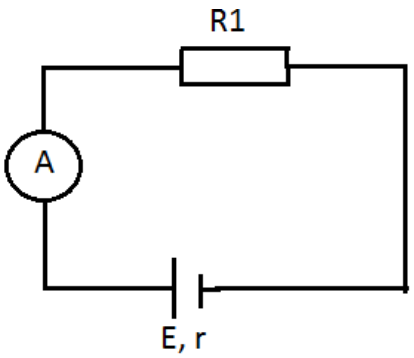
Answer to Question #72561, Physics / Electric Circuits

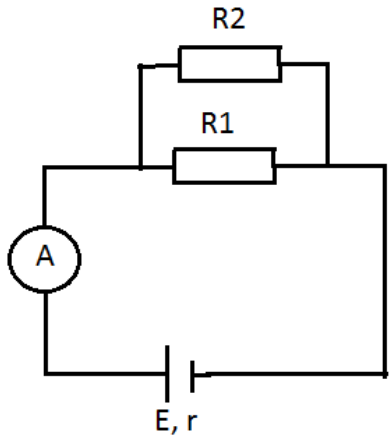
A cell of e.m.f E and Internal Resistance r, connected in series with a resistor and ammeter. A current of $0.8A$ is observed to pass when the resistor is $2ohm$. When another resistor of $5\ ohms$ is connected in parallel with the $2ohms$ resistor, the new ammeter reading is $1.0A$.

a. Draw circuit diagram to illustrate the two arragement
b. using circuit diagram drawn in a above write down the equation for e.m.f E of the cell in each case.
c. calculate the internal resistance and e.m.f of the cell

Solution.

a)





b)

For the first case:

$$E = I_1(R_1 + r)$$

where resistance $R_1 = 2\ ohms$; current $I_1 = 0.8\ A$

Answer to Question #72561, Physics / Electric Circuits

For the second case:

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R = \frac{R_1 R_2}{R_1 + R_2}$$

$$E = I(R + r) = I\left(\frac{R_1 R_2}{R_1 + R_2} + r\right)$$

where R is the total resistance of the circuit; $R_2 = 5\ ohms$; current $I = 1.0\ A$

c)

For the first case:

$$E = 0.8 \cdot (2 + r)$$

For the second case:

$$E = 1 \cdot \left(\frac{2 \cdot 5}{2 + 5} + r\right) = \frac{10}{7} + r$$

Then:

$$0.8 \cdot (2 + r) = \frac{10}{7} + r$$

$$0.2r = 1.6 - \frac{10}{7}$$

$$\frac{r}{5} = \frac{8}{5} - \frac{10}{7} = \frac{6}{35}$$

Answer:

$$r = 5 \cdot \frac{6}{35} = \frac{6}{7}\ ohms$$

$$E = 0.8 \cdot \left(2 + \frac{6}{7}\right) = \frac{4}{5} \cdot \frac{20}{7} = \frac{16}{7}\ V$$