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Bravo!

1a.)

$$E = 2 \times 10^{-3}$$

$$r = 5 \text{ mm}$$

$$r^2 = 25 \text{ mm}^2$$

$$E_c = \frac{E}{r^2}$$

$$E_c = \frac{2 \times 10^{-3} \text{ V/m}}{25 \text{ mm}}$$

$$E_c = 8 \times 10^{-5} \text{ V/m}$$

1b.)  $E = (8 \times 10^{-5} \text{ V/m}) (3 \mu\text{C})$

$$E_c = 2.4 \times 10^{-4} \text{ V/m}$$

2a.)

$$W = m * g \quad \text{mass} = \rho v \quad \text{mass (m)} = 4 \times 10^{-16} \text{ Kg}$$

$$E\text{-field} = 6131.25 \text{ N/C}$$

$$qE = mg \quad q = \frac{mg}{E} = \frac{(4 \times 10^{-16}) (9.8)}{6131.25 \text{ N/C}}$$

$$q = 6.3934 \times 10^{-19}$$

$$\frac{e \cdot 4}{\cancel{e}} = \frac{e}{e} = n$$

$$n = 3.9$$

$$n \approx 4 \quad \checkmark$$

$$2b.) \quad F_E = q' E = 2.94 \times 10^{-15}$$

$$m' = m - e = 4.0 \times 10^{-16}$$

$$F_g = m' g = 3.92 \times 10^{-15} \text{ N}$$

$$a = \frac{F_g - F_E}{m} = \frac{(3.92 \times 10^{-15} \text{ N}) - (2.94 \times 10^{-15} \text{ N})}{(4.0 \times 10^{-16} \text{ kg})}$$

$$a = 2.46 \text{ m/s}^2 \quad \checkmark$$

3a.)

$$K \cdot E = q V$$

$$KE_{\text{Hydrogen}} = (1.6 \times 10^{-19}) \times (4 \times 10^3) = 6.4 \times 10^{-16} \text{ J}$$

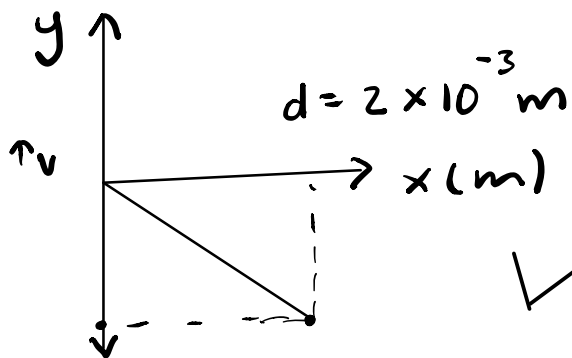
$$KE_{\text{Helium}} = 2 \times 1.6 \times 10^{-19} \times 4 \times 10^3 = 12.8 \times 10^{-16} \text{ J}$$

$$\checkmark$$

$$b) E = \frac{\Delta V}{\Delta x} = \frac{4 \times 10^3}{5 \times 10^{-2}} = \boxed{8 \times 10^4 \text{ V/m}} \checkmark$$

$$2) E = 1 \text{ kV/m}$$

or 1000 V/m



✓ Well done

(-2 volt)

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

$$y\text{-int} = 0$$

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

$$= \boxed{4.425 \times 10^{-13} \text{ F}} \checkmark$$

$$b) E = \frac{1}{2} C V^2 = \frac{1}{2} \times 4.425 \times 10^{-13} \times 25$$

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

4) The identical capacitors should be connected in parallel so the total capacitance increases. ✓

$$r_1 = 2\Omega \quad E_1 = 1.5\text{V} \quad r_2 = 2\Omega \quad E_2 = 1.5\text{V} \quad I = ? \quad R = 50\Omega$$

$$a) -E_2 + I r_2 + I r_1 - E_1 + I R = 0$$

$$-1.5 + I(r_1 + r_2 + R) - 1.5\text{V} = 0$$

$$I = \frac{3\text{V}}{r_1 + r_2 + R} = \frac{2}{2 + 2 + 50} = \frac{2}{54}$$

$$= 55.56 \text{ mA} \quad \checkmark$$

$$b) 0 = \frac{V_0 - 1.5}{2} + \frac{V_x - 1.5}{2} + \frac{V_x}{50}$$

$$0 = 25V_0 - 37.5 + 25V_x - 37.5 + V_x$$


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$$\frac{5, V_x = 75}{V_x = 1.47 \text{ V}}$$

50

$$I_1 = \frac{1.5 - 1.47}{2r} = 15 \text{ mAmp}$$

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

$$I = I_1 + I_2$$

$$= 30 \text{ mA}$$

$$\text{Total } P_C = P_{r1} + P_{r2} + P_r$$

$$= (15 \text{ m})^2 \times 2 + (15 \text{ m})^2 \times 2 + (30 \text{ m})^2 \times 50$$

$$= 45.9 \text{ mW}$$

$$P_{\text{Total}} = 45 \text{ mW}$$

C1

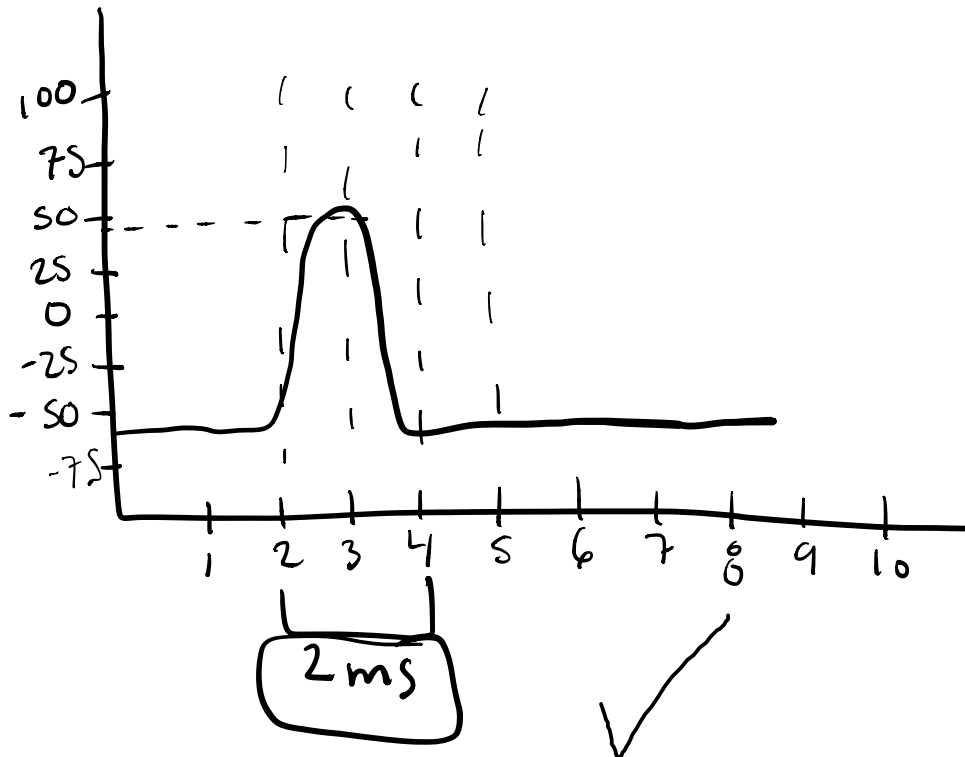
$$\begin{aligned}
 P_{\text{total}} &= (I^2)r_1 + (I^2)r_2 + (I^2)R \\
 &= (0.056\text{A})^2(2) + (0.056\text{A})^2(2) \\
 &\quad + (0.056\text{A})^2(50) \\
 &= 0.17\text{W} = \boxed{170\text{mW}} \quad \checkmark
 \end{aligned}$$

$C_2$  Parallel

$$\begin{aligned}
 P_{\text{total}} &= (I_1)^2 r_1 + (I_2)^2 r_2 + (I^2)R \\
 &= (0.015\text{A})^2(2) + (0.015\text{A})^2(2) + (0.030)^2(50) \\
 &= 0.045\text{AW} = \boxed{45.9\text{mW}} \quad \checkmark
 \end{aligned}$$

4.2)

a)



b)  $40 - (-75) = 40 + 75 = 115 \text{ mV}$