

Q1

$$v = 550 \text{ m/s}, \quad B = 0.045 \text{ T}, \quad q = +3.2 \times 10^{-19} \text{ C}, \quad m = 6.6 \times 10^{-27} \text{ kg}, \quad \phi = 52^\circ$$

$$(a) F_B = |q| v B \sin \phi \approx 6.24 \times 10^{-18} \text{ N}$$

$\begin{matrix} 3.2 \times 10^{-19} \text{ C} \\ 550 \text{ m/s} \\ 0.045 \text{ T} \\ \sin 52^\circ \approx 0.788 \end{matrix}$

$$(b) \vec{F} = m\vec{a} \Rightarrow F = ma \Rightarrow a = \frac{F}{m} \approx 9.46 \times 10^8 \text{ m/s}^2$$

$\begin{matrix} 6.6 \times 10^{-27} \text{ kg} \end{matrix}$

(c) As mentioned in class, because \vec{F}_B is always perpendicular to \vec{v} , it does not do any work on the particle. Therefore, from the work-kinetic energy theorem, the kinetic energy of the particle and hence the speed of the particle remain unchanged.

Q2

$$K = 1.20 \text{ keV} \approx 1.92 \times 10^{-16} \text{ J}, \quad r = 25 \text{ cm} = 0.25 \text{ m}$$

$\begin{matrix} 10^3 \leftarrow 1.6022 \times 10^{-19} \end{matrix}$

The charge particle is an electron. Therefore, $m = 9.1 \times 10^{-31} \text{ kg}$
 $q = -1.6022 \times 10^{-19} \text{ C}$

$$(a) K = \frac{1}{2} m v^2 \Rightarrow v = \sqrt{\frac{2K}{m}} \approx 2.05 \times 10^7 \text{ m/s}$$

$\begin{matrix} 1.92 \times 10^{-16} \\ 9.1 \times 10^{-31} \end{matrix}$

(b) Recall that for a charged particle circulating in uniform \vec{B} , the force \vec{F}_B provides the centripetal force.

$$|q| v B = m \frac{v^2}{r} \Rightarrow B = \frac{m v}{|q| r} \approx 4.67 \times 10^{-4} \text{ T}$$

$\begin{matrix} 0.25 \\ 1.6022 \times 10^{-19} \end{matrix}$

$$(d) T = \frac{2\pi r}{v} \approx 7.65 \times 10^{-8} \text{ s}$$

Annotations: 0.25 (pointing to 2π), 1.6022×10^{-19} (pointing to v), 0.25 (pointing to 7.65), Δ (pointing to the result).

from (a) (pointing to v)

$$(c) f = \frac{1}{T} \approx 1.31 \times 10^7 \text{ Hz}$$

cycles/second (pointing to Hz)

Q3

$$r = 26.1 \times 10^{-6} \text{ m}, F = 1.60 \times 10^{-17} \text{ N}$$

μ (pointing to 10^{-6})

same reason as Q2.

$$\underbrace{|q|vB}_{F_B} = m \frac{v^2}{r} \Rightarrow K = \frac{1}{2} m v^2 = \frac{1}{2} F_B r \approx 2.1 \times 10^{-22} \text{ J}$$

Annotations: $1.6 \times 10^{-17} \text{ N}$ (pointing to F_B), $26.1 \times 10^{-6} \text{ m}$ (pointing to r)

Q4

$$L = 1.8 \text{ m}, i = 13 \text{ A}, \theta = 35^\circ, B = 1.50 \text{ T}$$

$$F = i L B \sin \theta \approx 20.13 \text{ N}$$

Annotations: ≈ 20.574 (pointing to 20.13), 35° (pointing to θ), 1.50 T (pointing to B), 1.8 m (pointing to L), 13 A (pointing to i)