PHYSICS

BOOKS - CBSE COMPLEMENTARY MATERIAL PHYSICS (HINGLISH)

UNIT–III & UNIT–IV MAGNETIC EFFECTS OF CURRENT AND MAGNETISM & E.M.I. AND ALTERNATING CURRENT

Very Short Answer Questions 1 Mark

1. (a) What happens if a bar magnet is cut into two pieces (i) transverse to its length (ii) along its length?

(b) What happens if an iron bar magnet is melted? Does it retain its magnetism?

(c) A magnetised needle in a uniform magnetic field experiences a torque but no net force. However, an iron nail near a bar magnet experiences a force of attration in addition to a torque, explain.

(d) Must every magnetic field configuration have a north pole and a south pole? What about the field due to a toroid?

(e) Can you think of magnetic field configuration

with three poles?

(f) Two identical looking iron bars A and B are given, one of which is definitely known to be magnetised. How would one ascertain whether or not both are magnetised? If only one is magnetised how does one ascertain which one? Use nothing else but the bars A and B.

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2. How are the figure of merit and current sensitivity of galvanometer related with each other ?

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3. Show graphically the variation of magnetic field due to a straight conductor of uniform cross-section or radius 'a' and carrying steady currently as a function of distance r (a > r) from the axis of the conductor.

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4. The force per unit length between two parallel long current carrying conductor is F. If the current in each conductor is tripled, what would be the value of the force per unit length between them?

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5. How does the angle of dip vary from equator to poles?

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6. What is the effect on the current measuring range of a galvanometer when it is shunted?

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7. An electric current flows in a horizontal wire from East to West. What will be the direction of magnetic field due to current at a point (i) North of wire, (ii) above the wire.

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8. Suggest a method to shield a certain region of space from magnetic fields.

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9. Why the core of a moving coil galvanometer is made of soft iron?

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10. Where is the vertical component of earth's magnetic field zero?

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11. What are the SI units of pole strength and magnetic moment?

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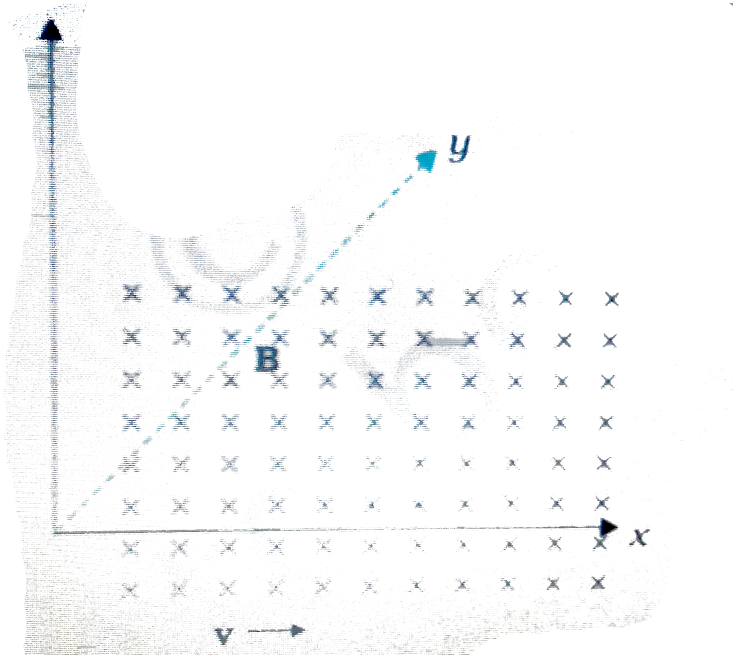
12. If the magnetic field is parallel to the positive y-axis and the charged particle is moving along the positive x-axis (Fig.), which way would the Lorentz force be for (a) an electron (negative charge), (b) a proton (positive charge).



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13. If a toroid uses bismuth for its core , will the field in the core be greater or less than when the core is empty .

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14. An electron beam projected along + X-axis, experience a force due to a magnetic field along the + Y-axis. What is the direction of the magnetic field?

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15. What do you understand by figure of merit ?

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16. What is the direction of magnetic dipole moment?

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17. What is the angle of dip at a place where horizontal and vertical components of earth's field are equal?

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18. Does a charge Particle gain K.E. when passed through magnetic field region? Justify.

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19. Sketch the magnetic field lines for a current carrying circular loop.

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20. The core of a transformer is laminated to reduce

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21. What is the direction of induced currents in metal rings 1 and 2 seen from the top when current I in the wire is increasing steadily

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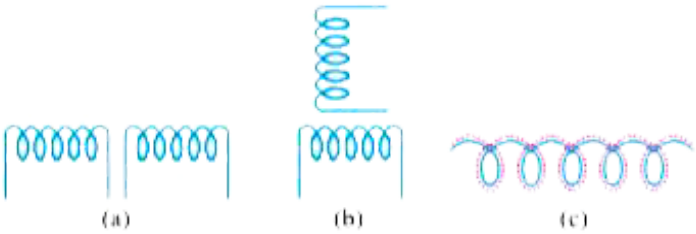
22. In which of the following cases will the mutual inductance be (i) minimum (ii) maximum?



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23. In a series L–C–R circuit, voltages across inductor, capacitor, and resistor are V_L, V_C and V_R respectively. What is the phase difference between (i) V_L and V_R (ii) V_L and V_C ?

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24. Can we a transformer be used to step up or step down a D.C. voltage? Explain.

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25. In an a.c. circuit, instantaneous voltage and current are $V = 200 \sin 300t \text{volt}$ and $i = 8 \cos 300t$ ampere respectively. What is the average power dissipated in the circuit?

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26. Sketch a graph that shows change in reactance with frequency of a series LCR circuit.

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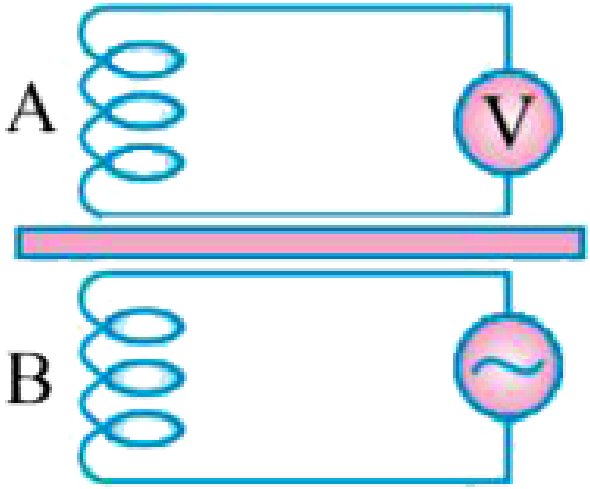
27. A coil A is connected to an A.C. ammeter and another coil B to A source of alternaing e.m.f. How will the reading of ammeter change if a copper plate is

introduced between the coils as shown.



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28. In a circuit instantaneously voltage and current are $V = 150 \sin 314t \text{volt}$ and $i = 12 \cos 314t$ ampere respectively. Is the nature of circuit is capacitive or inductive ?

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29. In a series LCR circuit, $V_L = V_C \neq V_R$. What is the value of power factor ?

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30. In an inductor L, current passed I_0 and energy stored in it is U. If the current is now reduced to $I_0/2$, what will be the new energy stored in the inductor?

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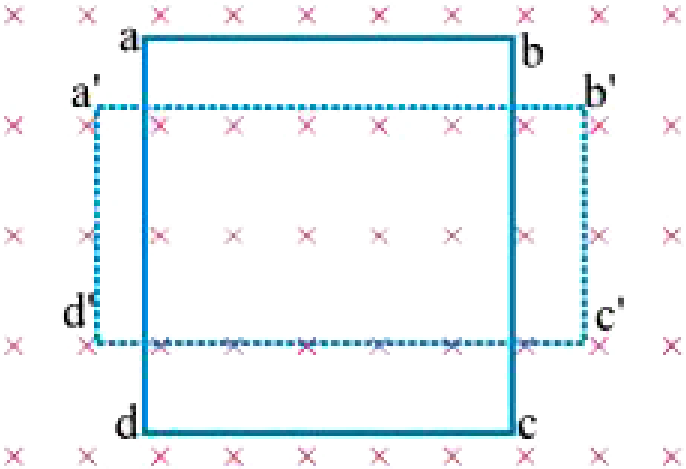
31. A square loop a, b, c, d of a conducting wire has been changed into a rectangular loop a', b', c', d' as shown in figure. What is the direction of induced current in the loop?



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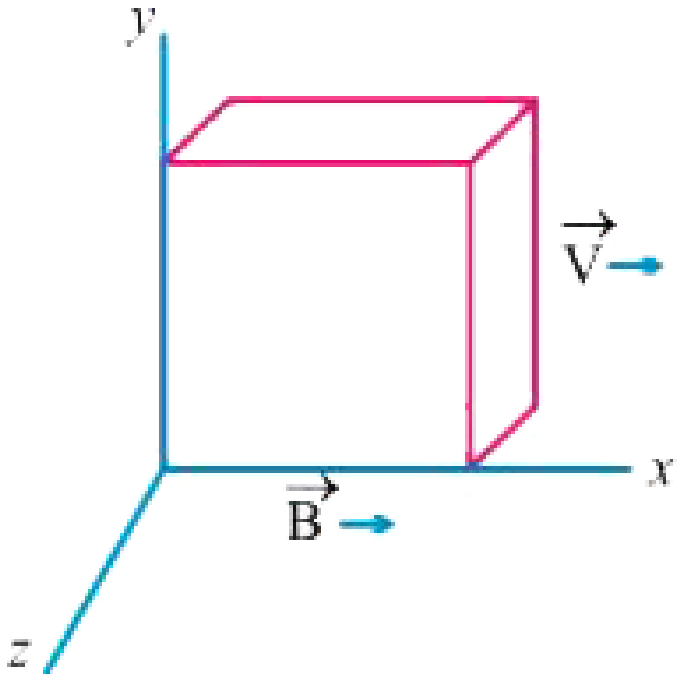
32. Twelve wires of equal lengths are connected in the form of a skeleton of a cube, which is moving with a velocity $\vec{V}$ in the direction of magnetic field $\vec{B}$. Find the emf in each arm of the cube.



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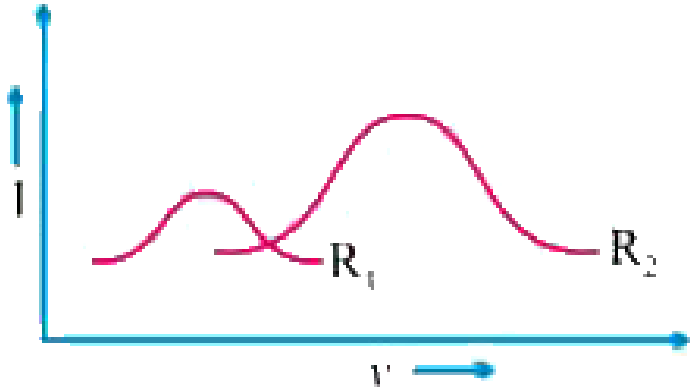
33. Current versus voltage (I – v) graphs for two different series L–C–R circuits have been shown in adjoining diagram. R_1 and R_2 are resistances of the two circuits. Which one is greater– R_1 or R_2?



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34. Why do we prefer carbon brushes than copper in an a.c. generator?

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35. What are the values of capacitive and inductive reactance in a dc circuit?

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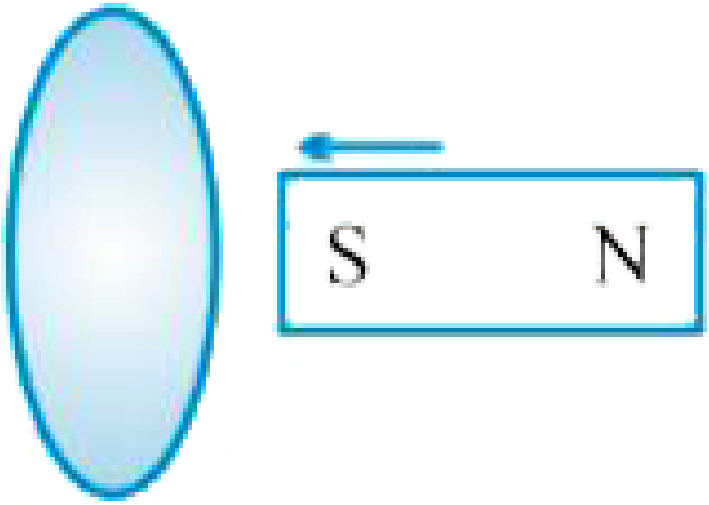
36. Give the direction of the induced current in a coil mounted on an insulating stand when a bar magnet is quickly moved along the axis of the coil from one side

to the other as shown in figure.



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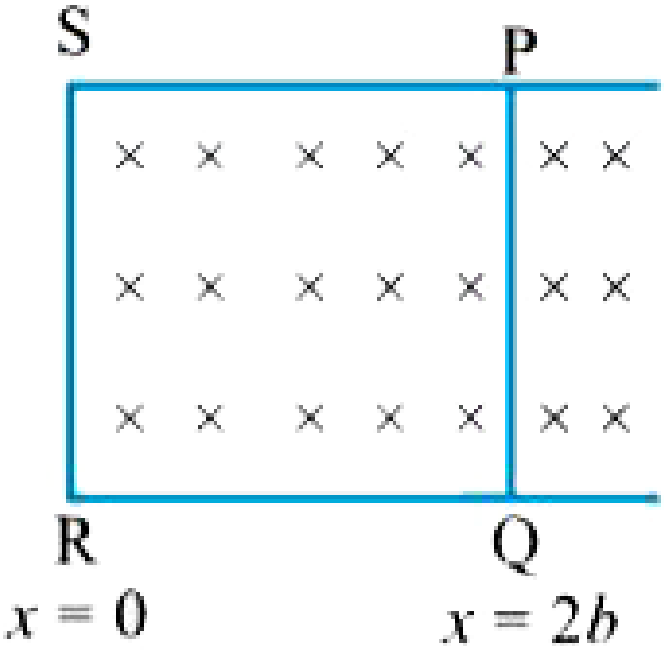
37. In figure, the arm PQ is moved from $x = 0 \text{to} x = 2b$ with constant speed V. Consider the magnet field as shown in figure. Write

(i) direction of induced current in rod

(ii) polarity induced across rod.



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38. A wire moves with some speed perpendicular to a magnetic field. Why is emf induced across the rod?

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39. Predict the polarity of the capacitor in the situation described in the figure below.

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40. Define RMS Value of Current.

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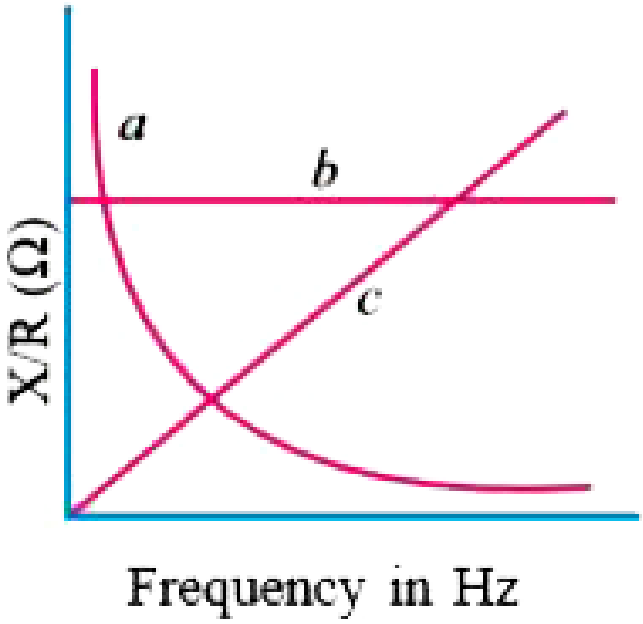
41. In given figure three curves a, b and c shows variation of resistance, (R) capacitive reactance (X_c)

and inductive (X_L) reactance with frequency. Identify the respective curves for these.



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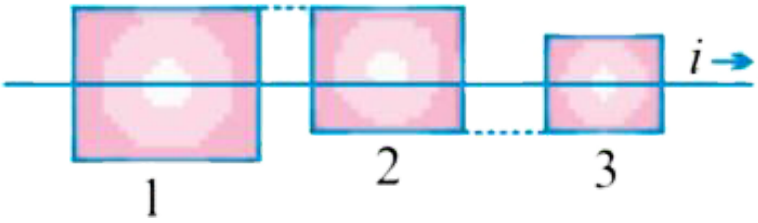
42. A long straight wire with current i passes (without touching) three square wire loops with edge lengths

2L, 1.5L and L. The loops are widely spaced (so as do not affect one another). Loops 1 and 3 are symmetric about the long wire. Rank the loops according to the size of the current induced in them if current i is (a) constant and (b) increasing.



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43. In an L–C circuit, current is oscillating with frequency 4×10^6 Hz. What is the frequency with which magnetic energy is oscillating?

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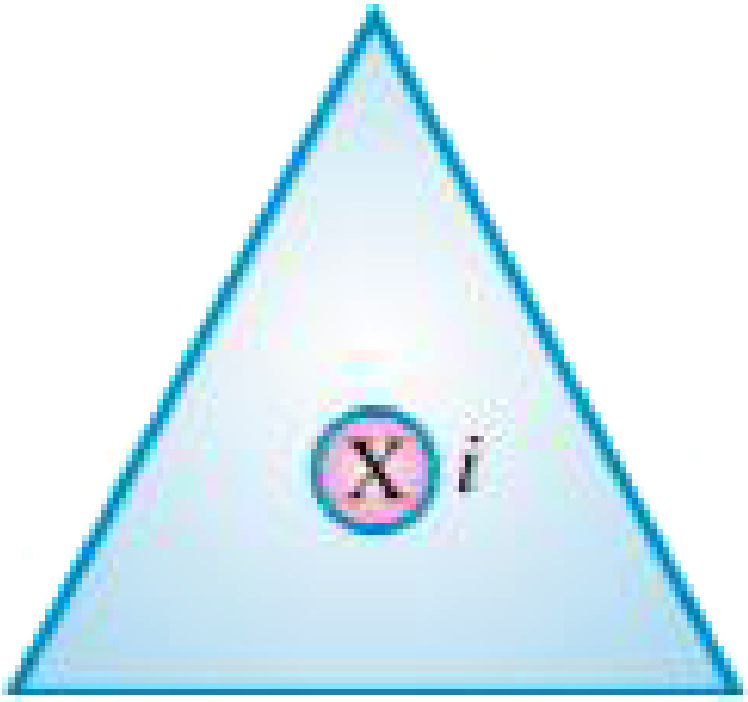
44. A current carrying wire (straight) passes inside a triangular coil as shown in figure. The current in the wire is perpendicular to paper inwards. Find the direction of induced current in the loop if current in

the wire is increasing with time.



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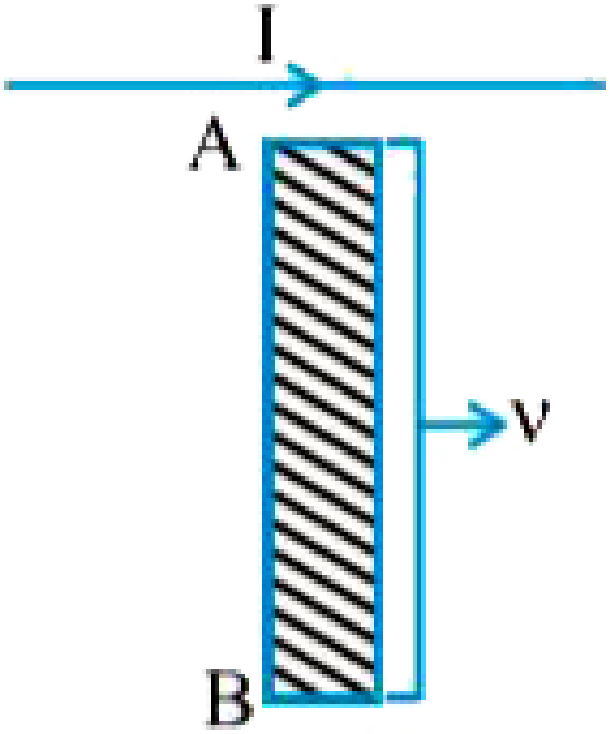
45. Wire carrying a study current and rod AB are in the same plane the rod move parallel to wire with velocity

v then which end of the rod is at higher potential.



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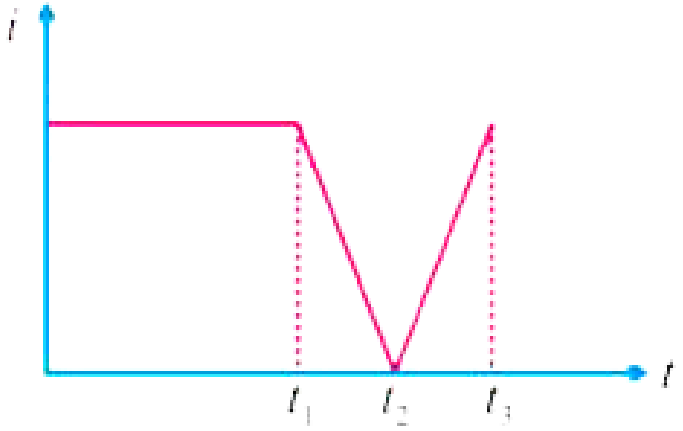
46. The current i in an induction coil varies with time t according to the graph



Draw the graph of induced e.m.f. with time.

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47. Can a capacitor of suitable capacitance be used in an AC circuit in place of the choke coil ?

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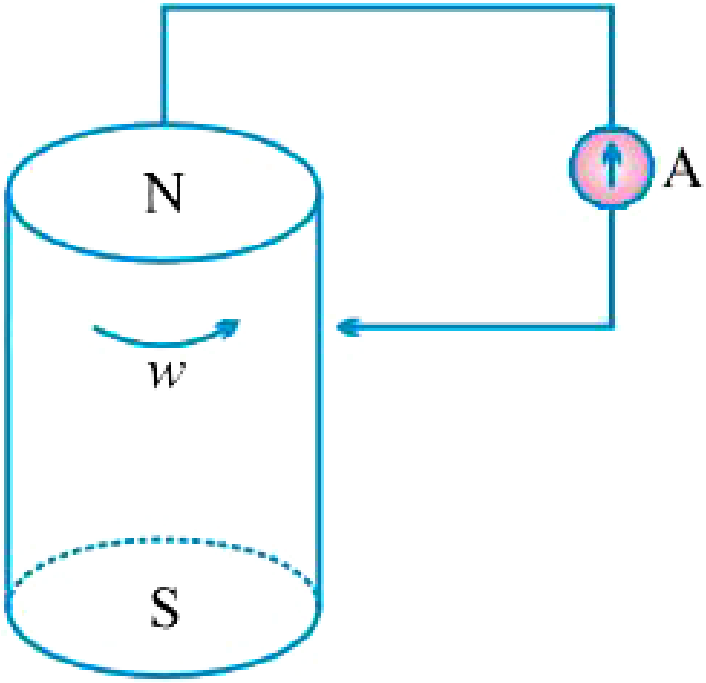
48. In the given figure,



a cylinderical bar magnet is rotated about its axis. A wire is connected from the axis and is made to touch

the cylinderical surface through a contact. Then, current in the Ammeter is.....

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Short Answer Questions 2 Marks

1. A galvanometer of resistance 120Ω gives full scale deflection for a current of 5mA. How can it be converted into an ammeter of range 0 to 5A? Also determine the net resistance of the ammeter.

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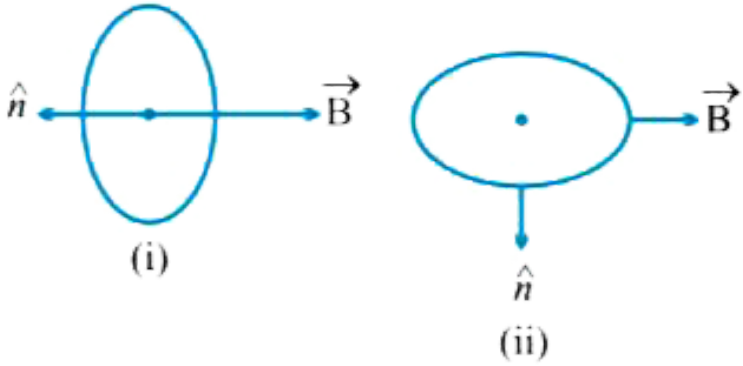
2. A current loop is placed in a uniform magnetic field in the following orientations (1) and (2). Calculate the magnetic moment in each case.



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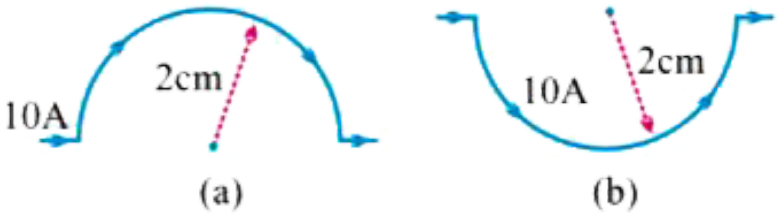
3. A current of 10A flows through a semicircular wire of radius 2 cm as shown in figure (a). What is direction and magnitude of the magnetic field at the centre of

semicircle? Would your answer change if the wire were bent as shown in figure (b) ?



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4. A proton an an $\alpha -$ particle, moving with the same velocity, enter a uniform magnetic field, acting normal to the plane of their motion. The ratio of the radii of the circular paths described by the proton and α-particle is

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5. Mention two properties of soft iron due to which it is preferred for making electromagnet.

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6. A magnetic dipole of magnetic moment M is kept in a magnetic field B. What is the minimum and maximum potential energy? Also give the most stable position and most unstable position of magnetic dipole.

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7. (a) What happens if a bar magnet is cut into two pieces : (i) transverse to its length. (ii) along its length?

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8. A steady current I flows along an infinitely long straight wire with circular cross-section of radius R. What will be the magnetic field outside and inside the wire at a point r distance far from the axis of wire?

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9. A circular coil of n turns and radius R carries a current I. It is unwound and rewound to make another square coil of side 'a' keeping number of turns and current same. Calculate the ratio of magnetic moment of the new coil and the original coil.

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10. A coil of N turns and radius R carries a current I. It is unwound and rewound to make another coil of radius $R/2$, current remaining the same. Calculate the ratio of magnetic moments of the new coil and the original coil.

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11. At a place horizontal component of the earths magnetic field is B and angle of dip at the place is 60^{o}. What is the value of horizontal component of the earths magnetic field.

(i) at Equator, (ii) at a place where dip angle is 30^{o}

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12. A galvanometer coil has a resistance G. 1% of the total current goes through the coil and rest through

the shunt. What is the resistance of the shunt in terms of G?

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13. Prove that magnetic moment of a hydrogen atom in its ground state is $eh/4\pi m$. Symbols have their usual meaning.

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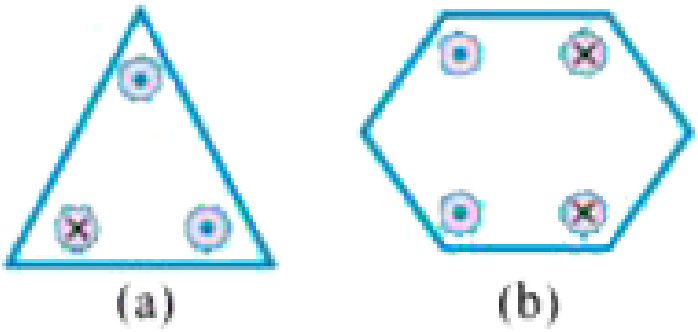
14. Each of conductors shown in figure carries 2A of current into or out of page. Two paths are indicated

for the line integral $\oint \vec{B}.\ \vec{d}I$. What is the value of the integral for the path (a) and (b).



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15. What is the radius of the path of an electron (mass 9×10^{-31} kg and charge $1.6 \times 10^{-19} C$) moving at a speed of $3 \times 10^{7} m/s$ in a magnetic field of $6 \times 10^{-4} T$ perpendicular to it? What is its frequency? Calculate its energy in keV. $\left(1eV = 1.6 \times 10^{-19} J\right)$.

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16. Why is it necessary for voltmeter to have a higher resistance?

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17. A DC ammeter cannot measure alternating current because

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18. Define the term: magnetic dipole moment of a current loop. Write the expression for the magnetic moment when an electron revolves at a speed v around an orbit of radius r in hydrogen atom.

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19. An ac source of rms voltage V is put across a series combination of an inductor L, capacitor C and a resistor R. If V_L, V_C and V_R are the rms voltage across L, C and R respectively then why is $V \neq V_L + V_C + V_R$? Write correct relation among V_L, V_C and V_R.

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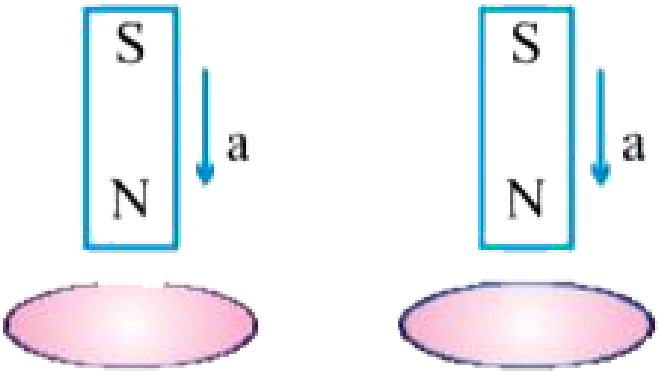
20. A bar magnet is falling with some acceleration 'a' along the vertical axis of a coil as shown in fig. What will be the acceleration of the magnet (whether a > g or a < g or a = g) if (a) coil ends are not connected to each other? (b) coil ends are connected to each other?



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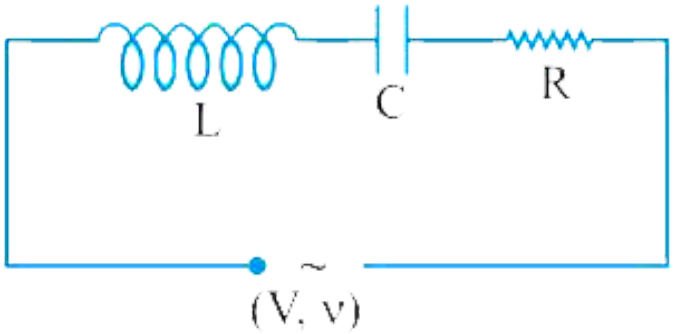
21. The series L–C–R circuit shown in fig. is in resonance state. What is the voltage across the inductor?



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22. The division marked on the scale of an a.c. ammeter are not equally spaced. Why?

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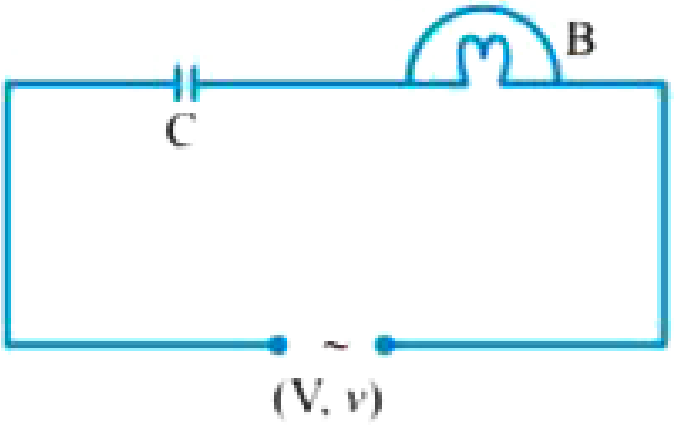
23. Circuit shown here uses an air filled parallel plate capacitor. A mica sheet is now introduced between the plates of capacitor. Explain with reason the effect on brightness of the bulb B.



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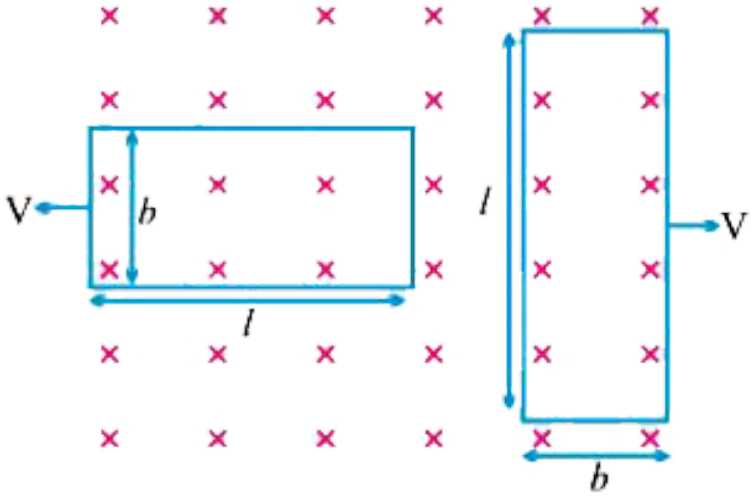
24. In the figure shown, coils P and Q are identical and moving apart with same velocity V. Induced currents in the coils are I_1 and I_2. Find I_1 / I_2.



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25. An electron is passing through a field but no force is acting on it. Under what conditions is it possible, if

the motion of the electron be in the (i) electric field (ii) magnetic field?

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26. A 1.5 μF capacitor is charged to 57V. The charging battery is then disconnected, and a 12 mH coil is connected in series with the capacitor so that LC Oscillations occur. What is the maximum current in the coil? Assume that the circuit has no resistance.

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

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28. A galvanometer needs 50mV for full scale deflection of 50 Divisions. Find it voltage sensitivity. What must be its resistance if its current sensitivity is 1 Div/A.

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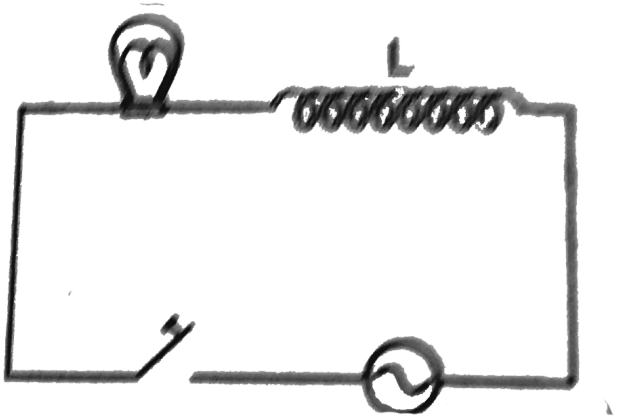
29. A light bulb and an open coil inductor are connected to an ac source through a key as shown in Fig. The switch is closed and after sometime, an iron rod is inserted inot the interior of the inductor. The glow of the ligth bulb (a) increases (b) decreases (c) is unchanged as the iron is inserted. Give your answer with reasosns. What will be your answer if ac source is replaced by dc source ?



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30. Show that in the free oscillations of an LC circuit, the sum of energies stored in the capacitor and and the inductor is constant in time.

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31. Show that the potential difference across the LC combination is zero at the resonating frequency in series LCR circuit

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32. When a large amount of current is passing through solenoid, it contract, explain why ?

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33. Answer the following questions :

(a) In any a.c. circuit, is the applied instantaneous voltage equal to the algebraic sum of the instantaneous voltages acorss the series elements of the circuit ? Is the same true for r.m.s. voltage?

(b) A capacitor is used in the primary circuit of an induction coil.

(c) An applied voltage signal consists of a

superposition of a d.c. voltage and an a.c. voltage of high frequency. The circuit consists of an inductor and a capacitor in series. Show that the d.c. signal will appear across C and the a.c. signal will appear across L.

(d) A choke coil in series with a lamp is connected to a d.c. line. The lamp is seen to shine brightly. Insertion of an iron core in the choke causes no change in the lamp's brightness. Predict the corresponding observation if the connection is to an a.c. line.

(e) Why is choke coil needed in use of fluorescent tubes with ac mains ? Why can we not use an ordinary resistor instead of choke coil?

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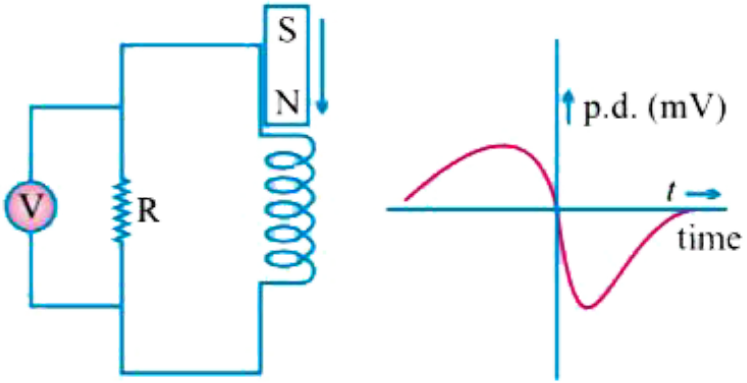
34. A bar magnet M is dropped so that is falls vertically through the coil C. The graph obtained for voltage produced across the coil Vs time is shown in figure.



(i) Explain the shape of the graph.

(ii) Why is the negative peak longer than the positive peak ?

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35. How does the mutual inductance of a pair of coils change when

(i) distance between the coils is increased and

(ii) number of turns in the coils is increased?

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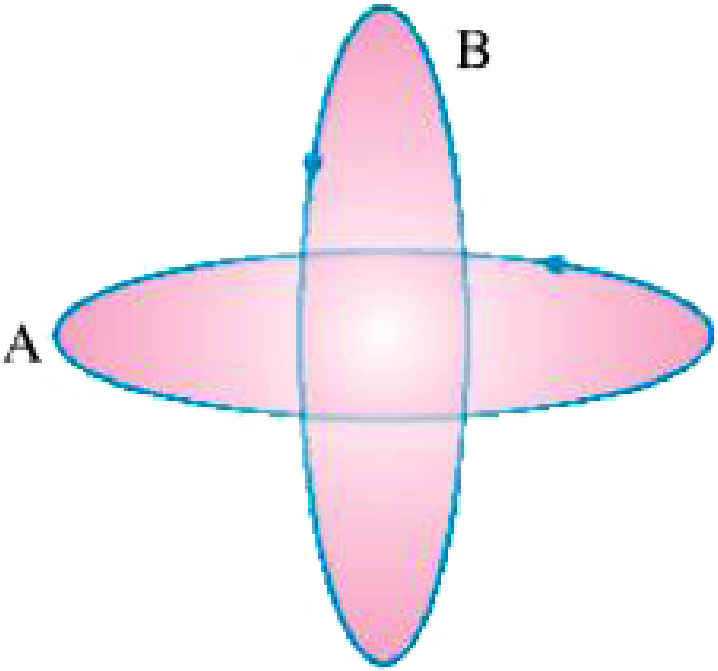
36. Two circular conductors are perpendicular to each other as shown in figure. If the current is changed in conductor B, will a current be induced in the

conductor A,



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37. What is a radial magnetic field? Why is it required in a galvanometer ?

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38. The hysterisis loop of material depends not only on the nature of material but also on the history of its magnetization cycles. Suggest a use of this property of material.

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

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40. prove that the charge induced does not depend on the rate of change of magnetic flux.

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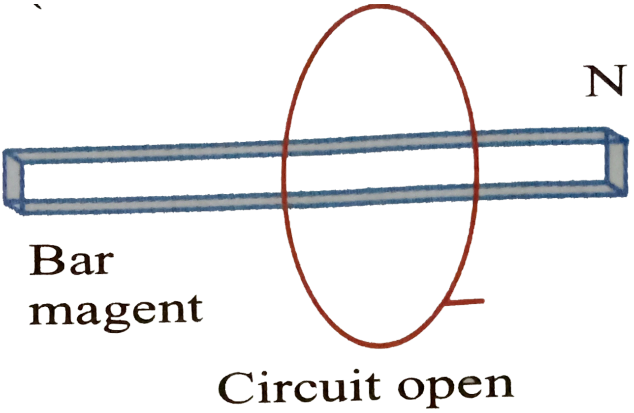
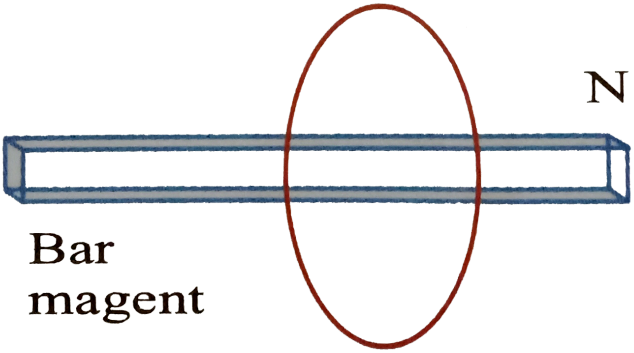
41. Consider a magnet surround by a wire with an on / of switch S (figure) if the switch is thrown from the off position (open circuit) to the on position the (closed

circuit).



Circuit open



Circuit closed

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Short Answers Questions 3 Marks

1. Derive an expression for the force between two long parallel current carrying conductors. Use this expression to define SI unit of current.

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2. Distinguish between the magnetic properties of dia, para and ferromagnetic substances in terms of (i) susceptibility

(ii) magnetic permeability and

(iii) Coercivity. Give one example of each of these materials.

Draw the field lines due to an external magnetic field

near a (i) diamagnetic

(ii) paramagnetic substance.

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3. Name the elements or parameters of earth's magnetic field.

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4. Describe the path of a charged particle moving in a uniform magnetic field with initial velocity

(i) parallel to (or along) the field.

(ii) perpendicular to the field.

(iii) at an arbitrary angle $\theta(0^\circ < \theta < 90^\circ)$.

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5. Obtain an expression for the magnetic moment of an electron moving with a speed 'v' in a circular orbit of radius 'r'. How does the magnetic moment change when :

(i) the frequency of revolution is doubled?

(ii) the orbital radius is halved?

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6. State Ampere's circuital law. Use this law to obtain the expression for the magnetic field inside an air cored toroid of average radius r having n-turns per unit length and carrying a steady current I.

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7. (a)Using Ampere's circuitlal law,obtain the expression for the magnetic field due to a long solenoid at a point inside the solenoid on its axis.

(b)In what respect is a toroid different from a solenoid?Draw and compare the pattern of the magnetic field lines in the two cases.

(c)How is the magnetic field inside a given solenoid made strong?

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8. A magnetic dipole of moment M is placed in uniform magnetic field B so that angle betweem direction of M and B is θ,the torque acting on the magnetic dipole is

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9. A moving coil galvanometer has N number of turns in a coil of effective area. A it carries a current I. The

magnetic field B is radial. The torque acting on the coil is

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10. One of the two identical conducting wires of length L is bent in the form of a circular loop and the other one into a circular coil of N identical turns. If the same current passed in both, the ratio of the magnetic field at the central of the loop (B_L) to that at the central of the coil (B_C), i.e. $\frac{B_L}{B_C}$ will be :

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11. Obtain an expression for the self inductance of a straight solenoid of length l and radius r (l > > r).

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12. In a series L–C–R circuit X_L, X_C and R are the inductive reactance, capacitive reactance and resistance respectively at a certain frequency f. If the frequency of a.c. is doubled, what will be the values of reactances and resistance of the circuit?

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13. Name four applications of Eddy currents.

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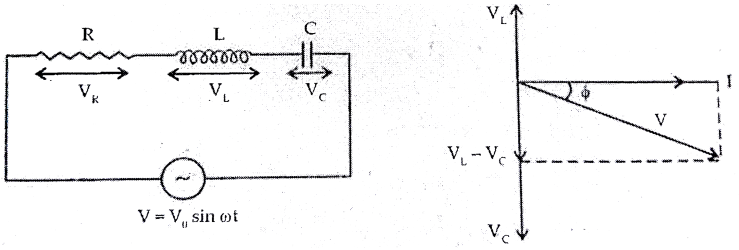
14. (i) An a.c. Source of voltage $V = V_0 \sin \omega t$ is connected to a series combination of L,C and R . Use the phasor diagram to obtain expression for impedance of the circuit and phase angle between voltage and current . Find the condition when current will be phase with the voltage . What is the circuit in this condition called ?

(ii) In a series LR circuit $X_L = R$ and power factor of the circuit is P_1. When capacitor which capacitance C

such that $X_L = X_C$ is put in series , the power factor becomes P_2 .Calculate P_1 / P_2



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15. A voltage, $E = E_0 \sin \omega t$ is applied across an inductor L. Obtain an expression for the current.

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16. The energy stored in an inductor of self-inductance L henry carrying a current of I ampere is

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17. A conducting rod held horizontally along East-West direction is dropped from rest at certain height near Earth's surface. Why should there be an induced e.m.f. across the ends of the rod? Draw a graph showing the variation of e.m.f. as a function of time from the instant it begins to fall.

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18. In an LC circuit, resistance of the circuit is negligible. If time period of oscillation is T then :

(i) at what time is the energy stored completely electrical

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19. In an LC circuit, resistance of the circuit is negligible. If time period of oscillation is T then :

(ii) at what time is the energy stored completely magnetic

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20. In an LC circuit, resistance of the circuit is negligible. If time period of oscillation is T then :

(iii) at what time is the total energy shared equally between the inductor and capacitor.

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21. An alternating voltage of frequency f is applied across a series LCR circuit.Le f_r be the resonance frequency for the circuit.Will the current in the circuit lag, lead or remain in phase with the applied voltage when (i)$f > f_r$,(ii)$f < f_r$? Explain your answer in each case.

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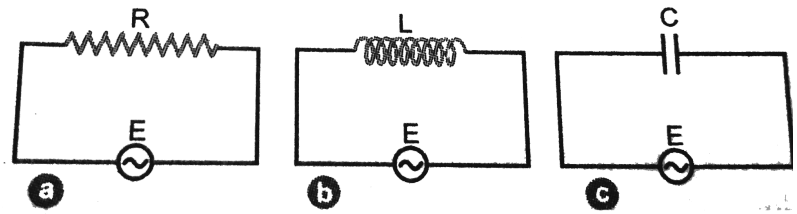
22. Fig. show three alternating circuits with equal currents. If frequency of alt. e.m.f be increased, what will be the effect on currents in the three cases? Explain.



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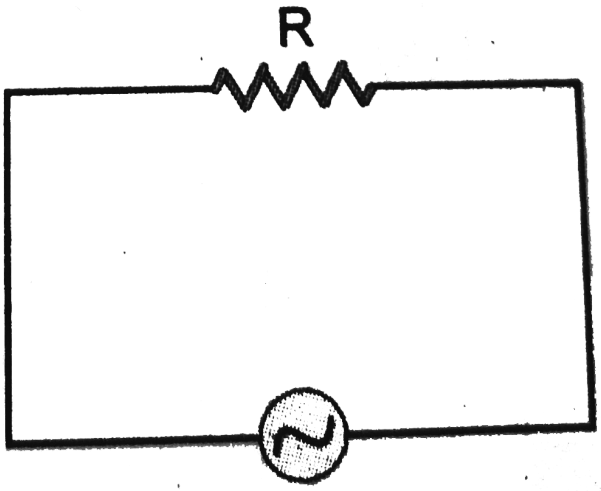
23. Study the circuit (a) and (b) shown in Fig. and answer the following questions.

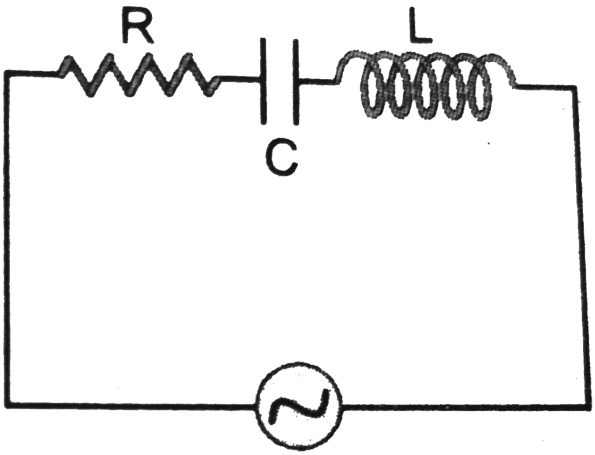
(a) Under which conditions would the rms currents in the two circuits be the same ?

Can the rms curent in circuit (b) be larger than that in (a) ?

a



b



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24. Can the instantaneous power output of an ac source ever be negative ? Can the average power output be negative ?

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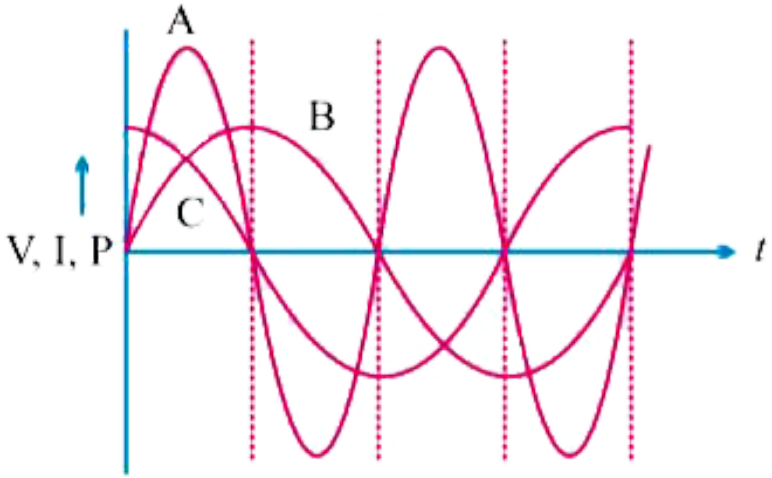
25. A device 'X' is connected to an AC source. The variation of voltage, current and power in one complete cycle is shown in fig.



(a) Which curves shows power consumption over a full cycle?

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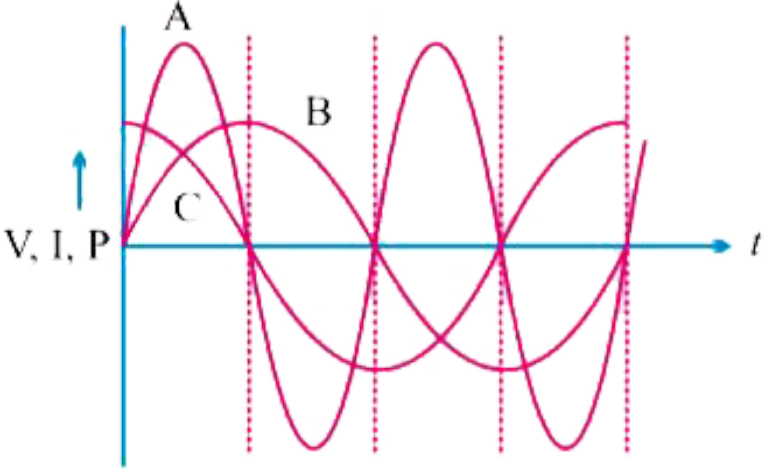
26. A device 'X' is connected to an AC source. The variation of voltage, current and power in one complete cycle is shown in fig.



(b) What is the average power consumption over a cycle?

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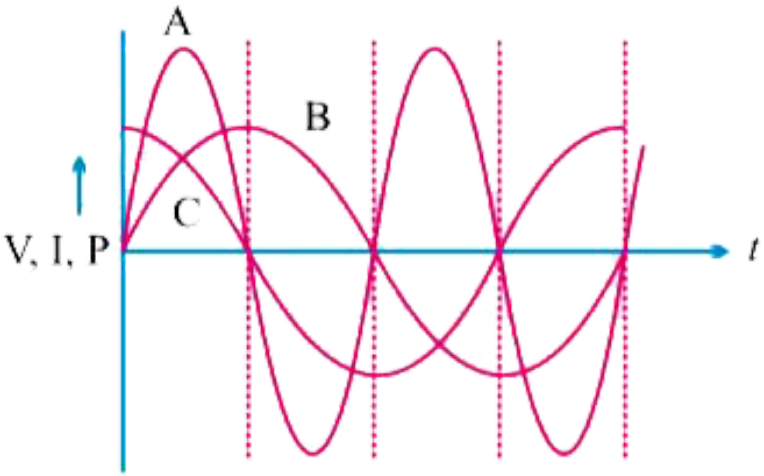
27. A device 'X' is connected to an AC source. The variation of voltage, current and power in one complete cycle is shown in fig.



(c) Identify the device X if curve B shows voltage.

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Long Answer Questions 5 Marks

1. Draw a neat and labelled diagram of a cyclotron. State the underlying principle and explain how a positively charged particle gets accelerated in this

machine. Show mathematically that the cyclotron frequency does not depend upon the speed of the particle.

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2. Draw a labelled diagram of AC generator. Derive the expression for the instantaneous value of the emf induced in the coil.

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3. Describe the construction and working of a transformer with a neat labelled diagram

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4. An L–C circuit contains inductor of inductance L and capacitor of capacitance C with an initial charge q_0. The resistance of the circuit is negligible. Let the instant the circuit is closed be t = 0.

(i) What is the total energy stored initially?

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5. An L–C circuit contains inductor of inductance L and capacitor of capacitance C with an initial charge q_0. The resistance of the circuit is negligible. Let the instant the circuit is closed be t = 0.

(i) What is the total energy stored initially?

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Numericals

1. An electron travels on a circular path of radius 10 m in a magnetic field of 2×10^{-3} T. Calculate the speed

of electron. What is the potential difference through which it must be accelerated to acquire this speed?

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2. A charge particle of mass m and charge q entered into magnetic field B normally after accelerating by potential difference V. Calculate radius of its circular path.

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3. Calculate the magnetic field due to a circular coil of 500 turns and of mean diameter 0.1m, carrying a current of 14A (i) at a point on the axis distance 0.12 m from the centre of the coil (ii) at the centre of the coil.

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4. An electron of kinetic energy 10 keV moves perpendicular to the direction of a uniform magnetic field of 0.8 milli tesla. Calculate the time period of rotation of the electron in the magnetic field.

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5. If the current sensitivity of a moving coil galvanometer is increased by 20% and its resistance also increased by 50% then how will the voltage sensitivity of the galvanometer be affected?

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6. A uniform wire is bent into one turn circular loop and same wire is again bent in two circular loop. For the same current passed in both the cases compare the magnetic field induction at their centres.

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7. A horizontal electrical power line carries a current of 90A from east to west direction. What is the magnitude and direction of magnetic field produced by the power line at a point 1.5 m below it?

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8. A galvanometer with a coil of resistance 90Ω shows full scale deflection for a potential difference 25mV. What should be the value of resistance to convert the galvanometer into a voltmeter of range 0V to 5V. How should it be converted?

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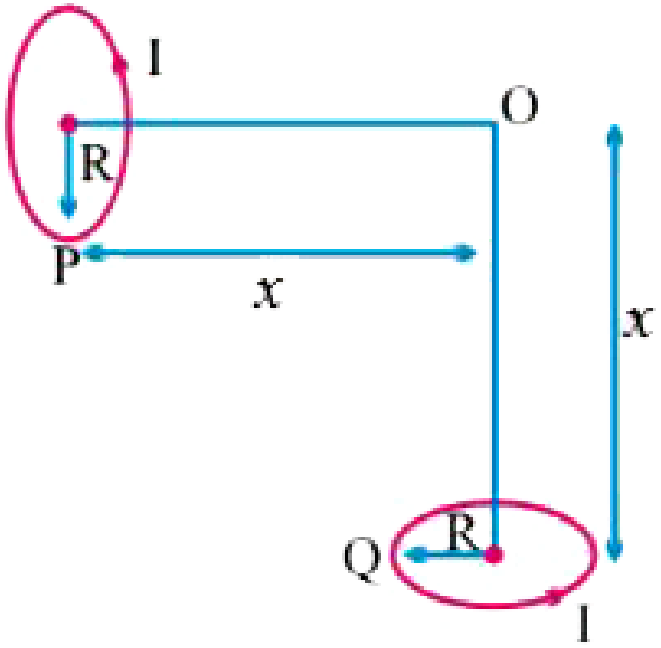
9. Two identical circular loops P and Q carrying equal currents are placed such that their geometrical axis are perpendicular to each other as shown in figure. And the direction of current appear's anticlockwise as seen from point O which is equidistant from loop P and Q. Find the magnitude and direction of the net magnetic field produced at the p oint O.



$$\tan\theta = \frac{B_2}{B_1} = 1, \theta = \pi/4.$$

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10. A cyclotron's oscillator frequency is 10 MHz. What should be the operating magnetic field for accelerating protons, if the radius of its dees is 60 cm ?

What is the kinetic energy of the proton beam produced by the accelerator? Given $e = 1.6 \times 10^{-19} C, m = 1.67 \times 10^{-27}$ kg. Express your answer in units of MeV $\left[1MeV = 1.6 \times 10^{-13} J\right]$.

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11. The coil of a galvanometer is 0.02 × 0.08 m2. It consists of 200 turns of fine wire and is in a magnetic field of 0.2 tesla. The restoring torque constant of the suspension fibre is 10^{-6} Nm per degree. Assuming the magnetic field to be radial.

(i) What is the maximum current that can be measured by the galvanometer, if the scale can accommodate

30° deflection?

(ii) What is the smallest, current that can be detected if the minimum observable deflection is 0.1°?

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12. A voltmeter reads 5V at full scale deflection and is graded according to its resistance per volt at full scale deflection as $5000\Omega V^{-1}$. How will you convert it into a voltmeter that reads 20V at full scale deflection? Will it still be graded as $5000\Omega V^{-1}$? Will you prefer this voltmeter to one that is graded as $2000\Omega V^{-1}$?

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13. A short bar magnet placed with its axis at 30^{o} with an external field 1000G experiences a torque of 0.02 Nm. (i) What is the magnetic moment of the magnet. (ii) What is the work done in turning it from its most stable equilibrium to most unstable equilibrium position?

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14. What is the magnitude of the equatorial and axial fields due to a bar magnet of length 4 cm at a distance of 40 cm from its mid point? The magnetic moment of the bar magnet is a $0.5Am^{2}$

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15. What is the magnitude of magnetic force per unit length on a wire carrying a current of 8A and making an angle of 30° with the direction of a uniform magnetic field of 0.15T?

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16. Two moving coil metres M_1 and M_2 have the following particular

$R_1 = 10\Omega, N_1 = 30, A_1 = 3.6 \times 10^{-3} m^2, B_1 = 0.25T,$

$R_2 = 14\Omega, N_2 = 42, A_2 = 1.8 \times 10^{-3} m^2, B_2 = 0.50T$

The spring constants are identical for the two metres. What is the ratio of current sensitivity and voltage sensitivity of M_2 to M_1?

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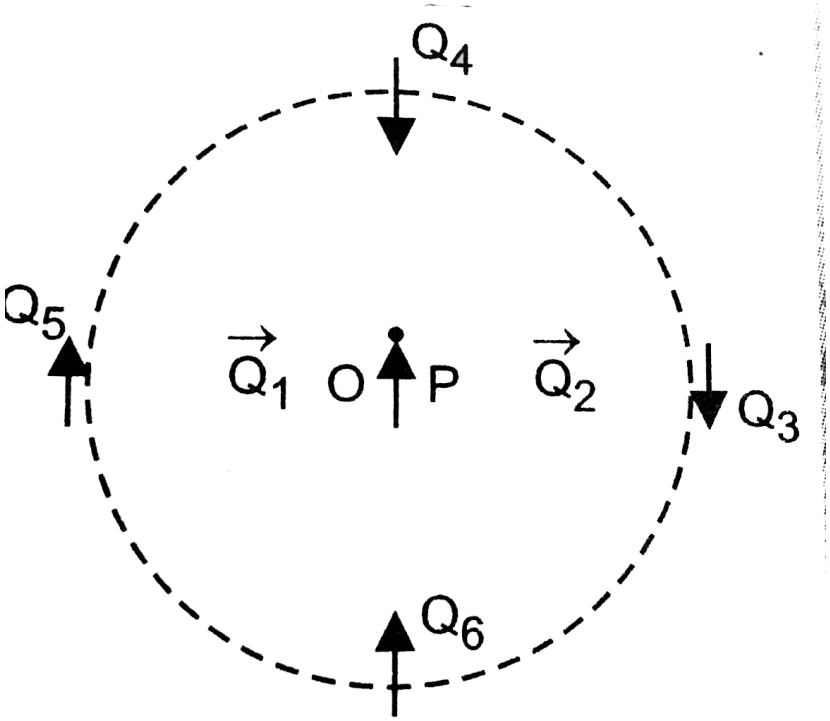
17. Figure shows a small magnetised needle P placed at a point O. The arrow shows the direction of magnetic moment. The other arrows show different positions (and orientations of the magnetic moment) of another identical magnetised needle Q.



(a) In which configuration is the system not in equilibrium?

(b) In which configuration is the system in (i) stable and (ii) unstable equilibrium?

(c) Which configuration corresponds to the lowest potential energy among all the configurations shown?

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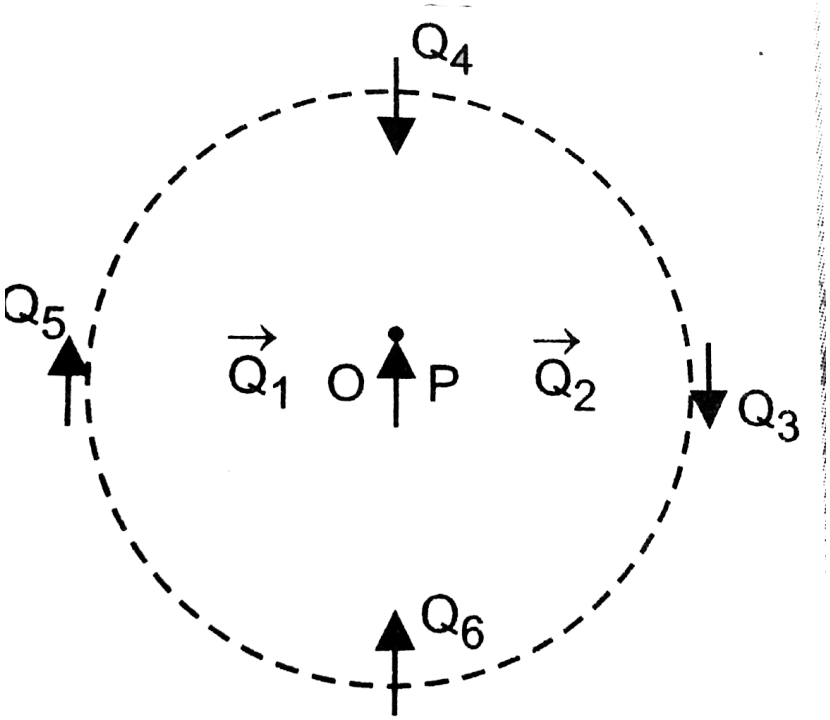
18. Figure shows a small magnetised needle P placed at a point O. The arrow shows the direction of magnetic moment. The other arrows show different positions (and orientations of the magnetic moment) of another identical magnetised needle Q.



(a) In which configuration is the system not in equilibrium?

(b) In which configuration is the system in (i) stable and (ii) unstable equilibrium?

(c) Which configuration corresponds to the lowest potential energy among all the configurations shown?

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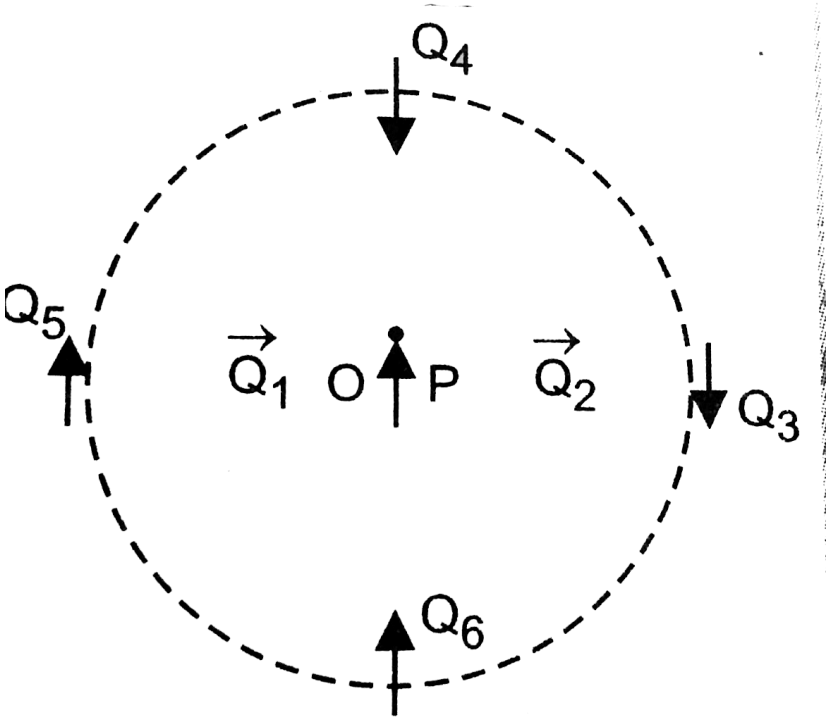
19. Figure shows a small magnetised needle P placed at a point O. The arrow shows the direction of magnetic moment. The other arrows show different positions (and orientations of the magnetic moment) of another identical magnetised needle Q.



(a) In which configuration is the system not in equilibrium?

(b) In which configuration is the system in (i) stable and (ii) unstable equilibrium?

(c) Which configuration corresponds to the lowest potential energy among all the configurations shown?

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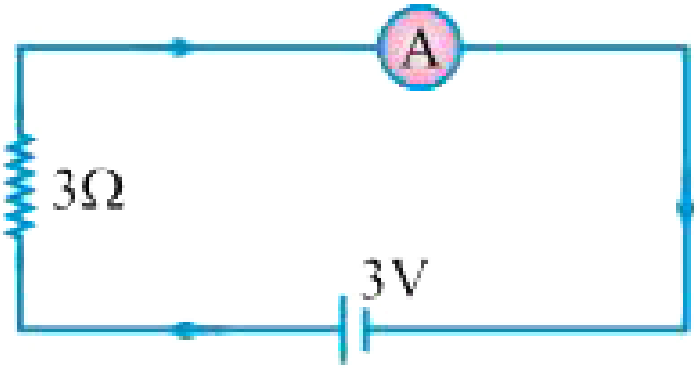
20. In the circuit, the current is to be measured. What is the value of the current if the ammeter shown :



(a) is a galvanometer with a resistance $R_G = 60\Omega$,

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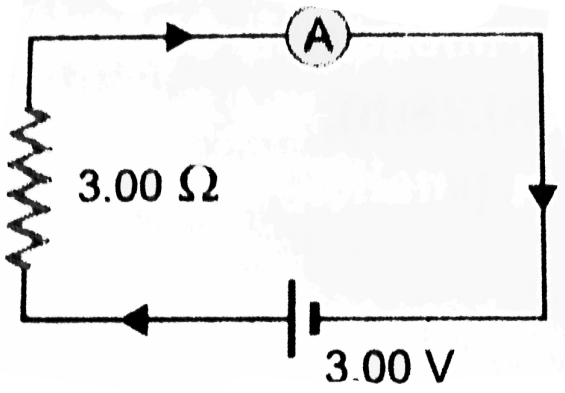
21. In the circuit shown in figure, the current is to measured. What is the value of the current if the ammeter shown (i) is a galvanometer with a resistance $R_G = 60 \cdot 00\Omega$. (ii) is a galvanometer described in (i) but converted to an ammeter by a shunt resistance $r_s = 0 \cdot 02\Omega$, (iii) is an ideal ammeter with zero resistance?



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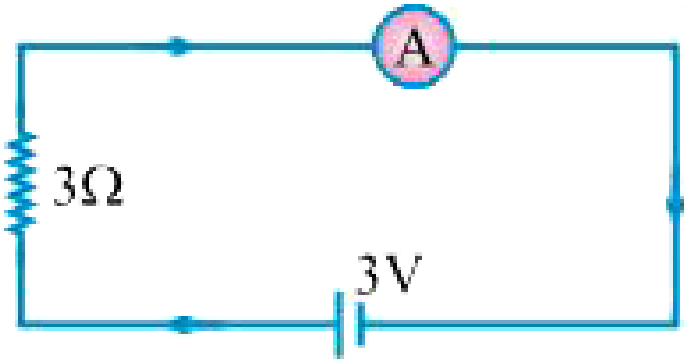
22. In the circuit, the current is to be measured. What is the value of the current if the ammeter shown :



(c) is an ideal ammeter with zero resistance?

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23. An element $d\vec{l} = dx\hat{i}$ (where $dx = 1cm$) is placed at the origin and carries a large current

$i = 10A$. What is the magnetic field on the Y-axis at a distance of $0.5m$?

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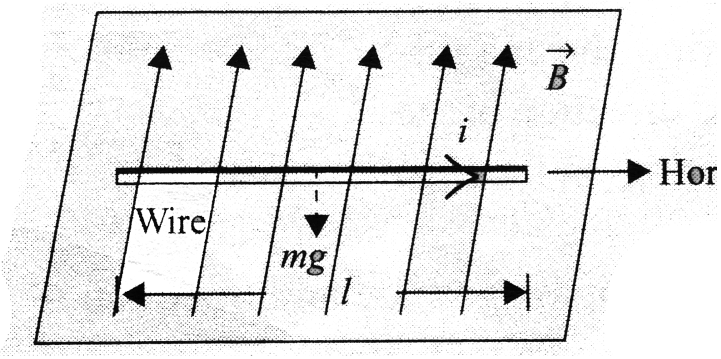
24. A straight wire of mass 200 g and length 1.5 m carries a current of 2 A. It is suspended in mid-air by a uniform horizontal magnetic field B. What is the magnitude of the magnetic field?



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25. A rectangular loop of sides 25 cm and 10 cm carrying current of 15A is placed with its longer side parallel to a long straight conductor 2.0 cm apart carrying a current of 25A. What is the new force on the loop ?

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26. In a chamber, a uniform magnetic field of $6 \cdot 5G\left(1G = 10^{-4}T\right)$ is maintained. An electron is shot into the field with a speed of $4 \cdot 8 \times 10^{6}ms^{-1}$

normal to the field. (i) Explain why the path of the electron is a circle. Determine the radius of the circular orbit. $\left(e = 1 \cdot 6 \times 10^{-19} C, m_e = 9 \cdot 1 \times 10^{-31} kg\right)$.

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27. In a chamber, a uniform magnetic field of $6 \cdot 5 G \left(1 G = 10^{-4} T\right)$ is maintained. An electron is shot into the field with a speed of $4 \cdot 8 \times 10^{6} m s^{-1}$ normal to the field. (i) Explain why the path of the electron is a circle. Determine the radius of the circular orbit. $\left(e = 1 \cdot 6 \times 10^{-19} C, m_e = 9 \cdot 1 \times 10^{-31} kg\right)$.

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28. The horizontal and veritical components of eaths's field at a place ar 0.22 gauss of 0.38 gauss, respectively. Calculate the angle of dip and resultant intensity of earth's field.

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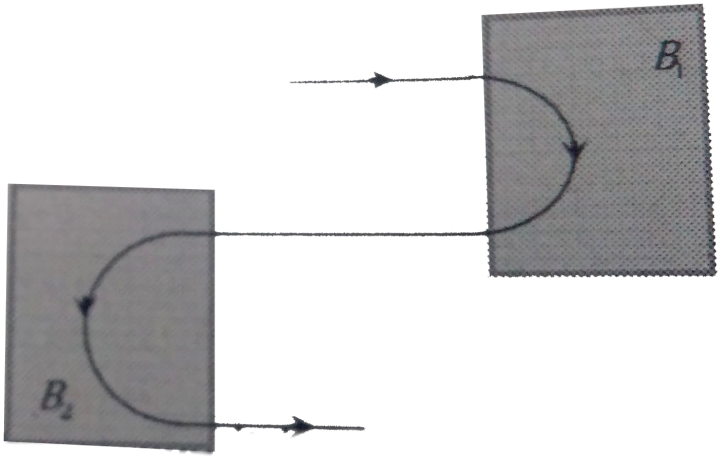
29. Following figure shows the path of an electron that passes through two regions containing uniform magnetic fields of magnitudes B_1 and B_2 . It's path in

each region is a half circle, choose the correct option



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30. In a series C–R circuit, applied voltage is $V = 110 \sin 314t$ volt. What is the (i) The peak voltage (ii) Average voltage over half cycle ?

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31. Magnetic flux linked with each turn of a 25 turns coil is 6 milliweber. The flux is reduced to 1 mWb in 0.5s. Find induced emf in the coil.

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32. The current through an inductive circuit of inductance 4mH is i = 12 cos 300t ampere. Calculate :

(i) Reactance of the circuit.

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33. The current through an inductive circuit of inductance 4mH is i = 12 cos 300t ampere. Calculate :

(ii) Peak voltage across the inductor.

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34. A power transmission line feeds input power at 2400 V to a step down transformer with its primary windings having 4000 turns. What should be the number of turns in the secondary windings in order to get output power at 240 V?

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35. The magnetic flux linked with a closed circuit of resistance 8Ω varies with time according to the expression $\phi = \left(5t^2 - 4t + 2\right)$ where ϕ is in milliweber and t in second. Calculate the value of induce current at $t = 15$s.

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36. A capacitor, a resistor and 4 H inductor are connected in series to an a.c. source of 50 Hz. Calculate capacitance of capacitor if the current is in phase with voltage.

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37. A series C–R circuit consists of a capacitance 16 mF and resistance 8Ω. If the input a.c. voltage is (200 V, 50 Hz), Calculate (i) voltage across capacitor and resistor. (ii) Phase by which voltage lags/leads current.

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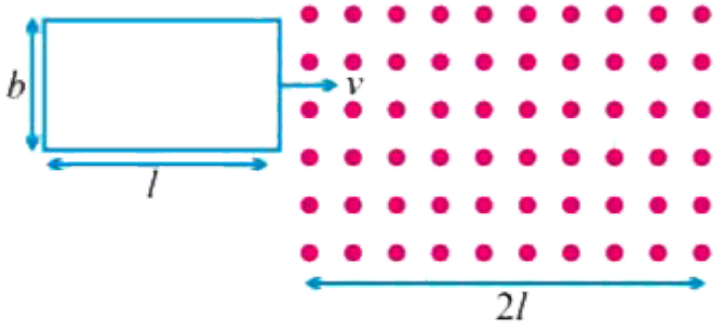
38. A rectangular conducting loop of length l and breadth b enters a uniform magnetic field B as shown below.



The loop is moving at constant speed v and at t = 0 it just enters the field B. Sketch the following graphs for the time interval t = 0 to $t = \frac{3I}{v}$.

(i) Magnetic flux versus time

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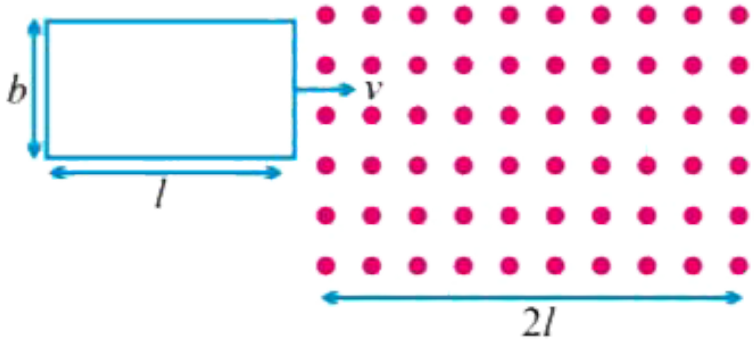
39. A rectangular conducting loop of length l and breadth b enters a uniform magnetic field B as shown below.



The loop is moving at constant speed v and at t = 0 it just enters the field B. Sketch the following graphs for the time interval t = 0 to $t = \frac{3l}{v}$.

(ii) Induced emf versus times

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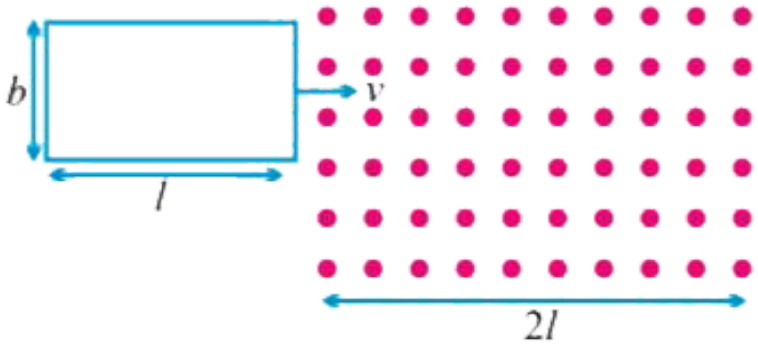
40. A rectangular conducting loop of length l and breadth b enters a uniform magnetic field B as shown below.



The loop is moving at constant speed v and at t = 0 it just enters the field B. Sketch the following graphs for the time interval t = 0 to $t = \frac{3l}{v}$.

(iii) Power versus time

Resistance of the loop is R.

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41. A charged 8mF capacitor having charge 5mC is connected to a 5mH inductor. What is :

(i) the frequency of current oscillations?

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42. A charged 8mF capacitor having charge 5mC is connected to a 5mH inductor. What is :

(ii) the frequency of electrical energy oscillations in the capacitor?

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43. A charged 8mF capacitor having charge 5mC is connected to a 5mH inductor. What is :

(iii) the maximum current in the inductor?

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44. A charged 8mF capacitor having charge 5mC is connected to a 5mH inductor. What is :

iv) the magnetic energy in the inductor at the instant when charge on capacitor is 4mC?

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45. A 31.4Ω resistor and 0.1H inductor are connected in series to a 200V, 50Hz ac source. Calculate

(i) the current in the circuit

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46. A 31.4Ω resistor and 0.1H inductor are connected in series to a 200V, 50Hz ac source. Calculate

(ii) the voltage (rms) across the inductor and the resistor.

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47. A 31.4Ω resistor and 0.1H inductor are connected in series to a 200V, 50Hz ac source. Calculate

(iii) is the algebraic sum of voltages across inductor and resistor more than the source voltage ? If yes, resolve the paradox.

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48. A squre loop of side a= 12 cm with its sides parallel to x, and y-axis is moved with velocity, V=8 cm/s in the positive x direction in a magnetic field along the positive z-direction. The field is neither uniform in space nor constant in time. It has a gradient $\partial B / \partial x = -10^{-3} T / cm$ along the x-direction, and it is changing in time at the rate $\partial B / \partial t = 7T / \sec$ in the loop if its resistance is R $= 4.5\Omega$. Find the current .

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

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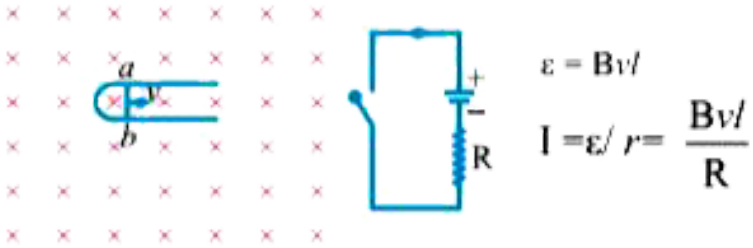
50. Figure shows a wire ab of length l which can slide on a U-shaped rail of negligible resistance. The resistance of the wire is R. The wire is pulled to the right with a constant speed v. Draw an equivalent circuit diagram representing the induced emf by a battery. Find the current in the wire.



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

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52. A coil of 0.01 henry inductance and 1 ohm resistance is connected to 200 volt, 50 Hz ac supply. Find the impedance of the circuit and time lag between max. alternating voltage and current.

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53. An electrical device draws 2 kW power form AC mains [voltage 223 V (rms) $= \sqrt{50,000}V$]. The current differs (lags) in phase by $\phi\left(\tan = \frac{-3}{4}\right)$ as compared to voltage. Find (i) R, (ii) $X_C - X_L$, and (iii) I_M. Another device has twice the values for R, X_C and X_L. How are the answers affected ?

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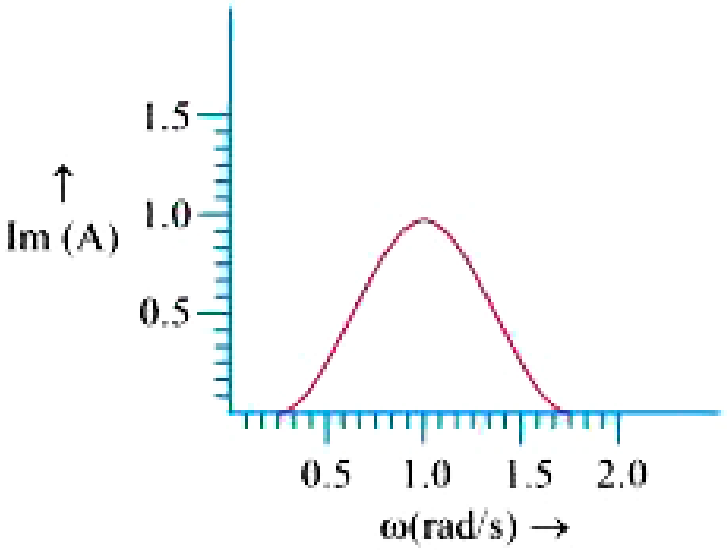
54. In a LCR circuit, the plot of $I_{\max}$ versus ω is shown in figure. Find the bandwith ?



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55. An inductor of unknown value, a capacitor of $100\mu F$ and a resistor of 10 ohm are conneted in series to a 200 V, 50 Hz a.c. source It is found that power factor of the circuit is unity. Calculate inductance of the inductor and current amplitude.

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56. A 100 turn coil of area $0.1m^2$ rotates at half a revolution per second. It is placed in a magnetic field of 0.01 T perpendicular to the axis of rotation of the coil. Calculate the maximum voltage generated in the coil.

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57. The magnetic flux linked with a large circular coil of radius R is 0.5×10^{-3} Wb, when current of 0.5A flows through a small neighbouring coil of radius r. Calculate

the coefficient of mutual inductance for the given pair of coils.

If the current through the small coil suddenly falls to zero, what would be the effect in the larger coil.

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