

mid term

Scaling problem a) E-field $E_c = 2.00 \times 10^{-3} \text{ V/m}$
distance of 1mm value of E cal sum

$$2 \times 10^{-3} = \frac{1}{4\pi\epsilon_0} \frac{2 \times 1}{2} \frac{1}{1^2}$$

$$2 \times 10^{-3} = \frac{1}{4\pi\epsilon_0} \frac{q}{(1 \times 10^{-3})^2}$$

$$2 \times 10^{-3} \times 10^{-6} = \frac{q}{4\pi\epsilon_0}$$

$$\frac{1}{4\pi\epsilon_0} \frac{q}{(1 \times 10^{-3})^2}$$

$$2 \times 10^{-3} \times 10^{-6} \cdot \frac{1}{25 \times 10^{-6}}$$

$$E = 0.05 \times 10^{-3} \Rightarrow \boxed{5 \times 10^{-5} \text{ V/C}}$$

B) 1 μC $E_c = 8.00 \times 10^{-3} \text{ V/m}$ E cal same d if

$$E = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \quad q = 1 \mu\text{C} \quad E = 8 \times 10^{-3} \text{ V/C}$$

$$8 \times 10^{-3} = \frac{1}{4\pi\epsilon_0} \frac{1 \times 10^{-6}}{r^2}$$

$$8 \times 10^{-3} = \frac{3 \times 10^{-6}}{4\pi\epsilon_0 r^2}$$

$$E = 8 \times 10^{-3} \times 3 \times 10^{-6}$$

$$\boxed{E = 24 \times 10^{-3} \text{ N/C}}$$

$$2) m = 4 \times 10^{-16} \text{ kg} \quad E = 6131.25 \text{ N/C}$$

$$a) E^- = 9.1 \times 10^{-31} \text{ kg}$$

$$\frac{4 \times 10^{-16}}{9.1 \times 10^{-31}} = 4.3956 \times 10^{14}$$

$$b) q = Ne = 4.3956 \times 10^{14}$$

$$a = qE/m$$

$$\frac{7.03296 \times 10^{-5} \times 6131.25}{4 \times 10^{-16}}$$

$$a = 1.078 \times 10^{15} \text{ m/sec}^2$$

$$1 \Rightarrow a) \Delta V = 4 \text{ kV} \quad H^+ = q_e \quad He^+ 2q_e$$

$$KE = qV$$

$$\frac{1}{2}mv^2 = qV$$

$$K.E. \text{ Hydrogen} = 1.6 \times 10^{-19} \times 4 \times 10^3 = 6.4 \times 10^{-16} \text{ J}$$

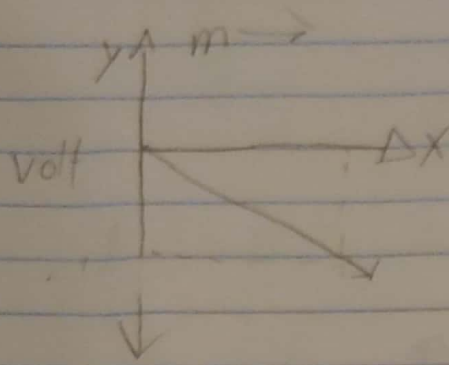
$$K.E. \text{ Helium} = 2 \times 1.6 \times 10^{-19} \times 4 \times 10^3 = 12.8 \times 10^{-16} \text{ J}$$

$$b) E = \frac{\Delta V}{\Delta x} \quad \Delta x = 5 \text{ cm}$$

$$\frac{4 \times 10^3}{5 \times 10^{-2}} = 8 \times 10^4 \text{ V/m}$$

$$E = 1000 \text{ V/m}$$

2)



$$\text{slope} = -1000 \text{ V/m}$$

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

$$37) a) C = \frac{\epsilon_0 A}{d} = \frac{8.85 \times 10^{-12} \times 10^{-4}}{2 \times 10^{-3}} = 4.425 \times 10^{-13}$$

$$b) E = \frac{1}{2} CV^2 = \frac{1}{2} \times 4.425 \times 10^{-13} \times 125$$

$$= 55.31 \times 10^{-13} \text{ J}$$

4) parallel because capacitance adds up in parallel capacitance

$$1) a) -E_2 + I_2 + I_1 - E_1 + I R_0 E_1 + E_2 + (I_3 + \dots) = 0$$

$$-1.5 + I(R_1 + R_2 + R_3) - 1.5 = 0$$

$$I = \frac{3V}{R_1 + R_2 + R_3} = \frac{3}{2+2+50} = \frac{3}{54} = 55.56 \text{ micro Amp}$$

$$b) P_{total} = P_1 + P_2 + P_R$$

$$(5.556 \text{ mA})^2 \times 2 + (55.56 \text{ mA})^2 \times 2 + 5.556 \text{ mA} \times 50$$

$$6.17 \text{ mW} + 6.17 \text{ mW} + 154.34 \text{ mW}$$

$$= 777.54 \text{ mWatts}$$

$$\boxed{P_R = 154.34 \text{ mWatts}}$$

$$\frac{V_x - 1.5}{2} + \frac{V_x - 1.5}{2} + \frac{V_x}{50} = 0$$

$$\frac{25V_x - 37.5}{50} + \frac{25V_x - 37.5}{50} + \frac{V_x}{50} = 0$$

$$51V_x - 75$$

$$\boxed{V_x = 1.47 \text{ Volts}}$$

$$I_1 = \frac{1.5 - 1.47}{2 \times}$$

$$I_2 = \frac{1.5 - 1.47}{2} = 15 \text{ mAmp}$$

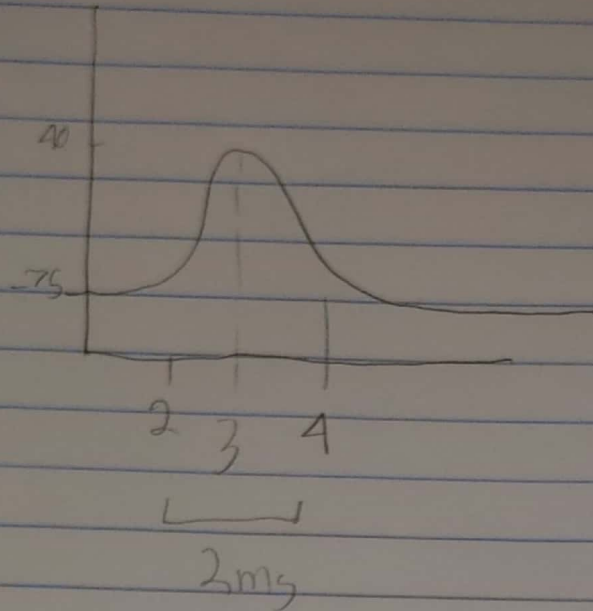
$$I = I_1 + I_2 = \boxed{30 \text{ mA}}$$

$$P_{total} = P_{x1} + P_{x2} + P_R$$

$$I_1^2 R_1 + I_2^2 R_2 + I^2 R$$

$$(15)^2 \times 2 + (15 \text{ mA})^2 \times 2 + (30 \text{ mA})^2 \times 50 = \boxed{45.9 \text{ mW}} \text{ FR}$$

2) a) 2
pulse width is 2ms



b) peak to peak voltage in millivolts

$$= 40 - (-75)$$
$$= 40 + 75$$

$V_{\text{peak-peak}}$

$$V_{\text{peak-peak}} = 115\text{mV}$$