Candidate's Name: .....

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545/2

CHEMISTRY

Paper 2

Oct. / Nov. 2020

2 hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Certificate of Education

CHEMISTRY

Paper 2

2 hours

INSTRUCTIONS TO CANDIDATES:

Section **A** *consists of 10 structured questions. Answer* **all** *the questions in this section.*

Answers to these questions **must** *be written in the spaces provided.*

Section **B** *consists of 4 semi-structured questions. Answer any* **two** *questions from this section. Answers to the questions* **must** *be written in the answer booklet(s) provided.*

In both sections all working **must** *be clearly shown and* **must** *be in* **blue** *or* **black** *ink.*

Any work done in **pencil** *will* **not** *be marked except drawings.*

Mathematical tables and silent non-programmable calculators may be used.

Where necessary use:

[H=1; C=12; N=14; O=16; Na =23; S=32; Cl=35.5]
1 mole of gas occupies 24 l at room temperature.
1 mole of gas occupies 22.4 l at s.t.p.

For Examiners' Use Only														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total

Turn Over

SECTION A: (50 MARKS)

Answer **all** *questions in this section.*

1. (a) State what would be observed if a bar magnet is brought close to;

(i) a mixture of iron and sulphur. *(01 mark)*

.....

(ii) iron (II) sulphide. *(01 mark)*

.....

(b) What is the practical application of the action in (a) (i)? *(01 mark)*

.....

.....

(c) State a suitable method by which the following substance can be obtained:

(i) Sugar from its mixture with sand. *(01 mark)*

.....

(ii) Sodium chloride from its mixture with sodium hydrogencarbonate. *(01 mark)*

.....

2. The atomic numbers of elements *X*, *Y* and *Z* are 12, 14 and 17 respectively.

(a) Write the electronic configuration of the ion formed by:

(i) *X*. *(½ mark)*

.....

(ii) *Y*. *(½ mark)*

.....

(b) Element *Z* can react with elements *X* and *Y* to form compounds *Q* and *R* respectively.

(i) Write the formula of the compound that can be formed between *Z* and:

X. *(01 mark)*

.....

Y. *(01 mark)*

.....

(ii) Which **one** of the compounds *Q* and *R* will conduct electricity when in molten state? (*½ mark*)

.....

(iii) Give a reason for your answer in (b) (ii). (*01 mark*)

.....

3. (a) Charcoal was burnt in a charcoal stove as shown in figure **1**.

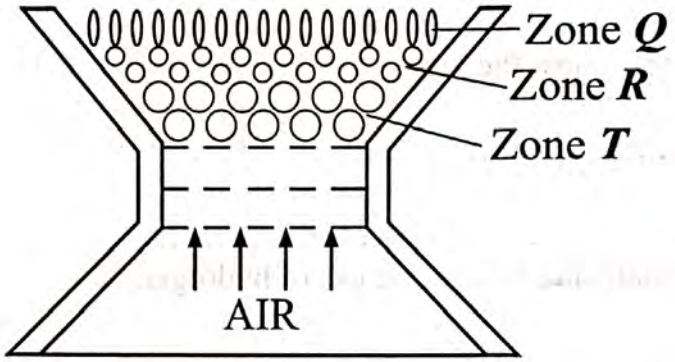

Fig. 1

Name the substance that was produced at zone:

(i) ***Q*** ..... (*01 mark*)

(ii) ***R*** ..... (*01 mark*)

(iii) ***T*** ..... (*01 mark*)

(b) State;

(i) the structural difference between charcoal and graphite.(*01 mark*)

.....

.....

(ii) **one** chemical property in which charcoal resembles graphite. (*01 mark*)

.....

.....

4. (a) (i) State the condition under which hydrochloric acid reacts with magnesium to produce hydrogen. (*½ mark*)

.....

.....

(ii) Write the ionic equation for the reaction in (a) (i). *(1½ marks)*

.....

.....

(b) A dry sample of hydrogen was burnt in air.

(i) Write the equation for the reaction that took place. *(1½ marks)*

.....

.....

(ii) State how the product in (b) (i) can be tested. *(01 mark)*

.....

.....

(iii) State **one** large scale use of hydrogen. *(½ mark)*

.....

5. When a mixture of dilute sodium hydroxide solution and a substance containing a cation *Q* was heated, a gas *X*, which gave dense white fumes with hydrogen chloride was evolved.

(a) Identify;

(i) the cation *Q*. *(½ mark)*

.....

(ii) gas *X*. *(½ mark)*

.....

(b) Write the equation for the reaction leading to the formation of;

(i) *X*. *(1½ marks)*

.....

.....

(ii) the dense white fumes. *(1½ marks)*

.....

.....

(c) X was bubbled through a solution containing zinc ions until there was no further change. State what was observed. *(1½ marks)*

.....

.....

6. 3.4 g of compound Z consists of 1.0 g calcium, 0.8 g sulphur and the rest being oxygen.

(a) (i) Calculate the empirical formula of Z. *(O =16; S =32; Ca= 40)* *(02 marks)*

.....

.....

.....

.....

.....

.....

(ii) Deduce the molecular formula of Z. *(Formula mass of Z =136)* *(01 mark)*

.....

.....

.....

.....

(b) (i) Name **one** reagent that can be used to identify the anion in an aqueous solution of Z. *(01 mark)*

.....

(ii) Write an ionic equation for the reaction that would take place if aqueous solution of Z was treated with the reagent you have named in (b) (i). *(1½ marks)*

.....

.....

Turn Over

7. Figure **2** shows an electrochemical cell.

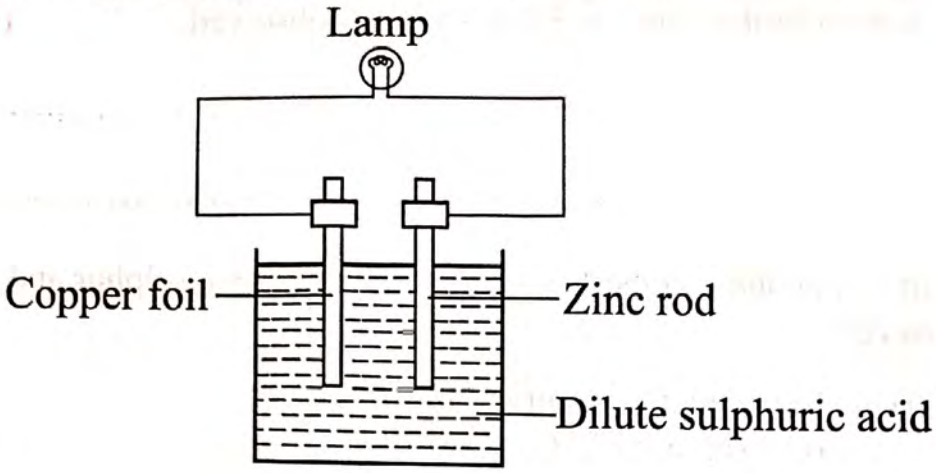

Fig.2

(a) State what is observed at the copper foil. *(½ mark)*

.....

.....

(b) Write the equation(s) for the reaction at the;

(i) cathode. *(01 mark)*

.....

.....

(ii) anode. *(01 mark)*

.....

.....

(c) Write the overall cell reaction equation. *(1½ marks)*

.....

.....

(d) State **one** application of an electrochemical cell. *(½ mark)*

.....

.....

8. (a) (i) State a suitable method of preparing iron(II) sulphate. *(01 mark)*

.....

(ii) Write the equation to show formation of iron(II) sulphate by the method you have stated in (a) (i). *(1½ marks)*

.....

.....

(b) When aqueous ammonia was added to iron(II) sulphate solution, a green precipitate which turned brown on standing was formed.

(i) Write the formula of the substance that appeared as the green precipitate. *(01 mark)*

.....

(ii) Give a reason why the green precipitate turned brown. *(01 mark)*

.....

.....

(iii) Name **one** substance, other than air, that would turn the green precipitate brown. *(½ mark)*

.....

9. (a) Chlorine dissolves in water to form hypochlorous acid.

(i) Write the equation for the reaction leading to the formation of hypochlorous acid. *(1½ marks)*

.....

.....

(ii) State what would be observed if a handkerchief stained with black ink was soaked in hypochlorous acid. *(½ mark)*

.....

.....

(b) Hypochlorous acid solution was exposed to bright sunlight. State what happened. *(1½ marks)*

.....

(c) State what would be observed if chlorine was bubbled into potassium bromide solution then tetrachloromethane added to the resultant mixture. *(1½ marks)*

.....

.....

.....

10. (a) Carbon dioxide is produced by the reaction of calcium carbonate with hydrochloric acid. Write an ionic equation for the reaction. *(1½ marks)*

.....

.....

.....

(b) The sketch graphs in figure **3** show variations in volumes of carbon dioxide evolved with time, when equal masses of calcium carbonate lumps were reacted separately with 50 cm^3 portions of 1.0 M solutions of monobasic acids ***T*** and ***R*** at room temperature.

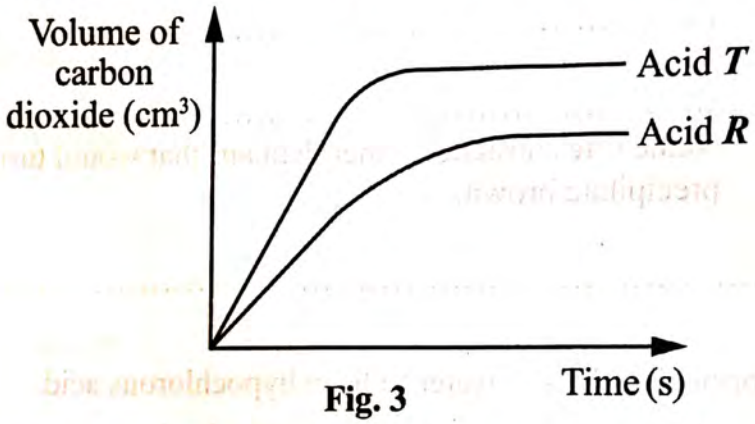

Fig. 3

(i) Which **one** of the acids is a stronger acid? *(½ mark)*

.....

(ii) Give reasons for your answer in (b) (i). *(02 marks)*

.....

.....

.....

.....

(iii) Sketch, on the same axes of figure **3**, the graph that would be obtained when an equal mass of calcium carbonate powder was reacted with 50 cm^3 of a 1.0 M acid ***T*** at room temperature.
(01 mark)

SECTION B (30 MARKS)

Answer any **two** *questions from this section.*
Additional question(s) answered will **not** *be marked.*

11. Sulphuric acid is manufactured from sulphur dioxide by the contact process.

(a) (i) Name **one** substance from which the sulphur dioxide used in the contact process can be prepared. (*01 mark*)

(ii) Write an equation to show how the substance you have named in (a) (i) is converted into sulphur dioxide. (*1½ marks*)

(iii) With the aid of equation(s), describe how sulphur dioxide is converted into sulphuric acid. (*6½ marks*)

(b) State how concentrated sulphuric acid reacts with the following substances, and in each case, write the equation for the reaction:

(i) Sulphur. (*02 marks*)
(ii) Sucrose ($C_{12}H_{22}O_{11}$). (*02 marks*)

(c) (i) Name **one** fertilizer manufactured from sulphuric acid. (*½ mark*)

(ii) Write an equation to show how the fertilizer you have named in (c) (i) is formed. (*1½ marks*)

12. (a) Describe the reactions of magnesium with;

(i) water. (*2½ marks*)
(ii) oxygen. (*02 marks*)
(iii) chlorine. (*02 marks*)

(b) Aqueous sodium hydrogencarbonate was added to a solution containing magnesium ions, and the mixture heated. Explain what happened;

(i) before the mixture was heated. (*03 marks*)
(ii) after the mixture was heated. (*3½ marks*)

(c) (i) Name **one** reagent that can be used to differentiate magnesium ion from lead(II) ion. (*01 mark*)

(ii) State what would be observed if magnesium ion and lead(II) ion are treated separately with the reagent you have named in (c) (i). (*01 mark*)

13. (a) (i) State **two** substances which when reacted together can form soap. *(01 mark)*

(ii) Briefly describe how a sample of solid soap can be prepared in the laboratory. *(04 marks)*

(b) Describe how soap removes dirt from clothes. *(04 marks)*

(c) Give reasons why detergents do not form scum with hard water. *(01 mark)*

(d) Explain why it is **not** advisable to dispose of detergents in water bodies. *(05 marks)*

14. (a) Methanol undergoes combustion according to the following equation.

$2CH_3OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 4H_2O(l)$; $\Delta H = -726\ kJ\ mol^{-1}$.

What is meant by the expression "$\Delta H = -726\ kJ\ mol^{-1}$" ? *(01 mark)*

(b) When 0.87 g of methanol was burnt, the heat evolved raised the temperature of 500 cm^3 of water by 7.0°C.
Calculate the enthalpy of combustion of methanol.
(H = 1; C = 12; O = 16; density of water = 1g cm^{-3}; specific heat capacity of water = 4.2 $J\,g^{-1}K^{-1}$.) *(3 ½ marks)*

(c) The Standard Enthalpy of Combustion of methanol is $-726\ kJ\ mol^{-1}$.
Compare the experimental value obtained in (b) with the standard value. Explain your answer. *(3 ½ marks)*

(d) The enthalpy of some straight chain alcohols are shown in the table **1**.

Table 1

Alcohol	CH_3OH	C_2H_5OH	C_3H_7OH	C_4H_9OH	$C_5H_{11}OH$	$C_6H_{13}OH$
Formula mass						
Enthalpy of combustion (kJ mol^{-1})	726	1371	2017	2673	3331	3984

(i) Copy the table and fill in the values for the formula masses of the alcohols. *(H = 1; C = 12; O = 16.)* *(1½ marks)*

(ii) Plot a graph of enthalpy of combustion against formula mass. *(04 marks)*

(iii) State how the enthalpies of the straight chain alcohols vary with their formula masses. *(½ mark)*

(iv) Use your graph to determine the enthalpy of a straight chain alcohol of formula mass 116. *(01 mark)*

END

Candidate's Name: .....

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545/2
CHEMISTRY
Paper 2
Oct./Nov. 2019
2 hours.

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Certificate of Education

CHEMISTRY

Paper 2

2 hours

INSTRUCTIONS TO CANDIDATES:

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In both sections **all** *working must be clearly shown.*

Where necessary use;

[H =1; C = 12; N =14; O = 16; Na =23; S = 32; Cl = 35.5]

1 mole of gas occupies 24 *l* at room temperature.

1 mole of gas occupies 22.4 *l* at s.t.p.

For Examiners' Use Only														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	**Total**

Turn Over

SECTION A (50 MARKS)

Answer **all** *questions in this section.*

1. (a) Write the chemical name of rust. *(01 mark)*

.....

(b) State the conditions necessary for rusting to occur. *(02 marks)*

.....

.....

(c) Figure **1** shows a set-up of apparatus that was used to investigate a condition necessary for iron nails to rust.

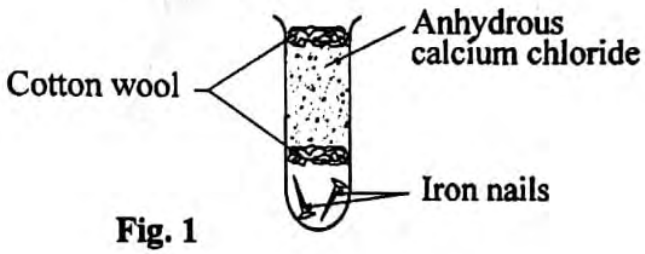


Fig. 1

State the condition that was being investigated. *(01 mark)*

.....

(d) State;

(i) **one** disadvantage of rust. *(01 mark)*

.....

.....

(ii) **one** method of preventing rusting. *(01 mark)*

.....

2. Table **1** shows the mass numbers and atomic numbers of elements *W*, *X* and *Y*. Study the table and answer the questions that follow.

Table 1

Element	Mass number	Atomic number
W	24	12
X	14	7
Y	39	19

(a) State the number of;

(i) electrons in the atom of element *Y*. (*01 mark*)

.....

(ii) neutrons in the atom of element *Y*. (*01 mark*)

.....

(b) Write the electronic configuration of the ion that can be formed by the atom of element *Y*. (*01 mark*)

.....

(c) Identify the group in the Periodic Table to which element ***X*** belongs. (*01 mark*)

.....

(d) Element *W* reacted with element *X* to form a compound *Z*. State the type of bond in *Z*. (*01 mark*)

.....

3. (a) A metallic element *T*, reacts with nitrogen to form a compound with the formula T_3N_2.

(i) State the valency of *T*. (*½ mark*)

.....

(ii) Write equation for the reaction between *T* and chlorine. (*1½ mark*)

.....

.....

(b) 3.2 g of *T* reacted completely with 600 cm^3 of nitrogen at s.t.p. Determine the atomic mass of *T*.
(*1 mole of a gas occupies 22.4 dm^3; T reacts with nitrogen in the ratio 3:1*) (*02 marks*)

.....

.....

.....

.....

4. Clean zinc granules were added to a solution of copper(II) sulphate.

(a) State what was observed. (*01 mark*)

.....

.....

(b) Explain your observation in (a). (*02 marks*)

.....

.....

(c) Write equation to support your answer in (b). (*1½ marks*)

.....

.....

5. Ammonium sulphate dissolves in water according to the following equation:

$$(NH_4)_2SO_4(s) + 2H_2O(l) \rightarrow 2NH_4OH(aq) + H_2SO_4(aq)$$

(a) State what would be observed if aqueous sodium hydrogencarbonate was added to the resultant solution. (*01 mark*)

.....

.....

(b) Briefly explain your answer in (a). (*04marks*)

.....

.....

.....

.....

.....

.....

6. The set-up of the apparatus in figure 2 was used for electrolysing silver nitrate solution.

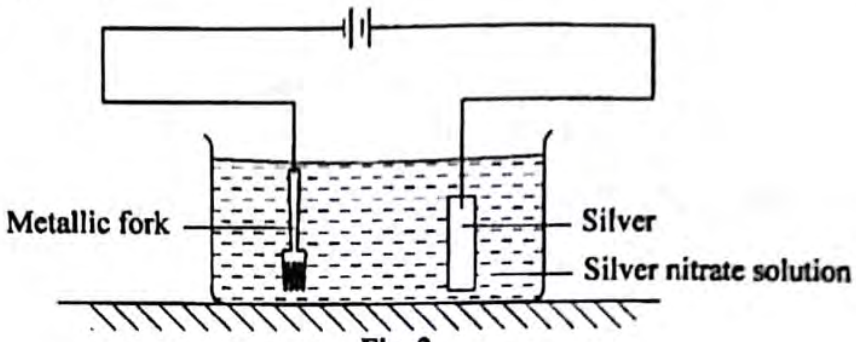


Fig. 2

(a) State what was observed on the;

(i) metallic fork. *(01 mark)*

.....

.....

(ii) silver. *(01 mark)*

.....

.....

(b) Write equation for the reaction that took place at the;

(i) electrode with the fork. *(01 mark)*

.....

.....

(ii) electrode with silver. *(01 mark)*

.....

.....

(c) (i) Name the process taking place at the electrode with the fork. *(½ marks)*

.....

.....

(ii) State **one** use of the process in (c)(i). *(½ mark)*

.....

.....

7. Lead(II) carbonate was heated until there was no further change.

(a) State what was observed. *(1½ marks)*

.....

.....

(b) Magnesium powder was added to the residue and the mixture heated strongly. Write equation for the reaction that took place. *(1½ marks)*

.....

.....

(c) The experiment in (b) was repeated using copper turning instead of magnesium powder.

(i) State what was observed. *(01 mark)*

.....

(ii) Give a reason for your answer in (c)(i). *(01 mark)*

.....

.....

8. When ammonium chloride was mixed with potassium hydroxide and the mixture heated strongly, ammonia was evolved

(a) Write equation for the reaction leading to the formation of ammonia. *(1½ marks)*

.....

.....

(b) Ammonia was bubbled through zinc sulphate solution until there was no further change.

(i) State what was observed. *(1½ marks)*

.....

.....

(ii) Give reason(s) for your observation(s) in (b) (i). *(02 marks)*

.....

.....

.....

.....

.....

9. (a) What is meant by the term **rate of reaction**? *(01 mark)*

.....

.....

.....

(b) During an experiment to determine the rate of production of carbon dioxide from calcium carbonate at room temperature, the volume of carbon dioxide varied with time as shown in the graph in figure **3**.

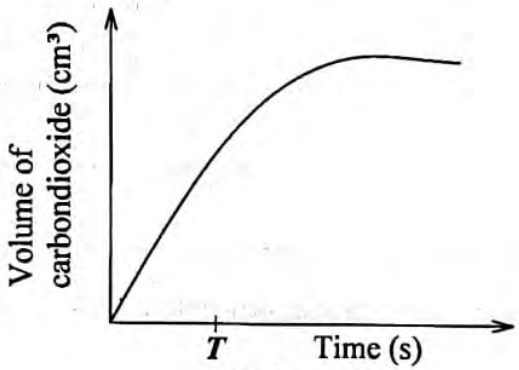


Fig. 3

Show how the rate of the reaction at time ***T*** can be determined.
(02 marks)

.....

.....

.....

(c) State **two** factors other than temperature that can affect the rate of a reaction. *(02 marks)*

.....

.....

10. (a) Write equation for the complete combustion of carbon. *(1½ marks)*

.....

.....

.....

(b) If 80 kg of charcoal cost UGX. 20,000. Calculate the cost of charcoal required to produce 163,750 kJ of heat energy.
(C = 12; The enthalpy of combustion of carbon = -393kJmol^{-1})
(03 marks)

.....

.....

.....

.....

.....

(c) State **one** use of charcoal other than fuel. *(½ marks)*

.....

SECTION B (30 MARKS)

Answer any **two** *questions from this section.*
Any additional question(s) answered will **not** *be marked.*

11. (a) Differentiate between **miscible** and **immiscible liquids**. (*02 marks*)

(b) (i) Name **two** compounds that can form a miscible liquid mixture and draw a diagram for the set-up of apparatus that can be used to separate the mixture. (*04 marks*)

(ii) State **one** method that can be used to determine the purity of the components of the mixture in (b)(i). (*01 mark*)

(c) Table **2** shows variation in temperature with time when a solid **X**, was heated to boiling.

Table 2

Temperature (°C)	25	47	80	80	162	218	218
Time (minutes)	0	1.0	2.5	4.5	7.0	8.7	9.5

(i) Draw a graph of temperature against time. (*04 marks*)

(ii) Explain the shape of the graph. (*04 marks*)

12. (a) Chlorine can be prepared in the laboratory by oxidation of concentrated hydrochloric acid.

(i) Name **one** suitable substance that can be used for oxidising hydrochloric acid. (*01 mark*)

(ii) Outline how a pure dry sample of chlorine can be prepared in the laboratory from the above reaction. (*Diagram is not required.*) (*06 marks*)

(b) State and write equation(s) to show how phosphorous reacts with chlorine. (*04 marks*)

(c) Explain the reaction of chlorine with potassium bromide. (*04 marks*)

13. (a) (i) State **two** ways by which water-bodies can be polluted. (*02 marks*)

(ii) Describe how polluted water can be treated on a large scale so that it is safe for use. (*Diagram not required.*) (*6½ marks*)

(b) When soap solution was added to a sample of water, a white precipitate was formed. But when the soap solution was added to another portion of the water that had been boiled, no precipitation took place. Explain. (*Your answer should include equation where possible*) (*6½ marks*)

14. (a) Using equations only, outline the processes involved in the manufacture of nitric acid. (*4½ marks*)

(b) A mixture of concentrated nitric acid and sulphur was warmed.
(i) State what was observed. (*1½ marks*)
(ii) Write equation for the reaction that took place. (*1½marks*)

(c) Ammonium nitrate is a mong the most widely used fertilisers. Write equation for the reaction leading to the formation of ammonium nitrate from nitric acid. (*1½ marks*)

(d) Ammonium nitrate dissolves in water according to the following equation:

$$NH_4NO_3(s) + H_2O(l) \longrightarrow HNO_3(aq) + NH_4OH\,(aq)$$

Excessive use of ammonium nitrate as a fertiliser can cause the soil to become acidic. Explain. (*2½ marks*)

(d) Write equation to show the effect of heat on;
(i) silver nitrate. (*1½ marks*)
(ii) potassium nitrate. (*1½ marks*)

(f) State **one** use of nitric acid other than in the manufacture of fertilisers. (*½ mark*)

SECTION A (50 MARKS)

1. Sea water contains mainly dissolved sodium chloride and traces of potassium bromide.

   a) State one practical method that can be used to obtain the following from sea water.

      i) Chlorine (01 mark)

      ii) A reasonably pure sample of sodium chloride. (01 mark)

      iii) Water free from ions. (01 mark)

   b) A vessel containing a sample of the water in a(iii) was connected to an ammeter which is turn was connected to a direct current source.

      i) State what was observed. (01 mark)

      ii) Give a reason for your observation in b(i). (01 mark)

2. a) The atomic numbers of hydrogen, magnesium and oxygen are 1, 12 and 8 respectively. Write the electronic configurations of the atoms of the elements. (1 ½ marks)

   b) Using outermost energy level electrons only, draw diagrams to show how oxygen forms a compound with

      i) Hydrogen (01 mark)

      ii) magnesium (01 mark)

   c) i) Which one of the compounds in (b) when dissolved in water will conduct electric current? (0 ½ mark)

      ii) Give a reason for your answer in c(i) (01 mark)

3. a) State why ammonia is not dried using

      i) anhydrous calcium chloride (01 mark)

      ii) concentrated sulphuric acid (1 ½ marks)

   b) Name the substance normally used in the laboratory for drying ammonia. (01 mark)

   c) Write equation for the reaction that can take place when copper (II) oxide is treated with ammonia. (1 ½ marks)

4. State the condition(s) under which sulphuric acid can react with the following substances and in each case write equation for the reaction that would take place

   a) Sugar ($C_{12}H_{22}O_{11}$)

      i) Condition(s) (01 mark)

ii) equation (1 ½ marks)

b) Magnesium

i) Condition (s) (01 mark)

ii) Equation (1 ½ marks)

5. The table below shows some tests carried out on a solution of salt Z and the observations that were made.

Test number	**Test**	**Observation**
I	Sodium hydroxide solution was added drop wise to aqueous Z until in excess	A white precipitate soluble in excess sodium hydroxide.
II	Ammonia solution was added drop wise to aqueous Z until in excess.	A white precipitate insoluble in excess ammonia
III	Dilute hydrochloric acid was added to aqueous Z and the mixture warmed	A white precipitate soluble on warming.

Use the observations from the table to answer the following questions

a) i) Identify the cation in Z. (01 mark)

ii) Write the ionic equation for the reaction in test III. (1 ½ marks)

b) Briefly describe how the cation in Z can be confirmed. (1 ½ marks)

6. Compound T contains 40.0% carbon, 6.7% hydrogen and the rest being oxygen.

a) i) Calculate the empirical formula of T. (03 marks)

ii) Determine the molecular formula of T. (01 mark)

(Relative formula mass of T = 60)

b) T dissolved in water to form a solution which turned blue litmus paper red.

i) State what would be observed when a few drops of T were added to sodium carbonate. (0 ½ mark)

ii) Write an ionic equation for the reaction that takes place in b(i). (1 ½ marks)

7. a) State what is meant by the term hard water. (01 mark)

b) Name two cations and two anions present in hard water.

i) Cations (01 mark)

ii) Anions (01 mark)

c) When a solution of barium nitrate was added to a sample of hard water, followed by dilute nitric acid, a white precipitate was formed that did not dissolve in the acid. Write equation for the reaction that took place. (02 marks)

8 a) When excess magnesium powder was added to 25cm^3 of portions of equimolar solutions of compounds of elements Q, W, X, Y and Z, the temperature rise in each case was noted as indicated in the table below.

Solution of compounds	Rise in temperature (^{o}C)
X	42
W	32
Y	0
Q	38
Z	14

i) Arrange the elements, Mg, X, W, Y, Q and Z in order of their reactivity, starting with the least reactive. (01 mark)

ii) State why there was no temperature rise when magnesium was added to the solution of the compound of Y. (01 mark)

b) Magnesium powder was added to copper(II) oxide and the mixture heated strongly.

i) State what was observed. (01 mark)

ii) Write equation for the reaction that took place. (1 ½ marks)

9 a) When a sample of copper(II) nitrate was strongly heated, a reddish brown gas was evolved.

i) Identify the gas. (0 ½ mark)

ii) Write the formula of the residue. (0 ½ mark)

b) A sample of copper(II) nitrate contaminated with zinc nitrate was dissolved in water and the solution was treated with excess sodium hydroxide solution and then filtered. Identify the cation in the

i) Filtrate (01 mark)

ii) Residue (01 mark)

c) The residue from (b) was strongly heated.

i) State what was observed. (01 mark)

ii) Write equation for the reaction that took place. (1 ½ marks)

10. a) State the difference between endothermic and exothermic reaction. (01 mark)

b) Carbon burns in air according to the following equation

$C_{(s)} + O_{2(g)} \quad CO_{2(g)} + \text{heat}$

When 4.00g of carbon was burnt in air, the heat produced raised the temperature of 550g of water by 56.8°C. Calculate the molar heat of combustion of carbon. (C = 12, specific heat capacity of water = $4.2Jg^{-1}K^{-1}$) (3 ½ marks)

c) From the equation in (b) suggest one use of carbon. (0 ½ mark)

SECTION B (30 MARKS)

Answer two questions from this section

11. a) Hydrogen peroxide gas bubbles slowly when exposed to air, but when aqueous iron (II) chloride is added, the production of gas bubbles becomes more rapid.

i) Name the gas produced when hydrogen peroxide is exposed to air. (01 mark)

ii) Write equation for the reaction that takes place. (1½ marks)

iii) State the role of iron (III) chloride in the reaction. (01 mark)

iv) Name another substance that can affect the production of the gas in the same way as iron(III) chloride. (01 mark)

b) The table below show the variation in the concentration of hydrogen peroxide with time when a sample of hydrogen peroxide was mixed with iron (III) chloride at room temperature.

Concentration of hydrogen peroxide (mol dm^{-3})	0.05	0.10	0.15	0.20	0.25
Time, t(s)	53	26	17	13	10.5
$1/t(s^{-1})$					

i) Copy and complete the table above by computing and filling in the values of 1/t. (2 ½ marks)

ii) Plot a graph of 1/t against concentration of hydrogen peroxide (04 marks)

iii) Using a graph, deduce how the rate of the reaction varies with the concentration of hydrogen peroxide. (01 mark)

iv) Determine the slope of the graph. (02 marks)

v) State two ways by which the rate of reaction in (b) could be made faster. (01 mark)

12. a) Explain how a dry sample of hydrogen chloride can be prepared from sodium chloride. (Your answer should include equation, but no diagram is required) (6½ marks)

b) State what would be observed and write equation for the reaction hat would take place if hydrogen chloride was passed.

i) over strongly heated iron wire (2 ½ marks)

ii) through aqueous silver nitrate (2 ½ marks)

c) Aqueous hydrogen chloride reacts with sodium carbonate solution to produce carbon dioxide according to the following equation

$Na_2CO_{3(aq)} + 2HCl_{(aq)} \longrightarrow 2NaCl_{(aq)} + H_2O_{(l)} + CO_{2(g)}$

Calculate the volume of carbon dioxide that would be produced at room temperature if excess sodium carbonate solution was added to $50.0cm^3$ of a solution containing 0.2 $moldm^{-3}$ of hydrogen chloride (1 mole of gas occupies $24.0dm^3$ at room temperature) (3 ½ marks)

13. a) i) Describe how sodium hydroxide can be manufactured using the mercury-cathode cell (Your answer should include equations f the reactions, but not diagram) (07 marks)

ii) State one use of the product formed at the anode and one use of the by product. (02 marks)

b) State how sodium hydroxide can react with the following substances and in each case write equation for the reaction

i) Sulphuric acid (2 ½ marks)

ii) Aluminium ion (3 ½ marks)

14. a) i) Draw a labeled diagram of the set-up of apparatus that can be used to prepare a dry sample of carbondioxide. (3 ½ marks)

ii) Write equation for the reaction leading to the formation of carbondioxide. (1 ½ marks)

b) Explain the reason for your choice of the

i) drying agent for carbondioxide (02 marks)

ii) method of collecting carbondioxide as shown in your diagram in a(i). (1½ marks)

c) Write equation(s) to show the reaction of carbondioxide with

i) water (1½ marks)

ii) Sodium hydroxide (03 marks)

d) State

i) Why carbon dioxide is used in making fire extinguishers. (01 mark)

ii) the effect of increased concentration of carbon dioxide on the environment.

(01 mark)

2017

Paper 2

SECTION A

1. Air is a mixture consisting mainly of two gases X and Y in the ratio 1:4 by volume respectively

   a) Name gas

      i) X (01 mark)

      i) Y (01 mark)

   b) i) State a suitable method by which the mixture of X and Y can be separated industrially. (01 mark)

      i) Give a reason for the choice of the method you have stated in b(i) above. (01 mark)

   c) Name one process during which the concentration of X in the atmosphere can be increased. (0 ½ mark)

   d) State one industrial use of Y. (0 ½ mark)

2. a) State the difference between hard water and soft water. (01 mark)

   b) Name one substance that causes

      i) temporary hardness of water. (01 mark)

      ii) permanent hardness of water. (01 mark)

   c) State one method that can be used to remove

      i) temporary hardness in water (01 mark)

      ii) permanent hardness in water. (01 mark)

3. The number of electrons, protons and neutrons in the atoms of elements A, B, C, D and E are shown in the table below.

Atoms	Electrons	Protons	Neutrons
A	8	8	8
B	13	13	14
C	16	16	16
D	Y	11	11
W	8	Z	10

   a) Determine the values of

      i) Y (0 ½ mark)

ii) Z (0 ½ mark)

b) State the mass number of atom C. (0 ½ mark)

c) Indicate which of the atoms

i) are isotopes (0 ½ mark)

ii) belong to the same group in the periodic table. (1 ½ marks)

d) Write the electronic configuration of

i) atom C (0 ½ mark)

i) ion A^{2+} (0 ½ mark)

iii) ion B^{3+} (0 ½ mark)

4. An oxide W of formula mass 160 consists of 70.0% iron

a) i) Calculate the empirical formula of W. (2 ½ marks)

ii) Deduce the formula of W. (1 ½ marks)

b) Write the chemical name of W. (01 mark)

5. In the preparation of ammonia in the laboratory, a mixture of ammonium chloride and calcium hydroxide is heated. The gas evolved is passed into a tower packed with calcium oxide before it is collected using upward delivery method.

a) i) Write an equation for the reaction that leads to the formation of ammonia. (1 ½ marks)

ii) State why ammonia is passed into the tower packed with calcium oxide. (0 ½ mark)

iii) Give a reason why ammonia is collected using upward delivery method. (0 ½ mark)

b) i) Name one reagent that can be used to identify ammonia. (01 mark)

ii) State what would be observed if ammonia was treated with the reagent you have named in b(i) above. (01 mark)

c) Name the catalyst that is used in the oxidation of ammonia during the manufacture of nitric acid. (1 ½ marks)

6 a) Hydrogen chloride can be produced from potassium chloride

i) Name another reagent that is used with potassium chloride to produce hydrogen chloride. (0 ½ mark)

ii) Write an equation for the reaction leading to the formation of hydrogen chloride. (1 ½ marks)

b) Write an equation for the reaction between hydrogen chloride and

i) Silver nitrate solution. (1 ½ marks)

ii) iron in the presence of water. (1 ½ marks)

7. Ethene is classified as an alkane and can be prepared in the laboratory by dehydration of ethanol

a) i) State what is meant by the term alkene. (01 mark)

ii) Write the structural formula of ethene. (01 mark)

iii) Name the reagent which is used as a dehydrating agent in the preparation of ethene. (01 mark)

b) Bromine was added to ethene. Write equation for the reaction that took place. (01 mark)

c) Under high temperature and pressure, ethene molecules can react with one another to form a big molecule Z.

i) Name Z (0 ½ mark)

ii) State one use of Z. (0 ½ mark)

8. In the extraction of sodium from sodium chloride, calcium chloride is added to sodium chloride and the mixture is melted. The molten mixture is then electrolyzed using graphite electrodes.

a) State the purpose of adding calcium chloride. (0 ½ mark)

b) Write the equation for the reaction that takes place at the

i) anode (1 ½ marks)

ii) cathode (1 ½ marks)

c) Bromine vapour was passed over heated sodium. Write an equation for the reaction that took place. (1 ½ marks)

9 a) Hydrogen peroxide decomposes quite easily at room temperature.

i) Write the equation for the decomposition of hydrogen peroxide. (01 mark)

ii) State two ways by which the decomposition can be made faster. (02 marks)

b) Using the space below, on the same axes sketch graphs of concentration of hydrogen peroxide versus time for the decomposition of the peroxide at

i) room temperature (01 mark)

ii) one of the conditions you have stated in a(ii) (01 mark)

10. a) State the conditions under which sulphuric acid can react with

i) sucrose $C_{12}H_{22}O_{11}$ (0 ½ mark)

ii) zinc oxide (0 ½ mark)

b) Write equation for the reaction of sulphuric acid with

i) sucrose (1 ½ marks)

ii) zinc oxide (1 ½ marks)

c) State the property of sulphuric acid which is shown by its reaction with

i) sucrose (0 ½ mark)

ii) zinc oxide (0 ½ mark)

SECTION B (30 MARKS)

Answer two questions from this section

11. a) Describe how a pure sample of carbon dioxide can be prepared in the laboratory from calcium carbonate and write the equation for the reaction that takes place. (Diagram is not required) (07 marks)

b) Explain with the aid of equations the changes that take place when excess carbon dioxide is bubbled into sodium hydroxide solution. (5 ½ marks)

c) Potassium hydrogen carbonate decomposes when heated according to the following equation: $2KHC_{3(s)}$ $K_2Co_{3(s)} + H_2O_{(l)} + CO_{2(g)}$

Calculate the mass of carbon dioxide evolved when 8g of potassium hydrogen carbonate is heated strongly (H = 1, C = 12, O = 16, K = 39) (2 ½ marks)

12. a) One of the ores from which iron is extracted is spathic iron ore

i) Write the formula of the iron compound that is the ore. (01 mark)

ii) Describe how impure iron is extracted from spathic iron ore. (Your answer should include equation) (07 marks)

b) Write equation(s) where possible and state the condition(s) for the reaction of iron with

i) Water (04 marks)

ii) chlorine (2 ½ marks)

c) State one use of iron. (0 ½ mark)

13. a) The elements copper, zinc and sulphur react with oxygen to form their oxides. Write the formula of the oxide of each of the elements and state the type of oxide whose formula you have written. (03 marks)

b) Hydrogen gas was passed separately over the heated oxides of copper and zinc.

i) State what was observed in each case and explain (04 marks)

ii) Write equation for any reaction that took place. (1 ½ marks)

c) Excess dilute sodium hydroxide solution was added to a mixture of the oxides of zinc and copper. State what was observed and give a reason for your observation. (2 ½ marks)

d) A mixture of oxides of zinc and copper was added to excess dilute sulphuric acid and warmed. State what was observed and write equation(s) for the reaction(s) that took place. (04 marks)

14. a) i) Write the equation for the complete combustion of ethanol. (01 mark)

ii) Outline an experiment that can be carried out in the laboratory to determine the enthalpy of combustion of ethanol. (6 ½ marks)

(*A diagram is not required, but your answer should include how the enthalpy of combustion of ethanol can be calculated from the experiment results)*

b) When 0.15g of compound W, molecular mass 60g was burnt, it caused the temperature of 150cm^3 of water to rise by 80^{0}C. Calculate the enthalpy of combustion of W. (Density of water = 1.0gcm^{-3}, specific heat capacity of water = 4.2Jg^{-1}K^{-1}) (02 marks)

c) The enthalpies of combustion ΔH_c of some hydrocarbons are shown in the table below.

Hydrogen	CH_4	C_2H_6	C_3H_8	C_4H_{10}	C_6H_{14}
ΔH_c	890	1560	2220	2880	4160

i) Plot a graph of enthalpy of combustion (Vertical axis) against number of carbon atoms in the hydrocarbons (horizontal axis) (03 marks)

ii) State from the graph you have plotted in c(i), the enthalpy of combustion of C_5H_{12}. (0 ½ mark)

iii) Determine the slope of the graph that you have drawn. (01 mark)

iv) Using your slope and the intercept, calculate the enthalpy of combustion of the hydrocarbon C_7H_{16}. (01 mark)

2016

Paper 2

SECTION A (50 MARKS)

1. a) State a method by which each of the following mixtures can be separated

i) Iron (II) chloride and iron (II) oxide. (0 ½ mark)

ii) Sodium carbonate and sodium hydrogen carbonate. (0 ½ mark)

b) Give a reason why it is possible to separate the mixture in a(i) using the method you have stated. (0 1mark)

c) State what would be observed if iron (II) chloride solution was mixed with aqueous silver nitrate. (01 mark)

d) Write the formula of the residue formed when a mixture of sodium carbonate and sodium hydrogen carbonate is heated strongly. (01 mark)

2. The atomic numbers of elements X, Y and Z are 18, 16 and 19.

a) State the

i) group in the periodic table to which X belongs. (01 mark)

ii) valency of Y (01 mark)

iii) period in the periodic table to which Z belongs. (01 mark)

b) Write the formula of the compound that can be formed when X reacts with

i) Y (01 mark)

ii) Z (01 mark)

c) State one physical property of the compound formed between X and Y in which it differs from the compound formed between X and Z. (01 mark)

3. a) State the conditions under which oxygen can react with

i) Sulphur (0 ½ mark)

ii) Copper (0 ½ mark)

b) Write equation for the reaction between oxygen and

i) Sulphur (1 ½ marks)

ii) copper (1 ½ marks)

c) i) State which one of the compounds formed in b(i) and (ii) will react with dilute hydrochloric acid, (1 ½ marks)

ii) Give a reason for your answer in c(i) (0 ½ mark)

4. a) A mixture of iron fillings and sulphur was heated strongly. Write equation for the reaction that took place. (1 ½ marks)

b) Dilute sulphuric acid was added to the product in (a)

i) State what was observed. (01 mark)

ii) Write equation for the reaction that took place. (1 ½ marks)

c) One of the substances formed in reaction b(ii) pollutes air.

i) Identify the substance. (0 ½ mark)

ii) Give one reason why the substance pollutes air. (0 ½ mark)

5. Ammonia reacts with oxygen in the presence of hot platinum to produce a colourless gas X, which eventually gives brown fumes.

a) Identify X. (0 ½ mark)

b) Write equation to show the formation of

i) X (1 ½ mark)

ii) the brown fumes (01 mark)

c) State the

i) role of platinum (0 ½ mark)

ii) industrial application of the reaction in (b) (0 ½ mark)

6. A gaseous organic compound J contains 82.76% carbon, the rest being hydrogen.

a) To which group of the organic compounds does J belong? (01 mark)

b) Calculate the empirical formula of J (H = 1, C = 12) (2 ½ marks)

c) 140cm3 of J weighed 0.363g at s.t.p. Determine the molecular formula of J.
(1 mole of a gas occupies 22400cm^3 at s.t.p) (2 ½ marks)

7. State what would be observed and write ionic equation for the reaction that would take place if hydrogen chloride was bubbled through aqueous

a) Sodium hydrogen carbonate

i) Observation (0 ½ mark)

ii) Equation (1 ½ marks)

b) Silver nitrate

i) observation (0 ½ mark)

ii) equation (1 ½ marks)

8 a) i) Name one process by which ethanol can be produced from sugar. (0 ½ mark)

ii) Write equation for the production of ethanol by the process you have named in a(i) (01 mark)

b) Ethanol can be converted to ethene by dehydration.

i) State the conditions under which the reaction takes place. (1 ½ marks)

ii) Write equation for the reaction leading ot he formation of ethene from ethanol. (01 mark)

c) Write equation for the reaction between ethene and bromine. (01 mark)

9. a) State what is meant by the term enthalpy of combustion. (01 mark)

b) Carbon burns in oxygen according to the following equation.

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$: $\Delta H = -393 kJmol^{-1}$

Calculate the

i) amount of heat evolved when 3.6g of carbon is burnt completely in oxygen. (C = 12) (02 marks)

ii) volume of oxygen at s.t.p that would be required to produce 78.6kg of heat. (1 mole of gas occupies 22.4dm3 at s.t.p) (02 marks)

10. Name one reagent that can be used o differentiate between the following pairs of ions and in each case state what would be observed when each of the ions is treated separately with the reagent you have named.

a) $HCO^{-}_{3\ (aq)}$ and $CO^{2-}_{3\ (aq)}$

i) Reagent (01 mark)

i) Observation (01 mark)

b) $Pb^{3+}_{(aq)}$ and $Zn^{2+}_{(aq)}$

i) Reagent (01 mark)

ii) observation (01 mark)

c) SO_4^{2-} and $Cl^{-}_{(aq)}$ (01 mark)

i) Reagent (01 mark)

ii) Observation (01 mark)

SECTION B (30 MARKS)

Answer any two questions from this section

11. a) Distinguish between the terms anode and cathode. (02 marks)

b) Explain why copper (II) chloride in solid form does not conduct electricity whereas in molten form it does. (2 ½ marks)

c) A dilute solution of copper (II) chloride was electrolyzed using graphite as electrodes

i) State what was observed at the cathode. (01 mark)

ii) Write equation for the reaction the anode and cathode respectively. (2 ½ marks)

d) Describe how the product at the anode can be identified. (02 marks)

e) The electrolysis of dilute copper (II) chloride was repeated for sometime using copper instead of graphite as electrodes.

i) State what was observed at the anode and cathode respectively. (02 marks)

ii) Write equation to support your observation at the anode. (01 mark)

f) State one factor other than change of electrodes from graphite to copper that would affect the products of electrolysis of copper (II) chloride solution and indicate how it would affect the process. (02 marks)

12. a) Describe how a dry sample of hydrogen can be prepared in the laboratory. (Diagram is not required.) (4 ½ marks)

b) Hydrogen burns in air to form liquid L

i) identify L (01 mark)

ii) Name a reagent that can be used to test for L and state what would be observed if L was treated with the reagent you have named. (02 marks)

c) Write equation to show the reaction of hydrogen with chlorine. (1 ½ marks)

d) State the condition(s) under which hydrogen can react with copper(II) oxide and write equation for the reaction

e) Hydrogen reacts with iron (II, III) oxide according to the following equation.

$Fe_3O_{4(s)} + 4H_{2(g)} \longrightarrow 3Fe_{(s)} + 4H_2O_{(l)}$

Calculate the volume of hydrogen measured at room temperature that would be required to produce 3.36g of iron. (Fe = 56, 1 mole of gas occupies 24dm3 at room temperature. (5 ½ marks)

f) State one industrial use of hydrogen. (01 mark)

13. a) Aluminium oxide is an amphoteric oxide

i) Define the term amphoteric oxide (01 mark)

ii) Write equation to show the reaction of aluminium oxide with dilute nitric acid. (1 ½ marks)

iii) Give two examples of amphoteric oxides other than aluminium oxide. (01 mark)

b) i) With the aid of an equation, describe how a pure dry sample of aluminium sulphate crystals can be prepared in the laboratory. Starting from aluminium oxide. (06 marks)

ii) Hydrated aluminium sulphate, $Al_2(SO_4)_3 . nH_2O$ contains 9.7% of aluminium. Calculate the value of n in the above formula. (Al = 27, S = 32, O = 16, H = 1) (2 ½ marks)

c) i) Name one reagent that can be used to distinguish between aluminum ion and lead (II) ions. (0 ½ mark)

ii) State what would be observed and write equation for the reaction that takes place if any, when the reagent you named in c(i) is treated separately with aluminium ions and lead(II) ions. (2 ½ marks)

14. Haematite is one of the ores from which iron can be extracted.

a) Write the chemical formula of haematite (0 ½ mark)

b) During the extraction of iron, roasted haematite is mixed with coke and

limestone. The mixture is fed into the blast furnace and a blast of hot air blown into the furnace from the bottom.

i) Write equation(s) for the reaction (s) in the blast furnace that leads to the formation of iron. (4 ½ marks)

ii) Explain the role of limestone. (4 ½ marks)

c) Write equation for the reaction of iron with

i) Water (1 ½ marks)

ii) hydrochloric acid (1 ½ marks)

d) To the resultant mixture in reaction c(ii) was added dilute ammonia solution until the alkali was in excess. State what was observed and write equation for the reaction that took place. (2 ½ marks)

2015

Paper 2

SECTION A (50 MARKS)

1. Duralumin is an alloy of aluminium, copper and element D.

a) i) Identify element D. (0 ½ mark)

ii) State one use of duralumin. (0 ½ mark)

b) Na\me the elements commonly used for making each of the following alloys and in each case give one use of the alloy.

i) Steel

Element (01 mark)

Use (0 ½ mark)

ii) Solder

Element (01 mark)

Use (0 ½ mark)

c) Some two reasons why alloys are commonly used instead of pure elements. (01 mark)

2. Hydrochloric acid reacts with sodium sulphite to form a gas Q.

a) Identify Q. (01 mark)

b) State the conditions under which the reaction takes place. (01 mark)

c) Write an ionic equation for the reaction leading to the formation of Q. (1 ½ marks)

d) i) Name one reagent that can be used to identify Q. (0 ½ mark)

ii) State what would be observed if Q was tested with the reagent you have named in d(i) . (01 mark)

3. The molecular formula of an organic compound J is C_3H_8.

a) i) Write the structural formula of J. (01 mark)

ii) Name J (01 mark)

iii) Name the group of organic compounds to which J belongs. (01 mark)

b) It is not wise to burn J in a living room with closed windows and doors. Give a reason. (01 mark)

c) State one use of J. (0 ½ mark)

4 a) i) Name two substances from which nitric acid can be prepared in the laboratory. (02 marks)

ii) Write an equation for the reaction between the substances you have named in c(i) (1 ½ marks)

b) Write an equation for the reaction between fuming nitric acid and copper. (1 ½ marks)

5. a) Soot is form of carbon.

i) Write an equation for the complete combustion of soot in oxygen. (01 mark)

ii) Calculate the volume of gas produced at room temperature, when 0.6g of soot is burnt in excess oxygen. (C = 12, 1 mole of a gas occupies 24.0dm^3 at room temperature) (02 marks)

iii) Deduce the volume of the gas that would be produced at room temperature if the same mass of graphite was burnt in excess oxygen. (0 ½ mark)

iv) Give a reason for your answer in a(iii). (01 mark)

b) State one industrial use of graphite. (0 ½ mark)

6. a) Write an equation to show the reaction that would take place leading to the formation of hydrogen if

i) acidified water was electrolyzed (01 mark)

ii) potassium was added to water. (1 ½ marks)

b) Dry hydrogen was passed over strongly heated copper(II) oxide.

i) State what was observed. (1 ½ marks)

ii) Write an equation for the reaction that took place. (1 ½ marks)

iii) Name one non metallic substance that would react with copper (II) oxide in a similar way to hydrogen. (0 ½ mark)

7. When excess iron fillings were added t0 200cm^3 of a 0.5M copper (II) sulphate solution in a plastic cup, the temperature of the solution rose by 17.9^{0}C.

a) Write an ionic equation for the reaction that took place. (1 ½ marks)

b) Suggest a reason why a plastic cup was used instead of a metallic cup. (0 ½ mark)

c) i) Calculate the enthalpy change for the reaction between iron fillings and copper (II) sulphate solution (O = 16, S = 32, Fe = 56, Cu = 64, the density of water = 1gcm-3 and the specific heat capacity of water = 4.2Jk^{-1}) (02 marks)

ii) State any assumption(s) you have made in the calculation in c(i) (01 mark)

8 During the manufacture of sodium hydroxide, concentrated sodium chloride solution is electrolyzed using mercury as the cathode.

a) i) Name the substance that is used as the anode. (0 ½ mark)

ii) Give a reason for the choice of the substance (01 mark)

iii) Identify the product collected at the anode. (0 ½ mark)

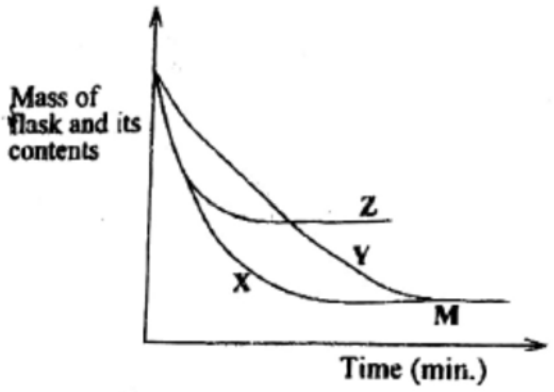
b) During the electrolysis, sodium amalgam is formed at the cathode

i) State how sodium amalgam is converted to sodium hydroxide. (0 ½ mark)

ii) Write an equation for the reaction leading to the formation of sodium hydroxide. (1 ½ marks)

c) State one industrial use of sodium hydroxide. (0 ½ mark)

9 Curve Y in the diagram below shows the results that were obtained during the investigation of the rate of the reaction between iron and dilute hydrochloric acid under normal conditions. Curves X and Z were obtained when some conditions of the experiment were changed.



a) i) List three conditions that were changed to obtain curve X. (03 marks)

ii) State what point M represents. (0 ½ mark)

b) Some conditions you have listed in a(i) were changed to obtain curve Z.

i) State the conditions changed. (01 mark)

ii) Give a reason for your answer. (01 mark)

10. a) Dilute ammonia solution was added to a solution containing lead (II) ions. Write an ionic equation for the reaction that took place. (01 mark)

b) To the resultant mixture in (a) was added dilute sodium hydroxide solution drop wise until in excess.

i) State what was observed. (01 mark)

ii) Give a reason for your answer in b(i) (01 mark)

c) Zinc powder was added to an aqueous solution of lead (II) nitrate and the mixture allowed to stand

i) Write an equation for the reaction that took place. (01 mark)

ii) State any conclusion that can be drawn from the equation you have written in c(i) (01 mark)

SECTION B (30 MARKS)

Answer two questions from this section

11. a) i) Name the fundamental particles in an atom and in each case state the type of charge on the particle. (03 marks)

ii) Draw a labeled diagram to show the location of the particles in an atom. (02 marks)

b) The full symbols of atoms of elements Q and R are $^{23}_{11}Q$ and $^{35}_{17}R$ respectively.

Write the name and number of particles in the atoms Q and R. (03 marks)

c) Name the type of bond that would be formed between

i) two atoms of R (0 ½ mark)

ii) an atom of R and an atom of Q. (0 ½ mark)

d) i) With the aid of diagrams describe how the bond you have named in (b) are formed. (05 marks)

ii) State one property of the compound formed between Q and R. (01 mark)

12. a) Briefly describe how a dry sample of hydrogen chloride can be prepared in the laboratory. (Diagram is not required) (5 ½ marks)

b) Hydrogen chloride was bubbled through a solution of lead (II) nitrate

i) State what was observed and explain your answer. (2 ½ marks)

ii) Write an equation for the reaction that took place. (1 ½ marks)

c) Concentrated hydrochloric acid is commonly used for removing oxides from metal surfaces (pickling). Explain why concentrated nitric acid is not used for the same purpose. (1 ½ marks)

d) A sample of hydrogen chloride gas was dissolved in water to make 250cm^3 of solution. 25.0cm3 of this solution required 46cm^3 of 2M sodium hydroxide for complete neutralization. Determine the mass of hydrogen chloride that was dissolved to make 250cm^3 of solution. (H = 1, Cl = 35.5) (04 marks)

13. a) Calcium nitrate was strongly heated.

i) State what was observed. (1 ½ marks)

ii) Write equation for the reaction that took place. (1 ½ marks)

iii) Name a gas that can be dried using the solid residue. (01 mark)

iv) Calculate the total gaseous products formed at room temperature when 4.5g of calcium nitrate is heated strongly. (N = 14, O = 16, Ca = 40, 1 mole of a gas occupies 24.0dm^3 at room temperature) (03 marks)

b) The residue in (a) was dissolved in water. Write equation for the reaction that took place. (1 ½ marks)

c) Excess carbondioxide was bubbled through the solution in (b). State

i) what was observed and write the equation(s) for the reaction(s) that took place. (4 ½ marks)

ii) one application of this reaction in gas analysis. (01 mark)

d) To the solution in (b) soap solution was added. State what was observed. (01 mark)

14. a) Describe how pure sugar can be obtained from sugar cane on industrial scale. (Diagram not required) (07 marks)

b) Sugar can be converted in the presence of an enzyme to ethanol. Name the

i) process leading to the formation of ethanol. (01 mark)

ii) enzyme used in the process. (01 mark)

c) Write an equation for the reaction that leads to the formation of ethanol. (01 mark)

d) When concentrated sulphuric acid was added to sugar, a black solid was formed. Explain what took place and illustrate your answer with an equation.

e) State one use of

i) sugar (01 mark)

ii) ethanol (01 mark)

2014

Paper 2

SECTION A (50 MARKS)

1. A small amount of ethanol was added to a large amount of water and the mixture shaken

   a) State what was observed. (0 ½ mark)

   b) In the mixture in (a), state which one of the components is the

      i) Solute (0 ½ mark)

      ii) Solvent (0 ½ mark)

   c) Name the method that would be used to separate the mixture formed in (a). (0 ½ mark)

   d) In another experiment, simsim oil was shaken with water.

      i) State what was observed. (0 ½ mark)

      ii) Give a reason for your answer in d(i) (01 mark)

      iii) Name the piece of apparatus that would be used to separate the mixture. (0 ½ mark)

2. The atomic numbers of elements Q, R and T are 6, 17 and 19 respectively.

   a) Write the electronic configuration of

      i) Q (0 ½ mark)

      ii) R (0 ½ mark)

      iii) T (0 ½ mark)

   b) R reacted separately with Q and T to form compound X and Y respectively. State the type of bond that exists in compound.

      i) X (01 mark)

      ii) Y (01 mark)

   c) Identify which one of the components in (b) would be soluble in

      i) Water (0 ½ mark)

      ii) petrol (0 ½ mark)

3. a) Sodium metal was burnt in excess oxygen

      i) State what was observed (01 mark)

      ii) Write the equation for the reaction that took place. (1 ½ marks)

   b) Water was added to the product in (a)

      i) State what was observed. (01 mark)

      ii) Write the equation for the reaction that took place. (1 ½ marks)

4. a) A mixture of magnesium powder and lead(II) oxide was heated strongly until

there was no further change.

i) State what was observed. (02 marks)

ii) Write equation for the reaction that took place. (1 ½ marks)

b) The experiment in (a) was repeated using a mixture of copper turnings and magnesium oxides. State what was observed. (0 ½ mark)

c) Briefly explain your observations in (a) and (b). (02 marks)

5 a) Natural rubber is soft and it is normally made hard before use.

i) Name one process by which natural rubber is made hard. (01 mark)

ii) State how natural rubber is made hard by the process you have named in a(i) (01 mark)

b) State:

i) two reasons why natural rubber is made hard before use. (01 mark)

ii) two uses of rubber. (01 mark)

6 a) i) Write equation to show how hydrogen can be prepared using zinc and dilute sulphuric acid. (1 ½ marks)

ii) State how hydrogen can be tested in the laboratory. (01 mark)

b) Hydrogen reacts with copper (II) oxide according to the following equation

$CuO(s) + H_2(g) \longrightarrow Cu(s) + H_2O(l)$

i) State what is observed when dry hydrogen is passed over heated copper (II) oxide. (01 mark)

ii) Calculate the volume of hydrogen at s.t.p that would react with copper(II) oxide to form 3.20g of copper (O = 16, Cu = 64, one mole of gas occupies $22.4dm^3$ at s.t.p) (2 ½ marks)

7 a) When a nitrate of a metal Y was heated strongly, brown fumes were observed together with a solid residue which was reddish brown when hot and yellow when cooled.

i) Identify Y. (01 mark)

ii) Write equation for the reaction hat took place. (1 ½ marks)

b) The residue from (a) was heated with dilute nitric acid. Write equation for the reaction that took place. (1 ½ marks)

c) To the product in (b), dilute sodium hydroxide was added drop wise until there was not further change. State what was observed. (1 ½ marks)

8. a) Carbon monoxide was passed over heated iron (II) oxide

i) Write equation for the reaction that took place. (1 ½ marks)

ii) Write equation for the reaction between the solid product in a(i) and dilute sulphuric acid. (1 ½ marks)

b) Chlorine was bubbled through the product in a(i)

i) State what was observed. (01 mark)

ii) Write ionic equation for the reaction that took place. (1 ½ marks)

9 a) Write equation for the complete combustion of methane. (1 ½ marks)

b) $0.12dm^3$ of methane was completely burnt in air. Calculate the

i) volume of oxygen at s.t.p that would be required for the complete combustion of methane. (02 marks)

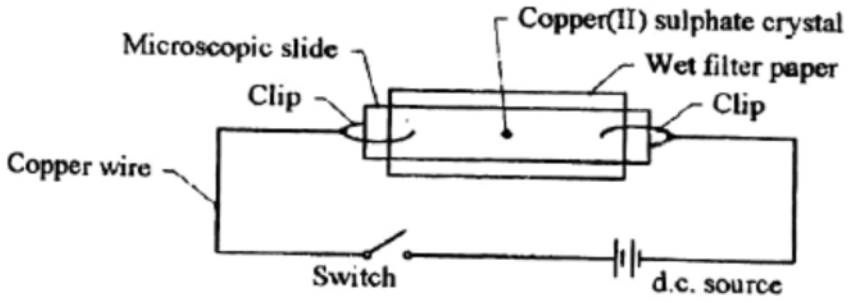
ii) quantity of heat that would be liberated during the reaction. (One mole of methane completely burns to give 890-KJ of heat: one mole of gas occupies 22.4dm3 at s.t.p) (1 ½ marks)

10. a) Both copper wire and copper (I) sulphate conduct electric current. Name the particles which conduct electric current in

i) copper wire (0 ½ mark)

ii) aqueous copper(II) sulphate (0 ½ mark)

b) The set up of apparatus in the diagram below was used to find out what happens when an electrolyte is connected to a source of electric current.



State what was observed.

i) when the switch was closed (0 ½ mark)

ii) if copper (II) sulphate crystal was replaced with potassium manganate (VII) crystal and the switch closed once again. (01 mark)

c) i) Give a reason for the observation you have made in b(i) and (i). (01 mark)

ii) State any general conclusion that can be drawn following the reason you have given in c(i) (01 mark)

SECTION B

Answer any two questions from this section .

11. a) i) With the aid of a labeled diagram, explain how a pure dry sample of sulphur dioxide can be prepared in the laboratory using sodium sulphite and sulphuric acid. (05 marks)

ii) Write an equation for the reaction leading to the formation of sulphur dioxide. (1 ½ marks)

b) Name one reagent that would be used to confirm the presence of sulphur dioxide and state what would be observed if the reagent you have named was treated with sulphur dioxide. (02 marks)

c) Write an equation to show the reaction between sulphur dioxide and

i) water (1 ½ marks)

ii) oxygen in the presence of hot platinum. (1 ½ marks)

d) The product of the reaction in c(ii) was mixed with water and barium nitrate solution added to the resultant mixture

i) State what was observed. (01 mark)

ii) Explain what took place (No equation required) (2 ½ marks)

12. a) State the difference between the following pairs of terms:

i) Synthetic polymer and natural polymer (02 marks)

ii) Thermosetting polymer and thermo softening polymer (or thermoplastic) (03 marks)

b) i) State the conditions under which sulphuric acid can react with ethanol to produce ethene. (1 ½ marks)

ii) Write an equation leading to the formation of ethene. (01 mark)

c) When reacted together, ethene molecules can form a polymer

i) Name the polymer. (01 mark)

ii) Write an equation leading to the formation of the polymer. (01 mark)

iii) State one use of the polymer. (01 mark)

d) Name one

i) synthetic polymer other than the one you have named in (c) (01 mark)

ii) natural polymer other than rubber. (01 mark)

e) State one

i) use of each of the polymers you have named in (d) (02 marks)

ii) disadvantage of the polymer formed in c(ii) (0 ½ mark)

13. a) Chlorine can be prepared in the laboratory using potassium manganate(VII) $KMnO_4$

i) Name one substance that reacts with potassium manganate (VII) to produce chlorine. (01 mark)

ii) State the condition for the reaction (01 mark)

iii) Write an equation for the reaction leading to the formation of chlorine. (1 1½ marks)

b) Damp blue litmus paper was dropped in a gas jar containing chlorine. State what was observed and explain your observation(s). (03 marks)

c) A boiling tube filled with chlorine water was inverted into a beaker containing chlorine water and exposed to sunlight for sometime.

i) State what was observed. (0 ½ mark)

ii) Explain with the aid of equation(s), your observation(s) in c(i) (03 marks)

d) Write an equation show how chlorine can react with

i) dilute potassium hydroxide solution. (1 ½ marks)

ii) turpentine $C_{10}H_{16}$. (1 ½ marks)

e) Briefly describe a test you would carryout to confirm the presence of chloride ion in solution. State what would be observed and write an equation for the reaction that would take place. (2 ½ marks)

14. a) Write an equation for the reaction between oxygen and

i) ammonia in the presence of hated platinum. (1 ½ marks)

ii) nitrogen monoxide. (1 ½ marks)

b) State how the product in a(ii) can be converted to nitric acid. (1 ½ marks)

c) Write an equation and state the conditions for the reaction between nitric acid and

i) sulphur (2 ½ marks)

ii) lead (II) oxide (2 ½ marks)

d) In each case, state what was observed and write an equation for the reaction that took place when, sodium nitrate was heated strongly

i) alone

ii) as a mixture with concentrated sulphuric acid. (5 ½ marks)

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SECTION A

Answer all questions in this section

1. Tea was placed in a cup of hot water and allowed to stand

   a) State what was observed. (01 mark)

   b) Name the process that occurred. (01 mark)

   c) State what the process you have named in (b) demonstrates. (02 marks)

2. The number of protons, electrons and neutrons in some particles (ions and atoms) A, B, E, G , H and F are shown in the table below.

	Particles					
	A	D	E	G	H	F
Protons	6	8	13	11	8	17
Electrons	6	8	10	11	8	18
Neutrons	6	8	14	12	10	18

   a) Identify which one of the particles is

      i) an anion (01 mark)

      ii) a cation (01 mark)

   b) State two particles which are atoms of the same element. (01 mark)

   c) State the type of bond formed when particle A, combines with particle H. (01 mark)

   d) Write the formula of the ion formed from particle G. (01 mark)

3. When hydrogen peroxide is exposed to sunlight, it composes to give a colourless gas.

   a) i) Write equation for the reaction that takes place. (1 ½ marks)

      ii) Calculate the volume of the gas that would be evolved at room temperature when 20g of hydrogen peroxide decomposes completely at room temperature. (02 marks)

   b) i) State what would be observed if manganese (IV) oxide was added to the hydrogen peroxide. (01 mark)

      ii) Give a reason for your answer in b(i) (01 mark)

4. Calcium dihydrogen phosphate is more used in agriculture as a source of phosphorus for plant nutrients than calcium phosphate

a) Write the formula of

i) calcium dihydrogen phosphate. (01 mark)

ii) calcium phosphate (01 mark)

b) i) Calculate the percentage of phosphorous in calcium phosphate. (02 marks)

ii) Suggest a reason why calcium dihydrogen phosphate is used more in agriculture than calcium phosphate. (0 ½ mark)

c) Write an ionic equation to show how calcium phosphate can be prepared in the laboratory. (1 ½ marks)

5. Steam was passed over heated magnesium

a) i) State what was observed. (01 mark)

ii) Write equation for the reaction that took place. (1 ½ marks)

b) To the solid produced in a(ii) was added dilute hydrochloric acid

i) State what was observed. (01 mark)

ii) Write equation for the reaction that took place. (1 ½ marks)

6. When a black solid, X was dissolved in warm dilute hydrochloric acid, a gas that smelt like a rotten egg was evolved and a green solution was formed. The solution when treated with aqueous sodium hydroxide formed a dirty green precipitate, Y which turned reddish brown on standing in air.

a) Identify

i) the anion in X. (0 ½ mark)

ii) the cation in X. (0 ½ mark)

b) i) Name Y. (01 mark)

ii) Write equation for the reaction which led to the formation of Y. (1 ½ marks)

c) State why Y turned reddish brown on standing in air. (01 mark)

7 The general formula of compounds Q and r are C_nH_{2n} and C_nH_{2n+2} respectively.

a) Write the molecular formula and the name of Q and r for n = 2

i) Q: formula (0 ½ mark)

Q: Name (0 ½ mark)

ii) R: formula (0 ½ mark)

R: Name (0 ½ mark)

b) State the structural difference between Q and R. (01 mark)

c) i) Name a reagent can be used to distinguish Q and R. (0 ½ mark)

ii) State what would be observed if the reagent you have named in c(i) was treated separately with Q and R. (1 ½ marks)

iii) Write equation for any reaction that would take place to illustrate your observation in c(ii). (01 mark)

8 In order to illustrate a redox reaction, zinc was added to copper (II) sulphate solution and the set up left to stand for sometime.

a) State what was observed. (01 mark)

b) State the substance that was:

i) oxidized (01 mark)

ii) reduced (01 mark)

c) Name one other substance that would react with copper (II) sulphate in a similar way like zinc. (0 ½ mark)

9. An aqueous solution of potassium iodide was electrolyzed between carbon electrodes.

a) State what was observed at the anode. (01 mark)

b) i) Name the product formed at the cathode. (0 ½ mark)

ii) Describe the test that can be carried out to identify the product at the cathode. (01 mark)

c) Litmus paper was dropped into the solution around the cathode at the end of the experiment.

i) State what was observed. (01 mark)

ii) Give a reason for your answer in c(i). (01 mark)

10. $90cm^3$ of 0.1M calcium hydroxide solution was added to a sample of water containing 0.01 moles of calcium hydrogen carbonate

a) State what was observed. (0 ½ mark)

b) Write equation for the reaction which took place. (1 ½ marks)

c) Calculate the number of moles of calcium ions in the $90cm^3$ of 0.1M calcium hydroxide. (1 ½ marks)

d) i) State what would be observed if soap solution was added to a sample of the water after the addition of calcium hydroxide. (0 ½ mark)

ii) Give a reason for your observation in d(i) (01 mark)

SECTION B

Answer two questions from this section.

11. a) Describe how a pure dry sample of chlorine can be prepared in the laboratory from potassium manganate (VII) crystals (Your answer should include a well labeled diagram and equation for the reaction) (06 marks)

b) State what would be observed if chlorine was bubbled through a:

i) blue litmus solution (01 mark)

ii) potassium bromide solution (01 mark)

iii) Solution of iron (II) ions (01 mark)

c) Write equation for the reaction in b(ii) and (iii) (03 marks)

d) Write equation for the reaction between chlorine and

i) heated iron (1 ½ marks)

ii) cold dilute sodium hydroxide solution. (1 ½ marks)

12. a) Nitrogen can react with hydrogen in the presence of catalyst which is finely divided to form ammonia in the Haber process.

i) State the source of nitrogen (0 ½ mark)

ii) Name the catalyst used in the reaction (0 ½ mark)

iii) Explain why the catalyst is finely divided (1 ½ marks)

iv) Write equation for the reaction leading to the formation of ammonia. (01 mark)

b) Write equation for the reaction to show that ammonia can:

i) act as a reducing agent (1 ½ marks)

ii) burn in oxygen (1 ½ marks)

c) Ammonia obtained by the Haber process can be converted to nitrogen (II) oxide.

i) Write equation for the reaction leading to the conversion of ammonia to nitrogen (II) oxide. (1 ½ marks)

ii) State the conditions for the reaction. (01 mark)

d) Write equation(s) to show nitrogen (II) oxide can be converted to nitric acid. (03 marks)

e) When aqueous ammonia was added drop wise until in excess to a solution of copper (II) nitrate a blue precipitate, P which dissolved in excess ammonia to give a deep blue solution was formed

i) Identify P. (01 mark)

ii) Write the formula and name of the cation in the deep blue solution.

(01 mark)

13. a) i) Write equation for the reaction that can take place between zinc oxide and dilute nitric acid. (1 ½ marks)

ii) Briefly describe how dry crystals of the product of the reaction in a(i) can be obtained in the laboratory (3 ½ marks)

b) State what would be observed and write equation for the reaction that would take place if:

i) the crystals in a(ii) were heated. (3 ½ marks)

ii) to the solution of the crystals in a(ii) was added few drops of aqueous ammonia. (02 marks)

c) Excess silver nitrate solution was added to a solution containing 2.72g of zinc chloride.

i) State what was observed. (0 ½ mark)

ii) Write equation for the reaction that took place. (01 mark)

iii) Calculate the mass of silver that was used in the reaction. (Relative formula mass of zinc chloride = 136) (03 marks)

14. Sodium thiosulphate reacts with dilute acids according to the following equation.

a) State what would be observed if dilute hydrochloric acid was added to sodium thiosulphate solution. (0 ½ mark)

b) The rate of the reaction is affected by the concentration of sodium thiosulphate.

i) State one factor other than concentration that can affect the rate of the reaction. (0 ½ mark)

ii) Briefly explain the effect of the factor you have stated in b(i) on the rate of the reaction. (02 marks)

iii) Describe an experiment that can be carried out in the laboratory to show the effect of the factor you have stated in b(i) on the rate of the reaction. (Diagram not required) (6 ½ marks)

c) The table below shows the variation in the concentration of sodium thiosulphate with time.

Time(s)	200	100	40	20	10
Concentration of thiosulphate ($moldm^{-3}$)	0.05	0.09	0.15	0.20	0.25
1/concentration of thiosulphate ($moldm^{-3}$)					

i) Determine the values for 1/concentration of sodium thiosulphate, copy the table and enter your answers in the spaces provided in the table. (01 mark)

ii) Plot the graph of 1/concentration of thiosulphate (Vertical axis) against time(horizontal axis) (03 marks)

iii) State any conclusion that can be drawn from the shape of the graph. (1 ½ marks)

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