1. Find the equivalent resistance.

All resistances in ohms

\[ \frac{1}{R} = \frac{1}{10} + \frac{1}{20} \]

\[ R = \frac{1}{\frac{1}{10} + \frac{1}{20}} = 10 \Omega \]

\[ \text{Short cut: } \frac{R_4}{R_5} = \frac{20}{2} = 10 \]

\[ \frac{1}{R} = \frac{1}{20} + \frac{1}{20} \]

\[ R = \frac{1}{\frac{1}{20} + \frac{1}{20}} = 10 \Omega \]
A 5V battery is connected to the resistor network of Problem 1.

**Find:**
- \( I \): Current from battery
- \( I_3 \): Current in \( R_3 \)
- \( P_2 \): Power in \( R_2 \)
- \( P_3 \): Power in \( R_3 \)
- \( E_3 \): Energy consumed in resistor \( R_3 \) in 1 minute
- \( Q_3 \): Charge passing through \( R_3 \) in 1 minute

\[
I = \frac{V}{R} = \frac{5V}{5.3\Omega} = 0.94\text{A}
\]

\[
I_3 = \frac{V_{\text{across 25}\text{\Omega}}}{25\Omega} = \frac{5V}{25} = 0.2\text{A}
\]

\[
P_2 = \frac{(V_{\text{across } R_2})^2}{R_2} = \frac{(I_{\text{through } R_2})^2}{R_2}
\]

*Note that \( I_3 \) is the total current through this part of the circuit, so current through combined \( R \) is the same.*

\( R_3, R_4, R_5 \) combined from Prob 1.

Also, \( 25\Omega \) is in parallel with 5V battery.

\[
P_2 = \frac{(5V)^2}{20\Omega} = 1.25\text{W}
\]
\[ P_3 = \left( \frac{V_{across\ R_3}}{R_3} \right)^2 \text{ or } \left( I_{\text{through } R_3} \right)^2 R_3 \]

\[ P_3 = I_3^2 R_3 = (0.2A)^2 \times 15\Omega = 0.6\ W \]

\[ E_3 = \frac{\Delta U}{\Delta t} = \frac{P_3 \Delta t}{\Delta t} = (0.6W)(60s) = 36J \]

\[ Q_3 = I_3 \Delta t = (0.2A)(60s) = 12\ C \]
Find the equivalent capacitance!

\[ \frac{1}{C} = \frac{1}{24 \mu F} + \frac{1}{18 \mu F} \]
\[ = \frac{1}{10.3 \mu F} + \frac{1}{29 \mu F} \]
\[ \frac{1}{C} = \frac{1}{7.2 \mu F} \]
\[ C = 7.2 \mu F + 18 \mu F \]
\[ C = 25.2 \mu F \]
\[ \text{Series} \]
\[ \frac{1}{C} = \frac{1}{25.2 \mu F} + \frac{1}{27 \mu F} \]
\[ \frac{1}{C} = \frac{1}{13 \mu F} \]
\[ C = 13 \mu F \]

Note: It would have been faster if I combined \( C_2 \) and \( C_3 \) first:

\[ \frac{24 \mu F}{29 \mu F} \]
\[ = \frac{24 \mu F}{29} \]
\[ = 12 \mu F \]
\[ \Rightarrow \]
\[ \frac{1}{12 \mu F} \]
\[ \Rightarrow \]
\[ \frac{1}{7.2 \mu F} \]