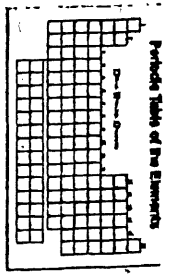


Name: _____

HW Assignment (IF not finished in-class): Due 10/29



Per:

The Periodic Table

Lesson 1 - Types of Elements and their Properties

Introduction

There are three main types of elements: metal, nonmetals, and metalloids. Elements of one type have set of physical and chemical properties that are used to distinguish them from elements of the other types. In this lesson you will learn about the three types of elements, their locations on the periodic table and properties.

Types of Elements

Location of metals, metalloids, and nonmetals																												
1	metals												metalloids			nonmetals		13	14	15	16	17	18					
H	He											Li	Be	B	C	N	O	F	Ne									
2	U	Be											Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
3	Na	Mg	Al	Si	P	S	Cl	Ar	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr		
4	metals												metalloids			nonmetals												
5	metals												metalloids			nonmetals												
6	metals												metalloids			nonmetals												
7	metals												metalloids			nonmetals												
8	metals												metalloids			nonmetals												
9	metals												metalloids			nonmetals												
10	metals												metalloids			nonmetals												
11	metals												metalloids			nonmetals												
12	metals												metalloids			nonmetals												
13	metals												metalloids			nonmetals												
14	metals												metalloids			nonmetals												
15	metals												metalloids			nonmetals												
16	metals												metalloids			nonmetals												
17	metals												metalloids			nonmetals												
18	metals												metalloids			nonmetals												

not required to know for NYS Regents.

Physical Properties of Elements

There are several physical properties that can be used to describe and identify the elements. The following is a list of these physical properties and their definitions.

Concept Facts

- Malleable** describes a solid that is easily hammered and flattened into a thin sheet. (Ex. Aluminum, Al)
- Ductile** describes a solid that is easily drawn into a thin wire. (Ex. Copper, Cu)
- Brittle** describes a solid that is easily broken or shattered into pieces when struck. (Ex. Sulfur, S)
- Luster** describes the shininess of a substance. (Ex. Gold, Au)
- Conductivity** describes the ability of heat or electricity to flow through a substance. (Ex. Copper, Cu)
- Electronegativity** describes an atom's ability to attract electrons from another atom during bonding.
- Ionization energy** describes an atom's ability to lose its most loosely bound valence electrons.
- Density** describes the mass to volume ratio of an element.
- Atomic radius** describes the size of the atom of an element.
- Ionic radius** describes the size of the element after it has lost or gained electrons to become an ion.

See Table 5

Metals

Metallic elements are located to the left of the periodic table.

All elements in Groups 1 to 12 (except hydrogen) are classified as metals. The rest of the metallic elements are located near the ~~left~~ **sketch** of Groups 13 through 17. The majority (about 75%) of the elements are metals. Below are some general properties (characteristics) of metals.

- Concept Facts** Study to remember these properties.
- Almost all metals are solids at room temperature. The exception is mercury (Hg), which is a liquid metal.
- Solid metals are malleable and ductile. Many have high luster.
- Metals tend to have high heat (thermal) and electrical conductivity due to their mobile valence electrons.
- Metals tend to have low electronegativity values (because they do not attract electrons easily)
- Metals tend to have low ionization energy values (which is why metals lose their electrons easily)
- Metals lose electrons and form positive ions
- Radius (size) of a metal atom decreases as it loses electrons and form a positive ion
- The size of a positive (+) ion is always smaller than the size of the neutral atom



Metalloids

Metalloids are the seven elements located between the metals and nonmetals. Metalloid elements are located on the periodic table along the thick zigzag line.

Below are some general properties (characteristics) of metalloids.

Concept Facts

- Study to remember these properties.
- Metalloids tend to have properties of both metals and nonmetals
- Metalloid properties are more like those of metals and less like those of nonmetals
- Metalloids exist only as solids at room temperature.



Nonmetals

Nonmetallic elements are located to the right of the periodic table.

All elements in Groups 17 and 18 (except At) are classified as nonmetals. The rest of the nonmetals are located near the ~~right~~ **top** of Groups 14, 15 and 16. Hydrogen (in Group 1) is also a nonmetal. Below are some general properties (characteristics) of nonmetals.

Concept Facts

- Study to remember these properties.
- Nonmetals are found in all three phases: solid, liquid and gas.
- Most nonmetals exist as molecular gases and solids. Bromine is the only liquid nonmetal. Sulfur (S)
- Solid nonmetals are generally brittle and dull (lack luster, not shiny)
- Nonmetals have low or poor electrical and heat (thermal) conductivity
- Nonmetals tend to have high electronegativity values (because they attract and gain electrons easily)
- Nonmetals tend to have high ionization energy (which is why nonmetals do not lose electrons easily)
- Nonmetals gain electrons and form negative ions
- Radius of a nonmetal atom increases as it gains electrons and forms a negative ion
- The size of a negative (-) ion is always bigger than that of the neutral atom



The Periodic Table

Types of Elements: Summary of Properties

	Phases at STP	Physical properties	Conductivity	Electronegativity	Ionization energy	Electrons in bonding	Common ion	Ionic size (radius)
Metals	Solid Liquid	Malleable Luster Ductile	High	Low	Low	Lose electrons	+ (positive)	Smaller than the atom
Nonmetals	Solid Liquid Gas	Brittle Dull	Low	High	High	Gain electrons	- (negative)	Bigger than the atom
Metalloids	Solid only	Properties of metals and nonmetals	Low	varies	varies	Lose electrons	+ (positive)	Smaller than the atom

After reading the info - complete the Qs below and to the right.

- Elements that can be hammered into thin sheets are
 - Ductile
 - Luster
 - Malleable
 - Brittle
- The tendency for an atom to give away its electrons during bonding is measured by its
 - Atomic radius value
 - Density value
 - Electronegativity value
 - Ionization energy value
- Nonmetal elements on the Periodic Table can be found in which phase or phases at STP?
 - Solid only
 - Liquid only
 - Solid or liquid only
 - Solid, liquid and gas
- Which two characteristics are associated with nonmetals?
 - Low first ionization energy and low electronegativity
 - Low first ionization energy and high electronegativity
 - High first ionization energy and low electronegativity
 - High first ionization energy and high electronegativity
- Metalloids tend to have properties resembling
 - Nonmetals only
 - Metals only
 - Both metals and nonmetals
 - Neither a metal nor a nonmetal
- Which is a property of most metals?
 - They tend to gain electrons easily when bonding.
 - They tend to lose electrons easily when bonding.
 - They are poor conductors of heat.
 - They are poor conductors of electricity.
- Which of these elements is a metalloid?
 - Gallium
 - Germanium
 - Phosphorus
 - Tin
- Which list consists of a metal, nonmetal, and metalloid respectively?
 - Al, B, Si
 - Cr, C, Cl
 - Ni, Si, P
 - C, Si, Ge
- Which element is brittle and non-conducting solid?
 - S
 - Ne
 - Ni
 - Hg
- Which of these elements has high thermal and electrical conductivity?
 - Iodine
 - Phosphorus
 - Carbon
 - Iron
- Which properties best describes the element mercury?
 - It has luster
 - It is brittle
 - It has a high electronegativity value
 - It is a poor electrical conductor
- Which is true of element carbon?
 - It is malleable
 - It has luster
 - It has low electrical conductivity
 - It is a gas at STP

13. You stumble upon an unknown white solid while working in the lab. Describe 2 tests you could conduct to determine if it is a metal, nonmetal or metalloid and explain how you would use the results of these tests to classify the unknown solid.

①

and to the right.

②

14. Look up the definition and examples of allotropes. Write them below. Then, state which types of elements (metals, nonmetals, or metalloids) are most likely to be found as allotropes.