Previous Years

Examination Questions

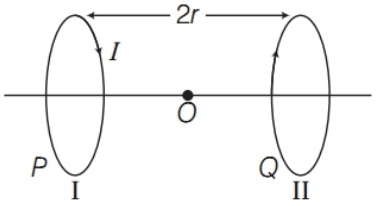
1 Mark Question

1. Draw the magnetic field lines due to current carrying loop. **Delhi 2013C**

2 Marks Questions

2. Derive with the help of diagram, the expression for the magnetic field inside a very long solenoid having n turns per unit length carrying a current I. **Delhi 2013C**

3. Two identical circular loops P and Q, each of radius r and carrying equal currents are kept in the parallel planes having a common axis passing through O. The direction of current in P is clockwise and in Q is anti-clockwise as seen from O which is equidistant from the loops P and Q. Find the magnitude of the net magnetic field at O. **Delhi 2012**



4. A long solenoid of length L having N turns carries a current I. Deduce the expression for the magnetic field in the interior of the solenoid. **All India 2011C**

5. A straight wire of length L is bent into a semi-circular loop. Use Biot-Savart's law to deduce an expression for the magnetic field at its centre due to the current I passing through it. **Delhi 2011C**

6. State Ampere's circuital law. Show through an example, how this law enables an easy evaluation of the magnetic field when there is a symmetry in the system? **All India 2010**

3 Marks Questions

7. (i) State Biot-Savart's law and express it in the vector form.

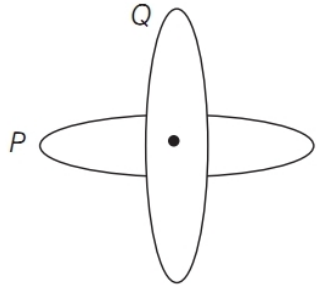
(ii) Using Biot-Savart's law, obtain the expression for the magnetic field due to a circular coil of radius r, carrying a current I at a point on its axis distant x from the centre of the coil. **CBSE 2018C**

8. (i) State Biot-Savart's law and express this law in the vector form.

(ii) Two identical circular coils, P and Q each of radius R, carrying currents 1 A and $\sqrt{3}$ A respectively, are placed concentrically and perpendicular to each other lying in the XY and YZ planes. Find the magnitude and direction of the net magnetic field at the centre of the coils. **All India 2017**

9. Two identical loops P and Q each of radius 5 cm are lying 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, if they carry currents equal to 3 A and 4 A, respectively. **Delhi 2017**



10. Use Biot-Savart's law to derive the expression for the magnetic field on the axis of a current carrying circular loop of radius R. **Delhi 2016**

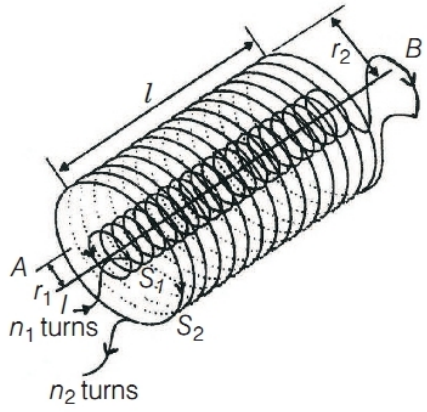
11. (i) State Ampere's circuital law expressing it in the integral form.

(ii) Two long co-axial insulated solenoids S_1 and S_2 of equal length are wound one over the other as shown in the figure. A steady current I flows through the inner solenoid S_1 to the other end B which is connected to the outer solenoid S_2 through which the some 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

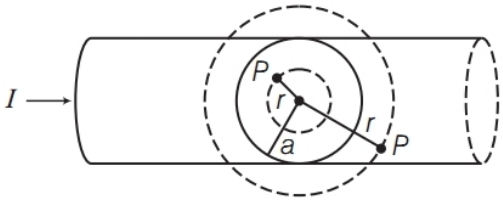
(a) inside on the axis and

(b) outside the combined system.

Delhi 2014



12. Figure shows a long straight wire of a circular cross-section of radius a carrying steady current I. The current I is uniformly distributed across this cross-section. Derive the expressions for the magnetic field in the region (i) $r < a$ and (ii) $r > a$. **All India 2011C**



13. 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 in the region for (i) $r < a$ and (ii) $r > a$. **Delhi 2010**

5 Marks Questions

14. (i) Write using Biot-Savart's law, the expression for the magnetic field $\mathbf{B}$ due to an element $d\mathbf{l}$ carrying current I at a distance $\mathbf{r}$ from it in a vector form.

Hence, derive the expression for the magnetic field due to a current carrying loop of radius R at a point P and distance x from its centre along the axis of the loop.

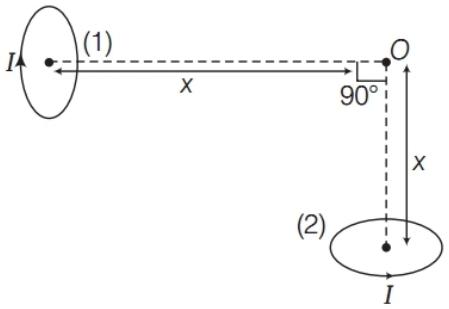
(ii) Explain how Biot-Savart's law enables one to express the Ampere's circuital law in the integral form, *viz.*

$$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 I$$

where, I is the total current passing through the surface. **Delhi 2015**

15. Two very small identical circular loop (1) and (2) carrying equal current I are placed vertically (with respect to the plane of the paper) with their geometrical axes perpendicular to each other as shown in the figure. Find the magnitude and

direction of the net magnetic field produced at the point O. **Delhi 2014**



16. State Biot-Savart's law expressing it in the vector form. Use it to obtain the expression for the magnetic field at an axial point distance d from the centre of a circular coil of radius a carrying current I. Also, find the ratio of the magnitudes of the magnetic field of this coil at the centre and at an axial point for which $d = a\sqrt{3}$.

Delhi 2013C

17. State Biot-Savart's law and give the mathematical expression for it.

Use this law to derive the expression for the magnetic field due to a circular coil carrying current at a point along its axis.

How does a circular loop carrying current behave as a magnet? **Delhi 2011**

18. (i) State Ampere's circuital law.

(ii) Use it to derive an expression for magnetic field inside along the axis of an air cored solenoid.

(iii) Sketch the magnetic field lines for a finite solenoid. How are these field lines different from the electric field lines from an electric dipole?

Foreign 2010

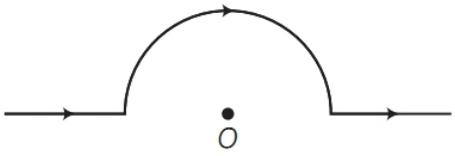
19. (i) Using Biot-Savart's law, deduce an expression for the magnetic field on the axis of a circular current carrying loop.

(ii) Draw the magnetic field lines due to a current carrying loop.

(iii) A straight wire carrying a current of 12 A is bent into a semi-circular arc of radius 2.0 cm as shown in the figure. What is the magnetic field **B** at O due to

(a) straight segments and

(b) the semi-circular arc?



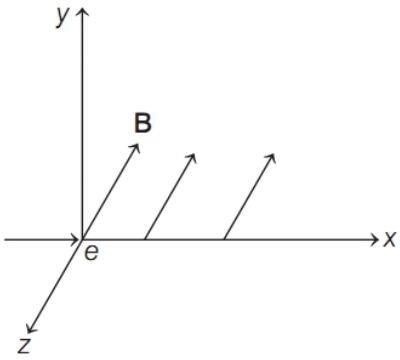
Foreign 2010

Previous Years

Examination Questions

1 Mark Questions

1. An electron moves along + x-direction. It enters into a region of uniform magnetic field **B** directed along – z direction as shown in figure. Draw the shape of trajectory followed by the electron after entering the field. **Delhi 2020**



2. Write the relation for the force acting on a charged particle q moving with velocity **v** in the presence of a magnetic field **B**.
All India 2019

3. When a charge q is moving in the presence of electric field (E) and magnetic field (B) which are perpendicular to each other and also perpendicular to the velocity v of the particle, write the relation expressing v in terms of E and B.
All India 2019

4. Two protons of equal kinetic energies enter a region of uniform magnetic field. The first proton enters normal to the field direction while the second enters at 30° to the field direction. Name the trajectories followed by them. **CBSE 2018C**

5. A proton and an electron travelling along parallel paths enter a region of uniform magnetic field, acting perpendicular to their paths. Which of them will move in a circular path with higher frequency?
CBSE 2018C

6. Write the expression in a vector form for the Lorentz magnetic force **F** due to a charge moving with velocity **v** in a magnetic field **B.** What is the direction of the magnetic force? **Delhi 2014**

7. A narrow beam of protons and deuterons, each having the same momentum, enters a region of uniform magnetic field directed perpendicular to their direction of momentum. What would be the ratio of the radii of the circular path described by them? **Foreign 2011**

8. Two particles A and B of masses m and $2m$ have charges q and $2q$ respectively. They are moving with velocities v_1 and v_2 respectively in the same direction, enters the same magnetic field B acting normally to their direction of motion. If the two forces F_A and F_B acting on them are in the ratio of 1 : 2, find the ratio of their velocities.

Delhi 2011C

9. A beam of α-particles projected along + X-axis, experiences a force due to a magnetic field along the + Y-axis. What is the direction of the magnetic field?

All India 2010

10. Use the expression $\mathbf{F} = q\,(\mathbf{v} \times \mathbf{B})$ to define the SI unit of magnetic field. **All India 2010C**

2 Marks Questions

11. A proton is accelerated through a potential difference V, subjected to a uniform magnetic field acting normal to the velocity of the proton. If the potential difference is doubled, how will the radius of the circular path described by the proton in the magnetic field change ? **All India 2019**

12. A charged particle q is moving in the presence of a magnetic field B which is inclined to an angle 30° with the direction of the motion of the particle. Draw the trajectory followed by the particle in the presence of the field and explain how the particle describes this path. **Delhi 2019**

13. Find the condition under which the charged particles moving with different speeds in the presence of electric and magnetic field vectors can be used to select charged particles of a particular speed.

All India 2017

14. Define one tesla using the expression for the magnetic force acting on a particle of charge q moving with velocity v in a magnetic field **B**. **Foreign 2014**

15. A particle of charge q and mass m is moving with velocity **v**. It is subjected to a uniform magnetic field **B** directed perpendicular to its velocity. Show that it describes a circular path. Write the expression for its radius. **Foreign 2012**

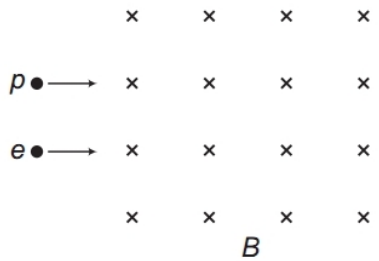
16. Write the expression for Lorentz magnetic force on a particle of charge q moving with velocity **v** in a magnetic field **B**. Show that no work is done by this force on the charged particle.

All India 2011

17. An electron and a proton moving with the same speed enter the same magnetic field region at right angles to the direction of the field.

Show the trajectory followed by the two particles in the magnetic field. Find the ratio of the radii of the circular paths which the particles may describe.

Foreign 2010



18. A deuteron and a proton moving with the same speed enter the same magnetic field region at right angles to the direction of the field. Show the trajectories followed by the two particles in the magnetic field. Find the ratio of the radii of the circular paths which the two particles may describe. **Foreign 2010**

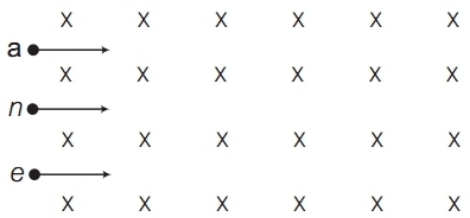
3 Marks Questions

19. (i) Write the expression for the force **F** acting on a particle of mass m and charge q moving with velocity **v** in a magnetic field **B**. Under what conditions, will it move in
(a) a circular path and
(b) a helical path?

(ii) Show that the kinetic energy of the particle moving in magnetic field remains constant. **Delhi 2017**

20. (i) Write the expression for the magnetic force acting on a charged particle moving with velocity **v** in the presence of magnetic field **B**.

(ii) A neutron, an electron and an alpha particle moving with equal velocities, enter a uniform magnetic field going into the plane of the paper as shown in the figure. Trace their paths in the field and justify your answer. **Delhi 2016**



21. A uniform magnetic field **B** is set up along the positive X-axis. A particle of charge q and mass m moving with a velocity v enters the field at the origin in XY-plane such that it has velocity components both along parallel and perpendicular to the magnetic field **B.** Trace, giving reason, the trajectory followed by the particle. Find out the expression for the distance moved by the particle along the magnetic field in one rotation. **All India 2011**

5 Marks Question

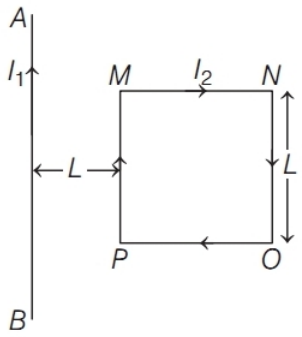
22. Write the expression for the force **F**, acting on a charged particle of charge q moving with a velocity **v** in the presence of both electric field **E** and magnetic field **B**. Obtain the condition under which the particle moves undeflected through the fields. **All India 2012C**

Previous Years

Examination Questions

1 Mark Questions

1. A square shaped current carrying loop *MNOP* is placed near a straight long current carrying wire *AB* as shown in the figure. The wire and the loop lie in the same plane. If the loop experiences a net force *F* towards the wire, find the magnitude of the force on the side *NO* of the loop. **Delhi 2020**



2. Define the term current sensitivity of a moving coil galvanometer. **Delhi 2020**

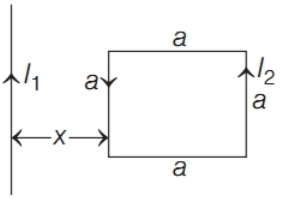
3. Write the underlying principle of a moving coil galvanometer. **CBSE Delhi 2016**

4. Using the concept of force between two infinitely long parallel current carrying conductors define one ampere of current. **All India 2014**

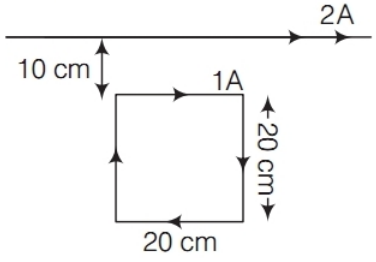
5. Is the steady electric current the only source of magnetic field? Justify your answer. **Delhi 2013C**

2 Marks Questions

6. A square loop of side a carrying a current I_2 is kept at distance x from an infinitely long straight wire carying a current I_1 as shown in the figure. Obtain the expression for the resultant force acting on the loop. **Delhi 2019**



7. A square loop of side 20 cm carrying current of 1 A kept near an infinite long straight wire carrying a current of 2 A in the same plane as shown in the figure.



Calculate the magnitude and direction of the net force exerted on the loop due to the current carrying conductor.
All India 2015C

8. A rectangular coil of sides l and b carrying a current I is subjected to a uniform magnetic field **B** acting perpendicular to its plane. Obtain the expression for the torque acting on it. **Delhi 2014C**

9. (i) Two long straight parallel conductors a and b carrying steady currents I_a and I_b respectively are separated by a distance d. Write the magnitude and direction, what is the nature and magnitude of the force between the two conductors?
(ii) Show with the help of a diagram, how the force between the two conductors would change when the currents in them flow in the opposite directions. **Foreign 2014**

10. A coil of N turns and radius R carries a current I. It is unwound and rewound to make a square coil of side a having same number of turns N. Keeping the current I same, find the ratio of the magnetic moments of the square coil and the circular coil. **Delhi 2013C**

11. A circular coil of closely wound N turns and radius r carries a current I. Write the expressions for the following:
(i) The magnetic field at its centre.
(ii) The magnetic moment of this coil.
All India 2012

12. A circular 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 I remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil. **All India 2012**

13. A circular coil of N turns and diameter d carries a current I. It is unwound and rewound to make another coil of diameter $2d$, current I remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil. **All India 2012**

14. 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 exert a magnetic force on the second wire. Deduce the expression for this force.
All India 2011

15. How is a moving coil galvanometer converted into a voltmeter? Explain giving the necessary circuit diagram and the required mathematical relation used.
All India 2011C

16. A square coil of side 10 cm has 20 turns and carries a current of 12 A. The coil is suspended vertically and normal to the plane of the coil, makes an angle θ with the direction of a uniform horizontal magnetic field of 0.8 T. If the torque, experienced by the coil equals 0.96 N-m, find the value of θ. **Delhi 2010C**

3 Marks Questions

17. Derive the expression for the force acting between two long parallel current carrying conductors. Hence, define 1 A current. **All India 2020**

18. Two infinitely long straight wires A_1 and A_2 carrying currents I and $2I$ flowing in the same directions are kept d distance apart. Where should a third straight wire A_3 carrying current $1.5\ I$ be placed between A_1 and A_2, so that it experiences no net force due to A_1 and A_2? Does the net force acting on A_3 depend on the current flowing through it? **Delhi 2019**

19. (i) Derive the expression for the torque acting on a current carrying loop placed in a magnetic field.
(ii) Explain the significance of a radial magnetic field when a current carrying coil is kept in it. **Delhi 2019**

20. (i) State the underlying principle of a moving coil galvanometer.

(ii) Give two reasons to explain why a galvanometer cannot as such be used to measure the value of the current in a given circuit.

(iii) Define the terms (i) voltage sensitivity and (ii) current sensitivity of a galvanometer. **Delhi 2019**

21. (i) Define SI unit of current in terms of the force between two parallel current carrying conductors.

(ii) Two long straight parallel conductors carrying steady currents I_a and I_b along the same directions are separated by a distance d. How does one explain the force of attraction between them? If a third conductor carrying a current I_c in the opposite direction is placed just in the middle of these conductors, find the resultant force acting on the third conductor. **CBSE 2018C**

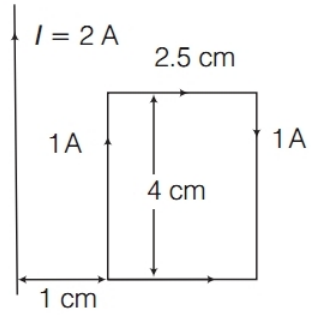
22. Two long straight parallel conductors carry steady current I_1 and I_2 separated by a distance d. If the currents are flowing in the same direction, show how the magnetic field set up in one produces an attractive force on the other. Obtain the expression for this force. Hence, define one ampere. **Delhi 2016**

23. 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 measure 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 2V. Also, find the resistance G of the galvanometer in terms of R_1 and R_2. **All India 2015**

24. A wire AB is carrying a steady current of 12A and is lying on the table. Another wire CD carrying 5A is held directly above AB at a height of 1 mm. Find the mass per unit length of the wire CD, so that it remains suspended at its position when left free. Give the direction of the current flowing in CD with respect to that in AB. [Take, the value of $g = 10\ \text{ms}^{-2}$] **All India 2013**

25. A rectangular loop of wire of size 2.5 cm × 4 cm carries steady current of 1 A. A straight wire carrying 2 A current is kept near the loop as shown. If the loop and the wire are coplanar, find the (i) torque acting on the loop and (ii) the magnitude and direction of the force on the loop due to the current carrying wire.

Delhi 2012



26. Draw a labelled diagram of a moving coil galvanometer and explain its working. What is the function of radial magnetic field inside the coil? **Foreign 2012**

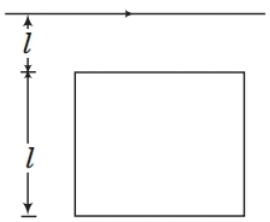
27. Depict the magnetic field lines due to two straight, long, parallel conductors carrying currents I_1 and I_2 in the same direction. Hence, deduce an expression for the force per unit length acting on one of the conductors due to the other. Is this force attractive or repulsive? **Delhi 2011C**

28. State the underlying principle of working of a moving coil galvanometer. Write two reasons why a galvanometer cannot be used as such to measure the current in a given circuit. Name any two factors on which the current sensitivity of a galvanometer depends. **Delhi 2010**

29. A moving coil galvanometer of resistance G gives its full scale deflection when a current I_g flows through its coil. It can be converted into a ammeter of range (0 to I) ($I > I_g$)

when a shunt of resistance S is connected, find the expression for the shunt required in terms of I_g and G. **Delhi 2010C**

30. Write the expression for the magnetic moment (**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 reasons to explain that the loop will experience a net force but no torque. Write the expression for this force acting on the loop. **Delhi 2010**

5 Marks Questions

31. Explain, using a labelled diagram, the principle and working of a moving coil galvanometer. What is the function of (i) uniform radial magnetic field (ii) soft iron core? Define the terms (i) current sensitivity and (ii) voltage sensitivity of a galvanometer.

Why does increasing the current sensitivity not necessarily increase voltage sensitivity? **Delhi 2015, Foreign 2016**

32. (i) Draw a labelled diagram of a moving coil galvanometer. Describe briefly its principle and working.

(ii) Answers the following questions.

(a) Why is it necessary to introduce a cylindrical soft iron core inside the coil of a galvanometer?

(b) Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity. Explain with giving reasons. **All India 2014**

33. (i) State using a suitable diagram, the working principle of a moving coil galvanometer. What is the function of a radial magnetic field and the soft iron core used in it?

(ii) For converting a galvanometer into an ammeter, a shunt resistance of small value is used in parallel, whereas in the case of a voltmeter a resistance of large value is used in series. Explain, why? **Delhi 2014C**

34. (i) Explain giving reasons, the basic difference in converting a galvanometer into (a) a voltmeter and (b) an ammeter.

(ii) Two long straight parallel conductors carrying steady currents I_1 and I_2 are separated by a distance d.

Explain briefly with the help of a suitable diagram, how the magnetic field due to one conductor acts on the other? Hence, deduce the expression for the force acting between the two conductors. Mention the nature of this force. **All India 2012**

35. A rectangular loop of size $l \times b$ carrying a steady current I is placed in a uniform magnetic field **B**. Prove that the torque τ acting on the loop is given by $\tau = \mathbf{M} \times \mathbf{B}$, where **M** is the magnetic moment of the loop. **All India 2012**

36. (i) Show that a planer loop carrying a current I, having N closely wound turns and area of cross-section A, possesses a magnetic moment $\mathbf{M} = NI\mathbf{A}$.

(ii) When this loop is placed in a magnetic field **B**, find out the expression for the torque acting on it.

(iii) A galvanometer coil of 50 Ω resistance shows full scale deflection for a current of 5 mA. How will you convert this galvanometer into a voltmeter of range 0 to 15 V? **Foreign 2011**

37. (i) With the help of a diagram, explain the principle and working of a moving coil galvanometer.

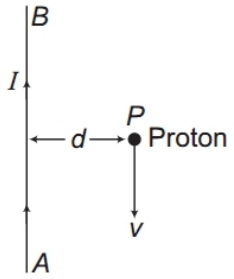
(ii) What is the importance of radial magnetic field and how is it produced?

(iii) Why is it that while using a moving coil galvanometer as a voltmeter, a high resistance in series is required whereas in an ammeter a shunt is used? **All India 2010**

38. (i) Derive an expression for the force between two long parallel current carrying conductors.

(ii) Use this expression to define SI unit of current.

(iii) A long straight wire AB carries a current I. A proton P travels with a speed v, parallel to the wire at a distance d from it in a direction opposite to the current as shown in the figure. What is the force experienced by the proton and what is its direction? **All India 2010**



39. (i) Two straight long parallel conductors carry currents I_1 and I_2 in the same direction.

Deduce the expression for the force per unit length between them. Depict the pattern of magnetic field lines around them.

(ii) A rectangular current carrying loop $EFGH$ is kept in a uniform magnetic field as shown in the figure.

(a) What is the direction of the magnetic moment of the current loop?

(b) When is the torque acting on the loop maximum and zero?

Foreign 2010