22. *If the total power dissipated in the circuit shown in the Fig. 1.113 is 18 watts, find the value of R and current through it.*

(Ans.: 12 Ω, 0.6 A)

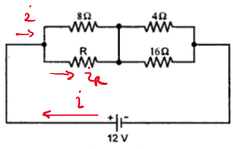


Fig. 1.113

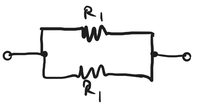
The total power dissipated in the circuit is equal to the power generated by the power source

$$P_{\text{diss}} = P_{\text{source}} = V i = 12 \times i = 18 \text{ watts} \Rightarrow$$

$$12\, i = 18 \Rightarrow i = \frac{18}{12} = \frac{6\times 3}{6\times 2} = \frac{3}{2} \text{ A}$$

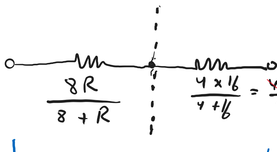
Next, you need to find the equivalent resistance

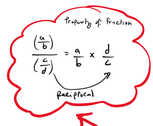
Remember The equivalent resistant of two parallel Resistance



$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

The equivalent resistance in the above figure is





$$R_{eq} = \frac{8R}{8+R} + \frac{16}{5}$$

Also note that $R_{eq} = \frac{V_s}{i} = \frac{12}{3/2} = 12 \times \frac{2}{3} = 8\ \Omega$

$$8 = \frac{8R}{8+R} + \frac{16}{5} = 8\left[\frac{R}{8+R} + \frac{2}{5}\right]$$

$$1 = \frac{R}{8+R} + \frac{2}{5} \Rightarrow \frac{R}{8+R} = 1 - \frac{2}{5}$$

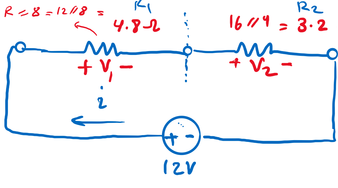
$$\frac{R}{R+8} = \frac{3}{5} \Rightarrow 5R = 3(R+8)$$

$$5R = 3R + 24 \Rightarrow 5R - 3R = 24$$

$$2R = 24 \Rightarrow \boxed{R = 12\ \Omega}$$

To find the current through (R) we need to calculate the voltage drop across R, which is the same voltage drop across the first parallel pair of resistors, i.e.,

The equivalent circuit can be drawn as



Using the voltage divider rule:

$$V_1 = V_s \frac{R_1}{R_1 + R_2} = 12 \times \frac{4.8}{4.8 + 3.2} = 12 \times \frac{4.8}{8} = 7.2 \text{ V}$$

which is the same voltage across R

$$i_R = \frac{V_R}{R} = \frac{7.2}{12} = \boxed{0.6 \text{ A}}$$