Suppose capacitors $C_5$ and $C_4$ are in parallel and are placed in series with $C_2$ and then that arrangement is placed in parallel with $C_3$ and then the entire arrangement is put in series with $C_1$ and hooked across the terminals of a 12 V battery. If all the capacitors are identical, with capacitance of 1 $\mu$F, find

(a) The total capacitance of the system.

(b) The potential difference across $C_3$.

(c) The positive charge on $C_2$. 
Solving this capacitor network: Start with 4 and 5, which are in parallel: Then \( C_{45} = C_4 + C_5 = 2 \ \mu\text{F} \).

Now 2 is in series with the combined 45, so \( C_{245} = \frac{C_2 C_{45}}{C_2 + C_{45}} = \frac{2}{3} \ \mu\text{F} \).

Now 3 is in parallel with the combined 245: \( C_{2345} = C_3 + C_{245} \), or 1.67 \( \mu\text{F} \).

Finally 1 is in series with the combined 2345, so \( C_{12345} = \frac{C_1 C_{2345}}{C_1 + C_{2345}} = 0.625 \ \mu\text{F} \).

How do we get the charge on capacitor \( C_2 \) and the potential difference across \( C_3 \)?

Looking at the diagram, \( V = V_1 + V_3 \) so \( V_3 = V - \frac{Q}{C_1} = V(1 - \frac{C_{12345}}{C_1}) = 4.5 \ \text{V} \).

Again looking at the diagram, \( Q_1 = Q_2 + Q_3 \) so \( Q_2 = Q_1 - Q_3 = Q - Q_3 \), so using the definition of capacitance,

\[
Q_2 = C_{12345} V - C_3 V_3 = 7.5 - 4.5 = 3 \ \mu\text{C}.
\]