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PHYS 135B : EMP
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Midterm Exam

Electric Charge and Electric Fields

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

$2.00\times10^{-3} = 1/4\pi\,(q/(1\times10^{-3})^2)$

$2.00\times10^{-3}(1\times10^{-6}) = q/4\pi$

$E_c = ?$ @ 5 mm

$E = 1/4\pi\,(q/(5\times10^{-3})^2$

$E = q/4\pi\,(1/25\times10^{-6})$

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

$E = .00008$

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

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

$\frac{8\times10^{-3}}{1mC} = \frac{x}{3mC}$

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

$x = 24\times10^{-3} \rightarrow \boxed{E_c = 24\times10^{-3}\ V/m}$

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

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

$q = 639348\times10^{-19}$

$n = \frac{q}{1.6\times10^{-19}}$

$n = 3.9959$

$\boxed{n \approx 4}$

b) $q = q - e$

$q = 4.79348\times10^{-19}$

$a = \frac{Fg - Fe}{m}$

$Fe = q'E = 2.939\times10^{-15}$

$Fg = m'g = 3.92\times10^{-15}$

$m = 4\times10^{-16}$ Kg

$a = \frac{3.92\times10^{-15} - 2.939\times10^{-15}}{4\times10^{-16}}$

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

Midterm Exam

Potential Energy and Voltage, Capacitors

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

$H = +1qe$ Hydrogen: $KE = (+1)(1.6\times10^{-19})(4\times10^{3}) = \boxed{6.4\times10^{-16}\,J}$

$He = +2qe$ Helium: $KE = (+2)(1.6\times10^{-19})(4\times10^{3}) = \boxed{12.8\times10^{-16}\,J}$

$KE = qV$

b) $\Delta x = 5\,cm$

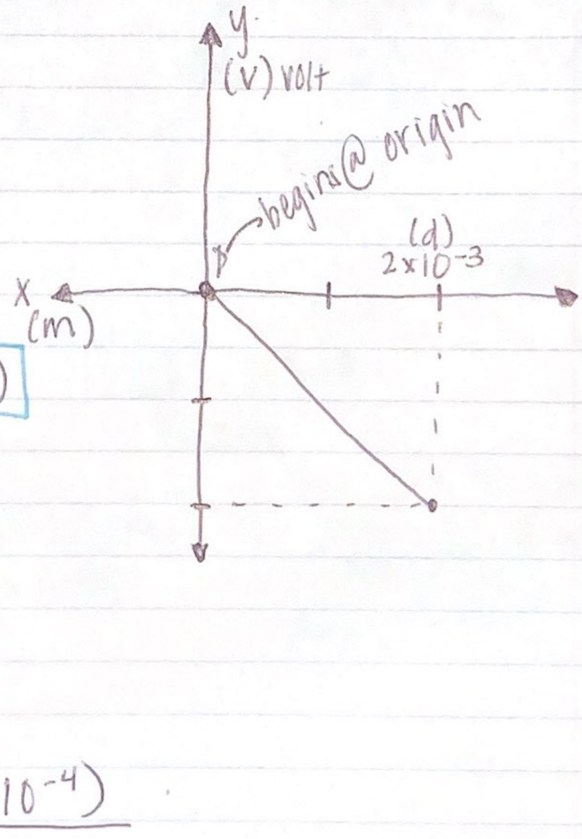
$E = \frac{\Delta V}{\Delta x} = \frac{4\times10^{3}}{5\times10^{-2}}$

$\boxed{E = 8\times10^{4}\,V/m}$

2 $E = 1\,kV/m$

separation = 2mm

$E = -\Delta d/\Delta x$



$\boxed{\text{y-intercept} = (0,0)}$

3 a) area = $1\,cm^2$

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

$C = \frac{(8.85\times10^{-12})(1\times10^{-4})}{(2\times10^{-3})}$

$\boxed{C = 4.425\times10^{-13}}$

b) $E = \frac{1}{2}CV^2$ energy stored = 5V

$E = \frac{1}{2}(4.425\times10^{-13})(5^2)$

$\boxed{E = 5.531\times10^{-12}\,J}$

Midterm Exam

④ We should connect $\boxed{\text{in parallel}}$ because the capitance would be added up, equalling more energy stored.

Current, Resistance, and DC Circuits

① $r_1 = r_2 = 2\Omega$

$\varepsilon_1 = \varepsilon_2 = 1.5V$

$R = 50\Omega$

serial case = 3V

parallel case = 1.5V

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

$-1.5 + I(r_2 + r_1 + R) = 0$ ✓

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

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

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

serial $\boxed{I = 55.556mA}$

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

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

$51V_r = 75$

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

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

$I = I_1 + I_2$

parallel $\boxed{I = 30mA}$

b) Serial

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

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

serial $= 6.173 + 6.173 + 154.3235$

$\boxed{= 166.669\ mW}$

Parallel

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

$= .45\ mW + .45\ mW + 45\ mW$

$\boxed{= 45.9\ mW}$ parallel

② a) $\boxed{2ms}$

b) $\boxed{100mV}$