PERAMIHO GIRLS' SECONDARY SCHOOL

FORM THREE MONTHLY TEST

032 **CHEMISTRY**

MARKING SCHEME **August, 2024**

A student required to answer all questions in sections **A** and **B** and two questions in section **C**.

SECTION A: (16 Marks)

1. Answers **(10 marks)**

(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
A	E	E	C	B	D	B	C	C	D

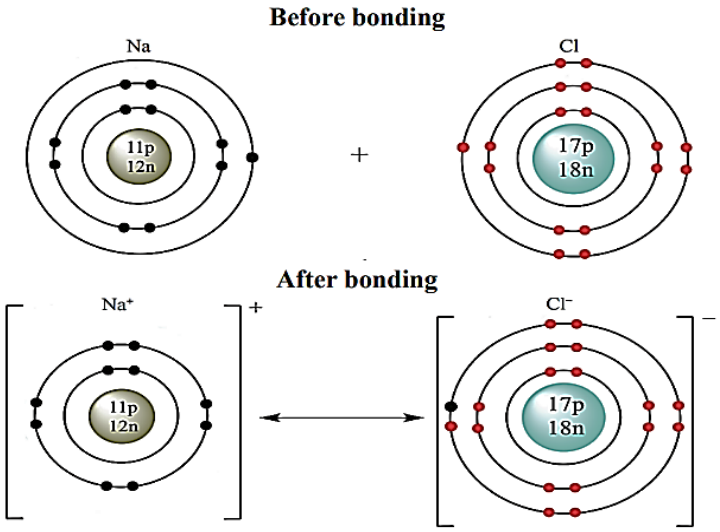
2. Answers **(06 marks)**

List A	(i)	(ii)	(iii)	(iv)	(v)	(vi)
List B	H	A	F	G	C	D

SECTION B: (54 Marks)

3. (a) (i) Ionic (electrovalent) bond **(01 mark)**

(ii)



(02 marks)

(b) **Data**

- Composition of carbon = 26.70 %
- Composition of hydrogen = 2.20 %
- Composition of oxygen = 71.10 %
- Vapour density of the compound = 45

(i) Required to determine empirical formula

Element	C	H	O
Percent by mass	26.70	2.20	71.10
Relative atomic mass (R.A.M)	12	1	16
$\frac{\text{Percent by mass}}{\text{R.A.M}}$	2.225	2.20	4.444
Dividing by the smallest value	$\frac{2.225}{2.20} = 1$	$\frac{2.20}{2.20} = 1$	$\frac{4.444}{2.20} = 2$

Therefore, the empirical formula of the compound is CHO_2 (03 marks)

(ii) Required to determine the molecular formula of the compound
Molecular mass of the compound = Vapour density x 2
Molecular mass of the compound = 45 x 2 = 90

From: (Empirical formula)n = Molecular mass
$(CHO_2)n = 90$ $45n = 90, n = 2$
From: Molecular formula = (Empirical formula)n
Molecular formula = $(CHO_2) \times 2 = C_2H_2O_4$
Therefore, the molecular formula of the compound is $C_2H_2O_4$ (03 marks)

4. (a) • Gas **X**: Hydrogen gas **(01 mark)**
• Gas **Z**: Oxygen gas **(01 mark)**

(b) • Chemical test of gas **X** (hydrogen gas)
"Gas **X** burns with a pop sound explosion". Pop sound' is a sound of small explosion. **(01 mark)**

• Chemical test of gas **Z** (oxygen gas)
"Gas **Z** relights a glowing wooden splint" **(01 mark)**

(c) Gas **Z** is collected over water by the process called "downward displacement of water" this is possible because gas **Z** is only slightly soluble in water and lighter than water, thus, during its preparation it easily displaces water and is collected over water. **(01 mark)**

(d) • Reaction of dilute acids with some metals
• Reaction of water with certain metals
• Reaction of water with hot carbon
• Electrolysis of water **(@01 = 02 marks)**

(e) • It is used in manufacture of ammonia
• It is used to make margarine
• It is used to produce oxy-hydrogen flame
• It is used in manufacture of hydrochloric acid
• It is used to prepare water gas (Fuel)
• It is used in filling weather balloons. **(@01 = 02 marks)**

5. (a) Sample **A** contains only temporary hard water. This is because before boiling it forms no lather with soap, but after boiling it forms lather with soap. This indicates that all hardness has been removed by boiling. **(02 marks)**

(b) Sample **D** contains permanent hard water. This is because before boiling it forms no lather with soap and after boiling it still forms no lather with soap. This indicates that boiling has no effect on the hardness of water sample **D**. **(02 marks)**

(c) Dissolved hydrogen carbonates of calcium and/or magnesium in water;
$Ca(HCO_3)_2$, $Mg(HCO_3)_2$ **(02 marks)**

(d) (i) $Ca(HCO_3)_2(aq) \xrightarrow{\text{Boiling}} H_2O(l) + CO_2(g) + CaCO_3(s)$ **($01\frac{1}{2}$ marks)**

(ii) $CaSO_4(aq) + Na_2CO_3(aq) \longrightarrow CaCO_3(s) + Na_2SO_4(aq)$ **($01\frac{1}{2}$ marks)**

6. (a) Electrical conductivity decreases across the periods from left to right in the periodic table because the number of free electrons decreases. Metals contains free electrons that conduct electricity, while non-metals do not have free electrons hence do not conduct electricity. **(03 marks)**

(b) Three (3) physical properties of alkali earth metals are:
- They are harder metals than those in group I.
- They are good conductors of heat and electricity.
- They are silvery grey in colour when pure and clean. However, they tarnish quickly when left in air due to the formation of the respective metal oxides. **(03 marks)**

(c) Alkali earth metals burn in air (oxygen) with a characteristic flame colour to form solid white oxide.
Metal + Oxygen $\longrightarrow$ Metal oxide
Example: Magnesium + Oxygen $\longrightarrow$ Magnesium oxide. **(03 marks)**

7. (a) $S(s) + Fe(s) \longrightarrow FeS(s)$ **(03 marks)**

(b) The mixture continue glowing even after heating has stopped because the reaction is exothermic (giving out heat). **(03 marks)**

(c) The product formed in (a) above cannot be attracted by magnet because the magnetic property of iron is lost when the new compound is formed. **(03 marks)**

8. The steps for lighting a Bunsen burner are re-arranged as follows

(i)	(ii)	(iii)	(iv)	(v)	(vi)
F	**D**	**A**	**C**	**E**	**B**

(@$01\frac{1}{2}$ = 09 marks)

SECTION C: (30 Marks)

9. (a) (i) Methyl orange indicator **(01 mark)**

(ii) Phenolphthalein indicator **(01 mark)**

(b) (i) At the end point of titration the colour of the solution was **pink.** **(02 marks)**

(ii)

Titration	**PILOT**	**1**	**2**	**3**
Final volume (cm^3)	15.90	30.90	45.90	15.00
Initial volume (cm^3)	0.00	15.90	30.90	0.00
Volume of acid used (cm^3)	15.90	15.00	15.00	15.00

(02 marks)

(iii) Average volume = $\frac{T1 + T2 + T3}{3}$

$= \frac{(15.00 + 15.00 + 15.00)\ cm^3}{3} = 15.00\ cm^3$ **(02 marks)**

(iv) During titration, only potassium carbonate (K_2CO_3) reacted with the acid while the salt (KCl) remained unreacted.

Reaction equation between potassium carbonate (K_2CO_3) with the acid (HA) is:

$K_2CO_3(aq) + 2HA(aq) \longrightarrow 2KA(aq) + H_2O(l) + CO_2(g)$ **(01 mark)**

From analytical equation: $\frac{MaVa}{MbVb} = \frac{na}{nb}$

$Mb = \frac{Ma \times Va \times nb}{Vb \times na} = \frac{0.25\ M \times 15.00\ cm^3 \times 1}{20.00\ cm^3 \times 2} = 0.0938\ M$ **(02 marks)**

Concentration of potassium carbonate (K_2CO_3) = Molarity x Molar mass

Concentration of K_2CO_3 = 0.0938 mol/dm^3 x 138 g/mol = 12.9444 g/dm^3

(01 mark)

Concentration of the mixture (KCl + K_2CO_3) = $\frac{9.57\ g}{0.5\ dm^3} = 19.14\ g/dm^3$

(01 mark)

Concentration of KCl = Concentration of mixture - Concentration of K_2CO_3

Concentration of KCl = 19.14 g/dm^3 – 12.9444 g/dm^3 = 6.1956 g/dm^3

Mass of KCl = 6.1956 g/dm^3 x 0.5 dm^3 = 3.0978 g **(02 marks)**

10. (a) A doctor prescribes the antacid tablet in order to neutralize excess gastric acid in the stomach by reacting with hydrochloric acid in the stomach to form magnesium chloride and water. **(03 marks)**

(b) $Mg(OH)_2(aq) + 2HCl(aq) \longrightarrow MgCl_2(aq) + 2H_2O(l)$ **(03 marks)**

(c) **Data given:** • The normal acid content (M_1) = 150 millimolar = 0.15 M
• Abnormal acid content (M_2) = 210 millimolar = 0.21 M
• Volume of gastric juice in a day (Va) = 0.5 L

1st step: Find excess acid (Ma) in the stomach
Excess acid (Ma) = $M_2 - M_1$ = 0.21 M – 0.16 M = 0.06 M

2nd Step: Find number of moles of excess acid (na)
na = Ma x Va = 0.06 M x 0.5 L = 0.03 mol

3rd Step: Find number of moles of tablet (nb) by stoichiometry
From balanced equation in (b) above;

$Mg(OH)_2$: HCl
1 : 2
X : 0.03 mol, 2X = 0.03, n ($Mg(OH)_2$) = 0.015 mol

4th step: Find molar mass of tablet ($Mg(OH)_2$)
Mr = 24 + 2(16 + 1) = 58 g/mol

5th step: Find mass of tablets given

From: Number of moles (n) = $\frac{\text{Mass (g)}}{\text{Molar mass } (\frac{\text{g}}{\text{mol}})}$

Mass of tablets = Number of moles x Molar mass
= (0.015 mol) x (58 g/mol) = 0.87 g

Therefore, the mass of tablets to be given to the student = 0.87 g
(03 marks)

(d) **Data given:** Mass of each tablet = 145 mg = 0.145 g
Total mass of tablet = 0.87 g

Number of tablets = $\frac{\text{Total mass of all tablets}}{\text{Mass of one tablet}} = \frac{0.87\text{ g}}{0.145\text{ g}}$ = 6 tablets

Therefore, 6 tablets will be given to the student **(03 marks)**

(e) 1 day (24 hrs.) = 2 tablets
X days = 6 tablets, 2X = 6, X = 3 days

Therefore, the student will finish the full dose for 3 days **(03 marks)**

11. Rate of chemical reaction is a measure of the progress of the reaction per unit time. Some reactions are so fast that they can take place within a fraction of a second, some are moderate while others are very slow. The rate of chemical reaction is determined by measuring the amount of product formed during a given time or by measuring amount of reactant used up during a given time.

02 marks

The following are the six (6) factors affecting the rate of chemical reactions:

Temperature. The rate of chemical reaction increases with an increase in temperature, This is because an increase in temperature increases the kinetic energy of the reactant particles, this causes the particles to move faster, Thus increasing the chances or frequencies for effective collisions between the reacting particles.

Concentration. Increase in concentration of one or more reactants increase the rate of chemical reaction. This is because there will be more particles per unit volume of the reaction mixture which will increase the frequency of collision. But the decrease in concentration of one or more reactants will decrease the rate of chemical reaction.

Pressure. Increase in pressure for a reaction involving gases will increase the rate of reaction. This is because the increase in pressure decreases the rate volume of the gaseous reaction mixture which causes the gas molecules to collide more frequently. Changing pressure of the reactants in solid or liquid has no effect in the rate of chemical reaction because solids and liquids are non-compressible since they have definite volumes which cannot come closer together under pressure.

Catalyst. A catalyst is a substance that alters the rate of chemical reaction but remains chemically unchanged at the end of the reaction. The catalyst remains unchanged because it does not get involved in the reaction chemically but only increases the rate. Although the catalyst remain chemically unchanged, it can change its physical nature for example from course powder to fine powder.

Light. Some chemical reactions depend on light to take place. Example photosynthesis and substitution reaction of some organic compounds. For these reactions; the increase in light intensity makes them to be faster because reactant molecules are likely to gain the required energy (activation energy) and react faster.

Surface area. For heterogeneous reactions; increase in surface area of the reactant(s) increase the rate of chemical reaction. This is because the increase in surface area will increase more number of reactant particles and so increases the frequency of collision. The surface area of solid reactants is increased by making them to be fine particles or powder form. **(@02 = 12 marks)**

Generally, to find the rate of reaction, a property of the reaction that can be observed is chosen without disturbing the reaction itself. Such properties of reactions includes; colour change, mass change, volume of gases, formation of precipitate, production of an odour, pH change. **(01 mark)**