Hayley Irving | Executive Study Notes

CHEMISTRY MODULE 2

1. CHEMICAL REACTIONS AND STOICHIOMETRY

Inquiry Question: What happens in chemical reactions?

A. Conduct practical investigations to observe and measure the quantitative relationships of chemical reactions, including but not limited to:

i. Masses of solids and/or liquids in chemical reactions

1. *Number of moles = mass / molar mass (n = m/MM)*

ii. Volumes of gases in chemical reactions

1. *1 mole of two gases weighed at the same temperature weigh the same.*

B. Relate stoichiometry to the law of conservation of mass in chemical reactions by investigating:

i. Balancing chemical equations

1. *Number of moles of each element must be equal on both sides*

ii. Solving problems regarding mass changes in chemical reactions

1. *In a reaction, you start and finish with the same mass, so if the weighing says there it weighs less, there has been gas production*
2. *"mass in an isolated system is neither created nor destroyed by chemical reactions or physical transformations"*

2. MOLE CONCEPT

Inquiry Question: How are measurements made in chemistry?

A. Conduct a practical investigation to demonstrate and calculate the molar mass of:

i. An element

1. *Use the weight and knowledge of how many moles there is to calculate the molar mass using n=m/MM*

ii. A compound

1. *Use the weight and knowledge of how many moles there are to calculate the compound's molar mass.*

B. Conduct an investigation to determine that chemicals react in simple whole number ratios by moles.

i. Coefficients in a balanced chemical equation give the amount of atoms or molecules in a compound as well as the number of moles of each substance. These coefficients are always whole numbers because you cannot have part of an atom or molecule so they always react in simple whole number ratios.

C. Explore the concept of the mole and relate this to Avogadro's constant to describe, calculate and manipulate masses, chemical amounts and numbers of particles in:

i. Moles of elements and compounds n = m/MM
   1. *Avogadro's number is $6.022x10^{23}$. If we divide the number of atoms in an element or compound by Avogadro's number, we can find the number of moles. The weight of one mole is the Molar Mass and this is what we use n = m/MM for.*

ii. Percentage composition calculations and empirical formula
   1. *To find percentage composition: (mass of a substance)/(total mass of mixture)x100*
   2. *Empirical formula is the simplest ratio for a compound, so for glucose instead of $C_6H_{12}O_6$, it becomes CH_2O. Find mass for each element in compound, convert using n=m/MM to moles, divide all through by the smallest number of moles and then multiply values into whole numbers.*

iii. Limiting reagent reactions
   1. *A limiting reagent is the reactant in a formula that has no excess. An excess reagent is the reactant in a formula that has excess at the end of a reaction.*
   2. *Limiting reagent is important as theoretical molar calculations are based on the parts of the reaction that are all used up.*
   3. *Use limiting reagent concepts in ENRU calculations, as the basis for the number of moles.*

3. CONCENTRATION AND MOLARITY

Inquiry Question: How are chemicals in solutions measured?

A. Conduct practical investigations to determine the concentrations of solutions and investigate the different ways in which concentrations are measured

i. Solute is the thing being dissolved and the solvent is what it is dissolved in.

ii. Concentration is the measure of the volume of solute in the solvent

iii. Percentage by volume is the (volume of solute in mL)/(volume of solution in mL)*100

iv. Percentage by mass is the (mass of solute in g)/(mass of solution in g)*100

v. Grams in a volume is the (mass of solute in g)/(volume of solution in mL)

vi. Parts per million by volume is the (volume of solute in mL)/(volume of solution in kL)

vii. Parts per million by mass is the (mass of solute in mg)/(mass of solution in kg)

viii. Milligrams per litre is the (mass of solute in mg)/(volume of solution in L)

B. Manipulate variables and solve problems to calculate concentration mass or volume using:

i. C = n/V

1. *Concentration of a solute = the number of moles of a solute/the volume of the solution*

ii. Dilutions (number of moles before dilution = number of moles of sample after dilution)

1. *Concentration changes because n/V is changing.*

iii. Conduct an investigation to make a standard solution and perform a dilution

C. Conduct an investigation to make a standard solution and perform a dilution

i. A standard solution is a solution containing an accurately known concentration of an element or substance. It is made by dissolving an accurate mass of reactant into water.

ii. A volumetric flask is needed to be able to get the most accurate standard solution.

iii. A primary standard is a pure reagent that can be weighed easily and is representative of the number of moles a substance contains.

iv. A standard solution allows us to accurately find the volume of other dilutions.

4. GAS LAWS

Inquiry Question: How does the ideal Gas Law relate to all other Gas Laws?

A. Conduct investigations and solve problems to determine the relationship between the Ideal Gas Law and:

i. Gay-Lussac's Law (temperature)

1. *"For a given mass and constant volume of an ideal gas, the pressure exerted on the sides of its container is directly proportional to its absolute temperature".* $P_1/T_2=P2/T_2$

ii. Boyle's Law (volume)

1. *"The volume of a given mass of a gas is inversely related to pressure when the temperature is constant".* $P_1V_1=P_2V_2$

iii. Charles' Law (volume and temperature)

1. *"For a given mass of an ideal gas at constant pressure, the volume is directly proportional to its absolute temperature".* $V_1/T_1 =V_2/T_2$

iv. Avogadro's Law (molecules)

1. *"The volume occupied by an ideal gas is directly proportional to the number of molecules present in the container".* $V_1/N_1=V_2/N_2$

v. Combined gas law merges this information to produce the following Ideal Gas Law: PV=nRT, where P is pressure, V is volume, n is number of moles, R is the rate 8.31 and T is temperature.