

SUKELLEMO JOINT EXAMINATION

CHEMISTRY PAPER 1

JUNE 2022- 2 HOURS

Marking Scheme

Name----- School-----

Class-----Index number-----

Instructions to candidates

- Answer all the questions in the spaces provided on the question paper.
- Non programmable silent electronic calculators and KNEC mathematical tables may be used.
- All working must be clearly shown where necessary.

For examiners use only

Question	Maximum Score	Candidate's score
1-31	80	

1. The element **Y** is represented by $^{27}_{13}\text{Y}$.

a) What does letter **Y** represent? (1 mark)

Chemical Symbol of the element

b) What name and symbol is given to the superscript and what does it represent? (1 mark)

Mass number, A ½ mk

Represents sum of protons and neutrons ½ mk

2. Element **W** (not the actual symbol) belongs to period 3 and group VI of the periodic table. Write the formula of its most stable ion. (1 mark)



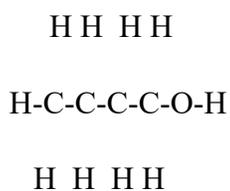
3. An alkanol has the following composition by mass: Hydrogen 13.5%, Oxygen 21.6% and Carbon 64.9%)

a. Determine the empirical formula of the alkanol. (C=12, H=1, O=16) (2 marks)

	<i>C</i>	<i>H</i>	<i>O</i>
<i>%</i>	<i>64.9.</i>	<i>13.5.</i>	<i>21.6</i>
<i>moles</i>	<i>64.9/12</i>	<i>13.5/1</i>	<i>21.6/16</i>
	<i>5.40833.</i>	<i>13.5</i>	<i>1.35</i>
	<i>5.40833/1.35.</i>	<i>13.5/1.35.</i>	<i>1.35/1.35</i>
<i>ratio</i>	<i>4.</i>	<i>10.</i>	<i>1</i>



- b. Given that the empirical formula and the molecular formula of the alkanol are the same, draw the structure of the alkanol. (1 mark)



4. With the help of an equation, show how chlorine water bleaches (1 mark)



5. The table below gives the ionization energies of group I elements.

Element	I	II	III	IV
Ionization energy (kJ/mole)	94	418	519	576

- Arrange the elements in order of reactivity starting with the most reactive (1 mark)

I II III IV

6. Oxygen and Sulphur belong to group VI of the periodic table. Explain why there is a big difference in their melting points (melting point of Oxygen is -216°C while that of Sulphur is 114°C) (2 marks)

Oxygen is a diatomic molecule while Sulphur exists as S_8 rings. 1mk

S_8 rings has a higher molecular mass $\frac{1}{2}$ mk, hence stronger Van Der Waals forces $\frac{1}{2}$ mk compared to oxygen molecule.

7. Heated iron can react with both Chlorine gas and hydrogen chloride gas. Write an equation for each reaction (2 marks)

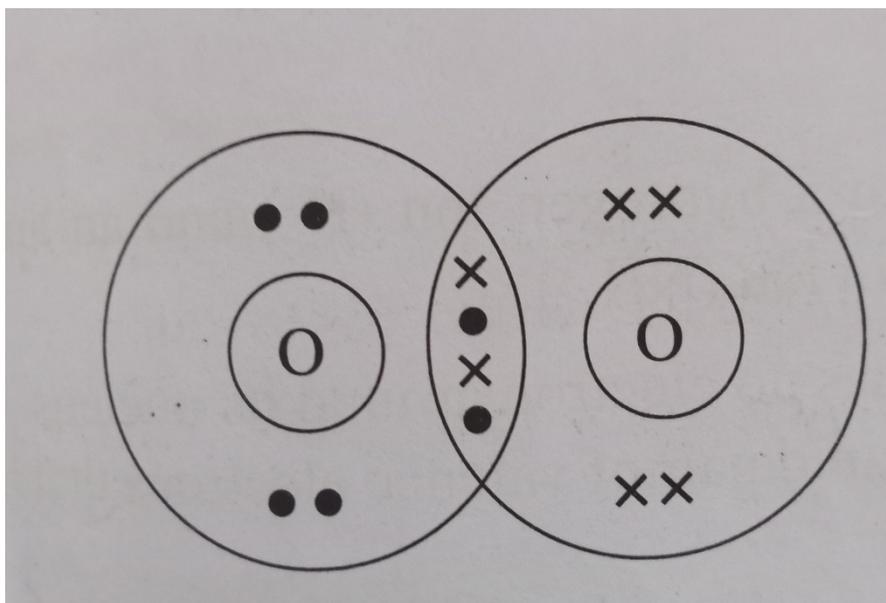


8. Distinguish between a covalent bond and a co-ordinate bond (2 marks)

Covalent bond – the sharing of a pair of electrons where each atom forming the bond contributes one electron. 1mk

Coordinate bond- the sharing of a pair of electrons which are contributed by only one of the atoms forming the bond. 1mk

9. Draw a dot (.) and cross (X) diagram of an Oxygen molecule (O₂) given that oxygen has an atomic number of 8. (2 marks)



10. a) Differentiate between a strong acid and a concentrated acid (2 marks)

A strong acid ionizes completely

A concentrated acid contains many moles of acid per litre of solution

- b). Identify the acid in the forward reaction given by the equation below. Explain (2 marks)



Acid ***H₂O***

Reason *It has donated a proton*

11. Describe how a sample of Lead (II) chloride can be prepared in the laboratory starting with Lead metal. (3 marks)

Add excess lead to dilute nitric V acid to form lead II nitrate. 1 mk

Filter off the excess lead ½ mk

Add sodium chloride solution to the lead II nitrate solution ½ mk

Filter the mixture, lead II chloride is obtained as the residue. ½ mk

Wash the residue with distilled water and dry between filter papers. ½ mk

12. The table below gives information on four elements represented by the letters K, L, M and N. Study it and answer the questions that follow. The letters do not represent the actual symbol of the elements.

Element	Electron Arrangement	Atomic Radius (nm)	Ionic Radius
K	2.8.2	0.136	0.065
L	2.8.7	0.099	0.181
M	2.8.8.1	0.203	0.133
N	2.8.8.2	0.174	0.099

- a) Which two elements have similar chemical properties? Explain (2 marks)

K and N

They have equal number of electrons in the outermost energy level

- b) What is the most likely formula of the oxide of L? (1 mark)

L₂O , L₂O₇

- c) Which element is a non-metal? (1 mark)

L

13. a) Define a binary electrolyte. (1 mark)

An electrolyte that contains two ions, one cation and one anion 1mk

- a) Solid Lead (II) Iodide does not conduct electricity, but fused Lead (II) Iodide does. Explain. (2 marks)

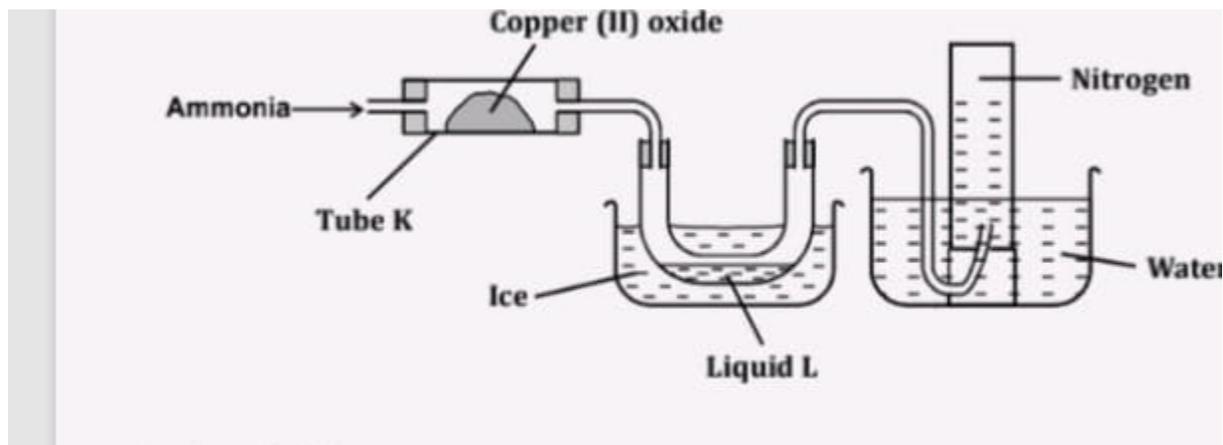
In solid state the ions are in fixed positions hence cannot conduct electricity 1mk

In molten state the ions are mobile therefore will conduct electricity 1mk

14. Write a half equation for what is formed at the cathode in the reaction above. (1 mark)



15. The diagram below shows a setup that can be used to obtain nitrogen gas in an experiment.



a) Name liquid L (1 mark)

Water

b) What observation would be made in tube K after heating for some time?
(1 mark)

Black solid changed to brown

c) Write an equation for the reaction that took place in tube K
(1 mark)



16. 60cm^3 of Oxygen gas diffused through a porous partition in 50 seconds. How long would it take 60cm^3 of Sulphur (IV) Oxide gas to diffuse through the same partition under the same conditions?

(S=32, O=16)

(2 marks)

$$\text{Rate of } O_2 = 60/50 = 1.2\text{cm}^3/\text{second}$$

$$\text{Rate of } SO_2 = 60/t$$

$$1.2/\text{rate of } SO_2 = (64/32)^{1/2} = 1.41421$$

$$\text{Rate of } SO_2 = 1.2/1.41421 = 0.84853$$

$$60/t = 0.84853$$

$$t = 70.71\text{seconds}$$

17. 30cm^3 of 0.06M Sodium Hydroxide reacted with 25cm^3 of a dibasic acid

$\text{HOOC}(\text{CH}_2)_x\text{COOH}$ containing 4g/litre. Calculate the value of X .

(C=12, H=1 O=16, Na=23).

(3 marks)

Moles of NaOH

$$30/1000 * 0.06 = 0.0018$$

$$\text{Moles of acid} = 0.0018 / 2 = 0.0009$$

$$\text{Molarity of acid} = 1000 * 0.0009/25 = 0.036M$$

$$\text{RFM of acid} = 4/0.036 = 111.11$$

$$\text{HOOC(CH}_2\text{)}_x\text{COOH} = 111.11$$

$$90 + (\text{CH}_2)_x = 111.11$$

$$14x = 111.11 - 90$$

$$14x = 21.11$$

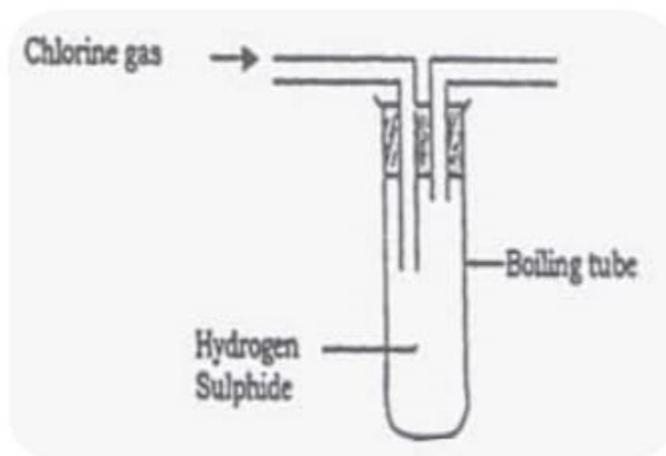
$$X = 21.11/14$$

$$= 1.5079$$

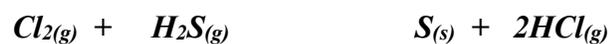
18. Water from a town in Kenya is suspected to contain sulphate. Describe how the presence of sulphate ions in the water can be tested. (2 marks)

Transfer 2cm³ of the water to a test tube then add two drops of acidified barium chloride solution 1mk. A white precipitate is formed 1mk

19. The figure below was set up by a student to investigate the reaction between chlorine gas and hydrogen sulphide gas.



- a) Write an equation for the reaction that took place in the flask. (1 mark)



- b) What observation was made in the flask? (1 mark)

A yellow solid is formed

- c) What precaution should be taken when carrying out the experiment? (1 mark)

The experiment should be carried out in a fume cupboard ½ mk both chlorine and hydrogen sulphide are poisonous gases ½ mk

20. Describe how Sulphur is extracted by the frasc process (2 marks)

Has three concentric pipes ½ mk

Superheated water at 170°C and 10atm is pumped through the outermost pipe ½ mk

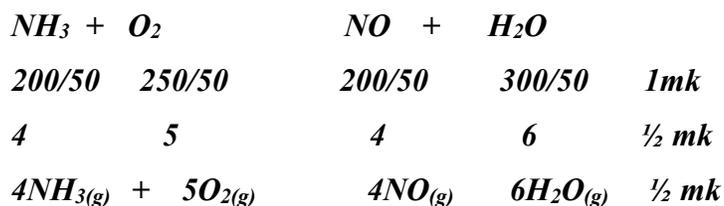
Hot compressed air at 15atm is passed through the innermost pipe ½ mk

Molten Sulphur passes through the middle pipe to the surface ½ mk

21. a) State Gay Lussac's law (1 mark)

When gases react, they do so in volumes that bear a simple ratio to one another and to the volume of the products if gaseous, temperature and pressure remaining constant.

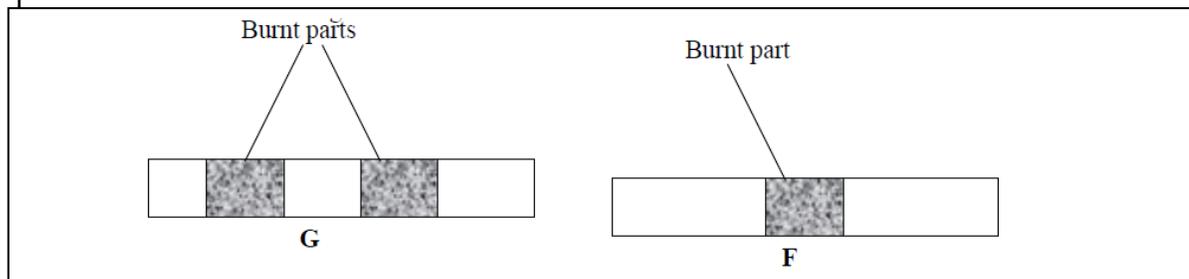
b) 200cm³ of Ammonia reacted with 300cm³ of Oxygen gas to form 200cm³ of Nitrogen (II) Oxide and 300cm³ of steam. 50cm³ of Oxygen remained unreacted. Determine the equation for the reaction. (2 marks)



22. Wooden splints F and G were placed in different zones of a Bunsen burner flame. The

d

i



below gives the observations that were made.

i) Explain the difference between F and G. (2 marks)

G. Not burnt uniformly. Burnt part was in contact with the blue part of the flame, the unburnt part was in contact with the almost colourless region

F. Burnt uniformly. Was placed at the top part (blue) region of the flame

ii) Name the type of flame that was used in the above experiment. (1 mark)

Non luminous flame

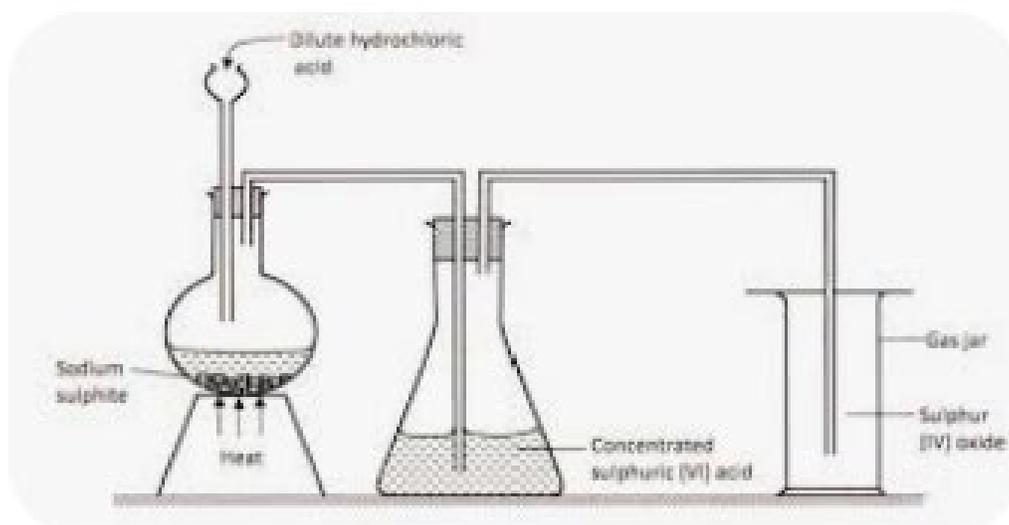
23. 1g of potassium carbonate was placed in two different tubes. 2M sulphuric (VI) acid was added into one test of the tubes and in the other test tube 2M ethanoic acid was added. Explain the observations that were made. (3 marks).

More bubbles/effervescence observed in the test tube with 2M Sulphuric VI compared to that containing 2M ethanoic acid. 1mk

Sulphuric VI acid is a strong acid, it ionizes completely, producing many hydrogen ions which react with potassium carbonate liberating a lot of carbon IV oxide. 1mk

Ethanoic acid is a weak acid is a weak acid, it ionizes partially giving few hydrogen ions which react with potassium carbonate producing little carbon IV oxide 1mk

24. Draw a set up of apparatus to show how dry sulphur (IV) oxide can be prepared in the laboratory starting with dilute hydrochloric acid. (3 marks)



Heat ½ mk

Sodium sulphite ½ mk

Drying ½ mk

Collection ½ mk

Workability 1mk

25. Give the formula of the polymer formed from the following monomers.

i) $\text{H}_2\text{N} - \text{R} - \text{NH}_2$ and $\text{HOOC} - \text{R} - \text{COOH}$ (1 mark)

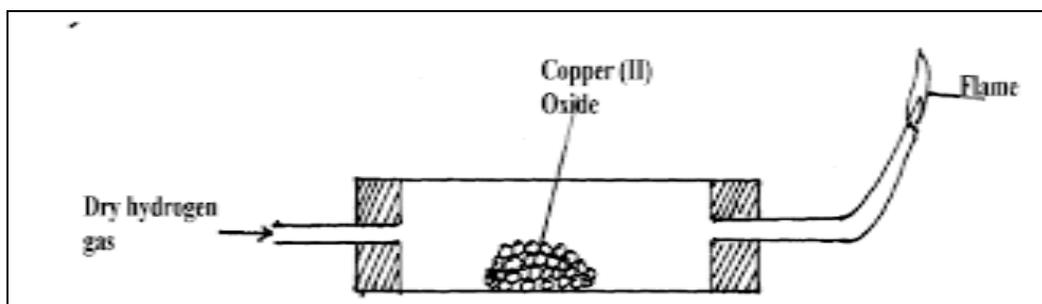


ii) Name the type of polymerization shown in (i) above (1 mark)

Condensation polymerisation

iii) What substance is lost during the polymerization named above? (1 mark)

Water



26. Study the diagram below and answer the questions that follow.

- i) Why is it necessary to pass hydrogen through the tube before lighting the hydrogen gas?(1 mark)

To drive out air from the apparatus because a mixture of hydrogen and oxygen is explosive when ignited

- ii) After reduction is complete, the apparatus is allowed to cool while hydrogen is still passed over the reduced oxide. Explain (1 mark)

To prevent re oxidation of the hot copper metal

- iii) Name another gas that can be used to reduce the metal oxide other than hydrogen. (1 mark)

Carbon II oxide

Ammonia

Any one

27. The table below shows solubility of two salts A and B at different temperatures.

Temp (⁰ C)	Salt	0	10	20	30	40	50
Solubility (g/100g H ₂ O)	A	3.0	5.0	7.4	10.0	14.0	19.0
	B	15.0	17.0	20.7	28.7	29.9	33.3

- i) If both A and B were present in 100 cm³ of a saturated solution at 50⁰ C. What would be the total mass of crystals formed if the solution is cooled to 20⁰ C. (2 marks)

$$A \quad 19.0 - 7.4 = 10.6g \quad \frac{1}{2} \text{ mk}$$

$$B \quad 33.3 - 20.7 = 12.6g \quad \frac{1}{2} \text{ mk}$$

$$\text{Total mass} = 23.2g \quad 1\text{mk}$$

- ii) Solubility of gases decreases as the temperature increases. Explain. (1 mark)

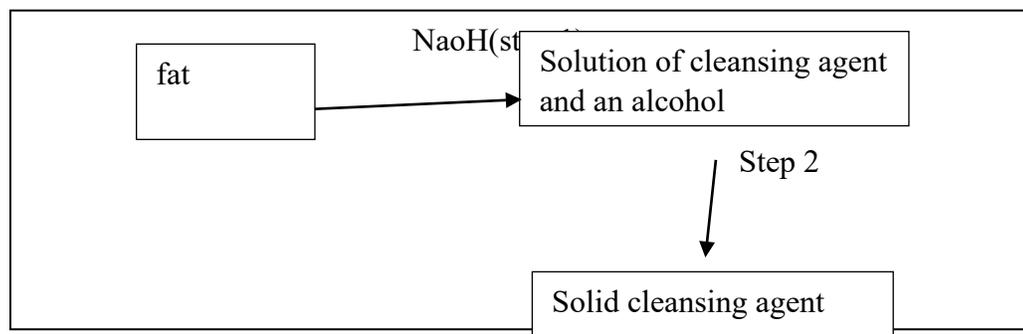
As the temperature rises, the kinetic energy of the gaseous solute increases, its molecules break from the attraction of solvent molecules and return to the gas phase

- iii) A certain salt C dissolves with absorption of heat from the surroundings. How would its solubility change with an increase in temperature? Explain.(2 marks)

The solubility will increase.

Increase in temperature provides heat required to break the lattice hence dissolves faster

28. The scheme below was used to prepare a cleansing agent. Study it and answer the questions that follow:



- i) Name the category of cleansing agent prepared by the method above.(1 mark)

Soapy detergent

- ii) Name one chemical substance added in step 2.(1 mark)

Sodium chloride

- iii) What is the purpose of adding the chemical substance named in ii) above (1 mark)

Precipitates the soap

- iv) Name another suitable substance to be used in step 1. (1 mark)

Potassium hydroxide

29. Melting and boiling points of Hexanoic acid is higher than hexan-1-ol. Explain. (1 mark)

Hexanoic acid forms more hydrogen bonds than hexan -1-ol therefore higher higher melting and boiling point.

30. Classify the following processes as chemical changes or physical changes.

i) Neutralization

Chemical

ii) Sublimation

Physical

iii) Fractional distillation

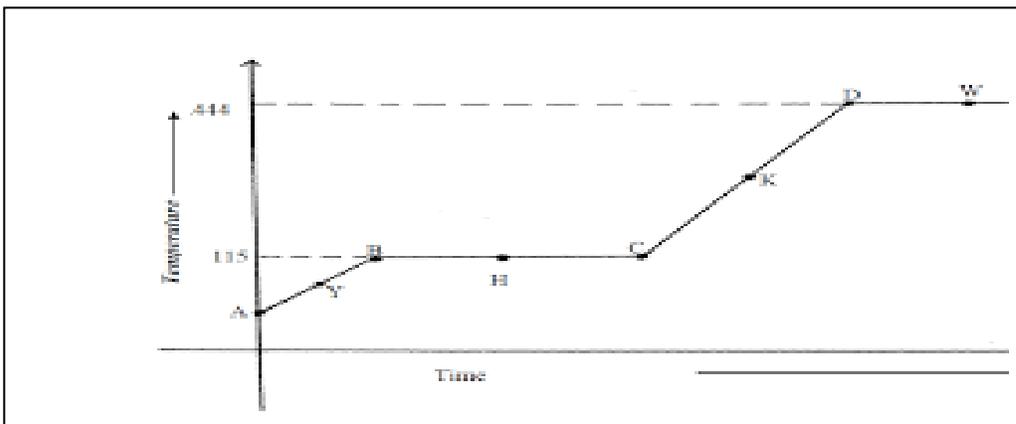
Physical

iv) Displacement

Chemical

(2 marks)

31. Study the heating curve below and answer the questions that follow:



i) What physical changes occur at H and W? (1 mark)

H. Melting

W. Evaporation

- ii) Explain what happens to the melting point if sodium chloride is added to this substance. (1 mark)

The melting point will be lowered $\frac{1}{2}$ mk and will melt over a range of temperatures $\frac{1}{2}$ mk

- iii) Give the names of the intermolecular forces of attraction in the segments: (1 mark)

a) AB *hydrogen bonds*

b) CD. *Hydrogen bonds*