MARANDA HIGH SCHOOL

Kenya Certificate of Secondary Education
MOCK EXAMINATIONS 2021

233/1 CHEMISTRY Paper 1

DECEMBER 2021 – TIME: 2Hours

Name: ..... MARKING GUIDE ..... Adm No: .....

Class: .....Candidate's Signature: ..... Date: ...../12/2021

Instructions to candidates

(a) Write your name, admission number and sign in the spaces provided above.

(b) Sign and write the date of the examination in the spaces provided

(c) Answer **ALL** the questions in the spaces provided.

(d) All working **MUST** be clearly shown.

(e) KNEC mathematical tables and silent non programmable electronic calculators may be used.

(f) This paper consists of 14 printed pages

(g) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing

FOR EXAMINER'S USE ONLY.

Question	Maximum score	Candidate's score
1 – 27	80	

1. (a) Give two reasons why luminous flame is not used for heating purposes in the laboratory. (2marks)

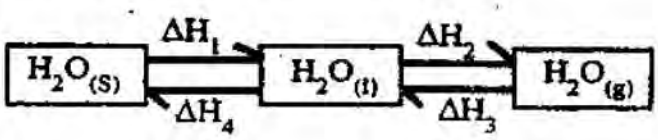
The soot it produces dirtifies the apparatus ✓1

The flame is not very hot ✓1

(b) Explain how the hotness of a Bunsen burner flame can be increased. (1mark)

Opening the air hole fully ✓1

2. The scheme below shows the energy changes that are involved between ice, water and steam. Study it and answer the questions that follow



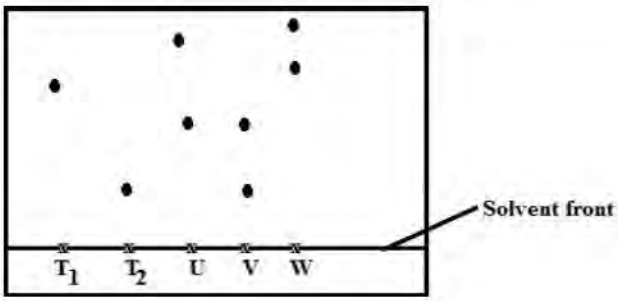
(a) What name is given to the process represented by energy change ΔH_4? (1 mark)

Latent heat of fussion ✓1

(b) What is the sign of ΔH_3? Give a reason (2 marks)

Negative (-). ✓1 The process loses heat ✓1

3. Samples of urine from three participants U, V and W at an international sport meeting were spotted onto chromatography paper alongside two from illegal drugs T1 and T2. A chromatogramwas run using methanol. The figure below shows the chromatogram.



(a) Identify the athlete who had used an illegal drug. (1mark)

V ✓1

(b) Which drug is more soluble in methanol? (1mark)

T1 ✓1

(c) Identify a mistake made on the chromatogram. (1mark)

Solvent front is labelled in place of baseline ✓1

4. The grid below is part of the periodic table. Study it and answer the questions that follow. Theletters are not actual symbols of elements.

A			D	E			H	I
B	C		M		F	G		J

a) What is the name given to the chemical family of element **C**? (1mark)

Alkaline earth metals ✓1

b) Would element **B** reacts with **J**? Explain. (1mark)

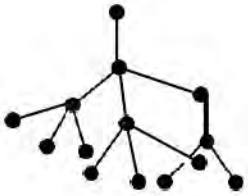
No. ✓½ J does not form compounds as it is chemically stable already ✓½

c) Compare the melting points of **B** and **M**. (1mark)

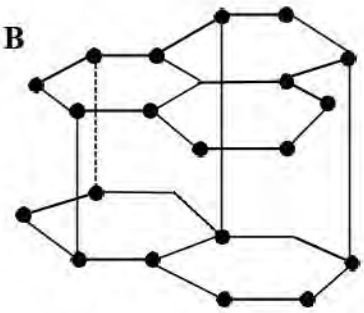
M has a higher melting point ✓½ than B as it has a stronger metallic bond ✓½ OR it has more delocalised electrons

5. The following diagrams show the structure of two allotropes of carbon. Study them and answerthe questions that follow.

A



B



(a) Name the allotropes. A and B (1 mark)

A: Diamond ✓½

B: Graphite ✓½

(b) Give **one** use of **A**. (½ mark)

Jewellery/Making drilling machines/bits ✓½

(c) Which allotrope conducts electricity? Explain. (1½ marks)

B ✓½ Existence of delocalised electrons which transfer electricity ✓1

6. (a) A few drops of freshly prepared Iron (II) Sulphate solution were added to Potassium nitrate solution in a test-tube. Concentrated sulphuric (VI) acid was then carefully added to the mixture. State the observations that were made. (1mark)

A brown ring/substance is formed between potassium nitrate and concentrated sulphuric(VI) acid ✓1

(b) Write an equation for the reaction that occurs when solid potassium nitrate is strongly heated. (1mark)

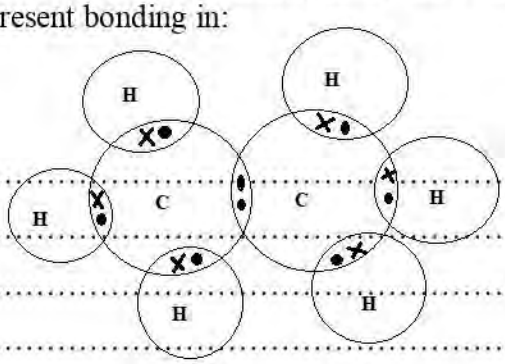
$2KNO_{3(s)} \longrightarrow 2KNO_{2(s)} + O_{2(g)}$ ✓1

(c) What is the role of the test shown in (a) above. (1mark)

Test for nitrates ✓1

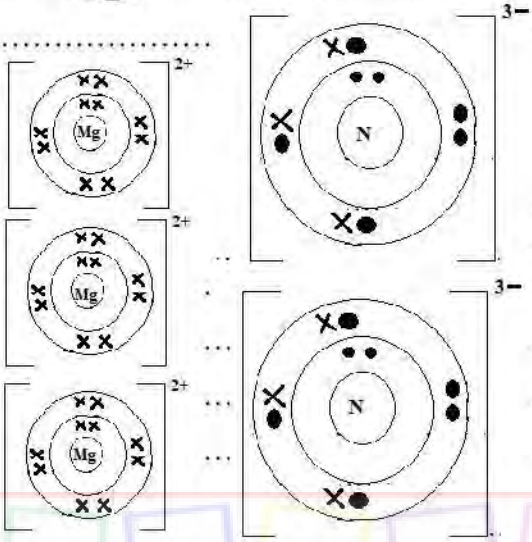
7. (a) Using electrons in the outermost energy level, draw the dot (•) and cross (X) diagrams torepresent bonding in:

(i) C_2H_6 (1mark)



✓1

(ii) Magnesium nitride (1mark)

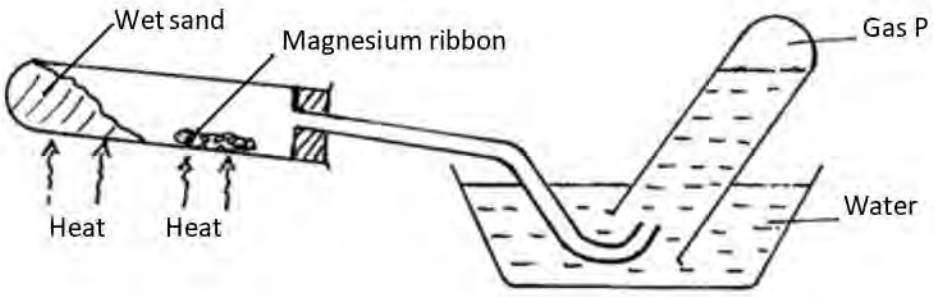


✓1

(b) The formula of a complex ion is $[Cu(NH_3)_4]^{2+}$. Name the type of bond that is likely to exist between copper and ammonia in the complex. (1 mark)

Dative covalent bond ✓1

8. The set-up below can be used to study the reaction of magnesium and steam



(a) Name gas **P**. (1 mark)

Hydrogen ✓1

(b) Explain the observation made when copper is used instead of magnesium in the set up above? (1 mark)

Copper would not react with steam ✓½ copper is below hydrogen in the reactivity series and hence cannot displace it in a reaction ✓½

(c) Write the equation for the reaction between magnesium and steam. (1mark)

$Mg_{(s)} + H_2O_{(g)} \rightarrow MgO_{(s)} + H_{2(g)}$ ✓1

9. 280cm³ of nitrogen gas diffuse through a porous plug in 70 seconds. How long will it take 400cm³ of carbon (IV) oxide gas to diffuse through the same porous plug? (C = 12, O = 16, N = 7).(3mks)

$R_{N_2} = \frac{280}{70} = 4cm^3/sec$ ✓½ $R_{CO_2} = \frac{400}{t}$ ✓½

Hence, $\frac{4}{\frac{400}{t}} = \sqrt{\frac{44}{28}}$ ✓1

$t = \sqrt{\frac{44}{28}} \times 100 = 125.36sec$ ✓1

10. State two factors that accelerate rusting. (2 marks)

Low pH/acidic conditions ✓1 (any two)

High temperature ✓1

Salty conditions

11. (a) Define the term ionization energy. (1mark)

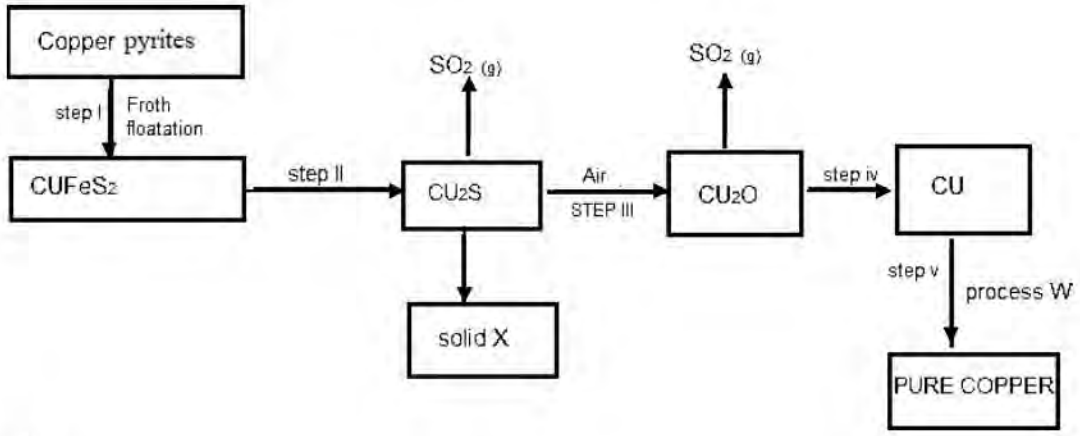
The minimum amount of energy needed to remove an electron from an atom in its gaseous state ✓1

(b) State and explain a factor that determine the value of ionization energy of a given element. (2marks)

Atomic radius/size of the atom ✓1

The distance between the outermost electron and the nucleus affects nuclear attration ✓1

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



a. Identify

i. Solid X (½ mark)

Iron (II) oxide/ FeO ✓½

ii. Process W (½ mark)

Electrolysis/Purification ✓½

b. Write an equation for the reaction in step II. (1mark)

$2CuFeS_{2(s)} + 4O_{2(g)} \longrightarrow Cu_2S_{(s)} + 2FeO_{(s)} + 3SO_{2(g)}$ ✓1

c. Explain why Copper is suitable in making soldering equipment. (1mark)

This is due to its high thermal conductivity ✓1

13. The table below shows the solubility of a salt at various temperatures.

Temperature ^0C	Solubility (g/100g water)
0	36
40	30
80	25
100	22
120	20

(a) Define the term Fractional Crystallization. (1 mark)

A process by which solutes are separated from each other according to their solubilities/separation of salts by making use of the differences in their solubility. ✓1

(b) Calculate the mass of salt formed when 20g of a saturated solution of the salt at 0^0C is place in a water bath maintained at 100^0C. (2 marks)

From the table, 100g of saturated solution will give =36g - 22g = 14g ✓1

Hence, If 100g of saturated solution = 14g of salt

Therefore 20g of saturated solution = $\frac{20 \times 14}{100}$ ✓½

= 2.8g of salt ✓½

14. The table below shows properties of some elements A,B,C and D which belong to the same period of the periodic table. The letters do not represent the actual symbols of the elements.

Element	A	B	C	D
M.P. °C	1410	98	-101	660
Atomic radii(nm)	0.117	0.186	0.099	0.143
Electrical conductivity	Poor	Good	Non Conductor	Good

(a) Arrange the elements in the order they would appear in the period. Give a reason. (2 marks)

B,D,A, C ✓1

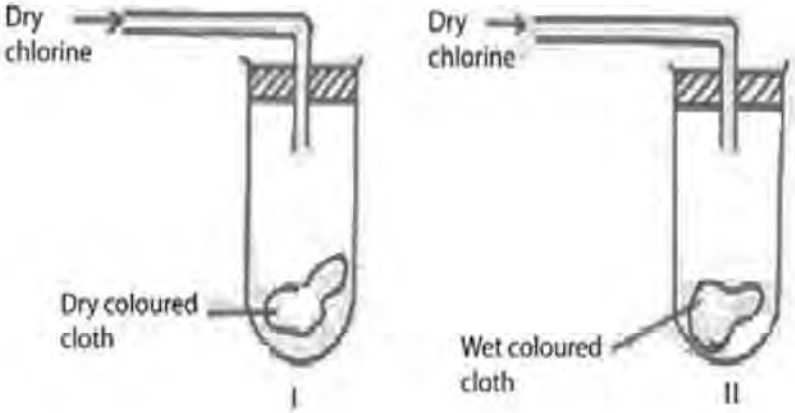
Because the atomic radius decreases across a period/decrease with increase in nuclear charge or number of proton. ✓1

(b) Select the metallic element which better conductor of electricity. Give a reason. (1 mark)

D ✓½

Because it has more delocalised electrons than B ✓½

15. Study the diagrams below.



(a) State the observations made at I and II. (1mark)

In I - There is NO bleaching ✓½

In II - There is bleaching ✓½

(b) Write the equations to show the reaction in II if dry sulphur (IV) oxide was used in place of dry chlorine. (2marks)

$SO_{2(g)} + H_2O_{(l)} \longrightarrow 2H^+_{(aq)} + SO^{2-}_{3(aq)}$ ✓1

$SO^{2-}_{3(aq)} + Dye \longrightarrow SO^{2-}_{4(aq)} + (Dye - [O])$ ✓1

16. A radioactive substance weighing **M** kg took 1900 years for the original mass to reduce to 15kg. Given that half-life of the radioactive substance is 380 years;

(a) Determine the original mass of the radioactive substance. (2 marks)

Number of half-life = $\frac{1900}{380}$ = 5 ✓½

480kg ← 240kg ← 120kg ← 15kg ✓½

Hence M = 480kg ✓1

(b) State two uses of radioactivity in medicine. (1 mark)

Used to destroy cancerous cells ✓½

Used to sterilise surgical instruments ✓½

17. 20cm³ of a dibasic acid required 25cm³ of 0.1M NaOH for complete neutralization.

(a) How many moles of sodium hydroxide reacted with the dibasic acid? (1mark)

Moles of NaOH = $\frac{25}{1000}$ ✓½

= 0.0025 moles ✓½

(b) Calculate the concentration of the dibasic acid in moles per litre. (2mks)

$H_2X_{(aq)} + 2NaOH_{(aq)} \longrightarrow Na_2X_{(aq)} + 2H_2O_{(l)}$

Mole ratio Acid:NaOH = 1:2 ✓½ (either from equation or just stated)

Moles of H_2X = $\frac{1}{2}$ x 0.0025 = 0.00125 ✓½

Concentration in moles per litre = $\frac{0.00125 \times 1000}{20}$ ✓½

= 0.0625 moles per litre ✓½

18. The table below shows the standard reduction potentials for four half–cells. Study it and answer the questions that follow (letter are not the actual symbols for the elements)

			E^{θ} (Volts)
$F_{2(aq)}$ +	2 e	$\longrightarrow 2F^{-}_{(aq)}$	+0.54
$G^{2+}_{(aq)}$ +	2e	$\longrightarrow G_{(s)}$	-0.44
$H^{2+}_{(aq)}$ +	2e	$\longrightarrow H_{(s)}$	+0.34
$2J^{+}_{(aq)}$ +	2e	$\longrightarrow J_{2(g)}$	0.00

i. Identify the strongest reducing agent. Explain (1mark)

$G_{(s)}$ ✓½ This is because it has the highest negative electrode potential ✓½

ii. Write the equation for the reaction which takes place when solid G is added to a solution containing H^{2+} ions. (1 mark)

$G_{(s)} + H^{2+}_{(aq)} \longrightarrow G^{2+}_{(aq)} + H_{(s)}$ ✓1

iii. Calculate the E^{0} value for the reaction in (ii) above. (1mark)

+0.34 + 0.44 = +0.78V ✓1

19. Starting with solid lead (II) carbonate, briefly describe how a sample of lead (II) chloride can be prepared. (3marks)

To excess lead (II) carbonate, add nitric (V) acid ✓1

Filter to obtain lead (II) nitrate filtrate ✓½

Add dilute hydrochloric acid/any soluble chloride to the filtrate ✓1

Filter to obtain lead (II) chloride residue ✓½

20. Chlorine and iodine are elements in the same group in the periodic table.

(a) What observation would be made if chlorine gas is bubbled through aqueous sodium iodine? Explain using an ionic equation. (2 marks)

Colourless solution would turn brown ✓½

This is because chlorine displaces iodine from iodine solution. ✓½

$Cl_{2(g)} + 2I^{-}_{(aq)} \longrightarrow 2Cl^{-}_{(aq)} + I_{2(aq)}$ ✓1

(b) Using the equation in (a) above, identify and explain the reducing agent. (1 mark)

$I^-_{(aq)}$ ✓½

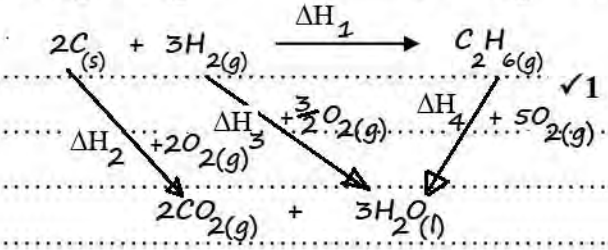
The oxidation number of iodine increases from in -1 in $I^-_{(aq)}$ to 0 in I_2 ✓½

21. Using energy cycle diagram, calculate the enthalpy of formation of ethane from the information given below.

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ $\quad \Delta H_C = -394 Kjmol^{-1}$

$H_{2(g)} + O_{2(g)} \longrightarrow H_2O_{(l)}$ $\quad \Delta H_C = -286 Kjmol^{-1}$

$C_2H_{6(g)} + 5O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(l)}$ $\quad \Delta H_c = -1300 Kjmol^{-1}$ (3 marks)



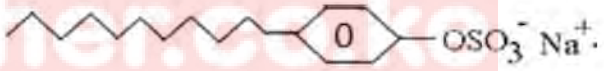
$\Delta H_1 = \Delta H_2 + \Delta H_3 - \Delta H_4$ ✓1

$= (2 \times -394) + (3 \times -286) - (-1300)$

$= -788 - 858 + 1300$

$= -346\ kJmol^{-1}$ ✓1

22. (a). Identify the following cleansing agents. (2 mark)

i $CH_3(CH_2)CH_2\text{-}\underset{\underset{O}{\|}}{C}\text{-}O\text{-}Na^+$ ii 

Soapy detergent ✓1 Soapless detergent ✓1

(b). State one disadvantage of using the cleansing agent in (a) (ii) above. (1mark)

Non biodegradable hence pollutes the environment ✓1 (any one)

It is expensive

23. The empirical formula of a hydrocarbon is C_2H_3. The hydrocarbon has a relative molecular mass of 54. (H=1.0, C=12.0).

(a) Determine the molecular formula of the hydrocarbon. (1mark)

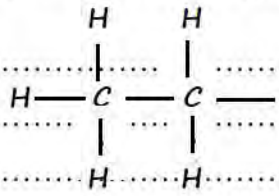
$(C_2H_3)_n = 54$

$27n = 54$

$n = 2$ ✓½

Molecular formula is C_4H_6 ✓½

(b) Draw the structural formula of the hydrocarbon. (1mark)



✓1

(c) To which homologous series does the hydrocarbon drawn in (b) above belong? (1mark)

Alkyne ✓1

24. (a) State the Boyle's law. (1mark)

The volume of a fixed mass of a gas is inversely proportional to its pressure at constant temperature ✓1

(b) A gas occupies 300cm^3 at 23°C and 100,000 Pa. What will be its volume at 0^{0}C and 101325Pa? (2marks)

$V1 = 300cm^3$ $V2 = x$

$T1 = 23 + 273 = 296K$ $T2 = 0 + 273 = 273K$

$P1 = 100,000Pa$ $P2 = 101,325Pa$

$$V2 = \frac{100,000 \times 300 \times 273}{296 \times 101,325}$$ ✓1

$= 273.07cm^3$ ✓1

25. In the laboratory, hydrogen sulphide gas is prepared by action of dilute hydrochloric acid on metal sulphides.

(a) Name the metal sulphide that can be used in preparing the gas. (1mark)

Iron (II) sulphide ✓1 (accept metal chloride that do not form insoluble chlorides)

(b) Write down the equation for the reaction in (a) above. (1mark)

$FeS_{(s)} + 2HCl_{(aq)} \rightarrow FeCl_{2(aq)} + H_2S_{(g)}$ ✓1

(c) Give one chemical test for hydrogen sulphide gas. (1mark)

Use lead acetate paper or lead (II) ethanoate paper or soak a paper in lead (II) nitrate solution. The paper turns from white to black ✓1

26. Some crystals of sugar cane were placed in a test-tube and a few drops of concentrated sulphuric (VI) acid added to it.

(i) State what was observed. (1mark)

The white crystals of sugar cane changes into a black mass ✓1

(ii) What name is given to the property of concentrated sulphuric (VI) acid in (i) above? (1mark)

Dehydration property ✓1

(iii) Write an equation for the reaction between glucose, $C_6H_{12}O_6$ and $H_2SO_{4\,(l)}$. (1mark)

$C_6H_{12}O_6(g) + H_2SO_4(l) \rightarrow 6C(s) + 6H_2O(l)$ ✓1

27. The following equation shows a reversible reaction.

$$H_{2(g)} + Br_{2(g)} \rightleftharpoons 2HBr_{(g)} \qquad \Delta H = -74.4kJ$$

brown *colourless*

(a). **State** and explain the observation that can be made when:-

(i). Temperature is increased. (1½marks)

Intensity of the brown colour will increased. ✓½ More reactants will be formed as the forward reaction is exothermic ✓1

(ii).Pressure is reduced (1½marks)

No effect. ✓½ The volume of the reactants and products are equal ✓1

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