MR OSHO
TUTORS
Researcher || Educator || Career coach
Content builder || Mathematician
08135056422
Mroshotutors@gmail.com

SECOND TERM E-LEARNING NOTE

SUBJECT: CHEMISTRY **CLASS: SS 1**

SCHEME OF WORK

WEEK	**TOPIC**
1.	Revision/Introduction to the mole concept: Molar volume of gases, Avogadro's number, Percentage of element in a compound. Writing and Balancing Chemical Equations.
2-3.	Stoichiometry of Reactions: Calculation of Masses of Reactants and Products, Calculation of Volume of Reacting Gases. Empirical and Molecular formulae.
4-5.	Chemical Laws and their Verification: Law of Conservation of Mass, Law of Constant Composition, Law of Multiple Proportion.
6-7.	Chemical Combinations: Electrovalent Bond: Properties of Electrovalent Compounds, Covalent Bond: Properties of Covalent Compounds. Other Types of Bonding
8-9.	TheKinetic theoryof Matter and the Gas Laws: Boyle's Law, Charles' Law, Ideal Gas Equation, Dalton's Law of Partial Pressure.
10.	Avogadro's law, Gay-Lussac's Law of Combining Volumes, Graham's Law of Diffusion.

REFERENCE BOOKS

- New Chemistry for Senior Secondary School by Osei Yaw Ababio; U.T.M.E Past Questions and Answers.
- Practical Chemistry for Senior Secondary Schools by Godwin Ojokuku
- Outline Chemistry for Schools & Colleges by Ojiodu C.C.
- Chemistry Pass Questions for S.S.C.E and UTME.

WEEK ONE **DATE----------**

TOPIC:INTRODUCTION TO THE MOLE CONCEPT

CONTENT

- Relative atomic mass
- Relative molecular mass
- Molar volume of gases
- Percentage of an element in a compound

THE MOLE

A mole is a number of particles of a substance which may be atoms, ions, molecules or electrons. This number of particles is approximately 6.02×10^{23} in magnitude and is known as Avogadro's number of particles.

The mole is defined as the amount of a substance which contains as many elementary units as there are atoms in 12g of Carbon-12.

RELATIVE ATOMIC MASS

The relative atomic mass of an element is the number of time the average mass of one atom of that element is heavier than one twelfth the mass of one atom of Carbon-12. It indicates the mass of an atom of an element. For e.g, the relative atomic mass of hydrogen, oxygen, carbon, sodium and calcium are 1, 16, 12, 23, and 40 respectively.

The atomic mass of an element contains the same number of atoms which is 6.02×10^{23}atoms; 1 mole of hydrogen having atomic mass of 2.0g contains 6.02×10^{23} atoms.

EVALUATION

1. Define relative atomic mass of an element
2. State the relative atomic mass of the following elements: potassium, chlorine, silver, lead, phosphorus and nitrogen

RELATIVE MOLECULAR MASS

The relative molecular mass of an element or compound is the number of times the average mass of one molecule of it is heavier than one-twelfth the mass of one atom of Carbon-12

It is the sum of the relative atomic masses of all atoms in one molecule of that substance. It is also called the formula mass. The formula mass refers not only to the relative mass of a molecule but also that of an ion or radical.

CALCULATION

Calculate the relative molecular mass of:

1. Magnesium chloride
2. Sodium hydroxide
3. Calcium trioxocarbonate

[Mg=24, Cl=35.5, Na=23, O=16, H=1, Ca=40,C=12]

Solution:

1. $MgCl_2 = 24 + 35.5x2 = 24 + 71 = 95gmol^{-1}$
2. $NaOH = 23 + 16 + 1 = 40gmol^{-1}$
3. $CaCO_3 = 40 + 12 + 16x3 = 100gmol^{-1}$

EVALUATION

1. What is relative molecular mass of a compound?
2. Calculate the relative molecular mass of (a) $NaNO_3$ (b) $CuSO_4.5H_2O$

MOLAR VOLUME OF GASES

The volume occupied by 1 mole of a gas at standard conditions of temperature and pressure (s.t.p) is 22.4 dm^3. Thus 1 mole of oxygen gas of molar mass $32.0gmol^{-1}$ occupies a volume of $22.4dm^3$ at s.t.p and 1 mole of helium gas of molar mass $4.0gmol^{-1}$ occupies a volume of 22.4 dm^3 at s.t.p.
Note: When the conditions of temperature and pressure are altered, the molar volume will also change. Also, standard temperature = 273K and standard pressure = 760mmHg.

RELATIONSHIP BETWEEN QUANTITIES

Molar mass = $\frac{\text{mass(g)}}{\text{Amount (moles)}}$ i.e. $M = \frac{m}{n}$ $gmol^{-1}$

Note: Amount = Number of moles

Molar volume of gas = $\frac{\text{volume (} cm^3 \text{ or } dm^3\text{)}}{\text{Amount (mole)}}$ i.e. $Vm = \frac{v}{n}$ dm^3mol^{-1}

Amount = $\frac{\text{Reacting mass (g)}}{\text{Molar mass } (gmol^{-1})}$

Also, Amount of substance = $\frac{\text{Number of particles}}{\text{Avogadro's constant}}$

But, Avogadro's constant = 6.02×10^{23}
Combining the two expressions:

$$\frac{\text{Reacting mass}}{\text{Molar mass}} = \frac{\text{Number of particles}}{6.02 \times 10^{23}}$$

CALCULATIONS

1. What is the mass of 2.7 mole of aluminium (Al=27)?

Solution:

$$\text{Amount} = \frac{\text{Reacting mass}}{\text{Molar mass}}$$

Reacting mass = Amount x Molar mass
= 2.7mole x 27 $gmol^{-1}$ = 72.9g.

2. What is the number of oxygen atoms in 32g of the gas (O=16, $N_A = 6.02 \times 10^{23}$)?

Solution:

$$\frac{\text{Reacting mass}}{\text{Molar mass}} = \frac{\text{Number of atoms}}{6.02 \times 10^{23}}$$

$$\text{Number of atoms} = \frac{\text{Reacting mass} \times 6.02 \times 10^{23}}{\text{Molar mass}}$$

Molar mass of O_2 = 16x2 =32$gmol^{-1}$

$$\text{Number of atoms} = \frac{32g \times 6.02 \times 10^{23}}{32gmol^{-1}}$$

$= 6.02 \times 10^{23}$
The number of oxygen atoms is 6.02×10^{23}

EVALUATION

1. Define the molar volume of a gas
2. How many molecules are contained in 1.12dm^3 of hydrogen gas at s.t.p?

PERCENTAGE OF AN ELEMENT IN A COMPOUND

The percentage composition of an atom in a compound is the amount of the atom expressed in percentage.

$$\text{Percentage of an element in a compound} = \frac{\text{Mass of element in the compound}}{\text{Molar mass of compound}} \times \frac{100}{1}$$

CALCULATIONS

1. What is the percentage by mass of nitrogen in NH_4NO_3 (H=1, N=14, 0=16)?

Solution:

Molar mass of NH_4NO_3 = 14x2 + 1x4 + 16x3 = 80$gmol^{-1}$

$$\text{Percentage by mass of } N_2 = \frac{\text{Mass of } N_2}{\text{Molar mass of } NH_4NO_3} \times \frac{100}{1}$$

$$= \frac{28}{80} \times \frac{100}{1} = 35\%$$

2. Calculate the percentage by mass of water of crystallization in $MgSO_4.7H_2O$ (Mg=24, S=32, 0=16, H=1)

Solution:

Molar mass of $MgSO_4.7H_20$ = 24 + 32 + 16x4 + 9(2+16) = 246$gmol^{-1}$
7 moles of water of crystallization = 126g

Percentage by mass of water = $\frac{\text{Mass of } H_2O}{\text{Molar mass of } MgSO_4.7H_2O} \times \frac{100}{1}$

$= \frac{126g}{246gmol^{-1}} \times \frac{100}{1}$

$= 51.2\%$

GENERAL EVALUATION

1. What is the number of molecules in 6.4g of SO_2 ($N_A = 6.02 \times 10^{23}$)?
2. What is the volume in cm^3 of 2.2g of CO_2 at s.t.p (C=12, O=16)?
3. Determine the percentage by mass of oxygen in $Al_2(SO_4).2H_2O$.(Al=27, S=32, O=16, H=1)

READING ASSIGNMENT

New School Chemistry for Senior Secondary Schools by O. Y Ababio, Pg 28-31

WEEKEND ASSIGNMENT

1. What is the relative atomic mass of potassium A. 40 B. 39 C. 32 D. 24
2. An element with relative atomic mass 108 is A. Ca B. Cl C. Ag D. Al
3. Modern standard element with which chemist define relative atomic mass is A.^{12}C B.C^{13} C.^{3}H D.^{16}O
4. Calculate the relative molecular mass of CH_3COOH.A. $60gmol^{-1}$B. $70gmol^{-1}$C. $80gmol^{-1}$D. $90gmol^{-1}$
5. How many moles are there in 12g of CO_2 (C=12, 0=16)?A. 0.27 B. 0.47 C. 0.16 D. 0.32

THEORY

1. Calculate the actual number of atoms contained in $2.8dm^3$ of chlorine (Molar volume of gas = $22.4dm^3$, $N_A = 6.02 \times 10^{23}$)
2. How many moles are there in 10g of iron (II) tetraoxosulphate (VI)?

WEEK TWO **DATE----------**

TOPIC: WRITNG AND BALANCING CHEMICAL EQUATIONS

Chemical equations are representation of chemical reactions in terms of the symbols and formulae of the elements and compounds involved. In a chemical equation, the reactants are always written on the left hand side while the products are written on the right hand side. For instance, if A and B combines together to give C and D, the equation of the reaction is written as:

A + B → C + D

Reactants Products

BALANCING CHEMICAL EQUATIONS

All equations must be balanced in order to comply with the law of conservation of matter. Equations are balanced through the use of coefficients in front of the formula and not by changing the subscript numbers within the formulae of the products.

Example 1: Write a balanced equation for the combustion of ammonia gas in air.

Solution:

Step I: Write the reactants and predict the products

$NH_{3(g)} + O_{2(g)} \rightarrow NO_{(g)} + H_2O_{(g)}$

Step II: The equation is not balanced. Therefore the equation can be balanced by placing the right coefficient in front of each molecule to balance the number of atoms. Thus, the balanced equation is:

$4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$

Example 2: Write a balanced equation for the combustion of ethane in oxygen.

Solution:

The general formula for the combustion of Alkanes is

$C_xH_y + (x + y/4)\ O_2 \rightarrow XCO_2 + y/2\ H_2O$

The molecular formula for ethane is C_2H_6, so, x=2 and y=6

Substituting x and y into the formula above gives

$C_2H_6 + (2 + 6/4)\ O_2 \rightarrow 2CO_2 + 6/2\ H_2O$

$C_2H_6 + 7/2\ O_2 \rightarrow 2CO_2 + 3H_2O$

The equation is balanced. However, equations are written with whole number coefficients. By multiplying the entire equation by 2, we get

$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

IMPORTANCE OF CHEMICAL EQUATIONS

1. It gives us information on the product that can be formed from the combination of two or more reactants in a particular reaction.
2. It tells us the physical states of the reactants and products.
3. It indicates the direction of the reaction and whether the reaction is reversible.
4. It tells us the stoichiometry of the reaction (i.e. the relationship between the amount of reactants and products) in terms of mole ratio of the reactants and products involved.

Consider the table below:

Equation	Mole ratio/ Mass ratio
$2HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$	2 mole of HCl and 1 mole of $CaCO_3$produced 1 mole of $CaCl_2$, 1 mole of $H_2O$and 1 moles of CO_2
$2HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$	73g of HCl and 100g of $CaCO_3$produced 111g of $CaCl_2$, 18g of $H_2O$and 44g of CO_2

GENERAL EVALUATION/REVISION

1. Balance the following equations:
   (a) $KClO_{3(s)} \rightarrow KCl_{(s)} + O_{2(g)}$
   (b) $ZnCO_{3(s)} + HCl_{(aq)} \rightarrow ZnCl_{(aq)} + H_2O + CO_{2(g)}$
2. What is the volume in dm^3 of 8g of oxygen gas at s.t.p?
3. State the use of each of the following apparatuses: triangular pipe clay, beehive shelf, bell jar, fume cupboard, dessicator.
4. Outline three differences between physical and chemical changes.

READING ASSIGNMENT

New School Chemistry for Senior Secondary Schools by O.Y. Ababio, pg 36-40

WEEKEND ASSIGNMENT

1. A balanced chemical equation obeys which of the laws? A. Law of conservation of matter B. Law of definite proportion C. Law of multiple proportion D. Boyle's law
2. The numerical coefficients in a balanced equation give the A. number of mole of reactants and products B. molar mass of the reactants and products C. number of reactants only D. mass ratio of the reactants.
3. A molecule of neon is A. diatomic B. monoatomic C.triatomic D. polyatomic
4. $H_2SO_4 + xKOH \rightarrow K_2SO_4 + yH_2O$. The value for x and y in the above equation is A. 1 and 2 B. 2 and 3 C. 2 and 1 D. 4 and2

5. The balanced chemical equation for the reaction between hydrochloric acid and sodium hydroxide isA. $NaOH + HCl \rightarrow NaCl + H_2O$ B. $NaCl + HCl \rightarrow NaOH + H_2O$
C. $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$ D. $H_2SO_4 + KOH \rightarrow K_2SO_4 + H_2O$

THEORY

1. Balance the following equation: $H_2SO_4 + Na_2CO_3 \rightarrow Na_2SO_4 + H_2O + CO_2$
   $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$
2. State two information provided by the equation of a chemical reaction.

WEEK THREE **DATE----------**

TOPIC: STOICHIOMETRY OF REACTIONS

CONTENT

- Calculation of masses of reactants and products
- Calculation of volume of reacting gases

STOICHIOMETRY OF REACTIONS

The calculation of the amounts (generally measured in moles or grams) of reactants and products involved in a chemical reaction is known as stoichiometry of reaction. In other words, the mole ratio in which reactants combine and products are formed gives the stoichiometry of the reactions.
From the stoichiometry of a given balanced chemical equation, the mass or volume of the reactant needed for the reaction or products formed can be calculated.

CALCULATION OF MASSES OF REACTANTS AND PRODUCTS

1. Calculate the mass of solid product obtained when 16.8g of NaHCO3 was heated strongly until there was no further change.

Solution:

The equation for the reaction is:
$2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + H_2O_{(g)}\ CO_{2(g)}$
Molar mass of $NaHCO_3 = 23 + 12 + 16x3 = 84gmol^{-1}$
Molar mass of $Na_2CO_3 = 23x2 + 12 + 16x3 = 106gmol^{-1}$
From the equation:
2 moles $NaHCO_3$ produces 1 mole Na_2CO_3
2x84g $NaHCO_3$ produces 106g Na_2CO_3
16.8g $NaHCO_3$ will produce Xg Na_2CO_3

$$Xg\ Na_2CO_3 = \frac{106g \times 16.8g}{2x84g} = 10.6g$$

Mass of solid product obtained = 10.6g

2. Calculate the number of moles of $CaCl_2$ that can be obtained from 25g of limestone [$CaCO_3$] in the presence of excess acid.

Solution:

The equation for the reaction is:
$CaCO_{3(s)} + 2HCl \rightarrow CaCl_{2(s)} + H_20_{(l)} + CO_{2(g)}$

$$\text{Number of moles} = \frac{\text{Reacting mass}}{\text{Molar mass}}$$

Molar mass of $CaCO_3 = 40 + 12 + 16x3 = 100gmol^{-1}$

$$\text{Number of moles of } CaCO_3 = \frac{25g}{100gmol^{-1}} = 0.25 \text{ mole}$$

From the equation of reaction,

1 mole $CaCO_3$ yields 1 mole $CaCl_2$
Therefore, 0.25 mole $CaCO_3$ yielded 0.25 mole $CaCl_2$.

EVALUATION

1. What does the term 'Stoichiometry of reaction' mean?
2. Ethane [C_2H_6] burns completely in oxygen. what amount in moles of CO_2 will be produced when 6.0g of ethane are completely burnt in oxygen

CALCULATION OF VOLUME OF REACTING GASES

1. In an experiment, 10cm^3 of ethene [C_2H_4] was burnt in 50cm^3 of oxygen.
   A. Which gas was supplied in excess? Calculate the volume of the excess gas remaining at the end of the reaction.
   B. Calculate the volume of CO_2 gas produced.

Solution:

The equation for the reaction is:
$C_2H_{4(g)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 2H_2O_{(g)}$

From the equation,
A.1 mole of ethene reacts with 3mole of oxygen
1 volume of ethene reacts with 3 volumes of oxygen
10$cm^3$of ethene will react with 30cm^3 of oxygen
Since 50cm^3 of oxygen was supplied, oxygen was in excess
Hence volume of the excess gas = initial volume – volume used up = 50-30 = 20cm^3

B.1 volume of ethene produces 2 volumes of CO_2
10 cm^3 of ethene will produce 20cm^3 of CO_2
Therefore, 20cm^3 of CO_2 was produced

2. 20cm^3 of CO was mixed and sparked with 200cm^3 of air containing 21% of O_2. If all the volumes are measured at s.t.p, calculate the total volume of the resulting gases.

Solution:

In 200cm^3 of air,
Volume of O_2 = $\frac{21}{100}$ x 200cm^3 = 42cm^3
Volume of N_2 and rare gases = 200-42 = 158cm^3
The equation for the reaction is:
$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

Volume ratio	2	: 1 :	2
Before sparking	20cm^3	42cm^3	
Reacting volume	20cm^3	10cm^3	
After sparking		32cm^3	20cm^3

Volume of resulting gases = 32 + 20 + 158 = 210cm^3

GENERAL EVALUATION/REVISION

1. Find the volume of oxygen produced by 1 mole of KClO3 at s.t.p in the following reaction:
   $2KClO_{3(s)} \rightarrow 2KCl_{(s)} + 30_{2(g)}$
2. Balance the following equations: (a) $Cu_2S_{(s)} + O_{2(g)} \rightarrow Cu_2O_{(s)} + SO_{2(g)}$

(b) $C_{(s)} + H_2O_{(g)} \rightarrow CO_{(g)} + H_{2(g)}$

3. Write the symbols of the following elements: mercury, silver, gold, lead, tin, antimony.
4. Define the term valency

READING ASSIGNMENT New School Chemistry for Senior Secondary School by O. Y. Ababio, Pg 156-164

WEEKEND ASSIGNMENT

1. Amount of a substance is expressed in A. mole B. grams C. kilograms D. mass
2. Determine the mass of CO_2produced by burning 104g of ethyne [C2H2]A. 256g B.352g C. 416g D. 512g
3. The mole ratio in which reactants combine and products are formed is known as A. rate of reaction B. stoichiometry of reaction C. equation of reaction D. chemical reaction
4. The unit for relative molecular mass is A. mole B. $gmol^{-1}$C. grams D. mass
5. What mass of $Pb(NO_3)$ would be required to 9g of $PbCl_2$ on the addition of excess NaCl solution? [Pb=207, Na=23, O=16, N=14] A. 10.7g B. 1.2g C. 6.4g D. 5.2g

THEORY

1. Calculate the number of molecules of CO_2produced when 10g of $CaCO_3$ is treated with $100cm^3$ of $0.20moldm^{-3}$ HCl.
2. Calculate the volume of nitrogen that will be producedat s.t.p from the decomposition of 9.60g ammonium dioxonitrate(iii), NH_4NO_2.

WEEK FOUR **DATE----------**

TOPIC: EMPIRICAL AND MOLECULAR FORMULAE

Empirical formula is the formula which shows the simplest whole number ratios of atoms present in a compound while molecular formula is the formula which shows the actual number of each kind of atoms present in the molecule. The molecular formula of a compound is a whole number multiple of its empirical formulae.

CALCULATIONS

1. An organic compound on analysis yielded 2.04g carbon, 0.34g hydrogen and 2.73g oxygen.

A. Calculate the empirical formulA.

B. If the relative molecular mass of the compound is 60. Calculate its molecular formulA.

Solution:

Elements		C		H		O	
Reacting mass			2.04		0.34		2.73
Mole ratio = Reacting mass / Atomic mass	=		2.04 / 12	:	0.34 / 1	:	2.73 / 16
	=	0.17	: 0.34	:	0.17		
Dividing through by the Smallest value		0.17	: 0.34	:	0.17		
			0.17		0.17		0.17
Whole number ratio			1	:	2	:	1

The empirical formula = CH_2O

Relative molecular mass of the compound = 60

Let the molecular formula = $(CH_2O)_n$

$(CH_2O)_n = 60$

$(12 + 1x2 + 16)n = 60$

$30n = 60$

$n = 60/30 = 2$

Therefore, the molecular formula is $(CH_2O)_2 = C_2H_4O_2$

Calculate the empirical formula of an organic compound containing 81.8% carbon and 18.2% hydrogen

Solution:

Element			C		H
% Composition by mass			81.8		18.2
Mole ratio = $\frac{\%\text{ by mass}}{\text{Atomic mass}}$ =		12	81.8	:	18.2
=	6.82	:	18.2		1
Dividing through by the			6.82	:	18.2
smallest value			6.82		6.82
Whole number ratio			1	:	2.67

Since the ratio is not completely whole, we continue to multiple to obtain the lowest multiple that is close to a whole number i.e.

1:2.67, 2:5.34, 3:8.01, 4:10.65, 5:13.35, etC. 3:8.01 is close to whole number.

Therefore, the empirical formula is C_3H_8

GENERAL EVALUATION/REVISION

1. An organic compound has the empirical formula CH2. If its molecular mass is 42gmol^{-1}, what is the molecular formula?
2. Determine the relative molecular mass of calcium trioxocarbonate (v).
3. Define the term radical.
4. Write the formula of the following compounds
   A. Mercury (i) dioxonitrate (iii)
   B.Sodium hydrogen trioxocarbonate (IV)
   C. Oxochlorate (I) acid

READING ASSIGNMENT

New School Chemistry for Senior Secondary School by O. Y. Ababio, Pg 31-32

WEEKEND ASSIGNMENT

1. The % by mass of carbon in CO2 is A.37% B. 27% C. 48% D. 52%
2. What is the molar mass of Na_2SO_4? A. 172 B.168 C.142 D.133
3. The empirical formula of a compound is CH, the molecular formula could be A. C_2H_4 B.CH_4C. C_7H_{12}D. C_6H_6
4. An oxide of nitrogen contains 69.6% of oxygen by mass. Its empirical formula is A. N_2O_3 B. N_2O_2C. N_2O D. NO_2
5. 5.0g of an oxide of a metal (M) gave 4.0g of the metal when reduced with hydrogen. What is the empirical formula of the oxide? [M=64, O=16] A. MO B. MO_2C. M_2O D. M_20_3

THEORY

1. Calculate the % by mass of water of crystallization in $Al_2(SO_4)_3.9H_2O$
2. Two compounds X and Y have the same % composition by mass 92.3% carbon and 7.7% hydrogen. Calculate the:

A. Empirical formula of X and Y

B. Molecular formula of each compound if the molar mass of X is 26gmol^{-1} and Y is 78gmol^{-1}.

WEEK FIVE **DATE----------**

TOPIC: LAWS OF CHEMICAL COMBINATION

CONTENT

- Law of conservation of mass
- Law of definite proportion or constant composition
- Law of multiple proportion

LAW OF CONSERVATION MASS

This law states that during chemical reactions, matter can neither be created nor destroyed but changes from one form to another.

EXPERIMENT TO VERIFY THE LAW

AIM: To verify the law of conservation of mass

THEORY: The equation of the reaction chosen for study is as follows:

$$HCl_{(aq)} + AgNO_{3(aq)} \rightarrow AgCl_{(s)} + HNO_{3(aq)}$$

White ppt

APPARATUS: Weighing balance, conical flask, small test tube, string cork stopper.

REAGENTS NEEDED: Solutions of HCl and $AgNO_3$ stored in two different reagent bottles.

METHOD: The dilute HCl is poured into a conical flask. The small test tube is filled with $AgNO_3$solution and by means of a string tied around the neck of the test tube, it is suspended inside the conical flask containing the acid in such a way that the two solutions do not mix together. The conical flask and its content are weighed using a weighing balance and the result recordeD. The two solutions are mixed together by swirling the conical flask and the weight of the conical flask and its content is taken again.

DIAGRAM

RESULT: After mixing the two solutions, a white precipitate of AgCl was formed indicating that a chemical reaction has taken place.

DISCUSSION: The masses of the conical flask and its content before and after the reaction remained the same indicating that the mass of the reactants equal that of the products.

CONCLUSION:Since the two masses obtained are equal, it confirms that matter was not created nor destroyed during the chemical reaction.

LAW OF DEFINITE PROPORTION OR CONSTANT COMPOSITION

The law states that all pure samples of a particular chemical compound contain the same elements combined in the same proportion by mass.

EXPERIMENT TO VERIFY THE LAW

AIM: To verify the law of definite proportion

APPARATUS: Crucible, test tube, combustion boats, combustion tube, weighing balance, Bunsen burner, U-tube and two retort stands with clamps.

REAGENTS NEEDED: $CuCO_3$ crystals, Na_2CO_3 solution, $Cu(NO_3)_2$ solution, dry hydrogen gas and $CaCl_2$ crystals.

METHOD: Two samples of black CuO are prepared using different methods. Sample A is prepared by placing the $CuCO_3$ crystals in a crucible and heating it strongly until it decomposes into black CuO. The equation for the reaction is:

$$CuCO3_{(s)} \rightarrow CuO_{(s)} + CO_{2(g)}$$

Sample B is prepared by reacting a solution of Na_2CO_3 in a test tube with a solution of $Cu(NO_3)_2$. A green precipitate of $CuCO_3$ is formeD. This is filtered off and then heated strongly in a crucible to obtain black CuO. The equation for the reaction is:

$$Na_2CO_{3(aq)} + Cu(NO_3)_2 \rightarrow CuCO_{3(s)} + 2NaNO_{3(aq)}$$

$$CuCO3_{(s)} \rightarrow CuO_{(s)} + CO_{2(g)}$$

The two samples of black CuO are placed in two dried and weighed combustion boats labelled A and B and weighed again. These boats are then placed in a combustion tube and heateD. A stream of dry hydrogen is passed through the combustion tube to reduce the CuO to metallic Cu. After heating for sometimes, a reddish-brown residue shows that all the CuO has been reduced to metallic copper. The flame is removed but the passing in hydrogen gas continues to prevent the re-oxidation of the hot copper residues by atmospheric oxygen. Any water formed during the reaction is absorbed by the fused CaCl2 in the adjacent U-tube. When the boat is cool, the weight of it is taken. From the results, the percentage of Cu in each sample is calculated.

DIAGRAM:

RESULT: Assuming the following result was obtained:

Sample	A	B
Mass of boat	3.16g	3.31g
Mass of boat + CuO	5.15g	5.29g
Mass of boat + Cu	4.76g	4.90g
Mass of CuO = (ii) – (i)	1.99g	1.98g
Mass of Cu = (iii) –(i)	1.60g	1.59g
% of Cu in CuO	$\frac{1.60}{1.99} \times \frac{100}{1}$	$\frac{1.59}{1.98} \times \frac{100}{1}$
	80.40%	80.30%
Therefore, % of Cu in CuO	80%	80%
% of O_2 in CuO	20%	20%

DISCUSSION: The % of Cu residue in the two samples is approximately 80% irrespective of the method of preparation of the CuO samples.

CONCLUSION: In pure CuO, Cu and O are always present in a definite proportion by mass of approximately 4:1.

LAW OF MULTIPLE PROPORTIONS
This states that if two elements combine to form more than one compound, the masses of one of the elements which separately combine with fixed mass of the other element are in simple ratio

EXPERIMENT TO VERIFY THE LAW
AIM: To verify the law of multiple proportions

APPARATUS: Combustion boats, combustion tube, weighing balance, Bunsen burner, U-tube and retort stand with clamp

REAGENTS NEEDED: Cu2O crystals, CuO crystals, dry hydrogen gas and calcium chloride crystals

METHOD: The two boats are dried and weighed. Cu2O is placed in one and labelled A and CuO is placed in the other and labelled B. The two boats are weighed again and placed in a combustion tube to reduce the oxides to copper by passing hydrogen gas into the combustion tube. When the samples are cooled, the residues obtained are weighed.

RESULT: Assuming the following result was obtained:

Sample	Cu_2O	CuO
Mass of sample (oxide)	3.04g	1.91g
Mass of Cu residue	2.55g	1.35g
Mass of oxygen removed from oxide	0.49g	0.53g

CALCULATION: Calculating the various masses of copper which combine separately with fixed mass (say 1g of oxygen)
For Cu_2O,
0.49g of O_2 combines with 2.55g of Cu
1.0g of O_2 will combine with Xg of Cu
Xg of Cu = $\frac{2.55g \times 1.0g}{0.49g}$
= 5.20g

For CuO,
0.53g of O2 combines with 1.38g of Cu
1.0g of O2 will combine with Xg of Cu
Xg of Cu = $\frac{1.38g \times 1.0g}{0.53g}$
= 2.60g

Oxides of copper	Cu_2O	CuO
Mass of copper	5.20g	2.60g
Ratio of copper	2 :	1

CONCLUSION: The masses of copper which combines with a fixed mass of oxygen in Cu_2O and CuO are in simple ratio of 2:1.

GENERAL EVALUATION/REVISION

1. State the law of (a) definite proportion (b) multiple proportion
2. Balance the following chemical equation
3. $Ca(HCO_3)_{2(s)} \rightarrow CaCO_{3(s)} + H_2O_{(l)} + CO_{2(g)}$
4. $SO_{2(g)} + H_2O_{(l)} + 0_{2(g)} \rightarrow H_2SO_{4(aq)}$
5. Determine the oxidation number of: (a) Cu in $CuCO_3$ (b) P in H_3PO_4 and name the compound

READING ASSIGNMENT

New School Chemistry for Senior Secondary School by O.Y.Ababio, Pg 34-37

WEEKEND ASSIGNMENT

1. All pure samples of chemical compound contain the same element in the same proportion by mass is a the law of------ A. definite proportion B. reciprocal proportion C. multiple proportion D. conservation of matter
2. What is used to measure the mass of atom and molecules? A. Beam balance B. Spring balance C. Chemical balance D. Mass spectrometer
3. What is the ratio by mass of oxygen and hydrogen in 1 mole of water?A. 3:1 B. 2:1 C.1:2 D. 2:4
4. In two separate experiments 0.18g and 0.36g of chlorine combine with a metal M, to give A and B respectively. An analysis showed that A and B contain 0.10g and 0.20g of M respectively. Which law is illustrated by the data? A A. Law of multiple proportions. B.Law of conservation of mass. C. Law of constant composition. D. Law of simple proportion
5. An element E forms the following compounds with bromine: EBr_2, EBr_3, and EBr4. This observation illustrates the A. Law of conservation of mass.B. Law of definite proportion.C. Law of multiple proportion.D. Law of chemical combination

THEORY

1. 8.50g of CuO when heated in a current of dry hydrogen gas gave 6.58g of copper and 2.16g of water. Calculate the proportion of oxygen to hydrogen by mass in water.
2. Balance the following equations:
   $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$
   $H_2SO_4 + NaOH \rightarrow Na_2SO_4 + H_2O$

WEEK SIX AND SEVEN **DATE----------**
TOPIC: CHEMICAL COMBINATIONS

CONTENT

- Electrovalent (ionic) bond
- Covalent bond
- Dative bond
- Hydrogen bond
- Metallic bond

ELECTROVALENT (IONIC) BOND

Electrovalent bond is characterised by transfer of electrons from metallic atoms to non-metallic atoms during reaction. The metallic atom that donates electron becomes positively charged while the non-metallic atom that accepts electron becomes negatively charged. The strong electrostatic attraction that holds the oppositely charged ions together is called ionic bond.

ELECTRON DOT REPRESENTATION OF FORMATION OF IONIC COMPOUNDS

Formation of sodium chloride

Formation of calcium oxide

PROPERTIES OF SOME IONIC COMPOUNDS

1. They are solids at room temperature.
2. They contain oppositely charged ions.
3. They readily dissolve in water and other polar solvents like ethanol.
4. They have high melting and boiling points
5. They are good conductors of electricity when in molten or in aqueous form.

EVALUATION

1. How is an ionic compound formed?
2. State the properties of ionic compound

COVALENT BOND

This involves the sharing of a paired of electron between two reacting atoms. The shared electrons are each contributed by the reacting atoms and are called shared pair. A shared pair of electron in covalent bond is represented by a horizontal line
(----) between the two atoms

ELECTRON DOT REPRESENTATION OF FORMATION OF COVALENT COMPOUNDS

Formation of hydrogen molecule

Formation of carbon (iv) oxide

PROPERTIES OF COVALENT COMPOUNDS

1. They consist of molecules with definite shape.
2. They are gases or volatile liquids.
3. They readily dissolve is non-polar organic solvents
4. They have low melting and boiling points
5. They do not conduct electricity because the molecules do not contain charged particles.

EVALUATION

1. What is covalent bond?
2. Outline the properties of covalent compounds

COORDINATE COVALENT (DATIVE) BOND

In coordinate covalent bond, the shared pair of electrons is supplied by one of the combining atoms. Coordinate covalent bond is often formed in molecules that have a lone pair of electrons, i.e. a pair of electron not directly concerned in an existing bond.

ELECTRON DOT REPRESENTATION TO SHOW FORMATION OF DATIVE BOND

Formation of hydroxonium ion (H_3O^+)

Formation of Ammonium ion (NH_4^+)

Compounds containing coordinate covalent bond are similar in properties to purely covalent compounds. Both do not conduct electricity, but the presence of coordinate covalent bond tends to make a compound less volatile.

HYDROGEN BOND

Hydrogen bond is a dipole-dipole intermolecular force of attraction which exists when hydrogen is covalently bonded to a highly electronegative element of small atomic size. The electronegative element can be N, O, F, Cl, Br or I.

The highly electronegative element has very strong affinity for electrons. Hence, they attract the shared pair of electrons in the covalent bond toward themselves, resulting in the formation of a dipole which leaves a partial positive charge on the hydrogen atom and a partial negative charge on the electronegative atom. An electrostatic attraction between two dipoles is set up when the positive pole of one molecule attracts the negative pole of the other. This attractive force is known as hydrogen bond.

IMPORTANCE OF HYDROGEN BOND

It accounts for the solubilities of some compounds containing O, N and F in certain hydrogen containing solvents such as water

The crystalline shape of solid water (ice) is due to hydrogen bond.

EVALUATION

1. Define hydrogen bond
2. State two importance of hydrogen bond.

METALLIC BOND

Metal atoms are held together in solid crystal lattice by metallic bond. each metallic atom contributes its outer (valence) electron to the electron cloud, thus becoming positively charged. The resulting positively charged metallic ions tend to repel each other but are held together by the moving electron cloud and overlapping residual electron orbits. Thus, a metallic bond is a force of attraction between the positive metal ions and the free mobile electrons.

VAN DER WAALS' FORCES

The attractive forces which make it possible for non-polar molecules like nitrogen and CO_2 molecules to form liquid and solid is called van der Waals' force. This force though very weak when compared to ionic and covalent bond is important in the liquefaction of gases and in the formation of molecular lattices as in iodine and naphthalene crystals.

GENERAL EVALUATION/REVISION

1. Using electron dot representation, show the formation of MgO and O2 molecule
2. Define hydrogen bond
3. How is metallic bond formed?
4. Describe how you will separate a mixture of NaCl, Iodine and $PbCl_2$

READING ASSIGNMENT

New School Chemistry for Senior Secondary School by O.Y Ababio, Pg 55-66

WEEKEND ASSIGNMENT

1. Noble gases are stable because they A. are volatile B. have octet configuration C. have no neutron in their nucleusD. forms ions easily
2. The bond type in diatomic nitrogen gas is A. double covalent bondB. triple covalent bondC. single covalent bondD. double electrovalent bond
3. In electrovalency, valence electrons are transferred and the atomic number is A. reduced B. stabilized C. unaffected D. increased
4. An element Y having an atomic number of 19 combines with another element Z with atomic number 17. The likely compound formed is A. Y_2Z B. Y_3Z_2C. YZ D. Y_2Z_2
5. The type of attractive force which exist between discrete molecules is calledA. metallic bond B. hydrogen bondC. dative bondD.van der Waals' forces

THEORY

1. A. Illustrate the formation of the compound AlCl3 using electron dot representation
   B. State two properties of the compound
2. Define hydrogen bond

WEEK EIGHT **DATE----------**

TOPIC: KINETIC THEORY OF MATTER

CONTENT

- States of matter
- Change of state: melting, boiling, evaporation, condensation and freezing
- Kinetic theory of gases
- Phemomena supporting kinetic theory of matter

STATES OF MATTER

The three states of matter: solid, liquid and gaseous states can be distinguished by the motion of particles they are made of and the attractive force between their particles.

SOLID	LIQUID	GASES
Have definite shape and volume	Have no definite shape but definite volume	Have no definite shape and volume
Very dense	Less dense	Least dense
Incompressible	Incompressible	Compressible
Fixed mass	Fixed mass	Fixed mass
Particle vibrate and rotate about a fixed point	Particles vibrate and move about within a restricted space	Particles move about constantly at great speed and at random

CHANGE OF STATE

MELTING

Melting is the physical process where a substance changes from a solid to a liquid. When a solid is heated, the particles acquire greater kinetic energy and move violently. A point is reached when the forces of vibration overcome the cohesive forces holding the solid particles together and the crystalline structure collapses. The particles are no longer held in fixed positions but are free to move about and the liquid state is reached. The temperature at which this occurs is called the melting point of the solid.

BOILING

When a liquid is heated, the rate of evaporation increases and the value of the saturated vapour pressure equal the prevailing atmospheric pressure. When this happens, the liquid is said to boil and the temperature at which this happen is known as the boiling point of the liquid.
The boiling point of a liquid change with change in atmospheric pressure. If the pressure is raised, the boiling point will increase and if the pressure is lowered the boiling point will decrease. Also, the presence of impurities increases the boiling point of a liquid.

EVAPORATION

Evaporation is the process of vapourization of liquids at all temperatures. When the surface of a liquid is exposed, the molecules near the surface of the liquid will acquire extra kinetic energy, large enough to enable them break away from the cohesive force binding them to the neighbouring particles. Once free, they escape from the liquid surface to become molecules in the vapour state.

Evaporation results in decrease in the volume of liquid and lowering the temperature of the liquid, therefore it causes cooling. Also, it occurs at all temperature but increases with increase in temperature. In addition, it is slower in electrovalent liquids than in covalent liquids.

DIFFERENCES BETWWEEN EVAPORATION AND BOILING

EVAPORATION	BOILING
Takes place at the surface of the liquid	Involves the entire volume of the liquid
Takes place at all temperature	Takes place at a fixed temperature

CONDENSATION AND FREEZING

Condensation is a process whereby a vapour loses some of its kinetic energy to a colder body and changes into the liquid state.
When a liquid cools, it loses heat energy to its surroundings, causing its temperature to drop. If the cooling continues, the temperature of the liquid keeps dropping until it reaches the freezing point of the liquid. At this temperature, the liquid changes into solid.

EVALUATION

1. Describe the melting process of a solid.
2. State two differences between evaporation and boiling.

KINETIC THEORY OF GASES

The theorypostulates the following for an ideal or perfect gas:
Gas molecules are in constant, rapid, straight motion, colliding with one another and with the walls of the container.

The collision of gas molecules is perfectly elastic.
The total volume of the gas molecule is negligible compared to the volume of the container.
The force of attraction between the gas molecules is negligible.
The average kinetic energy of the molecule is a measure of the temperature of the gas molecules.

PHENOMENA SUPPORTING THE KINETIC THEORY OF GASES

Brownian motion: This is the constant, irregular movement of particles in a liquid or gas. It shows that gas molecules are in constant motion.
Diffusion: Diffusion is the movement of particles from a region of higher concentration to lower concentration. Diffusion is common in gases and it results from the random movement of particles of a gas.

GENERAL EVALUATION/REVISION

1. Compare the three states of matter under the following headings: Shape/volume, Density, Compressibility and Motion of particles.
2. Write short note on (a) Boiling (b) Evaporation.
3. $100cm^3$ each of $0.02moldm^{-3}$ solution of HCl and $Pb(NO_3)_2$ were mixed. Assuming the $PbCl_2$ is completely insoluble; determine the mass of the $PbCl_2$ precipitated.
4. State the postulates of Dalton's Atomic theory.

READING ASSIGNMENT

New School Chemistry for Senior Secondary School by O.Y. Ababio, Pg 71-77

WEEKEND ASSIGNMENT

1. ------ is measure of the average kinetic energy of the molecules of a gas. A. mass B. volume C. pressure D. temperature.
2. All the following are the assumptions of the kinetic theoryof gases except A. Gases are composed of many elastic particles called molecules. B. The molecules are of negligible C. The molecules collide with one another and with the walls of container.D. The molecules are in constant random motion.
3. Presence of sodium chloride in ice will A. decrease the melting point of the ice B. increase the melting point of the ice C. make sodium chloride impure D. lower the freezing point of sodium chloride
4. Which of these does not support the kinetic theory? A. Brownian motion B. Diffusion C.Osmosis D. Linear expansivity
5. The phenomenon whereby the atmospheric pressure equals the saturated vapour pressure is called A. freezing B. latent heat C. boiling D. normal pressure

THEORY

1. A bottle of milk is taken out of the refrigerator and placed on the table. Droplets of water are noticed on the surface of the milk bottle. Explain the observation
2. State two phenomena that support the kinetic theoryof gases.

WEEK NINE **DATE----------**

TOPIC: GAS LAWS

CONTENT

- Boyle's law
- Charles' law
- Ideal gas equation
- Dalton's law of partial pressure

BOYLE'S LAW

It states that the volume of a fixed mass of gas is inversely proportional to the pressure provided the temperature remains constant.

Mathematically,

$V \alpha 1/P$

$V = k/P$

$PV = k$

Hence, $P_1V_1 = P_2V_2$

Boyle's law can be represented graphically as shown below.

The graph shows that if the pressure is doubled, the volume is reduced to half its former value and if it is halved, the volume is doubled.

EXPLANATION OF BOYLE'S LAW USING THE KINETIC THEORY

When the volume of fixed mass of gas is decreased, the molecules of the gas will collide with each other more rapidly. This gives rise to an increase in pressure. However, if molecules are farther apart the number of collisions for unit time decreases, resulting in a decrease in pressure.

CHARLES' LAW

Charles' law states that the volume of a fixed mass of gas at constant pressure is directly proportional to its temperature in the Kelvin scale.

Mathematically,

$V \propto T$

$V = k/T$

$\frac{V}{T} = k$

Hence, $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

The graphical representation of Charles' law is as shown below:

EXPLANATION OF CHARLES' LAW USING THE KINETIC THEORY

When a given gas is heated at constant pressure, the molecules acquire more kinetic energy and move faster. They collide with one another and with the walls of the container more frequently. To maintain the same number of collisions on the walls of container (i.e. keep the pressure constant) the volume of the gas increases.

CALCULATIONS BASED ON BOYLE'S AND CHARLES' LAW

1. 200cm3 of a gas has a pressure of 510mmHg. What will be its volume if pressure in increased to 780mmHg, assuming there is no change in temperature?

Solution:

$V_1 = 200cm^3$, $P_1 = 510mmHg$, $P_2 = 780mmHg$ $V_2 = ?$

Using the expression for Boyle's law:

$P_1V_1 = P_2V_2$

$V_2 = \frac{P_1V_1}{P_2} = \frac{510mmHg \times 200cm^3}{780mmHg} = 130.769 = 131\ cm^3$

2. A certain mass of a gas occupies $300cm^3$ at 35^oC. At what temperature will it have its volume reduced by half assuming its pressure remains constant?

Solution:

$V_1 = 300cm^3$, $T_1 = 35^oC = (35 + 273)K = 308K$, $V_2 = V_1/2 = 300/2 = 150cm^3$, $T_2 = ?$

Using the formula for Charles' law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$T_2 = \frac{V_2T_1}{V_1} = \frac{150cm^3 \times 308K}{300cm^3} = 154K$$

EVALUATION

1. State Boyle's law
2. Explain Charles' law using the kinetic theory

GENERAL GAS EQUATION

Boyle's and Charles' laws are combined into a single expression known as the general gas equation which can be expressed mathematically as

$$\frac{P_1V_1}{T_1T_2} = \frac{P_2V_2}{T_1T_2}$$

IDEAL GAS EQUATION

This equation states that for an ideal gas PV/T is a constant.

That is, $\frac{PV}{T} = R$ (R = molar gas constant)

$$PV = RT$$

That is, for n mole of a gas, the equation becomes

$$PV = nRT$$

CALCULATIONS

1. What is the volume at s.t.p of a fixed mass of a gas that occupies $700cm^3$ at 25^oC and 0.84×10^5 Nm^{-2} pressure?

Solution:

$T_1 = 273K$, $P_1 = 1.01 \times 10^5Nm^{-2}$, $T_2 = 25^oC = (25 + 273) = 298K$, $P_2 = 0.84 \times 10^5Nm^{-2}$, $V_2 = 700cm^3$, $V_1 = ?$

Using the general gas equation

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$V_1 = \frac{P_2V_2T_1}{P_1T_2} = \frac{0.84 \times 10^5Nm^{-2} \times 700cm^3 \times 273K}{1.01 \times 10^5Nm^{-2} \times 298K} = 533.337 = 533cm^3$$

2. Calculate the number of moles present in a certain mass of gas occupying $6.5dm^3$ at 3atm and 15^oC ($R = 0.082atmdm^3K^{-1}mol^{-1}$)

Solution:

V = 6.5dm3, P = 3atm, $T = 15^oC = (15 + 273)K = 288K$, n =?

Using PV = nRT

$$n = \frac{PV}{RT} = \frac{3atm \times 6.5dm3}{0.082atmdm^3K^{-1}mol^{-1} \times 288K} = 0.8257$$

Number of moles = 0.83 mole

DALTON'S LAW OF PARTIAL PRESSURE

This law state that in a mixture of gases which do not react chemically together, the total pressure exerted by the mixture of gases is equal to the sum of the partial pressure of the individual gases that make up the mixture.

Mathematically, the law can be expressed as:

$P_{total} = P_A + P_B + P_C ..... P_n$

Where P_{total} is the total pressure of the mixture and P_A, P_B, P_C are the partial pressure exerted separately by the individual gases A, B, C that make up the mixture.

The pressure each constituent gas exerts is called partial pressure and is expressed as

Partial pressure of gas A (P_A) = $\frac{\text{Number of moles of gas A}}{\text{Total number of moles of gas in mixture}} \times P_{total}$

That is, $P_A = \frac{n_A}{n_A + n_B + n_C} \times P_{total}$

If the gas is collected over water, it is likely to be saturated with water vapour and the total pressure becomes

$P_{total} = P_{gas} + P_{water\ vapour}$

$P_{gas} = P_{total} - P_{water\ vapour}$

CALCULATION ON THE LAW

A gaseous mixture containing 64g of O_2 and 70g of N_2 exerts a total pressure of 1.8oatm. What is the partial pressure exerted by oxygen in the mixture?

Solution:

Molar mass of $O_2 = 16 \times 2 = 32 gmol^{-1}$

Molar mass of $N_2 = 14 \times 2 = 28 gmol^{-1}$

Number of mole of $O_2 = \frac{64g}{32 gmol^{-1}} = 2.0 mole$

Number of mole of $O_2 = \frac{70g}{28 gmol^{-1}} = 2.5 mole$

Total number of moles of gases in mixture = 2.0 + 2.5 = 4.5 mole

Partial pressure of $O_2 = \frac{2.0}{4.5} \times 1.80 = 0.80 atm$

GENERAL EVALUATION/REVISION

1. State Dalton's of partial pressure.
2. Calculate the pressure at 27^oC of 16.0g O_2 gas occupying $2.50 dm^3$
3. A certain mass of hydrogen gas collected over water at 10^oC and 760mmHg pressure has a volume of $37 cm^3$. Calculate the volume when it is dry at s.t.p (Saturated vapour pressure of water at 10^oC =1.2mmHg)
4. Determine the number of electrons, protons and neutrons in each of the following: $^{39}K_{19,}$ $^{63.5}Cu_{29}$.
5. If an element R has isotopes 60% of $^{12}R_6$ and 40% $^{x}R_6$ and the relative atomic mass is 12.4, find x.

READING ASSIGNMENT

New School Chemistry for Senior Secondary School by O.Y. Ababio, Pg 78-85.

WEEKEND ASSIGNMENT

1. Kelvin temperature can be converted into temperature by A.^oC = K-273 B. K + 273 C.^oC + 273/K D. K + 273/^oC
2. The pressure exerted by a gas is a result of the A. continuous random motion of its particle. B. bombardment of the walls of the container by its molecules. C.expansion of the gas molecules D. collision between the gas molecules.
3. From the ideal gas equation, PV = nRT, the unit of n is A. atmdm^{3}B. atmdm^3/K C. mole D. K/mole
4. What will be the new volume (V) if the new pressure is halved and the initial pressure remain the same the sameA. $2P_1V_1 = P_2V_2$B. $P_1V_1 = 2P_2V_2$C. $P_1V_1/2= P_2V_2/2$ D. $P_1V_1 = P_2V_2/2$
5. A fixed mass of gas of volume 546cm3 at 0^{o}C is heated at constant pressure. What is the volume of the gas at 2^{o}C? A. 550cm^{3}B. 560cm^{3}C. 570cm^{3}D. 580cm^3

THEORY

1. A given mass of nitrogen is 0.12dm^3 at 60^{o}C and 1.01 x 10^5Nm^{-2}. Find its pressure at the same temperature if its volume is changed to 0.24dm^3
2. 272cm3 of CO2 was collected over water at 15^{o}C and 782mmHg pressure. Calculate the volume of dry gas at s.t.p (saturated vapour pressure of water at 15^{o}C is 12mmHg).

WEEK TEN **DATE----------**

TOPIC: GAS LAWS

CONTENT

- Avogadro's law
- Gay lussac's law of combinig volumes
- Graham's law of diffusion

AVOGADRO'S LAW

This law states that equal volume of all gases at the same temperature and pressure contain the same number of molecules. This means that 1 mole of any gas at s.t.p has a volume of 22.4dm^3.

GAY LUSSAC'S LAW OF COMBINING VOLUMES

It states that when gases react they do so in volumes which are simple ratios to one another and to the volumes of the products if gaseous, provided that the temperature and pressure remain constant.

CALCULATION ON THE LAW

Calculate the volume of oxygen required to burn 500cm^3 of methane completely.

Solution:

The equation for the reaction is:

$$2CH_{4(g)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 2H_2O_{(g)}$$

By Gay Lussac's law,

2 volumes of CH_4 requires 3 volumes of O_2 for complete combustion

Therefore, 2cm^3 of CH_4 requires 3cm^3 of O_2

500cm^3 of CH_4 will require Xcm^3 of O_2

$$X\text{cm}^3 \text{ of } O_2 = \frac{500\text{cm}^3 \times 3\text{cm}^3}{2\text{cm}^3} = 750\text{cm}^3$$

Thus, 750cm^3 of O_2 is required

EVALUATION

1. State the Gay Lussac's law of combining volumes

2. $40cm^3$ of hydrogen was sparked with $160cm^3$ of oxygen at 100^oC and 1atm. Determine the volume of oxygen left after the reaction.

GRAHAM'S LAW OF DIFFUSION

It states that the rate of diffusion of a gas is inversely proportional to the square root of its density at constant temperature and pressure.

Mathematically,

$$R \alpha 1/\sqrt{d}$$

$$R = k/\sqrt{d}$$ where k is a constant

Comparing the rate of diffusion of two gases:

$$\frac{R_1}{R_2} = \frac{\sqrt{d_2}}{\sqrt{d_1}}$$

In terms of relative molecular mass, M

$$R \alpha 1/\sqrt{M}$$

For two gases,

$$\frac{R_1}{R_2} = \frac{\sqrt{M_2}}{\sqrt{M_1}}$$

But rate of diffusion is reciprocal of time, R =1/t

That is,

$$\frac{R_1}{R_2} = \frac{t_2}{t_1}$$

From the inverse relationship we can deduce that the less dense a gas is, the higher the rate of diffusion and vice versa.

CALCULATION

1. A given volume of SO_2 diffuses in 60 seconds. How long will it take the same volume of CH_4 to diffuse under the same condition (SO_2 = 64, CH_4 = 16)

Solution:

Using the expression:

$$\frac{t_1}{t_2} = \frac{\sqrt{M_2}}{\sqrt{M_1}}$$

$$t_2 = \frac{\sqrt{M_2}}{\sqrt{M_1}} \times t_1 = \frac{\sqrt{16}}{\sqrt{64}} \times 60\text{seconds} = 30\text{seconds}$$

GENERAL EVALUATION/REVISION

1. State Graham's law of diffusion
2. Under the same condition of temperature and pressure, hydrogen diffuses 8 times as fast as gas Y. Calculate the relative molecular mass of Y.
3. State the following rule/principle: (a) Hund's rule of maximum multiplicity (b) Aufbau principle
4. Write the electronic configuration of (a) oxide ion, (b) Aluminium ion, (c) potassium (d) phosphorus.

READING ASSIGNMENT

New School Chemistry for Senior Secondary School by O.Y. Ababio, Pg 86-92

WEEKENDASSIGNMENT

1. $400cm^3$ of a gas X diffuses through a porous pot in 2 minutes. Calculate the rate at which X diffuses. A. $6.3cm^3s^{-1}$ B. $20cm^3s^{-1}$ C. $200cm^3s^{-1}$ D. $3.33cm^3s^{-1}$#
2. The relationship between the density (d) of a gas and the rate at which the gas diffuses is A. R = kd B. R= k/√d C. R = k√d D. k/d

3. Calculate the minimum volume of oxygen required for the complete combustion of a mixture of $20cm^3$ CO and $20cm^3$ of H_2. A. $10cm^3$ B. $20cm^3$ C. $40cm^3$ D. $60cm^3$
4. If sulphur (iv) oxide and methane (CH_4) are released at the same time at opposite ends of a tube, the rate of diffusion will be in the ratio A. 2:1 B. 4:1 C. 1:4 D. 1:2
5. 'Equal volume of all gases at the same temperature and pressure contain same number of molecules' is a state of which law A. Avogadro's law B. Boyle's law C. Charles' law D. Chemical law

THEORY

1. Arrange the following gases in order of increasing rate of diffusion: CO, SO_2, H_2S, NO_2 and O_2.
2. The vapour densities of O_2 and Cl_2 are 16 and 36 respectively. If $60cm^3$ of O_2 diffuses through a porous partition in 14 seconds, how long will it take $1000cm^3$ of Cl_2 to diffuse through the same partition?