PROBLEMS

1. An electron is accelerated through a potential of 40V. 1 before it enters magnetic field intensity of $0.91\,wb/m^2$ at an angle of 30 with field. Find position of electron after which it has completed one revolution in filed.

Sol. $V_a = 40V$

$B = 0.91 wb/m^2$

$\phi = 30^0$

Pitch of helix $P = TV$

$$= Tv\cos\phi$$
$$= T\sqrt{\frac{2eV_a}{m}}\cos\phi$$
$$= \frac{2\pi m}{eB}T\sqrt{\frac{2eV_a}{m}}\cos\phi$$

$$P = \frac{2\pi}{B}\sqrt{\frac{2mV_a}{e}\cos\phi}$$

But we know that

e is charge of electron $= 1.6\times10^{-19}c$

m is mass of electron $= 9.1\times10^{-31}kg$

$$\therefore P = \frac{2\pi}{B}\sqrt{\frac{2\times9.1\times10^{-31}\times V_a}{1.6\times10^{-19}}}\cos\phi$$

On substituting given values

$$\therefore P = \frac{2\times22}{7\times0.91}\sqrt{\frac{2\times9.1\times10^{-31}\times40}{1.6\times10^{-19}}}\times\sqrt{\frac{3}{2}}$$

$= 12721 \times 10^{-7}$

$= 12.721 \times 10^{-5} m$

$= 1.2721 \times 10^{-4} m$

$\therefore$ position of electron after it has completed one revolution = pitch of revolution

$= 1.27 \times 10^{-4} m$

2. In a CRT deflection plates are 2cm long and are spaced 0.5cm apart the screen is 20cm away from centre of plates. Final anode voltage is 800V. Calculate

(i) vel. of beam on merging into field.

(ii) voltage that must be applied to deflecting plates to have a deflection of 1cm.

Sol. $l = 2cm; \quad d = 0.5cm \quad L = 20cm \quad V_a = 800V$

(i) vel. of beam on emerging into field

= vel. with which it enters

$$\Rightarrow v_{ox} = \sqrt{\frac{2eV_a}{m}}$$

$$= \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 800}{9.1 \times 10^{-31}}}$$

$$= \sqrt{\frac{256}{91} \times 10^{14}}$$

$$= 1.67 \times 10^{7}$$

$$= 16.7 \times 10^{6} cm/\sec$$

(ii) $D = \frac{lLV_d}{2dV_a}$

$$1cm = \frac{(2)(20)V_d}{2(0.5)(800)}$$

$$V_d = (0.5)(40)$$

$$= 20V$$

3. In a CRT distance of CRT from centre of plates is 20cm. Deflecting magnetic field of flux density $10^{-4} wb/m^2$ extends for 2cm along x-axis. Final $V_{anode} = 800V$. Calculate deflection of spark and deflection sensitivity.

Sol. $D = \frac{lLB}{\sqrt{V_a}}\sqrt{\frac{e}{2m}}$

$$= \frac{2\times10^{-2}\times20\times10^{-2}\times10^{-4}}{\sqrt{800}}\sqrt{\frac{1.6\times10^{-19}}{2\times9.1\times10^{-3}}}$$
$$= \frac{4\times10^{-7}}{10}\sqrt{\frac{10^{-19}}{91\times10^{-31}}}$$
$$= \frac{4\times10^{-8}}{\sqrt{91}}\times10^{6}$$
$$= 4.193\times10^{-3} m$$
$$= 0.4193 cm$$

$$S = \frac{D}{B} = \frac{lL}{\sqrt{V_a}}\sqrt{\frac{e}{2m}}$$
$$= \frac{4.193m = \times10^{-3}}{10^{-4}}$$
$$= 4.193\times10 = 41.93 m^3/wb$$

4. The magnetic flux density $= 0.02 wb/m^2$ and electric field strength $\varepsilon = 10^5 v/m$ are uniform fields $\perp' r$ to each other. A pure source of an electron is placed in the field Determine the min. distance at which an e^- at 0v will again have 0v in its trajectory under influence of fsdl combined electric and mag. Fields.

Sol. Minimum distance $= 2\pi Q$

$$= 2\pi\left(\frac{\mu}{\omega}\right)$$
$$= \frac{2\pi\varepsilon m}{dB^2}$$
$$= \frac{2\times 3.14\times 10^5}{1.759\times 10^{11}\times 0.02}$$
$$= 0.892 mts$$

5. In an electro static deflection CRT length of plates is 2cm and spacing between deflection plates is 0.5cm distance from centre of deflection plates to screen is 20cm and deflecting voltage is 25V. Find 'S' and angle of deflection. Velocity of beam. Assume final anode potential $= 1000V$?

So. $S = \frac{lL}{2dV_a} = \frac{20\times 10^{-2}\times 5\times 10^{-2}}{2\times 5\times 10^{-3}\times 1000}$

$$= 4\times 10^{-4} m/V = 0.04 cm/v$$

$\tan\theta = \frac{D}{L}$ $\qquad$ $D = \frac{lLV_d}{2dV_a}$

$= \frac{10^{-2}}{20\times 10^{-2}}$ $\qquad$ $= 4\times 10^{-4}\times 25$

$= \frac{1}{20}$ $\qquad$ $= 10^{-2} m$

$= 0.05$

$\theta = \tan^{-1}(0.05)$

$= 2.862$

$v = \sqrt{\frac{2ev_a}{m}} = 5.93\times 10^5\sqrt{V_a}$

$= 5.93\times 10^5\times 31.622$

$= 187.52\times 10^5 m/\sec$