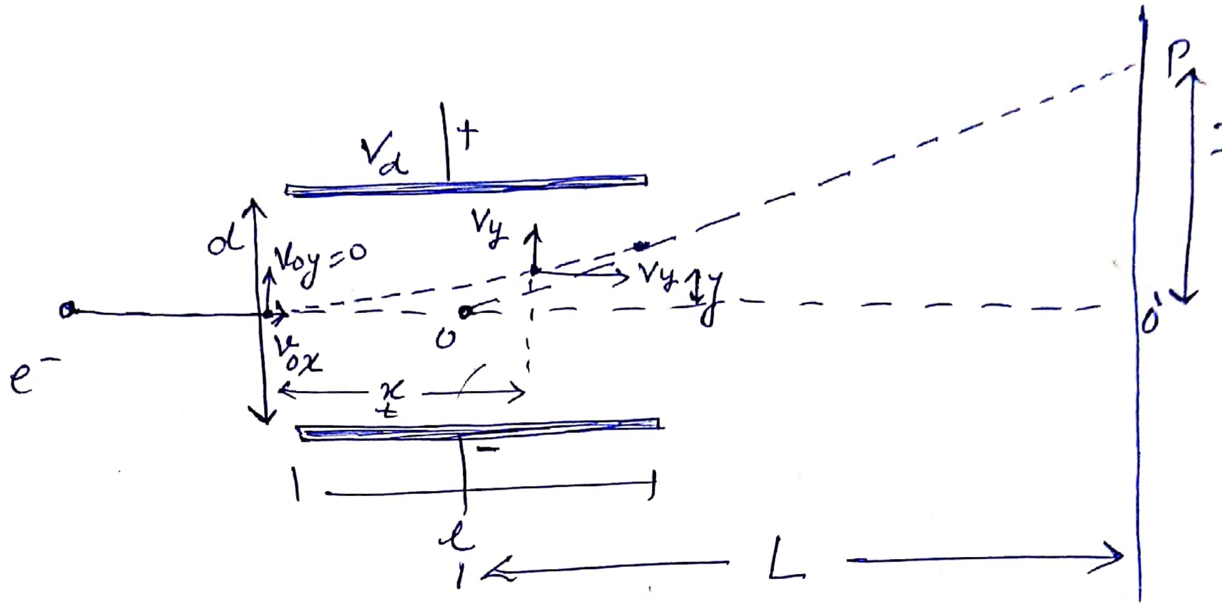
Deflection Sensitivity of CRT.



Deflection sensitivity of CRT is defined as the deflection produced on the screen per unit voltage applied at the vertical deflection plates.

Consider the vertical deflection plates having length 'l' separated by distance 'd'. Let the e^- be moving ~~with~~ in x direction. When it enters the vertical deflection plates (VDP), let its velocity be V_{ox} in x-direction while velocity in y direction be V_{oy} (=0). The force experienced by e^- in y direction due to electric field 'E_y' be F_y then

$$F_y = -eE_y$$

$$m a_y = -e E_y$$

$$a_y = -\frac{e E_y}{m} \quad —(1)$$ (a_y - acceleration in y direction.)
(e - charge of e^-)
(m - mass of e^-)

Let the distance travelled in y-direction by the electron in time 't' be 'y' then

$$y = V_{0y} t + \frac{1}{2} a_y t^2$$

$$y = 0 + \frac{1}{2} a_y t^2$$

$$y = \frac{1}{2} a_y t^2 \quad —(2)$$

(1) in (2)

$$y = \frac{1}{2}\left(-\frac{e E_y}{m}\right) t^2 \quad —(3)$$

Eqn (3) represents the variation in distance (y) in y direction with time. Since $y \propto t^2$, $\therefore$ the path traced by e^- within VDP is is parabolic

Let the distance travelled by e^- in x direction be 'x' in time t then

$$t = \frac{x}{V_{0x}} \quad —(4)$$

(4) in (3) $$y = \frac{1}{2}\left(-\frac{e E_y}{m}\right)\left(\frac{x}{V_{0x}}\right)^2 \quad —(5)$$

Let the tangent drawn at the point when e^- leaves the VDP meets the centre point O at an angle θ with x axis then

$$\tan\theta = \frac{D}{L} \quad - (6) \qquad \text{from } \Delta OPO'$$

Also from eq. (5)

$$\left(\frac{dy}{dx}\right)_{x=l} = \left(\frac{-eE_y}{mu_{0x}^2}\right)l \quad - (7)$$

equating (6) & (7) as both represent the slope of line OP i.e

$$\frac{D}{L} = \left(-\frac{eE_y}{mu_{0x}^2}\right)l$$

$$D = \frac{-eLlE_y}{mu_{0x}^2} \quad - (8)$$

Also $E_y = \frac{V_d}{d}$

$$\therefore D = \left(-\frac{eLl}{mu_{0x}^2}\right)\left(\frac{V_d}{d}\right) \quad - (9)$$

Let V_a be the accelerating voltage at accelerating grids then

$$\frac{1}{2}mu_{0x}^2 = eV_a$$

$$\text{or } mu_{0x}^2 = 2eV_a \quad - (10)$$

10 in 9

$$D = \frac{L l V_d}{2 V_a d} \quad \text{--- (11)}$$

or
$$\frac{D}{L} = \frac{l V_d}{2 V_a d} \quad \text{--- (12)}$$

~~but~~ According to the definition of deflection sensitivity (s)

$$S = \frac{D}{V_d}$$

$\therefore$ from 12
$$\boxed{S = \frac{L l}{2 V_a d}}$$