The Periodic Table

OBJECTIVE #1: Know the Development of the Periodic Table

A) In 1869, a Russian chemist by the name of _____ was given credit for creating the first version of the periodic table

- He listed elements in order of _____ _____ because atomic number (# of protons) was not yet discovered

Series	Group I	Group II	Group III	Group IV	Group V	Group VI	Group VII	Group VIII
1	H=1							
2	Li=7	Be=9.1	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24.4	Al=27	Si=28	P=31	S=32	Cl=35.5	Fe=56, Ni=58.5,
4	K=39.1	Ca=40	— =44	Ti=48.1	V=51.2	Cr=52.3	Mn=55	Co 59.1, Cu 63.3.
5	(Cu)=63.3	Zn=65.4	— =68	— =72	As=75	Se=79	Br=80	Rh=103, Ru=103.8,
6	Rb=85.4	Sr=87.5	Y=89	Zr=90.7	Nb=94.2	Mo=95.9	— =100	Pd=108, Ag=107.9.
7	(Ag)=107.9	Cd=112	In=113.7	Sn=118	Sb=120.3	Te=125.2	I=126.9	
8	Cs=132.9	Ba=137	La=138.5	Ce=141.5	Di=145	—	—	— — —
9	(—)	—	—	—	—	—	—	Ir=193.1, Pt=194.8,
10	—	—	Yb=173.2	—	Ta=182.8	W=184	—	Os=200, Au=196.7.
11	(Au)=196.7	Hg=200.4	Tl=204.1	Pb=206.9	Bi=208	—	—	
12	—	—	—	Tb=233.4	—	U=239	—	— — —

- He placed elements with similar _____ in the same vertical column, and arranged rows of the table so that the same pattern of properties was repeated

B) In 1913, a student of Mendeleev by the name of _____ developed the concept of atomic numbers.

- He identified the atomic number with the number of _____ in the nucleus of the atom
- The discovery of atomic number clarified some of the issues with Mendeleev's table

C) In 1916, after the work of many scientists, the periodic table was revised into a table that is still used today, called the "Modern Periodic Table"

- Instead of arranging the elements in order of increasing atomic *mass*, the table was modified to order the elements by _____
  - Most of the anomalies and defects of Mendeleev's Periodic Table disappeared if the basis of the classification was changed from atomic masses to atomic numbers
  - This allowed for elements in the same vertical column to still have similar _____ _____

The Modern Periodic Law states: when elements are arranged in order of increasing atomic number, _____ _____ can be seen

Development of Periodic Table Questions

1. Elements in Mendeleev's periodic table were arranged according to their
   a) atomic number b) atomic mass c) relative activity d) relative size

2. The elements in the modern periodic table are arranged according to their
   a) atomic number b) oxidation number c) atomic mass d) nuclear mass

3. The observed regularities in the properties of the elements are periodic functions of their
   a) atomic numbers b) mass numbers c) number of neutrons. d) valence electrons

OBJECTIVE #2: Know the Setup of the Periodic Table

The elements on the periodic table are numbered 1-118. The numbers begin at the upper left-hand corner of the chart, and then proceed across the table left to right, and then down each subsequent row. There are two main ways elements are organized: by periods and by groups.

A) Periods: the horizontal _____ that run across the periodic table

- There are a total of _____ periods
- The number at the beginning of the period indicates the _____ _____ in which the _____ electrons are located in

B) Groups: the vertical _____ that run up and down the periodic table

- There are a total of _____ groups
- With a few exceptions, each member of a given group contains the same number of _____ _____
- Within a group, the elements also have *similar* _____ properties

OBJECTIVE #3: Knowing the Types of Elements

A) Metals

The majority of the elements on the _____ side of the periodic table are classified as metals.

- Metals comprise about _____% of all of the elements

Properties of Metals at room temperature (must memorize!!!)

- Have luster (shiny)
- Malleable (hammered into a shape)
- Ductile (can be stretched thin and made into wires)
- tend to lose electrons and become positively charged
- Most are solids, only exception is mercury (liquid)
- Good conductors of heat and electricity

B) Non-metals

The elements on the _____ side of the periodic table are classified as nonmetals.

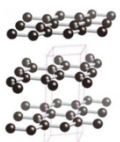
Properties of Non-metals at room temperature (must memorize!!!)

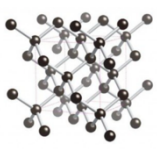
- Lack luster and appear dull
- Brittle and break/crumble easily
- Poor conductors of heat and electricity
- tend to gain electrons and become negatively charged
- Most nonmetals are solids or gases
- Only liquid is Bromine

There following categories also pertain to the non-metals group, but only a few elements are involved.

a. Allotropes

- Two or more _____ forms of an elements in the same phase
  - The different forms arise from the different ways atoms are bonded together





- Commonly seen with:

  Carbon → _____ vs. _____

  Oxygen → _____ vs. _____

b. Monatomic elements ◯

- _____ - atom elements that rarely bond with any other element on the periodic table
    - All of the nonmetal elements in vertical group _____ (noble gases) are monatomic

c. Diatomic elements ◯◯

- Elements that cannot physically exist _____ in nature, and that are too reactive to stand alone
    - A molecule contains _____ of the same atoms chemically bonded together
    - They are _____, _____, _____, _____, _____, _____, _____

C) Metalloids (or semi-metals)

The semi-metals are a unique set of elements that are sandwiched between the metals and nonmetals

- they border the darkened _____ line on the periodic table
- they include elements: B, Si, Ge, As, Sb, Te, Po and At (but NOT Aluminum!)
- this group of elements can have both metallic and nonmetallic properties, depending on the _____

Types of Element Questions

1. Which three groups of the Periodic Table contain the most elements classified as metalloids?
   a) 1, 2, and 13 b) 2, 13, and 14 c) 14, 15, and 16. d) 16, 17, and 18

2. Which elements have the most similar chemical properties?
   a) K and Na b) K and Cl c) K and Ca d) K and S

3. The element sulfur is classified as a
   a) metal b) metalloid c) nonmetal d) noble gas

4. An atom of an element contains 20 protons, 20 neutrons, and 20 electrons. This element is in Group
   a) 1 b) 2 c) 4 d) 18

5. Which sequence of atomic numbers represents elements which have similar chemical properties?
   a) 19, 23, 30, 36 b) 9, 16, 33, 50 c) 3, 12, 21, 40 d) 4, 20, 38, 88

6. On the Periodic Table, an element classified as a semimetal (metalloid) can be found in
   a) Period 6, Group 15 b) Period 2, Group 14 c) Period 3, Group 16 d) Period 4, Group 15

7. Which element is considered malleable?
   a) gold b) hydrogen c) sulfur d) radon

8. Which element is malleable and conducts electricity?

a) iron b) iodine c) sulfur d) phosphorus

9. Which element is brittle and does *not* conduct heat or electricity?

a) S(s) b) Mg(s) c) Al(s) d) K(s)

10. Which of the following is a diatomic element?

a) sulfur b) carbon c) nitrogen d) helium

11. Which characteristics describe most solid nonmetals?

a) They are malleable and have metallic luster
b) They are malleable and lack metallic luster
c) They are brittle and have metallic luster.
d) They are brittle and lack metallic luster.

12. Which element exists as monatomic element?

a) Cl b) N c) Ne d) O

13. The element arsenic (As) has the properties of

a) metals, only
b) nonmetals, only
c) both metals and nonmetals
d) neither metals nor nonmetals

14. Magnesium and calcium have similar chemical properties because a magnesium atom and a calcium atom have the same

a) atomic number
b) mass number
c) total number of electron shells
d) total number of valence electrons

15. Oxygen exists in two forms, $O_2(g)$ and $O_3(g)$. These two forms of oxygen have

a) same molecular structure and different properties
b) same molecular structure and same properties
c) different molecular structure and same properties
d) different molecular structure and different properties

16. Which group contains elements composed of diatomic molecules?

a) 2 b) 7 c) 11 d) 17

17. Which element is *not* a metalloid?

a) arsenic b) boron c) silicon d) sulfur

18. Atoms of metals tend to

a) lose electrons and form negative ions
b) lost electrons and form positive ions
c) gain electrons and form negative ions
d) gain electrons and form positive ions

19. Which group on the periodic table contains elements that are monatomic?

a) 1 b) 2 c) 17 d) 18

20. An element is a gas at room temperature. It could be

a) a metal or metalloid
b) a metal or a nonmetal
c) a metal only
d) a nonmetal only

OBJECTIVE #4: Know the Specifics of Groups on the Periodic Table

The elements in any vertical group of the periodic table have related chemical properties. For most groups, inspection shows that all of the members have the same number of valence electrons, and it is this similarity that accounts for the similarity in chemical properties.

Below are properties that are unique to each group and MUST BE MEMORIZED!!!

A) Group 1: _____ Metals
- *Extremely reactive* group of metals and never found alone as atoms
- Easily lose their 1 valence electron and form a +1 charge
- More reactive as you move *down* the group
- Fr (francium) is the most reactive and metallic of all metals

B) Group 2: _____ _____ Metals
- Slightly less reactive group of metals and never found alone as atoms
- Lose their 2 valence electrons and form a +2 charge
- More reactive as you move *down* the group

C) Group 3-12: _____ Metals
- More dense and higher melting points than metals in group 1 and 2
- These strong, solid metals have a variety of everyday uses
- Compounds with transition metals in them are brightly colored

D) Group 17: _____
- Most reactive non-metal group and found in compounds only
- only group to have all three phases (F & Cl = gases, Br = liquid, I & At = solids)
- reactivity decreases as you move down the group
- Fluorine (F) is the most reactive and non-metallic of all non-metals
- Gain 1 electrons to form a +1 charge

E) Group 18: _____
- Most stable non-metal group
- Unreactive, colorless and odorless gases at room temperature
- These elements rarely form compounds
- Known as monatomic (single-atom) gases
- Each element contains an octet (eight) valence electrons
  - The octet of valence electrons is reason for low reactivity

F) Hydrogen
- This element does not match the properties of any other group so it stands alone.
- It is placed above group 1 only because it has 1 valence electron
- A very reactive gas
- Colorless and odorless at room temperature.

Groups of the Periodic Table Questions

1. Which of these elements is the best conductor of electricity?
   a) S b) N c) Br d) Ni

2. Which element is malleable and conducts electricity?
   a) iron b) iodine c) sulfur d) phosphorus

3. The elements in the Periodic Table are arranged in order of increasing:
   a) atomic number c) atomic mass number
   b) atomic radius d) neutron number

4. Which element is classified as a noble gas?
   a) hydrogen b) oxygen c) neon d) nitrogen

5. Which pair of symbols represents a metalloid and a noble gas?
   a) Si and Bi b) As and Ar c) Ge and Te d) Ne and Xe

6. Germanium is classified as a
   a) metal b) metalloid c) non-metal d) noble gas

7. Which element is a metal that is in the liquid phase?
   a) bromine b) cobalt c) hydrogen d) mercury

8. The element in Period 4 and Group 1 of the Periodic Table would be classified as a:
   a) alkali metal b) alkaline earth metal c) halogen d) noble gas

9. The element in Period 4 and Group 7 of the Periodic Table would be classified as a:
   a) transition metals b) alkali metals c) halogens d). noble gases

10. Which group of solids only is extremely reactive in water?
   a) noble gases b) transition metals c) alkali metals d) Halogens

11. What is the name given to the elements in group 2 of the periodic table?
   a) alkali metals b) alkaline earth metals c) halogens d) noble gases

12. What elements are used in compounds to produce substances that are bright and colorful?
   a) alkali metals b) alkaline earth metals c) transition metals d) noble gases

13. The group of elements that are stable and inert are called:
   a) transition metals b) alkali metals c) halogens d) noble gases

14. The group of elements that contain two solids, a liquid and two gases:
   a) transition metals b) alkali metals c) halogens d) noble gases

15. Which element in Period 4 is classified as an active metal?
   a) calcium b) strontium c) sulfur d) copper

16. What is the name given to the non-metal group of elements on the Periodic Table that are extremely reactive?

a) alkali metals b) alkaline earth metals c) halogens d) noble gases

17. The MOST reactive metal element is:

a) hydrogen b. neon c) francium d) oxygen

18. The MOST reactive non-metal element is:

a) hydrogen b) fluorine c) helium d) Oxygen

19. Which compound forms a colored aqueous solution?

a) $CaCl_2$ b) $CrCl_3$ c) NaOH d) KBr

20. Which halogen is the only liquid element?

a) fluorine b) chlorine c) bromine d) iodine

OBJECTIVE #5: Know the Trends on the Periodic Table

Periodic Law: when the elements are arranged in order of increasing atomic number, there is a periodic repetition of their physical and chemical properties

A) Atomic Radius – the _____ of an atom from the center of the nucleus to its valence electron

Going ACROSS a period: the atomic radius of each element *generally* _____

- This is due to the number of _____ increasing in the nucleus, which increases the attraction of the electrons towards the nucleus

Going DOWN a group: the atomic radius of each element *generally* _____

- This is due to the number of _____ _____ increasing, as well as _____ from inner electrons.

B) Ionic Radius – the _____ of an ion when losing or gaining electrons

Metals: when bonding with other elements, these elements all _____ their valence electron(s) and become _____ charged.

- this then _____ the size of the atom due to the outermost _____ _____ being lost, or due to the number of protons being _____ than the number of electrons.

Non-metals: when bonding with other elements, these elements all _____ electron(s) and become _____ charged.

- this then _____ the size of the atom due to the number of electrons being _____ than the number of protons.

C) Electronegativity (EN) – an element's _____ for electrons

Going ACROSS a period: the electronegativity of each element *generally* _____

- This is due to the number of _____ increasing in the nucleus, which increases the attraction of the electrons towards the nucleus

Going DOWN a group: the electronegativity of each element *generally* _____

- This is due to the number of _____ _____ increasing, which places valence electrons farther away and thus _____ attracted to the nucleus

D) Ionization Energy **(**IE**)** – energy needed to _____ an electron from an atom

Going ACROSS a period: the ionization energy of each element *generally* _____

- This is due to the number of _____ increasing in the nucleus, which increases the attraction of the electrons towards the nucleus and makes it _____ to remove an electron

Going DOWN a group: the ionization energy of each element *generally* _____

- This is due to the number of _____ _____ increasing, which places valence electrons farther away and thus _____ to remove

Periodic Trends Questions

1. As the elements in Period 2 are considered in succession from left to right, there is a decrease in atomic radius with increasing atomic number. This may best be explained by the fact that the
   a) number of protons increases, the number of shells of electrons remains the same
   b) number of protons increases, and the number of shells of electrons increases
   c) number of protons decreases, the number of shells of electrons remains the same
   d) number of protons decreases, and the number of shells of electrons increases

2. Which of the following electron configurations represents the element with the smallest radius?
   a) 2-4 b)2-5 c) 2-6 d)2-7

3. An atom of which element has the largest radius?
   a) Fe b) Mg c) Si d) Zn

4. As the elements of Group 16 are considered in order from top to bottom, the covalent radius of each successive element increases. This increase is primarily due to an increase in
   a) atomic number
   b) mass number
   c) the number of protons occupying the nucleus
   d) the number of occupied electron shells

5. An ion of which element has a larger radius than an atom of the same element?

a) aluminum b) chlorine c) magnesium d) sodium

6. Which general trend is found in Period 3 as the elements are considered in order of increasing atomic number?

a) increasing atomic radius
b) increasing electronegativity
c) decreasing atomic mass
d) decreasing first ionization energy

7. Which statement describes the general trends in electronegativity and metallic properties as the elements in Period 2 are considered in order of increasing atomic number?

a) Both electronegativity and metallic properties decrease.
b) Electronegativity decreases and metallic properties increase.
c) Electronegativity increases and metallic properties decrease.
d) Both electronegativity and metallic properties increase.

8. Which atom has the *weakest* attraction for electrons in a chemical bond?

a) boron b) calcium c) fluorine d) nitrogen

9. Which general trend is demonstrated by the Group 17 elements as they are considered in order from top to bottom on the Periodic Table?

a) a decrease in atomic radius
b) an increase in first ionization energy
c) a decrease in electronegativity
d) an increase in nonmetallic behavior

10. Which properties are most common in nonmetals?

a) low ionization energy and low electronegativity
b) low ionization energy and high electronegativity
c) high ionization energy and low electronegativity
d) high ionization energy and high electronegativity

11. Which general trend is found in Period 2 on the Periodic Table as the elements are considered in order of increasing atomic number?

a) decreasing atomic mass
b) increasing ionization energy
c) increasing atomic radius
d) decreasing electronegativity

12. As the elements of Group 1 on the Periodic Table are considered in order of increasing atomic radius, the ionization energy of each successive element generally

a) decreases b) increases c) remains the same

13. The amount of energy required to remove the outermost electron from a gaseous atom in the ground state is known as

a) first ionization energy
b) conductivity
c) activation energy
d) electronegativity

14. Which atom in the ground state requires the least amount of energy to remove its valence electron?

a) lithium atom b) potassium atom c) rubidium atom d) sodium atom

15. Low ionization energies are most characteristic of atoms that are

a) metals b) metalloids c) nonmetals d) noble gases