PHYS135B Midterm

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1. a) $E = \frac{1}{4\pi E_0} \times \frac{q_1}{r^2}$

@ $r = 1mm$

$2\times10^{-3} = \frac{1}{4\pi E_0} \times \frac{9}{(1\times10^{-3})^2}$ $\quad 2\times10^{-3}(1\times10^{-6}) = \frac{9}{4\pi E_0}$

@ $r = 5\ mm$

$E = \frac{1}{4\pi E_0} \times \frac{9}{(5\times10^{-3})^2}$

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

$= 0.08\times10^{-3}$

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

b) $8\times10^{-3} = \frac{1}{4\pi E_0} \times \frac{1\times10^{-6}}{r^2}$

$8\times10^{3} = \frac{1}{4\pi E_0 r^2}$

$E = \frac{1}{4\pi E_0} \times \frac{3\times10^{-6}}{r^2}$ $\quad = 8\times10^{3}(3\times10^{-6})$

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

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2. a) $\frac{qE}{E} = \frac{mg}{E}$ $q = \frac{mg}{E} = \frac{4 \times 10^{-16} \times 9.8}{6131.25}$

$= 6.39348 \times 10^{-19}$

$\frac{q}{e} = \frac{n \cdot e}{e}$ $n = \frac{q}{e} = 3.995922528$ $\boxed{\approx 4}$

b) $Fe = q'E$ $q' = q - e$ $a = \frac{Fg - Fc}{m}$

$= 2.939 \times 10^{-15}$ N. $= 4.79 \times 10^{-19}$

$m' = m - m_e$ $Fg = m'g$

$= 4 \times 10^{-16}$ $= 3.92 \times 10^{-15}$ N

$a = \frac{3.92 \times 10^{-15} N - 2.939 \times 10^{-15} N}{4 \times 10^{-16}}$

$\boxed{= 2.45 \ \frac{m}{s^2}}$

1. a) $KE = qV$

$KE_H = 1.6 \times 10^{-19} (4 \times 10^3)$

$\boxed{= 6.4 \times 10^{-16} \text{ J}}$

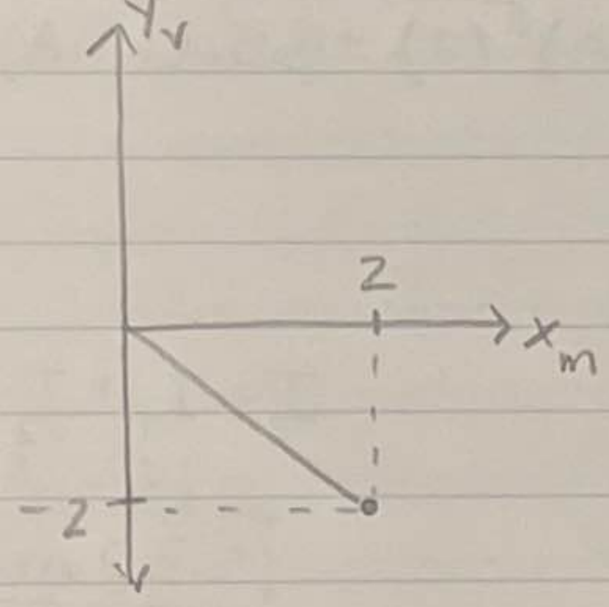
$KE_{He} = 2 \times 1.6 \times 10^{-19} (4 \times 10)^3$

$\boxed{= 12.8 \times 10^{-16} \text{ J}}$

b) $E = \frac{\Delta V}{\Delta x} = \frac{4 \times 10^3}{5 \times 10^{-2}} = \boxed{8 \times 10^4 \frac{V}{m}}$

2. $E = 1000 \frac{V}{m}$ $\quad d = 2 \times 10^{-3} \text{ m}$ $\quad \boxed{y\text{-int} = 0}$

$m = -1000 \frac{V}{m}$



3. a) $C = \frac{E_0 A}{d} = \frac{8.85 \times 10^{-12} \times 10^{-4}}{2 \times 10^{-3}}$ $\boxed{= 4.425 \times 10^{-13} \text{ f}}$

b) $E = \frac{1}{2} CV^2 = \frac{1}{2} \times 4.425 \times 10^{-13} \times 25$

$\boxed{= 55.31 \times 10^{-13} \text{ J}}$

a)

4. We shald connect the identical capacitors in parallel.

b) $C_{tot} = C_1 + C_2 + C_3$

$E = \frac{1}{2}(3C)V^2$

1. a) a) serial case

$-E_2 + I r_2 + I r_1 - E_1 + IR = 0$

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

$I = \frac{3V}{r_1 + r_2 + R} = \frac{3}{4+50}$ $\boxed{= 55.56\ mA}$

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

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

$\boxed{= 777.5\ mW}$

a) parallel case

$I = I_1 + I_2$

$= 15\ mA + 15mA$

$\boxed{= 30\ mA}$

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

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

$51V_x = 75 \quad V_x = 1.47V$

b) $P_{tot} = P_{r_1} + P_{r_2} + P_R = I_1^2 R_1 + I_2^2 r_2 + I^2 R$

$= 0.45mW + 0.45\ mW + 45\ mW$

$\boxed{= 45.9\ mW}$

2. a) ≈2 milliseconds

b) $40 - (-75) = 115$

115 mV

c) Time required for a nerve signal to travel from toe to spinal cord is