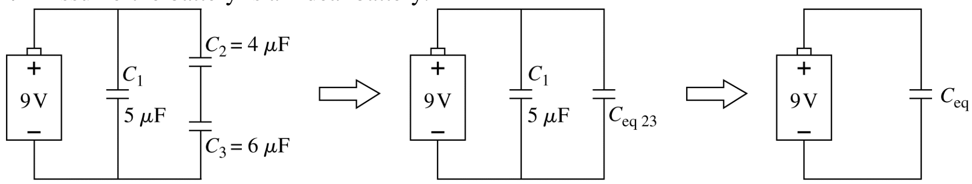
30.65. Model: Assume the battery is an ideal battery.

Visualize:



The pictorial representation shows how to find the equivalent capacitance of the three capacitors shown in the figure.

Solve: Because C_2 and C_3 are in series,

$$\frac{1}{C_{\text{eq 23}}} = \frac{1}{C_2} + \frac{1}{C_3} = \frac{1}{4\ \mu\text{F}} + \frac{1}{6\ \mu\text{F}} = \frac{10}{24}(\mu\text{F})^{-1} \Rightarrow C_{\text{eq 23}} = \tfrac{24}{10}\ \mu\text{F} = 2.4\ \mu\text{F}$$

$C_{\text{eq 23}}$ and C_1 are in parallel, so

$$C_{\text{eq}} = C_{\text{eq 23}} + C_1 = 2.4\ \mu\text{F} + 5\ \mu\text{F} = 7.4\ \mu\text{F}$$

A potential difference of $\Delta V_C = 9$ V across a capacitor of equivalent capacitance 7.4 μF produces a charge

$$Q = C_{\text{eq}}\Delta V_C = (7.4\ \mu\text{F})(9\ \text{V}) = 66.6\ \mu\text{C}$$

Because C_{eq} is a parallel combination of C_1 and $C_{\text{eq 23}}$, these capacitors have $\Delta V_1 = \Delta V_{\text{eq 23}} = \Delta V_C = 9$ V. Thus the charges on these two capacitors are

$$Q_1 = (5\ \mu\text{F})(9\ \text{V}) = 45\ \mu\text{C} \qquad Q_{\text{eq 23}} = (2.4\ \mu\text{F})(9\ \text{V}) = 21.6\ \mu\text{C}$$

Because $Q_{\text{eq 23}}$ is due to a series combination of C_2 and C_3, $Q_2 = Q_3 = 21.6\ \mu$C. This means

$$\Delta V_2 = \frac{Q_2}{C_2} = \frac{21.6\ \mu\text{C}}{4\ \mu\text{F}} = 5.4\ \text{V} \qquad \Delta V_3 = \frac{Q_3}{C_3} = \frac{21.6\ \mu\text{C}}{6\ \mu\text{F}} = 3.6\ \text{V}$$

In summary, $Q_1 = 45\ \mu$C, $V_1 = 9$ V; $Q_2 = 21.6\ \mu$C, $V_2 = 5.4$ V; and $Q_3 = 21.6\ \mu$C, $V_3 = 3.6$ V.