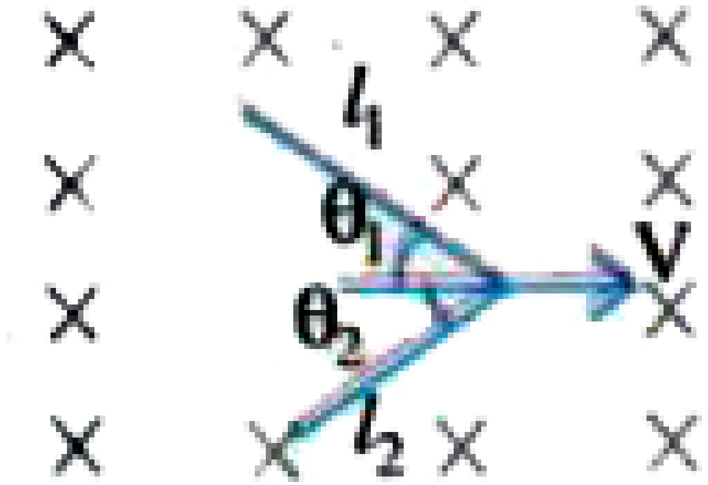
10. Find the emf induced across the ends of the conductor shown in the figure



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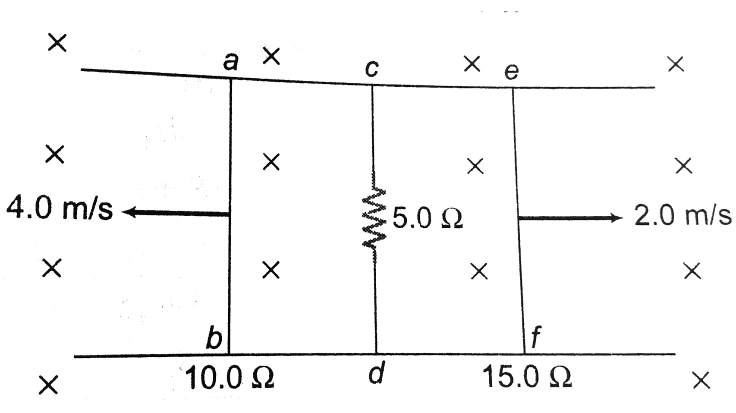
11. Two parallel rails with negligible resistance are $10.0cm$ apart. The are connected by a 5.0Ω resistor. The circuit also contains two metal rods having resistances of 10.0Ω and 15.0Ω along the rails. The rods are pulled away from the resistor at constant speeds $4.00\frac{m}{s}$ and $2.00m/s$ respectively.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

resistor.



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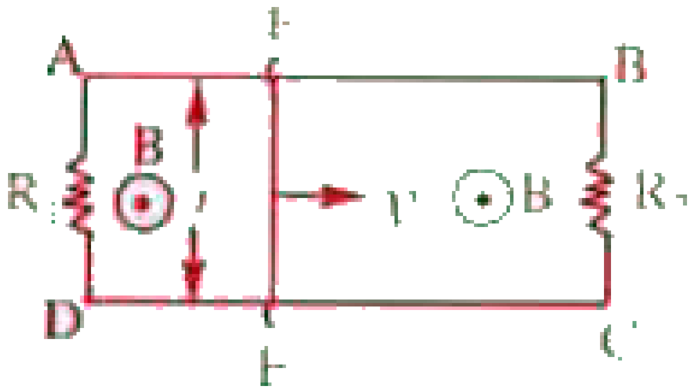
12. A loop ABCD containing two resistors as shown in figure is placed in a uniform magnetic field B directed outward to the plane of page. Asliding conductor EF of length l and of negligible resistance moves to the right with a uniform velocity v as shown in Fig. Determine the current in each branch.



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13. 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.

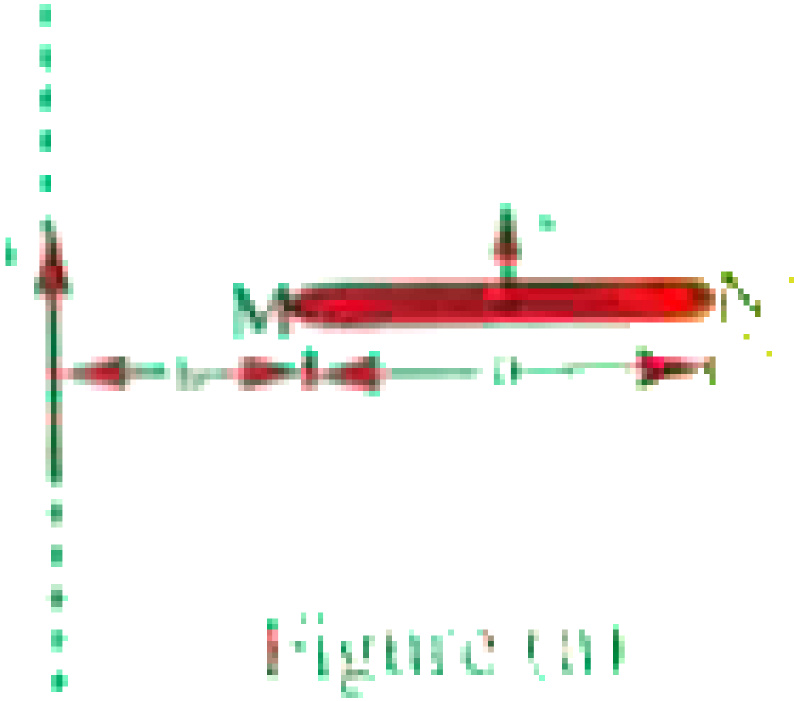

Figure (a)

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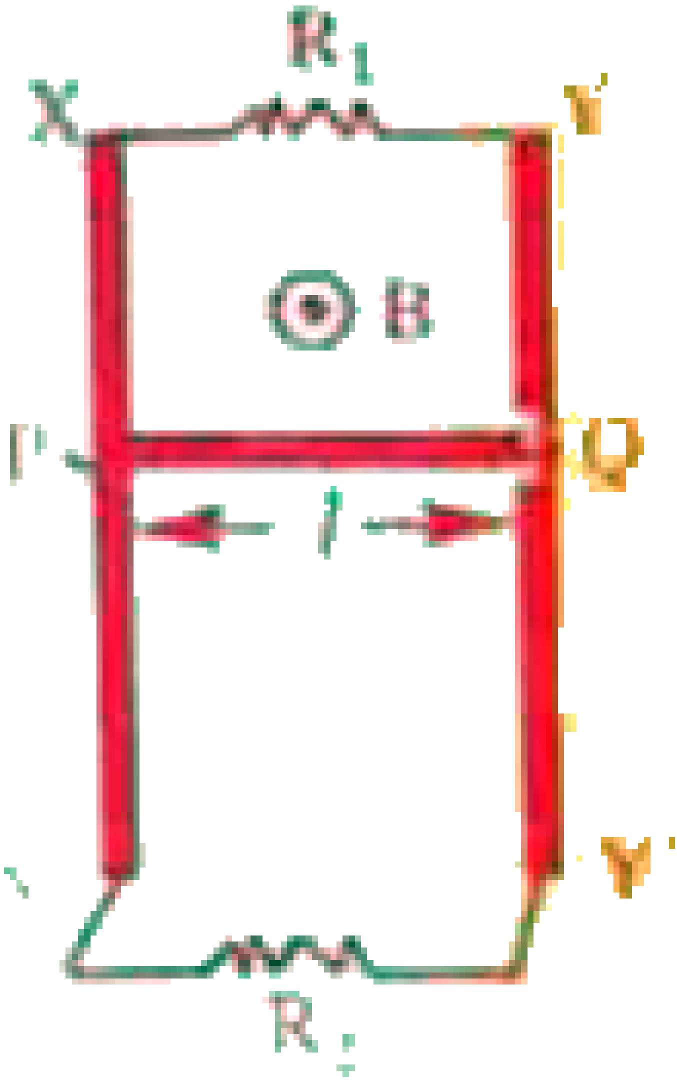
14. Two parallel vertical metallic bars XX.and YY., of negligible resistance and separated by a length .l., are as shown in Fig. The ends of the bars are joined by resistance R_1 and R_2. A uniform magnetic field of induction B exists in space normal to the plane of the bars. A horizontal metallic rod

PQ of mass m starts falling vertically, making contact with the bars. It is observed that in the steady state the powers dissipated in the resistance R_1 and R_2 are P_1 and P_2 respectively. Find an expression for R_1, R_2 and the terminal velocity attained by the rod PQ



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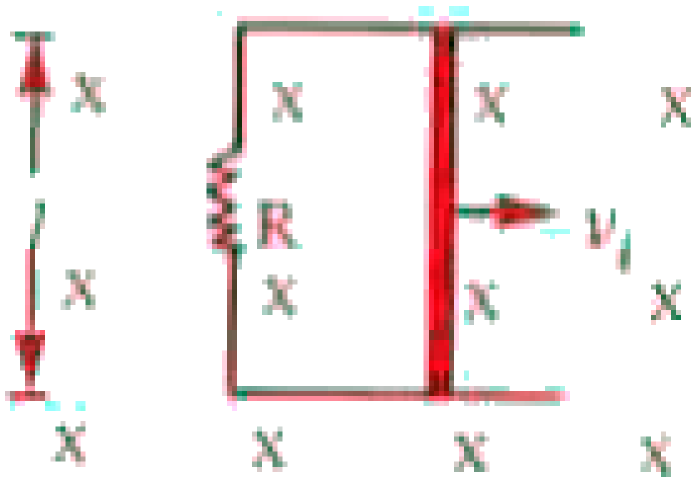
15. A bar of mass mand length l moves on two frictionless parallel rails in the presence of a uniform magnetic field directed into the plane of the paper. The bar is given an initial velocity v_i to the right and released. Find the velocity of bar, induced emfacross the bar und the current in the circuit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



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16. A copper rod of length 2m is rotated with a speed of 10 rps, 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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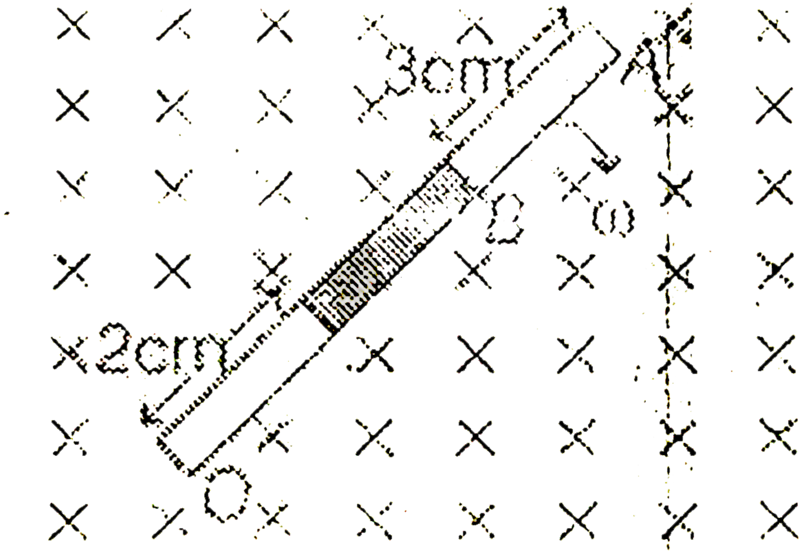
17. A rod of length 10cm made up of conducting an non-conducting). The road is roatate with constant angular velocity 10rad/s about point O, is constant magnetic field of 2T as shown in the figure. The induced emf between the points A and B of rod will be



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

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19. A wheel with 10 metallic spokes each 0.5 m long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of earth's magnetic field H_E at a place. If H_E = 0.4 G at the place, what is the induced emf between the axle and the rim of the wheel? Note that 1 G = 10^{-4} T.

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

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

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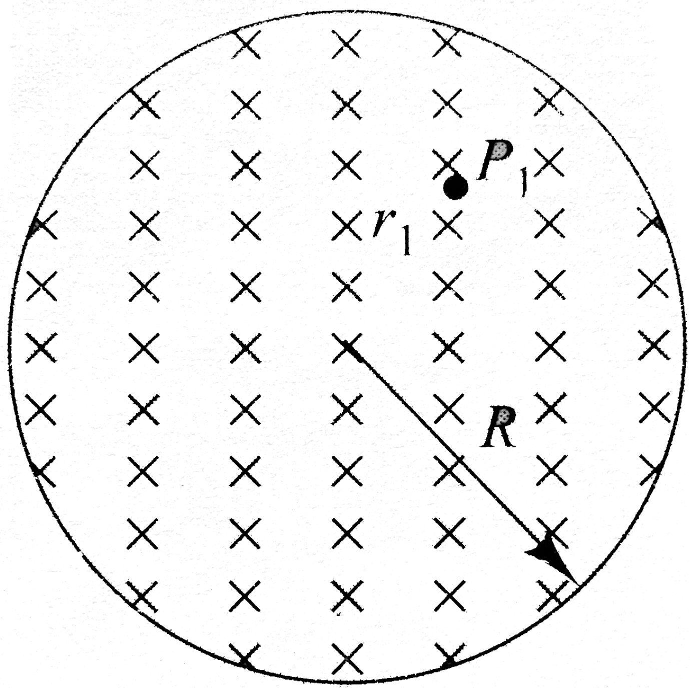
22. A magnetic field directed into the page changes with time according to $B = (0.0300t^2 + 1440)T$, where t is in seconds. The field has a circular cross section of radius $R = 2.50cm$. What are the magnitude and direction of the electric field at point P_1 when $t = 3.00s$ and $r_1 = 0.0200m$?



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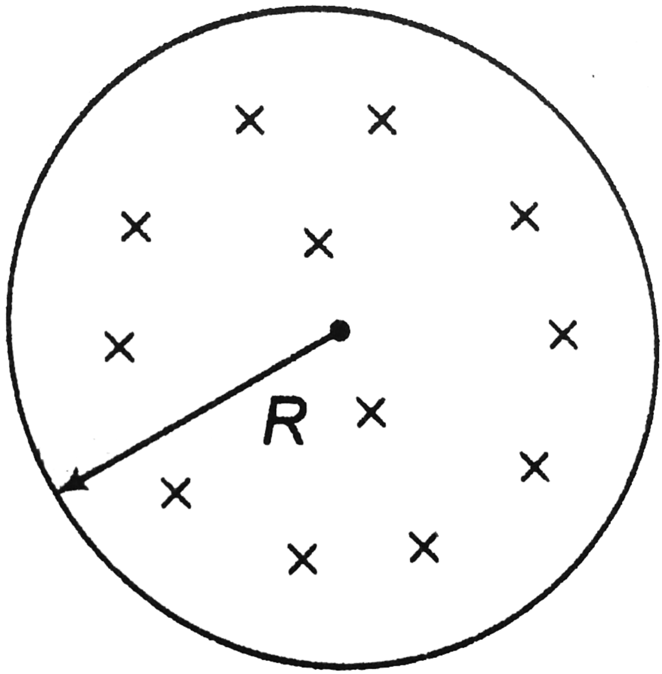
23. The magnetic field at all points within the cyllindrical region whose cross section is indicated in the accompanying Figure starts increasing at a constant rate $\alpha . T / s$. find the magnitud of electric field as a function of r, the distance from the geometric centre of the region.



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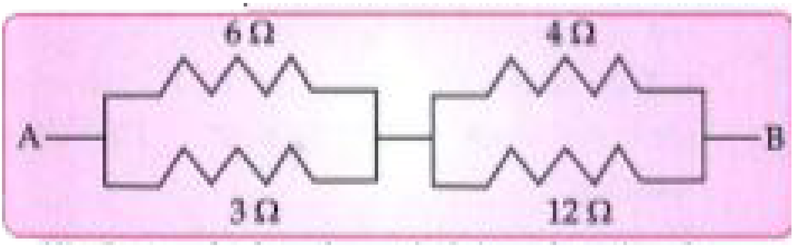
24. Find the equivalent resistance between A and B.



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25. Shown in the figure is a circular loop of radius, r and resistance R. A variable magnetic field of induction $B = e^{-t}$ is established inside the coil. If the key (K) is closed at t=0 , the electrical power developed at the instant is equal to

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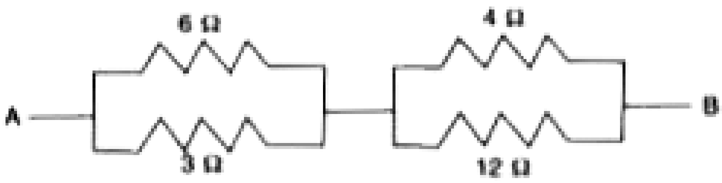
26. Find the equivalent resistance between A and B.



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27. The self-inductance of a coil having 200 turns is 10 milli henry. Calculate the magnetic flux through the cross-section of the coil corresponding to current of 4 milliampere. Also determine the total flux linked with each turn.

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

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29. An inductor of 5 H inductance carries a steady current of 2A. How can a 50 V self-induced emf be made to appear in the inductor ?

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

(i) induced voltage

(ii) current

(iii) energy stored in two coils at that instant

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

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

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33. A solenoid is of length 50 cm 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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34. An air cored solenoid is of length 0.3m, area of cross section is $1.2 \times 10^{-3} m^2$ and has 2500 turns. Around its central section, a coil of 350 turns is wound. The solenoid and the coil are electrically insulated from each other. Calculate the emf induced in the coil if the initial current of 3A in the solenoid is reversed in 0.25s.

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35. A solenoid of length 50cm with 20 turns per centimetre and area of cross-section 40cm? completely surrounds another coaxial solenoid of the same length, area of cross-section $25 cm^2$ with 25 turns per centimetre. Calculate the mutual inductance of the system.

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36. 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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37. Two concentric circular coils, one of small radius r_1 and the other of large radius r_2, such that $r_1 > \; > r_2$, are placed co-axially with centres coinciding. Obtain the mutual inductance of the arrangement.

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38. (a) A toroidal solenoid with an air core has an average radius of 0.15m, area of cross section $12 \times 10^{-4} m^2$ and 1200 turns. Obtain the self inductance of the toroid. Ignore field variation 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 emf in the secondary coil.

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39. A circular loop of radius 0.3 cm lies parallel to a much 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

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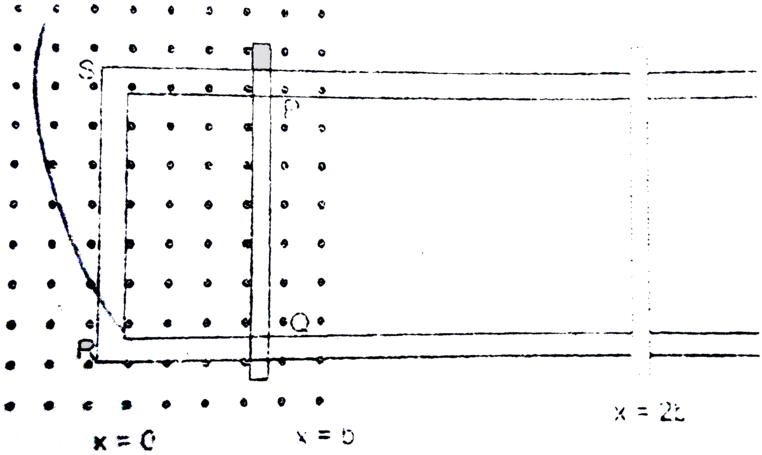
Exercise Long Answer Questions

1. State Faraday's law of electromagnetic induction.

Figure shows a rectangular conductor $PQRS$ in which the conductor PQ is free to move in a uniform magnetic field B perpendicular to the plane of the paper.The field extends from $x = 0$ to $x = b$ and is zero for $x > b$.Assume that only the arm PQ posses resistance r.When the arm PQ is pulled outward from $x = 0$ with constant speed v, obtain the expressions for the flux and the induced emf. sketch the variations of these quantities with distance $0 \leq x \leq 2b$.



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Exercise Short Answer Questions

1. A current -carrying loop of irregular shape is located in an external magnetic field. If the wire is flexible, why does it becomes circular?

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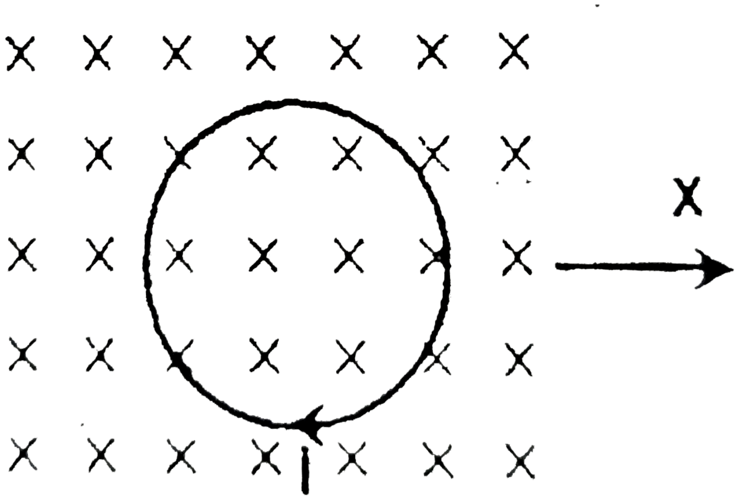
2. A circular loop of wire is carring a current i (as shown in the figure). On applying a uniform magnetic field inward perpendicular to the plane of the loop, the loop



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3. Figures 1 and 2 show planar loops of different shapes moving out or into a region of magnetic field, which is directed normal to the plane of the loop and away for reader. Determine the direction of induced current

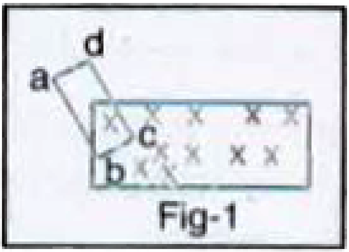

Fig-1

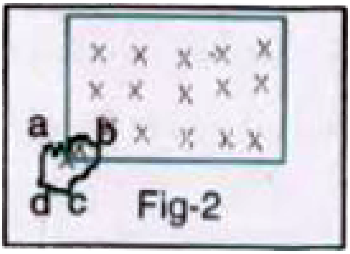

Fig-2

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4. Use Lenz's law to determine the direction of induced current in the situations described by the fig 3 and 4

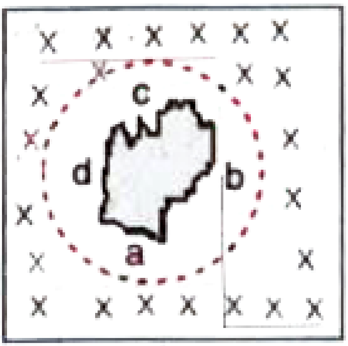

Fig-3

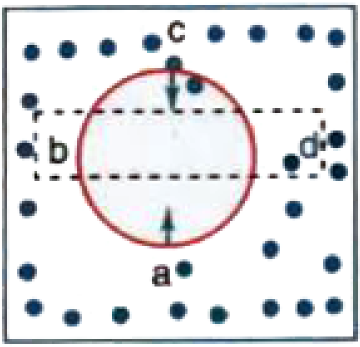

Fig-4

(a) In fig 3, a wire of irregular shape turn into a circular shape and

(b) In fig.4 a circular loop being deformed into a narrow straight wire. The cross (x) indicates magnetic field into the paper and the dot (.) indicates magnetic filed out of paper.

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5. A conducting loop is held stationary normal to the field between the NS poles of a fixed permanenet magnet. By choosing a magnet sufficiently strong, can we hope to generate current in the loop?

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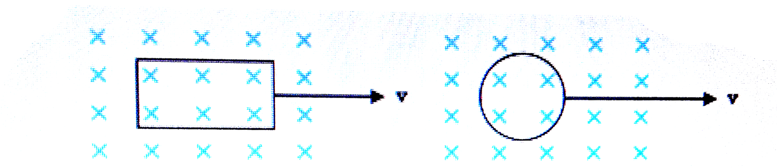
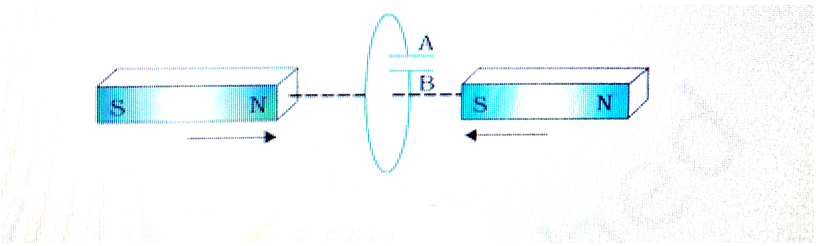
6. (a) A closed loop is held stationary in the magnetic field between the north and south poles of two permanent magnets held fixed. Can we hope to generate current in the loop by using very strong magnets?

(b) A closed loop moves normal to the constant electric field between the plates of a large capacitor. Is a current induced in the loop (i) when it is wholly inside the region between the capacitor plates (ii) when it is partially outside the plates of the capacitor? The electric field is normal to the plane of the loop.

(c) A rectangular loop and a circular loop are moving out of a uniform magnetic field region (Fig. 6.8) to a field-free region with a constant velocity v. In which loop do you expect the induced emf to be constant during the passage out of the field region? The field is normal to the loops.



(d) Predict the polarity of the capacitor in the situation described by Fig. 6.9.



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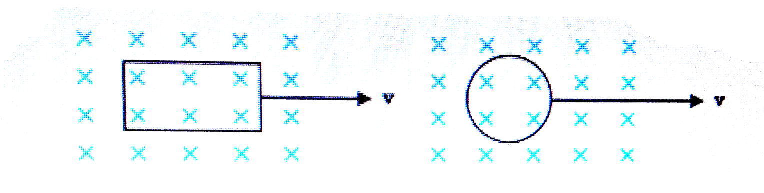
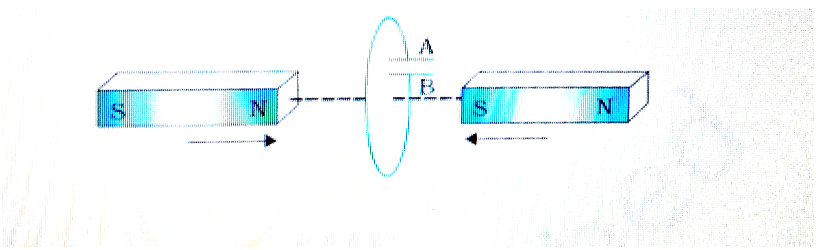
7. (a) A closed loop is held stationary in the magnetic field between the north and south poles of two permanent magnets held fixed. Can we hope to generate current in the loop by using very strong magnets?

(b) A closed loop moves normal to the constant electric field between the plates of a large capacitor. Is a current induced in the loop (i) when it is wholly inside the region between the capacitor plates (ii) when it is partially outside the plates of the capacitor? The electric field is normal to the plane of the loop.

(c) A rectangular loop and a circular loop are moving out of a uniform magnetic field region (Fig. 6.8) to a field-free region with a constant velocity v. In which loop do you expect the induced emf to be constant during the passage out of the field region? The field is normal to the loops.



(d) Predict the polarity of the capacitor in the situation described by Fig. 6.9.



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8. (A): An induced current develop in a conductor moved in a direction parallel to the magnetic field. (R): An induced current is developed when the number of magnetic lines of force associated with conductor is changed.

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9. An iron bar falling vertically through the hollow region of a thick cylindrical shell made of copper experiences a retarding force and attains a terminal velocity. What can you conclude about the iron bar?

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10. A small resistor (say, a lamp) is usually put in parallel to be current carrying coil of an electromagnet. What purpose does it serve?

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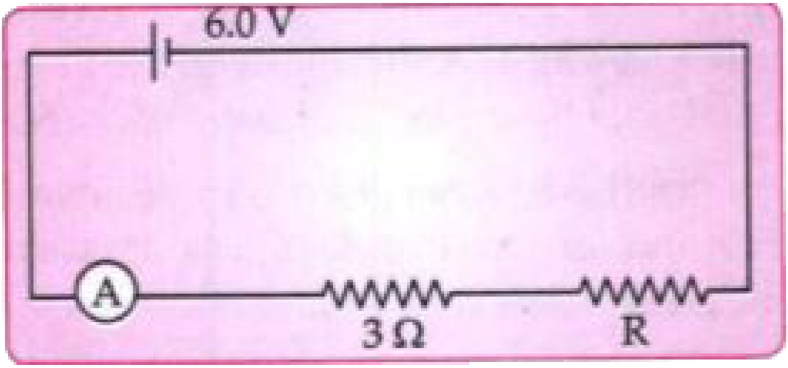
11. The figure shows a circuit.

When the circuit is switched on, the ammeter reads 0.5A.



Calculate the value of the unknown resistor R.

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12. As soon as current is switched on in a high-voltage wire, the bird sitting on it flies away, why?

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13. A wire of fixed length is wound on a solenoid of length 'l' and radius 'r' . Its self inductiane is found to be Now if same wire is wound on a solenoid of length ad radius $\frac{r}{2}$ then the self inductance will be

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14. (A) : A spark occur between the poles of a switch when the switch is opened.

(R) : Current flowing in the conductor produces magnetic field.

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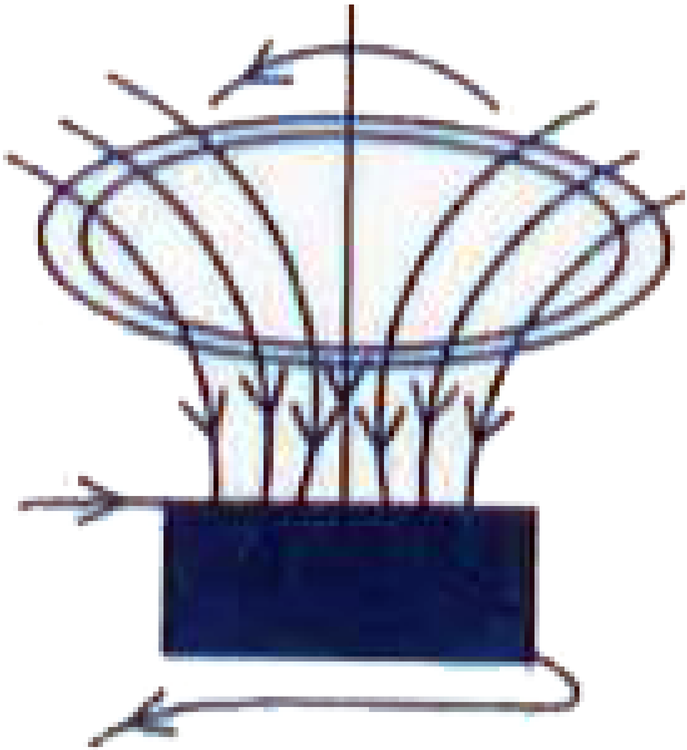
15. The figure shows the magnetic field of a current carrying coil and a ring falling down the field. Is the direction of induced current in the ring correctly shown?



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16. A copper ring is suspended by a thread. One end of a magnet is brought horizontally towards the ring. How. Will it affect the position of the ring?

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17. A: When a bar magnet is dropped into a vertical long hollow metallic tube, the magnet ultimately moves with zera acceleration.

R: The magnet falling into metallic tube causes the eddy currents in the metal tube, so the motion of the magnet is damped.

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18. In the above problem if block is released from there, what would be maximum extension.

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19. A lamp in a circuit consissing of a coil of large number of turns and a battery does not light up to full brilliance instantly on switching on the circuit. Why?

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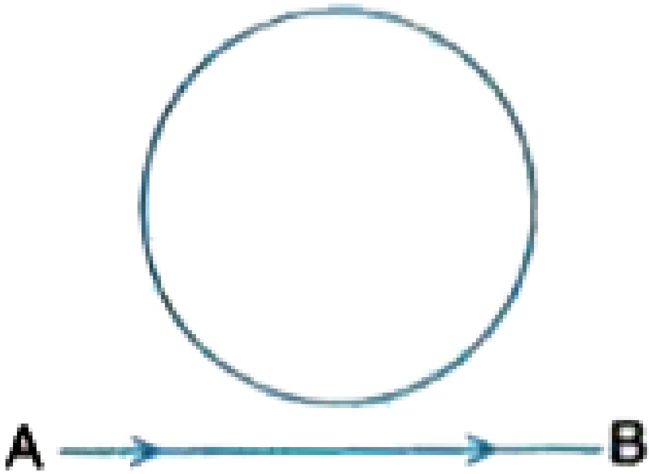
20. The magnitude of electric current is increasing in a wire at a constant rate in the direction from A to B. Will there be induced current in the conduting loop show in fig? What will be its direction?



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21. Assertion:- A piece of copper and a similar piece of stone are dropped simultaneously from a height near the earth's surface. Both will touch the ground at the same time.

Reason:- There is not effect of the earth's magnetic field on the motion of falling bodies.

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Exercise Very Short Answer Questions

1. Define magnetic flux . Give its SI unit. I

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2. Is magnetic flux a scalar or vector?

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3. Weber is the unit of which physical quantity?

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4. Is an induced e.m.f developed in a conductor, when moved in a direction parallel to the magnetic field?

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5. What do you understand by positive flux?

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6. When the magnetic flux is said to be neutral?

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7. A glass rod of length l moves with velocity v in a uniform magnetic field B. What is the e.m.f induced in the rod?

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8. Two coils are being moved out of magnetic field, one coil is moved rapidly and the other slowly. In which case is more work done and why?

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9. Name the scientists who discovered the generation of electric current by means of magnetic field.

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10. Name the scientist associated with the direction of induced current.

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11. State Lenz's law.

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12. Why the induced emf is also called as back emf?

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13. What is the basic cause of induced emf?

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14. Does Lenz's law violate the law of conservation of energy?

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15. Does Lenz's law hold for an open circuit

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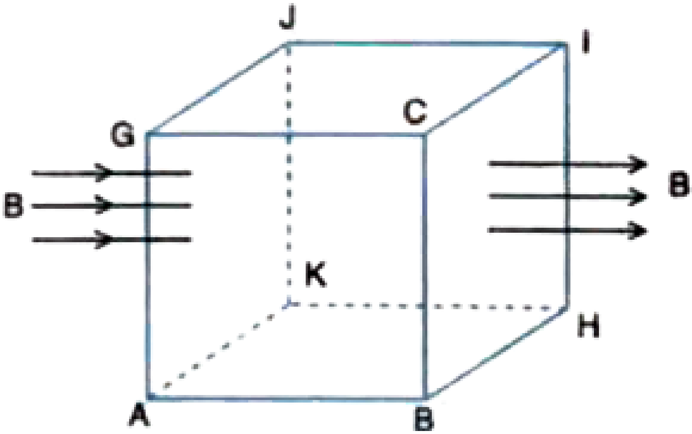
16. Consider a cube ABCGHIJK of sides a placed in a uniform magnetic field B acting perpendicular to the face BHIC as shown in figure.



(i) What is the flux through face ABCG?

(ii) What is the flux through face GCIJ?

(iii) What is the flux through face AKJG?

(iv) What is the flux through face BHIC?

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17. Who discovered eddy current?

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18. What is an ideal inductor?

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19. Name the quantity that plays an identical role in an electrical circuit as is played by inertia in mechanics?

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20. The induced e.m.f. in a coil does not depend on

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21. Name two factors on which the self-inductance of an air-core coil depends.

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22. What is the effect of metallic core on self inductance?

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23. Why inductors are made of copper?

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24. Name two factors on which mutual inductance between a pair of coils depends?

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25. If two coils are very tightly would one over the other, will M increase or decrease as compared to the case when the coils are placed some distance apart?

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26. What are the dimensions of L/R?

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27. Why the inductance per unit length for a solenoid near its centre is different from inductance per unit length near its ends?

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28. An artificial satellite with a metal surface is orbiting the earth in equatorial plane. Why no current is induced due to earth's magnetism?

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29. Why the coil of a dead beat galvanometer is would on a metal frame?

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30. Two identical coils, one of copper and the other of iron, are rotated with the same angular velocity ω in a uniform magnetic field. In which case the induced e.m.f. is more and why?

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31. A wire kept along north-south direction is allowed to fall freely. Will an induced e.m.f be set up?

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32. A wire kept in east west direction is allowed to fall freely, will an emf be induced in the wire?

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33. Why a thick metal plate oscillating about a horizontal axis stops when a strong magnetic field is applied on the plane?

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Problems Level I

1. A coil of wire enclosing an area of $100cm^2$ is placed at an angle of 70° with a magnetic field B to $10^{-1}Wbm^{-2}$. What is the flux through the coil? B is reduced to zero in 10^{-3}sec. What e.m.f. is induced in the coil?

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2. A given wire is bent into a rectangular loop of size $15cm \times 5cm$ and placed perpendicular to a magnetic field of 1.0 Tesla. Within 0.5sec, the loop is changed into a 10cm square and the field increases to 1.4 Tesla.Calculate the value of e.m.f. induced in the loop?

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3. A jet plane is travelling towards west at a speed of 1800 km/h. What is the voltage difference developed between the ends of the wing having a span of 25 m, if the Earth's magnetic field at the location has a magnitude of $5 \times 10^{-4} T$ and the dip angle is 30°.

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4. A straight rod 2m long is placed in an aeroplane in the east-west direction. The aeroplane lifts itself in the upward direction at a speed of 36km/hour. Find the potential difference between the two ends of the rod if the vertical component of earth's magnetic field is $(1/4\sqrt{3})$ gauss and angle of dip $= 30^\circ$.

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5. The magnetic flux threading a coil changes from $12 \times 10^{-3} Wb$ to $6 \times 10^{-3} Wb$in 0.01 sec. Calculate the induced emf.

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6. A wire of length 0.1m moves with a speed of $10ms^{-1}$ perpendicular to a magnetic field of induction $1Wbm^{-2}$. Calculate induced emf

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7. Find the magnitude of emf induced in a 200 turn coil with cross-sectional area of $0.16m^2$ if the magnetic field through the coil changes from 0.10 Weber/m^2 to 0.50 Weber/m^2 at a uniform rate over a period of 0.02 second

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8. A uniform magnetic flux density of $0.1 Wbm^{-2}$ extends over a plane circuit of area $1m^2$ and is normal to it. How quickly must the field be reduced to zero if an emf of 100 volt is to be induced in the circuit?

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9. The horizontal component of earth's magnetic field is $3 \times 10^{-5} Wb/m^2$. The magnetic flux linked with a coil of area $1m^2$ and having 5 turns, whose plane is normal to the magnetic field, will be

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10. A metal disc of the radius 100 cm is rotated at a constant angular speed of $60 rads^{-1}$ in a plane at right angles to an external field of magnetic induction 0.05 Wbm^{-2} . The emf induced between the centre and a point on the rim will be

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11. A circular copper disc 100cm in radius rotates at $20\pi \text{rad}/s$ about an axis through its centre and perpendicular to the disc. A uniform magnetic field of 0.2T acts perpendicular to the disc. Calculate the potential difference developed between the axis of the disc and the rim

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12. A 10Ω resistance coil has 1000 turns and at a certain time 5.5×10^{-4} Wb of flux passes through it. If the flux falls to $0.5 \times 10^{-4} Wb$ in 0.1. second find the emf generated in volts and the charge flown through the coil in coulombs.

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13. A horizontal straight wire 10 m long extending from east to west is falling with a speed of 5.0 m s^{-1}, at right angles to the horizontal component of the earth's magnetic field, $0.30 \times 10^{-4} Wbm^{-2}$.

(a) What is the instantaneous value of the emf induced in the wire?

(b) What is the direction of the emf?

(c) Which end of the wire is at the higher electrical potential?

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14. A train is moving in the north-south direction with a speed of $108kmh^{-1}$. Find the e.m.f. generated between two wheels, if the length of the axle is 2m. Assume that the vertical component of earth's field is $8.0 \times 10^{-5}Wbm^{-2}$

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15. When a wheel with metal spokes 1.2m long is rotated in a magnetic field of flux density $5 \times 10^{-5}T$ normal to the plane of the wheel, an e.m.f. of 10^{-2} volt is induced between the rim and the axle. Find the rate of rotation of the wheel.

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

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17. Magnetic flux of 5 microweber is linked with a coil, when a current of 1mA flows through it. What is the self-inductance of the coil?

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18. If a rate change of current of $4As^{-1}$ induces an emf of 20mV in a solenoid, what is the self inductance of the solenoid?

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19. What emf will be induced in a 10H inductor in which the current changes from 10A to 7A in 9.0×10^{-2} seconds?

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20. A coil of inductance 0.5 henry is connected to a 18 volt battery. Calculate the initial rate of growth of current.

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21. A current of 10A in the primary of a circuit is reduced to zero at a uniform rate in 10^{-3} sec. If the coefficient of mutual inductance is 3 henry, what is the induced emf?

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22. If the current in the primary circuit of a pair of coils changes from 5 amp to 1 amp in 0.02 sec, calculate (i) induced emf in the secondary coil if the mutual inductance between the two coils is 0.5H and (ii) the change of flux per turn in the secondary, if it has 200 turns.

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

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24. What is the self inductance of an air core solenoid 50cm long and 2cm radius if it has 500 turns? Find the magnetic flux when a current of 2 amp passes through it

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25. A 2 m long solenoid with diameter 2 cm and 2000 turns has a secondary coil of 1000 turns wound closely near its midpoint. The mutual inductance between the two coils is.

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26. Over a solenoid of 50cm length and 2cm radius and having 500turns is would another wire of 50 turns near the centre. Calculate

(i) mutual inductance of the two coils

(ii) Induced emf in the second coil when the current in the primary changes from 0 to 5A in 0.02 sec.

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27. A conducting wire of 100 turns is wound over and near the centre of a solenoid of 100cm length and 2cm radius having 1000 turns. Calculate the mutual induction of the two coils.

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28. A coil of area $0.04m^2$ having 1000 turns is suspended perpendicular to a magnetic field of 5.0×10^{-5} Wb m^2. It is rotated through 90° in 0.2 second. Calculate the average emf induced in it.

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Problems Level Ii

1. A rectangular loop of sides 8cm and 2cm with a small cut is kept stationary in a uniform magnetic field directed normal to the loop. The current feeding the electromagnet that produces the magnetic field is gradually reduced so that the field decreases from its initial value of 0.3T at the rate of $0.02T^{-1}$. If the cut is joined and the loop has a resistance of 1.6Ω, how much power is dissipated by loop as heat ? What is the source of this power ?

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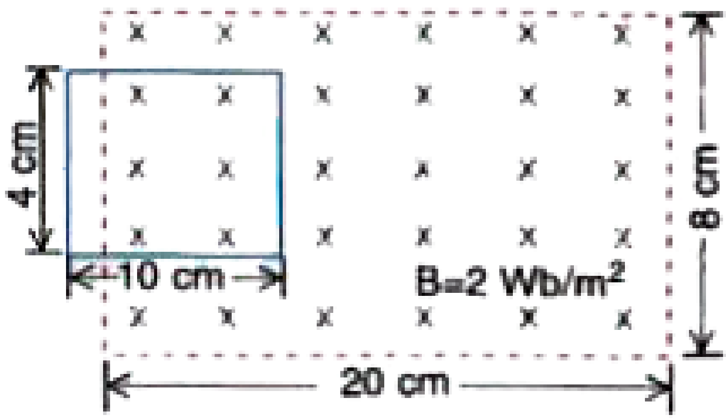
2. A rectangular loop of length 10cm and width 4cm is pulled at a constant speed of $1.0 ms^{-1}$ through a uniform magnetic field of strength 2.0 Weber/m^2 spread over an area $20cm \times 8cm$ in such a way that the field remains perpendicular to the plane of loop throughout and directed away from the reader as shown in fig. Discuss the variation of emf in the loop as it moves through the field.



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3. An air-cored solenoid with length 30 cm, area of cross-section 25 cm^2 and number of turns 500, carries a current of 2.5 A. The current is suddenly switched off in a brief time of 10^{-3} s. How much is the average back emf induced across the ends of the open switch in the circuit? Ignore the variation in magnetic field near the ends of the solenoid.

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4. It is desired to measure the magnitude of field between the poles of a powerful loud speaker magnet. A small flat search coil of area $2cm^2$ with 25 closely wound turns, is positioned normal to the field direction, and then quickly snatched out of the field region. Equivalently, one can give it a quick 90° turn to bring its plane parallel to the field direction). The total charge flown in the coil (measured by a ballistic galvanometer connected to coil) is 7.5 mC. The combined resistance of the coil and the galvanometer is 0.50 Ω. Estimate the field strength of magnet.

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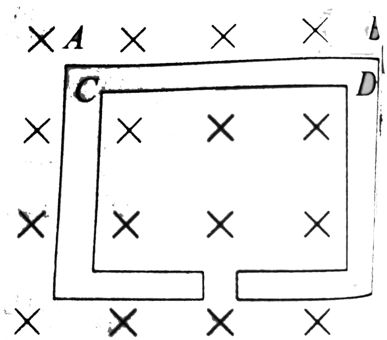
5. A wire is bent to form the double loop shown in. There is a uniform magnetic field directed into the plane of the loop. If the magnitude of this field is decreasing, the current will flow from



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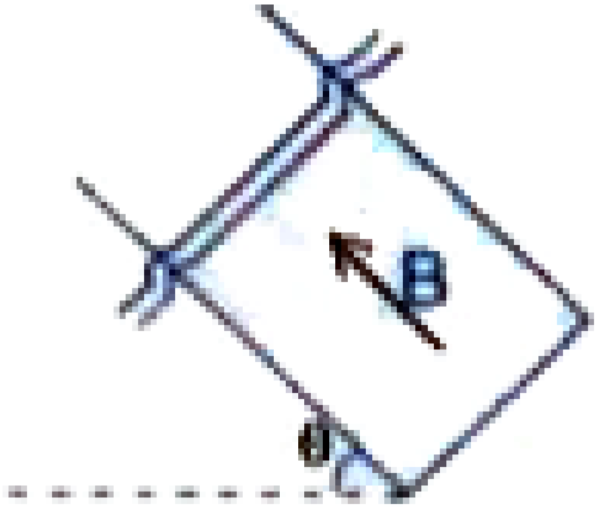
6. A wire of length l, mass m and resitance R slides without any friction down the parallel conducting rails of negligible resistance (Fig). The rails are connected to the wire so that the wire and the rails form a closed rectangular conducting loop. The plane of the rails makes an angle θ with the horizontal and a uniform vertical magnetic field of induction B exists throughout the region. Find the steady-state velocity of the wire



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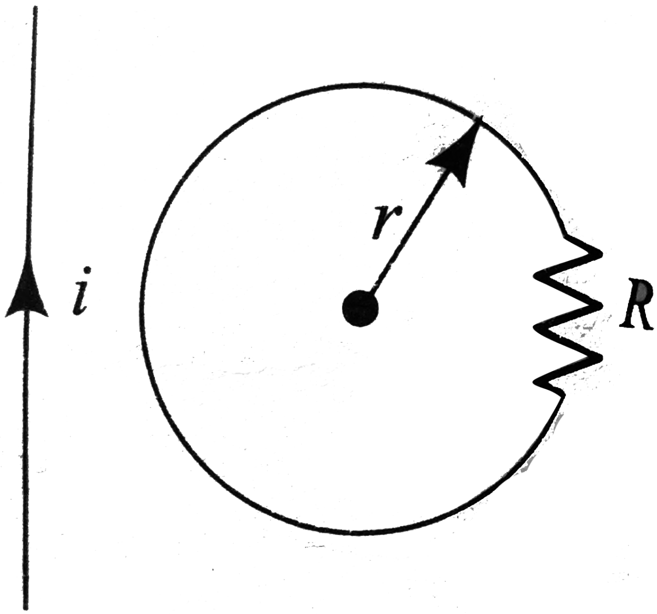
7. In Fig, the mutual inductance of a coil and a very long straight wire is M, coil has resistance R and self-inductance L. The current in the wire varies according to the law $I = at$, where a is a constant and t is the time, the time dependence of current in the coil is



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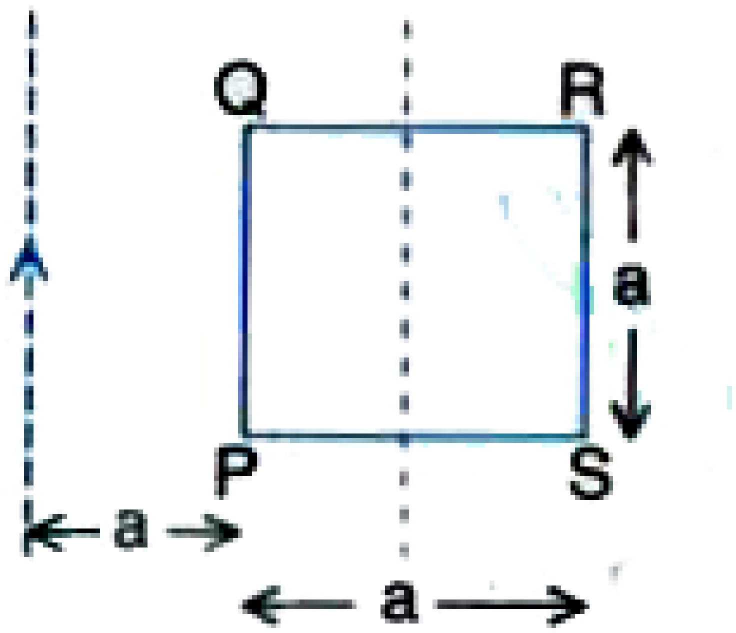
8. In Fig., a square loop PQRS of side a and resistance r is placed near an infinitely long wire carrying a constant current I. The sides PQ and RS are parallel to the wire. The wire and the loop are in the same plane. The loop is rotated by 180° about an axis parallel to the long wire and passing through the midpoints of the sides QR and PS. Find the total amount of charge which passes through any point of the loop during the rotation



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9. An inductor of 3H is connected to a battery of emf 6V through a resistance of 100 Ω. Calculate the time constant. What will be the maximum value of current in the circuit ?

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

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

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12. An inductor of 10mH is connected to a 18V battery through a resistor of $10k\Omega$ and a switch. After a long time, when the maximum current is set up in the circuit, the battery is disconnected from the circuit. Calculate the current in the circuit after $15\mu s$

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13. Calculate the back e.m.f of a 10H, 200 Ω coil 100 ms after a 100Vdc supply is connected to it.

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14. The time constant of a certain inductive coil was found to be 2.5 ms. With a resistance of 80Ω added in series, a new time constant of 0.5 ms was obtained. Find the inductance and resistance of the coil.

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Additional Exercise

1. What would you do to obtain a large deflection of the galvanometer? (b) How would you demonstrate the presence of an induced current in the absence of a galvanometer?

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

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3. A circular coil of radius 10 cm, 500 turns and resistance 2 Ω is placed with its plane perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180° in 0.25 s. Estimate the magnitudes of the emf and current induced in the coil. Horizontal component of the earth's magnetic field at the place is $3.0 \times 10^{-5} T$.

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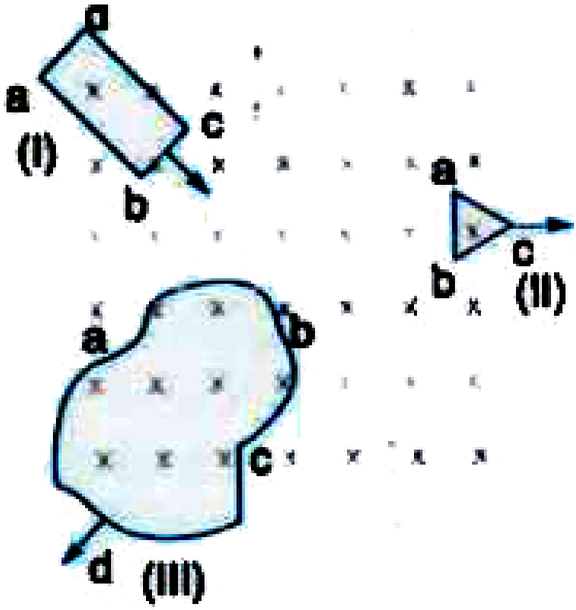
4. Figure shows planar loops of different shapes moving out of or into a region of a magnetic field which is directed normal to the plane of the loop away from the reader. Determine the direction of induced current in each loop using Lenz's law.



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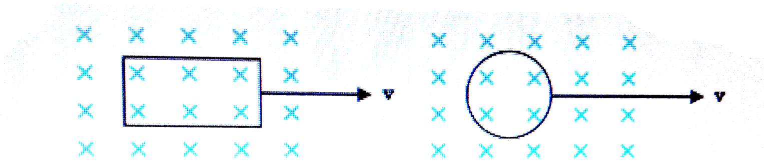
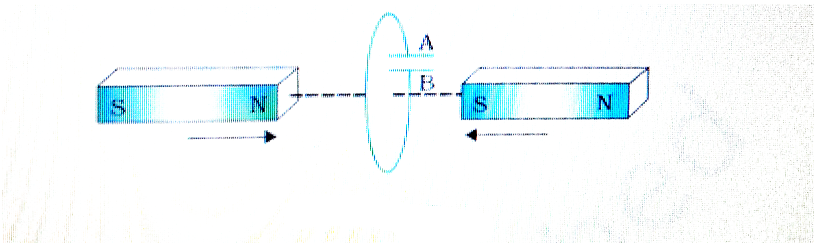
5. (a) A closed loop is held stationary in the magnetic field between the north and south poles of two permanent magnets held fixed. Can we hope to generate current in the loop by using very strong magnets?

(b) A closed loop moves normal to the constant electric field between the plates of a large capacitor. Is a current induced in the loop (i) when it is wholly inside the region between the capacitor plates (ii) when it is partially outside the plates of the capacitor? The electric field is normal to the plane of the loop.

(c) A rectangular loop and a circular loop are moving out of a uniform magnetic field region (Fig. 6.8) to a field-free region with a constant velocity v. In which loop do you expect the induced emf to be constant during the passage out of the field region? The field is normal to the loops.



(d) Predict the polarity of the capacitor in the situation described by Fig. 6.9.



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6. A metallic rod of 1 m length is rotated with a frequency of 50 revolution per second, with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius 1 m about an axis passing through the centre and perpendicular to the plane of the ring. A constant uniform magnetic field of 1T parallel to the axis is present everywhere. The emf between the centre and the metallic ring is

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7. A wheel with 10 metallic spokes each 0.5m long is rotated with a speed of 120 rev/min in a plane normal ot the horizontal components of earth's magnetic field B_H at a place. If $B_H = 0.4G$ at the place, what is the induced emf between the axle and the rim of the wheel ? Note that $1G = 10^{-4}T$

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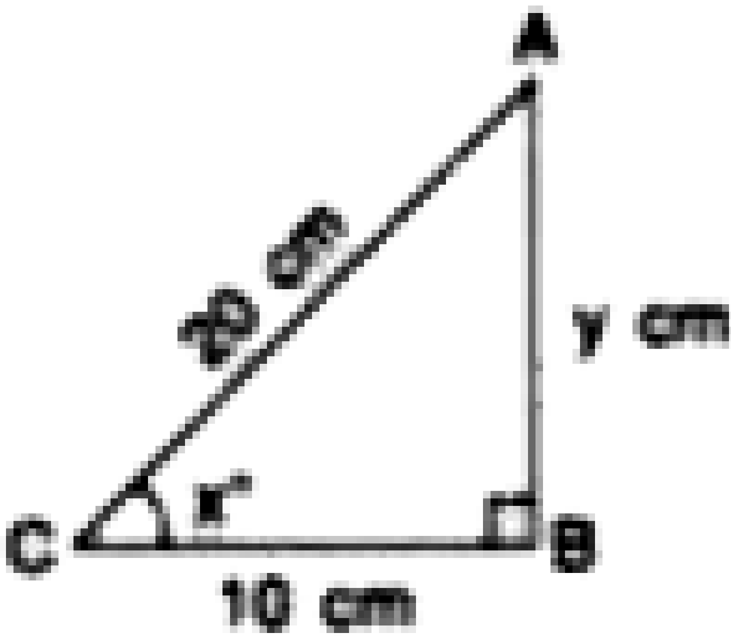
8. From the given figure, find :



x°

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9. Two concentric circular coils, one of small radius r_1 and the other of large radius r_2, such that $r_1 > \; > r_2$, are placed co-axially with centres coinciding. Obtain the mutual inductance of the arrangement.

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10. (a) Obtain the expression for the magnetic energy stored in a solenoid in terms of magnetic field B, area A and length l of the solenoid. (b) How does this magnetic energy compare with the electrostatic energy stored in a capacitor?

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11. A person peddles a stationary bicycle the pedals of the bicycle are attached to a 100 turn coil of area 0.10 m^2. The coil rotates at half a revolution per second and it is placed in a uniform magnetic field of 0.01 T perpendicular to the axis of rotation of the coil, What is the maximum voltage generated in the coil ?

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