Physics 1C - Discussion 1   Name: Tejas Kamtam   UID: 305749402

Problem 1. Moving electron in a magnetic field

An electron at point A has a speed v_0 of 1.41×10^6 m/s. Find (a) the magnitude and direction of the magnetic field that will cause the electron to follow the semicircular path from A to B, and (b) the time required for the electron to move from A to B.

$m_e = 9.1 \times 10^{-31}$ kg

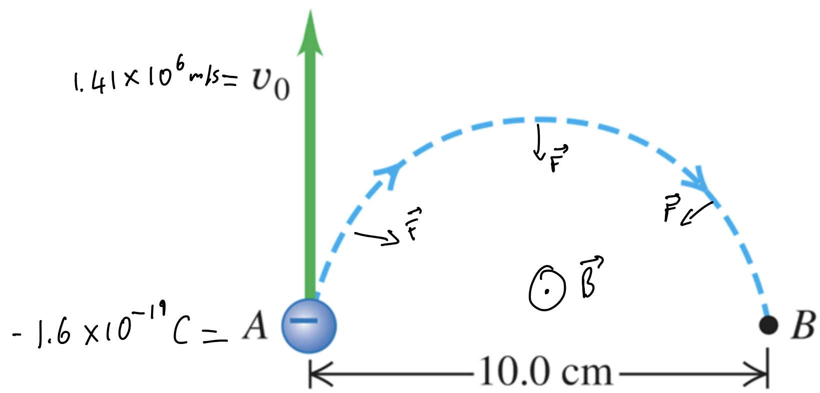


Figure 1: Moving electron in a magnetic field

a) $F_c = \dfrac{m_e v_0^2}{r}$ $F_m = q v_0 B \sin\theta$ $\Rightarrow \dfrac{m_e v_0^2}{r} = q v_0 B$ $\Rightarrow B = \dfrac{m_e v_0}{q r}$

right-hand rule

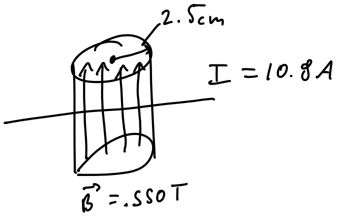
$$B = \frac{(9.1 \times 10^{-31})(1.41 \times 10^6)}{(1.6 \times 10^{-19})(0.05)} \boxed{\approx 1.60 \times 10^{-4} \text{ T} \quad (\text{out of the page } \odot)}$$

b) $\dfrac{\pi r}{v_0} = t$

$$t = \frac{0.05\pi}{1.41 \times 10^6} \boxed{\approx 1.11 \times 10^{-7} \text{ s}}$$

Problem 2. Current carrying wire in a magnetic field

An electromagnet produces a magnetic field of 0.550 T in a cylindrical region of radius 2.50 cm between its poles. A straight wire carrying a current of 10.8 A passes through the center of this region and is perpendicular to the axis of the cylindrical region and the magnetic field. What magnitude of force does this field exert on the wire? (Assume the magnetic field is uniform within the cylindrical region)



$l = 2r$

$F = IlB\sin\theta$

$\Rightarrow F = IB2r$

$F = (10.8)(.550)(0.05) \boxed{= 0.297\ N}$

Problem 3. DC motor in series

A dc motor with its rotors and field coils connected in series has an internal resistance of 3.2 Ω. When the motor is running at full load on a 120 V line, the emf in the motor is 105 V. (a) What is the current drawn by the motor from the line? (b) What is the power delivered to the motor? (c) What is the mechanical power developed by the motor?

a) $E = V + IR \Rightarrow I = \frac{E - V}{R}$

$I = \frac{105 - 120}{3.2} \boxed{= -3.125\ A}$

Negative values due to power consumption instead of production

b) $P = IV$

$P = (-3.125)(105) \boxed{= -326.56\ W}$

c) $P_{mech} = I V_{in}$

$P_{mech} = (120)(-3.125) \boxed{= -378\ W}$