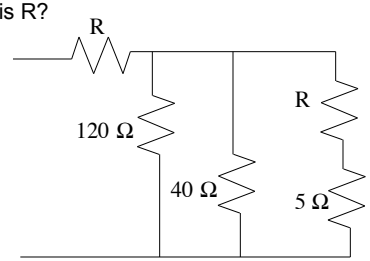
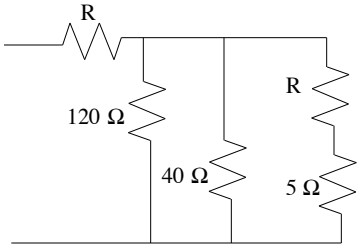
Problem 18.11

If the equivalent resistance is $75\ \Omega$, what is R?



18.11) If the equivalent resistance is $75\ \Omega$, what is R?

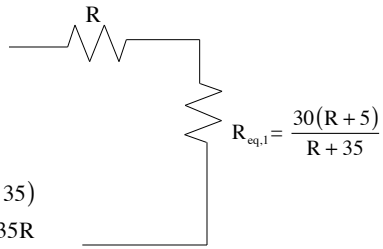
The three branches in parallel have an equivalent resistance of:



$$\frac{1}{R_{eq,1}} = \frac{1}{120} + \frac{1}{40} + \frac{1}{(R+5)}$$
$$= \frac{1}{120} + \frac{3}{120} + \frac{1}{(R+5)}$$
$$= \frac{1}{30} + \frac{1}{(R+5)}$$
$$= \frac{R+5}{30(R+5)} + \frac{30}{30(R+5)}$$
$$= \frac{R+35}{30(R+5)}$$
$$\Rightarrow \quad R_{eq,1} = \frac{30(R+5)}{R+35}$$

The two series resistors have to equal $75\ \Omega$

The three branches in parallel have an equivalent resistance of:



$$75 = \frac{30(R+5)}{R+35} + R$$
$$\Rightarrow \quad 75(R+35) = 30(R+5) + R(R+35)$$
$$\Rightarrow \quad 75R + 2475 = 30R + 150 + R^2 + 35R$$
$$\Rightarrow \quad R^2 - 10R - 2475 = 0$$
$$\Rightarrow \quad R = 55\ \Omega$$

Check:

$$R_{eq} = \left(\frac{1}{120} + \frac{1}{40} + \frac{1}{(55+5)}\right)^{-1} + 55$$
$$= 75\ \Omega$$