☹ em-que-01002

If an ink drop has a mass of 50×10^{-9}g and is given a charge of -200×10^{-15} C, find vertical displacement in an inkjet printer with 3keV deflection potential, 3mm plate separation and 15 mm deflection plate length. The nozzle ejects the drop with velocity 25 m $\sec^{-1}$ and leaving edge of the deflection plate is at a distance 15 mm from the paper.

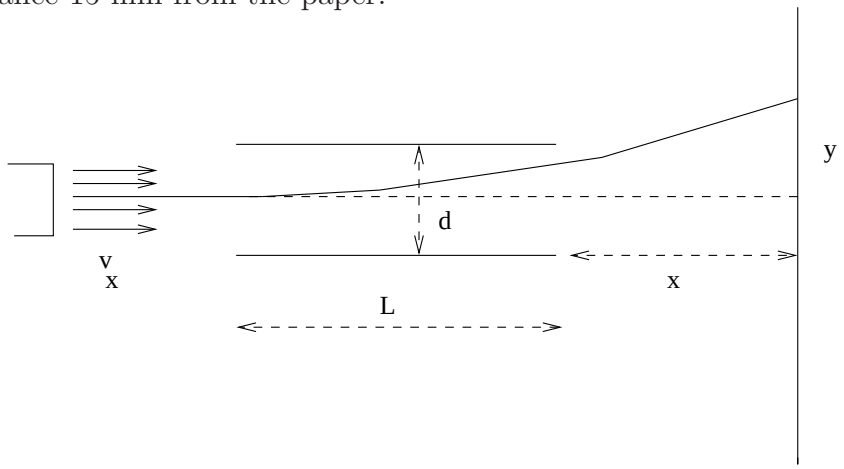

Fig. **1** Inkjet Printer

Do you take gravity into account? Justify your answer.

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Remark: `http://0space.org/node/2995`

Ans::2.16 mm

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☺*Solution*: Time spent between the plates $= t_1 = L/u = \dfrac{15\times10^{-3}\text{m}}{25\text{m/s}} = \dfrac{3}{5}\times10^{-3}\text{s}$

Vertical acceleration due to the electric field, a, is

$$\begin{aligned} a &= \frac{qE}{m} = \frac{200\times10^{-15}\text{C}\times}{50\times10^{-12}\text{kg}}\frac{3000\text{V}}{15\times10^{-3}\text{m}} \\ &= 4\times10^{3}\text{m}s^{-2} \end{aligned} \tag{1}$$

Vertical deflection at the edge of the plates, y_1, is

$$y_1 = \frac{1}{2}at_1^2 = \frac{1}{2}\times4\times10^{3}\times\frac{9}{25}\times10^{-6}\text{m} \tag{2}$$

$$= \frac{18}{25}\times10^{-3} = 7.2\times10^{-4}\text{m} \tag{3}$$

$$= 0.72\text{mm} \tag{4}$$

Time spent after leaving the edge of the plate and before hitting the screen, t_2 is

$$t_2 = x/u = \frac{15 \times 10^{-3}\text{m}}{25\text{m/s}} = t_1 \tag{5}$$

Vertical velocity when leaving the edge of the plates, $v_2 = at_1$ The vertical deflection $y_2 = v_2 t_2 = v_2 t_1^2 = 2y_1 = 1.46\text{mm}$.
Therefore, total deflection $= y_1 + y_2 = 2.16$**mm.**