MARANDA HIGH SCHOOL

Kenya Certificate of Secondary Education 2021

CHEMISTRY PAPER 1

(THEORY)

JANUARY 2021 TIME: 2 HOURS.

MARANDA HIGH SCHOOL POST MOCK

Name: _____ Index Number: _____

Candidates Signature: _____ Date: _____

Instructions to Candidates

1. *Write your name and index number in the spaces provided above.*
2. *Sign and write the date of examination in the spaces provided above.*
3. *Answer ALL the questions in the spaces provided in the question paper.*
4. *Mathematical tables and silent electronic calculators may be used.*
5. *All working MUST be clearly shown where necessary.*
6. *This paper consists of 14 printed pages.*
7. ***Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.***

For Examiners use only

Questions	Maximum Score	Candidates Score
1 - 27	80	

- *This paper consists of 14 printed pages.*
- *Candidates should check the question paper to ensure that all pages are pointed as indicated and no questions are missing.*

Scanned with CamScanner

1 mm

(3marks)

1. State the process that takes place when;

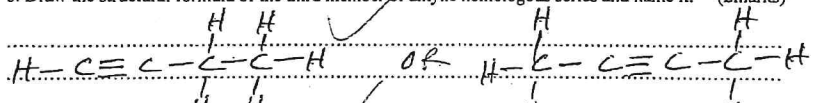
a. Natural fats or oil are hydrolysed using alkalis
Saponification

b. Sulphur is added to natural rubber and heated to form cross links
Vulcanization

c. A heavy nuclide is broken down by a fast-moving neutron.
Nuclear fission

2. a. Define the term homologous series as used in the study of organic chemistry (1mark)
family of organic compounds whose members have similar structures, physical properties and chemical formula.

b. Draw the structural formula of the third member of alkyne homologous series and name it. (2marks)



But-1-yne OR But-2-yne

3. The element has isotopic species **A** and **B** each with a mass number 39 and 40 respectively. The percentage of A is 60% and in **B** is 40% for an isotopic element X. Calculate the relative atomic mass of X. (2marks)

$$RAM = \frac{(39\times60)+(40\times40)}{100}$$

$$= \frac{2340+1600}{100}$$

$$= \frac{3940}{100} = 39.40$$

Scanned with CamScanner

J

4. a. Define the term solubility (1mark)

Amount of solute that can form a saturated solution in 100g of water at a given temperature

b. 70g of salt W were added to 80 cm3 of water at 25°C. After stirring 10g of crystals of salt W were filtered out. Determine the solubility of salt W at 25°C (2marks)

70g − 10g = 60g

If 80g of water → 60g of W

100g of water → ?

$= \frac{100 \times 60}{80}$

= 75g / 100g of water

5. a. Define molar heat of solution (1mark)

The amount of heat change involved when one mole of a solute completely dissolve in a solvent / water.

b. The lattice energy of 500mm bromide and hydration energies of sodium and bromide ions are 733, 406 and 335Kjmol^{-1} respectively

Determine the heat of solution of Sodium Bromide (2marks)

$\Delta H_{sol} = \Delta H_{latt} + \Delta H_{hyd}$

$= +733 + (-406 + -335)$

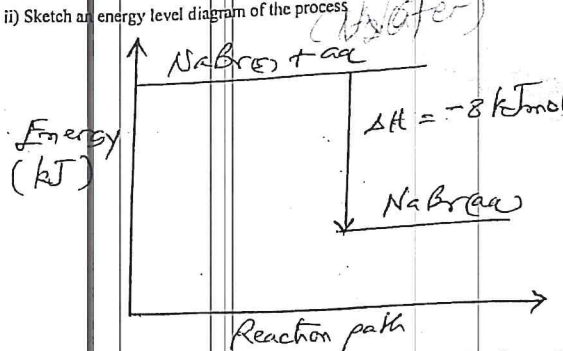
$= -8 kJmol^{-1}$

small K, Capital J

Scanned with CamScanner

Getty

ii) Sketch an energy level diagram of the process (2marks)



Equation showing the type of reaction or ΔH = −

6. The table below gives some experimental results on four samples of water. Use the information to answer the questions that follow.

	Drops of soap needed for form lather	
Sample of water (50 cm3)	Before boiling	After boiling
A	25	15
B	8	8
C	18	8
D	25	25

a. Which samples contain permanent hardness? Explain (1½marks)

B and D

The drops / amount of soap needed to form lather remains the same even after boiling

b. Which samples are likely to contain calcium hydrogen carbonate? Explain (1½marks)

A and C

The drops / amount of soap needed to form lather decreased after boiling

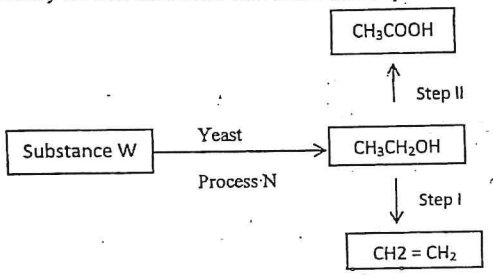
Scanned with CamScanner

Jessy Opiyo

7. Describe how you could prepare dry sample of Lead (II) Chloride starting with Lead (II) Carbonate. (3marks)

To some amount of dilute HNO_3 in a beaker add $PbCO_3$ as you stir till in excess, filter to obtain $Pb(NO_3)_2$ as filtrate
Add NaCl solution to $Pb(NO_3)_2$ solution
filter to obtain $PbCl_2$ as residue
Wash the residue with distilled water and dry between filter paper

8. Study the flow chart below and use it to answer question that follow.



a. Name the process N (1mark)
fermentation

b. Suggest a suitable reagent for use in step II (1mark)
Acidified potassium manganate(VII) / H^+ / $KMnO_4$
Acidified potassium dichromate(VI) / H^+ / $K_2Cr_2O_7$

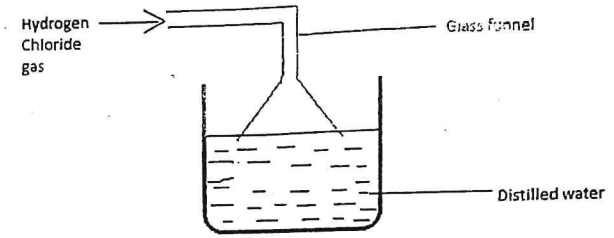
c. Describe how step I is carried out. (1mark)
Ethanol is reacted with Concentrated H_2SO_4 acid at a temperature of 180°C for ethene and water to be formed.

Scanned with CamScanner

Imbuga

9. Sodium hydroxide solution and graphite are both capable of conducting and electric current. What is the major difference between the two substances in their electrical conductivity? (1mark)
Sodium hydroxide conducts electric current by using mobile ions while graphite does by using delocalized electrons

10. An aqueous solution of hydrogen chloride can be prepared as shown in the diagram below.



a. Give two reasons for using an inverted funnel (1mark)
To prevent the suck back
To increase the surface over which the gas dissolves in water.

b. Four drops of Lead (II) Nitrate solution were added to 4cm3 of the solution obtained above followed by excess aqueous ammonia. Explain the observation (2marks)
A white precipitate is formed
Pb^{2+} ions react with Cl^- ions to form the insoluble $PbCl_2$

Scanned with CamScanner

Victor Odundo

11. Nitrogen reacts with oxygen according to the equation.

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$, $\Delta H = +197 kJmol^{-1}$. What is the effect of increase of the following on the position of the equilibrium? Explain.

i. Pressure (1½marks)

No effect; The number of molecules on both sides of the reaction are the same // Total volumes of reactants and products are equal.

ii. Temperature (1½marks)

Equilibrium shifts to the right, Forward reaction is favoured as an endothermic process will proceed

12. The standard reduction potentials of two half cells are

$Ag^+(aq) + e^- \rightarrow Ag(s)$ $E^\theta = +0.80V$

$Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$; $E^\theta = -2.37v$

a. Draw a well labelled diagram of an electrochemical cell that can be constructed using the two half cells. (2marks)



b. Determine the e.m.f of the above cell (1mark)

Emf = $E_{red.} - E_{oxid.}$

= $+0.80 - (-2.37)$

= $+3.17V$

7

Scanned with CamScanner

M. G

13. A white solid L changes to yellow solid R when strongly heated but on cooling becomes white again when L is reacted with dilute nitric(v)acid effervescence occurs.

i. Identify L (1mark)

Zinc carbonate // $ZnCO_3$

ii. Write the equation for the reaction of L and Nitric (v) acid. (1mark)

$ZnCO_{3(s)} + 2HNO_{3(aq)} \rightarrow Zn(NO_3)_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$

iii. Name and write the formula of the salt formed when solid R dissolves in Sodium Hydroxide solution. (1mark)

Sodium zincate

Na_2ZnO_2

14. The table below shows the PH values of J to N

Solution	J	K	L	M	N
PH	5	13	2	10	7

a. Which solution

i. Contains the largest concentration of hydroxide ions? Explain (1mark)

K; It is a strong alkali which dissociates completely in water

ii. Is likely to be a solution of ethanoic acid? Explain (1 mark)

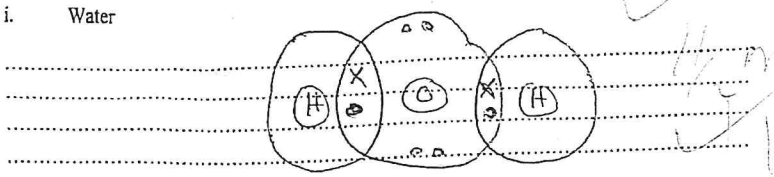
J; It is a weak acid

Scanned with CamScanner

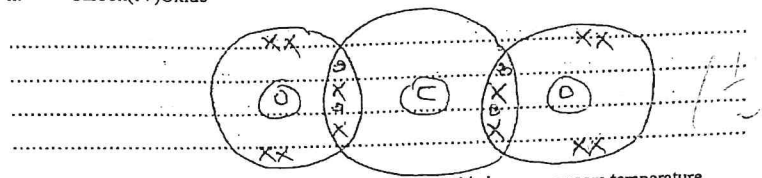
Ongech

15. a. Using dots (o) and crosses (x), show the bonding in; (2marks)

i. Water



ii. Carbon(IV)Oxide



b. Why is water a liquid at room temperature while Carbon (IV) Oxide is a gas as room temperature (1mark)

Water has stronger hydrogen bonds between its molecules unlike Carbon(IV) oxide which has weak Van der waals forces

16. A gaseous compound consists of 86% carbon and 14% hydrogen by mass. At s.t.p, 3.2 dm3 of the compound has a mass 6g. (C=12; H=1, Molar gas volume at s.t.p=22.4dm3)

a. Calculate its empirical formula (1mark)

Element	C	H
Mass	86	14
RAM	12	1
Mols	$\frac{86}{12}=7.166$	$\frac{14}{1}=14$

Mole ratio $\frac{7.166}{7.166}=1$ $\frac{14}{7.166}=2$

$\therefore EF = CH_2$

b. Calculate its molecular formula (2marks)

If $3.2dm^3 \rightarrow 6g$

$22.4dm^3 \rightarrow ?$

$= \frac{22.4 \times 6}{3.2}$

$= 42$

$MF = (EF)_n$

$n = \frac{RMM}{EFM}$

$= \frac{42}{14} = 3$

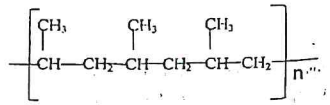
$\therefore MF = (CH_2)_3$

$= C_3H_6$

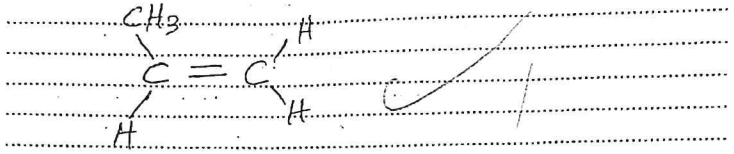
Scanned with CamScanner

Rose

17. The structure below represents a segment of a polymer. Use it to answer the questions that follow.



a. Draw the structure of the monomer (1mark)



b. Given that the molecular mass of the polymer is 2,000 find the value of **n** (2marks)

RMM of monomer = 42

$n = \frac{2000}{42}$

$= 47.6 \approx 48$

18. The chief are aluminum bauxite which mainly contains $AL_2O_3.2H_2O$. The ore is initially purified before aluminum is extracted electronically.

a. Identify the main impurities associated with this ore. (1mark)

Iron(III) oxide / Fe_2O_3 // Silicon(IV) oxide / SiO_2 / Silica

b. Sodium hydroxide solution is used in the purification process. State its role. (1mark)

It reacts with acidic SiO_2 and Amphoteric Al_2O_3 so that Fe_2O_3 is removed as red mud

React with impurities to form slag.

Scanned with CamScanner

Makedi

c. Give an equation for the reaction that forms aluminum oxide (Alumina) from Aluminum hydroxide. (1mark)

$2Al(OH)_{3(s)} \xrightarrow{heat} Al_2O_{3(s)} + 3H_2O_{(l)}$

19. When a current of 0.5 amperes was passed for 32 minutes and 10 seconds through chloride of metal P. 0.44g of P was deposited. Determine the charge of the ion of metal P. (1f=96500c, p=88) (3marks)

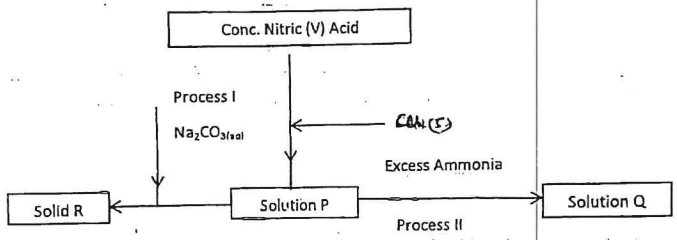
Q = It
$= 0.5 \times [(32 \times 60) + 10]$
$= 0.5 \times 1930 = 965C$

0.44g → 965C
88g = $\frac{88 \times 965}{0.44} = 193000C$

1F = 96500C
? = 193000C
$= \frac{193000 \times 1}{96500} = 2F$

Thus charge = 2+

20. Study the flow chart below and answer the questions that follow.



i. Identify the solution P (1mark)

Copper(II) nitrate // $Cu(NO_3)_2$

ii. Write the chemical equation to show how solid R is formed. (1mark)

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

iii. State the observation made in process II (1mark)

A blue ppt is formed which dissolves to form a deep blue solution

Scanned with CamScanner

Joshua

21. If 25.0 cm3 of 0.1MH2So4soultion neutralized a solution containing 1.06g of sodium carbonate in 250 cm3 of solution. Calculate,

a. The Molarity of sodium carbonate solution. (Na=23, O=16, C=12). (1½marks)

Moles of $Na_2CO_3 = \frac{1.06}{106} = 0.01mol$

If 250cm³ → 0.01mol
1000cm³ = $\frac{1000 \times 0.01}{250}$
$= 0.04M$

b. Volume of Sodium Carbonate solution used. (1½marks)

$H_2SO_{4(aq)} + Na_2CO_{3(s)} \rightarrow Na_2SO_{4(aq)} + H_2O_{(l)} + CO_{2(g)}$
1 : 1

If 1000cm³ → 0.1mol
25cm³ = $\frac{25 \times 0.01}{1000}$
$= 0.00025mols$

If 0.04mols → 1000cm³
0.00025mols = $\frac{0.00025 \times 1000}{0.04}$
$= 6.25cm^3$

22. The following elements belong to the same group of periodic table. (Letters do not represent the actual symbols)

Element	Atomic radius (nm)	Ionic radius (nm)	1st Ionization Energy ($kJmol^{-1}$)
P	0.137	0.066	736
Q	0.089	0.031	900
R	0.174	0.099	590

i. State whether the elements are metals or non-metals. Explain your answer. (2marks)

Metals
They have smaller ionic radii than atomic radii

ii. Which element is the most reactive? Explain (2marks)

R
Has the largest atomic radius hence loses electrons most easily

Scanned with CamScanner

Obanyo

23. Given the following substances: wood ash, lemon, juice and sodium chloride

a. Name one commercial indicator that can be used to show whether wood ash, lemon juice and sodium chloride and acidic, basic and neutral (1mark)

Universal indicator or Litmus paper

b. Classify the substances in 23(a) above as acid, base and neutral (2marks)

Acid	Base	Neutral
Lemon juice	wood ash	Sodium chloride

All correct 2 marks, 2 correct 1 mark

24. A compound whose general formula is $M(OH)_3$ reacts as shown by the equation.

$$M(OH)_{3(s)} + OH^-_{(aq)} \longrightarrow M(OH)^-_{4(aq)}$$

$$M(OH)_{3(s)} + 3H^+_{(aq)} \longrightarrow M^{3+}_{(aq)} + 3H_2O_{(l)}$$

a. What name is given to compounds which behave like $M(OH)_3$ in the two reactions.

Amphoteric (1mark)

b. Name two elements whose hydroxides behave like that of M. (2marks)

Aluminium, Lead and Zinc Accept formula

25. In an experiment on rates of reaction, Potassium Carbonate was reacted with dilute Sulphuric(VI) acid.

a) What would be the effect of an increase in the concentration of the acid on the rate of reaction? (1mark)

Rate increases

Scanned with CamScanner

Peter

b) Explain why the rate of reaction is found to increase with temperature (2marks)

Temperature increase increases Kinetic energy of reacting particles hence increasing the number of fruitful collision

26. a. State Boyles law. (1mark)

Volume of a fixed mass of a gas is inversely proportional to its pressure provided the temperature remains the same

b. A gas occupies 500cm3 at 27°C and 100,000Pa. What will be its volume at 0°C and 101325Pa? (2marks)

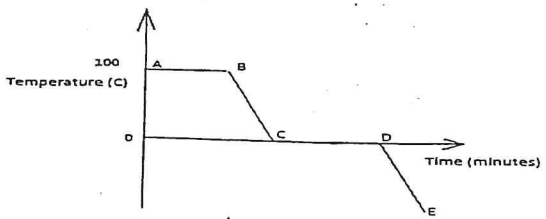
$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$V_2 = \frac{P_1V_1T_2}{P_2T_2}$

$\frac{100,000 \times 500 \times 273}{101325 \times 300}$

$= 449.05\ cm^3$

27. The graph below is a cooling curve for water. Study it and answer the questions that follow.



a. Explain what happens to the molecules of water in the region BC in terms of Kinetic theory. (2marks)

Molecules of water are losing heat (the Kinetic energy decreases) and molecules move closer to each other

b. In what state is the water in the region DE? (1mark)

Solid

Scanned with CamScanner