③ a) area = 1 cm²

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

$C = \frac{(8.85 \times 10^{-12})(1 \times 10^{-4})}{(2 \times 10^{-3})}$

$\boxed{C = 4.425 \times 10^{-13}}$

b) $E = \frac{1}{2} CV^2$

$E = \frac{1}{2}(4.425 \times 10^{-13})(5^2)$

$\boxed{E = 5.531 \times 10^{-12}\ J}$

④ We should connect an identical capacitor to the first in parallel because the capacitance gets added up. Therefore, storing more energy

ex. parallel = $C_1 + C_2 + C_3 \ldots$

Current, Resistance, and DC circuits

① $r_1 = r_2 = 2\Omega$ $\quad \varepsilon_1 = \varepsilon_2 = 1.5v$ $\quad R = 50\,\Omega$ $\quad$ serial case = 3v $\quad$ parallel case = 1.5

a) $-E_2 + Ir_2 + Ir_1 - E_1 + IR = 0$

$-1.5 + I(r_2 + r_1 + R) - E_1 = 0$

$-3v + I(r_2 + r_1 + R) = 0$

$I = \frac{3v}{r_2 + r_1 + R}$

$= \frac{3v}{2+2+50}$

$I\ \boxed{= 55.556\ mA}$

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

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

$51V_r = 75$

$V_r = 1.47\,v$

$I_1 = \frac{1.5 - 1.47}{2} = 15\ mA$

$I_2 = \frac{1.5 - 1.47}{2} = 15\ mA$

$I = I_1 + I_2$

$\boxed{I = 30\ mA}$

b) Power Consumption

Serial

$P_{total} = I^2 r_1 + I^2 r_2 + I^2 R$

$= (55.556)^2(2) + (55.556)^2(2) + (55.556)^2(50)$

$= 6.173 + 6.173 + 154.3235$

$\boxed{= 166.669\ mW}$

Parallel

$P_{total} = (15m)^2(2) + (15m)^2(2) + (30m)^2(50)$

$= 0.45mW + 0.45mW + 45mW$

$\boxed{= 45.9\ mW}$

② a) 2 ms

$-\frac{1}{2}$

b) 100 mV ?

19.5/20

nice work!

Phys135B Midterm

① a) $E_c = 2.00\times10^{-3}$ V @ 1 mm $E_c = ?$ @ 5mm

$2.00\times10^{-3} = \frac{1}{4\pi\varepsilon}\left(\frac{q}{(1\times10^{-3})^2}\right)$ $E = \frac{1}{4\pi\varepsilon}\left(\frac{q}{(5\times10^{-3})^2}\right)$

$2.00\times10^{-3}(1\times10^{-6}) = \frac{q}{4\pi\varepsilon}$ $E = \frac{q}{4\pi\varepsilon}\left(\frac{1}{25\times10^{-6}}\right)$

$E = 2\times10^{3}(1\times10^{-6}) \times \left(\frac{1}{25\times10^{-6}}\right)$

$E = 0.00008 = \boxed{8\times10^{-5}\ \text{V/m}}$

b) $E_c = 8.00\times10^{-3}$ V/m @ 1 μC $E_c = ?$ @ 3 μC

$\frac{8.00\times10^{-3}}{1\ \mu C} = \frac{x}{3\ \mu C}$

$x = 3(8\times10^{-3})$

$\boxed{F_c = 24\times10^{-3}\ \text{V/m}}$

② mass $= 4\times10^{-16}$ Kg E-field $= 6131.25$ N/C downward

a) $q = \frac{(4\times10^{-16})(9.8)}{6131.25}$ $n = \frac{q}{1.6\times10^{-19}}$

$q = 6.39348\times10^{-19}$ $\boxed{n = 3.9959 \approx 4}$

b) $q' = q - e$ $F_e = q'E = 2.939\times10^{-15}$

$q' = 4.79348\times10^{-19}$ $F_g = m'g = 3.92\times10^{-15}$

$a = \frac{F_g - F_e}{m}$ $m = 4.0\times10^{-16}$

$a = \frac{3.92\times10^{-15} - 2.939\times10^{-15}}{4.0\times10^{-16}}$

$\boxed{a = 2.453\ \text{m/s}^2}$

Potential Energy and Voltage, Capacitors

① a) $\Delta V = 4$ kV H $= +1 q_e$ He $= +2 q_e$

$KE = qv$

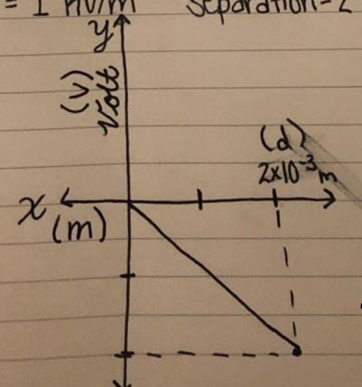
hydrogen $= KE = (+1)(1.6\times10^{-19})(4\times10^{3}) = \boxed{6.4\times10^{-16}\ \text{J}}$

helium $= KE = (+2)(1.6\times10^{-19})(4\times10^{3}) = \boxed{12.8\times10^{-16}\ \text{J}}$

b) $\Delta x = 5$ cm

$E = \frac{\Delta V}{\Delta x} = \frac{4\times10^{3}}{5\times10^{-2}} = \boxed{8\times10^{4}\ \text{V/m}}$

② E = 1 kV/m separation = 2 mm $E = -\Delta d/\Delta x$



y-intercept = (0,0)
starts @ origin