CATHODE RAY TUBES

WORKED EXAMPLES C.R.TS

(1) In a C.R.T, the distance between the plates is 1cm, the length of the deflecting plates is 4.5cm and the distance of the screen from the centre of the plate is 33cm. If the accelerating voltage is 300V and deflecting voltage is 50V, find

a) Velocity of electron reaching the field
b) Deflection produced on the screen
c) Deflection sensitivity

a) Solution:

$d = 1\,cm \Rightarrow 1\times10^{-2}\,m$, $L = 4.5cm \Rightarrow 4.5\times10^{-2}\,m$

$D = 33 = 33\times10^{-2}\,m$, $V_a = 300V$ (accelarcting voltage)

$V_d = 50V$ (deflecting voltage)

a) velocity of electron reaching the field

$$V_{ox} = \sqrt{\frac{2eV_a}{m}} \qquad e = 1.6\times10^{-19}$$

$$= \sqrt{\frac{2\times1.6\times10^{-19}\times300}{9.107\times10^{-31}}}$$

$$= 1.0267\times10^{7}\ m/s$$

b) Deflection produced on the screen

$$Y_{AB} = \frac{DV_dL}{2dV_a}$$

$$= \frac{4.5\times10^{-2}\times50\times33\times10^{-2}}{2\times1\times10^{-2}\times300}$$

$$= 0.1237\,m$$

(2)

c) Deflection sensitivity

$$S = \frac{Y}{V_d} = \frac{0.1237}{50}$$

$$= 2.474 \times 10^{-3} \, m/V$$

2 In a cathode Ray tube having electric deflection system, the deflecting plates are 2 cm long and have a uniform spacing of 4 mm between them. The fluorescent screen is 25cm away from the center of the deflection plates. Calculate the deflection sensitivity, if the potenial of the final Anode is 1000V.

Solution

$L = 2cm \Rightarrow 2 \times 10^{-2} m \quad d = 4mm = 4 \times 10^{-3} m$

$D = 25cm = 25 \times 10^{-2} m$

Sensitivity is given by :-

$$S = \frac{Y}{V_a} = \frac{lD}{2dV_a}$$

$$S = \frac{2 \times 10^{-2} \times 25 \times 10^{-2}}{2 \times 4 \times 10^{-3} \times 1000}$$

$$S = 6.25 \times 10^{-4} \, m/V$$

(3) An electrostatically deflected C.R.T has plane parallel deflecting plates which are 2.5cm long and 0.5cm apart, The distance of the screen from the centre of the plates is 20cm. The accelarating voltage is 2500V. Calculate the deflecting voltage required to get the corresponding deflection of 4cm on the screen, and the velocity of the beam entering the field.

Solution:

$y = 4cm \Rightarrow 4\times10^{-2}m$, $D = 2.5cm \Rightarrow 2.5\times10^{-2}m$

$l = 20cm = 20\times10^{-2}m$, $d = 0.5cm = 0.5\times10^{-2}m$

and $V_a = 2500V$

deflecting voltage is :-

$$y = \frac{D V_d l}{2 d V_a}$$

$$4\times10^{-2} = \frac{2.5\times10^{-2}\times V_d \times 20\times10^{-2}}{2\times0.5\times10^{-2}\times2500}$$

$$V_d = 200V$$

$\Rightarrow$ velocity of the electron beam,

$$V_{ox} = \sqrt{\frac{2eV_a}{m}}$$

$$= \sqrt{\frac{2\times1.6\times10^{-19}\times2500}{9.107\times10^{-3}}}$$

$$= 2.9638\times10^{7}\ m/s$$