Shayla Sakkaphanaune
3/30/2022
PHYS 1358

Midterm

electric charge + e-fields

1) ⓐ $E_c = 2.00\times10^3$ V/m, $r_1 = 1$ mm $= 0.001$m, $E_{c_2} = ?$, $r_2 = 5$mm $= 0.005$m

$E_1 = \frac{kQ}{r^2}$, $E_2 = \frac{kQ}{5r^2} = \frac{kQ}{25r}$, $E_2 = \frac{1}{25}(E_1) = \frac{1}{25}(2\times10^3)$

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

ⓑ $q = 1\mu C$, $E_c = 8.00\times10^3$ V/m, $E_{c_2} = ?$, $q_2 = 3\mu C$

$E_1 = \frac{kQ}{r^2}$, $E_2 = \frac{k3Q}{r^2} = 3(E_2)$

$= 3(8.00\times10^{-3}$ V/m)

$= 0.024$ V/m

2) ⓐ $m_e = 4\times10^{-16}$ kg, $E = 6131.25$ N/C, #e- = ?, $q_{e^-} = 1.6\times10^{-19}$C

$F = ma = (4\times10^{-16}\text{kg})(9.81\text{m/s}^2)$

$F_g = 3.924\times10^{-15}$ N

$F = qE$

$q = \frac{F}{E} = \frac{3.924\times10^{-15}\text{N}}{6131.25\text{N/C}}$

$= \frac{6.4\times10^{-19}\text{C}}{1.6\times10^{-19}\text{C}} = 4e^-$

ⓑ $a = ?$, $-1e^-$

$F_{e^-} = qE = (1.6\times10^{-19}\text{C})(6131.25\text{N/C})$

$F_{e^-} = 9.81\times10^{-16}$ N

$F = ma \rightarrow a = \frac{F}{m} = \frac{(9.81\times10^{-19}\text{N})^3}{4\times10^{-16}\text{kg}}$

$a = 2.36\times10^{-30}$ m/s^2

capacitors + PE

1) ⓐ $KE_{tot} = ?$, $q_H = 1q_e$, $q_{He} = 2q_e$, $\Delta V = 4$kV

$KE_0 + PE_0 = KE_f + PE_f$

$KE_f = -PE_f = q\Delta V$

$= (1q_e)(4\text{kV}) + (2q_e)(4\text{kV})$

$= 4$kJ $+ 8$kJ

$= 12\text{kJ}\cdot\frac{1000\text{J}}{1\text{kJ}}\cdot\frac{1\text{eV}}{1.6\times10^{-19}\text{J}}$

$= 7.5\times10^{22}$ eV

ⓑ $\Delta x = 5$cm, $E = ?$

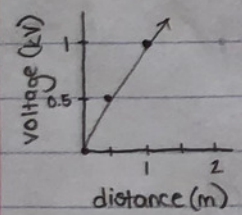
$\Delta V = Ed$

$E = \frac{\Delta V}{d}$

$= \frac{4\text{kV}}{5\text{cm}}$

$= 0.8$ kV/cm

★2) $E = 1$kV/m, $\Delta x = 2$mm $= 0.002$m



y-int = (0,0)

3) ⓐ $a = 1\text{cm}^2 = 0.01$m, $C = ? = \frac{\varepsilon_0 A}{d}$

$= \frac{(8.85\times10^{-12}\text{F/m})(0.01\text{m}^2)}{0.002\text{m}}$

$= 4.425\times10^{-11}$

$= 4.43\times10^{-11}$ F

ⓑ $V = 5$V, $E_{cap} = ?$

$E_{cap} = \frac{QV}{2}$

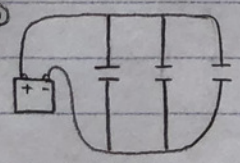
$Q = CV = (4.43\times10^{-11}\text{F})(5\text{V})$

$Q = 2.213\times10^{-10}$C

$E_{cap} = \frac{(2.2\times10^{-10}\text{C})(5\text{V})}{2}$

$= 5.53\times10^{-10}$ J

4) ⓐ an identical capacitor should be connected to the first in parallel to store more energy w/ the same voltage

ⓑ 

$E_{tot} = ? = \frac{QV}{2}$

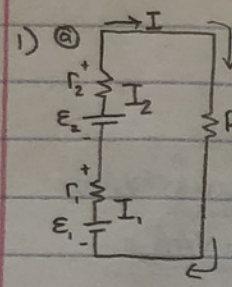
$= \frac{(C_{tot}V)V}{2}$

$= \frac{3(4.43\times10^{-11}\text{F})(5\text{V})(5\text{V})}{2}$

$= 1.66\times10^{-9}$ J

current,
resistance,
+ DC circuits

1) ⓐ



$r_1 = r_2 = 2\Omega$

$\mathcal{E}_1 = \mathcal{E}_2 = 1.5V$ (emf)

$R = 50\Omega$

$I = ?$

$I = \frac{V}{R_s} = \frac{3V}{2\Omega + 2\Omega + 50\Omega}$

$I = 0.05\bar{5}A$

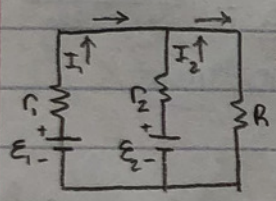
$emf = Ir_1 + Ir_2 + IR$

$3V = (0.05\bar{5}A)(2\Omega) + (0.05A)(2\Omega) + I(50\Omega)$

$3V = 0.2\bar{2}V + 50I$

$50I = 2.\bar{7}V$

$I = 0.055A$



$I = I_1 + I_2$

$\mathcal{E}_1 = I_1 R_1$

$I_1 = \frac{\mathcal{E}_1}{R_1} = \frac{1.5V}{2\Omega}$

$I_1 = 0.75A$

$I = 0.75A + 0.75A$

$= 1.5A$

ⓑ $P_s = I_s V_s = (0.055A)(3V)$

$= 0.16W$

$P_p = I_p V_p = (1.5A)(3V)$

$= 4.5W$

2) ⓐ

pulse-width = 4 - 2ms $= 2ms$

ⓑ

peak-to-peak V = 40 + 60mV $= 100mV$