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Physics 135 B
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5/10/21

Physics Midterm

1.) a.) $E_c = \frac{KQ}{r^2}$

$$2.00\times10^{-3} = 9\times10^{9} \times \frac{q}{(0.001)^2}$$

$$q = 2.2222\times10^{-19}$$

$$E_c = \frac{(9\times10^{9})(2.2222\times10^{-19})}{(0.005)^2}$$

$$\boxed{E_c = 7.99992\times10^{-5} \text{ or } 8\times10^{-5}\ V/m}$$

b.) $E_c = 8.00\times10^{-3}\ V/m$ at 1 μC charge at 3 times the charge the value of E_c will change by the same factor so,

$$8.00\times10^{-3} \times 3 = \boxed{24\times10^{-3}\ V/m}$$

2.7 a.) mass = 4×10^{-16} Kg oriented downward

$E_c = 6131.25$ N/C

$F = qE$ $\quad mg = qE$ $\quad q = ne$ (n = number of electrons, e = electron charge)

$e = (1.6 \times 10^{-19})$

$q = \frac{mg}{E}$

$ne = \frac{(4 \times 10^{-16})(9.8)}{(6131.25)}$

$n = \frac{(4 \times 10^{-16})(9.8)}{(6131.25)(1.6 \times 10^{-19})}$

$n = 4$ electrons

b.) Remove one electron.

4 electrons total so charge is

$6.4 \times 10^{-19} - 1.6 \times 10^{-19} = 4.8 \times 10^{-19} = q$ (charge of one electron)

$F_E = qE$

$F_E = (4.8 \times 10^{-19})(6131.25) = 2.943 \times 10^{-15}$

$F_g = mg$

$F_g = (4 \times 10^{-16})(9.8) = 3.92 \times 10^{-15}$

$F = ma$

$a = \frac{9.77 \times 10^{-16}}{(4 \times 10^{-16})} = 2.44 \text{ m/s}^2$ downwards

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

$1eV = 1.60218 \times 10^{-19} J$

$1J = 6.242 \times 10^{18}$

$U = q\Delta V \qquad U_{tot} = KE_{tot}$

hydrogen $= (1.6 \times 10^{-19})(4000V) = 6.4 \times 10^{-16} J \times 6.242 \times 10^{18}$

helium $= 2(1.6 \times 10^{-19})(4000V) = 1.28 \times 10^{-15} J \times 6.242 \times 10^{18}$

hydrogen = 3994.88 eV

helium = 7989.76 eV

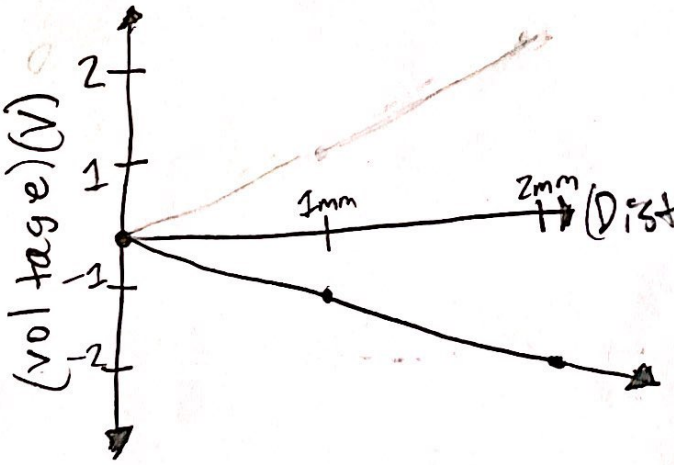
together would be

11,984.64 eV

b.) $E = -\frac{\Delta V}{\Delta x}$

$E = \frac{-4000}{0.05m} =$ $-80{,}000\ V/m$

2.)



$E = 1KV/m$

$E = -\frac{\Delta V}{\Delta x}$

slope must be negative as in order for E to be positive the voltage must be negative.

The y-intercept must be 0 as when distance is zero voltage must also be 0.

3.) a) $C = \frac{\epsilon_0 A}{d}$ $\epsilon_0 = 8.85 \times 10^{-12}$

$$C = \frac{(8.85 \times 10^{-12})(0.0001\ m^2)}{(0.002)} = \boxed{4.43 \times 10^{-13}\ F}$$

b.) $E = \frac{CV^2}{2}$

$$= \frac{(4.43 \times 10^{-13})(25)}{2} = \boxed{5.54 \times 10^{-12}\ J}$$

4.) In **parallel** as it would be

$C = C_1 + C_2 + C_3 \ldots$ instead of the inverse

$C = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \ldots$

Parallel results in more capacitance.

1.) a.) $\downarrow$series $\mathcal{E}_1 + \mathcal{E}_2 \ldots = 0$

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

$$3V = Ir_1 + Ir_2 - IR$$

$$3V = I(r_1 + r_2 + R)$$

$$3V = I(54\,\Omega)$$

$$I = \frac{3V}{54\,\Omega}$$

In series = $\boxed{I = 0.0556\ A}$

b.) $\downarrow$Parallel

$$I_t = I_1 + I_2$$

Parallel will essentially only include one battery in the calculations.

V will only be 1.5 since it is in parallel. $I = \frac{1.5V}{50\,\Omega} = 0.03\ A$

$\boxed{I = 0.03\ A}$

$$I = \frac{\left(\frac{1.5}{2} + \frac{1.5}{2}\right)}{50}$$

b) Series

$P = IV$

$P = (0.0556)(3)$

$P_{total} = 0.1668\ W$

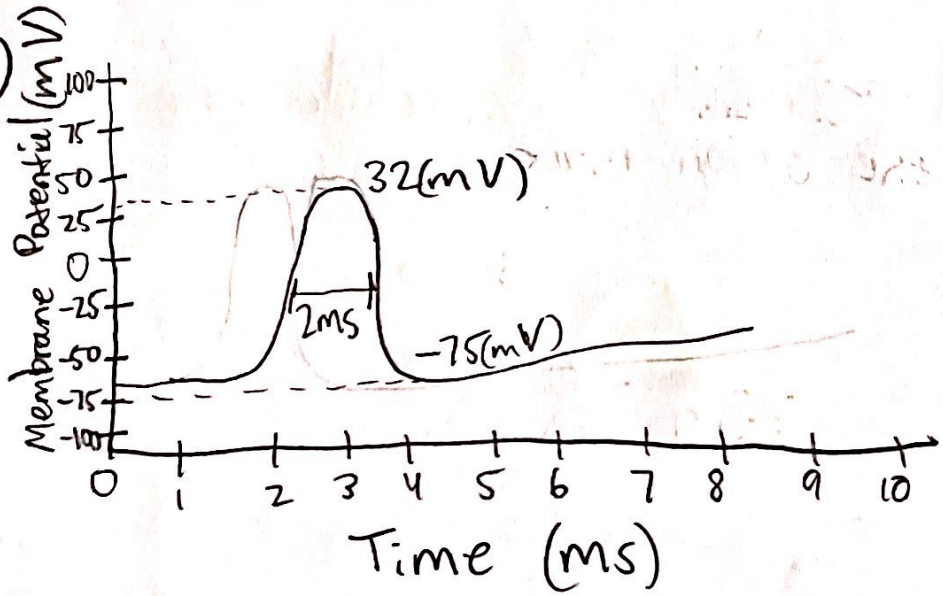
Parallel

$P = IV$ ← Since it is in parallel only 1.5 volts.

$P = (0.03)(1.5)$

$P_{total} = 0.045\ W$

2.)



a.) Pulse width is 2 ms.

b) Greatest voltage = 32mV

Least voltage = -75mV

$32 + 75 =$ **107 mV**