**Electrical Resistance**

* Georg Simon Ohm (1789 – 1854) noticed that for a substance, the ratio of the voltage drop through it compared to the current flowing through it was a constant. He called this ratio resistance.
* Even though most materials can be classified as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, some conductors allow charges to move through them more easily than others.
* The opposition to the motion of charge (current flow) in a conductor is the conductor’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Where the S.I. unit for resistance

is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Four Main Factors That Determine the Resistance**

|  |  |  |  |
| --- | --- | --- | --- |
| **Factor** | **Explanation** | **Relationship** | **Equation** |
| **Type of Material** | Some materials are easier to flow through than others |  |  |
| **Length of Material** | Traveling longer distance requires more energy |  |  |
| **Cross-Sectional Area** | Larger traveling space means more charges can flow |  |  |
| **Temperature** | Charges are moving through atoms; higher temperature mean atoms move more |  |  |

**Example 1** The resistance of a curling iron is . What is the current in the iron when it is plugged into a outlet?

**Example 2** A toaster uses a strip of metal long as a heating element. Initially, it has a resistance of .

1. What current will it draw when plugged into a source?
2. What happens to the current it draws as time progresses? Justify your answer.

**Example 3** A piece of metal, long, cross-sectional area is used as a heating element.

1. When plugged into a wall socket at it draws of current. What is it’s resistance?
2. If the element is plugged into a wall socket in Europe (), what current will it draw?
3. The wire is now stretched and cut so that it is long and in area. What is it’s new resistance?

**Electrical Power**

**Recall:** Power is the rate at which \_\_\_\_\_\_\_\_\_\_\_\_ is done and work is the change in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* Power can also be expressed

in terms of \_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_:

* But, using Ohm’s Law \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, electric power can be expressed in the following alternate forms:

* The SI unit of power is the watt (\_\_\_\_) which is a (\_\_\_\_\_\_\_).

**Example 1** Find the resistance of a space heater which is plugged into a outlet.

**Example 2** A bulb is plugged into a plug. What current does it draw?

**Kirchoff’s Laws and Resistors in Circuits**

Resistors in Series

* When resistors (loads) are connected one after another in series, there is only \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for the current to follow.

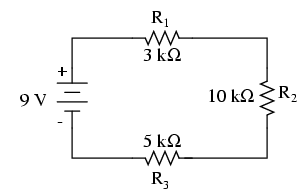
Note: If one load burns out, the whole circuit goes out.

**Kirchhoff’s Laws for a series circuit state that:**

* The equivalent resistance in a series circuit (total resistance) is the \_\_\_\_\_\_\_\_ of the individual resistances:
* The current in each resistor is the \_\_\_\_\_\_\_\_\_\_\_\_ and is also equal to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ current flowing in the circuit:
* The sum of the \_\_\_\_\_\_\_\_\_\_\_\_\_ across each of the individual loads will equal the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Note: Ohm’s Law can also be applied to the total quantities.

**Example 1** Find and for the following circuit:



**Resistors in Parallel**

* When resistors (loads) are connected one after another in parallel, there is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for the current to follow.

Note: If one load burns out, the others will keep on working.

Kirchhoff’s Laws for a parallel circuit state that:

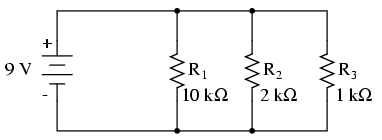
* The reciprocal of the equivalent resistance in a parallel circuit (total resistance) is the \_\_\_\_\_\_\_\_ of the reciprocal of the individual resistances:

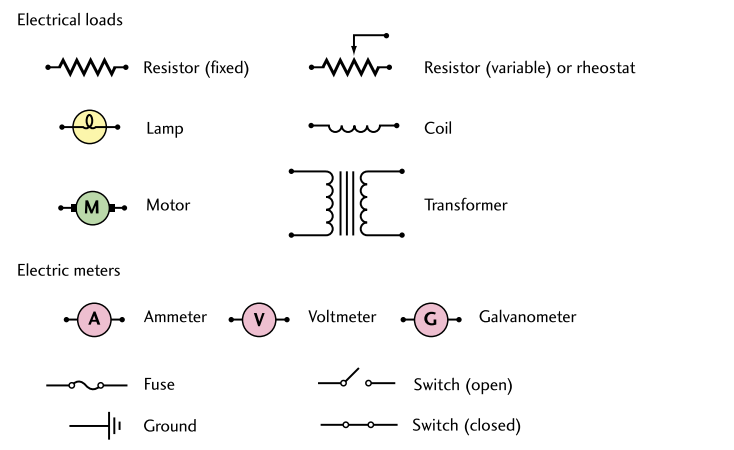
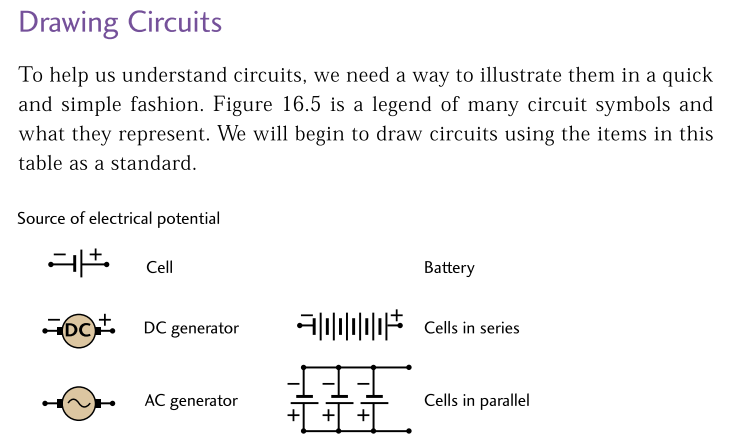
Note: The total resistance will always be \_\_\_\_\_\_\_\_\_\_ than any of the individual branch resistances.

* The total current in the circuit is the \_\_\_\_\_\_\_\_\_ of all the individual branch currents. Or the total current into a junction point is equal to the total current out of a junction point.
* The voltage across each of the individual branches will be the \_\_\_\_\_\_\_\_\_\_\_.

Note: Ohm’s Law of \_\_\_\_\_\_\_\_\_\_\_\_\_\_ still applies to the total quantities.

**Example 2** Find and for the following circuit:





**Homework:** pg. 575 #7, 8, 21 – 28 Read 16.6 pg. 563 #1 – 3 pg. 575 #5, 29 – 34