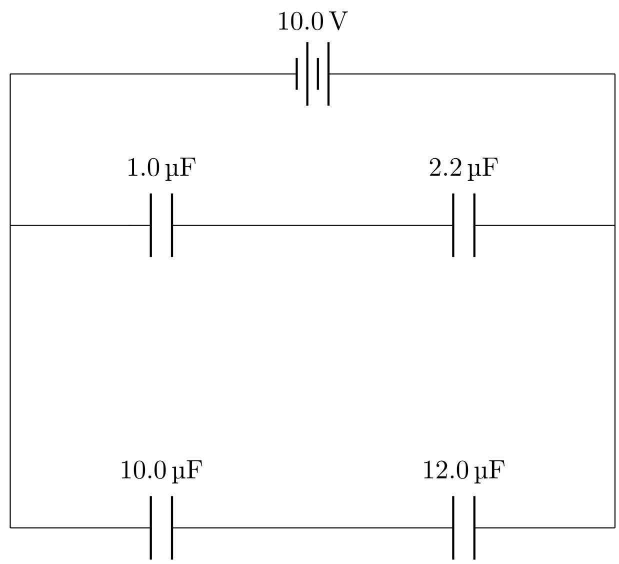
Name: ________________________________

Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page.

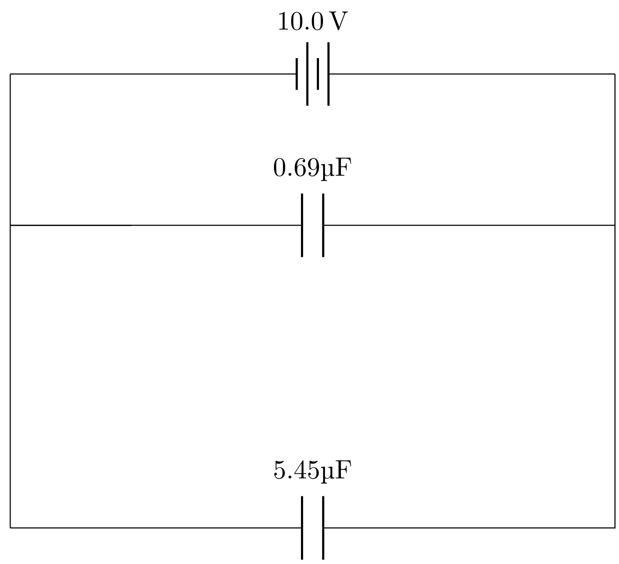
1. For the following circuit, find the equivalent capacitance for the entire circuit and the charge on each capacitor. *Hint: first find the equivalent capicitor for those that are in series together, then redraw the circuit with those two equivalent resistors to get a single circuit in parallel.*



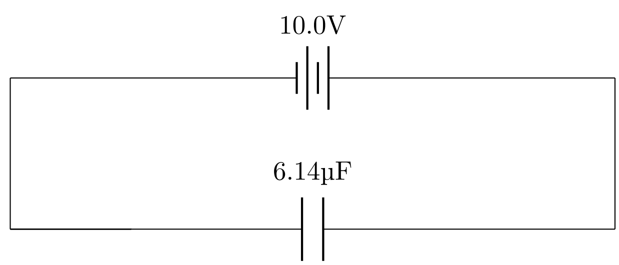
Solution: Our first step is to find the equivalence capacitance for the pairs of capacitors in series. Recall that capacitors in series have an equivalent capacitance given by,

$$\frac{1}{C_{\text{eq}}} = \sum_{j=1}^{n} \frac{1}{C_j}$$

The top equivalent capacitor is 0.69µF, the bottom is 5.45µF. This results in the following circuit:



For capacitors in parallel, the equivalent capacitance is found by the equation $C_{\text{eq}} = \sum_{j=1}^{n}$, and so we simply add the two capacitors to get:

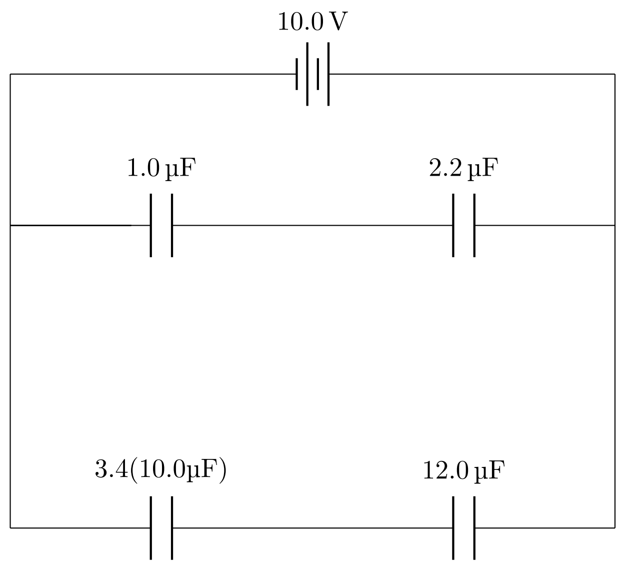


Now we use the relation $Q = VC$, so for the equivalent circuit the total charge would be $Q = 10.0(6.14)\mu\text{C} = 61.42\mu\text{C}$. **Remember that capacitors in series have the same charge.**

Going back to the second equivalent circuit, the top branch will have a charge $Q = VC = 10.0(0.69)\mu\text{C} = 6.88\mu\text{C}$ which will be the charge on each of the capacitors in that branch; the bottom branch will have charge $Q = VC = 10.0(5.45)\mu\text{C} = 54.55\mu\text{C}$ which will be the charge on each of the capacitors in that branch.

2. Now assume that a nylon slab has been inserted into the 10.0 μF capacitor. For nylon, $\kappa = 3.4$. Find the equivalent capacitance for this circuit and the charge on each capacitor.

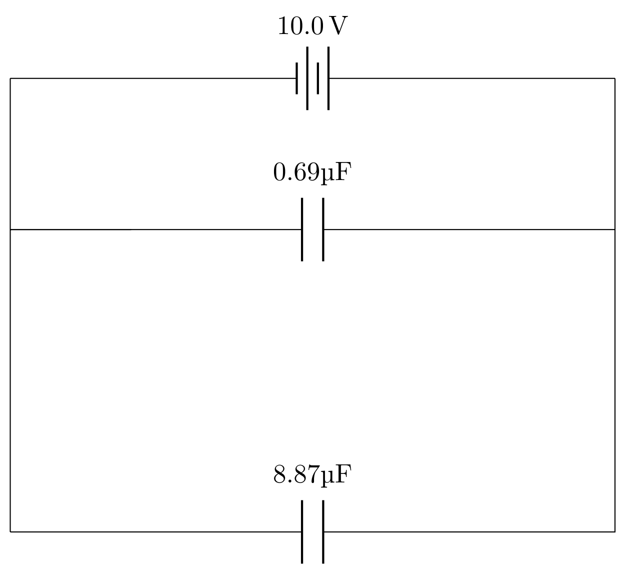
Solution:



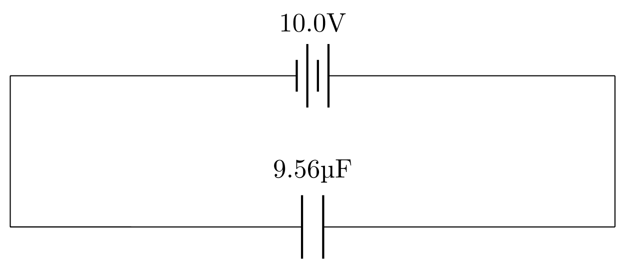
Our first step is to find the equivalence capacitance for the pairs of capacitors in series. Recall that capacitors in series have an equivalent capacitance given by,

$$\frac{1}{C_{\text{eq}}} = \sum_{j=1}^{n} \frac{1}{C_j}$$

The top equivalent capacitor is 0.69μF, the bottom is 8.87μF. This results in the following circuit:



For capacitors in parallel, the equivalent capacitance is found by the equation $C_{\text{eq}} = \sum_{j=1}^{n}$, and so we simply add the two capacitors to get:



Now we use the relation $Q = VC$, so for the equivalent circuit the total charge would be $Q = 10.0(9.56)\mu\text{C} = 95.57\mu\text{C}$. **Remember that capacitors in series have the same charge.**

Going back to the second equivalent circuit, the top branch will have a charge $Q = VC = 10.0(0.69)\mu\text{C} = 6.88\mu\text{C}$ which will be the charge on each of the capacitors in that branch; the bottom branch will have charge $Q = VC = 10.0(8.87)\mu\text{C} = 88.70\mu\text{C}$ which will be the charge on each of the capacitors in that branch.