

Name: _____

1. Wolfson, Volume II, 2nd Edition, 25.28

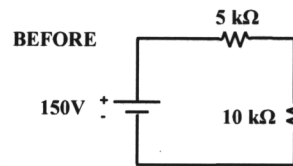
Note: First find the voltage across the 10 kΩ resistor as it's drawn in the circuit. Then find the voltage across that resistor when a 200 kΩ resistor (the non-ideal voltmeter) is in parallel with it. Then calculate the percent difference between the two measurements:

$$\left| \frac{V_{ideal} - V_{measured}}{V_{ideal}} \right| \times 100\%$$

Before

$$V_2 = I R_2, \quad I = \frac{V_b}{R_1 + R_2}$$

$$\Rightarrow V_{2B} = \frac{R_2}{R_1 + R_2} V_b = \frac{10}{15} \cdot 150 = \boxed{100V}$$

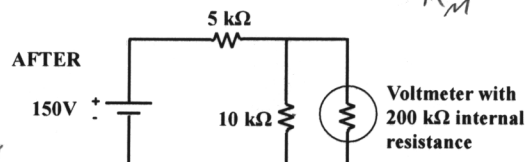


$$R_1 = 5k\Omega$$

$$R_2 = 10k\Omega$$

$$V_b = 150V$$

$$R_M = 200k\Omega$$



After

$$V_{2A} = I R_{2M}, \quad I = \frac{V_b}{R_{eff}} \Rightarrow V_2 = \frac{R_{2M}}{R_{eff}} \cdot V_b$$

$$R_{2M} = \left(\frac{1}{10 \times 10^3} + \frac{1}{200 \times 10^3} \right)^{-1} = 9.5 \times 10^3 = \underline{9.5k\Omega}$$

$$R_{eff} = 5 \times 10^3 + 9.5 \times 10^3 = \underline{14.5k\Omega}$$

$$V_{2A} = \frac{9.5k\Omega}{14.5k\Omega} \cdot 150V = \underline{98.3V}$$

$$Error = \frac{100 - 98.3}{100} \cdot 100 = \boxed{1.7\%}$$

Circuits – Set 2

Name: _____

2. Wolfson, Volume II, 2nd Edition, 25.29

Note: First find the current through the 10 kΩ resistor as it's circuit. Then find the current through that resistor when a 100 Ω non-ideal ammeter is in series with it. Then calculate the difference between the two measurements:

$$\left| \frac{I_{ideal} - I_{measured}}{I_{ideal}} \right| \times 100\%$$

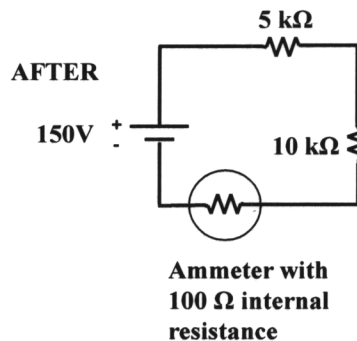
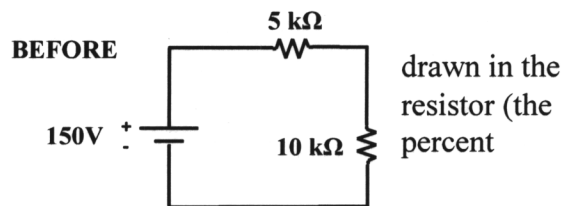
Before

$$I_B = \frac{V}{R_{eff}} = \frac{150}{15 \times 10^3} = 10 \text{ mA}$$

After

$$I_A = \frac{V}{R_{eff}} = \frac{150}{15.1 \times 10^3} = \underline{9.93 \text{ mA}}$$

$$\text{Error} = \frac{10 - 9.93}{10} \cdot 100 = \underline{0.7\%}$$



3. Wolfson, Volume II, 2nd Edition, 25.30

$$P = IV$$

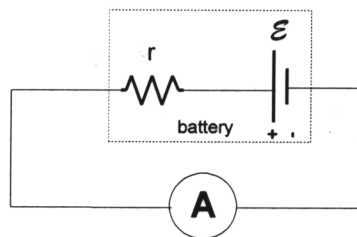
$$I = \frac{V}{R} \Rightarrow P = \frac{V^2}{R}$$

$$\Rightarrow P = \frac{12^2}{0.11} = \underline{1.3 \text{ kW}} \quad \text{Too much!}$$

$$I = \frac{12}{0.11} = 109 \text{ Amps}$$

↑
That's a LOT!

Household circuits are
generally 20 Amps max.



Circuits – Set 2

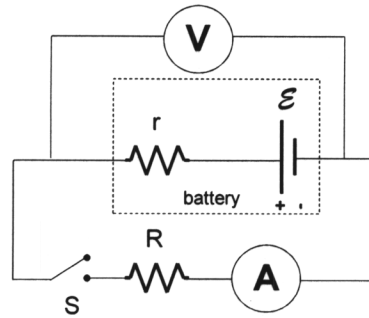
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Problems Solved ___ / 4

4. This problem reviews your laboratory method for measuring the internal resistance of a real battery.

Imagine that you've wired the circuit shown in the figure. When open, the (ideal) voltmeter reads 3.08 V. When the switch is closed, the voltmeter reading drops to 2.97 V, and the (ideal) ammeter reads 1.65 A. Find \mathcal{E} , r , and R . Explain why the voltage drops when the switch



emf and

switch S is closed, the 1.65 A. is closed.

Open switch

No current flow, so internal resistor drops no voltage
Voltmeter will read maximum voltage. $\Delta V = 3.08 \text{ V}$

Closed switch

Current flows, r drops some voltage, and V goes down.

$$V = \mathcal{E} - Ir \Rightarrow r = \frac{\mathcal{E} - V}{I} = \frac{3.08 - 2.97}{1.65} = \boxed{0.07 \Omega}$$

We can also find R : $R = \frac{\Delta V}{I}$ $\swarrow \mathcal{E} - Ir$

$$= \frac{2.97}{1.65} = \boxed{1.8 \Omega}$$