Name ..... Index Number .....

233/1
CHEMISTRY
Paper 1
Nov. 2016
2 hours

Candidate's Signature .....

Date .....

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education
CHEMISTRY
Paper 1
(THEORY)
2 hours

Instructions to candidates

(a) *Write your name and index number in the spaces provided above.*
(b) *Sign and write the date of examination in the spaces provided above.*
(c) *Answer **all** the questions in the spaces provided in the question paper.*
(d) *KNEC mathematical tables and silent non-programmable electronic calculators may be used.*
(e) *All working must be clearly shown where necessary.*
(f) ***This paper consists of 16 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.***
(h) ***Candidates should answer the questions in English.***

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Question	Maximum Score	Candidate's Score
1–29	80	

1. A student investigated the effect of an electric current by passing it through some substances. The student used inert electrodes and connected a bulb to the circuit. The table below shows the substances used and their states.

Experiment	Substance	State
1	Potassium carbonate	Solid
2	Copper (II) sulphate	Solution
3	Sugar	Solution
4	Lead (II) iodide	Molten

(a) In which experiment did the bulb not light? (1 mark)

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(b) Explain your answer in (a) above. (2 marks)

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2. 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 = 12.0, H = 1.0, O = 16) (2 marks)

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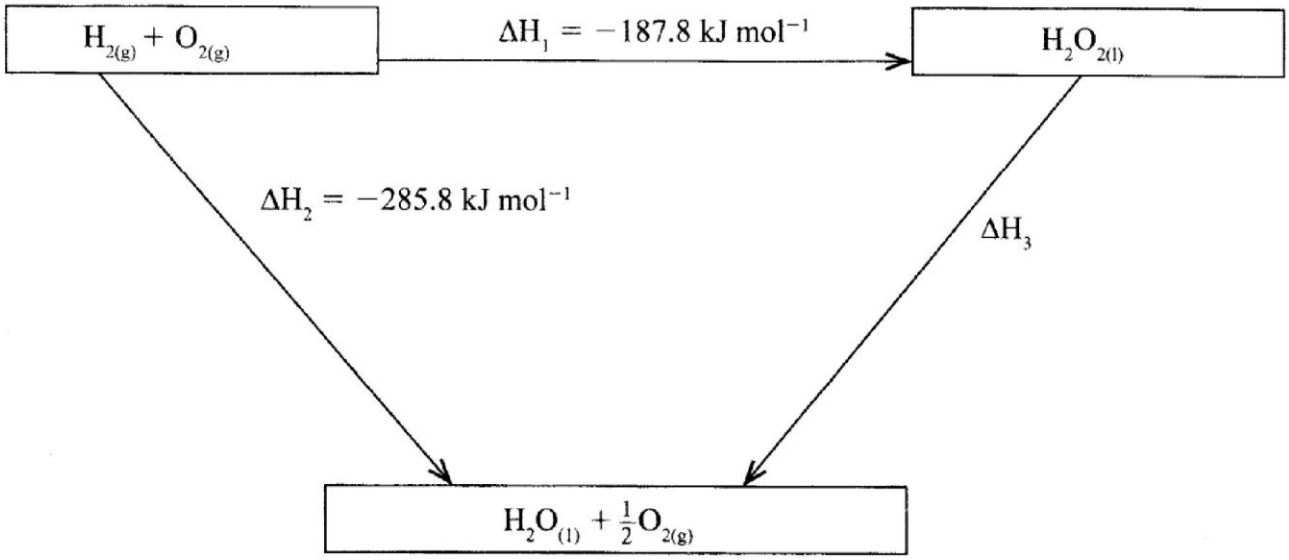
(b) Given that the empirical formula and the molecular formula of the alkanol are the same, draw the structure of the alkanol. (1 mark)

3. The figure below shows an energy cycle.



(a) Give the name of the enthalpy change ΔH_1. (1 mark)

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(b) Determine the value of ΔH_3. (2 marks)

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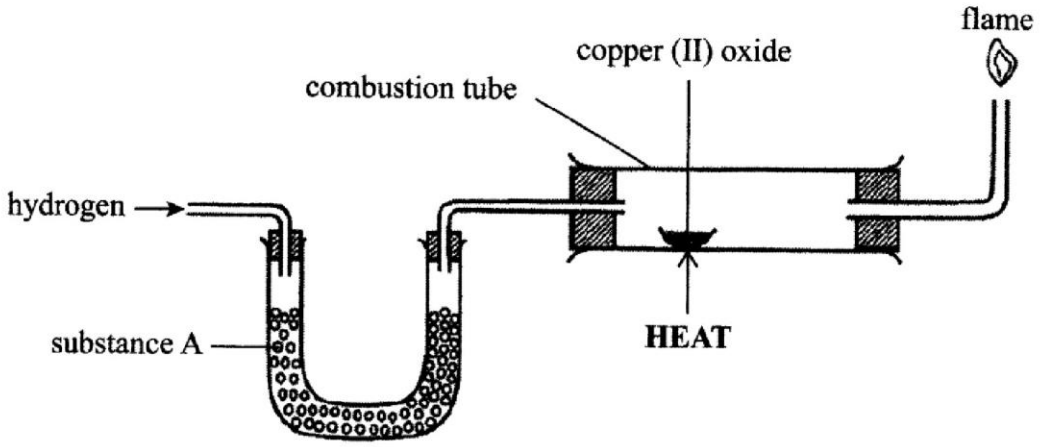
4. The set up below was used to investigate the reaction between dry hydrogen gas and copper (II) oxide.



(a) Name substance A. (1 mark)

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(b) State the observation made in the combustion tube. (1 mark)

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(c) Explain the observation made in (b) above. (1 mark)

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5. Starting with sodium metal, describe how a sample of crystals of sodium hydrogen carbonate may be prepared. (3 marks)

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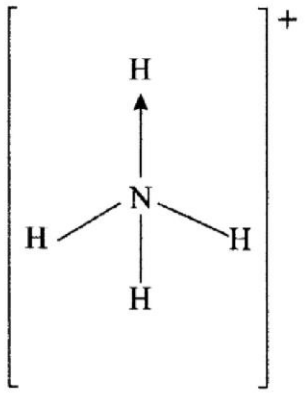
6. Ammonium Ion has the following structure.



Label on the structure the:

(a) Covalent bond (1 mark)

(b) Coordinate (dative) bond (1 mark)

7. When 8.53 g of sodium nitrate was heated in an open test tube, the mass of oxygen gas produced was 0.83 g. Given the equation of the reaction as:

$2NaNO_{3(s)} \rightarrow 2NaNO_{2(s)} + O_{2(g)}$

Calculate the percentage of sodium nitrate that was converted to sodium nitrite
(Na = 23.0, N = 14.0, O = 16.0) (3 marks)

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8. Aluminium is both malleable and ductile;

(a) What is meant by?

(i) Malleable (½ mark)

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(ii) Ductile (½ mark)

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(b) State **one** use of aluminium based on;

(i) Malleability (½ mark)

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(ii) Ductility (½ mark)

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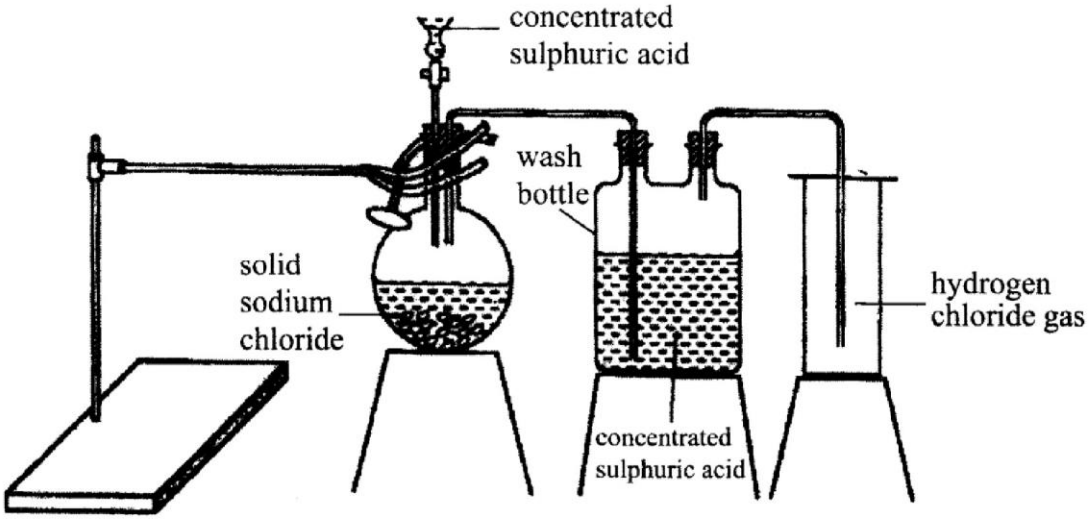
9. The diagram below represents the set up that was used to prepare and collect hydrogen chloride gas in the laboratory.



(a) State the purpose of concentrated sulphuric acid in the wash bottle. (1 mark)

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(b) Write an equation for the reaction between dry hydrogen chloride gas and heated iron. (1 mark)

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10. Iron (III) oxide was found to be contaminated with copper (II) sulphate. Describe how a pure sample of iron (III) oxide can be obtained. (3 marks)

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11. Complete the nuclear equation below.

(a) $^{131}_{53}I \rightarrow {}^{131}_{54}Xe +$ _____ (1 mark)

(b) The half life of $^{131}_{53}I$ is 8 days. Determine the mass of $^{131}_{53}I$ remaining if 50 grammes decayed for 40 days. (2 marks)

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(c) Give **one** harmful effect of radioisotopes. (1 mark)

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12. During an experiment, chlorine gas was bubbled into a solution of potassium iodide.

(a) State the observations made. (1 mark)

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(b) Using an ionic equation, explain why the reaction is redox. (2 marks)

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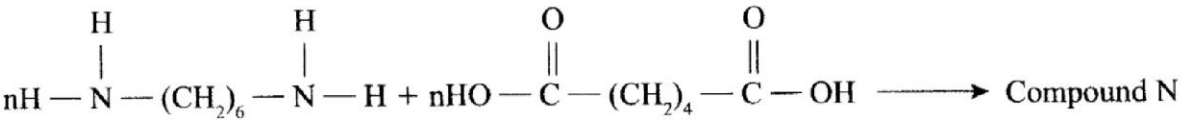
13. (a) Draw the structure of compound N formed in the following reaction. (1 mark)



$$nH-\overset{\overset{H}{|}}{N}-(CH_2)_6-\overset{\overset{H}{|}}{N}-H + nHO-\overset{\overset{O}{\|}}{C}-(CH_2)_4-\overset{\overset{O}{\|}}{C}-OH \longrightarrow \text{Compound N} + 2nH_2O.$$

(b) Give **one** use of compound N. (1 mark)

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14. When fuel burns in the internal combustion engine at high temperature, one of the products formed is nitrogen (II) oxide.

(a) Write the equation for the formation of nitrogen (II) oxide. (1 mark)

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(b) Give a reason why nitrogen (II) oxide is not formed at room temperature. (1 mark)

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(c) Describe how formation of nitrogen (II) oxide in the internal combustion engine leads to gaseous pollution. (2 marks)

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15. Sodium hydroxide can be prepared by the following methods; I and II

I Sodium metal $\xrightarrow{\text{Cold water}}$ sodium hydroxide + hydrogen

II Concentrated Sodium chloride $\xrightarrow{\text{Process A}}$ sodium hydroxide + chlorine + hydrogen

(a) Name **one** precaution that needs to be taken in method I. (1 mark)

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(b) Give the name of process A. (1 mark)

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(c) Give **one** use of sodium hydroxide. (1 mark)

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16. The atomic number of sulphur is 16. Write the electron arrangement of sulphur in the following? (2 marks)

(a) H_2S .....

(b) SO_3^{2-} .....

17. 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. (1 mark)

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

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18. A water trough, aqueous sodium hydroxide, burning candle, watch glass and a graduated gas jar were used in an experimental set up to determine the percentage of active part of air. Draw a labelled diagram of the set up at the end of the experiment. (3 marks)

19. 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 the reaction? (1 mark)

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

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20. $60\,cm^3$ of oxygen gas diffused through a porous partition in 50 seconds. How long would it take $60\,cm^3$ sulphur (IV) oxide gas to diffuse through the same partition under the same condition? (S = 32.0, O = 16.0) (3 marks)

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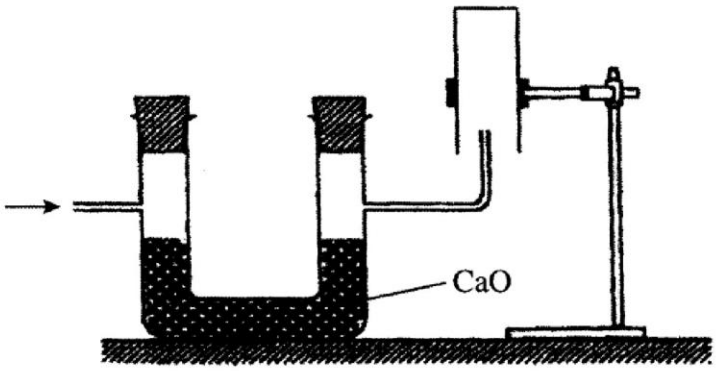
21. Draw and name the isomers of pentane. (3 marks)

22. The set up below was used to collect a dry sample of a gas.



Give **two** reasons why the set up cannot be used to collect carbon (IV) oxide gas. (2 marks)

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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 are acidic, basic or neutral. (1 mark)

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(b) Classify the substances in (a) above as acids bases or neutral. (2 marks)

Acid	Base	Neutral

24. Describe how a solid sample of potassium sulphate can be prepared starting with 200 cm^3 of 2M potassium hydroxide. (3 marks)

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25. Charcoal is a fuel that is commonly used for cooking. When it burns it forms two oxides.

(a) Name the **two** oxides (2 marks)

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(b) State **one** use of the two oxides. (1 mark)

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26. Hydrogen sulphide is a highly toxic and flammable gas. It is normally prepared in a fume chamber.

(a) Name **two** reagents that can be used to prepare hydrogen sulphide in the laboratory. (1 mark)

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(b) One of the uses of hydrogen sulphide is to produce sulphur as shown in the following equation.

$$2H_2S_{(g)} + SO_{2(g)} \longrightarrow 3S_{(s)} + 2H_2O_{(l)}$$

Identify the reducing agent in this reaction and give a reason for your answer. (1 mark)

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(c) Other than production of sulphuric (VI) acid. State **one** commercial use of sulphur. (1 mark)

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27. Describe an experimental procedure that can be used to extract oil from nut seeds. (2 marks)

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28. A mixture contains ammonium chloride, Copper (II) oxide and sodium chloride. Describe how each of the substances can be obtained from the mixture. (3 marks)

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29. When a student was stung by a nettle plant, a teacher applied an aqueous solution of ammonia to the affected area of the skin and the student was relieved of pain. Explain. (2 marks)

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Name ..... Index Number .....

233/3
CHEMISTRY
Paper 3
(PRACTICAL)
Nov. 2016
2¼ hours

Candidate's Signature .....

Date .....

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education
CHEMISTRY
Paper 3
2¼ hours

Instructions to candidates

(a) Write your name and index number in the spaces provided above.
(b) Sign and write the date of examination in the spaces provided above.
*(c) Answer **all** the questions in the spaces provided in the question paper.*
(d) You are not allowed to start working with the apparatus for the first 15 minutes of the 2¼ hours allowed for this paper. This time is to enable you to read the question paper and make sure you have all the chemicals and apparatus that you may need.
*(e) All working **must** be clearly shown where necessary*
(f) KNEC mathematical tables and silent electronic calculators may be used.
(g) This paper consists of 7 printed pages.
(h) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.
(i) Candidates should answer the questions in English

For Examiner's Use Only

Question	Maximum Score	Candidate's Score
1	16	
2	14	
3	10	
	Total Score	

1. You are provided with the following:

- Aqueous potassium iodide, solution A_1
- Aqueous sodium thiosulphate, solution A_2
- Acidic solution, solution A_3
- Starch solution, solution A_4
- Dilute hydrogen peroxide, solution B
- Distilled water

You are required to determine the rate of reaction between acidified potassium iodide and hydrogen peroxide.

Procedure

Step 1
Using a 10 ml measuring cylinder, place 2 cm^3 of solution A_1 into a 100 ml beaker. Add 2 cm^3 of solution A_2 followed by 2 cm^3 of solution A_3. Add 5 drops of solution A_4. Finally, add 12 cm^3 of distilled water and shake the mixture.

Step 2
Using a burette, place 6 cm^3 of solution B into a test tube. Pour the measured 6 cm^3 of solution B into the beaker in Step 1 above and immediately start a stopwatch/clock. Swirl the mixture and place on a white paper. Observe the mixture and immediately stop the stopwatch/clock when a blue colour appears.

Record the time taken in table 2. Measure the temperature of the mixture and record in table 2. These are the results of experiment 1.

Step 3
Repeat steps 1 and 2 using the volumes of solutions given in table 1 for experiments 2, 3, 4, 5 and 6 and record in table 2.

Table 1

Experiment number	Volume of solutions (cm^3)				Distilled Water (cm^3)
	A_1	A_2	A_3	A_4	
1	2	2	2	5 drops	12
2	4	2	2	5 drops	10
3	6	2	2	5 drops	8
4	8	2	2	5 drops	6
5	10	2	2	5 drops	4
6	12	2	2	5 drops	2

(a) Calculate the rate of reaction $\frac{1}{\text{time}}$ S^{-1} for each experiment and fill in table 2.

Table 2

Experiment number	Volume of solution A_1 Acidified Potassium iodide (cm_3)	Temperature (°C)	Time (sec) t	Rate $\frac{1}{t}S^{-1}$
1	2			
2	4			
3	6			
4	8			
5	10			
6	12			

(8 marks)

(b) Plot a graph of rate of reaction $\frac{1}{\text{time}}$ vertical axis against volume of potassium iodide.

(3 marks)

(c) Explain why it is necessary to record the temperature for each experiment. (1 mark)

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(d) If the experiment was repeated using 7 cm^3 of acidified potassium iodide, solution A_1, determine:

(i) the volume of distilled water that would be used. (1 mark)

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(ii) the time taken for the blue colour to appear. (2 marks)

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(e) Explain how the rate of the reaction is affected by the volume of acidified potassium iodide. (1 mark)

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2. You are provided with Solution **G**. Carry out the following tests and record your observations and inferences in the spaces provided.

(a) Measure the pH of the solution using 2 cm^3 of Solution **G** and universal indicator paper.

observations	inferences

(1 mark) (1 mark)

(b) To about 2 cm^3 of **G** in a test tube, add dropwise dilute nitric (V) acid until no further change. Retain the mixture for use in tests (c)(i) and (c)(ii)

observations	inferences

(1 mark) (1 mark)

(c) Divide the mixture obtained in (b) above into two portions.

(i) To the first portion, add 3 drops of aqueous lead (II) nitrate.

observations	inferences

(1 mark) (2 marks)

(ii) To the second portion, add 3 drops of aqueous barium nitrate.

observations	inferences

(1 mark) (1 marks)

(d) Describe a test that you would carry out to find out if Zn^{2+} ions are present in Solution **G**.

test	observations

(2 marks) (1 mark)

(e) Carry out the test described in (d) above.

observations	inferences

(1 mark) (1 mark)

3. You are provided with Solid **H**. Carry out the following tests and record your observations and inferences in the spaces provided.

(a) Place all of Solid **H** in a boiling tube. Add about 10 cm^3 of distilled water and shake the mixture thoroughly.

observations	inferences

(1 mark) (1 mark)

(b) To about 2 cm^3 of the mixture in a test tube, add about half of the solid sodium hydrogen carbonate.

observations	inferences

(1 mark) (1 mark)

(c) To the remaining amount of the mixture of **H** in the boiling tube add about 10 cm^3 of dilute hydrochloric acid. Shake thoroughly then filter the mixture. Wash the residue with distilled water. Dry the residue using filter papers. Use the residue for tests (i), (ii) and (iii) below.

(i) Place about one third of the residue in a test tube. Add about 10 cm^3 of distilled water and warm the mixture. To the warm mixture, add the remaining amount of solid sodium hydrogen carbonate.

observations	inferences

(1 mark) (1 marks)

(ii) To about one third of the residue in a test tube, add about 5 cm^3 of distilled water, shake the mixture and then add 3 drops of bromine water.

observations	inferences

(1 mark) (1 marks)

(iii) To the remaining amount of the residue in the boiling tube, add about 10 cm^3 of distilled water, about 5 cm^3 of dilute sulphuric (VI) acid and then about 5 cm^3 of ethanol. Warm the mixture.

observations	inferences

(1 mark) (1 marks)

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