SOLUTION 7 FOR 6.013

Oct.21,2002

Solution 7.1

a) The electron is accelated by the system, the energy is conserved. So,

$$W = F \cdot S = e\frac{V}{D} \cdot D = eV = \frac{1}{2}mv^2$$

$$v = \sqrt{2eV/m} = \sqrt{2 \times 1.6 \times 10^{-19} \times 20,000/9.1 \times 10^{-31}} = 8.39 \times 10^7 [\text{v/s}]$$

b) The time needed from deflection plates to anode is:

$$t = d_1/v = d_2/v_v,\ v_v = d_2 \cdot v/d_1 = v/4$$

where $d_1 = 40$cm, $d_2 = 10$cm, v_v is vertivcal velocity, v is horizontal velocity componen. The energy from the deflection plates:

$$W = F \cdot S = e\frac{V_2}{d_2} \cdot d_2/2 = eV_2/2 = \frac{1}{2}mv_v^2,\ v_v = \sqrt{eV_2/m}$$

So,

$$v_v = \sqrt{eV_2/m} = v/4 = \sqrt{2eV/m}/4$$

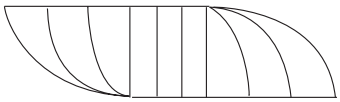
$$V_2 = V/8 = 2500[\text{volts}]$$

Solution 7.2

(a) The stored energy of the system $W_e = \frac{1}{2}CV^2 = \frac{1}{2}C(\frac{Q}{C})^2 = \frac{Q^2 d}{2\epsilon WL} = \frac{\epsilon WLV^2}{2d}$
The force : $f = -\frac{dW_e}{dl} = -\frac{\epsilon WV^2}{2d}$
b)The capacitor is written as $C = \frac{\epsilon WL}{d} = \frac{Q}{V}$

$$\frac{d}{dt}\frac{\epsilon WL}{d} = \frac{d}{dt}\frac{Q}{V},\ \frac{dL}{dt}\frac{\epsilon W}{d} = \frac{dQ}{dt}\frac{1}{V} = \frac{V}{R}\frac{1}{V} = \frac{1}{R}$$

$$v = -\frac{dL}{dt} = -\frac{d}{R\epsilon W}$$



c) Please see the figure for the E line. Because the fringe field exists, there is force along the z direction.