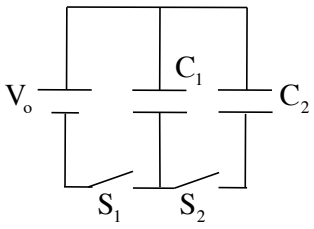
Problem 26.24

Initially, S_1 is closed, the voltage across the battery is the same as the voltage across C_1 and the initial charge "in the system" is:



$$\begin{aligned} Q_{start} &= V_o C_1 \\ &= (20.0\ \text{V})(6.00\text{x}10^{-6}\ \text{F}) \\ &= 1.20\text{x}10^{-4}\ \text{C} \end{aligned}$$

a.) In throwing both switches, the battery is removed from the circuit and the charge redistributes until the voltage across the two caps is the same. If we take the final charge on C_1 to be "Q," then the charge on the other cap will be "$1.20\text{x}10^{-4} - Q$" and we can write:

$$V_1 = \frac{Q_1}{C_1} = V_2 = \frac{Q_2}{C_2}$$

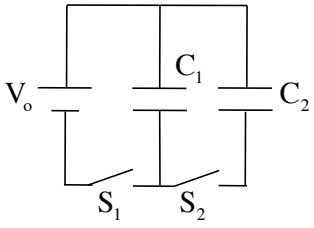
$$\Rightarrow \quad C_2 Q_1 = C_1 Q_2$$

$$\Rightarrow \quad C_2 Q = C_1 (1.20\text{x}10^{-6} - Q)$$

$$\Rightarrow \quad C_2 Q + C_1 Q = C_1 (1.20\text{x}10^{-6})$$

$$\Rightarrow \quad Q = \frac{C_1 (1.20\text{x}10^{-6})}{(C_2 + C_1)}$$

Putting in the numbers, we get:



$$Q = \frac{C_1 (1.20\text{x}10^{-6})}{(C_2 + C_1)}$$

$$\Rightarrow \quad Q = \frac{(6.00\text{x}10^{-6}\ \text{F})(1.20\text{x}10^{-6})}{(3.00\text{x}10^{-6}\ \text{F}) + (6.00\text{x}10^{-6}\ \text{F})}$$

$$= 8.00\text{x}10^{-5}\ \text{C}$$

This is the charge on C_1. The charge on C_2 is:

$$\begin{aligned} Q_2 &= 1.20\text{x}10^{-6} - Q \\ &= 1.20\text{x}10^{-6} - 8.00\text{x}10^{-5}\ \text{C} \\ &= 4.00\text{x}10^{-5}\ \text{C} \end{aligned}$$