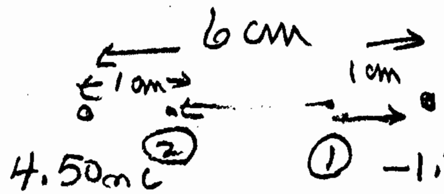
EXAM I A

(a) $F = \frac{K q_1 q_2}{r^2}$ $\quad q_2 = \frac{.60 * .5^2}{(9\times10^9)(.5\times10^{-6})}$ $= \boxed{3.33\times10^{-5}\ \text{Coulombs}}$ +

(b) $\Phi_{Total} = \frac{q_{enc}}{\varepsilon_0}$ $\quad \Phi_{1Face} = \Phi_{Total}/6 = \frac{q_{enc}}{6\varepsilon_0} = \frac{6\times10^{-9}}{(6)(8.85\times10^{-11})} = 11.3\ \text{V-m}$ or $\left(\frac{N}{C}\text{-}m^2\right)$

(c) $V = \frac{Kq}{r}$ $\quad r = \frac{9\times10^9\ 6\times10^{-11}}{50} = .011\ m$

(d) $C = \frac{Q}{V}$ $\quad V = \frac{Q}{C} = \frac{.450\times10^{-6}}{500\times10^{-12}} = .9\times10^3\ V = 900\ \text{Volts}$

2. 

$U_1 + K_1 = U_2 + K_2$ 5 ~~10~~ 5 write it right understand it.

$V_1 e + 0 = V_2 e + \frac{1}{2} m_e v_e^2$

$$V_1 = \frac{9\times10^9(-1.2\times10^{-9})}{10^{-2}} + \frac{9\times10^9(4.5\times10^{-9})}{5\times10^{-2}} = -270\ V \ +5$$

$$V_2 = \frac{(9\times10^9)(-1.2\times10^{-9})}{5\times10^{-2}} + \frac{9\times10^9(4.5\times10^{-9})}{10^{-2}} = 3834\ V \ +5$$

$$v_e = \sqrt{\frac{2e}{m_e}(V_1 - V_2)}$$

$$\boxed{v_e = 3.8\times10^{7}\ m/s}$$

Sign wrong $-\cancel{2}$

-2

Unit

3. (a) $r<a$ Gauss's Law $\oint \vec{E}\cdot d\vec{A} = \frac{q_{encl}}{\varepsilon_0}$

Use spherical gaussian Surface. Then $\vec{E}\cdot d\vec{A} = E\,dA$. E is constant for given r $\therefore$ $\oint \vec{E}\cdot d\vec{A} = E\int dA = 4\pi r^2$ for all regions

$q_{encl} = -Q$

$\therefore\ E\,4\pi r^2 = -\frac{Q}{\varepsilon_0}$

$E = -\frac{1}{4\pi r^2}\frac{Q}{\varepsilon_0}$ [- Sign means it is inward along a radius]

(b) $a<r<b$ $E=0$ because it is in a conductor.

(c) $r>b$ $q_{enc} = -Q - 3Q = -4Q$

$E = -\frac{1}{4\pi r^2}\frac{4Q}{\varepsilon_0}$ [inward along radius]

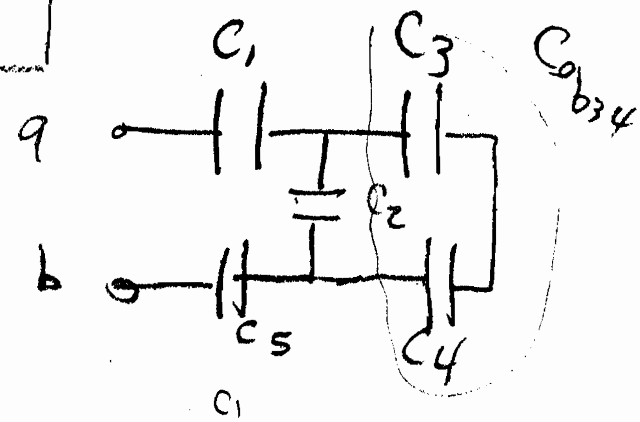
(d) on outer Surface : $q_{total} = -4Q$ [+Q is pulled in by -Q in cavity]

$\therefore\ \sigma = \frac{-4Q}{4\pi b^2} = -\frac{Q}{\pi b^2}$

(e) $V = -\int_\infty^r \vec{E}\cdot d\vec{l} = -\int_\infty^b -\frac{4Q}{4\pi r^2\varepsilon_0}\hat{r}\cdot d\vec{l} - \int_b^a \vec{\emptyset}\cdot d\vec{l} - \int_a^r \frac{-Q}{4\pi r^2}\hat{r}\cdot d\vec{l}$

$= -\frac{K4Q}{b} + \emptyset - KQ\left[\frac{1}{r} - \frac{1}{a}\right]$

$$\boxed{V = -\frac{K4Q}{b} - \frac{KQ}{r} + \frac{KQ}{a}}$$

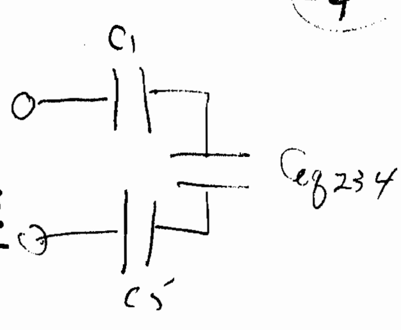


4. (a) $\frac{1}{C_{eq34}} = \frac{1}{6.2} + \frac{1}{5}$ = 2.77 μF

$C_{eq234} = 2.77 + 5 = 7.77$ μF

$\frac{1}{C_{eq}} = \frac{1}{7.77} + \frac{1}{6.2} + \frac{1}{5.0}$

$C_{eq} = 2.04$ μF



(b) $Q_{C1} = Q_{C5} = Q_{Ceq} = 2.04\times10^{-6}\times 540V = 1.11\times10^{-3}C$

$V_1 = \frac{1.11\times10^{-3}}{6.2\times10^{-6}} = 177.8V$ $V_5 = \frac{1.11\times10^{-3}}{5\times10^{-6}} = 220.4V$

$V_{eq234} = V_2 = 540 - 220.4 - 177.8 = 141.8V$

$Q_2 = 5 \times 141.8 \times 10^{-6} = 7.1 \times 10^{-4} C$

$Q_4 = Q_3 = Q_1 - Q_2 = 3.93 \times 10^{-4} C$

$V_3 = (6.2 \times 10^{-6})^{-1} \, 3.93 \times 10^{-4} C = 63.3V$

$V_4 = 3.93 \times 10^{-4} / 5 \times 10^{-6} = 78.5V$