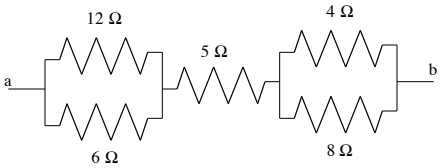
## Problem 18.6

a.) Equivalent resistance?




b.) If the voltage between “a” and “b” is 35 volts, what are the currents through each branch.



a.) Equivalent resistance?

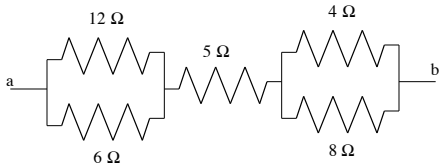
$$R_{equ1} = \left(\frac{1}{12\ \Omega} + \frac{1}{6\ \Omega}\right)^{-1} = 4\Omega \qquad R_{equ1} = \left(\frac{1}{8\ \Omega} + \frac{1}{4\ \Omega}\right)^{-1} = 2.67\Omega$$


so:

$$\begin{aligned} R_{eq} &= R_{eq1} + R_5 + R_{eq2} \\ &= 4\ \Omega + 5\ \Omega + 2.67\ \Omega \\ &= 11.67\ \Omega \end{aligned}$$



b.) If the voltage between “a” and “b” is 35 volts, what are the currents through each branch.




With the equivalent resistance being 11.67 ohms, the current into the group will be:

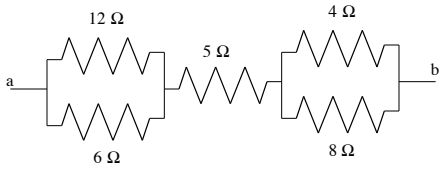
$$\begin{aligned} i_{in} &= \frac{\varepsilon}{R_4} = \frac{35V}{11.67\Omega} \\ &= 3\ \text{amps} \end{aligned}$$

That means that 3 amps flows through the 5 ohm resistor in the middle.

As for the first parallel combination, the 12 ohm resistor is twice as large as the 6 ohm resistor, so it will have *half as much* current through it as does the smaller 6 ohm resistor. In other words, 2 amps will go through the 6 ohm resistor while 1 amp flows through the 12 ohm resistor. (As a minor side point: notice that the voltage across the 12 ohm resistor is iR=(1 amp)(12 ohms) = 12 volts. This is the same as the voltage across the 6 ohm resistor (iR=(2 amp)(6 ohms) = 12 volts), as expected.



Similarly to the first parallel combination, the second parallel circuit has an 8 ohm resistor which is twice as large as the 4 ohm resistor in the combination. That means *half as much* current will flow through it as does the smaller 4 ohm resistor. 3 amps flows into the combination, so 2 amps must go through the 4 ohm resistor while 1 amp flows through the 8 ohm resistor. (And again: notice that the voltage across the 8 ohm resistor is iR=(1 amp)(8 ohms) = 8 volts. This is the same as the voltage across the 4 ohm resistor (iR=(2 amp)(4 ohms) = 8 volts), as expected.




As an additional side point: Notice that 12 volts is across the first parallel combination, 8 volts is across the second parallel combination which would suggest that 15 volts must be across the 5 ohm resistor (35 – 12 – 8 = 15). Low and behold,

$$\begin{aligned} V_5 &= i_o R_5 = (3\ \text{A})(5\ \Omega) \\ &= 15\ \text{volts} \end{aligned}$$

Damn! We are good!