Physics 172
Winter Quarter 1988
March 4, 1988
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$\overline{X} = 7.32$

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FOURTH EXAM

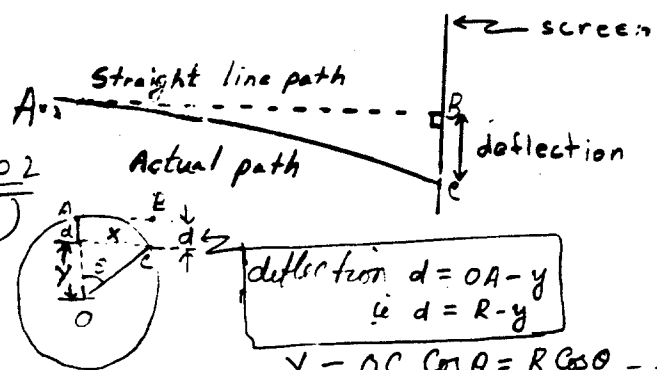
Name (print) Md. Hariq Rahi Name (signed) Solution

Discussion Instructor (circle one): Cady McAllister Molina Stone

Discussion Section #: _____

SHOW ALL WORK!!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

An electron is accelerated from rest by a potential difference of 525 volts. The electron is moving horizontally in a vacuum and enters a region where there is a magnetic field of 1.32×10^{-4} T at right angles to its velocity. After it travels 12.5 cm (measured along its actual path) in the magnetic field the electron strikes a screen. Calculate the deflection of the electron from the path it would have followed in the absence of the magnetic field.



STEP 1

AB = Undeflected path (without $\vec{B}$-field)

AC = Actual path = Arc of a circle

= 12.5 cm.

$\therefore AC = \boxed{12.5 \text{ cm} = R\theta}$ (See Figure.) ---- (1)

R = Radius of circle = OA = OC

STEP 2 (3 pts)

deflection $d = OA - y$

i.e. $d = R - y$

$y = OC \cos\theta = R\cos\theta$ ---- (2)

R, θ both are UNKNOWN.

STEP 3 [15 pts For v and R]

charged particle an uniform $\vec{B}$-field experience circular motion

i.e., $qvB = \frac{mv^2}{R}$ i.e., $\boxed{R = \frac{mv}{qB}}$ ---- (3)

v = speed of electron in $\vec{B}$-field.

Now $Te = \frac{1}{2}mv^2 = qV$ Here V = P.D = 525 volt

$\therefore qV = eV = 525 \text{ eV}$

$= 525 \text{ eV} \times 1.6 \times 10^{-19} \frac{\text{J}}{\text{eV}}$

$\boxed{qV = 8.40 \times 10^{-17} \text{ J}}$

$\therefore v = \sqrt{\frac{2(qV)}{m_e}} = 13.6 \times 10^6 \text{ m/s}$

STEP 4

$\therefore R = \frac{mv}{qB} = \frac{9.1 \times 10^{-31} \text{ kg} \times 13.6 \times 10^6 \text{ m/s}}{1.6 \times 10^{-19} \text{ C} \times 1.32 \times 10^{-4} \text{ T}} = \boxed{0.586 \text{ m}}$

But $R\theta = 0.125$ m

[5 pts For θ] $\therefore \theta = 0.2133$ rad $= \boxed{12.22^\circ = \theta}$

so $y = R\cos 12.22^\circ = (58.6 \text{ cm})\cos 12.22^\circ = 57.28 \text{ cm}$

(2 pts) $\therefore d = \text{deflection} = R - y = (58.6 - 57.28)\text{cm} = \boxed{1.33 \text{ cm}}$