SCS139 HW1

Monday, January 24, 2013 9:46 PM

Q1

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

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

(3.2×10^{-19} C, 550 m/s, 0.045 T, $52°$, $\sin 52° \approx 0.788$)

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

(6.6×10^{-27} kg)

(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

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

(10^3, 1.6022×10^{-19})

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

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

(1.92×10^{-16}, 9.1×10^{-31})

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

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

(0.25, 1.6022×10^{-19})

0.25

1.6022×10^{-19} ← ~ 0.25

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

r: 0.25; v: from (a)

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

Hz: cycles/second

Q3

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

10^{-6}: μ

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

same reason as Q2.

$|q| v B$: F_B

F_B: 1.6×10^{-17} N

r: 26.1×10^{-6} m

Q4

$L = 1.8$ m, $i = 13$ A, $\phi = 35°$, $B = 1.50$ T

$F = iLB \sin\phi \approx 20.13$ N

$\sin\phi$: ≈ 0.574; $35°$

B: 1.50 T

L: 1.8 m

i: 13 A