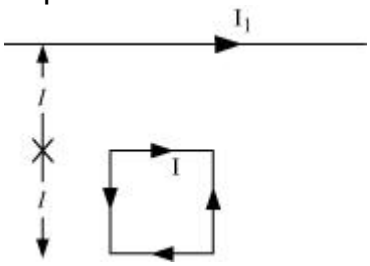
Moving Charges and Magnetism

Q.No.1:
Write the expression for the magnetic moment $(\vec{m})$ due to a planar square loop of side 'l' carrying a steady current I in a vector form.
In the given figure this loop is placed in a horizontal plane near a long straight conductor carrying a steady current I_1 at a distance *l* as shown. Give reason to explain that the loop will experience a net force but no torque. Write the expression for this force acting on the loop.



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Q.No.2:
A long straight wire of a circular cross-section of radius 'a' carries a steady current 'I'. The current is uniformly distributed across the cross-section. Apply Ampere's circuital law to calculate the magnetic field at a point 'r' in the region for (i) r < a and (ii) r > a.
OR
State the underlying principle of working of a moving coil galvanometer. Write two reasons why a galvanometer can not be used as such to measure current in a given circuit. Name any two factors on which the current sensitivity of a galvanometer depends.

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Q.No.3:
A steady current (I_1) flows through a long straight wire. Another wire carrying steady current (I_2) in the same direction is kept close and parallel to the first wire. Show with the help of a diagram how the magnetic field due to the current I_1 exerts a magnetic force on the second wire. Write the expression for this force.

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Q.No.4:
(a) State the principle of the working of a moving coil galvanometer, giving its labeled diagram.
(b) "Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity." Justify this statement.
(c) Outline the necessary steps to convert a galvanometer of resistance RG into an ammeter of a given range.

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Q.No.5:
(a) Derive the expression for the torque on a rectangular current carrying loop suspended in a uniform magnetic field.
(b) A proton and a deuteron having equal momenta enter in a region of a uniform magnetic field at right angle to the direction of a the field. Depict their trajectories in the field.
OR
(a) A small compass needle of magnetic moment 'm' is free to turn about an axis perpendicular to the direction of uniform magnetic field 'B'. The moment of inertia of the needle about the axis is 'I'. The needle is slightly disturbed from its stable position and then released. Prove that it executes simple harmonic motion. Hence deduce the expression for its time period.
(b) A compass needle, free to turn in a vertical plane orients itself with its axis vertical at a certain place on the earth. Find out the values of (*i*) horizontal component of earth's magnetic field and (*ii*) angle of dip at the place.

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Q.No.6:
An ammeter of resistance 0.6 Ω can measure current upto 1.0 A. Calculate (i) The shunt resistance required to enable the ammeter to measure current upto 5.0 A (ii) The combined resistance of the ammeter and the shunt.

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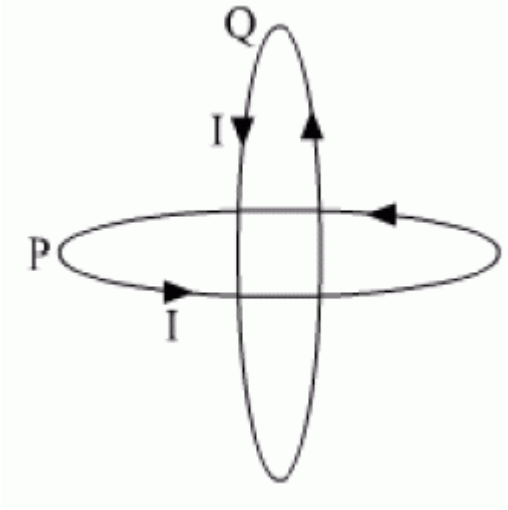
Q.No.7:
Two identical circular wires P and Q each of radius R and carrying current 'I' are kept in perpendicular planes such that they have a common centre as shown in

the figure. Find the magnitude and direction of the net magnetic field at the common centre of the two coils.



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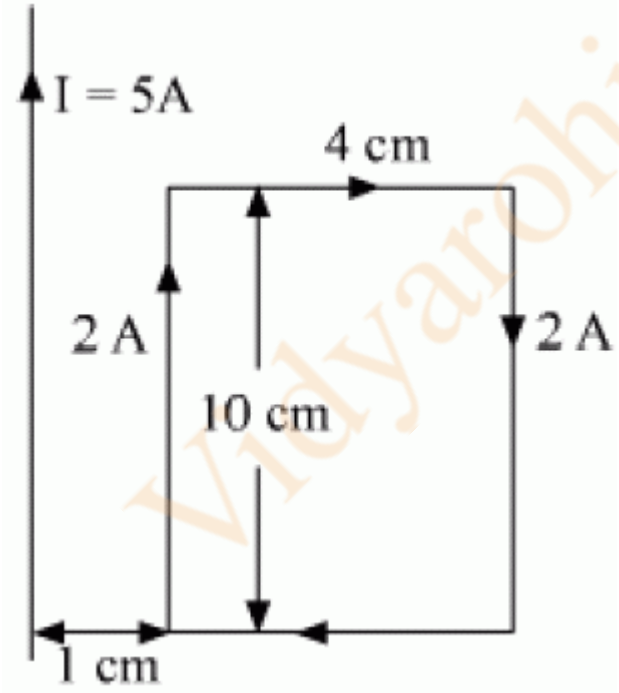
Q.No.8:
A rectangular loop of wire of size 4 cm × 10 cm carries a steady current of 2 A. A straight long wire carrying 5 A current is kept near the loop as shown. If the loop and the wire are coplanar, find



(i) the torque acting on the loop and
(ii) the magnitude and direction of the force on the loop due to the current carrying wire.

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Q.No.9: Write the expression, in a vector form, for the Lorentz magnetic force

$\vec{F}$ due to a charge moving with velocity $\vec{V}$ in a magnetic field $\vec{B}$. What is the direction of the magnetic force? **CBSE Board Paper 2014**

Q.No.10: (a) State Ampere's circuital law, expressing it in the integral form.
(b) Two long coaxial insulated solenoids, S_1 and S_2 of equal lengths are wound one over the other as shown in the figure. A steady current "I" flow thought the inner solenoid S_1 to the other end B, which is connected to the outer solenoid S_2 through which the same current "I" flows in the opposite direction so as to come out at end A. If n_1 and n_2 are the number of turns per unit length, find the magnitude and direction of the net magnetic field at a point (i) inside on the axis and (ii) outside the combined system.

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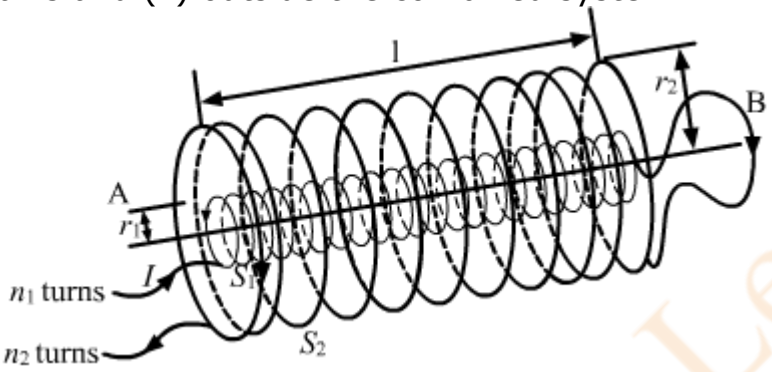

Q.No.11: State the principle of working of a galvanometer.
A galvanometer of resistance *G* is converted into a voltmeter to measure upto *V* volts by connecting a resistance R_1 in series with the coil. If a resistance R_2 is connected in series with it, then it can measures upto *V*/2 volts. Find the resistance, in terms of R_1 and R_2, required to be connected to convert it into a voltmeter that can read upto 2 V. Also find the resistance *G* of the galvanometer in terms of R_1 and R_2. **CBSE Board Paper 2015**

Q.No.12: Write the underlying principle of a moving coil galvanometer.
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