**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 $19.0$ . What is the current in the iron when it is plugged into a $120 V$ outlet?

**Example 2** A toaster uses a strip of metal $15.0 cm$ long as a heating element. Initially, it has a resistance of $2500$ .

1. What current will it draw when plugged into a $120 V$ source?
2. What happens to the current it draws as time progresses? Justify your answer.

**Example 3** A piece of metal, $20.0 cm$ long, $2.50 cm^{2}$ cross-sectional area is used as a heating element.

1. When plugged into a wall socket at $120 V$ it draws $3.50 A$ of current. What is it’s resistance?
2. If the element is plugged into a wall socket in Europe ($240 V$), what current will it draw?
3. The wire is now stretched and cut so that it is $15.0 cm$ long and $1.00 cm^{2}$ 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 $1320 W$ space heater which is plugged into a $120 V$ outlet.

**Example 2** A $60 W$ bulb is plugged into a $120 V$ 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 $R\_{T}$ and $I\_{T}$ 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 $R\_{T}$ and $I\_{T}$ for the following circuit:





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