Chemistry
Unit 5 (Ch 10) Study Guide

Name KEY
Period _____ Date _____

1. Identify the representative particle for the following substances
   a. molecular compound — molecule
   b. ionic compound — formula unit
   c. elemental substance — atom
   d. water — molecule
   e. table salt — formula unit
   f. a piece of coal (carbon) — atom

2. Define the following:
   a. gram formula mass – the number of grams in one mole of an ionic substance
   b. gram molecular mass – the number of grams in one mole of a molecular substance
   c. gram atomic mass – the number of grams in one mole of an elemental substance
   d. molar mass – the number of grams in one mole of any substance
   e. molar volume – the volume one mole of a gas occupies. At standard temperature and pressure (STP), this value is 22.4 L/mol
   f. STP – standard temperature and pressure. T = 0°C, P = 1 atm

3. Find the molar mass of the following of the following compounds
   a. $PbSO_4$ 303.26 g/mol
   b. $Al_2(C_2O_3)_3$ 270.02 g/mol
   c. $C_{18}H_{28}O_3N_5$ 362.51 g/mol

4. How many atoms are there in 2.55 moles of calcium?

$$(2.55 \text{ mol Ca})\left(\frac{6.02\times10^{23} \text{ atoms Ca}}{1 \text{ mol Ca}}\right) = 1.54\times10^{24} \text{ atoms Ca}$$

5. How many molecules of oxygen gas are there in 3.90 L at STP?

$$(3.90 \text{ L})\left(\frac{1 \text{ mol}}{22.4 \text{ L}}\right)\left(\frac{6.02\times10^{23} \text{ molecules}}{1 \text{ mol}}\right) = 1.05\times10^{23} \text{ molecules } O_2$$

6. How many grams of sodium phosphate are there in 0.417 moles of sodium phosphate? $Na_3PO_4 \Rightarrow (23.0_g\times3) + (31.0_g\times1) + (16.0_g\times4) = 164.0 \frac{g}{mol}$

$$(.417 \text{ mol } Na_3PO_4)\left(\frac{164.0 \text{ g}}{1 \text{ mol}}\right) = 68.4 \text{ g } Na_3PO_4$$

7. How many atoms are there in 125 g of ethanol (C_2H_6O)? $C_2H_6O \Rightarrow (12.0_g\times2) + (1.01\times6) + 16. = 46.1\frac{g}{mol}$

$$(125 \text{ g } C_2H_6O)\left(\frac{1 \text{ mol } C_2H_6O}{46.1 \text{ g}}\right)\left(\frac{6.02\times10^{23} \text{ molecules}}{1 \text{ mol}}\right)\left(\frac{9 \text{ ATOMS}}{1 \text{ molecule}}\right) = 1.47\times10^{25} \text{ ATOMS}$$

8. An unknown gas has a density of 0.760 g/L at STP. Which of the following gases could this be (NO, SO_2, O_2, Cl_2, NH_3)? FIND DENSITY OF EACH GAS & COMPARE TO .760 g/L

$= \frac{30.0\ g}{mol} \times \left(\frac{1\ mol}{22.4\ L}\right) = 1.34\ \frac{g}{L}$ $O_2 = \frac{32.0\ g}{mol} \times \left(\frac{1\ mol}{22.4\ L}\right) = 1.43\ \frac{g}{L}$

$SO_2 = \frac{64.0\ g}{mol} \times \left(\frac{1\ mol}{22.4\ L}\right) = 2.85\ \frac{g}{L}$ $Cl_2 = \frac{70.9\ g}{mol} \times \frac{1\ mol}{22.4\ L} = 3.17\ \frac{g}{L}$

$NH_3 = \frac{17.0\ g}{mol} \times \frac{1\ mol}{22.4} = .759\ \frac{g}{L}$

9. Find the percent composition of HCl

$H: 1.01\ g \times 1 = 1.01\ g$ $\%H = \frac{1.01\ g}{36.46\ g} \times 100\% =$ 2.77% H

$Cl: 35.45\ g \times 1 = \frac{35.45\ g}{36.46\ g/mol}$ $\%Cl = \frac{35.45}{36.46} \times 100\% =$ 97.23% Cl

10. A compound with a gram molecular mass of 231.27 g/mol has the following percent composition:

Carbon = 77.90 % C
Hydrogen = 3.93 % H
Nitrogen = 18.17 % N

Find the empirical and molecular formulas of the compound

ASSUME 100.0 g OF COMPOUND

$(77.90\ g\ C)\left(\frac{1\ mol\ C}{12.01\ g\ C}\right) = 6.486\ mol\ C$

$(3.93\ g\ H)\left(\frac{1\ mol\ H}{1.01\ g\ H}\right) = 3.89\ mol\ H$

$(18.17\ g\ N)\left(\frac{1\ mol\ N}{14.01\ g\ N}\right) = 1.297\ mol\ N$

$\frac{C_{6.486}}{1.297}\ \frac{H_{3.89}}{1.297}\ \frac{N_{1.297}}{1.297}$

$\Downarrow$

C_5H_3N

$\Downarrow$ EMPIRICAL FORMULA

EFM = $(12.0 \times 5) + (1.01 \times 3) + (14.0 \times 1)$

EFM = 77.0 g/mol

$\frac{\text{MOLAR MASS}}{\text{EFM}} = \frac{231.27\ g/mol}{77.0\ g/mol} = 3$

$C_5H_3N \xrightarrow{\times 3}$ $C_{15}H_9N_3$

(EMPIRICAL FORMULA) (MOLECULAR FORMULA)