CBSE Test Paper-04
Class - 12 Physics (Moving Charges and Magnetism)

1. Direction of magnetic force on a positive charge moving in a magnetic field is given by
   a. thumb rule
   b. two hand rule
   c. left hand rule
   d. right hand rule
2. The magnitude of the magnetic field due to a circular coil of radius R carrying a current I at an axial distance x from the centre is
   a. $B = \frac{\mu_0 I R^3}{2(x^2 + R^2)^{\frac{3}{2}}}$
   b. $B = \frac{\mu_0 I R^2}{2(x^2 + R^2)^{\frac{3}{5}}}$
   c. $B = \frac{\mu_0 I R^2}{3(x^2 + R^2)^{\frac{3}{2}}}$
   d. $B = \frac{\mu_0 I R^2}{2(x^2 + R^2)^{\frac{3}{2}}}$
3. A voltmeter has a range O-V with a series resistance of R ohm. With a series resistance of 2R, its range is 0 - V' then
   a. V = 2V
   b. $\mathrm{V} \geq 2\mathrm{V}$
   c. V > 2V
   d. V' < 2V
4. protons move parallel to each other with equal speeds 3×10^5 ms^{-1}. The ratio of magnetic and electric force between them is
   a. 10^{-6}
   b. 1
   c. 10^{-3}
   d. 10^{-9}
5. A rectangular current-carrying coil having n turns, area A and a current I flowing, in a uniform magnetic field B experiences a maximum, torque equal to
   a. nIAB

b. IAB
c. nIB
d. nIA

6. Magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid. Why?
7. An electron moving through a magnetic field does not experience any force. Under what condition is this possible?
8. Define magnetic flux. Give its SI units.
9. Define the terms (i) Capacitance of capacitor (ii) Dielectric strength of a dielectric.
10. A circular coil of wire consisting of 100 turns, each of radius 8.0 cm carries a current of 0.40 A. What is the magnitude of the magnetic field B at the centre of the coil?
11. A charge q is moving in a region where both the magnetic field $\overrightarrow{B}$ and electric field $\overrightarrow{E}$ are simultaneously present. What is the Lorentz force acting on the charge?
12. A coil in the shape of an equilateral triangle of side 0.02 m is suspended from a vertex such that it is ranging in a vertical in plane magnetic field of $5 \times 10^{-2}T$. Find the couple acting on the coil when a current of 0.1 ampere is passed through it and the magnetic field is parallel to its plane.
13. A uniform magnetic field of 3000 G is established along the positive zdirection. A rectangular loop of sides 10 cm and 5 cm carries a current 12 A. What is the torque on the loop in the different cases shown in the figure below. What is the force on each case? Which case corresponds to stable equilibrium?
14. An electron of 45 eV energy is revolving in a circular path in a magnetic field of intensity $9 \times 10^{-5} Wb\ m^{-2}$.
Determine (i) the speed of the electron (ii) radius of the circular path.
15. A circular coil of 20 turns and radius 10 cm is placed in a uniform magnetic field of 0.10 T normal to the plane of the coil. If the current in the coil is 5.0 A, what is the
    a. total torque on the coil,
    b. total force on the coil,
    c. average force on each electron in the coil due to the magnetic field?

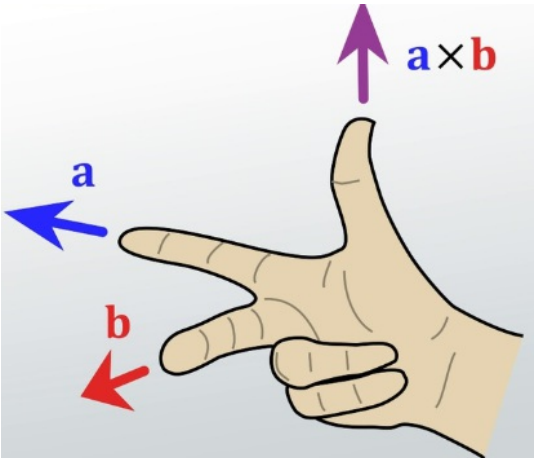
CBSE Test Paper-04

Class - 12 Physics (Moving Charges and Magnetism)

Answers

1. d. right hand rule

   Explanation: The force experienced by a charged particle in a magnetic field is given by $\vec{F}$ = q$\left(\vec{v} \times \vec{B}\right)$.The right hand rule for vector product can be used to determine the direction of $\vec{F}$

2. d. $B = \frac{\mu_0 I R^2}{2(x^2+R^2)^{\frac{3}{2}}}$

   Explanation: magnetic field at a point located at a distance x from the center of the coil of radius R carrying current along its axis is $B = \frac{\mu_0 I R^2}{2(x^2+R^2)^{\frac{3}{2}}}$

3. d. V' < 2V

   Explanation: In the first case, V = I_g(G + R) where, G is the resistance of the galvanometer, Ig is the current for full scale deflection and R is the series resistance. In the second case, V' = I_g(G + 2R) Therefore, V' < 2V.

4. a. 10^{-6}

   Explanation: The ratio of the forces is equal to

   $\frac{F_m}{F_e} = \frac{\mu_0}{4\pi} \times \frac{V^2}{1/4\pi\varepsilon_0}$

   = $\frac{10^{-7}}{9\times10^9} \times 9 \times 10^{10} = 10^{-6}$

5. a. nIAB

   Explanation: The torque experienced by a current carrying conductor placed in a magnetic field is given by $\tau = NBIA\sin\theta$.

This has a maximum value when $\sin\theta = 1; \sin\theta = 1$

6. Because the magnetic field induction outside the toroid is zero.

7. As $F = qvB\sin\theta$

   So either electron is moving parallel to the direction of the magnetic field or it is at rest.

8. The total number of magnetic lines of force crossing the surface A in a magnetic field $\overrightarrow{B}$ is termed as magnetic flux.

   $\phi = BA\cos\theta$

   Its SI unit is Weber. It is a scalar quantity.

9. i. The amount of charge required to raise the potential of a capacity by unity is termed as the capacitance of a capacitor.

   ii. The maximum electric field that a dielectric medium can with stand without breaking down of its insulating property is called the dielectric strength of a dielectric.

10. Given, I = 0.40 A, r = 8.0 cm $= 8 \times 10^{-2}m$

    n = 100

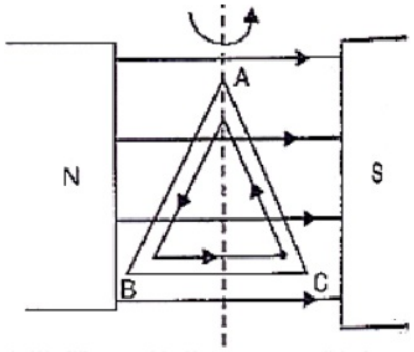
    $B = \frac{\mu_0 nI}{2r} = \frac{4\pi\times10^{-7}\times100\times0.4}{2\times8.0\times10^{-2}}T$

    $= 3.1 \times 10^{-4}T$

11. Lorentz force, $\vec{F} = q\vec{E} + q(\vec{v} \times \vec{B})$

    or $\overrightarrow{F} = q(\overrightarrow{E} + \overrightarrow{v} \times \overrightarrow{B})$

12. As the coil is in the form of an equilateral triangle, its area



$A = \frac{\sqrt{3}}{4} \times 0.02 \times 0.02$
$A = \sqrt{3} \times 10^{-4} m$
$= \sqrt{3} \times 10^{-4} m^2$

Torque on current carrying coil in magnetic field is

$\tau = BINA \sin\alpha$

$\alpha = 90^\circ$

N = 1

$\tau = BIA$
$= 5 \times 10^{-2} \times 0.1 \times \sqrt{3} \times 10^{-4} N - m$
$= 0.5 \times \sqrt{3} \times 10^{-6}$
$= 5\sqrt{3} \times 10^{-7}$

13. a. Torque on the loop,

    $\tau = BIA\ \cos\theta$

    Where θ is the angle between the plane of loop and direction of magnetic field.

    Here, $\theta = 0^\circ$ B = 3000 gauss

    $= 3000 \times 10^{-4} T$

    = 0.3 T

    I = 12 A, A $= 10 \times 10^5 cm^2 = 50 \times 10^{-4} m^2$

    $\tau = 0.3 \times 12 \times 50 \times 10^{-4} = 1.8 \times 10^{-2} Nm$

    The direction of torque or force on arm 5 cm, lower arm +x axis upper arm $-x$ axis by Fleming's left hand rule.

    b. Similar to (a) but torque act on side of 10 cm.

    c. $\tau = 1.8 \times 10^{-2} Nm$ along -x direction of torque on lower arm of 5 cm towards -y axis.

    d. This case is similar to (c). Direction of torque is 60°.

    e. Zero (∵ angle between plane of loop and direction of magnetic field is 90°)

    f. zero.

    Force is zero in each case. Stable equilibrium is corresponded by case (e).

14. $\frac{1}{2} mv^2 = 45 \times 1.6 \times 10^{-19}$

    $v = \sqrt{\frac{2 \times 45 \times 1.6 \times 10^{-19}}{9.1 \times 10^{-31}}} ms^{-1} = 3.98 \times 10^6 ms^{-1}$

    Now, $Bev = \frac{mv^2}{r}$ or $r = \frac{mv}{Be}$

$r = \frac{9.1 \times 10^{-31} \times 3.98 \times 10^{6}}{9 \times 10^{-5} \times 1.6 \times 10^{-19}} m$

15. Given, N = 20, r = 10 cm, $= 10 \times 10^{-2} m$

    B = 0.10 T, I = 5.0 A

    $\theta = 0^\circ$ (angle between field and normal to the coil)

    Area of the coil, $A = \pi r^2 = \pi \times (10 \times 10^{-2})^2 = \pi \times 10^{-2} m^2$

    a. Torque $\tau = NIBA\ \sin\theta$

       $= 20 \times 5.0 \times 0.10 \times \pi \times 10^{-2} \sin 0^\circ$

       $= 20 \times 5.0 \times 0.10 \times \pi \times 10^{-2} \times 0 = 0$

    b. Net force on a planer current loop in a magnetic field is always zero, as net force due to couple of force is zero.

    c. If v_d is the drift velocity of electron

       $F = qv \times B$

       $= ev_d \cdot B \sin 90^\circ$

       Force on one electron $= Bev_d = Be \frac{I}{neA} = \frac{BI}{nA}$

       Here, n = $10^{29} m^{-3}$, A = $10^{-5} m^2$

       Force on one electron $= \frac{0.10 \times 5.0}{10^{29} \times 10^{-5}} = 5 \times 10^{-25} N$