

OPENER EXAMINATION: TERM 1 2024

233/2

Chemistry Theory

Paper 2

Form 4 (MARKING SCHEME)

Time: 2 Hours

INSTRUCTIONS

1. Write your name and school and index number in the spaces provided at the top of this page
2. All answers should be written in the spaces provided.
3. **Non-programmable** silent electronic calculators and KNEC mathematical tables may be used.
4. Students should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

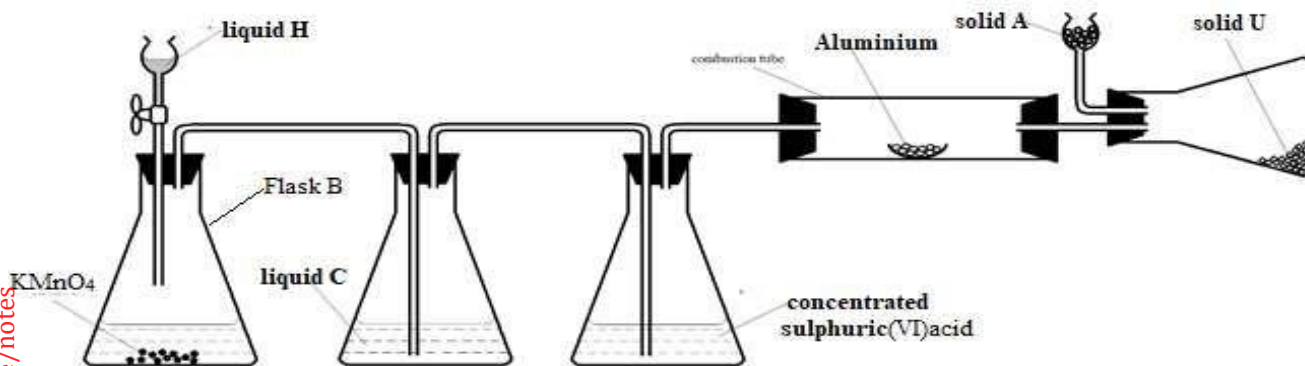
FOR EXAMINER'S USE ONLY.

Questions	Maximum score	Candidates score
1	12	
2	13	
3	12	
4	11	
5	11	
6	10	
7	11	
Total score	80	

This paper consists of 13 printed pages. Candidates are advised to check and to make sure all pages are as indicated and no question is missing.

1. Study the diagram below and use it to answer the questions that follow

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- (a) i) Suggest a suitable reagent that can be used as **solid A** (1 mark)
Calcium oxide / anhydrous calcium chloride ✓1
- ii) Name liquids **C** and **H**. (2 marks)
C- water ✓1
H - concentrated hydrochloric acid ✓1
- iii) Write a balanced chemical equation for the reaction in conical flask **B** (1 mark)
 $2\text{KMnO}_4(\text{s}) + 16\text{HCl}(\text{aq}) \rightarrow 2\text{KCl}(\text{aq}) + 2\text{MnCl}_2(\text{aq}) + 8\text{H}_2\text{O}(\text{l}) + 5\text{Cl}_2(\text{g})$ ✓1
- iv) Explain why **solid U** collects further away from aluminium metal (1 mark)
Solid U sublimes ✓½ **when heated and deposits in flask B where the temperature is low.** ✓½
- (b) During a class experiment, chlorine gas was bubbled into a solution of potassium iodide.
- i) State the observation made. (1 mark)
Colourless solution changes to dark brown ✓½ **then a black solid** ✓½ **is deposited.**
- ii) Write the ionic equation for the reaction that took place. (1 mark)
 $\text{Cl}_2(\text{g}) + 2\text{I}^-(\text{aq}) \rightarrow \text{I}_2(\text{s}) + 2\text{Cl}^-(\text{aq})$ ✓1
- (c) Write a balanced chemical equation for the reaction between hot concentrated sodium hydroxide and chlorine gas. (1 mark)
 $6\text{NaOH}(\text{aq}) + 3\text{Cl}_2(\text{g}) \rightarrow \text{NaClO}_3(\text{aq}) + 5\text{NaCl}(\text{aq}) + 3\text{H}_2\text{O}(\text{l})$ ✓1
- (d) Explain the difference in bleaching by chlorine and bleaching by sulphur (IV) oxide gas. (2 marks)
Chlorine bleaches by adding oxygen to the dye (oxidation) ✓1 **hence permanent, while Sulphur (IV) oxide bleaches by removing oxygen from the dye (reduction)** ✓1 **hence temporary since the action can be reversed when the dyed material is exposed to air.**
- (e) Describe how to test for the presence of chloride ions in a water sample (2 marks)
To the water sample, add a few drops of lead(II) nitrate/ silver nitrate solution. ✓1 **Formation of a white precipitate confirms the presence of chloride ions.** ✓1

2. (a) Give the systematic name of the following organic compound:

- i) $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{Br})\text{CH}_3$ (1 mark)
2,3-Methylbromobutane.....

- ii) $\text{CHC}(\text{CH}_3)_2\text{CH}_3$ (1 mark)

.....Pent-1-yne.....

(b) The following tests were carried out on some organic compound Q. Study the information in the table and use it to answer the questions that follow.

Test	Observation
i) Three drops of acidified potassium manganate (vii) was added to Q	The acidified potassium manganate (vii) was decolourised
(ii) To a solution of Q bromine water was added.	Yellow colour of bromine was decolourised.

i) Identify the functional group of the organic compound Q. (1 mark)

.....C=C / C≡C.....

ii) Draw the structural formula of the first member of the homologous series in which the organic compound Q belongs. (1 mark)



iii) Use the information in the table below to answer the question that follows.

No. of carbon atoms per Molecule	Molecular mass
3	40
4	54
5	68

a) Identify the homologous series in which the above hydrocarbons belongs. (1mk)

...Alkynes.....

b) Write the general formula of this homologous series. (1mk)

..... C_nH_{2n-2}

c) Name and draw the structure of the third member of this homologous series. (2mks)

.....H-C=C-C-C-H.....

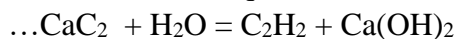
d) Predict the molecular mass of the hydrocarbon with eight carbon atoms per molecule in this series.

.....110..... (1mk)

e) i) Name two reagents used to prepare a hydrocarbon with two carbon atoms per molecule in this this homologous series. (1mk)

.....Calcium carbid
 water.....

ii) Write chemical equation for the laboratory preparation of the first member of this homologous series.



..... (1mks)

f) Give two uses of the hydrocarbons in this series. (2mks)

.....Ethyne used in welding (oxy-acetylene flame)

Manufacture of adhesives and synthetic fibres

3. The figure below represents a section of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbol of the element.

B							
C	L		D	E		W	G
H	J						

- (a) Give the chemical family to which element J belongs to. (1 mark)

Alkaline earth metals. √1

- (b) Compare the reactivity of elements C and H. Explain your answer. (2 marks)

H is more reactive than C because H has a larger atomic radius, √1 hence its valence electron is less strongly attracted by the nucleus, √½ making it easier for H/ H requires less energy to lose its valence electron. √½

- (c) Give one property of elements found in the shaded region. (1 mark)

Have variable valencies, hence show different oxidation states in their compounds/ form coloured compounds as solids and in aqueous solutions/ have very high melting and boiling points/ do not react with water/ have very high densities. √1

- (d) Write the chemical formula of the chloride of D. (1 mark)

DCl₃ / AlCl₃ √1

- (e) i) Name the type of structure of the chloride in (d) above. (1 mark)

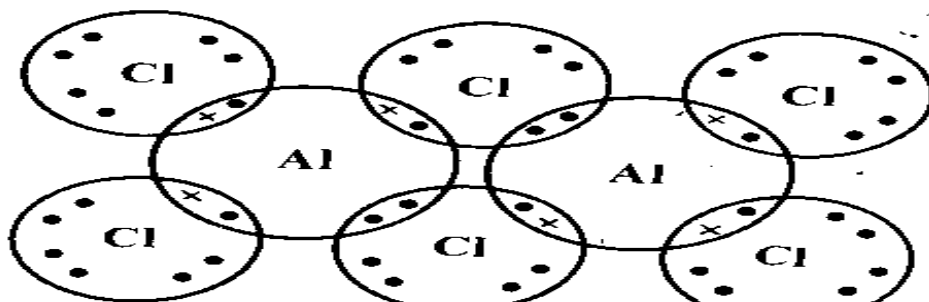
(Simple) molecular √1

- ii) Identify the bonds that exist in the compound in (d) above. (1 mark)

- Covalent √½

-Dative √½

- iii) Using dots and crosses to represent the valence electrons show the bonding in the compound formed in (d) above. (2 marks)



(f) State and explain the difference in atomic and ionic radius of element W.

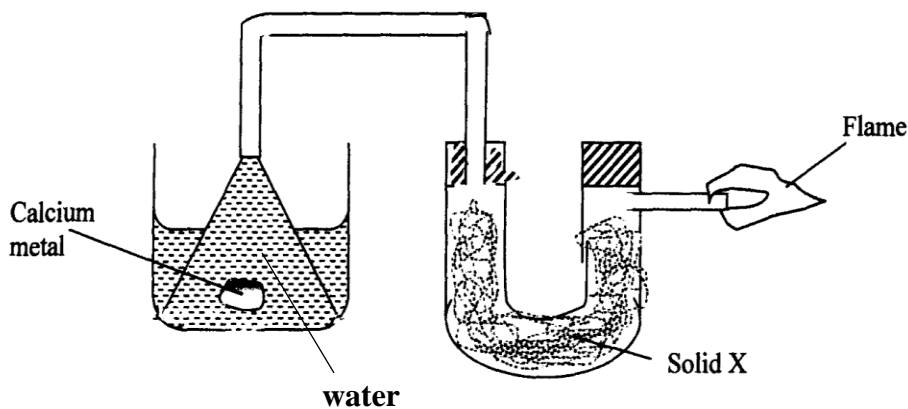
Ionic radius of W is larger than its atomic radius √1 because W forms an ion by gaining an electron which is repelled by other electron in the outermost energy level. √1

(g) Give one observation made when element C is placed in water.

(1 mark)

C darts about on the surface of water/ melts into a silvery ball/ hissing sound is produced. √1

4. S(a) The setup below was used to investigate the reaction between metals and water.



i) Identify solid X and state its purpose.

Solid X ***Anhydrous calcium chloride/ Calcium oxide √½***

(½ mark)

Purpose ***To dry hydrogen gas √½***

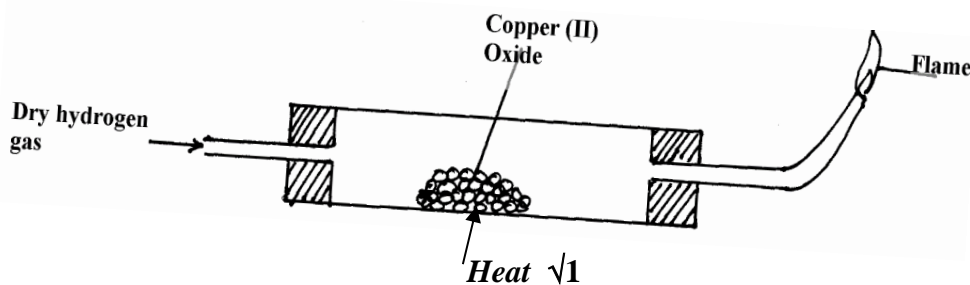
(½ mark)

ii) Write a chemical equation for the reaction that produces the flame.

(1 mark)



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



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

(1 mark)

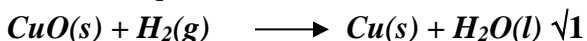
ii) Hydrogen gas is allowed to pass through the tube for some time before it is lit. Explain.

(1 mark)

To drive away air which would form an explosive mixture with hydrogen when ignited. √1

iii) Write an equation for the reaction that occurs in the combustion tube.

(1 mark)



iv) When the reaction is complete, hydrogen gas is passed through the apparatus until it cools down.

Explain.

(2 marks)

To prevent re-oxidation of hot copper metal √1 by atmospheric oxygen. √1

v) What property of hydrogen is being investigated? ***Being investigated? √1***

(1 mark)

Reducing property / Reduction. √1

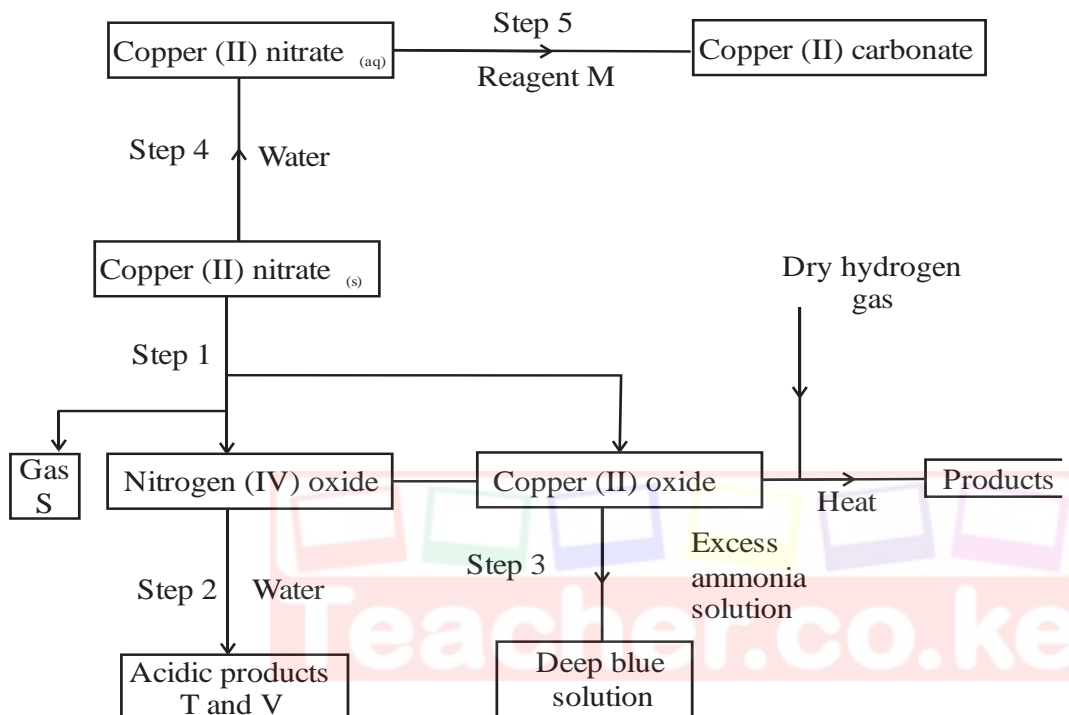
vi) What observation confirms the property stated in (v) above? (1 mark)

Black copper (II) oxide powder turns to reddish brown copper metal. √1

vii) Why is zinc oxide not used to investigate this property of hydrogen gas? (2 marks)

Zinc is more reactive than hydrogen, √1 hence cannot be displaced from its oxide by hydrogen. √1

5. The flow chart below shows some reactions starting with copper (II) nitrate. Study it and answer questions that follow.



a) State the condition necessary in step 1. (1mark)
Heating

i. Identify Reagent M (1mark)

.....Sodium carbonate

Gas S Oxygen (1mark)

Acidic products (2marks)

T... – nitric (v) acid

V... nitric(III)acid.....

ii. Write the formula of the complex ion formed in step 3. (1mark)ssss



iii. Write the equations for the reaction in,

Step 1


.....

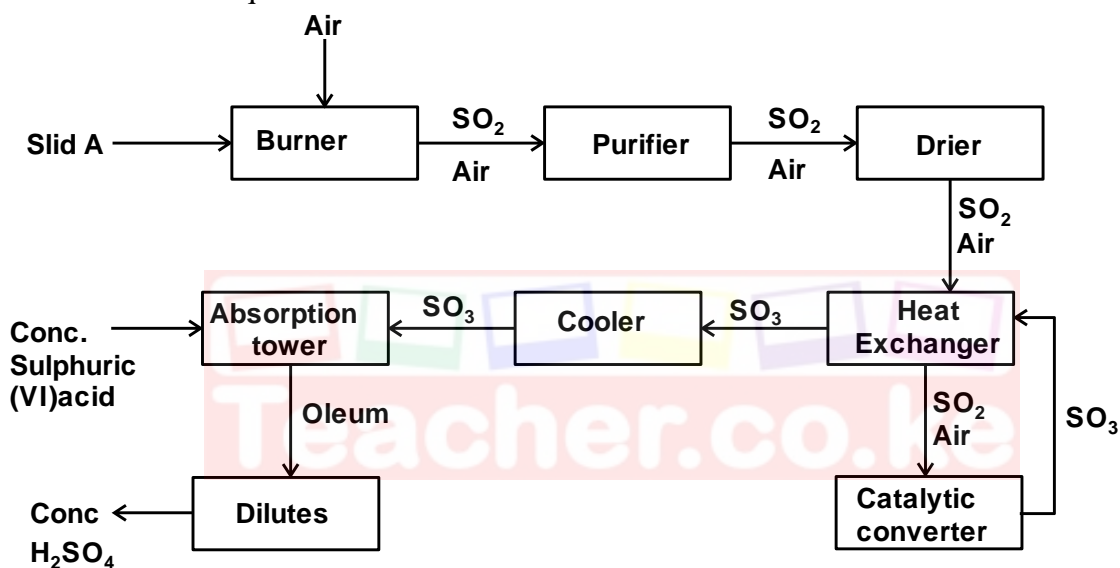
Step 2


iv. Write an ionic equation for that occurs in step 5. (1mark)


 v. State any **one** observation made in STEP 1, (1mark)

Black residue Brown gas.....

6. The diagram below illustrates the contact process for the manufacture of sulphuric (VI) acid. Study it and answer the questions that follow.


 a) Name **three** possible identities of solid A. (1½ marks)

.... Sulphur, iron (II) sulphide, zinc (II) sulphide, lead (II) sulphide, copper (i) sulphide
any 3

 b) i) Name **two** impurities removed by the purifier. (1 mark)

... Dust ✓½, arsenic compounds /arsenic
 oxide ✓½.....

ii) Why is it necessary to remove the impurities? (1 mark)

.....) To avoid poisoning of the catalyst

✓1.....

c) Write down the equation for the reaction that takes place in the catalytic converter. (1 mark)



✓1.....

d) i) Name **two** catalysts that can be used in the converter. (2 marks)

- Vanadium (V) oxide ✓1
- Platinum /platinised asbestos ✓1

ii) Which of the **two** catalysts is most commonly used and why? (1 mark) ss

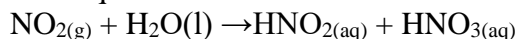
- .. - Vanadium (V) oxide ✓½
- It is cheaper and not easily

poisoned.....

e) Why is sulphur (VI) oxide not absorbed directly into water? (1 mark)

The reaction is highly exothermic causing the solution to boil forming mist ✓1 of sulphuric (VI) acid spray which is corrosive

f) Give the equation for the reaction that takes place in the absorption chamber. (1 mark)



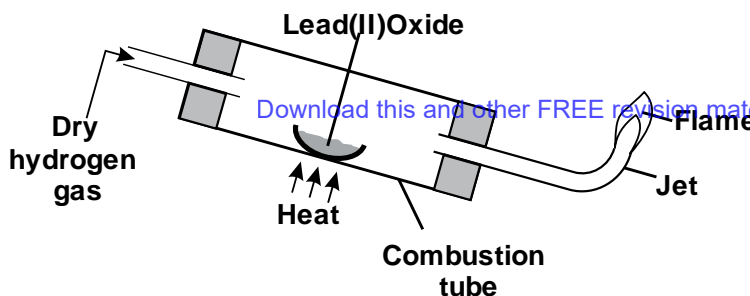
g) Name the main pollutant in the contact process. (½ mark)

Sulphur (IV) oxide ✓½

h) Name **one** method by which the pollution is controlled in the contact process. (1 mark)

- Recycling the unreacted gases ✓1
 - Reacting the unreacted gases with oxides or carbonates of metals or with heated carbon
- any one**

7. The diagram below shows an experiment to demonstrate the properties of hydrogen as a reducing agent. Study it and answer the questions that follow.



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a) Before lighting hydrogen gas at the jet, it is important to drive off all the air in the combustion tube. Explain. (1 mark)

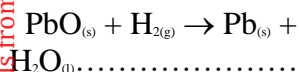
... This is to avoid an explosion because a mixture of hydrogen and air is highly explosive.....

b) State what would be observed in the boat containing lead (II) oxide at the end of the experiment. (1 mark)

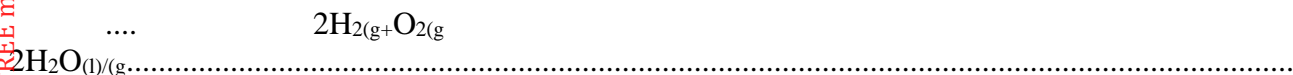
..... Grey solid observed.....

c) Write chemical equations for the reaction taking place;

i) In the combustion tube. (1 mark)



ii) At the jet as the flame burns. (1 mark)



d) Why should the supply of hydrogen continue until the apparatus are cool? (1 mark)

.) To prevent re-oxidation of the hot metallic lead by atmospheric oxygen.....

e) Why is it important to clamp the glass tube or combustion tube in a slanting position?

To prevent water formed in the reaction from running back into the hot part of the glass tube that can cause it to crack

(1 mark)

f) i) Cars in Mombasa rust faster than in Kisumu. Explain. (1 mark)

. Mombasa is around the Indian Ocean whose water is salty while Kisumu is around lake Victoria whose water is fresh ½

ii) Give the factors that are necessary for rusting. (1 mark)

. Water ½ and oxygen ½

iii) Name **two** methods used to prevent rusting. (1 mark)

..) Oiling, greasing, painting, galvanizing, electroplating, sacrificial protection, use of silica gel.

(any two for 1mk)

iv) Explain why a nail placed in a sealed tube containing tap water rusts while a nail placed in a sealed tube containing boiled water fails to rust. (1 mark)

- Tube of tap water contains dissolved oxygen while tube of boiled water has no oxygen.....

v) State **two** industrial uses of oxygen gas. (1 mark)

- A mixture of oxygen and acetylene burns with hot flame used in welding and cutting of metals
- Oxygen mixed with hydrogen is used in rocket fuel
- Oxygen is used in steel making where it oxidizes impurities in molten iron.
- Oxygen is used in hospitals for patients with breathing problems
- Oxygen is used by high mountain climbers and deep sea divers.

any two for 1mk

ng

i) M – sodium carbonate/ potassium carbonate

S – oxygen

T – nitric (v) acid

V – nitric (III) acid

iii) $[\text{Cu}(\text{NH}_3)_4]^{2+}$

v) I) $2\text{Cu}(\text{NO}_3)_2(\text{s}) \rightarrow 2\text{CuO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2$

II) $\text{NO}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{HNO}_2(\text{aq}) + \text{HNO}_3(\text{aq})$

