2.1 A) $E = \frac{1}{(4\pi\varepsilon_0)} \frac{q_1}{r^2}$ ($r = 1mm$)

r = distance

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

$2\times10^{-3} \times 1\times10^{-6} = \frac{q}{4\pi\varepsilon_0}$

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

$E = 2\times10^{-3} \times 10^{-6} \cdot \frac{1}{25\times10^{-6}}$

$8\times10^{-5}\ V/C$

B) $E = \frac{1}{(4\pi\varepsilon_0)} \frac{q}{r^2}$

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

$\frac{8\times10^{-3}}{1\times10^{6}} = 8\times10^{3}$

$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{3\times10^{-6}}{r^2}$

$= 8\times10^{3} \times 3\times10^{-3}$

$= 24\times10^{-3}\ N/C$

2.2 A) ↓ mass (gravity)

$m = 4\times10^{-16}kg$ $qE = 6131.25$

$g = 9.81\ m/s^2$ $qe = 1.6\times10^{-19}C$

$\frac{4\times10^{-16}(9.81)}{6131.25} = \frac{6.4\times10^{-19}C}{1.6\times10^{-19}C}$ = 4 electrons are on the drops

B) ↓ acceleration, ↓ mass (gravity) $a = \frac{mg - qE}{m}$

↑ qE

$q = (4-1) = 3\times1.6\times10^{-19}C$

$= 4.8\times10^{-19}C$

$q = \frac{(4\times10^{-16}\times 9.81) - (4.8\times10^{-19} * 6131.25)}{9\times10^{-16}}$

$= \frac{(39.24\times10^{-16}) - (29.43\times10^{-16})}{9\times10^{-16}} = 2.45\ m/s^2$

3.1 A) $q_e = 1.6 \times 10^{-19} C$

$1 kV = 1000 eV$; 4×10^3

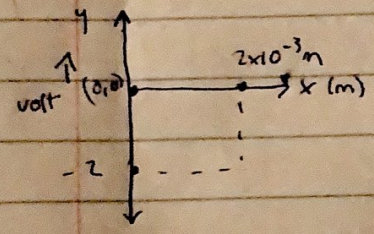
hydro - $(1.6 \times 10^{-19})(4 \times 10^3) = 6.4 \times 10^{-16}$ J

heli - $(2 \times 10^{-19})(4 \times 10^3) = 128 \times 10^{-16}$ J

B) $E = \frac{\Delta V}{\Delta x} = \frac{4 \times 10^3}{5\ cm} = 8 \times 10^2$ V/cm

3.2 $1 kV/m = 1000 v/m$ $\quad E = -\frac{\Delta V}{\Delta x}$

$2mm = 2 \times 10^{-3} m$



$\frac{-2}{2 \times 10^{-3}} = -1000 \frac{v/m}{}$ slope

yint = 0

3.3 A) $C = \frac{\varepsilon_0 A}{d}$

$\varepsilon_0 = 8.85 \times 10^{-12} F/m$

$A = 1 cm^2 = \_\_ m$

$(1 cm)^2 = (0.01 m)^2$

$0.001 = 1 \times 10^{-4}$

$C = \frac{8.85 \times 10^{-12} \times 1 \times 10^{-4}}{2 \times 10^{-3}} = 4.425 \times 10^{-13} F$

B) $C = 4.425 \times 10^{-13} F$

$V = 5$

$Q = C \Delta V$

$4.225 \times 10^{-13} (5) = 2.2125 \times 10^{-12}$ J

3.4 parallel

4.1 A) $r_1 = 2\Omega$ (series)

$E_1 = 1.5V$ $R = 50\Omega$

$r_2 = 2\Omega$ $I = ?$

$E_2 = 1.5V$

-loop rule = 0

$E_2 + E_1 + r_2 + r_1 + R = 0$

$1.5 + 1.5 \quad 2 + 2 + 50$

$I = \frac{3V}{54} = 55.56\ mA$

A) parallel

$\frac{V_x - E_1}{r_1} + \frac{V_x - E_2}{R_2} + \frac{V_x}{R} = 0$

$25\left(\frac{V_x - 1.5}{2}\right) + \left(\frac{V_x - 1.5}{2}\right)25 + \frac{V_x}{50} = 0$

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

50

$\frac{51V_x}{51} = \frac{75}{51}$

$V_x = 1.47V$

$I_1, I_2 = \frac{1.5 - 1.47}{2} = 15\ mAmp$

$I = I_1 + I_2 = 15 + 15 = 30\ mA$

B) series) $P_{tot} = P_R + P_{r_1} + P_{r_2}$

$= I^2R + I^2r_1 + I^2r_2$

$= (55.56)^2 \cdot 50 + (55.56)^2 \cdot 2 + (55.56)^2 \cdot 2 / 1000$

$= 154.34 + 6.17 + 6.17$

$= 777.51\ m\ watts$

Parallel) $P_{tot} = P_R + P_{r_1} + P_{r_2}$

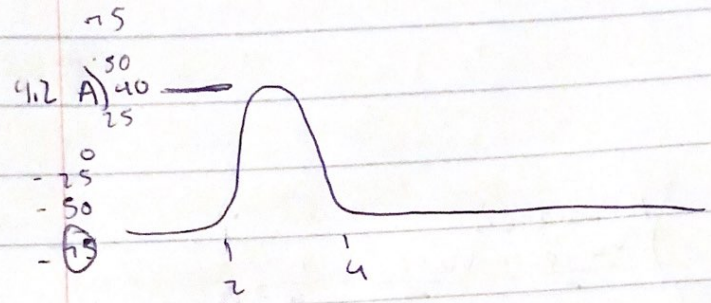
$= I^2R + I^2R_1 + I^2r_2$

$= (30)^2(50) + (15)^2(2) + (15)^2(2)/1000$

$= 45 + 0.45 + 0.45$

$= 45.9\ m\ watts$

4.2 A)



4 - 2 = 2 milliseconds

B) 40 + (+75)

= 115 millivolts