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SL Chemistry

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Chapter 1 Review Notes

* 1. **The mole concept and Avogadro’s constant**
     1. **Apply the mole concept to substances:** 12 grams of Carbon^12 = 6.022\*10^23 molecules of Carbon^12. 1 mol = 6.022\*10^23 molecules.
     2. **Determine the number of particles and the amount of substance (in moles):** The atomic mass of an element is the same number of grams in one mole. 4 grams of Helium = 1 mol = 6.022\*10^23 molecules
  2. **Formulas**
     1. **Define the terms relative atomic mass (Ar) and relative molecular mass (Mr):** Relative Atomic Mass (RAM) is the weighted average of the isotopes of the atoms of an element relative to Carbon-12. Relative Molecular Mass is the sum of the RAMs in the molecular formula, mass of the molecule relative to C-12 (no units).
     2. **Calculate the mass of a mole of a species from its formula:**

What is the mass of 2 moles of Lithium?

Moles \* Molar Mass = Mass

2 mol \* 7g/mol = 14 g = 1.204\*10^24 Li atoms

So 14 g of Lithium contains 2 moles of Li atoms.

* + 1. **Solve problems involving the relationship between the amount of substance in moles, mass, and molar mass:**

6g of hydrogen reacts with fluorine to produce hydrogen fluoride. What mass of HF is produced?

Moles = mass / molar mass

H2 + F2 -> 2 HF

|  |  |  |  |
| --- | --- | --- | --- |
|  | H2 + | F2 -> | 2HF |
| Mol | 3 | 3 | 6 |
| Mass (g) | 6g | 114g | 120g |
| Molar mass g/mol | 1+1 = 2 | 19 + 19 = 38 | 1 + 19 = 20 |

* + 1. **Distinguish between the terms empirical formula and molecular formula:**

Empirical Formula – simplest ratio of atoms in a molecule (C6H6)

Molecular Formula – Show the number of each atom in a molecule (CH)

* + 1. **Determine the empirical formula from the percentage composition or from other experimental data:**

If 56 g of Fe reacts with 32 g of S, what is the empirical formula of the product?

Fe 56g/56g/mol S 32g/32g/mol

* + 1. **Determine the molecular formula when given both the empirical formula and experimental data:**

A hydrocarbon is composed of 85.72% carbon and has a molecular mass of 280g/mol. Identify the formula of the hydrocarbon.

C 85.72 / 12g/mol H 100-85.72 / 1g/mol

C 7.14(percent)/7.14(smallest value) H 14.28(percent)/7.14(smallest value)

C1H2 – Empirical Formula = 14 g/mol

280g/mol / 14g/mol -> C20H40 Molecular Formula

* 1. **Chemical Equation**
     1. **Deduce chemical equations when all reactants and products are given:** Number of each type of atom must be the same on both sides. Charge must also be identical on each side.
     2. **Identify the mole ratio of any two species in a chemical equation:**

***1***CH4 + ***2***O2 -> ***1***CO2 + ***2***H2O

* + 1. **Apply the state symbols (s), (l), (g) and (aq):**

(s) – solid

(l) – liquid

(g) – gas

(aq) – aqueous

* 1. **Mass and gaseous volume relationships in chemical reactions**
     1. **Calculate theoretical yields from chemical equations.**

Given 3.2 g of CH4, what is the theoretical yield of CO2 in moles and H2O in grams?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **CH4 +** | **H2S +** | **3.5O2 ->** | **CO2 +** | **3H2O +** | **SO2** |
| **Moles** | **0.2** | **0.2** | **0.7** | **0.2** | **0.6** | **0.2** |
| **Mass (g)** | **3.2** |  |  |  | **0.6 \*18 = 10.8** |  |
| **Molor mass (g/mol)** | **12+1+1+1+1 = 16** |  |  |  | **1+1+16 = 18** |  |

* + 1. **Determine the limiting reactant and the reactants in excess when quantities of reacting substances are given:**

If 14g of each reactant is present, which is in excess? How many moles of product is made?

|  |  |  |  |
| --- | --- | --- | --- |
|  | N2(limiting) + | 3H2(excess) -> | 2NH3 |
| Mol | .5 | 7 (1.5) | **1** |
| Mass (g) | 14 | 14 |  |
| Mmass g/mol | 28 | 2 |  |

* + 1. **Solve problems involving theoretical, experimental and percentage yield:**

% yield = (experimental yield / theoretical yield) \* 100

* + 1. **Apply Avogadro’s law to calculate reacting volumes of gases:**

1 mole of any gas at STP occupies 22.4 L

N2 + 3H2 -> 2NH3

Mol: 1 : 3 : 2

Vol: 1L : 3L : 2L

2SO2 + O2 -> 2SO3

* + 1. **Apply the concept of molar volumes at standard temperature and pressure in calculations:**

Using 200g of calcium carbonate, how many moles of CO2 gas are produced and what is the volume of this gas at STP? 2 moles are produced.

1 mol of any gas at STP has a volume of 22.4L. vol. of 2 mol CO2 = 2\*22.4L = 44.8L

* + 1. **Solve problems involving the relationship between temperature, pressure and volume for a fixed mass of an ideal gas:**

PV = nRT

n = fixed moles

R = constant

P = pressure kPa

T = temperature Kelvin

V = volume L or dm^3

PV/T = nR

P1V1/T1 (initial) = P2V2/T2 (final) = constant

* + 1. **Solve problems using the ideal gas equation:**

PV = nRT

What is the temperature of 1.5 mol of a gas that occupies a 50. L volume with a pressure of 200. kPA?

200. \* 50. = 1.5 \* 8.75 \* T = Temperature in Kelvin to 2 sig figs = 801.9K

**1.4.8) Analyze graphs relating to the ideal gas equation:**

* 1. **Solutions**
     1. **Distinguish between the terms solute, solvent, solution and concentration:**

Solute – smallest component in a solution

Solvent – the largest component of a solution

Solution – solute and solvent combined

* + 1. **Solve problems involving concentration, amount of solute and volume of solution:**

Concentration = moles(solute)/volume(volume of solution in dm^3) or (M, Molar)