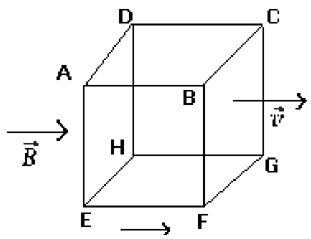
THE GURUKUL INSTITUTE

PLOT 5C, 2ND FLOOR, GANAPATI COMPLEX, SEC-13, OPP. JAIPURIA
SCHOOL, VASUNDHARA, GHAZIABAD (U.P)

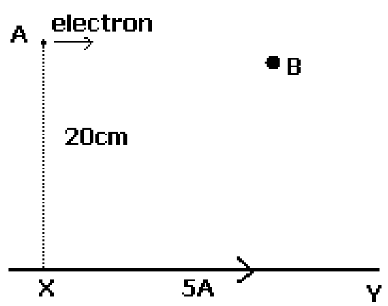
MAGNETIC EFFECTS OF CURRENT

1. Write two properties of a material used as a suspension wire in a moving coil galvanometer.
2. An electron beam projected along +X-axis experiences a force due to a magnetic field along Y-axis. What is the direction of the magnetic field?
3. Name the physical quantity whose S.I unit is Weber. Is it a scalar or a vector quantity?
4. The force $\vec{F}$ experienced by a particle of charge q moving with velocity $\vec{v}$ in a magnetic field $\vec{B}$ is given by $\vec{F} = q(\vec{v} \times \vec{B})$. Of these, name the pairs of vectors which are always at right angles to each other.
5. Two wires are bent in the form of two loops. One of the loops is square shaped whereas the other loop is circular. These are suspended in a uniform magnetic field and the same current is passed through them. Which loop will experience greater torque? Give reasons.
6. Which one of the following will experience maximum force, when projected with the same velocity 'v' perpendicular to the magnetic field 'B' : (i) α-particle, (ii) β-particle ?
7. Which one of the following will the minimum frequency of revolution when projected with the same velocity 'v' perpendicular to the magnetic field 'B' : (i) α-particle, (ii) β-particle ?
8. State the principle of working of a cyclotron. Write two uses of this machine.
9. Derive an expression for the maximum force experienced by a straight conductor of length l, carrying I and kept in a uniform magnetic field, B.
10. How do you convert a galvanometer into an ammeter? Why is an ammeter always connected in series?
11. How does the magnetic field of an electron in a circular orbit of radius 'r' and moving with a speed 'v' change, when the frequency of revolution is doubled?
12. You are given a low resistance R_1, a high resistance R_2 and a moving coil galvanometer. Suggest how you would use these to have an instrument that will be able to measure (i) current, (ii) potential differences.
13. A straight wire, of length L, carrying a current I, stays suspended horizontally in mid air in a region where there is a uniform magnetic field $\vec{B}$. The linear mass density of the wire is λ. Obtain the magnitude and direction of this magnetic field.
14. Define the S.I unit of magnetic field. " A charge moving at right angle to a uniform magnetic field does not undergo change in kinetic energy." Why?
15. A stream of electrons travelling with speed 'v' m/s at right angles to a uniform magnetic field 'B', is deflected in a circular path of radius 'r'. Prove that $\frac{e}{m} = \frac{v}{rB}$.
16. Twelve wires of equal lengths are connected in the form of a skeleton-cube which is moving with a velocity $\vec{v}$ in the direction of a magnetic field $\vec{B}$ find the e.m.f in each arm of the cube.

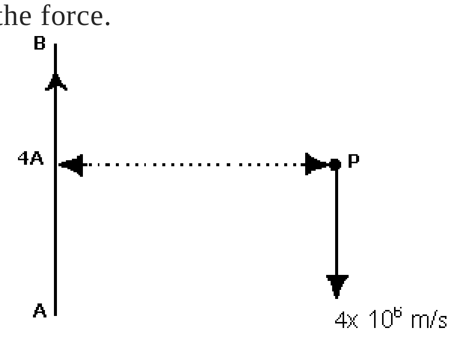


17. A current loop is considered a magnetic dipole. Explain.
18. An electron of kinetic energy 25KeV moves perpendicular to the direction of a uniform magnetic field of 0.2 millitesla. Calculate the time period of rotation of the electron in the magnetic field.

19. A galvanometer coil has a resistance of 15 ohm and shows full scale deflection for a current of 4mA. Calculate the value of resistance required to convert it into an ammeter of range 0 to 6A. How will you connect the resistance to the galvanometer?
20. What is a cyclotron? Show that the cyclotron frequency of a charged particle, moving in a perpendicular uniform magnetic field, is independent of the speed of the particle.
21. Using Biot-Savart law, deduce an expression for the magnetic field on the axis of a circular current loop. Draw the magnetic field lines due to a circular current carrying loop.
22. A hydrogen ion of mass 'm' and charge 'q' travels with a speed 'v' in a circle of radius 'r' in a magnetic field intensity 'B'. Write the equation in terms of these quantities only, relating to force on the ion to the required centripetal force. Hence derive an expression for its time period.
23. A straight wire, of length $\frac{\pi}{2}$ meter, is bent into a circular shape. If the wire were to carry a current of 5A, calculate the magnetic field , due to it, before bending, at a point distant 0.01 times the radius of the magnetic field, at the center of the circular loop formed, for the same value of current.
24. Two straight, parallel, current carrying conductors are kept at a distance 'r' from each other, in air. The direction of current in both the conductors is the same. Find the magnitude and direction of the force between them. Hence define one ampere.
25. A hydrogen ion of mass 'm' and charge 'q' travels with a speed 'v' along a circle of radius 'r' in a uniform magnetic field of flux density 'B'. Obtain the expression for the magnetic force on the ion and determine its time period.
26. An infinitely long straight conductor 'XY' is carrying a current of 5A. an electron is moving with a speed of 10^5 m/s parallel to the conductor in air from point A to B, as shown in figure. The perpendicular distance between the electron and the conductor 'XY' is 20 cm. Calculate the magnitude of the force experienced by the electron. Write the direction of this force.



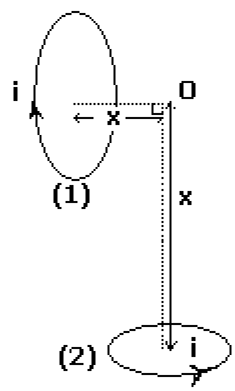
27. A long straight wire AB carries a current of 4A. A proton P travels at 4x 10^6 m/s, parallel to the wire, 0.2 m from it and in a direction opposite to the current as shown in the figure. Calculate the force which the magnitude field of current exerts on the proton. Also specify the direction of the force.



28. A voltmeter reads 5.0 V at full scale deflection ad is graded according to its resistance per volt at full scale deflection as 2000 Ω/V. how will you convert it into a voltmeter that reads 15 V at full scale deflection?
29. How can a moving coil galvanometer be converted into an ammeter? To increase the current sensitivity of a moving coil galvanometer by 50%, its resistance is increased so that the new resistance becomes twice its initial resistance. By what factor does its voltage sensitivity change?

30. A proton and an alpha particle of the same velocity enter in turn a region of uniform magnetic field moving in a plane perpendicular to the magnetic field in a plane perpendicular to the magnetic field. Deduce the ratio of the particles. Explain why the kinetic energy of the particle after emerging from the magnetic field remains unaltered.
31. What is meant by radial magnetic field? A moving coil galvanometer consisting of a rectangular coil of N turns, each of area A is suspended in a radial magnetic field of flux density B. with the help of labeled diagram when a current I passes through it.
32. With the help of a neat and labeled diagram, explain the underlying principle and working of a moving coil galvanometer. What is the function of : (i) uniform radial field (ii) soft iron core, in such a device?
33. Derive a mathematical expression for the force per unit length experienced by each of the two long current carrying conductors placed parallel to each other in air. Hence define one ampere. Explain why two parallel straight conductors carrying current in the opposite direction kept near each other in air repel?
34. a. State Biot-Savart's law. Using this law derive the expression for the magnetic field due to a current carrying circular loop of radius 'R', at a point which is at a distance 'x' from its centre along the axis of the loop.

    b. Two small identical circular loops, marked (1) and (2), carrying equal currents, are placed with the geo-metrical axes perpendicular to each other as shown in fig. find the magnitude and direction of the net magnitude field produced at the point O.



MAGNETISM

1. Why does a paramagnetic substance display greater magnetization for the same magnetizing field when cooled? How does a diamagnetic substance respond to similar temperature changes?
2. Define the terms 'Magnetic Dip' and "magnetic Declination' with the help of relevant diagrams.
3. Explain with the help the terms (i) magnetic declination (ii) angle of dip at a given place.
4. A magnetic compass needle of magnetic moment $60 Am^2$ is placed at a place. The needle points towards the geographical north. Using the data given below, find the value of declination at that place. Horizontal component of earth's magnetic field = 40×10^{-6} Wb m^{-2} and torque experienced by the needle = 1.2×10^{-3} Nm.
5. Define 'intensity of magnetization' of a magnetic material. How does it vary with temperature for a paramagnetic material?
6. A bar magnet of magnetic moment M is aligned parallel to the direction of a uniform magnetic field B. What is the wok done, to turn the magnets, so as to align its magnetic moment: i) opposite to the field direction ii) normal to the field direction?
7. A magnetized needle of magnetic moment 4.8×10^{-2} JT^{-1} is placed at 30° with the direction of uniform magnetic field. The torque acting on the needle is 7.2×10^{-4} J. Calculate the magnitude of magnetic field.
8. A magnet makes angular oscillations in a horizontal plane with time period T_1 and T_2 at two places, where the horizontal components of earth's magnetic field are B_H and B'_H respectively. Deduce an expression to compare the horizontal components at the two places.

9. A magnetized needle suspended freely in a uniform magnetic field experiences a torque but no net force. An iron nail near a bar magnet however experiences a force of attraction in addition to torque. Why?
10. You are given two identical looking bars A and B. One of these is a bar magnet and the other an ordinary piece of iron. Give an experiment to identify which one of the two is a bar magnet. You are not to use any additional materials for the experiment.
11. A short bar magnet placed with its axis inclined at 30° to the external magnetic field experiences a torque of 0.016 Nm. Calculate (i) the magnetic moment of the magnet, (ii) the work done by an external force in moving it from most stable to most unstable position, (iii) what is the work done by the force due to external magnetic field in the process mentioned in (ii)?
12. How will a dia, para- and ferro magnetic materials behave when kept in a non- uniform external magnetic field? Give one example of each of these materials.
13. Bars A, B and C made from three different types of materials field. While bars B and C tend to move from the weak to the strong field region, bar A tends to move from the strong to weak field region. The effect, observed in bar C is much stronger than that observed in bar B. Identify to which the three bars belong.

    Show, with the help of diagrams, the behavior of field of lines due to external magnetic field near bars A, B and C.
14. Explain briefly the elements required to specify the earth's magnetic field at a given place. How does the value of angle of dip vary from the earth's equator to the North Pole?
15. A short bar magnet of magnetic moment $0.9JT^{-1}$ is placed with its axis at 45° to a uniform magnetic field. If it experiences a torque of 0.063 joule,
    a. Calculate the magnitude of the magnetic field and
    b. What orientation of the bar magnet corresponds to the stable equilibrium in the magnetic field?

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