midterm

1) a) $E = \frac{1}{4\pi\varepsilon_0} \frac{q_1}{r^2}$ @ $r = 1mm$, $E = 2\times10^{-3}$

$2\times10^{-3} = \frac{1}{4\pi\varepsilon_0} = \frac{q}{(1\times10^{-3})^2}$

$r = 5mm \rightarrow E = \frac{1}{4\pi\varepsilon_0} \frac{q}{(5\times10^{-3})^2}$

$E = 2\times10^{-3} \times 10^{-6} \cdot \frac{1}{25\times10^{-6}} \rightarrow \boxed{8\times10^{-5} \frac{V}{C}}$

b) $8\times10^{-3} = \frac{1}{4\pi\varepsilon_0} \frac{1\times10^{-6}}{r^2}$

$3\,\mu C \rightarrow \; = E = \frac{1}{4\pi\varepsilon_0} \frac{3\times10^{-6}}{r^2}$

$= 8\times10^{3} \times 3\times10^{-6} = \boxed{24\times10^{-3} \frac{\mu}{C}}$

2) $m = 4\times10^{-16}$ kg , $E = 6131.25$ N/C

a) one electron $= 9.1\times10^{-31}$ kg

total # of electrons $= \frac{4\times10^{-16}}{9.1\times10^{-31}} = \boxed{4.39\times10^{14}}$

b) $q = 4.39\times10^{14} \times 1.6\times10^{-19} = 7.03\times10^{-5}C$

$qE = ma = \frac{7.03\times10^{-5}\times6131.25}{4\times10^{-16}} = \boxed{1.078\times10^{15}\ m/sec^2}$

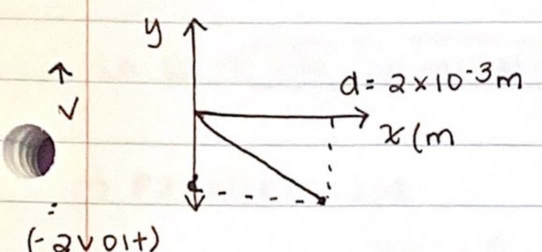
1) a) $K \cdot E = qV$

$KE_{Hyd} = 1.6\times10^{-19} \times 4\times10^{3} = 6.4\times10^{-16}\,J$

$KE_{He} = 2\times1.6\times10^{-19} \times 4\times10^{3} = 12.8\times10^{-16}\,J$

b) $E = \dfrac{\Delta V}{\Delta x2} = \dfrac{4\times10^{3}}{5\times10^{-2}} = \boxed{8\times10^{4}\,V/m}$

2) $E = 1\,KV/m$ or $1000\,v/m$



the slope is : $m = -1000V/m$

the y-int of the fxn is 0 as the graph initiates at the origin.

3) a) $C = \dfrac{\varepsilon_0 A}{d} = \dfrac{8.85\times10^{-12}\times10^{-4}}{2\times10^{-3}} = \boxed{4.425\times10^{-13}\,F}$

b) $E = \frac{1}{2}CV^2 = \frac{1}{2}\times 4.425\times10^{-13}\times 25 = \boxed{55.31\times10^{-13}\,J}$

4) To get more capacitance, we should connect the identical capacitors in parallel. The total capacitance will increase.

$I = ?$ $R = 50r$

1) a) $r_1 = 2r$

$E_1 = 1.5V$ $\rightarrow -E_2 + Ir_2 + Ir_1 - E_1 + IR = 0$

$r_2 = 2r$ $= -1.5 + I(r_1 + r_2 + R) - 1.5V = 0$

$E_2 = 1.5V$ $I = \frac{3V}{r_1 + r_2 + R} = \frac{3}{2+2+50} = \boxed{55.56 mA}$

b) $P_{total} = P_{r_1} + P_{r_2} + P_R$

$= (55.56 mA)^2 \times 2 + (55.56mA)^2 2 + (55.56mA)^2 \times 50$

$= \boxed{777.51 \text{ mWatts}}$

in $R \rightarrow \boxed{154.34 \text{ mWatts}}$

→ parallel case:

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

$25Vx - 37.5 + 25Vx - 37.5 + Vx = 0$

$= \boxed{1.47 V}$

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

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

$\left.\right\}$ 30 m Amp

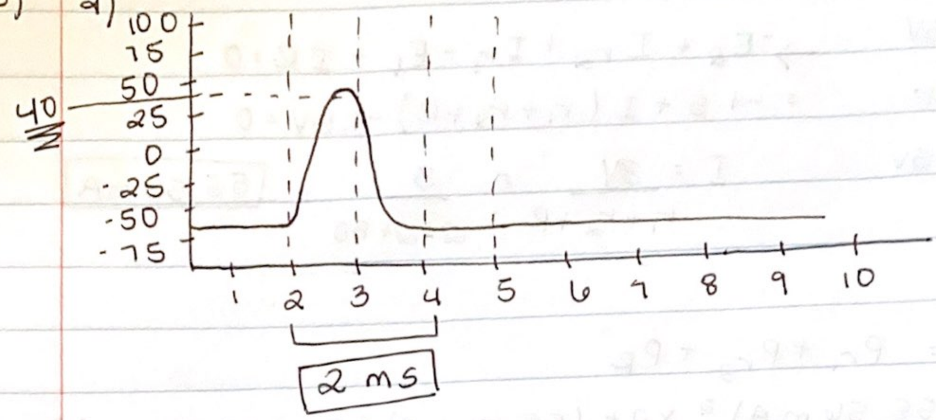
Total PC: $P_{r_1} + P_{r_2} + P_R$

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

$= \boxed{45.9 mW}$

$R \rightarrow \boxed{45 mW}$

2) a)



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