Physics Midterm

Katie Ann Huy

$\frac{18}{20}$

nice job!

2- Electric Charge + Fields

1. a.) $E = 2.0\times10^{-3}$ V/m ; $r = 1$mm

$E = ?$; $r = 5$mm

$E = k\frac{q}{r^2}$

$E = kq\left(\frac{1}{25}\right) \Rightarrow \frac{2.0\times10^{-3}}{25} \approx \boxed{8.0\times10^{-5}\ V/m}$ ✓

b.) $q = 1\mu C$ or 1×10^{-6} C

$E_c = 8.0\times10^{-3}$ V/m

value of E @ $q = 3\mu C$ or 3×10^{-6}

$E = k\frac{q}{r^2}$

$E = \frac{k}{r^2}(3) \Rightarrow 8.0\times10^{-3}(3) \approx \boxed{2.4\times10^{-2}\ V/m}$ ✓

2. a.) $m = 4\times10^{-16}$ kg

$E = 6131.25$ N/C down

e^- ?

$E = \frac{\text{weight}}{\text{charge}} \Rightarrow 6131.25 = \frac{3.92\times10^{-15}}{\text{charge?}} \Rightarrow \text{charge} = 6.393\times10^{-19}$ C

$W = m\cdot g$

$W = (4\times10^{-16})(9.8) = 3.92\times10^{-15}$ kg

$\#\text{ of } e^- = \frac{6.393\times10^{-19} C}{1.6\times10^{-19} C}$ ✓

$= 3.996 \approx \boxed{4\text{ electrons}}$

b.) removal of $1e^-$

↳ charge $= (6.393\times10^{-19}) - (1.6\times10^{-19}) \approx 4.79\times10^{-19}$ C

Acceleration: $a = \frac{E\cdot q}{m}$ $a = \frac{(6131.25 N/C)(4.79\times10^{-19} C)}{4\times10^{-16} kg} \Rightarrow \boxed{a = 7.34\ m/s^2}$

$-\frac{1}{2}$ gotta subtract a $g = 9.81\ \frac{m}{s^2}$

3. Potential Energy, Voltage + Capacitors

1. a.) $\Delta V = 4$kV

H = +1qe

He = +2qe

$\Delta U = q\Delta V$

$\Delta U = (3q_e)(4000V) = 12{,}000$ eV $\approx \boxed{12\ ekV}$ ✓

b.) $\Delta x = 5$cm

$E = \frac{\Delta V}{\Delta x} \Rightarrow E = \frac{4000V}{0.05m} = 80{,}000$ V/m $\approx \boxed{8.0\times10^{4}\ V/m}$ ✓

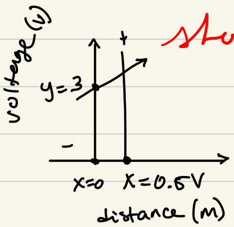
2. $E = 1$kV/m

$\Delta x = 2$mm

$\Delta V = \frac{1\times10^{3} V/m}{2\times10^{-3} m} = 0.5V$

$-\frac{1}{2}$ multiply

$\Delta V = E\,\Delta x$



should be linear ✓

$F(x) = mx + b$

$V(x) = Ex + b \Rightarrow 5.0 = (1\times10^{3})(2\times10^{-3}) + b$

$= 5 - 2 = b \Rightarrow \boxed{b = 3}$

3. a.) $C = \frac{\varepsilon_0 A}{d}$

$A = 1cm^2 \approx 1\times10^{-4} m^2$

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

$C = \frac{(8.85\times10^{-12})(10^{-4} m^2)}{(2\times10^{-3} m)} = \frac{8.85\times10^{-13}}{2} = \boxed{4.42\times10^{-13} C}$ ✓

3. cont.

b.) $V = 5V$

$U = \frac{1}{2}CV^2$

$U = \frac{1}{2}(4.42\times10^{-13}C)(5V)$

$= \boxed{1.105\times10^{-12}\,J}$

-1/2

gotta square the 5

4. To store more energy for the same voltage (capacitance), an identical capacitor should be placed in parallel.

$\Rightarrow C_{tot}$ (in parallel) $= C_1 + C_2 + C_n \ldots$

C_{tot} (in series) $= \left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_n}\ldots\right)^{-1}$

4 - Current, Resistance, & DC circuits

1. a.) Current through R?

In series: $I_{total} = I_1 = I_2 = I_3$

$I = \frac{V}{R_{total}} = \frac{3V}{54\Omega} = 0.06A$

I is same across all resistors, so current through R is $\boxed{0.06A}$

In parallel: V = same across all resistors.

$I_R = \frac{V}{R} \Rightarrow \frac{1.5V}{50\Omega} = 0.03A$

Since V is the same across all resistors, then $V = 1.5V$ (Volts are not additive in parallel), then I_R is $\boxed{0.03A}$

b.) Power consumption?

In series: $P = I^2R$

$P = (0.06)^2(54)$

$\boxed{P = 0.194\,W}$

In Parallel: $P = I^2R \rightarrow \frac{1}{R} = \frac{1}{2} + \frac{1}{2} + \frac{1}{50} = 0.98$

$P = (0.03)^2(0.98\Omega)$

$\boxed{P = 8.8\times10^{-4}\,W}$

-1/2

R?

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

c.) Checked & found to be correct.

hmm... how?

2. a.) Pulse width:

$3ms - 5ms \approx \boxed{3ms}$

b.) Peak to peak voltage:

$35mV - (-75mV) = \boxed{110mV}$