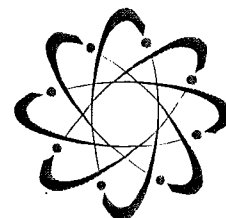




## Atomic Theory and Bonding

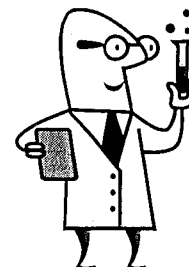
1. Complete the table for the subatomic particles:

Part of an atom	Relative position in the atom	Mass	Charge
Proton			
Neutron			
Electron			



2. Complete the table.

Element or Ion	Symbol	Atomic #	Mass #	Protons	Neutrons	Electrons	Charge
Sulfur-33							0
		29				29	
Uranium-235						92	
Uranium-238							0
Phosphide ion			31			18	
Aluminum ion	Al <sup>+3</sup>		27				

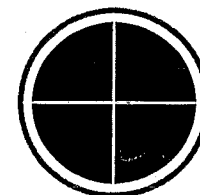


3. Explain how is it possible that there are 2 different mass numbers for uranium in the above question.
4. Draw the Bohr diagram for magnesium. Also draw the Bohr diagram for the magnesium ion. (ie: show how many electrons are in each orbital)
5. A sample of magnesium was analyzed and found to be made up of three different isotopes:

Magnesium-24: mass 23.98504 – 78.70 %

Magnesium-25: mass 24.98584 – 10.13 %

Magnesium-26: mass 25.98259 – 11.17 %



Calculate the atomic mass of magnesium. (Answer to three decimal places. Do not round off till the end.)

6. Define the following terms:

Ionization energy-

Atomic radii-

Metallic properties

7. For the following questions use **only** the elements: **carbon, nitrogen, silicon, and phosphorus.**

Name the element listed above with the :      -largest atomic radius      \_\_\_\_\_

Name the element listed above with the :      -largest ionization energy      \_\_\_\_\_

Name the element listed above with the :      -smallest ionization energy      \_\_\_\_\_

Name the element listed above with the :      -greatest metallic properties      \_\_\_\_\_

8. What is the difference between a binary compound and a diatomic molecule?

9. What is a covalent bond?

10. Draw a Lewis Bonding Diagram for:

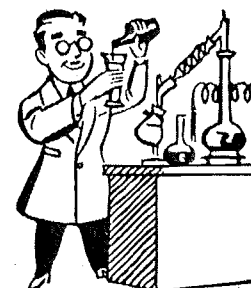
a) HOCl

b) NH<sub>4</sub><sup>+1</sup>

c) CO<sub>2</sub>

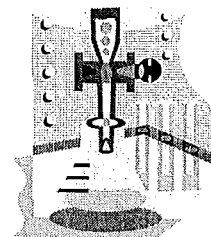
d) PCl<sub>3</sub>

e) SO<sub>4</sub><sup>2-</sup>



## The Mole Concept

1. How many moles are in 34.4g of  $H_2O$ ?
2. How many moles are in  $8.39 \times 10^{49}$  molecules of  $Au_2O_3$ ?
3. How many molecules are in 2.40 moles of  $CH_4$ ?
4. How many atoms of hydrogen are in question # 3.
5. How many molecules are in 39.4 g of  $KMnO_4$ ?
6. What is the mass of  $3.56 \times 10^{26}$  atoms of Au?
7. What is the volume of 2.3 moles of  $N_2$  gas at STP?
8. What is the % composition of the **nitrogen** in  $(NH_4)_2S$ ?
9. A certain compound was analyzed and found to contain 43.2g of C and 115.8g of O. What is this compound's empirical formula?
10. A compound is 30.4% N and 69.6% O. Find its empirical formula. If the real formula is 184 g/mol, what is the molecular formula?



## Molarity

1. What is the molarity of a solution if 5.3 g of  $CaCO_3$  is dissolved in 9.2L of water?
2. How many grams of NaI need to be weighed out to make 0.250 L of a 4.2 M solution?
3. 0.200L of a 3.77 M solution is diluted with 0.150 L of water. What is the molarity of this new solution?
4. What *volume* of a 1.50 M stock solution is needed to make 250.0 mL of 0.450 M?



## Nomenclature

### Ionic Naming:

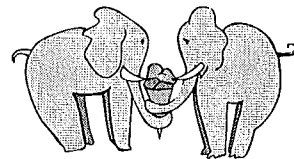
- |   |       |                                  |       |
|---|-------|----------------------------------|-------|
| 1. $\text{Ag}_2\text{S}$                  | _____ | 11. aluminum sulfate             | _____ |
| 2. $\text{Na}_2\text{O}$                  | _____ | 12. calcium hydrogen carbonate   | _____ |
| 3. $\text{Sr}_3\text{P}_2$                | _____ | 13. lithium nitride              | _____ |
| 4. $\text{Sr}_3(\text{PO}_4)_2$           | _____ | 14. hydrochloric acid            | _____ |
| 5. $\text{Zn}(\text{NO}_3)_2$             | _____ | 15. aluminum phosphate           | _____ |
| 6. $(\text{NH}_4)_2\text{SO}_3$           | _____ | 16. ammonium nitride             | _____ |
| 7. $\text{CH}_3\text{COOH}_{(\text{aq})}$ | _____ | 17. ammonium nitrite             | _____ |
| 8. $\text{Au}_2\text{S}$                  | _____ | 18. nickel (II) sulfate          | _____ |
| 9. $\text{PbO}$                           | _____ | 19. lead (IV) hydrogen carbonate | _____ |
| 10. $\text{AuPO}_4$                       | _____ | 20. tungsten (III) nitride       | _____ |

### Covalent Naming:

(use the prefixes: *mono, di, tri, tetra, penta, hexa, hepta, octa, nona, deca*)

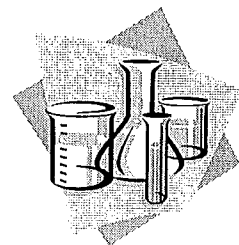
(mono is optional at the beginning of the name but mandatory in the middle, as in CO: carbon monoxide)

- |                              |       |                          |       |
|------------------------------|-------|--------------------------|-------|
| 1. $\text{OF}_2$             | _____ | 7. sulfur trioxide       | _____ |
| 2. $\text{PCl}_3$            | _____ | 8. dinitrogen pentaoxide | _____ |
| 3. $\text{P}_4\text{O}_{10}$ | _____ | 9. water                 | _____ |
| 4. $\text{N}_2\text{O}$      | _____ | 10. methane              | _____ |
| 5. $\text{SF}_6$             | _____ | 11. carbon monoxide      | _____ |
| 6. $\text{NH}_3$             | _____ | 12. carbon tetrachloride | _____ |



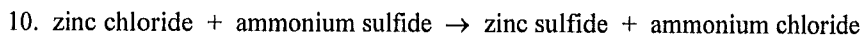
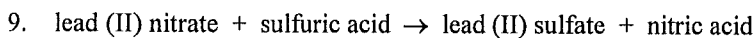
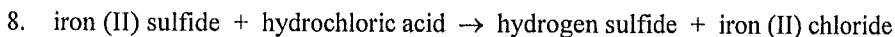
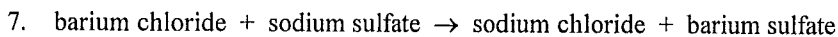
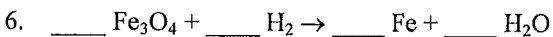
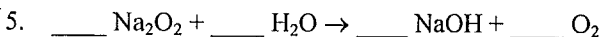
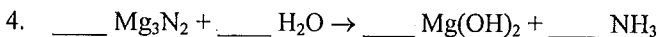
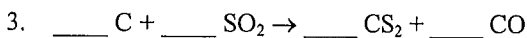
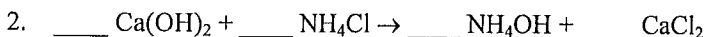
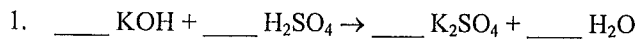
### Ionic, Covalent, and Acid Naming

- |   |       |                             |       |
|---|-------|-----------------------------|-------|
| 1. $\text{Ag}_2\text{SO}_3$                           | _____ | 7. sulfur trioxide          | _____ |
| 2. $\text{CO}$  | _____ | 8. iron (II) chlorite       | _____ |
| 3. $(\text{NH}_4)_3\text{P}$                          | _____ | 9. iron (II) chloride       | _____ |
| 4. $\text{SnO}_2$                                     | _____ | 10. potassium permanganate  | _____ |
| 5. $\text{Zn}(\text{OH})_2$                           | _____ | 11. phosphoric acid         | _____ |
| 6. <del><math>\text{HNO}_2</math></del> $(\text{aq})$ | _____ | 12. sodium hydrogen sulfide | _____ |



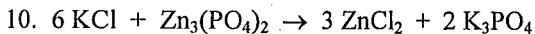
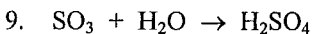
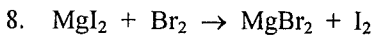
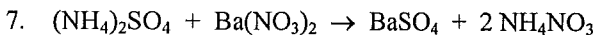
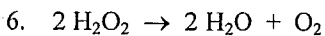
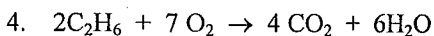
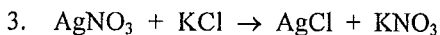
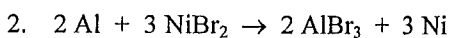
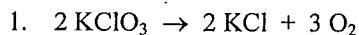
## Chemical Reactions

A. **Balance the following reactions.** If needed, put the word equation into a formula equation and then balance.

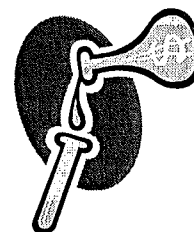
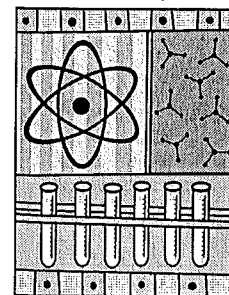
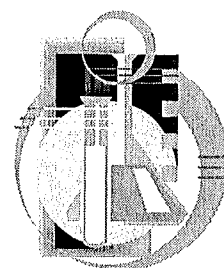
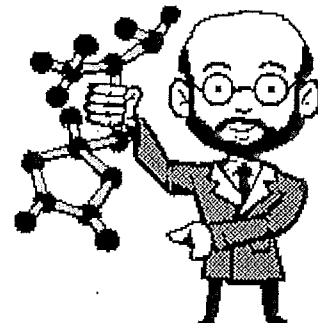
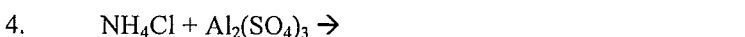
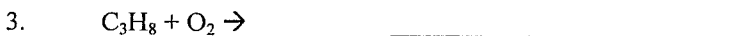
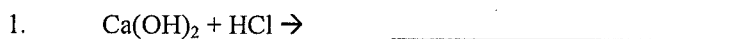


B. **Classify** each of the following reactions as:

**synthesis, decomposition, single replacement, double replacement, acid-base neutralization or combustion**

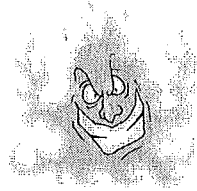


C. **Predict** the products of the reactions. **No need to balance.**



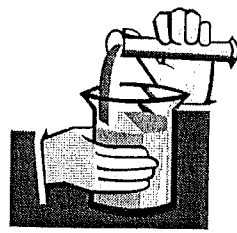
## Energy Changes in Reactions

1.  $\Delta H = +25 \text{ kJ}$  for the reaction:  $A \rightarrow B$ . Re-write this equation with the energy term in the equation. Draw a graph of *potential energy* versus *progress of reaction*, showing the reactants and products, and the enthalpy change. Will the surroundings feel warmer or cooler as the reaction occurs?
2. What is the  $\Delta H$  for the reaction  $C \rightarrow D + 30 \text{ kJ}$ ? Which would have more energy, the reactants or the products? Draw a graph of *potential energy* versus *progress of reaction*, showing the relative enthalpies of the reactants and products, and the enthalpy change. Will the surroundings feel warmer or cooler as the reaction occurs?
3. Draw a graph of *potential energy* versus *progress of reaction* for a reaction in which  $R + 20 \text{ kJ} \rightarrow T$ . Will the surroundings feel warmer or cooler as the reaction occurs?
4. Define the terms: *activation energy* and *enthalpy*.



## Stoichiometry

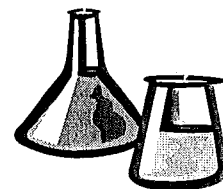
1. Ammonium hydroxide and iron (III) nitrate react with each other in a double replacement reaction. Determine the number of moles of ammonium hydroxide required to produce 0.13 mol of iron (III) hydroxide (product).
2.  $(\text{NH}_4)_2\text{SO}_4 + \text{Ba}(\text{NO}_3)_2 \rightarrow \text{BaSO}_4 + 2 \text{NH}_4\text{NO}_3$   
3.55 moles of  $\text{Ba}(\text{NO}_3)_2$  is reacted with excess  $(\text{NH}_4)_2\text{SO}_4$ .
  - a) How many moles of  $\text{BaSO}_4$  are produced?
  - b) How many moles of  $\text{NH}_4\text{NO}_3$  are produced?
  - c) How many moles of  $(\text{NH}_4)_2\text{SO}_4$  are actually needed to fully react with the  $\text{Ba}(\text{NO}_3)_2$ ?
3. Magnesium metal and oxygen gas react in a synthesis reaction to produce magnesium oxide. What mass of magnesium is needed to react with 4.89 moles of oxygen?
4. In the production of water, hydrogen gas is united with oxygen gas. Calculate the mass of water that could be produced if 11.2 moles of oxygen were used.  
 $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$
5. 2.00 moles of Ca reacts with an excess of  $\text{Cl}_2$ . The experimental yield of  $\text{CaCl}_2$  is 206 g. What is the percent yield of  $\text{CaCl}_2$ ?  
Equation: \_\_\_\_\_
6. 1.92 moles of  $\text{H}_2$  is reacted with an excess of  $\text{N}_2$ . The experimental yield is 14.5 g of  $\text{NH}_3$  are produced. What is the percent yield?  
Equation: \_\_\_\_\_
7. 8.55 mole hydrogen gas and 9.25 moles of oxygen gas produce water.  
Equation: \_\_\_\_\_  
Find: a) The limiting reactant \_\_\_\_\_  
b) Amount by which the other is in excess \_\_\_\_\_
8. 13.1 g of potassium are reacted with 18.0 g of oxygen to produce potassium oxide,  $\text{K}_2\text{O}$ . Determine:
  - a) Which reactant is in excess?
  - b) By what amount (in moles) is it in excess?
  - c) The number of grams of potassium oxide formed.
9. 1.12 L of a 2.22 M solution of  $\text{Ca}(\text{OH})_2$  and 2.45 L of a 1.45 M solution of  $\text{HCl}$  react according to the equation:  
 $\text{Ca}(\text{OH})_2 + 2 \text{HCl} \rightarrow \text{CaCl}_2 + 2 \text{H}_2\text{O}$ 
  - a) Which reagent is the limiting reagent?
  - b) How many moles of water are produced from the reaction?
  - c) What is the theoretical yield of  $\text{CaCl}_2$  (grams)?



## The Nature of Solutions

1. Classify the following solutions as ionic or molecular and predict conductivity.

Compound	Ionic or Molecular	Conductivity ( $\checkmark$ or $x$ )
$MgCl_2$		
$NaOH_{(aq)}$		
$CO$		
$H_2SO_{4(aq)}$		
$CH_3CH_2OH$ (an alcohol)		



2. If 5.40 L of 2.25 M NaCl solution is diluted to 10.0 L with water. What is the new concentration?
3. What is the volume of water needed to prepare a 2.5 M solution of hydrochloric acid, when starting with 165.0 mL of 6.0 M HCl?
4. Write the dissociation equation and calculate the concentration of each of the ions for the following salts in water.
- 4.25 M  $LiOH_{(s)}$
  - $3.6 \times 10^{-3}$  M  $K_2S_{(s)}$
  - 2.89 M  $Al_2(SO_4)_{3(s)}$
  - 1.25 g  $Mg_3(PO_4)_{2(s)}$  is dissolved in 137.0 mL of solution
5. Calculate the concentration of all ions in solution when
- 25.0 mL of 0.25 M KBr is mixed with 35.0 mL of  $1.2 \times 10^{-2}$  M  $NH_4I$ .
  - 123.0 mL of 2.357 M  $K_3PO_4$  is mixed with 189.0 mL of 1.456 M  $Mg_3(PO_4)_2$ .



## Solubility

- Write the reaction for a saturated  $CaCl_2$  solution.
  - What is the forward reaction called?
  - What is the reverse reaction called?
  - Describe what is equal about equilibrium in the above example.
  - Sketch what a saturated  $CaI_2$  solution would look like.
- Define **solubility**. What are the units for solubility?
- What is the solubility of a solution made by dissolving 1.58 moles of  $Mg(OH)_2$  in 450 mL of water to form a saturated solution?
- Differentiate between the terms **soluble** and **low soluble**.
- Classify each compound as soluble (S) or of low solubility (LS)
  - $Ca(OH)_2$
  - SrS
  - $Na_3PO_4$
  - CuBr
- Will a precipitate form when equal amounts of:
  - 0.20 M solutions of KI and  $Pb(NO_3)_2$  are mixed?
  - 0.20 M  $AgNO_3$  and NaCl are mixed?



If the answer is "yes" write the balanced full-formula equation, the full (complete) ionic equation and the net ionic equation for each reaction.

Good Luck on your Chemistry  
Exam!  
The End!