Homework week 6
53)

SOLUTION Using data for the second resistor, the voltage across the resistors is equal to

$$V = IR = (3.00 \text{ A})(64.0 \text{ }\Omega) = 192 \text{ V}$$

a. The current through the 42.0-Ω resistor is

$$I = \frac{V}{R} = \frac{192 \text{ V}}{42.0 \text{ }\Omega} = \boxed{4.57 \text{ A}}$$

b. The power consumed by the 42.0-Ω resistor is

$$P = I^2 R = (4.57 \text{ A})^2 (42.0 \text{ }\Omega) = 877 \text{ W}$$

while the power consumed by the 64.0-Ω resistor is

$$P = I^2 R = (3.00 \text{ A})^2 (64.0 \text{ }\Omega) = 576 \text{ W}$$

Therefore the total power consumed by the two resistors is $877 \text{ W} + 576 \text{ W} = \boxed{1450 \text{ W}}$.

---

54. ***REASONING AND SOLUTION*** Each piece has a resistance of $\frac{1}{3}R$. Then

$$\frac{1}{R_p} = \frac{1}{\frac{1}{3}R} + \frac{1}{\frac{1}{3}R} + \frac{1}{\frac{1}{3}R} = \frac{9}{R} \qquad \text{or} \qquad R_p = \boxed{\tfrac{1}{9}R}$$

---

55. $\boxed{\text{SSM}}$ ***REASONING*** The equivalent resistance of the three devices in parallel is R_p, and we can find the value of R_p by using our knowledge of the total power consumption of the circuit; the value of R_p can be found from Equation 20.6c, $P = V^2 / R_p$. Ohm's law (Equation 20.2, $V = IR$) can then be used to find the current through the circuit.

SOLUTION
a. The total power used by the circuit is $P = 1650 \text{ W} + 1090 \text{ W} + 1250 \text{ W} = 3990 \text{ W}$. The equivalent resistance of the circuit is

$$R_p = \frac{V^2}{P} = \frac{(120 \text{ V})^2}{3990 \text{ W}} = \boxed{3.6 \text{ }\Omega}$$

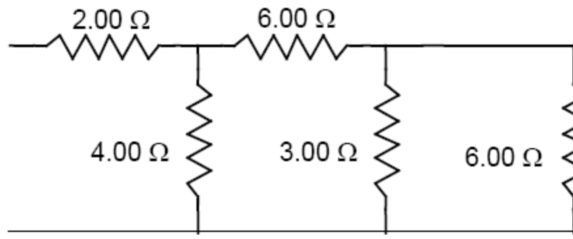
b. The total current through the circuit is

$$I = \frac{V}{R_p} = \frac{120 \text{ V}}{3.6 \text{ }\Omega} = \boxed{33 \text{ A}}$$

This current is larger than the rating of the circuit breaker; therefore, the $\boxed{\text{breaker will open}}$.

58. ***REASONING*** We will approach this problem in parts. The resistors that are in series combined according to Equation 20.16, and the resistors that are in parallel will be co: according to Equation 20.17.

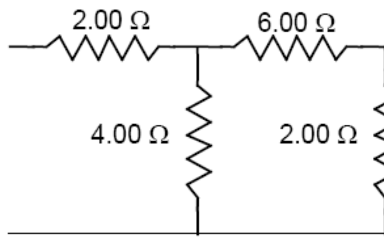
SOLUTION The 1.00 Ω, 2.00 Ω and 3.00 Ω resistors are in series with an equivalent resistance of R_S = 6.00 Ω.



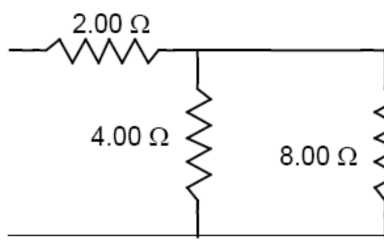
This equivalent resistor of 6.00 Ω is in parallel with the 3.00-Ω resistor, so

$$\frac{1}{R_P} = \frac{1}{6.00\ \Omega} + \frac{1}{3.00\ \Omega}$$

$$R_P = 2.00\ \Omega$$



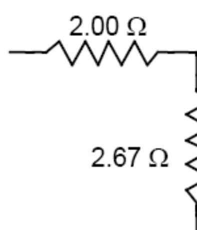
This new equivalent resistor of 2.00 Ω is in series with the 6.00-Ω resistor, so R_S' = 8.00 Ω.



R_S' is in parallel with the 4.00-Ω resistor, so

$$\frac{1}{R_P'} = \frac{1}{8.00\ \Omega} + \frac{1}{4.00\ \Omega}$$

$$R_P' = 2.67\ \Omega$$



Finally, R_P' is in series with the 2.00-Ω, so the total equivalent resistance is $\boxed{4.67\ \Omega}$.

59. SSM ***REASONING*** To find the current, we will use Ohm's law, together with the proper equivalent resistance. The coffee maker and frying pan are in series, so their equivalent resistance is given by Equation 20.16 as $R_{\text{coffee}} + R_{\text{pan}}$. This total resistance is in parallel with the resistance of the bread maker, so the equivalent resistance of the parallel combination can be obtained from Equation 20.17 as $R_{\text{p}}^{-1} = (R_{\text{coffee}} + R_{\text{pan}})^{-1} + R_{\text{bread}}^{-1}$.

SOLUTION Using Ohm's law and the expression developed above for R_{p}^{-1}, we find

$$I = \frac{V}{R_{\text{p}}} = V\left(\frac{1}{R_{\text{coffee}} + R_{\text{pan}}} + \frac{1}{R_{\text{bread}}}\right) = (120\ \text{V})\left(\frac{1}{14\ \Omega + 16\ \Omega} + \frac{1}{23\ \Omega}\right) = \boxed{9.2\ \text{A}}$$