**Resistors in Series and Parallel**

Not all circuits are as simple as the ones we have seen so far. Some have hundreds of small components that are set up in a variety of ways. When dealing with these complicated circuits we need to find some rules that govern how our components will work.

**Resistors in Series**

The total resistance in a circuit is the measure of the resistance of all the resistors in a circuit.

When resistors are placed in series, like so:

the circuit follow a set of properties.

|  |  |
| --- | --- |
|  | Series Circuit |
| Total Current | IT = I1 = I2 = I3 = I4 |
| Total Voltage | VT = V1 + V2 + V3 + V4 |
| Total Resistance | RT = R1 + R2 + R3 + R4 |

This chart says:

**Current:**

**Voltage:**

**Resistance:**

**Example 1**: Three resistors, of 28 Ω, 56 Ω, and 106 Ω, are connected in series. What is the total resistance?

**Example 2**: Two resistors, R1=20 Ω and R2=60 Ω are connected in series to a source. 0.6 A of current is measured flowing through the second resistor.

a) How much current is flowing through the first resistor?

b) What is the voltage across the first resistor?

c) What is the total voltage in the circuit?

**Resistors in Parallel**

When resistors are placed in parallel the current is split among the resistors. Resistors in parallel look like so:

The circuit follow a set of properties.

|  |  |
| --- | --- |
|  | Parallel Circuit |
| Total Current | IT = I1 + I2 + I3 + I4 |
| Total Voltage | VT = V1 = V2 = V3 = V4 |
| Total Resistance | RT = R/number of resistors (if all the resistors are the same) |

This chart says:

**Current:**

**Voltage:**

**Resistance:**

**Example 3:** Three identical resistors are attached in parallel. The first resistor has a resistance of 70 Ω and a current of 0.050 A running through it.

a) What is the total voltage of the circuit?

b)What is the total resistance of the circuit?

**Example 4:** Two identical resistors are attached in parallel. The source provides 5V of charge and 0.02A of current is measured through the whole circuit.

a) What is the total resistance of the circuit?

b) What is the voltage and current running through one resistor?

c) What is the resistance of one resistor?

**Combined Circuits**

Resistors can be set up in ways that are in both series and in parallel. You can find the total resistance of one portion of the circuit and redraw the circuit using this new resistance as just one resistor. This is shown in the following examples: