Remote Learning Packet 3

Subject-Physical Science

School- VCHS

Thursday April 23- Wednesday May 6, 2020

Students if you are working online then please continue to work online. If you are using paper and pencil you can then please adhere to the daily instructions that are attached.

Google Classroom Code- Mr Dw. Thompson- y2lcuyh & Ms. Morgan- yppjana

Students you can join my Google Classroom at the link above. If not you will complete the packet that is provided.

Day	Date	Online Activity	Paper and Pencil
Day 21	April 23	Google Classroom Topic: **Classifying Matter**	Paper Pencil Topic: **Classifying Matter**
Day 22	April 24	Google Classroom Topic: **Phase Change**	Paper Pencil Topic: **Phase Change**
Day 23	April 27	Google Classroom Topic: **Structure of an atom & Writing Chemical Formulas**	Paper Pencil Topic: **Structure of an atom & Writing Chemical Formulas**
Day 24	April 28	Google Classroom Topic: **Atomic Structure**	Paper Pencil Topic: **Atomic Structure**
Day 25	April 29	Google Classroom Topic: **The Periodic Table**	Paper Pencil Topic: **The Periodic Table**
Day 26-27	April 30-May 1	Google Classroom Topic: **Test on the Atomic Structure & Periodic Table**	Paper Pencil Topic: **Test on the Atomic Structure & Periodic Table**
Day 28-29	May 4-5	Google Classroom Topic:**Balancing Chemical Equations**	Paper Pencil Topic:**Balancing Chemical Equations**
Day 30	May 6	Google Classroom Topic: **Classifying Chemical Reactions**	Paper Pencil Topic: **Classifying Chemical Reactions**
Day 29	May 5	Google Classroom	Paper Pencil

		Topic: **Acids, Bases & Salts**	Topic: **Acids, Bases & Salts**
Day 30	May 6	Google Classroom Topic:**Nuclear Chemical**	Paper Pencil Topic:**Nuclear Chemical**

April 23, 2020

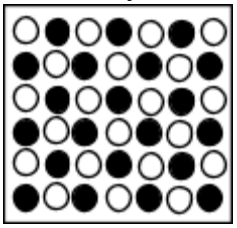
Physical Science Date_____ Period_____
Name_____

Classifying Matter

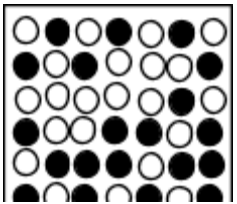
(Section 2.1 Review)

1) What is a *pure substance*? Please include **2 examples** as part of your answer.

2) Do samples of a pure substance have the **SAME** or **DIFFERENT** properties? Why?
3) What is an *element*?
4) Why does an element have a fixed composition?
5) Most elements are **SOLIDS/LIQUIDS/GASES**.
6) What are the only two elements that are liquids at room temperature?
7) What is a *compound*?
8) What is the MAIN difference between a compound and an element?
9) "*The properties of compounds are different from those of which it is made*." Please give an example that demonstrates this statement.
10) Why can the properties of a mixture vary?
11) How are mixtures classified?
12) Describe a "heterogeneous" mixture.
13) Describe a "homogeneous" mixture.
14) State whether each of the below pictures represents a homogeneous or heterogeneous mixture. **EXPLAIN** your answer.

a.  **HOMOGENEOUS** or **HETEROGENEOUS**

Explain:



b. **HOMOGENEOUS** or **HETEROGENEOUS**

Explain:

A

15) What do we use to classify solutions, suspensions, and colloids?
16) State whether each of the following statements applies to a solution, suspension, or colloid.

_____ Intermediate-sized particles.
_____ Largest particles.
_____ Smallest particles.
_____ Can separate particles by a filter.
_____ Light is not scattered by its particles.
_____ Another name for a homogeneous mixture.
_____ Heavier particles separate or settle over time upon standing.

17) Please fill out the following chart:

Properties of Three Mixtures			
	Scatters Light	**Separates into Layers**	**Can be Separated by Filtration**
Colloid			
Solution			
Suspension			

18) Please state an example of a SOLUTION, SUSPENSION, and COLLOID.

APRIL 24, 2020

Physical Science Date_____ Period_____
Name_____

Phase Changes Worksheet

1. Phases of Matter: *Use the word bank provided to complete the following statements.*

Vibrate	Tightly	Without	Shape	Flow
Volume	Fill	Definite	Loosely	Tightly

Solid : The type of matter that has _____ volume and shape.

The molecules are packed together _____ and _____ slowly.

Liquid: The type of matter that has definite _____ but not _____.

The molecules of a liquid are _____ packed yet do not have an orderly arrangement

allowing them the freedom to _____.

Gas: The type of matter _____ definite volume and shape. Molecules of a gas are so

_____ arranged and move so rapidly that they will _____ their container.

3. Phase Change Descriptions:

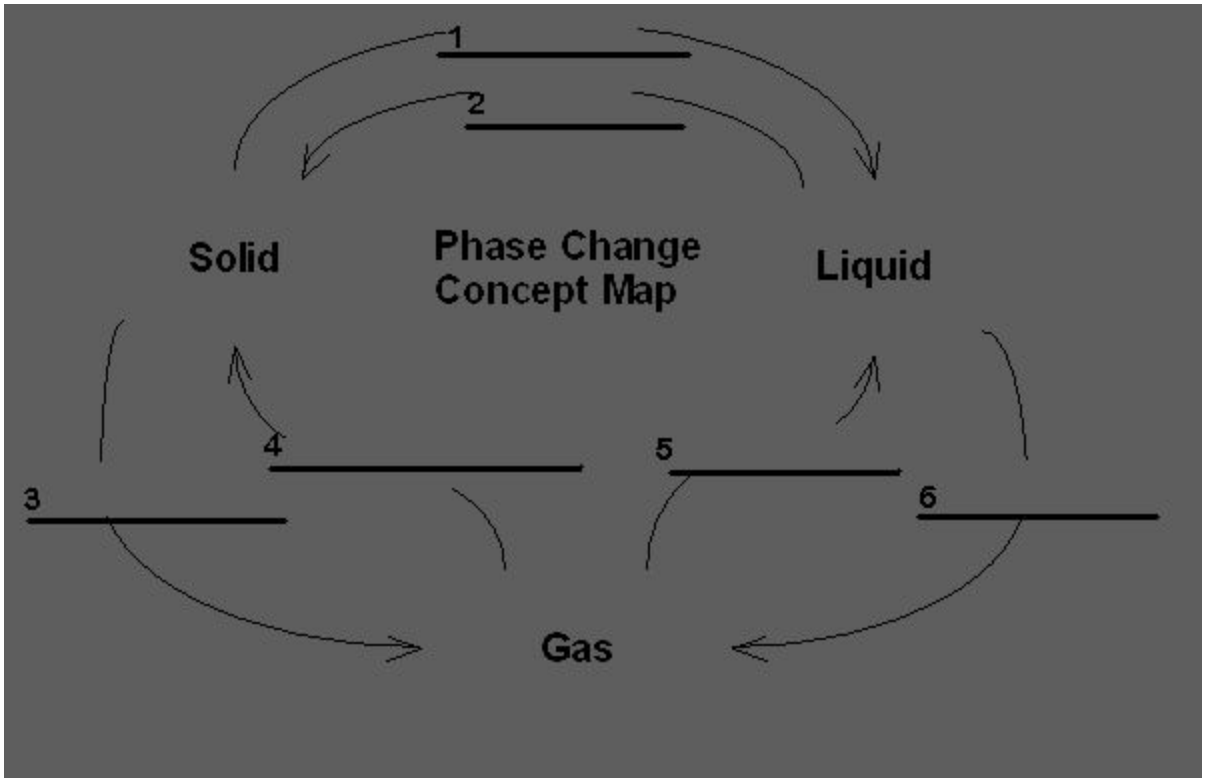
- **Melting :** the change from _____ to _____.
- **Freezing**: the change from _____ to _____.
- **Condensation**: the change from _____ to _____.
- **Vaporization**: the change from _____ to _____.
  - **Evaporation**: vaporization from the surface of a _____.
  - **Boiling**: vaporization from within as well as from the surface of a _____.
- **Sublimation**: the change from _____ to _____.
- **Deposition**: the change from _____ to _____.

4. Use the data table to answer the following questions:

Substance	Melting Point (C)	Boiling Point (C)
Ethanol	-119	79
Hexane	-95	69
Methane	-182	-164
Methanol	-94	65

a. At what temperature does Hexane turn into a gas?
b. At what temperature does Ethanol freeze?
c. Which substance is a gas at 45 C?
d. Which substance is a liquid at -100 C?

5. Label the phase changes in the blanks provided.



APRIL 27, 2020

Date_____ Period_____ Name_____

TOPIC: Structure of an Atom & Chemical Formula

Directions: *Match the words in the bank with the definitions below.*

A) Proton B) Neutron C) Mass Number D) Energy Levels

E) Electron Cloud F) Orbital G) Electron Configuration H) Ground State

1. _____ The sum of the protons and the neutrons in the nucleus of the atom.

2. _____A region of space around the nucleus where an electron is likely to be found.
3. _____A positively charged subatomic particle found in the nucleus of the atom.
4. _____A visual model of the most likely locations for electrons in an atom.
5. _____The arrangement of electrons in the orbitals of an atom.
6. _____A neutrally charged subatomic particle that is found in the nucleus of an atom.

Directions: *Define the following words in your own words.*

7. Electron:

   _____

   ____

8. Atomic Number:

   _____

9. Subscript_____

   _____

   _

10. Coefficient_____

    _____

11. Write the chemical formulas for the following compounds.

a) Magnesim Chloride

b) Sodium Sulphide

c) Calcium Hydroxide

d) Potassium Fluoride

Write the balanced equation for :

A) Sodium Oxide + Calcium Chloride

B) Lithium Sulphide and Aluminium oxide

C) Calcium hydroxide and Berilium posphide

NOTES

Topic: Atomic Structure

April 28, 2020

I. STUDYING ATOMS

A. Ancient Greek Models of Atoms

1. How far can you keep cutting a substance in half?

2. The philosopher Democritus believed that all matter consisted of extremely small particles that could not be divided.

a. He called these particles "atoms" meaning "uncuttable"

3. Aristotle did not believe there was a limit to the number of times matter could be divided.

4. Neither Democritus nor Aristotle were proven right since neither had experimental support for their ideas.

5. By the late 1800s, though, scientists began to support an atomic theory of matter.

B. Dalton's Atomic Theory

1. Dalton (b. 1766) noticed, like other scientists, that whether the sample of matter was large or small, the atoms were fixed in constant ratios.

a. *e.g.,* A 100-gram sample of magnesium combines with 65.8 grams of oxygen.

b. *e.g.,* A 10-gram sample of magnesium combines with 6.58 grams of oxygen.

c. The ratio of the mass of magnesium to the mass of oxygen is constant in magnesium oxide.

2. Dalton proposed the theory that all matter is made up of individual particles called atoms, which cannot be divided. The main ideas of Dalton's theory are:

a. All elements are composed of atoms.

b. All atoms of the same element have the same mass, and atoms of different elements have different masses.

c. Compounds contain atoms of more than one element.

d. In a particular compound, atoms of different elements always combine in the same way.

3. Recall that a theory must explain the data from many experiments. Because Dalton's atomic theory met that goal, the theory became widely accepted.

a. Over time, though, parts of his theory have been proven to not always be true, but it was not discarded, only revised.

C. Thomson's Model of the Atom

1. Objects can gain charges.

2. Objects with like charges repel each other, while objects with opposite charges attract each other.

3. Some charges can flow from object to object. This is called an electric current.

4. Joseph John Thomas used a device called a Cathode Ray Tube (CRT).

a. A CRT is a glass tube with a gas in it under low pressure.

b. CRT has two electrodes (metal disks) at each end, one becoming positively charged and the other negatively charged.

5. When Thomson passed an electric current through the tube, a beam, called a **cathode ray**, shown through the CRT.

6. When Thomson placed magnets near the beam, he noticed it was either attracted to the positive pole or repelled by the negative pole.
   a. Because opposites attract, Thomson concluded the beam had a negative charge!
   b. Draw Thomson's experiment (with and without magnets)

7. Another experiment Thomson did was to place a paddlewheel in the CRT. When the beam was emitted, it caused the paddlewheel to move down the tube.
   a. This showed the beam had mass.

D. Evidence for Subatomic Particles

1. Thomson concluded these negative particles were inside all atoms.
   a. No matter what metal Thomson used for the disk, the particles produced were identical.
   b. The particles had about 1/2000 the mass of a hydrogen atom, the lightest atom.
2. Thomson's experiments provided the first evidence that atoms are made of even smaller particles.
3. Thomson's model was called the "plum-pudding model" because he pictured the electrons were stuck in a lump of positive charge like raisins in a pudding.
   a. Has to have just as much positive as negative to balance the overall charge.
   b. Might be better called the 'chocolate-chip ice cream model' today.

E. Rutherford's Atomic Theory

1. In 1899, Rutherford discovered fast-moving particles that had a positive charge that he called alpha (α) particles.
2. Rutherford composed an experiment to test the atomic model theory of his day.
3. The alpha particles were shot through barriers to focus the beams to a sheet of gold foil.
4. The gold foil was just a few atoms thick
5. A specially coated film around the gold foil would light up when hit by the alpha particles, to show where they had gone.
6. The hypothesis: Alpha particles should go straight through the gold foil and be deflected only slightly, if at all.

7. Draw a picture of Rutherford's experiment.

8. The result: Most of the alpha particles went straight through. Some bounced off at very large angles. Some even bounced straight back!
9. NEW ATOMIC MODEL! Rutherford's model (nuclear model) says
   a. most of the atom is empty space.

Draw Rutherford's model

b. There is a region called the **nucleus**.
- **i.** Very small space.
- **ii.** All the positive charge of the atom.
- **iii.** Most of the mass of the atom.

c. The **nucleus** is the tiny central core of an atom and is composed of protons and neutrons.

10. According to Rutherford's model, all of an atom's positive charge is concentrated in its nucleus.

11. This model is still incomplete, but better.

Scientist	Evidence	Model

II. THE STRUCTURE OF THE ATOM

A. Properties of Subatomic Particles

1. Protons, electrons, and neutrons are subatomic particles.

B. Protons

1. A **proton** is a positively charged subatomic particle that is found in the nucleus of an atom.

2. Protons are in all elements, but vary in number from element to element.

3. The number of protons in the nucleus is unique for each element.

4. Each proton is assigned a charge of 1+.

C. Electrons

1. An **electron** is a negatively charged subatomic particle that is found in the space outside the nucleus.

2. Each electron is assigned a charge of 1−.

D. Neutrons

1. English physicist James Chadwick (in 1932) showed the existence of neutrons.

2. Charged objects did not deflect their path, so they had no charge.

3. A **neutron** is a neutral subatomic particle that is found in the nucleus of an atom.

4. It has a mass almost exactly equal to that of a proton.

5. Each neutron is assigned a charge of 0.

E. Comparing Subatomic Particles

1. Protons, electrons, and neutrons can be distinguished by mass, charge, and location in an atom.

2. Protons and neutrons have almost the same mass.

Particle	Symbol	Relative Charge	Relative Mass (proton = 1)	Actual Mass (g)	Location in Atom

3. Everything we know about subatomic particles comes from their behaviors, since we do not have instruments fine enough to see them (yet).

F. Atomic Number

1. The **atomic number** of an element equals the number of protons in an atom of that element.
2. The atoms of any given element always have the same number of protons.
   a. *e.g.,* Hydrogen, Atomic Number = 1, has 1 proton.
3. Atoms of different elements have different numbers of protons.
4. To remain balanced in charge overall, the number of positive = the number of negative.
   a. So, in neutral atoms, the # of protons = atomic number = # of electrons

G. Mass Number

1. The **mass number** of an atom is the sum of the protons and neutrons in the nucleus of that atom.
2. So, if you know the mass number (protons + neutrons) and the atomic number (protons), you can find out the number of just neutrons.
   a. Number of neutrons = Mass number – Atomic Number

H. Isotopes

1. Every atom of the same element has the same number of protons, but the number of neutrons can vary.
2. **Isotopes** are atoms of the same element that have different numbers of neutrons and different mass numbers.
3. Isotopes of an element have the same atomic number but different mass numbers because they have different numbers of neutrons.
   a. *e.g,,* Oxygen with 8 protons and 8 neutrons has a mass of 16.
   b. *e.g,,* Oxygen with 8 protons and 9 neutrons has a mass of 17.

I. Shorthand Notations

1. Nuclear Notation is written with the element's symbol, the mass number at the top and the atomic number at the bottom.

   a. Z – Atomic Number
   b. A – Mass Number (Rounded to a whole number)
2. Hyphen Notation

a. The name of the element is written first, then hyphenated with the mass number attached (rounded to a whole number)
b. The Atomic Number is not given because this is constant, giving the identity of the element.
c. For instance, Oxygen with a mass of 16 is written Oxygen-16.
d. This helps to distinguish between isotopes of elements.

J. Isotopes of Hydrogen
1. Protium, most often simply called Hydrogen is most Hydrogen. Hydrogen-1.
2. Deuterium has 1 neutron, so a mass of 2. It is written Hydrogen-2.
a. Heavy water is water with deuterium as its hydrogen atoms instead.
3. Tritium has 2 neutrons, so a mass of 3. It is written Hydrogen-3.

III. MODERN ATOMIC THEORY

A. Introduction
1. When atoms gain/absorb energy, several things can occur
a. an increase in kinetic energy (temperature)
b. a phase change
c. Energy may be absorbed and then re-emitted as light (fireworks)

B. Bohr's Model of the Atom
1. Niels Bohr (1885–1962), a Danish physicist created a model of the atom that explained how the electrons behaved in the atom.
2. In Bohr's model, electrons move with constant speed in fixed orbits around the nucleus, like planets around a sun.
a. Often called the solar system model.
3. Each electron in an atom has a specific amount of energy.
4. If an atom gains or loses energy, the energy of an electron can change.
5. The possible energies that electrons in an atom can have are called **energy levels**.
a. Like the rungs in a ladder.
6. The lowest energy level is closest to the nucleus. The highest energy level is farthest from the nucleus.
7. An electron in an atom can move from one energy level to another when the atom gains or loses energy.
a. If it gains enough energy, it can move up energy levels.
b. If it loses enough energy, it moves down energy levels.
8. This change in light can be seen by fluorescent markers and neon signs and glow-in-the-dark items.

C. Electron Cloud Model
1. Bohr's model was better, but still incomplete. Electrons did not move in specific orbits like planets around the sun; they move less predictably.
2. An **electron cloud** is a visual model of the most likely locations for electrons in an atom, where the denser colored area is more likely to find electrons.
3. Scientists use the electron cloud model to describe the possible locations of electrons around the nucleus.
a. Like fan blades moving, you can't tell where they are exactly when moving.

D. Atomic Orbitals

1. An **orbital** is a region of space around the nucleus where an electron is likely to be found.
2. An orbital is the most likely region an electron can be found, kind of like the classrooms or places in the school you are most likely to be found.
3. An electron cloud is a good approximation of how electrons behave in their orbitals.
4. Each orbital can contain only 2 electrons.

ENERGY LEVELS, ORBITALS, AND ELECTRONS		
Energy Level	**Number of Orbitals**	**Maximum Number of Electrons**

E. Electron Configurations
1. An **electron configuration** is the arrangement of electrons in the orbitals of an atom.
2. The most stable electron configuration is the one in which the electrons are in orbitals with the lowest possible energies.
3. When all the electrons in an atom have the lowest possible energies, the atom is said to be in its **ground state**.
4. Lithium, for instance, has 3 electrons. The first two electrons are in the first energy level. The third electron would be in the second energy level.
5. If a (lithium) atom absorbs enough energy, one of its electrons can move to an orbital with a higher energy. This configuration is referred to as an excited state.
6. The excited state is less stable and eventually, it will go back to the ground state.

April 29, 2020 ----- Guided NOTES

THE PERIODIC TABLE

I. ORGANIZING THE ELEMENTS

A. The Search for Order
1. In 1750, scientists only knew of 17 elements.
2. Soon, more and more elements were discovered and scientists needed to be able to classify them.
3. In 1789, French chemist Antoine Lavoisier (la vwah zee ay) grouped the known elements into categories he called metals, nonmetals, gases, and earths.
4. Dmitri Mendeleev, a Russian chemist would come up with a new system of organizing the elements.

B. Mendeleev's Periodic Table
1. Mendeleev devised a system of organizing the 63 elements known at the time.
2. Mendeleev organized the elements by

a. Their atomic masses
b. Similarities in their reactivity (especially with hydrogen and oxygen)

3. Mendeleev arranged the elements into rows in order of increasing mass so that elements with similar properties were in the same column.
a. The columns were arranged by similarities in reactivity.
b. Within a column, atomic masses increased.
c. Generally, across rows, masses increased.

4. A **periodic table** is an arrangement of elements in columns, based on a set of properties that repeat from row to row.

C. Mendeleev's Prediction
1. Mendeleev's periodic table was incomplete
2. He left spaces for and predicted (at least) three elements
3. Mendeleev was not the first to arrange a periodic table, but he offered the best explanation for this method.
a. His model correctly predicted (and left space for) elements that were unknown at the time.
b. Good scientific models should be able to predict trends and the like.

D. Evidence for Mendeleev's table
1. Gallium was discovered in 1875.
a. Mendeleev had left a space in his periodic table predicting an element with a density of 5.9 g/mL and low melting point.
b. Gallium had a density of 5.91 g/mL and a melting point of 29.7°C.

2. The close match between Mendeleev's predictions and the actual properties of new elements showed how useful his periodic table could be.

3. The discovery of scandium (Sc) in 1879 and the discovery of germanium (Ge) in 1886 provided more evidence.

4. With the periodic table, chemists could explain the chemical behavior of different groups of elements!!! (VERY IMPORTANT)

II. THE MODERN PERIODIC TABLE

A. Introduction
1. The octave scale on a piano (in music) is an example of a repeating, periodic trend.

B. The Periodic Law
1. Mendeleev's periodic table was before the discovery of protons.
a. He did not know no two elements could have the same number of protons.

2. In the modern periodic table, elements are arranged by increasing atomic number (number of protons).

C. Periods
1. A **period** is the horizontal rows in the periodic table.

2. The number of elements per period varies because the number of available orbitals increases from energy level to energy level.
a. Period 1 has 2 elements
b. Periods 2 and 3 have 8 elements.
c. Periods 4 and 5 have 18 elements.
d. Period 6 has 32 elements

3. Elements in the same period are filling the same outer energy level (generally).

D. Groups

1. **Groups** are the vertical columns in the periodic table.
   a. Groups are also called families since the elements react very similarly and sometimes look similar.
2. Properties of elements repeat in a predictable way when atomic numbers are used to arrange elements into groups.
3. The elements in a group have similar electron configurations.
   a. This determines its chemical properties and behavior.
4. Elements in groups often react in a very similar fashion to each other and in the same ratios to other elements as others in their group.
5. **Periodic law** is the pattern of repeating properties displayed by elements in the periodic table.

E. Atomic Mass

1. Atomic mass is a value that depends on the distribution of an element's isotopes in nature and the masses of those isotopes.
2. An **atomic mass unit** (amu) is defined as one twelfth the mass of a carbon-12 atom.
   a. This standard is used to compare all other elements to each other.
3. In nature, most elements exist as an isotope of more than one element.
   a. Chlorine exists as 2 isotopes: Chlorine-35 (~75%) and Chlorine-37 (~25%).
   b. Most Chlorine is 35, so the weighted average of Chlorine is 35.45 on the P.T.

F. Classes of Elements

1. Elements can be classified by:
   a. State of Matter: Solid, Liquid and Gas
   b. Those that occur naturally and those that do not (synthetic)
   c. Elements are classified as metals, nonmetals, and metalloids.
      i. In the periodic table, metals are located on the left, nonmetals are on the right, and metalloids are in between.
2. Metals
   a. The majority of the elements
   b. **Metals** are elements that are good conductors of electric current and heat.
   c. All are solid at Room Temperature, except Mercury (a liquid).
   d. Most metals are malleable (able to be hammered into sheets)
   e. Many metals are ductile (they can be drawn into thin wires)
   f. Some metals are extremely reactive and some do not react easily.
   g. **Transition metals** are the metals in Groups 3-12 of the periodic table.
      i. One property of many transition metals is their ability to form compounds with distinctive colors.
3. Nonmetals
   a. **Nonmetals** are elements that are poor conductors of heat and electric current.
   b. Many nonmetals are gases at room temperature because most have low boiling points.
      i. All the gases in the periodic table are nonmetals. (reverse not true)
   c. The nonmetals that are solids at room temperature tend to be brittle (shatter or crumble easily if hit).
   d. Nonmetals vary a lot

    i. Some nonmetals are extremely reactive, some hardly react at all, and some fall somewhere in between.
    ii. Fluorine is the most reactive of all elements.
4. Metalloids
    a. Sometimes called semi-metals.
    b. **Metalloids** are elements with properties that fall between those of metals and nonmetals.
    c. A metalloid's ability to conduct electric current varies with temperature.
    d. Pure silicon (Si) and germanium (Ge) are good insulators at low temperatures and good conductors at high temperatures.
        i. Used in a lot of electronics because of this.

G. Variation Across a Period

1. Across a period from left to right, the elements become less metallic and more nonmetallic in their properties.
    a. The most reactive metals are on the left side of the table.
    b. The most reactive nonmetals are on the right in Group 17.

III.REPRESENTATIVE GROUPS

A. Hydrogen

1. The only nonmetal on the left side of the periodic table.
2. It is placed in Group 1 because of its outer electron configuration.

B. Valence Electrons

1. A **valence electron** is an electron that is in the highest occupied energy level of an atom.
2. Remember: Electrons fill 2-8-18-32
3. These electrons play a key role in chemical reactions.
4. Properties vary across a period because the number of valence electrons increases from left to right.
5. Elements in a group have similar properties because they have the same number of valence electrons.
    a. Not identical, since the electrons are in different energy levels, but very similar.
6. Because Hydrogen has only 1 valence electron, it is placed in Group 1.
7. Group Numbers can help determine the number of valence electrons:

GROUP NUMBER/ atomic number	NUMBER OF VALENCE ELECTRONS
1	
2	
13	
14	
15	
16	
17	
18	

C. The Alkali Metals
- **1.** The elements in Group 1 (except Hydrogen).
- **2.** They have 1 valence electron.
  - **a.** Thus, they are extremely reactive.
  - **b.** And so, are found only as compounds in nature.
- **3.** The reactivity of alkali metals increases from the top of Group 1A to the bottom.
  - **a.** Sodium is more reactive than Lithium
  - **b.** Potassium is more reactive than Sodium.
  - **c.** Rubidium is more reactive than Potassium.

D. The Alkaline Earth Metals
- **1.** The elements in Group 2.
- **2.** All alkaline earth metals have two valence electrons.
- **3.** Harder, less reactive than the elements in Group 1.
  - **a.** Still found only in compounds in nature.
- **4.** Differences in reactivity among the alkaline earth metals are shown by the ways they react with water.
- **5.** Magnesium and calcium have essential biological functions and they provide materials used in construction and transportation.
- **6.** Magnesium
  - **a.** The center of a molecule of chlorophyll, so very important in photosynthesis.
  - **b.** A mixture of magnesium and other metals can be as strong as steel, but much lighter.
  - **c.** This is important for transportation. The frames of bicycles and backpacks often contain magnesium.
- **7.** Calcium
  - **a.** Your body needs calcium to keep your bones and teeth strong.
  - **b.** Calcium carbonate—a compound of calcium, carbon, and oxygen—is the main ingredient in chalk, limestone, coral, pearl, and your bones.
  - **c.** Toothpaste may contain the compound calcium carbonate because this hard substance can polish your teeth

E. The Boron Family
- **1.** Group 13 (3A): All of these have 3 valence electrons.
- **2.** Boron
  - **a.** Metalloid (only one not a metal in Group 13)
  - **b.** Glass that contains boron is used to make laboratory glassware..
  - **c.** It is also used in cookware that can go directly from the oven to the refrigerator.
- **3.** Aluminum
  - **a.** Aluminum is the most abundant metal in Earth's crust.
  - **b.** Usually found combined with oxygen in bauxite.
  - **c.** Aluminum is very lightweight, so often used in airplanes and such.
  - **d.** People are encouraged to recycle aluminum because the energy needed to purify recycled aluminum is only about 5 percent of the energy needed to extract aluminum from bauxite.

F. The Carbon Family
1. Group 14 (4A): All of these have 4 valence electrons.
2. Contains 1 nonmetal (Carbon), 2 nonmetals (Silicon and Germanium) and 2 metals (Tin and Lead).
3. Notice the farther down the group goes, the more metallic. (Ge is a better conductor than Si, for instance).
4. Except for water, most of the compounds in your body contain carbon.
   a. Organic chemistry is chemistry of compounds containing carbon.
5. Silicon is the second most abundant element in Earth's crust, found in sand, clay and quartz rocks.

G. The Nitrogen Family
1. Group 15 (5A): All of these have 5 valence electrons.
2. Contains two nonmetals (Nitrogen and Phosphorus), two metalloids (Arsenic and antimony), and one metal (Bismuth).
3. "Nitrogen and Phosphorous are the most important elements in Group 5A."
4. Besides nitrogen, fertilizers often contain phosphorus.
5. Phosphorus exists as an element in several forms with different properties. These are called allotropes.
   a. White phosphorus is so reactive that it bursts into flame when it is in contact with oxygen.
   b. Red phosphorus is less reactive and is used to make matches ignite.

H. The Oxygen Family
1. Group 16 (6A): All of these have 6 valence electrons.
2. Contains three nonmetals (Oxygen, Sulfur, and Selenium), and two metalloids (Tellurium and Polonium).
3. Oxygen is the most abundant element in Earth's crust.
4. Ozone
   a. Ozone is another form of the element oxygen.
   b. At ground level, ozone can irritate your eyes and lungs.
   c. At upper levels of the atmosphere, ozone absorbs harmful radiation emitted by the sun.
5. Sulfur is one of the first elements found, since it occurs naturally as an element.
   a. Used mostly to produce sulfuric acid, the most commercially produced chemical in the United States.
   b. Sulfuric acid is used to produce fertilizers.

I. The Fluorine Family
1. Group 17 (7A): All of these have 7 valence electrons.
2. Another name for these elements are **halogens**.
3. Fluorine and chlorine are gases, bromine is a liquid that evaporates quickly, and iodine is a solid that sublimes.
4. Despite their physical differences, the halogens have similar chemical properties.
5. They are highly reactive nonmetals, with fluorine being the most reactive and chlorine a close second.
6. Fluorine is the most reactive of all elements.

7. Chlorine is used in bleach and is poisonous, so used to kill bacteria in drinking water and swimming pools.
8. Iodine is needed to keep the thyroid gland working properly.
    a. Seafood is a good source of iodine. Salt is usually iodized now to provide iodine.

J. The Noble Gases

1. Group 18 (8A): All of these have 8 valence electrons (except Helium that has 2)
2. The noble gases are colorless and odorless and extremely unreactive.
3. Very stable elements, so rarely react to form compounds.
4. It is not easy to discover a colorless, odorless gas. It is even harder if the gas rarely reacts.
    a. Very useful to have elements that are nonreactive.
    b. Some light bulbs are filled with argon because the glowing filament in the bulb will not react with argon as it would react with oxygen. Using argon increases the number of hours the bulb can be lit before it burns out.

APRIL 30- May 1, 2020

Physical Science Test Date_____ Period_____

Name_____

Test on the atomic structure & Periodic Table

_____ 1. Dalton's model of an atom is best described as:

a. A solar system. b. a solid sphere c. a plum pudding d. an electron cloud

_____ 2. Who provided the first evidence that atoms contain subatomic particles?

b. Dalton b. Rutherford c. Thomson d. Bohr

_____ 3. Almost all the mass of an atom is located in its:

c. Protons b. electrons c. electron cloud d. nucleus

_____ 4. Which particle is the least massive?

d. Proton b. electron c. neutron d. nucleus

_____ 5. All atoms of an element have the same:

e. Mass number b. number of isotopes. c. atomic number d. number of neutrons

_____ 6. The number of neutrons in an atom equals the:

f. Mass number minus atomic number c. atomic number plus number of electrons

g. Mass number plus atomic number d. atomic number minus mass number

_____ 7. The atomic number of sulfur is 16. How many electrons are there in an atom of sulfur-34?

h. 16 b. 34 c. 18 d. 50

_____ 8. Atoms emit energy as light when:

i. Electrons move to a higher energy level. c. electrons move to a lower energy level.

j. Protons move to a higher energy level. d. protons move to a lower energy level.

_____ 9. Mendeleev arranged the elements in his periodic table in order of:

a. Atomic number b. number of electrons c. mass d. number of neutrons

_____ 10. In a modern periodic table, elements are arranged in order of:

b. Atomic number b. number of isotopes. c. atomic mass d. number of neutrons

_____ 11. How many periods does the periodic table have?

c. 18 b. 7 c. 9 d. 8

_____ 12. An element that is shiny and conducts electric current is likely to be a:

d. Gas b. metal c. metalloid d. nonmetal

_____ 13. Copper is an example of:

e. An alkali metal b. an alkaline earth metal c. a nonmetal. d. a transition metal

_____ 14. Elements that have the same number of valence electrons are:

f. In the same period. b. in the same group c. called noble gasses d. called transition metals

_____ 15. The most reactive metals are the:

g. Transition metals b. alkaline earth metals c. alkali metals d. metalloids

_____ 16. Which elements are all gases at room temperature?

h. Group 1A b. Period 3 c. Group 7A d. Group 8A

17. Fill in the chart for isotopes of these neutral elements:

Element	***Symbol***	***Atomic Number (Z)***	***Mass Number (A)***	***# p^+***	***# n^0***	***# e^-***	***Isotope Notation*** $_{Z}E^{A}$
Lithium					7		

		14	30				
	Sr				54		
Copper			62				
					17	12	
			3	1			

18. The drawing below represents the nucleus of an element. Using the drawing and your periodic table, answer the following.

Element Name: _____ Element Symbol: _____

Atomic Number: _____ Number of Protons: _____

Number of Neutrons: _____ Number of electrons: _____

Mass Number: _____

19. Fill in the missing information from the chart:

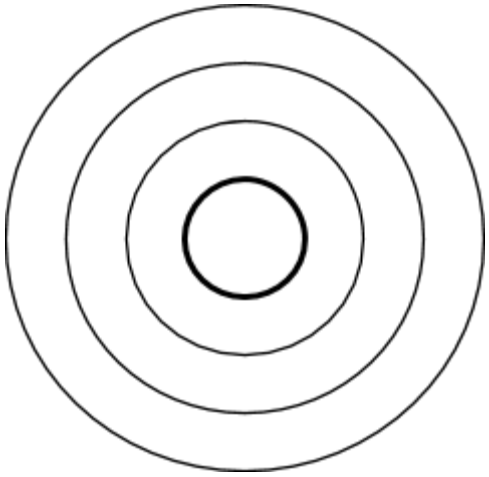
Particle	**Symbol**	**Relative charge**	**Relative Mass**
Electron		-1	
Proton	p^+		
Neutron			1

In the following two problems, calculate the number of protons, neutrons and electrons for the following two elements. Then draw the protons/neutrons in the nucleus and the electrons in the appropriate energy level.

Use ⊕ to represent a proton, ○ to represent a neutron and $\mathbf{e^-}$ to represent an electron.

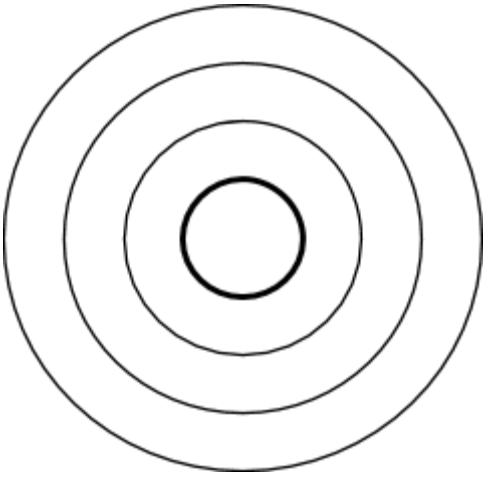
20. Oxygen-17

p^+ = ____ n^0 = ____ e^- = ____



21. Sodium-23

p^+ = ____ n^0 = ____ e^- = _____



22. Identify each of the areas on the accompanying periodic table by writing the appropriate family names in the spaces below. Use the list of group names provided. The numbers below correspond to the numbers written in each box on the periodic table.

1)_____

2) _____

3) _____

4) _____

5) _____

6) _____

Alkali Metals	***Note: Not***
Rare Earth Metals	***all of these***
Chalcogens	***will be***
Noble Gases	***used.***
Transition Metals	
Tetragens	
Halogens	
Carbides	
Alkaline Earth Metals	
Nitrogens	

23. What is the purpose of the *Stair-step line* on the periodic table?

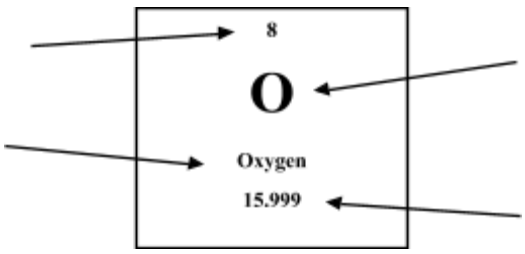
24. Name 5 elements that are metalloids (element symbols will be sufficient)

25. What makes the metalloids unique? (hint: why are they called metalloids?)

26. What family on the periodic table is known for not going through chemical reactions?

27. An isotope of Calcium has a mass number of 42. Write this information in both forms of isotope notation ($_Z E^A$ *and* *Element – Mass#.)*

28. The periodic table gives us four pieces of information about each element. Use the box below to label the following element.



29. a) Draw a picture that illustrates the instrument Rutherford used in his Gold Foil Experiment. b) Give a description of the results to his experiment. c) What did he say about the structure of the atom as a result of his experiment?

Bonus: What are the names given to the following isotopes of hydrogen?

Isotope notation	**Hydrogen-1**	**Hydrogen – 2**	**Hydrogen – 3**
Name			

Topic balancing Chemical Equations
MAY 4, 2020

Balance the following equations by placing the coefficient on the lines provided

1) ___ $AlBr_3$ + ___ K → ___ KBr + ___ Al

2) ___ P_4 + ___ Br_2 □ ___ PBr_3

3) ___ LiCl + ___ Br_2 □ ___ LiBr + ___ Cl_2

4) ___ FeO + ___ PdF_2 □ ___ FeF_2 + ___ PdO

5)___ $PbBr_2$ + ___ HCl □ ___ HBr + ___ $PbCl_2$

6) ___ Na_3P + ___ CaF_2 □ ___ NaF + ___ Ca_3P_2

7) ___ Mn + ___ HI □ ___ H_2 + ___ MnI_3

8) ___ Li_3PO_4 + ___ NaBr □ ___ Na_3PO_4 + ___ LiBr

9) ___ CaF_2 + ___ Li_2SO_4 □ ___ $CaSO_4$ + ___ LiF

10) ___ $AgNO_3$ + ___ Li □ ___ $LiNO_3$ + ___ Ag

11) ___ HBr + ___ $Mg(OH)_2$ □ ___ $MgBr_2$ + ___ H_2O

12) ___ $LiNO_3$ + ___ $CaBr_2$ □ ___ $Ca(NO_3)_2$ + ___ LiBr

13) ___ $CoBr_3$ + ___ $CaSO_4$ □ ___ $CaBr_2$ + ___ $Co_2(SO_4)_3$

14) ___ $Si(OH)_4$ + ___ NaBr □ ___ $SiBr_4$ + ___ NaOH

15) ___ NaCN + ___ $CuCO_3$ □ ___ Na_2CO_3 + ___ $Cu(CN)_2$

May 5-6, 2020

I. DESCRIBING REACTIONS

A. Introduction

1. Describe the changes occurring when a candle burns:

2. When a substance undergoes a chemical change, a chemical reaction is said to take place.

B. Chemical Equations

1. What is present before and after is often helpful.
2. The **reactants** are the substances that undergo a chemical reaction—the ones that you start with.
3. The **products** are what comes out of a chemical reaction—the ones you end up with.
4. Word equations are useful to represent chemical reactions:
   a. Reactants □ Products
   b. Carbon + Oxygen □ Carbon dioxide
5. Chemical formulas give more information.
   a. $C + O_2$ □ CO_2
6. A **chemical equation** is a representation of a chemical reaction in which the reactants and products are expressed as formulas.

C. Law of conservation of mass

1. French scientist Antoine Lavoisier saw that if you measure the mass of reactants and compare it to the mass of the products, it should be the same.
2. □ The law of conservation of mass states that mass is neither created nor destroyed in a chemical reaction.
3. Draw the reaction $C + O_2$ □ CO_2 to show mass is conserved:

D. Equation symbolism

1. You need to know certain symbols often used in chemical reactions:
   a. □ "Yields" "forms" "produces" "reacts to yield"
   b. + **"a**nd"
   c. (s) solid
   d. (cr) crystalline solid (mostly the same as (s))
   e. (l) liquid
   f. (g) gaseous
   g. (aq) "aqueous" meaning "dissolved in water"
   h. ↑ gas product
   i. ↓ precipitate
   j. Δ over □ means adding heat
   k. elec. over □ means electricity applied
   l. <-> Reversible Reaction

E. How to Balancing Equations

1. When hydrazine, a component in rocket fuel, is burned, you get nitrogen gas and water.
   a. $N_2H_4 + O_2$ □ $N_2 + H_2O$
   b. Notice the number of atoms on each side does not equal the number on the other side.
2. □ In order to show that mass is conserved during a reaction, a chemical equation must be balanced.
3. To balance a chemical equation, which means to get the number of atoms of each element on each side to equal (balance), you can change ONLY the COEFFICIENTS!!!
   a. **Coefficients** are the numbers that appear before a formula in a chemical equation to show the relative proportions of each reactant and product.

b. **NEVER** change the subscripts! Changing the formula changes the identity of that reactant or product.

F. Balancing Your First Equation

1. The first step in balancing an equation is to count the number of atoms of each element on each side of the equation.

a. $N_2H_4 + O_2 \rightarrow N_2 + H_2O$

2. Notice the hydrogen and oxygen are not balanced. Go to the side that has fewer atoms and add to it.

a. Since there are fewer on the right, add there.

b. Water has H and O in it, so change the coefficient from an assumed 1 to 2.

c. Recount to check: $N_2H_4 + O_2 \rightarrow N_2 + 2H_2O$

3. It is now balanced!

G. Couple more Balancing Equations

1. $CH_4 + O_2 \rightarrow CO_2 + H_2O$

2. $Al + Cl_2 \rightarrow AlCl_3$

H. NOTE

1. We will skip the rest of Chapter 7, Section 1. You do not need to know about moles and how to calculate using them.

II. TYPES OF REACTIONS

A. Classifying Reactions

1. Some general types of chemical reactions are synthesis reactions, decomposition reactions, single-replacement reactions, double-replacement reactions, and combustion reactions.

B. Synthesis

1. A **synthesis reaction** is a reaction in which two or more substances react to form a single substance.

2. Letter equation:

a. $A + B \rightarrow AB$

3. Draw a visual picture:

C. Decomposition

1. A **decomposition reaction** is a reaction in which a compound breaks down into two or more simpler substances.

2. Letter equation:

a. AB □ A + B

3. Draw a visual picture:

D. Single-Replacement (aka Single Displacement)

1. A **single-replacement reaction** is a reaction in which one element takes the place of another element in a compound.

a. Can be either the cation or the anion.

2. Letter equation:

a. A + BC □ B + AC

b. D + BC □ C + BD

3. Draw a couple visual pictures:

E. Double-replacement (aka Double Displacement)

1. A **double-replacement reaction** is one in which two different compounds exchange positive ions and form two new compounds.

2. Letter equation:

a. AB + CD □ AD + CB

3. Draw a visual picture:

F. Combustion (type 5 you need to know—kind of an oddball)

1. A **combustion reaction** is one in which a substance reacts rapidly with oxygen, often producing heat and light.

a. Combustion means "rapid burning"

2. Basic equation is usually some hydrocarbon with oxygen producing carbon dioxide and water.

a. $C_xH_y + O_2 \rightarrow CO_2 + H_2O$

3. The combustion of hydrogen looks like this:

a. $2H_2 + O_2 \rightarrow 2H_2O$

G. Reactions as Electron Transfers

1. So far, we've described five reactions types by the number and type of products and reactants.

2. The discovery of subatomic particles enabled scientists to classify certain chemical reactions as transfers of electrons between atoms.

3. A reaction in which electrons are transferred from one reactant to another is called an **oxidation-reduction reaction**, or redox reaction, for short.

H. Oxidation

1. Metals reacting with oxygen were traditionally called oxidations.

2. Any process in which an element loses electrons during a chemical reaction is called oxidation.

a. A reactant is oxidized if it loses electrons.

3. Sodium reacting with chlorine is an oxidation reaction since sodium loses electrons to chlorine.

a. i.e., any formation of an ionic bond from neutral atoms.

I. Reduction

1. Reduction is the process in which an element gains electrons during a chemical reaction.

a. A reactant is said to be reduced if it gains electrons.

2. Always occurs with oxidation. When one atom loses electrons, another gains them.

3. The synthesis of water, hydrogen partially loses electrons to oxygen (by sharing them), so Oxygen is still said to be reduced in this case.

a. $2H_2 + O_2 \rightarrow 2H_2O$

III. ENERGY CHANGES IN REACTIONS

A. Chemical Bonds and Energy

1. The reason chemical reactions occur is because elements want to gain a more stable configuration by breaking and re-forming bonds.

2. As these bonds are broken and reformed, energy is released and absorbed in the forms of heat and light and sound.

3. Equations are often written with heat on one side of the equation.

a. $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O + \text{Heat}$

b. This means the heat is released and comes from the reactants.

4. **Chemical energy** is the energy stored in the chemical bonds of a substance.

5. Energy is stored in bonds of molecules.

6. Chemical reactions involve the breaking of chemical bonds in the reactants and the formation of chemical bonds in the products.

7. Propane has a lot of bonds to be broken, as well as double-bonded oxygen. This is why to burn propane and start the combustion reaction, you must start with a spark. This gives the energy to start the reaction.

B. Forming Bonds

1. The formation of chemical bonds release energy, since it is more stable.

2. The heat and light given off by a propane stove result from the formation of new chemical bonds.

C. Exothermic Reactions

1. During a chemical reaction, energy is either released or absorbed.

2. In Exothermic reactions, energy is released.

a. Often, exothermic reactions feel warm because of the energy released.

3. Combustion is an example of an extremely exothermic reaction.

4. Energy is often measured in kilojoules.

5. Draw an exothermic reaction energy diagram:

6. Notice there is a hump to get over first. This is what the spark provides when lighting propane.
    a. That peak is the amount of energy required to break the old bonds.

D. Endothermic Reactions

1. During a chemical reaction, energy is either released or absorbed.
2. In Endothermic reactions, energy is absorbed.
    a. Often, endothermic reactions feel cool because of the energy absorbed.
3. The difference between the first energy and final energy is how much must be absorbed from the environment.
4. Draw an endothermic reaction energy diagram:

5. Energy term would be written on the reactant side of the equation since it is needed to make the reaction go.

IV. REACTION RATES

A. Reactions over time

1. Any reaction can be measured as to how much time it takes to complete.
2. TNT exploding is almost instantaneous, while leaves changing color is very slow.
3. A **reaction rate** is the rate at which reactants change into products over time.
4. Reaction rates tell you how fast a reaction is going.
    a. That is, how fast the reactants are being consumed, how fast the products are being formed, or how fast energy is being absorbed or released.

B. Factors Affecting Reaction Rates

1. Reactions involve collisions between molecules and particles.
    a. If they collide often, the reaction usually goes more quickly.
    b. If they collide less often, the reaction is less likely to occur.
2. Factors that affect reaction rates include temperature, surface area, concentration, stirring, and catalysts.
3. Temperature
    a. Generally, an increase in temperature will increase the reaction rate, while a decrease in temperature will decrease the reaction rate.
    b. Just like when you cook, the hotter it is, the faster it cooks!
    c. Milk will spoil in a refrigerator, but the rate at which it spoils is decreased because it is at a lower temperature.
    d. Increasing temperature increases the speed of the particles.
    e. The faster the particles the move, the more likely they are to collide.
    f. The more likely they are to collide, the more likely they are to react!
4. Surface Area
    a. Grain can be very dangerous.
    b. Because it is so fine, it can catch on fire and even explode.
    c. The smaller a particle is, the more surface area it has.
    d. An increase in surface area increases the exposure of reactants to one another.
    e. The greater this exposure, the more collisions there are that involve reacting particles.

f. With more collisions, more particles will react.

5. Stirring
- **a.** Sugar dissolves faster in water/tea if you stir it.
- **b.** Collisions between the particles of the reactants are more likely to happen.

6. Concentration
- **a.** Concentration refers to the number of particles in a given volume.
- **b.** The more reacting particles that are present in a given volume, the more opportunities there are for collisions involving those particles. reaction rate is faster.
- **c.** For gases, concentration changes with pressure.
  - **i.** The greater the pressure of a gaseous reactant, the greater is its concentration, and the faster is the reaction rate.

7. Catalysts
- **a.** **Catalysts** are substances that affects the reaction rate without being used up in the reaction.
- **b.** Chemists often use catalysts to speed up a reaction or enable a reaction to occur at a lower temperature.
- **c.** Catalysts are written over the arrow.
- **d.** Because the catalyst is not consumed, it can be used to speed up the same reaction over and over again.
- **e.** Catalysts make a surface, a place, where particles are more likely meet and react.
- **f.** Draw the energy diagram with a second line to show the catalyst's effect.

V. EQUILIBRIUM

A. Introduction
1. During the middle of the day, the number of people entering Wal-Mart equals the number of people exiting Wal-Mart.
2. The number of people inside Wal-Mart stays about the same.

B. Types of Equilibrium
1. **Equilibrium** (plural *equilibria*) is a state in which the forward and reverse paths of a change take place at the same rate.
2. Equilibrium can be for either physical changes or chemical changes.

C. Physical Equilibrium
1. A closed bottle of liquid water, some water molecules will evaporate and enter the gaseous state.
2. Later, these particles will slow down, condense and re-enter the liquid state.
3. Eventually, the rate of evaporation and condensation will equal.
4. When a physical change does not go to completion, a physical equilibrium is established between the forward and reverse changes. When a chemical reaction does not

go to completion, a chemical equilibrium is established between the forward and reverse reactions.

D. Chemical Equilibrium

1. A **<u>reversible reaction</u>** is a reaction in which the conversion of reactants into products and the conversion of products into reactants can happen simultaneously.
2. When a chemical reaction does not go to completion, a chemical equilibrium is established between the forward and reverse reactions.

E. Factors Affecting Chemical Equilibrium

1. When a condition changes that affects equilibrium, the equilibrium will either shift to favor the forward or reverse reaction.
2. When a change is introduced to a system in equilibrium, the equilibrium shifts in the direction that relieves the change.
   - **a.** Today, the rule above is known as Le Châtelier's principle.
3. The Haber Process is a reversible reaction: $N_2\,(g) + 3H_2\,(g) \leftrightarrow 2NH_3\,(g) + \text{heat}$
4. Temperature
   - **a.** In the synthesis of ammonia, heat is written as a product.
     - **i.** Means the reaction is exothermic.
   - **b.** According to Le Châtelier's principle, if you added heat to the system, the equilibrium would shift in the direction that removes heat from the system.
     - **i.** To the left in this case.
5. Pressure
   - **a.** According to Le Châtelier's principle, if you increased the pressure, the equilibrium would shift in the direction that decreases the pressure of the system.
   - **b.** Basically, this means the direction in which there are fewer gas molecules.
   - **c.** There are 1 + 3 gas molecules on the left and 2 gas molecules on the right.
   - **d.** So, an increase in pressure would favor the direction to the right, making more ammonia.
6. Concentration
   - **a.** If ammonia was removed, Le Châtelier's principle tells you that the equilibrium would shift in the direction that produces ammonia (the forward/right reaction).
   - **b.** If ammonia is added, it will try to get rid of the excess and would favor the reverse or left reaction.
7. Volume
   - **a.** Volume is not mentioned in the book, but if you remember Boyle’s law, pressure and volume are inversely related.
   - **b.** So, increases in volume can be thought of as decreases in pressure.
   - **c.** And decreases in volume can be thought of as increases in pressure.