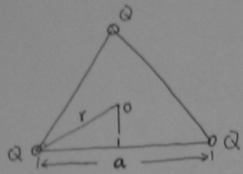
1. $a = 0.06\ m$

$Q = 2.0\times10^{-6}\ C$.

$r = \frac{a}{\sqrt{3}} = 3.464\times10^{-2}\ m$.



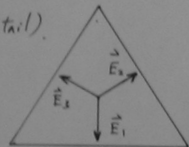
(a). $V = 3\cdot\frac{KQ}{r}$

$= \frac{(3)(8.99\times10^{9})(2.0\times10^{-6})}{3.464\times10^{-2}}$

$= 1.56\times10^{6}\ V$

(b) By symmetry (OR Head-to-tail).

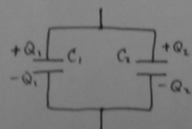
$\vec{E} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3 = 0$.



2. Total charge after combination:

$Q = Q_1 + Q_2$

Total capacitance: $C = C_1 + C_2$



(a). Final Voltage: $V = \frac{Q}{C}$

$= \frac{Q_1+Q_2}{C_1+C_2}$ $\cancel{(3.0+4.0)\times10}$

$= \frac{10.0\times10^{-6} + 18.0\times10^{-6}}{3.0\times10^{-6} + 4.0\times10^{-6}}$

$= 4.0$ Volts.

(b). Now. $C_1' = K C_1 = 25\ C_1$

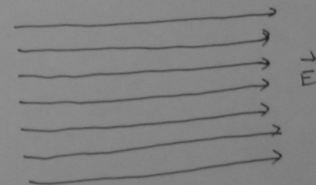
Total capacitance: $C' = C_1' + C_2 = 25\,C_1 + C_2$

$V = \frac{Q_1+Q_2}{25C_1+C_2} = V_2$ (The voltage across the second capacitor is the same as the total voltage.)

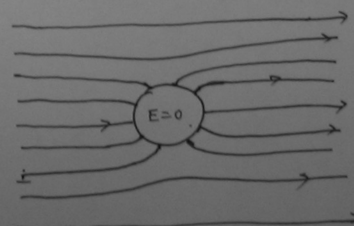
$= \frac{(10.0+18.0)\times10^{-6}}{(3\times25+4)\times10^{-6}}$

$= 0.354$ Volts.

3. (a).

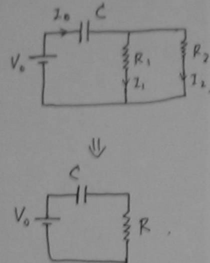


(b).



4. Total resistance:

$$R = R_1 // R_2 = \frac{R_1 R_2}{R_1 + R_2}$$



Total current:

$$I = \frac{V_0}{R} e^{-t/RC}.$$

(a). at $t=0$, $I_0 = \frac{V_0}{R}$.

The current through R_1 at $t=0$:

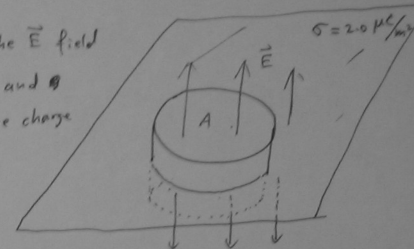
$$I_1 = \frac{V_0}{R_1} = \frac{20.0\,V}{11.0\,\Omega} = 1.82\ A.$$

(b). $I_0 = \frac{V_0}{R} = \frac{20.0V}{\frac{R_1 R_2}{R_1+R_2}} = \frac{20.0\,(11.0+18.5)}{11.0\times 18.5} = 2.90\ A.$

(c). $I_1 = 0$ for $t \to \infty$ (Since the capacitor will be fully charged, The voltage across the capacitor will be the same as the battery. Then, No current can flow.

5.

By symmetry, the $\vec{E}$ field should be uniform and perpendicular to the charge sheet.



consider a gaussian surface being in a cylindrical shape. The electric field lines will go through the Top and bottom areas. Then, the total flux through the Gaussian surface:

$$\therefore \Phi = \Phi_{Top} + \Phi_{bottom} + \Phi_{side}.$$

$$= E \cdot A + EA + 0.$$

$$= 2EA.$$

Charge enclosed: $q = \sigma A$

Gauss's Law: $\Phi = \frac{q}{\varepsilon_0}$.

$$2EA = \frac{\sigma A}{\varepsilon_0}$$

$$\therefore E = \frac{\sigma}{2\varepsilon_0} = \frac{2.0\times10^{-6}}{2\times 8.85\times10^{-12}} = 1.13\times10^{-5}\ N/C.$$