21. 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)

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

8×10^{-5} V/C ✓ N/C

18.5 / 20

Nice job

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 $qE = 6131.25$

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

↑ qE

$a = \frac{mg - qE}{m}$

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

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

$a = \frac{(4\times10^{-16} \times 9.81) - (4.8\times10^{-19} \times 6131.25)}{4\times10^{-16}}$ ✓

$= \frac{(39.24\times10^{-16}) - (29.43\times10^{-16})}{4\times10^{-16}} = 2.45\ m/s^2$

3.1 A) $q_e = 1.6\times10^{-19}C$

$1KV = 1000eV$; 4×10^{3}

hydro − $(1.6\times10^{-19})(4\times10^{3}) = 6.4\times10^{-16} J$

heli − $(2\times10^{-19})(4\times10^{3}) = 128\times10^{-16} J$ $-\frac{1}{2}$

$3.2 = 1.6\times2$

B) $E = \frac{\Delta V}{\Delta x} = \frac{4\times10^{3}}{5\ cm} = 8\times10^{2}\ V/cm$

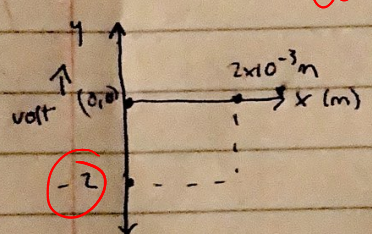
3.2 $1KV/m = 1000 V/m$ $E = -\frac{\Delta V}{\Delta x}$

$2mm = 2\times10^{-3} m$

Well done

$\frac{-2}{2\times10^{-3}} = -1000 V/m$ slope

yint = 0



3.3 A) $C = \frac{\varepsilon_0 A}{d}$ $C = \frac{8.85\times10^{-12}\times1\times10^{-4}}{2\times10^{-3}} = 4.425\times10^{-13}F$

$\varepsilon_0 = 8.85\times10^{-12}F/m$

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

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

$0.001 = 1\times10^{-4}$ nice job

B) $C = 4.425\times10^{-13}F$ true but how do you find energy?

$V = 5$? $-\frac{1}{2}$

$Q = C\Delta V$

$4.225\times10^{-13}(5) = 2.2125\times10^{-12} J$

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

[illegible] $E_2 + E_1 + r_2 + r_1 + R = 0$

$1.5 + 1.5$ $2 + 2 +$ 50

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

A) parallel)

$\frac{V_x - E_1}{r_1} + \frac{V_x - E_2}{r_2} + \frac{V_x}{R} = 0$

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

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

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

$V_x = 1.47V$

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

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

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

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

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

$= 154.34 + 6.17 + 6.17$

$= 777.51\ m\ watts$ $-\frac{1}{2}$ the 55 is mA

huge #

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

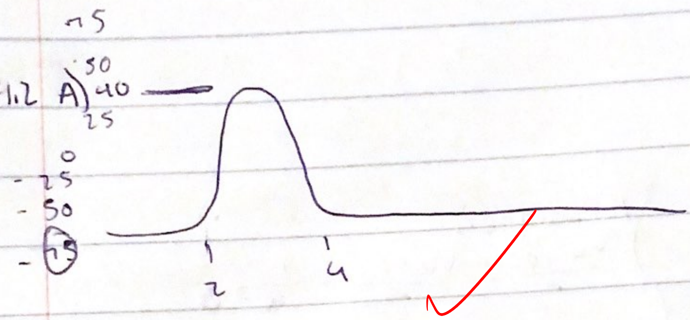
$= I^2R + I^2r_1 + I^2r_2$

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

$= 45 + 0.45 + 0.45$

$= 45.9\ m\ Watts$

4.2 A)



4-2 = 2 milliseconds

B) 40 + (+75)

= 115 millivolts