WKS

Mole Conversions

Name ___________________________________

Period _________

PART I: Find the Molar Masses (MM) for the following substances. *(Look up the mass of each element on the periodic table and add them all up.)* Write all molar masses with at least 4 sig figs.

a) MM of Al = ____________________________________

b) MM of PCl_3 = __________________________________

c) MM of Na_2SO_4 = ____

d) MM of $Mg(NO_3)_2$ = ____

For the Rest of the WKS: Use the dimensional analysis/factor label method. Every number must have units. Write answers with correct number of sig figs.

PART II: Conversions between grams and moles. (*All molar mass values must have at least 4 sig figs.)*

Use: $\text{grams} \xleftrightarrow{\text{Molar Mass (? g/mol)}} \text{moles}$

1) 45.0 g of Ca = ? moles of Ca

2) 0.0190 moles MgO = ? grams of MgO

3) 7.32 g of $Ba(OH)_2$ = ? moles of $Ba(OH)_2$

PART III: Conversions between moles and atoms or molecules

REMEMBER: $\text{moles} \xleftrightarrow[\text{(6.022}\times 10^{23}\text{ atoms or mlcls/mol)}]{\text{Avogadro's \#}} \text{atoms or molecules}$

4) 4.87×10^{23} atoms of H = ? moles of H

5) 0.56 moles of PCl_5 = ? molecules of PCl_5

PART IV: Combination questions. Use your flow chart!!

$$\text{grams} \xleftrightarrow{\text{Molar Mass (? g/mol)}} \text{moles} \xleftrightarrow[\text{(}6.022\times10^{23}\text{ atoms or mlcls/mol)}]{\text{Avogadro's \#}} \text{atoms or molecules}$$

6) 51 g of S = ? atoms of S *(g → moles → atoms)*

7) 8.34×10^{23} molecules of $Fe_2(CO_3)_3$ = ? g of $Fe_2(CO_3)_3$ *(molecules → moles → grams)*

8) 3.20 g of Ag_2SO_4 = ? molecules of Ag_2SO_4

PART V: Mixed review (all types of mole conversions) with a few complications.

9) Which of the following has a greater mass: 2 atoms of lead or 5.1×10^{-23} moles of helium? (Show work.)

10) A 25.0 g sample of Cu_2S, has…
   a) … how many molecules of Cu_2S?

   b) … how many atoms of copper?

11) How many moles of Br_2 are in a 22.5 mL sample of liquid Br_2? *Density of liquid Br_2 = 3.12 g/mL*
   Hint: mL → g → moles

PART VI: Molar Volume of Gases

Concept:

- Avogadro's Hypothesis states that "Equal volumes of gases at the same temperature and pressure have the same number of particles.
- Thus, at any one set of temperature and pressure conditions, all gases have the same volume.
- It is conventional to define a standard set of conditions which is called **S**tandard **T**emperature and **P**ressure or STP. At STP, T= 0°C and P = 1 atm
- It is known that at STP, 1 mole of any gas has a volume of 22.4 L

Flow chart:

$$\text{grams} \xleftrightarrow{\text{Molar Mass (? g/mol)}} \text{moles} \xleftrightarrow[(6.022\times10^{23}\text{ atoms or mlcls/mol})]{\text{Avogadro's \#}} \text{atoms or molecules}$$

$$\text{moles} \;\Big\updownarrow\; \begin{array}{c}\text{Molar Volume}\\ \text{(22.4 L/mol of any gas at STP}\end{array}$$

$$\text{L of gas at STP}$$

Calculations using molar volume: *Use the dimensional analysis/factor label method to make the following conversions. Show all work. Every number written must have units and answers need correct # of sig figs.*

1) 2.5 moles of O_2 gas at STP = ? L

2) 3.56 L of H_2 gas at STP = ? moles of H_2

3) A clown fills up his balloon with helium gas until it has a volume of 18.5 L at STP. How many atoms of helium are in his balloon?

4) What would be the volume of an 84.0 g sample of nitrogen gas, N_2, at STP?

5) What is the density of CO_2 gas at STP? *Hint: Assume you have a 1 mole sample of CO_2 gas at STP.*

6) **Fun with trying to grasp the enormous amount of particles in a mole.** Assume that one can count 100 molecules per minute. How many years would be required to count a mole of molecules?

$$?\text{ yr} = 6.022\times10^{23}\text{ molecules } \times \frac{\qquad}{\qquad}$$

Answers: Part I a) 26.98 g/mol; b) 137.3 g/mol; c) 142.1 g/mol; d) 148.3 g/mol; Part II 1) 1.12 mol; 2) 0.766 g; 3) 0.0427 mol; Part III 4) 0.810 mol; 5) 3.4×10^{23} mlcl; Part IV 6) 9.6×10^{23} atoms; 7) 404 g; 8) 6.18×10^{21} mlcl; Part V 9) 6.881×10^{-21} g Pb vs. 2.0×10^{-22} g He; 10a) 9.46×10^{23} mlcl; 10b) 1.89×10^{24} mlcl; 11) 0.439 mol; Part VI 1) 56 L; 2) 0.159 mol; 3) 4.97×10^{23} atoms; 4) 67.2 L; 5) 1.96 g/L; 6) 1.145×10^{16} yr