TERM 2 - 2023

CHEMISTRY (233)

FORM TWO (2)

Time - 2 Hours

MARKING SCHEME

1. (a) The table below shows some of the properties of period III elements.

Element	Q	R	V	X	Y	Z
Atomic Radii(nm)	0.136	0.099	0.125	0.117	0.110	0.157
Formulae of oxide	QO	R_2O	V_2O_3	XO_2	Y_2O_5	Z_2O
Melting point(°C)	650	110	660	119	44.2	97.8
Conductivity	Good	Poor	Good	Poor	Poor	Good

(i) From the table which elements could be:

I. Magnesium ***Q*** (1mark)

II. Sulphur ***X*** (1mark)

(ii) Write the formula of the chloride of X. ***XCl_4*** (1mark)

(iii) Arrange the elements as they appear from left to right in the periodic table (2marks)

Z, Q, V, X, Y, R

(iv) What type of bonding would you expect the chloride of Y to exhibit? (1mark)

Covalent bonding

(v) Write a chemical equation for the reaction of oxide of Y with water. (1mark)

$Y_20_{5(s)} + 3H_2O_{(l)} \rightarrow 2H_3YO_{4(aq)}$ / $P_20_{5(s)} + 3H_2O_{(l)} \rightarrow 2H_3PO_{4(aq)}$

(b) Use the information in the table below to answer the questions that follow.

	Ionization Energy in kJ			
Element	1st	2nd	3rd	4th
V	320	580	4900	7200
W	430	4300	6200	8300
X	600	1050	1450	16000
Y	7000	9000	10500	14000
Z	200	420	5200	6600

(i) Name two elements that can be found in the same group? (1mark)

V and Z

(ii) To which group does element W belong? Explain. (2marks)
Group III. The ionization energy for the third electron is very high meaning it is being removed from a stable ion

(iii) Element Y is found to be in Group IV. Write the formula when it reacts with reacts oxygen gas. (1mark)
YO_2

(iv) Which of the elements named in 'i' above is more reactive? Explain.(2marks)
Z, it has a lower first ionization energy, hence more electropositive.

2. (a) Hydrogen can be prepared by reacting zinc with dilute hydrochloric acid.

(i) Write an equation for the reaction (1mark)
$Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + H_{2(g)}$

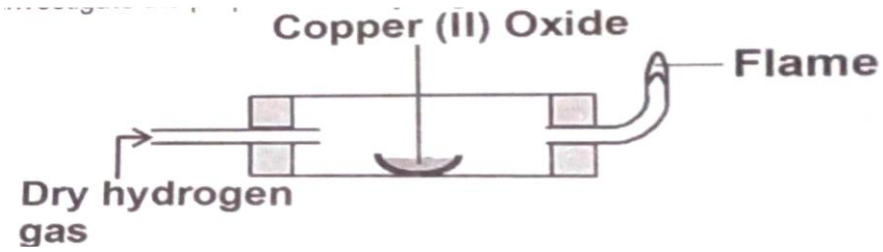
(ii) Name an appropriate drying agent for hydrogen gas. (1mark)
Concentrated Sulphuric (IV) acid
Anhydrous Calcium Chloride

(iii) Explain why copper metal cannot be used to prepare hydrogen gas. (1mark)
Copper is below hydrogen in the reactivity series, hence cannot displace hydrogen from dilute acids

(iv) Hydrogen burns in oxygen gas to form an oxide. Write an equation for the reaction. (1mark)
$H_{2(g)} + O_{2(g)} \rightarrow H_2O_{(l)}$

(v) When zinc is heated to redness in a current of steam, hydrogen gas is obtained. Write an equation for the reaction. (1mark)
$Zn_{(s)} + H_2O_{(g)} \rightarrow ZnO_{(s)} + H_{2(g)}$

(b). The set up below is used to investigate the properties of hydrogen.



(i) On the diagram, indicate what should be done for the reaction to occur.(1mark)

(ii) Hydrogen gas is allowed to pass through the tube for some time before it is lit. Explain. (1mark)
To drive out air that was initially in the combustion tube

(iii) Write a chemical equation for the reaction that occurs in the combustion tube. (1mark)

$CuO_{(s)} + H_{2(g)} \rightarrow Cu_{(s)} + H_2O_{(l)}$

(iv) When the reaction is complete, hydrogen gas is passed through the apparatus until they cool down. Explain. (1mark)

To prevent re oxidation of the reduced copper metal

(v) What property of hydrogen is being investigated? (1mark)

Reducing property

(vi) Describe how copper could be obtained from the mixture containing copper and copper (II) oxide. (2 marks)

Add dilute sulphuric (VI) acid to the mixture.
Filter to obtain copper as the residue.

(vii) Why is zinc oxide not used to investigate this property of hydrogen gas? (1mark)

Zinc is more reactive than hydrogen; hence hydrogen cannot remove combined oxygen from zinc oxide.

3. The table below shows some of the elements of the periodic table and their atomic numbers, atomic masses and melting point. The letters are not the actual symbols of the elements

Element	B	C	D	E	F	G	H	I	J	K
Atomic Number	7	8	19	15	2	9	6	16	12	11
Mass number	14	16	39	31	4	19	12	32	40	23
Melting point(°C)	-209	-218	63	44	-272	223	VARRY	113	669	98

(a) Select two elements with oxidation state of -3. (2 marks)

B and E

(b) Which elements represent the most powerful reducing agent? (1 mark)

D

(c) How does the atomic radii of D compare with that of K. Explain. (2 marks)

D has a larger atomic radius than K. D has more occupied number of energy levels than K.

(d) How do you compare the electrical conductivity of element J and K. Give your reason? (2 marks)

J is a better electrical conductor than K. J has more delocalized electrons than K

(e) Select two elements which when reacted with element G forms a compound that conducts electricity both in molten and aqueous state. (2 marks)
D and K

(f) Select two elements that have a common valency. State the elements. (2 marks)
C and I (oxygen and Sulphur)
D and K (potassium and sodium)

(g) In which group and period does element D belong? (1 mark)
Group ***Group I***

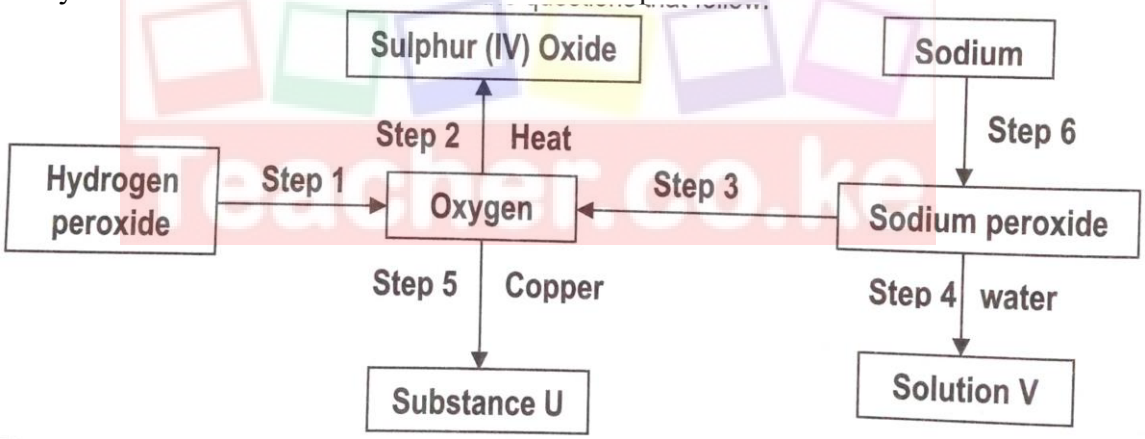
Period. ***Period 4***

(h) Select one element stored in (2 marks)

i) Water ***E***

ii) Paraffin ***K / D***

4. Study the reaction scheme below and answer the questions that follow.



(a) Identify substance U and solution V (2marks)
U – ***copper (II) oxide***

V – ***sodium hydroxide***

(b) Name the reagents necessary for the reactions in the following steps. (2marks)
Step 1
Manganese (IV)oxide

Step 2
Sulphur
Step 3
Water
Step 6

Excess oxygen gas

(c) Give condition necessary for the reaction in step 5 to take place. (1mark)
Heat

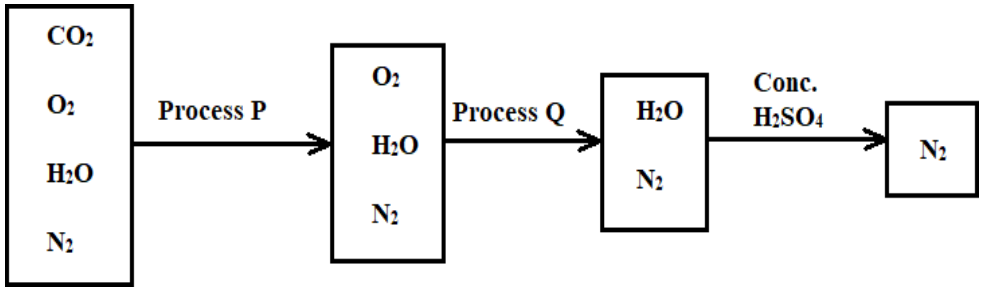
(d) Write balanced chemical equations for the reactions in the following steps.
Step 1 (1mark)
$H_2O_{2(l)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$
Step 2 (1mark)
$S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$
Step 5 (1mark)
$2Cu_{(s)} + O_{2(g)} \rightarrow 2Cu_{(s)}$

(e) State and explain the observation made in step 5. (1mark)
Brown copper turns to black. Copper combines with oxygen to form copper(II)oxide which is a black substance

5. A form two student was asked to prepare a sample of copper (II) sulphate crystals using the procedure below.
   → Measure 100cm^3 of 2M sulphuric (VI) acid then warm. Add excess copper (II) oxide powder.
   → Filter the resulting mixture. Heat the filtrate and leave it overnight.
   (a) Why was the acid heated before the start of the reaction? (1mark)
   To speed up the rate of the reaction
   (b) Why was excess copper (II) oxide used? (1mark)
   To ensure that all the acid has reacted
   (c) What was observed when copper (II) oxide was added to the warm acid? (2marks)
   Black copper (II) oxide dissolved
   Blue solution is formed
   (d) Write an equation for the reaction that took place in (c) above. (1mark)
   $CuO_{(s)} + H_2SO_4 \rightarrow CuSO_{4(aq)} + H_2O_{(l)}$
   (e) Give reasons for carrying out the following processes:
      i. Filtration of the mixture. (1mark)
      To remove/eliminate unreacted/excess copper(II)oxide
      ii. Heating the filtrate and leaving it overnight (2marks)
      To cool; and form crystals
   (f) Explain how dry crystals of copper (II) sulphate are finally obtained. (1mark)
   Wet crystals are dried between filter papers

   (g) Explain why it would not be possible to prepare copper (II) sulphate salt by reaction of dilute sulphuric acid with copper metal. (2marks)
   Copper is below hydrogen in the reactivity series. Copper can therefore not displace hydrogen from the acids.

6. The flow diagram below shows the process of obtaining nitrogen from a sample of air. Use it toanswer the questions that follow



(a) What is the purpose of processes **P** and **Q**?

P ***To remove carbon (IV) oxide*** (1mark)

Q ***To remove oxygen*** (1mark)

(b) Identify the reagents used in the processes **P** and **Q**

P ***Concentrated sodium hydroxide solution*** (1mark)

Q ***Heated copper turnings*** (1mark)

(c) Write equations for the reactions taking place during processes **P** and **Q** (2marks)

P: - $2NaOH_{(aq)} + CO_{2(g)} \rightarrow Na_2CO_{3(aq)} + H_2O_{(l)}$

Q:- $Cu_{(s)} + O_{2(g)} \rightarrow CuO_{(s)}$

(d) Comment on the purity of the nitrogen gas collected (1mark)

It's impure, since it is mixed with the noble gases.

(e) A student categorized air as a compound and not as a mixture. Give **two** reasons as to why the student was wrong (2marks)

The components of a mixture can be physically separated while that of a compound cannot be physically separated.

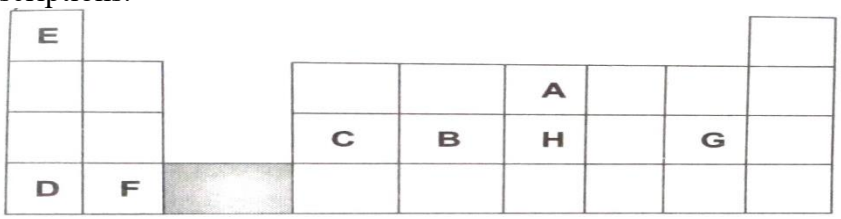
The properties of a mixture are the average of those of the components, while that of a compound is totally different

7. Study the information given in the table below and use it to answer the questions that follow.

Element	Description
A	An element with 7 protons
B	It belongs to period three and has 4 electrons in the outermost energy level
C	An element with oxidation number +3 and with 13 protons
D	An element that forms its ions by loss of one electron and belongs to period 4

E	An element that can be placed in group I or group VII
F	An element with the highest number of energy levels and belongs to group II.
G	An element with electronic configuration of 2.8.7
H	An element with a valiancy of 3. It gains electrons to form ions and belongs to period 3

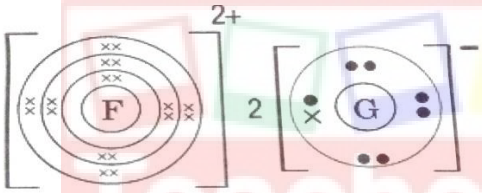
(a) Put the above letters A to H in the correct places in the periodic table below to fit the descriptions. (4marks)



(b) State the name given to the elements placed in the shaded region. (1mark)

Transition metals

(c) Draw a dot (.) and cross (x) diagram to show the bonding between the elements F and G. (1mark)



(d) Compare the atomic radius of elements D and H. Explain. (2marks)

D has a bigger atomic radius than H. D has more occupied energy levels than H

(e) State two uses of element E (2marks)

Manufacture of ammonia in the Haber Process

Manufacture of hydrochloric acid

Hardening of oils into fats

Liquid hydrogen is used as rocket fuel