

Name: _____

Points: ___/10

SMITH - INDUSTRIAL SCIENCE B - 1RST PERIOD - OFF-SITE LEARNING PACKET DAY 7

Chapter 9 Electricity
Lesson 7 – **Electric Circuits**

Lesson Objectives

- **define bellwork vocabulary (series circuit, parallel circuit, schematic)** with 100 percent accuracy
- **calculate current, volts, or resistance using Ohm's law and circuit diagrams** with 100 percent accuracy
- **identify the symbols used in an electric circuit** with 100 percent accuracy

Associated Text:

Chapter 9 Lesson 7

Electric Circuits

Any path along which electrons can flow is a *circuit*. For a continuous flow of electrons, there must be a complete circuit with no gaps. A gap is usually provided by an electric switch that can be opened or closed to either cut off or allow energy flow.

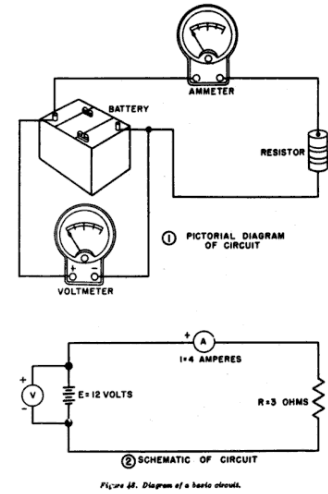
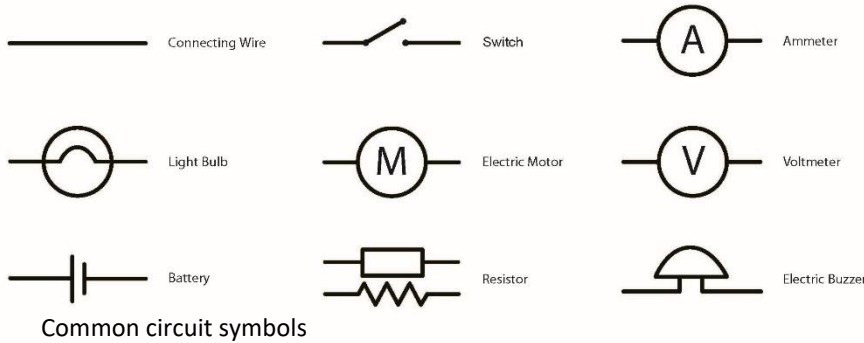


Figure 46. Diagram of a basic circuit.

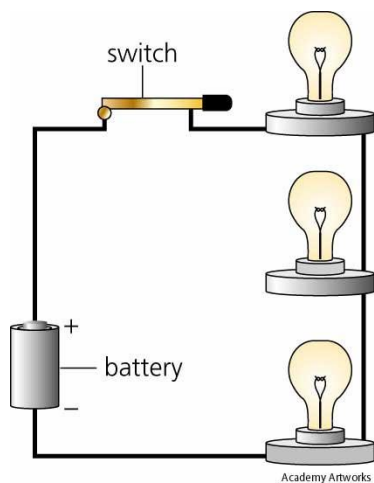
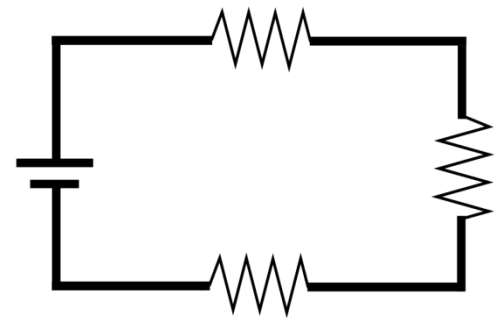


Most circuits contain more than one device that receives electric energy from the circuit. These devices are commonly connected in a circuit in one of two ways, series or parallel. When connected in series, the devices and the wires connecting them form a single pathway for electron flow between the terminals of the battery, generator, or wall socket. When connected in parallel, the devices and wires connecting them form branches, each of which is a separate path for the flow of electrons. Series and parallel connections each have their own distinctive characteristics.

Series Circuits

A simple series circuit is shown in the following figure., where three lamps are connected in series with a battery. When the switch is thrown shut, the same current exists almost immediately in all three lamps. The current does not “pile up” in any lamp but flows through each lamp. Electrons that make

up this current leave the negative terminal of the battery, pass through each resistive filament of the lamps in turn, and then return to the positive terminal of the battery (the electrons then pass through the battery and out the negative terminal again, which means that the amount of current passing through the battery is the same as the amount passing through the lamps). This is the only path of the electrons through the circuit. A break anywhere in the path results in an open circuit, and the flow of electrons ceases. Burning out one of the lamp filaments or simply opening a switch causes such a break.



The circuit shown in the previous figure illustrates the following important characteristics of series connections:

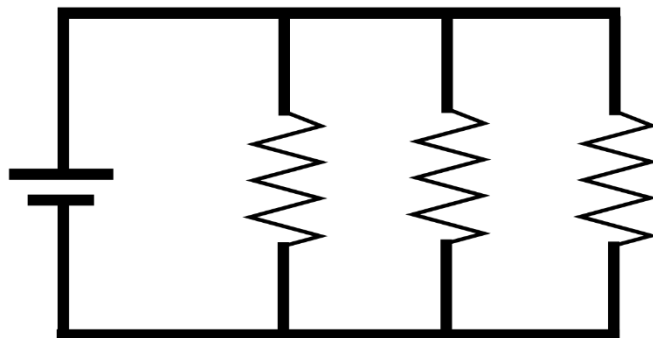
- Electric current has a single pathway through a series circuit. This means that the current is the same through each electrical device in the circuit.
- This current is resisted by the resistance of the first device, the resistance of the second, and that of the third also, and so the total resistance to current in the circuit is the sum of the individual resistances along the circuit path.
- The current in the circuit is numerically equal to the voltage supplied by the source divided by the total resistance of the circuit. This is in accord with Ohm's law.
- The total voltage impressed across a series circuit divides among the electrical devices in the circuit so that the sum of the "voltage drops" across each device is equal to the total voltage supplied by the source.
- The voltage drop across each device is proportional to its resistance.

It is easy to see the main disadvantage of a series circuit: If one device fails, current in the whole circuit ceases. Some cheap Christmas tree lights are connected in series. When one bulb burns out, it's fun and games (or frustration) trying to find which one to replace.

Most circuits are wired so that it is possible to operate several electrical devices, each independently of the others. In your home, for example, a lamp can be turning on and off without affecting the operation of other lamps or electrical devices on the same circuit. This is because these devices are connected not in series, but in parallel.

Parallel Circuits

A simple parallel circuit is shown in the following figure. Three lamps are connected to the same two points A and B. Electrical devices connected to the same two points of an electrical circuit are said to be connected in parallel. Electrons leaving the negative terminal of the battery need travel through only one lamp filament before returning to the positive terminal of the battery. In this case current branches into three separate pathways from A to B. A break in any one path does not interrupt the flow of charge in the other paths. Each device operates independently of the other devices.



The circuit shown in the following figure illustrates the following major characteristics of parallel connections:

- Each device connects the same two points A and B of the circuit. The voltage is therefore the same across each device.
- The total current in the circuit divides among the parallel branches. Because the voltage across each branch is the same, the amount of current in each branch is inversely proportional to the resistance of the branch.
- The total current in the circuit equals the sum of the currents in its parallel branches.
- As the number of parallel branches is increased, the overall resistance of the circuit is decreased.

Parallel Circuits and Overloading

Electricity is usually fed into a home by way of two wires called *lines*. These lines are very low in resistance and are connected to wall outlets in each room – sometimes through two or more separate circuits. About 110-120 volts of electric potential is impressed on these lines by a transformer in the neighborhood that steps down the higher voltage supplied by the power utility. This voltage is then applied across appliances and other devices connected in parallel by plugs to the house circuit. As more devices are connected to a circuit, more pathways for current result in lowering of the combined resistance of the circuit. Therefore a greater amount of current exists in the circuit, and this can be a problem. Circuits that carry more than a safe amount of current are said to be *overloaded*.

To prevent overloading in circuits, fuses are connected in series along the supply line. In this way the entire line current must pass through the fuse. The fuse shown in the following figure is constructed with a wire ribbon that heats up and melts at a given current. If the fuse is rated at 20 amperes, it will pass 20 amperes but no more. A current above 20 amperes melts the fuse, which “blows out” and breaks the circuit. Before a blown fuse is replaced, the cause of the overloading should be determined and remedied. Often, insulation that separates the wires in a circuit wears away and allows the wires to touch each other. This greatly reduces the resistance in the circuit, which causes the current to overload, and is called a short circuit.

In modern buildings, fuses have been largely replaced by circuit breakers, which use magnets or bimetallic strips to open a switch when the current is too great. Utility companies use circuit breakers to protect their lines all the way back to the generators.

Image URLs

<http://hdz.horizonpower.com.au/assets/section/Circuit-cropped.jpg>

<http://cf.ydcdn.net/1.0.1.18/images/main/series%20circuit.jpg>

<http://www.technologystudent.com/images5/prc4.gif>

https://upload.wikimedia.org/wikipedia/commons/thumb/5/5a/Parallel_circuit.svg/1280px-Parallel_circuit.svg.png

Guided Reading Questions: (10 pts.)

use the chapter text and guided notes found above

Electric Circuits

1. What is an electric circuit?
2. What is the role of a gap in an electric circuit?
3. Most circuits contain more than one device that receives electric energy from the circuit. These devices are commonly connected in a circuit in one of two ways, _____ and _____.
4. How many pathways do charges (electrons) have to flow in a series circuit?
5. The total resistance of a series circuit is the _____ of all the resistances.
6. If there is a break in any one of the devices in a series circuit, what happens to the rest of the devices?
7. In a circuit consisting of two lamps connected in series, if the current through one lamp is 1 A, what is the current through the other lamp?
8. If there are 6 volts impressed across a series circuit with two resistors, and the first resistor has a 2 volt drop, what is the voltage drop across the second resistor?
9. How many pathways do charges (electrons) have to flow in a parallel circuit?
10. If a circuit consisting of two lamps connected in parallel, if there is a 6 V across one lamp, what is the voltage across the second lamp?
11. As you add more and more devices to a parallel circuit, what happens to the overall current?
12. Household circuits normally wired in _____.
13. Fuses or breakers are always wired in _____ with the rest of the circuits in the house.

Lesson Notes:

Electric Circuits

- any path along which electrons can flow is a circuit
- a gap is usually provided by an electric switch that can be opened or closed to either cut off or allow energy flow
- most circuits contain more than one device that receives electric energy from the circuit
- these devices are commonly connected in a circuit in one of two ways, series or parallel

Series versus Parallel Circuits

- when connected in series, the devices and the wires connecting them form a single pathway for electron flow
- in parallel circuits, the devices and wires connecting them form branches, each of which is a separate path for the flow of electrons

Series Circuits

- electric current has a single pathway
 - the current is the same through each electrical device in the circuit
- current is resisted by the resistance of each device
- the total resistance to current in the circuit is the sum of the individual resistances
- current in the circuit is the voltage divided by the total resistance of the circuit
- the voltage divides among the electrical devices in the circuit
 - the sum of the “voltage drops” is equal to the total voltage
- the voltage drop across each device is proportional to its resistance.

Parallel Circuits

- the voltage is the same across each device
- the total current in the circuit divides among the parallel branches
 - the amount of current in each branch is inversely proportional to the resistance of the branch
- the total current in the circuit equals the sum of the currents in its parallel branches
- as the number of parallel branches is increased, the overall resistance of the circuit is decreased

Vocabulary

series circuit – an electric circuit in which the current has only one path

parallel circuit – an electric circuit in which the current has multiple paths

schematic – a line drawing of an electrical circuit with standard symbols for the components of the circuit