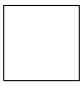
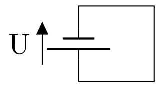
Contents

1 Review circuits

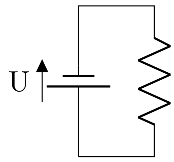
A *circuit* is a loop of *conductive material*



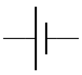
An example of a very boring circuit



A slightly less boring circuit



A circuit with a battery and a resistor



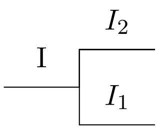
The longer leg of the battery is the negative pole, while the shorter one is the positive pole.

1.1 Ohm's Law

Ohm's Law states that $U = I \times R$ where U is voltage, measured in volts (V), I is current, measured in amps (A), and R is resistance, measured in ohms (Ω).

1.2 Kirchoff's Law

Kirchoff's Law states that, at a junction, currents before and after must equal.

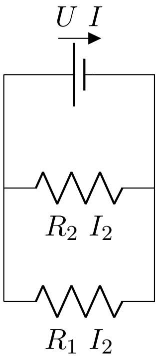


In this case, $I = I_1 + I_2$

2 Multiple resistors

2.1 Paralell

In Paralell, the voltage is the same for all components, but current and resistance may change. In a circuit that looks like this, $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$



The following is a proof of this:

$$\text{According to Ohm's Law,}$$

$$U = I \times R \implies I = \frac{U}{R}$$

$$U = I_1 \times R_1 \implies I_1 = \frac{U}{R_1}$$

$$U = I_2 \times R_2 \implies I_2 = \frac{U}{R_2}$$

$$\text{According to Kirchoff's Law } (I = I_1 + I_2)$$

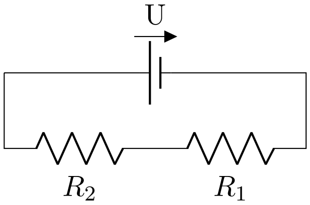
$$\frac{U}{R} = \frac{U}{R_2} + \frac{U}{R_2}$$

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

This shows that adding a resistor in paralell increases R^{-1}, which means that R gets smaller.

2.2 Series

In series, the current is the same for all components, but voltage and resistance may change. In a circuit that looks like this, $R = R_1 + R_2$.



The following is a proof of this, using Ohm's law.

$$U_1 = I \times R_1$$

and

$$U_2 = I \times R_2$$

and

$$U_1 + U_2 = U$$

using Ohm's Law we can now find the resistances by substituting U for $I \times R$

$$I \times R = I \times R_1 + I \times R_2$$

the currents cancel.

$$R = R_1 + R_2$$

3 Measuring devices

3.1 Voltmeters

Components in paralell have the same voltage accross, thus voltage meters should be connected in paralell with the resistor.

3.2 Current meters

Components in series have the same current flowing through them, thus current meters should be connected in series with the resistor.

4 Multiple Batteries

4.1 Series

If there are batteries in series, the voltage adds and current remains the same.

4.2 Paralell

If the batteries are in paralell, the current adds and voltage remains the same. This means the batteries will last for longer, or be able to output more current.