Answer on Question #51019-Physics-Electric Circuits

Two resistances $R_2 = 2\Omega$ and $R_3 = 3\Omega$ are in parallel. The combination is in series with $R_1 = 1.5\Omega$ resistance and a power supply of voltage V. There is a current of $I_2 = 3A$ through the 2Ω resistance. What are the values of the current I delivered by, and the voltage V across the power supply?

Solution

$$V_2 = V_3 \to I_2R_2 = I_3R_3 \to I_3 = \frac{I_2R_2}{R_3}.$$

$$I = I_1 = I_2 + I_3 = I_2 + \frac{I_2R_2}{R_3} = I_2\left(1 + \frac{R_2}{R_3}\right) = 3A\left(1 + \frac{2}{3}\right) = 5A.$$

$$V = V_1 + V_2 = I_1R_1 + I_2R_2 = 5A \cdot 1.5\Omega + 3A \cdot 2\Omega = 13.5\,V.$$

Two wires P ad Q, each of the same length and same material, are connected in parallel to a battery. The diameter of P is half that of Q. What fraction of the total current passes through P?

Solution

$$R = \rho\frac{l}{A}.$$

$$I_P = I_{tot} - I_Q.$$

$$\frac{I_P}{I_{tot}} = 1 - \frac{I_Q}{I_{tot}}.$$

$$V_P = V_Q \to I_QR_Q = I_PR_P \to \frac{I_Q}{I_{tot}} = \frac{I_Q}{I_Q + \frac{I_QR_Q}{R_P}} = \frac{1}{1 + \frac{R_Q}{R_P}}.$$

Thus

$$\frac{I_P}{I_{tot}} = 1 - \frac{1}{1 + \frac{R_Q}{R_P}} = \frac{\frac{R_Q}{R_P}}{1 + \frac{R_Q}{R_P}}.$$

$$\frac{R_Q}{R_P} = \frac{A_P}{A_Q} = \left(\frac{d_P}{d_Q}\right)^2 = \left(\frac{1}{2}\right)^2 = \frac{1}{4}.$$

So

$$\frac{I_P}{I_{tot}} = \frac{\frac{1}{4}}{1 + \frac{1}{4}} = \frac{4}{5}.$$

In an experiment to determine the relationship between the current I through a piece of tungsten wire and the potential difference V across it, the theoretical relationship used was $I = kVn$, where k and n are constants which may be obtained from a straight line graph of the form $y = mx + c$, the symbols having their usual meaning. The corresponding linear equation for this experiment is

$I = nV + k$

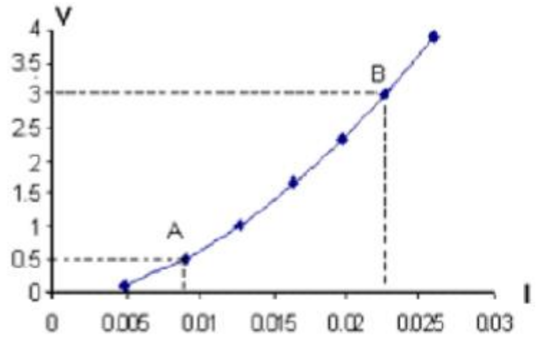
$4I = nV^2 + k$

$I = expV^n + k$

$\log I = n \log V + \log k$

Solution

The corresponding linear equation for this experiment is $\log I = n \log V + \log k$.



As we can see from this graph other variants are not applicable.

A current of 0.5A flowing through a wire produces $Q = 21J$ of heat in $t = \frac{1}{2}\ min$. The resistance of the wire is ----------- ohms to 1 place of decimal

Solution

The power is

$$P = \frac{Q}{t}.$$

But it is also

$$P = I^2R.$$

Thus

$$R = \frac{Q}{tI^2} = \frac{21}{0.5 \cdot 60 \cdot 0.5^2} = 2.8\Omega.$$