(1): A particle of charge \(-2.48 \times 10^{-8} \ C\) is moving with a instantaneous velocity
\[
\vec{v} = (-3 \times 10^4 \ m/s)\hat{i} + (5 \times 10^4 \ m/s)\hat{j}
\]
What is the force exerted on this particle by a magnetic field (a) \(\vec{B} = (2 \ T)\hat{i}\); (b) \(\vec{B} = (2 \ T)\hat{k}\). (Ans:(a)\(2.48 \times 10^{-3}\kappa \ N\) (b)\(-2.48 \times 10^{-3}\hat{i} + 1.488 \times 10^{-3}\hat{j} \ N\))

(2): Each of the lettered circles at the corners of the cube if Fig-1 represents a positive charge \(q\) moving with a velocity of magnitude \(v\) in the direction indicated. The region in the figure is a uniform magnetic field \(\vec{B}\), parallel to the \(x\)-axis and directed toward the right. Find the magnitude and the direction of the force on each charge.
(Ans:a : \(-F_o\kappa\) b : \(F_o\jmath\) c : 0 d : \(-(F_o/\sqrt{2})\jmath\) e : \(-(F_o/\sqrt{2})(\hat{i} + \jmath)\) where \(F_o = qvB\))

(3): A particle carries charge of \(4.97 \times 10^{-9} \ C\). When it is moves with a velocity \(v_1\) of \(3.57 \times 10^4 \ m/s\) at 45° above the \(x\) axis in the \(xy\)-plane, a uniform magnetic field exerts a force \(F_1\) along the negative \(z\) axis. When the particle moves with a velocity \(v_2\) of \(2 \times 10^4 \ m/s\) along the \(z\)-axis, there is a force \(F_2\) of \(4 \times 10^{-5} \ N\) exerted on it along the \(x\)-axis. What are the magnitude and the direction of the magnetic field? (See Fig-2.) (Ans:0.402 \(T\))

(4): A particle of mass \(m\) and charge \(+q\) starts from rest at origin in Fig-3. There is a uniform electric \(E\) in the positive \(y\)-axis and a uniform magnetic field \(B\) directed toward positive \(z\)-axis.
(a) Prove that speed at any point is equal to \(\sqrt{2qEy/m}\)
(b) Show that the equation of motion of the particle is
\[
\begin{align*}
\begin{cases}
    m\ddot{x} &= qBy \\
    m\ddot{y} &= qE - qB\dot{x}
\end{cases}
\tag{1}
\end{align*}
\]

(c) By direct substitution show that the following equations

\[
\begin{align*}
\begin{cases}
    x &= a(\omega t - \sin \omega t) \\
    y &= a(1 - \cos \omega t)
\end{cases}
\end{align*}
\]

is the solutions of the equation (1).

where \( a = \frac{mE}{qB^2} \) and \( \omega = \frac{qB}{m} \) is the solutions of the equation (1).

(5): An electron at point \( A \) in Fig-4 has a speed \( v_o \) of \( 1.0 \times 10^7 \) m/s. Find (a) the magnitude and the direction of the magnetic field that will cause the electron to follow the semicircular path from \( A \) to \( B \). (5.69 \times 10^{-4} T \) (b) the time required for the electron to move from \( A \) to \( B \). (3.14 \times 10^{-8} s)

(6): Fig-5 shows a portion of a silver ribbon with \( z_1 = 1.45 cm \) and \( y_1 = 0.29 mm \), carry a current of 150 A in the positive x-direction. The ribbon lies in a uniform magnetic field, in the y-direction, of magnitude 1.5 T. If there are \( 5.85 \times 10^{28} \) free electrons per cubic meter, find a) the drift velocity of the electron in the x-direction. (3.81 mm/s) b) the magnitude and the direction of the electric field in the z-direction due to the Hall effect. (5.7 \times 10^{-3} V/m, +z) c) the Hall emf. (8.3 \times 10^{-5} V)

(7): In the Bainbridge mass spectrometer suppose the magnetic field in the velocity selector is 1.0 T, and the ion having the speed of \( 4.0 \times 10^6 \) m/s pass through undeflected. (a) What should be the electric field in the velocity selector? (4 \times 10^6 V/m) (b) If the separation of the electric plate is 0.5 cm, what is the potential difference between the plate? (2 \times 10^4 V)

(8): The electric field between the plates of the velocity selector in a Bainbridge mass spectrometer is \( 1.20 \times 10^5 \) V/m, and the magnetic field in both region is 0.6 T. A stream of singly charged neon moves in a circular path of 0.728 m radius in the magnetic field. Determined the mass number of the neon isotope. (Ans:21)
(9): Deuterons in a cyclotron describe a circle of radius 32.0 cm just before emerging from the dees. The frequency of the applied alternating voltage is 10 MHz. Find (a) the magnetic field. (2.62 T) (b) the energy of the speed of the deuterons upon emergence. (5.4 × 10^{-12} J)

(10): The rectangular loop in Fig-6 is pivoted about the y-axis and carry a current of 10 A in the direction indicated. (a) If the loop in a uniform magnetic field of magnitude 0.2 T, parallel to the x-axis, find the torque required to hold required to hold the loop in the position shown. (b) Same as (a), except that the field is parallel to the z-axis.

(Ans:(a)8.3 × 10^{-3} N⋅m (b)4.8 × 10^{-3} N⋅m)

(11): The rectangular loop of wire in Fig-7 has a mass of 0.1 g per centimeter of length and is pivoted about side ab as a frictionless axis. The current in the wire is 10 A in the direction shown. Find the magnitude and the sense of the magnetic field, parallel to the y-axis, that will cause the loop swing up until its plane makes an angle of 30° with the yz-plane, and find the equilibrium position of the loop.

(Ans:B = 6.13 × 10^{-2}T, +y, the equilibrium position: θ = 15°)