Answer on Question #47998, Physics, Electric Circuits

Question:

In investigating an existing design of a circuit, it was found that a 25Ω resistor dissipates 9W. The engineer decides to put a 12.5Ω 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:

First of all we find the supply voltage from the given information. For this purpose we write the formula for power dissipation on resistor R_1:

$$P = U_{supply} \times I_1,$$

where P is the power dissipation on resistor R_1 , U_{supply} is the supply voltage, I_1 is the current that flows through the resistor R_1.

Used the Ohm's law we expressed I_1 in terms of R_1 and U_{supply}:

$$I_1 = \frac{U_{supply}}{R_1}.$$

Substituting I_1 in the expression for power dissipation on resistor R_1 we obtain:

$$P = \frac{\left(U_{supply}\right)^2}{R_1},$$

$$U_{supply} = \sqrt{P \times R_1} = \sqrt{9W \times 25\Omega} = 15V.$$

From the voltage divider theory we can find voltage drops across the resistor R_1 :

$$U_1 = U_{supply} \times \frac{R_1}{(R_1 + R_2)} = \frac{15V \times 25\Omega}{(25\Omega + 12.5\Omega)} = \frac{375\ V \times \Omega}{37.5\ \Omega} = 10V.$$

Then we can find the current I_1 after the resistor R_2 was added:

$$I_1 = \frac{U_1}{R_1} = \frac{10V}{25\Omega} = 0.4A$$

Finally we can obtain the power dissipation on resistor R_1 after the resistor R_2 was added:

$$P = U_1 \times I_1 = 10V \times 0.4A = 4W$$

Answer:

$P = 4W$