# Unit 8.1: Electric Charges

**Notes for/from class**

**Further Reference: 17.1 Electricity**

**A LITTLE CHEMISTRY**

1. All matter is made up of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Atoms are made of:
   1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_)
   2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_)
   3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_)
3. Atoms can have a\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge, a \_\_\_\_\_\_\_\_\_\_\_\_charge, or \_\_\_\_\_\_\_\_\_\_\_\_ charge.

**ELECTRIC CHARGE**

1. Electrical charge is caused by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of \_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_
   1. Positive charged objects have more \_\_\_\_\_\_\_\_\_\_\_\_ than \_\_\_\_\_\_\_\_\_\_\_
   2. Negative charged objects have more \_\_\_\_\_\_\_\_\_\_\_\_ than \_\_\_\_\_\_\_\_\_\_\_
   3. Neutral charged objects have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Like charges \_\_\_\_\_\_\_\_\_\_ and opposite charges \_\_\_\_\_\_\_\_\_\_

**Draw the charge arrows for each scenario**

Opposites? Likes?

1. Like energy, electric charges can never be \_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_. It only \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from one object to the next when \_\_\_\_\_\_\_\_\_\_\_\_ move from one object to another.

**TRANSFER OF ELECTRIC CHARGE**

**Notes for/from class**

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: Transferring a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ by bringing a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ near a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ without touching it..
   1. The total charge on the door knob will still be \_\_\_\_\_\_\_\_\_\_\_\_\_, but the oppsite sides will have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge.
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: Electrons are transferred from one object to the next by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. When a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged rubber rod touches a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ , some electrons move from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to give the doorknob a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: two objects \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, leaving \_\_\_\_\_\_\_\_\_\_ built up one side, leaving both objects \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. Give 2 examples:

**CONDUCTOR AND INSULATOR**

1. Electrical conductors are:
   1. List 2 examples:
2. Electrical Insulators are:
   1. List 2 examples:
3. Charges in the electrical cord of an appliance can move through the \_\_\_\_\_\_\_\_\_\_, but cannot excape through the surrounding \_\_\_\_\_\_\_\_\_\_\_\_\_.

# Unit 8.2: Current and Ohm’s Law

**Notes for/from class**

**Further Reference: 17.2 Current**

1. Electricity is:
2. Electric Current is:
3. Ohm’s Law Equation:

In words In symbols

1. The SI unit of voltage is the \_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_)
2. The SI unit of current is the \_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_)
3. The SI unit of resistance is the \_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_)

**VOLTAGE AND CURRENT**

1. Voltage is the difference in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between two places where \_\_\_\_\_\_\_\_\_\_\_\_\_ are flowing.
   1. A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ wants to move away from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Electrons flow from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ provides the energy that \_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_ electrons through a circuit.
2. Batteries can have different \_\_\_\_\_\_\_\_\_\_\_\_\_\_, and therefore different \_\_\_\_\_\_\_\_\_\_ currents.
   1. The two different ends of a battery are called \_\_\_\_\_\_\_\_\_\_\_\_\_
   2. The voltage ranges from \_\_\_\_\_\_\_\_\_\_\_ on a small battery to \_\_\_\_\_\_\_\_\_\_\_ on a car battery.
3. Voltage is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that sets charges\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (it is *“the push”*).
4. Electric current is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. The SI unit for current is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_)
   2. In metals, moving \_\_\_\_\_\_\_\_\_\_\_\_ make up the current.
   3. Electrons travel from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   4. Direction of current is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , which is \_\_\_\_\_\_\_\_\_\_\_\_\_ as the direction as the electron flow.
5. There are two types of current.

**Notes for/from class**

* 1. AC:
     1. AC examples:
  2. DC:
     1. DC examples:

**ELECTRIC RESISTANCE**

1. Objects use difference amounts of power because they have \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in them.
   1. The difference in current between these objects is due to the \_\_\_\_\_\_\_\_\_\_.
2. Resistance is:
   1. Resistance is caused by \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Conductors have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ resistance.
   1. The better the conductor, the \_\_\_\_\_\_\_\_\_\_\_\_\_ electrons will move through the material
   2. Give 2 examples:
4. Insulators have\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ resistance.
   1. The better the insulator, the more the substance will \_\_\_\_\_\_\_\_\_\_\_\_\_\_ the movement of electrons
   2. Give 2 examples:
5. The resistance of the filament of a light bulb determines \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the light bulb will be.
   1. The filament of a 40-watt light bulb has a much \_\_\_\_\_\_\_\_\_\_\_\_\_\_ resistance than that of a 100-watt light bulb. This is because \_\_\_\_\_\_\_\_\_\_\_ resistance means \_\_\_\_\_\_\_\_\_\_\_\_ current, which means a \_\_\_\_\_\_\_\_\_\_\_\_\_ light bulb.
6. What are 2 things that we can do to increase resistance?
7. Explain how we accomplish these two methods within the filament of a lightbulb or a toaster?

**Practice Problems:** Show the formula. Show your work. Show your units.

1. The headlights of a typical car are powered by a 12V battery. What is the resistance of the headlights if they draw 3.0 A of current when turned on?

# Unit 8.3: Series and Parallel Circuits

**Notes for/from class**

**Further Reference: 17.3 Circuits**

**WHAT ARE CIRCUITS?**

1. Electric circuit is:
   1. Because of the \_\_\_\_\_\_\_\_\_\_\_ of the outlet, \_\_\_\_\_\_\_\_\_\_\_ move through the wires and bulbs from one side of the outlet to the other.
   2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ need to travel around the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in order for anything to work.
2. When there is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ path for current connected to a voltage source, it is considered a \_\_\_\_\_\_\_\_\_\_\_\_\_ circuit
3. When there is no \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ path for current connected to a voltage source, it is considered an \_\_\_\_\_\_\_\_\_\_\_\_\_ circuit
   1. A switch allows you to \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_ a circuit

**SAFETY PRECAUTIONS: FUSES AND CIRCUIT BREAKERS**

1. If many devices are connected across an electrical outlet, the overall resistance of the circuits is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
   1. As a result, the electrical wires carry \_\_\_\_\_\_\_\_\_\_ than a safe level of current, which is called an \_\_\_\_\_\_\_\_\_\_\_\_.
   2. The high currents in overloaded circuits can cause \_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Fuses \_\_\_\_\_\_\_\_\_\_\_\_ to prevent circuit overload.
   1. A fuse is a ribbon of wire that has a \_\_\_\_\_\_\_\_\_\_\_\_\_.
   2. If the current in the line becomes \_\_\_\_\_\_\_\_\_\_\_\_\_\_, the fuse \_\_\_\_\_\_\_\_\_\_\_\_ and the circuit is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
   3. Each fuse can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and then must be replaced.
   4. Each fuse has a certain current level that will cause it to melt.
3. Circuit breakers \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with a high current.
   1. Circuit breakers use a \_\_\_\_\_\_\_\_\_\_\_\_\_ strip that responds to \_\_\_\_\_\_\_\_\_\_ overload by \_\_\_\_\_\_\_\_\_\_\_ the circuit.
   2. The circuit breaker acts as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
   3. Unlike fuses, circuit breakers can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (reset).
      1. Must be reset after the circuit breaker has been \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Schematic diagrams are used to represent circuits:

**Notes for/from class**

**Schematic Diagram Symbols:** Draw the following

Resistor Battery (with + and - terminal)

Light Bulb Open Switch

**Practice Schematic Drawings:** Draw the following:

1. A circuit with one resistor, one battery, and one switch.

1. A circuit with two resistors, three batteries, and one switch.

|  |  |  |
| --- | --- | --- |
|  | **Series Circuit** | **Parallel Circuit** |
| Pathways for current |  |  |
| Current (I) |  |  |
| Voltage (V) |  |  |
| Resistance (Ω) |  |  |

**Notes for/from class**

**Practice Drawings:** Practice Drawings

Series: with 2 resistors (one is 4 ohm, one is 7ohm), a 12V battery, and a 10 ohm light bulb.

Parallel: with a 1.5 volt battery and 3 light bulbs (each on its own branch). Light bulbs have a resistance of 2, 4, and 6 ohms.

Series: 6v battery, one switch, one 20ohm resistor.

Parallel: 12volt battery, 3 light bulbs. 2 light bulbs (2 and 3 ohms) are on one branch, while the 3rd light bulb (8ohms) is on another branch)

**SERIES CIRCUITS**

1. There is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ path for current/electrons to travel
   1. If the circuit opens in any way, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, because current \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Current \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as it flows through every part of a circuit.
   3. The resistance, and therefore voltage, will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at different points on a series circuit.
   4. Electric current always flows \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
   5. Add up \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to get \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a series circuit.
   6. Voltage \_\_\_\_\_\_\_\_\_\_\_\_\_ after each resistor.

**Notes for/from class**

**Class Notes:** Voltage Drop

1. Draw a series circuit with a 3 different1.5 V batteries (all together), 2 equal resistors, and a current of 0.5 A.

Drawing:

What is the total voltage of the circuit?

What is the total resistance of the circuit?

What is the resistance of each resistor?

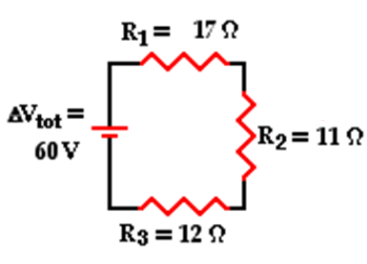
1. Use the picture to the right for the following:

What is the total resistance of the circuit?

What is the current for the circuit?

What is the voltage drop across each resistor?

R1 R2 R3



**PARALLEL CIRCUITS**

1. Parallel circuits have \_\_\_\_\_\_\_\_\_\_\_\_\_\_ paths for current.
   1. Paths are known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. If one of the bulbs or resistors in the circuits were removed, the other branches still \_\_\_\_\_\_\_\_\_\_\_\_\_
   3. When devices are connected in parallel, the voltage across each branch is the \_\_\_\_\_\_\_\_\_\_\_\_.
   4. When devices are connected in parallel, the current in each branch depends on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      1. If one light bulb in a parallel circuit has less resistance, \_\_\_\_\_\_\_ charge moves through that bulb because the bulb offers \_\_\_\_\_\_\_\_ opposition to the movement of charges.
   5. Instead, the \_\_\_\_\_\_\_\_\_\_ of the currents in all the devices equals the total current.

**Class Notes:** Parallel Drawing

1. Draw a parallel circuit with two resistors, one 2 ohm and one 3 ohm (one on each branch) and a 12 V battery.

Drawing:

What is the voltage through each resistor?

What is the current flowing through each branch?

What is the total current?

# Unit 8.4: Magnets and Electricity

**Notes for/from class**

1. What is a magnet?
2. What are the 4 elements that can be magnetic?
   1. What are 2 other examples of magnets?
3. All magnets have 2 poles: \_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_
   1. Like poles \_\_\_\_\_\_\_\_\_\_\_\_\_, opposite poles \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. If a magnet is cut, each piece will have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. What is a permanent magnet?
   1. How long can permanent magnets last?
5. What is a magnetic field?
   1. Leave \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pole and enter \_\_\_\_\_\_\_\_\_\_\_\_\_ pole
   2. Magnetic field lines that are closer together mean a \_\_\_\_\_\_\_\_\_\_\_\_\_ magnetic field
   3. Magnetic fields are strongest at the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Electric currents produce \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. Magnetics is produced by \_\_\_\_\_\_\_\_\_\_\_\_\_\_ electric charges
   2. The magnetic field of a coil of wire resembles \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. What is/How do you create an electromagnet?
8. Strength of an electromagnet depends on :
   1. \_\_\_\_\_\_\_\_\_\_\_ wire
      1. \_\_\_\_\_\_\_\_\_\_\_\_ wire = \_\_\_\_\_\_\_\_\_\_ resistance
   2. Number of \_\_\_\_\_\_\_\_\_\_\_\_ in the wire
      1. More \_\_\_\_\_\_\_\_\_\_ = stronger electromagnet
   3. The amount of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      1. More \_\_\_\_\_\_\_\_\_\_\_\_ = stronger electromagnet
   4. The size of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_
      1. Bigger \_\_\_\_\_\_\_\_\_\_\_\_ = stronger electromagnet
9. The 2 reasons that electromagnets are useful are:

1.

2.

1. What is a motor?
2. What is a generator?
   1. Does a generator produce AC or DC?