SPSP 313
Date: 072

Name(s) KEY
Circle Table A B C D E F G

Electron beam in magnetic field

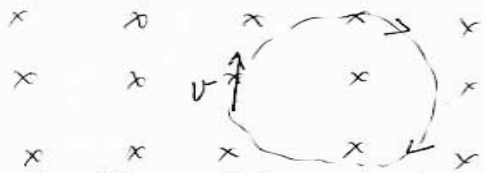
(a) How does the size of the circle the electron beam makes change as the accelerating voltage is increased?

increases

(b) How does the size of the circle the electron beam makes change as the current creating the magnetic field is increased?

decreases

(c) Assume the magnetic field points in the -z-direction (into the paper), and the initial velocity of the electron is in the +y-direction. Sketch the field [**x**] and the velocity.



$\vec{v} \times \vec{B} \leftarrow$
but $\vec{F} = q\vec{v} \times \vec{B}$
and $q_e < 0$
so F $\longrightarrow$

(d) What is the direction of the magnetic force on the electron at this first instant?

$\longrightarrow$, +x, to right

(e) Sketch the path the electron follows in the magnetic field on the diagram in (c).

(f) If the electron is accelerated through a potential difference V = 1000 V, calculate the initial speed of the electron.

$\Delta U = q\Delta V$, when e^- is accelerated, electric PE $\rightarrow$ KE

$$e\Delta V = \frac{1}{2}mv^2 \longrightarrow v = \sqrt{\frac{2e\Delta V}{m}} = \sqrt{\frac{2(1.6\times10^{-19}C)(1000V)}{9.11\times10^{-31}kg}}$$

$$= 1.87\times10^{7}\ m/s$$

(g) If B = 0.00400 T, find the radius of the circle the electrons travel in.

$\Sigma F = ma$ ← centripetal because moves in circle

$$qvB = \frac{mv^2}{r} \longrightarrow r = \frac{mv}{qB} = \frac{(9.11\times10^{-31}kg)(1.87\times10^{7}m/s)}{(1.6\times10^{-19}C)(.004\ T)} = .0266\ m$$

$$= 2.66\ cm$$

(h) How does this answer compare to the observed radius?

similar

(i) Why might this be true? **IF** V were (>) < 1000 volts? If you said "larger" in (h)

OR **IF** B were > (<) 0.00400 T ? Circle the one(s) that apply.

(j) If the direction of the initial velocity is tilted slightly out of the page (has a large +y-component and a small +z-component), what is the new path of the electron beam?

helix

Does the radius of the "circle" **increase** (**decrease**) **stay same** ?

slightly!

2/3/06