

Given

The circuit as drawn on the right.

1/4

$$V_{\text{Batt}} = 120\text{V}$$

$$R_1 = 20\Omega$$

$$R_2 = 20\Omega$$

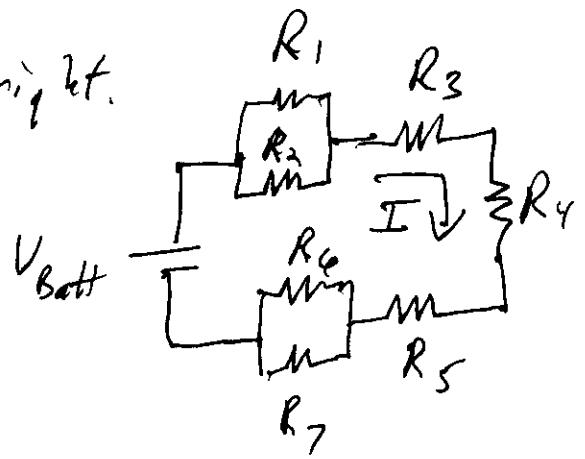
$$R_3 = 5\Omega$$

$$R_4 = 10\Omega$$

$$R_5 = 15\Omega$$

$$R_6 = 25\Omega$$

$$R_7 = 100\Omega$$



Required

Find (a) I

(b) the power supplied by the battery

(c) the voltage across R_5

Solution

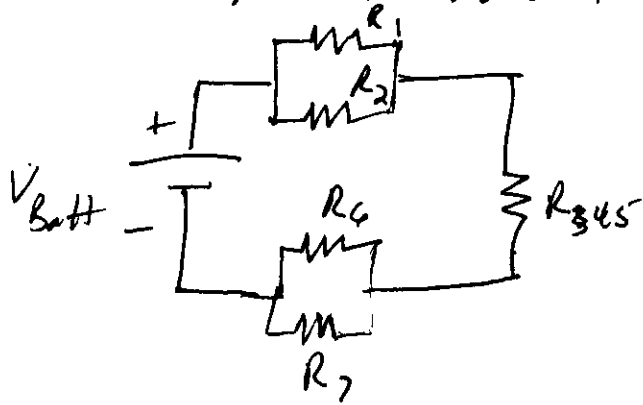
(a) First, combine all resistors in series.

$$R_{345} = R_3 + R_4 + R_5$$

$$= 5\Omega + 10\Omega + 15\Omega$$

$$R_{345} = 30\Omega$$

We can now redraw the circuit.



Now, we can combine all resistors in parallel.
By inspection, we note that R_1 & R_2 are in parallel,
and R_6 & R_7 are in parallel.

$$R_{12} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

$$R_{67} = \frac{1}{\frac{1}{R_6} + \frac{1}{R_7}}$$

$$R_{12} = \frac{1}{\frac{1}{20\Omega} + \frac{1}{20\Omega}}$$

$$R_{67} = \frac{1}{\frac{1}{25\Omega} + \frac{1}{100\Omega}}$$

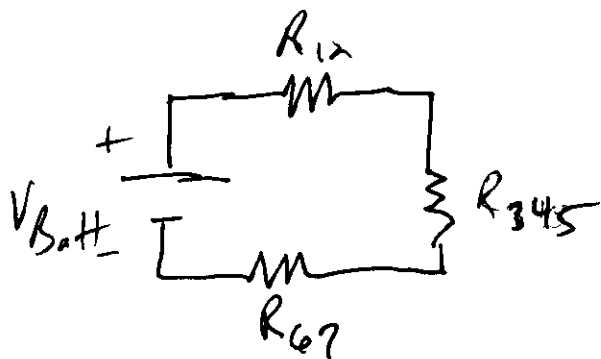
$$R_{12} = \frac{1}{\frac{2}{20\Omega}}$$

$$R_{67} = \frac{1}{\frac{5}{100\Omega}}$$

$$R_{12} = 10\Omega$$

$$R_{67} = 20\Omega$$

Again, we can redraw the circuit



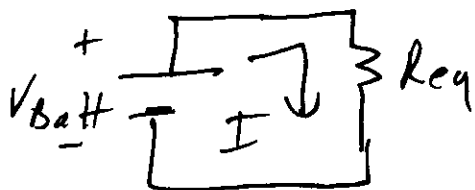
We can find R_{eq} by combining all series resistors.

$$R_{eq} = R_{12} + R_{345} + R_{67}$$

$$R_{eq} = 10\Omega + 30\Omega + 20\Omega$$

$$R_{eq} = 60\Omega$$

Redrawing the circuit once more,



$$I = \frac{V_{Batt}}{R_{eq}}$$

$$I = \frac{120V}{60\Omega}$$

$$\underline{\underline{I = 2A}}$$

$$(b) P_{\text{Batt}} = V_{\text{Batt}} I$$

$$P_{\text{Batt}} = 120V \cdot 2A$$

$$\underline{\underline{P_{\text{Batt}} = 240W}}$$

$$(c) V_{R_5} = I \cdot R_5$$

$$= 2A \cdot 15\Omega$$

$$\underline{\underline{V_{R_5} = 30V}}$$

4/4

Discussion.

The answers seem reasonable.

The combinations of series ^{resistors} resulted in equivalent resistances which were greater than any single resistor, as expected.

The combinations of parallel resistors resulted in equivalent resistances less than any single resistor in the combination, as expected.

The voltage across R_5 was less than the voltage supplied by the battery, as expected.