Ch—04 Moving Charges and Magnetism

Daily Practice Problem 04

Q1. A charged particle of mass 5 mg and charge q = +2 μC has velocity $\vec{v} = 2\hat{\imath} - 3\hat{\jmath} + 4\hat{k}$. Find out the magnetic force on the charged particle and its acceleration at this instant due to magnetic field $\vec{B} = 3\hat{\jmath} - 2\hat{k}$. $\vec{v}$ and $\vec{B}$ are in m s^{-1} and Wb m^{-2}, respectively.

Q2. A charged particle has acceleration $\vec{a} = 2\hat{\imath} + x\hat{\jmath}$ in a magnetic field $\vec{B} = -3\hat{\imath} + 2\hat{\jmath} - 4\hat{k}$, Find the values of x.

Q3. When a proton has a velocity $\vec{v} = (2\hat{\imath} + 3\hat{\jmath}) \times 10^6\, ms^{-1}$, it experiences a force $\vec{F} = -(1.28 \times 10^{-13}\, k)$ N. When its velocity is along the z-axis, it experiences a force along the x-axis. What is the magnetic field?

Q4. A charge $q = -4\,\mu C$ has an instantaneous velocity $\vec{v} = (2\hat{\imath} - 3\hat{\jmath} + \hat{k})\, x\, 10^6\, ms^{-1}$ in a uniform magnetic field $\vec{B} = \left(2\hat{\imath} + 5\hat{\jmath} - 3\hat{k}\right) \times 10^{-2}\, T$. What is the force on the charge?

Q5. A particle with charge -5.60 nC is moving in a uniform magnetic field $\vec{B} = -(1.25\, T)\hat{k}$. The magnetic force on the particle is measured to be $\vec{F} = -(3.36 \times 10^{-7}\, N)\hat{\imath} + (7.42 \times 10^{-7}\, N)\hat{\jmath}$.

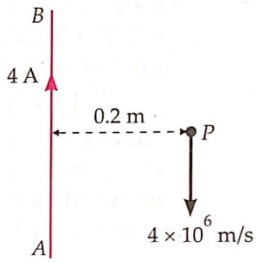
a. Calculate all components of velocity of the particle from this information.

b. Calculate the scalar product $\vec{v}.\vec{F}$. What is the angle between v and F?

Q6. An electron is moving at 10^6 ms^{-1} in a direction parallel to a current of 5 A, flowing through an infinitely long straight wire, separated by a perpendicular distance of 10 cm in air. Calculate the magnitude of the force experienced by the electron.

Q7. A positive charge of 1.5 μC is moving with a speed of 2 x $10^6$$ms^{-1}$ along the positive X-axis. A magnetic field, $\vec{B} = (0.2\,\hat{\jmath} + 0.4\,\hat{k})$ tesla acts in space. Find the magnetic force acting on the charge.

Q8. A long straight wire AB carries a current of $4\ A$. A proton P travels at 4 x 10^6 m /s, parallel to the wire, 0.2 m from it and in a direction opposite to the current as shown in Fig. Calculate the force which the magnetic field of current exerts on the proton. Also specify the direction of the force.



Q9. An electron is moving through a uniform magnetic field given by $\vec{B} = B_x\hat{\imath} + (3.0B_x)\hat{\jmath}$ At a particular instant, the electron has velocity $\vec{v} = (2.0\hat{\imath} + 4.0\hat{\jmath})$ m/s and the magnetic force acting on it is $(6.4\ x\ 10^{-19}\ N)\hat{k}.\ Find\ B_x$

Q10. A particle of mass m and charge q is in an electric and magnetic field is given by

$$\vec{E} = 2\hat{\imath} + 3\hat{\jmath}\ , B = 4\hat{\jmath} + 6\hat{k}$$

The charged particle is shifted from the origin to the point $P(x = 1, y = 1)$ along a straight path. The magnitude of the total work done is

a. (0.35) q **b.** (0.15) q

c. (2.5) q **d.** 5 q

Q11. An ionized gas contains both positive and negative ions. If it is subjected simultaneously to an electric field along the +x-direction and a magnetic field along the +z-direction, then

a. positive ions deflect towards +y-direction and negative ions towards -y-direction

b. all ions deflect towards +y-direction

c. all ions deflect towards -y-direction

d. positive ions deflect towards -y-direction and negative ions towards -y-direction

ANSWERS

1. $2 \times 10^{-6}[-6\hat{\imath} + 4\hat{\jmath} + 6\hat{k}]N;$

$0.8[-3\hat{\imath} + 2\hat{\jmath} + 3\hat{k}]ms^{-2}$

2. 3

3. $-(0.4\hat{\jmath})T$

4. $-16(\hat{\imath} + 2\hat{\jmath} + 4\hat{k}) \times 10^{-2}N$

5. **a.** $v_x = -106\ ms^{-1}; v_y = -48\ ms^{-1}$

b. $\vec{v}.\vec{F} = 0;\ 90°$

6. $1.6 \times 10^{-18}N$

7. $(0.6\hat{k} - 1.2\hat{\jmath})N$

8. $2.56 \times 10^{-18}N$

9. -2.0 T

10. d

11. c