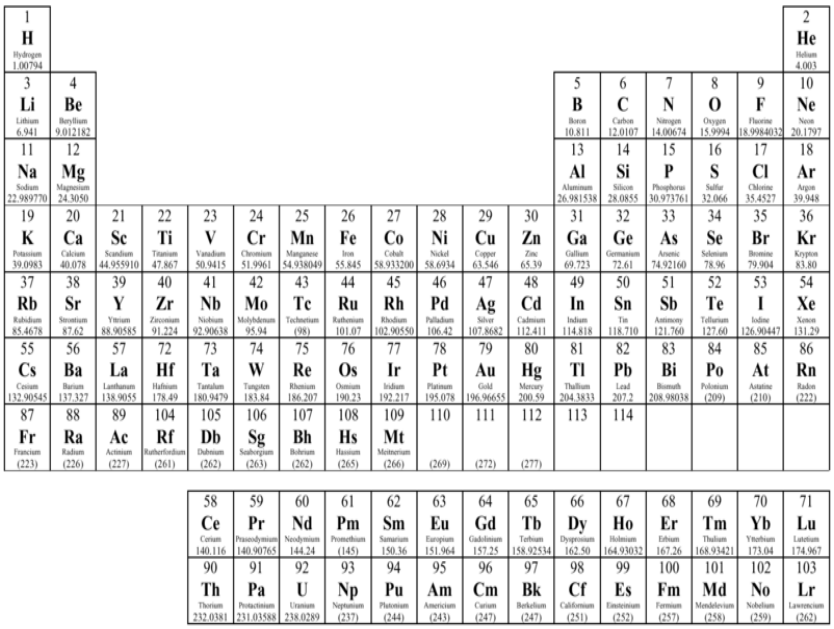
Name: _____ Date: _____ CHEM 1A

Wednesday/Thursday, October 2 & 3, 2019 –Atoms, Ions, and Molecules Practice

I. **Warm-Up –**

1. On the blank periodic table, indicate where the metals, nonmetals, and metalloids are found. Also show which columns are the noble gases, alkali metals, alkaline earth metals, halogens, and transition metals.



2. **Phenomena (Truncated)**

What patterns do you notice in the data samples below?

Substance X	**Mass of A**	**Mass of B**		**Mass of A**	**Mass of B**
Sample 1	0.86 g	1.96 g	**Substance Y**	0.86 g	0.98 g
Sample 2	4.26 g	9.73 g	**Substance Z**	0.43 g	0.25 g
Sample 3	32.8 g	74.9 g			

Play with the data, you'll notice that both the Law of Definite Proportions and the Law of Multiple Proportions both hold true. Assume a formula AB for one of the substances, and figure out what the formulae for the other two substances will be relative to AB.

Law of Conservation of Mass $m_{beginning} = m_{products}$

Law of Definite Proportions

When two or more elements combine to form a compound, their masses in that compound are in a fixed and definite ratio

Law of Multiple Proportions

When two elements form a series of compounds, the ratio of the masses of the second element that combined with 1 gram of the first element can always can be reduced to small whole numbers.

3. *How was the homework?*
   Chapter 2: 28,42,90,91

How do we know there are atoms?

4. Compound X_2Y is 60% X by mass. Calculate the percent Y by mass of the compound X_2Y_2.

Assume 100g of X_2Y, therefore 60g in X_2Y and 40g of Y. If one unit of X is 30g, and one unit of Y is 40g in X_2Y, then the percent of Y in X_2Y_2 is given by $\frac{40+40}{30+30+40+40} \times 100\% = 57\%\ Y\ in\ X_2Y_2$.

II. Ions

1. Predict the charge if the following elements were in their ionic form.

a. Li (+1) b. Ca (+2) c. Ga (+3)

d. N (-3) e. S (-2) f. B (+3)

g. Ag (+1) h. Cd (+2) i. V (a lot)

Atoms will gain or lose electrons until they have the same number of electrons as ____the noble gases_____.

A positively charged ion is called a _cation____. They are formed by elements on the _left side_ of the periodic table.

A negatively charged ion is called an__anion___. They are formed by elements on the _right side of the periodic table.

III. Naming Compounds

2. Name the following compounds:

$NiNO_3$ Nickel (I) nitrate N_2O_5 dinitrogen pentaoxide

AgBr Silver Bromide $(NH_4)_2CO_3$ Ammonium carbonate

H_2SO_3 (aq) Sulfurous Acid SF_6 sulfur hexafluoride

Types of Compounds

Molecular Compound – electrically neutral, sharing electrons, usually only nonmetals

Ionic Compound – held together by electrostatic attraction to be electrically neutral, metal & nonmetal

V. Practice

3. For each of the following determine the number of protons, neutrons and electrons:

a. ^{47}Ti b. $^{90}Sr^{2+}$ c. $^{32}P^{3-}$

p = 22 p=38 p = 15

n=25 n=52 n=17

e = 22 e = 36 e = 18

4. Fill in the following table

Symbol	$^{37}Cl^-$	$^{23}Na^+$	$^{81}Br^-$	$^{226}U^{6+}$
# of Protons	17	11	35	92
# of neutrons	20	12	46	134
# of electrons	18	10	36	86
Mass number	37	23	81	226

5. An element's most stable ion forms an ionic compound with chlorine having the formula XCl_2. If the mass number of the ion is 24 and it has 10 electrons, what is the element and how many neutrons does it have?

The ion has a 2+ charge and has 10 electrons, therefore it has 12 protons and is magnesium. 24 mass number - 12 protons = 12 neutrons

6. Which of the following represents a pair of isotopes?

a. ^{32}S *and* $^{32}S^{2-}$ b. O_2 *and* O_3

c. $^{15}_{7}N$ *and* $^{15}_{8}O$ d. $^{12}_{6}C$ *and* $^{13}_{6}C$

e. $^{18}_{8}O$ *and* $^{19}_{9}F$

7. Here are some common names that you're expected to know – write the chemical formula.

a. Water H_2O

b. methane CH_4

c. ammonia` NH_3

IV. Name the following compounds:

a. $LiHCO_3$ Lithium hydrogen carbonate

b. Na_2SO_3 Sodium sulfite

c. $(NH_4)_3PO_4$ Ammonium Phosphate

d. $Fe(OH)_3$ Iron(III) hydroxide

e. SnS_2 Tin(II) sulfide

f. $HF_{(g)}$ Hydrogen fluoride (gas)

g. $HClO_{(aq)}$ Hypochlorous acid (aq)

h. $H_2C_2O_{4(aq)}$ oxalic acid

i. SBr_6 sulfur hexabromide

j. CO carbon monoxide

k. P_2O_5 diphosphorus pentaoxide

V. What are the names of the following elements: Mo, Mg, and Sn?

Molybdenum, Magnesium, Tin

VI. Predict the formula for the following:

a. calcium cyanide $Ca(CN)_2$

b. aluminum sulfate $Al_2(SO_4)_3$

c. lead(IV) oxalate $Pb(C_2O_4)_2$

d. hydrosulfuric acid H_2S

e. sulfuric acid H_2SO_4

f. phosphorous acid H_3PO_4

g. sulfur trioxide SO_3

h. carbon tetrachloride CCl_4

VII. Which one of the following statements about atomic structure is false?

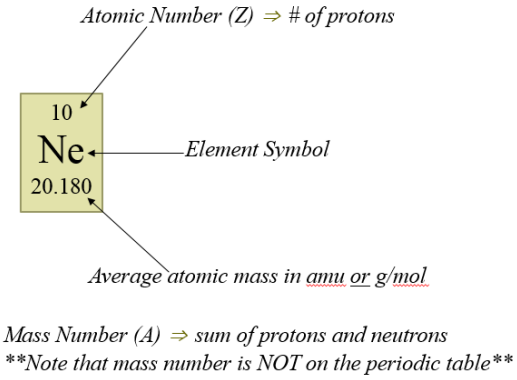
a. The protons and neutrons in the nucleus are very tightly packed.

b. The electrons occupy a very large volume compared to the nucleus.

c. The number of protons and the number of neutrons are always the same in the neutral atom.

d. Almost all of the mass of the atom is concentrated in the nucleus.

e. All of the above statements are true.



Mass Number (A) ⇒ sum of protons and neutrons

Note that mass number is NOT on the periodic table

Isotopes ⇒

atoms of the same element (same number of protons) with varying number of neutrons (different mass number)

ex: Chlorine has two naturally occurring isotopes

$^{35}_{17}Cl$ and $^{37}_{17}Cl$

Mass Number (A) *Atomic Number (Z)*

These can also be written Cl-35 and Cl-37

Naming Ionic Compounds

1. *metals with fixed charges (Grps 1, 2, Al, Ga, Ag, Zn and Cd – see diagram below)⇒ use the elements name as is*
2. *metals with varying charges (all other metals) ⇒ use the elements name and a Roman numeral (denotes the charge)*
3. *NH_4^+ ⇒ ammonium*

The second name is the anion:

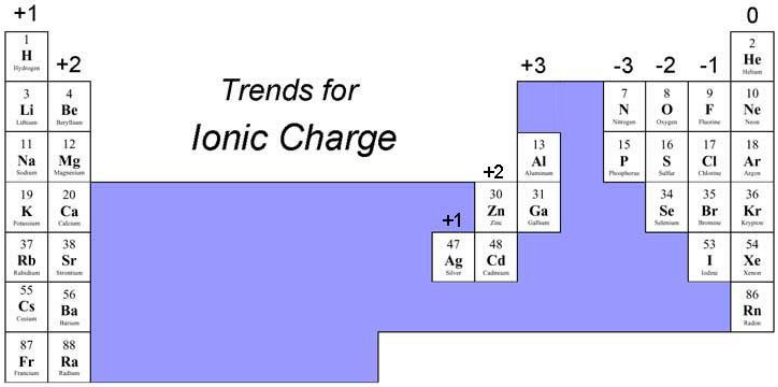
1. *monoatomic ⇒ elements name with the suffix –ide*
2. *polyatomic ⇒ you'll eventually memorize these names*

1⁻ charge	2⁻ charge	3⁻ charge
hydroxide ⇒ OH^-	sulfite ⇒ SO_3^{2-}	borate ⇒ BO_3^{3-}

cyanide ⇒ CN^-
nitrite ⇒ NO_2^-
nitrate ⇒ NO_3^-
hypochlorite ⇒ ClO^-
chlorite ⇒ ClO_2^-
chlorate ⇒ ClO_3^-
perchlorate ⇒ ClO_4^-
acetate ⇒ $C_2H_3O_2^-$
hydrogen carbonate ⇒ HCO_3^-
dihydrogen phosphate ⇒ $H_2PO_4^-$
hydrogen sulfite ⇒ HSO_3^-
hydrogen sulfate ⇒ HSO_4^-
permanganate ⇒ MnO_4^-
thiocyanate ⇒ SCN^-
bromate ⇒ BrO_3^-
bromite ⇒ BrO_2^-

sulfate ⇒ SO_4^{2-}
carbonate ⇒ CO_3^{2-}
oxalate ⇒ $C_2O_4^{2-}$
hydrogen phosphate ⇒ HPO_4^{2-}
chromate ⇒ CrO_4^{2-}
dichromate ⇒ $Cr_2O_7^{2-}$

phosphite ⇒ PO_3^{3-}
phosphate ⇒ PO_4^{3-}
arsenate ⇒ AsO_4^{3-}



Naming Acids

1. *Acids without oxygen:*
   a. *Add prefix hydro to the anion's name*
   b. *Change suffix to ic acid ex: HCN ⇒ hydrocyanic acid or H_2S ⇒ hydrosulfuric acid*
2. *Acids with oxygen:*
   Change suffix of anion in the acid
   ate ⇒ ic acid
   ite ⇒ ous acid
   ex: HNO_2 ⇒ nitrous acid vs. HNO_3 ⇒ nitric acid

Naming Molecular Compounds

1. *Add a Greek prefix to the first element's name when there's 2 or more*
2. *Always add a Greek prefix to the 2nd element and change the suffix to –ide ex: NF_3 ⇒ nitrogen trifluoride*

Greek prefixes

1-mono 2-di 3-tri 4-tetra 5-penta 6-hexa 7-hepta 8-octa 9-nona 10-deca

Image Credit 1 - Terri Bentzinger's CLAS Worksheets