Topic 6 – Stoichiometry: Mole Interpretation and Calculations

Vocabulary

Mole – a unit that describes a quantity of 6.02 x 1023

Avogadro’s number – quantity of particles in one mole of a substance; 6.02 x 1023

Molar mass – mass, in grams, of 1 mole of that substance

Gram-atomic mass – mass, in grams, of 1 mole of an element (found on periodic table)

Gram-formula mass – mass of one mole of an ionic substance; sum of the atomic masses in the formula

Gram-molecular mass – mass of one mole of a molecular (covalent) substance; sum of the atomic masses in a molecule

Molar volume – volume of one mole of a gas at STP; 22.4 L

Percent composition by mass – indicates what portion of the mass of a substance that is represented by the mass of an individual element in the substance

Hydrate – group of ionic compounds that contain water within their crystalline structures

Anhydrous – solid that remains after a hydrate is heated and the water is removed

Percent composition of a hydrate – portion of a hydrate that is salt and the portion that is water

Concept Tasks

1. Determining the number of moles of each atom in a given mole of formula (p.1; pkt. 1)

* # moles of each atom = given moles x # of atoms in the formula

1. Determining the total number of moles of atoms in a given formula (p. 1; pkt. 1)

* Determine how many moles of each atom; add up all the moles of the atoms

1. Determining the gram-atomic mass (molar mass) of an element

* Look in the upper left-hand corner of the periodic table

1. Calculating the gram-formula mass (gram-molecular mass, molar mass) of a compound (p. 2; pkt. 1)

* Determine the number of each atom, multiply by the atomic masses, add up all the masses

1. Calculating the mass of any given mole of a substance (p. 3; pkt. 1)

* Determine the molar mass of the substance; multiply by the number of the substance

1. Calculating the number of moles of any given mass of a substance (p. 4; pkt. 1)

* Divide the mass given in the question by the molar mass of the substance

1. Calculating the percent composition by mass of an element in a formula (p. 5; pkt. 1)

* Determine the total mass of each element in the formula; add up all the masses to obtain the formula mass; divide the mass of the element by the formula mass, then multiply by 100

1. Calculating percent composition of water in a hydrate (p. 7; pkt. 1)

* Determine the total mass of water; determine the molar mass of the hydrate; divide the mass of the water by the molar mass of the hydrate, then multiply by 100

1. Calculating percent composition of water in a hydrate from lab information (p. 9; pkt. 1)

* Determine the mass of water driven off; determine the total mass of the hydrate used; divide the mass of the water driven off by the total mass of the hydrate, then multiply by 100

1. Determining the molecular formula from molecular mass and empirical formula (p. 10; pkt. 1)

* Determine the mass of the empirical formula, determine how many empirical formula there are in a given molecular mass; multiply each subscript by the answer to step 2

1. Determining empirical formula from percent composition and mass

* Change percent to mass by assuming a 100-gram sample
* Determine mole of each element by dividing mass by the atomic mass of the element
* Find mole ratio (subscripts) by dividing each mole by the smallest of the moles
* Write empirical formula using smallest whole-number ratio

Example – A compound was found to consist of 85.6% carbon and 14.4% hydrogen. What is its empirical formula?

(1) (2) (3) (4)

85.6% C 85.6 g 85.6/12 = 7.1 7.1/7.1 = 1 C

14.4% H 14.4 g 14.4/1 = 14.4 14.4/7.1 = 2 H CH2

1. Determining mole ratio of a substance in a balanced equation. (p.1; pkt. 2)

* Use the coefficients of the substances in the question

1. Solving mole to mole problems in a balanced chemical equation (p. 2; pkt. 2)

* Obtain a balanced chemical equation
* Use the question to determine the number of moles of one of the substances in the equation
* Determine the number of moles of another substance in the equation using mole ratios and a proportion

1. Solving volume to volume problems in a balanced chemical equation (p. 3; pkt. 2)

* Obtain a balanced chemical equation
* Use the question to determine the volume of one of the substances in the equation
* Convert this volume to moles
* Determine the number of moles of another substance in the equation using mole ratios and a proportion
* Convert number of moles of the other substance to liters by multiplying by 22.4L/mol

1. Solving mass to mass problems in a balanced chemical equation (p. 4; pkt. 2)

* Obtain a balanced chemical equation
* Use the question to determine the mass of one of the substances in the equation
* Convert this mass to moles by dividing by the molar mass
* Determine the number of moles of another substance in the equation using mole ratios and a proportion
* Convert number of moles of the other substance to grams by multiplying by the molar mass of the substance

1. Determining percent yield

* Divide actual yield by theoretical yield and multiply by 100

1. Determining the limiting reactant in a chemical reaction

* Obtain a balanced chemical equation
* Convert masses of both reactants to moles by dividing by individual molar masses
* Use these calculated moles to create a mole ratio that is reduced to have a denominator of 1 (This is your HAVE ratio)
* Use the coefficients in the chemical equation to create a mole ratio that is reduced to have a denominator of 1 (This is your NEED ratio)
* Compare the HAVE and NEED ratios – the reactant in the smallest quantity is the limiting reactant ; the other reactant is in excess
* Use the limiting reactant moles (given and in equation) to create the first ratio of the proportion
* Create the second ratio using X and the coefficient of the product you are looking for
* Solve the proportion
* Multiply the number of moles of product calculated by the molar mass to determine number of grams of product produced