Answer on Question#63147 – Physics – Electric Circuits

When a battery is connected to a 103.0-Ω resistor, the current is 3.05 A. When the same battery is connected to a 400.0-Ω resistor, the current is 0.798 A. Find the internal resistance of the battery.

Solution. Using relationship for electromotive force and internal resistance

$$\varepsilon = I(R + r)$$

ε – electromotive force in volts;
I – current in amperes;
R – resistance of the load in the circuit in ohms;
r – internal resistance of the battery in ohms.
For battery ε, r – constant value.
Write a system of equations for different resistances of the load
$$\begin{cases} \varepsilon = I_1(R_1 + r) \\ \varepsilon = I_2(R_2 + r) \end{cases}$$
According to the condition of the problem
$I_1 = 3.05A \; R_1 = 103\Omega$
$I_2 = 0.798A \; R_2 = 400\Omega$
Hence $I_1(R_1 + r) = I_2(R_2 + r) \; r = \frac{I_2R_2 - I_1R_1}{I_1 - I_2} = \frac{0.798 \cdot 400 - 3.05 \cdot 103}{3.05 - 0.798} \approx 2.24\Omega.$

Answer. 2.24Ω