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Physics 135B
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Midterm

1a.)

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

$r = 5mm$

$r^2 = 25mm$

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

$E_C = \frac{2 \times 10^{-3} \, v/m}{25 \, mm}$

$E_C = 8 \times 10^{-5} \, v/m$

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

$E_C = 2.4 \times 10^{-4} \, v/m$

2a.)

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

E-field = 6131.25 N/C

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

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

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

$n = 3.9$ $\quad$ $n \approx 4$

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

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

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

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

$a = 2.46 m/s^2$

3a.)

$K.E = qV$

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

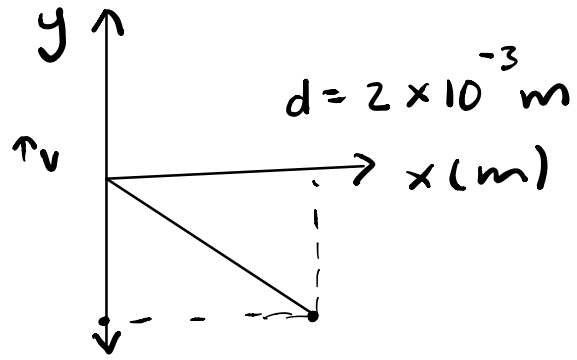
KE Helium $= 2 \times 1.6 \times 10^{-19} \times 4 \times 10^{3} =$

$12.8 \times 10^{-16} J$

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

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

or 1000 V/m



Slope = −1000 V/m

y-int = 0

3 a) $C = \frac{E_0 A}{d} = \frac{8.85 \times 10^{-12} \times 10^{-4}}{2 \times 10^{-3}}$

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

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

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

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

$r_1 = 2r \quad \mathcal{E}_1 = 1.5V \quad r_2 = 2r \quad \mathcal{E}_2 = 1.5V \quad I = ? \quad R = 50r$

a) $-\mathcal{E}_2 + Ir_2 + Ir_1 - \mathcal{E}_1 + IR = 0$

$-1.5 + I(r_1 + r_2 + R) - 1.5V = 0$

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

$= 55.56 mA$

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

$0 = 25V_r - 37.5 + 25V_r - 37.5 + V_r$

50

$5 \cdot V_x = 7.5$

$V_x = 1.47\ V$

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

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

$$I = I_1 + I_2$$

$$= 30\ mA$$

Total PC $= P_{r_1} + P_{r_2} + P_R$

$$= (15m)^2\,2 + (15m)^2 \times 2 + (30m)^2 \times 50$$

$$= 45.9\ mW$$

$P_{Total} = 45\ mW$

C_1

$$P_{total} = (I^2) r_1 + (I^2 r_2) + (I^2) R$$

$$= (0.056A)^2 (2) + (0.056A^2)(2) + (0.056A)^2 (50)$$

$$= 0.17W = \boxed{170mW}$$

C_2 Parallel

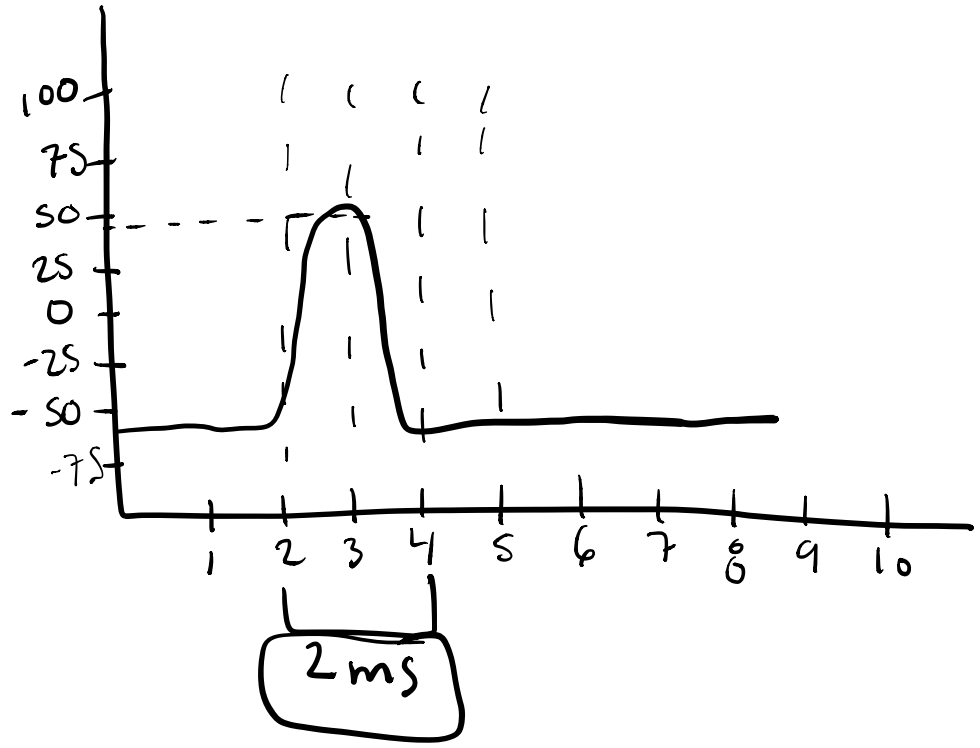
$$P_{total} = (I_1)^2 r_1 + (I_2)^2 r_2 + (I^2) R$$

$$= (0.015A)^2 (2) + (0.015A)^2 + (0.030)^2 (50)$$

$$= 0.045AW = \boxed{45.9mw}$$

4.2)

a)



b) $40-(-75)=40+75=$ **115 mV**