Answer on Question#50158 - Physics - Electric Circuits

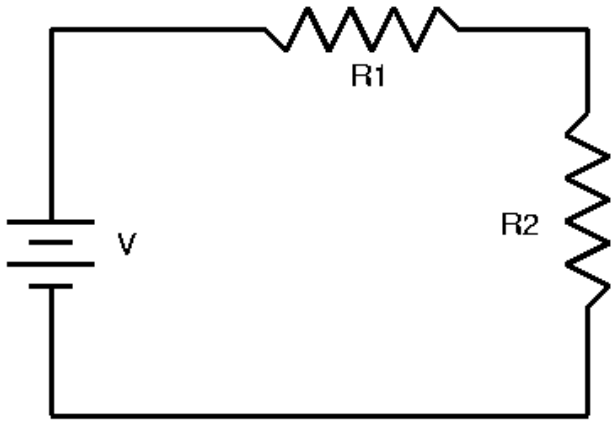
In investigating an existing design of a circuit, it was found that a $R_1 = 25\Omega$ resistor dissipates $P = 9W$.

The engineer decides to put a $R_2 = 12.5\Omega$ resistor in series with this 25Ω resistor.

What is the power dissipation now in the 25Ω resistor with the same supply voltage after the 12.5Ω resistor was added?

Clue - determine what the supply voltage is from the given information. Then you can either use the voltage divider theory to find the voltage now dropped across the 25Ω and then work out the power, or you can calculate the total current now drawn by both resistors and then work out the power across the 25Ω resistor!

Solution:



The voltage of the source can be found from the following expression for the dissipative losses

$$P = \frac{V^2}{R_1}$$

So for the voltage of the source we obtain

$$V = \sqrt{P \cdot R_1} = \sqrt{9W \cdot 25\Omega} = 15\text{V}$$

The series of resistors R_1 and R_2 has the overall resistance of $R = R_1 + R_2 = 37.5\Omega$. so the current flowing through this series will be

$$I = \frac{V}{R} = \frac{15\text{V}}{37.5\Omega} = 0.4\text{A}$$

The power dissipation in the resistor R_1 now will be

$$P' = I^2 R_1 = (0.4\text{A})^2 \cdot 25\Omega = 4W$$

Answer: $4W$.