Motion of Charges

[1] An electron moving with speed of 5.0×10^8cm/sec is shot parallel to an electric field strength of 1.0×10^3nt/coul arranged so as to retard its motion.

(a) How far will the electron travel in the field before coming (momentarily) to rest ?

(b) how much time will elapse?

(c) If the electric field ends abruptly after 0.8 cm, what fraction of its initial energy will the electron loose in traversing the field?

em-que-01001

[2] 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.

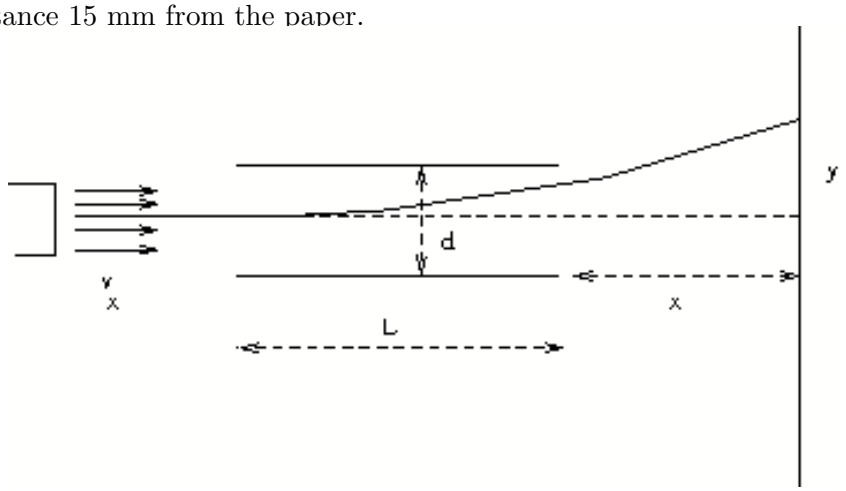

Fig. **1** Inkjet Printer

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[3] Two similar balls of mass m are hung from silk threads of length and carry equal charges q. Assuming θ to be small show that the separation, x, betweeen the balls is given by

$$x \approx \frac{q^2 \ell}{2\pi\epsilon_0 mg}$$

What is the value of q if $\ell = 120$c, $m = 10$gm, $x = 5$cm ? em-que-01003

[4] A gold nucleus contains a positive charge equal to that of 79 protons. An α particle, $Z = 2$, has kinetic energy K at points far away from the nucleus and is traveling directly towards the charge, the particle just touches the surface of the charge and is reversed in direction. relate K to the radius of the gold nucleus. Find the numerical value of kinetic energy in MeV is the radius R is given to be 5×10^{-15} m.

[1 MeV = 10^6 eV and 1 eV = 1.6×10^{-16}]

em-que-01004

[5] An electron is constrained to move along the axis of a ring of charge q and radius a. Show that the electron can perform small oscillations along the axis of with time period given by

$$T = \frac{1}{2\pi}\frac{4\pi\varepsilon_0 m a^2}{eq}$$

em-que-01004

[6] An alpha particle travels in a circular path of radius 0.45m in a magnetic field with $B = 1.2\text{w/m}^2$. Calculate
(i) its speed (ii) its period of revolution, and (iii) its kinetic energy.
Mass of alpha particle $= 6.64424.10^{-27}\text{kg} \approx 4 \times M_p = 4 \times 938.27$ MeV.

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