

Name:.....

Index No: .....

233/1  
CHEMISTRY  
Paper 1  
(THEORY)  
Oct./Nov. 2015  
2 hours

Candidate's signature: .....

Date: .....



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



02315200

**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 15 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.**

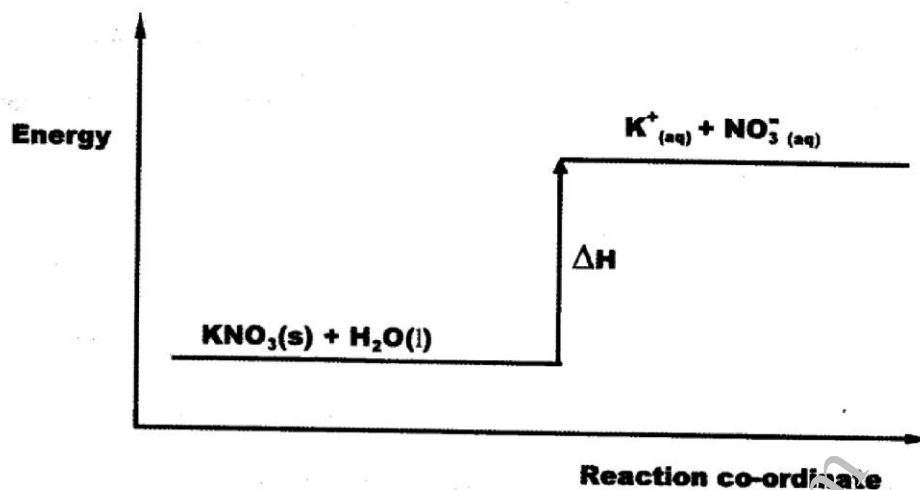
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Questions	Maximum Score	Candidate's Score
1 - 29	80	



- 1 (a) Give the name of the first member of the alkene homologous series. (1 mark)
- .....
- (b) Describe a chemical test that can be used to distinguish butanol from butanoic acid. (2 marks)
- .....
- .....
- .....
- .....
- 2 (a) Name the raw material from which sodium is extracted. (1 mark)
- .....
- (b) Give a reason why sodium is extracted using electrolysis. (1 mark)
- .....
- (c) Give two uses of sodium metal. (1 mark)
- .....
- .....
- .....
- 3 (a) What is meant by lattice energy? (1 mark)
- .....
- .....

- (b) Study the energy level diagram below and answer the question that follows:



What type of reaction is represented by the diagram? (1 mark)

.....

- 4 (a) State the Boyles law. (1 mark)

.....

- (b) A gas occupies  $500 \text{ cm}^3$  at  $27^\circ\text{C}$  and  $100,000 \text{ Pa}$ . What will be its volume at  $0^\circ\text{C}$  and  $101325 \text{ Pa}$ ? (2 marks)

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- 5 Calculate the mass of Zinc oxide that will just neutralise dilute nitric (V) acid containing 12.6 g of nitric (V) acid in water. ( $Z_n = 65.0$ ;  $O = 16.0$ ,  $H = 1.0$ ,  $N = 14.0$ ). (3 marks)

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- 6 Describe how sodium carbonate is used to remove water hardness. (2 marks)

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- 7 Hydrogen chloride gas can be prepared by reacting sodium chloride with an acid.

(a) Write an equation for the reaction between sodium chloride and the acid. (1 mark)

.....

.....

(b) Give two chemical properties of hydrogen chloride gas. (1 mark)

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.....

(c) State two uses of hydrogen chloride. (1 mark)

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- 8 When solid A was heated strongly, it gave off water and a solid residue. When water was added to the solid residue, the original solid A, was formed .

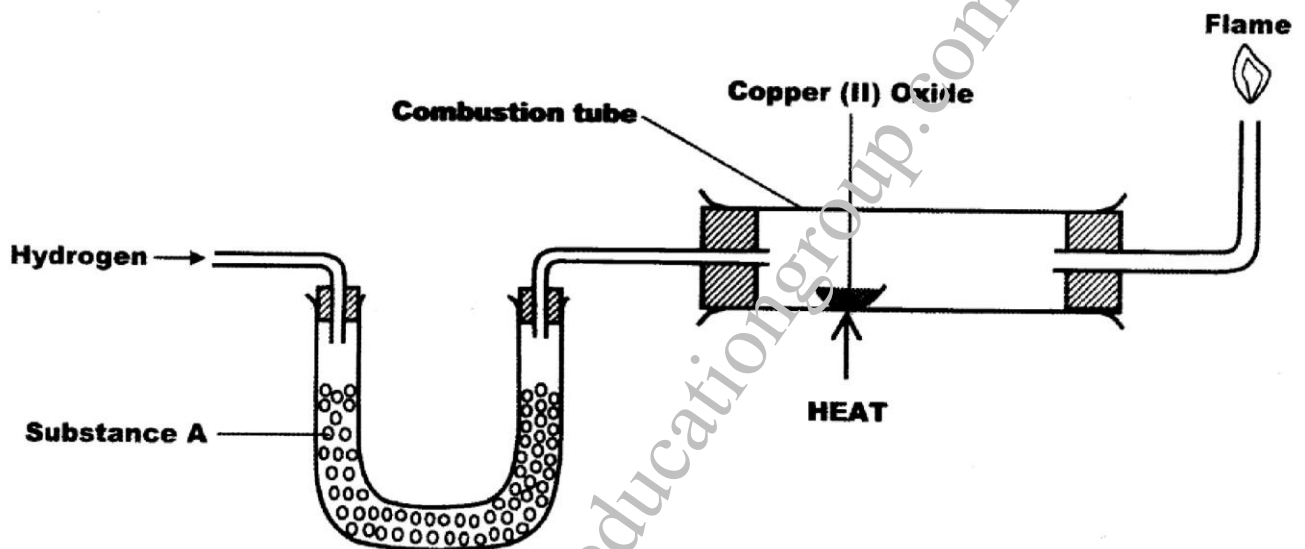
(a) What name is given to the process described? (1 mark)

.....

(b) Give one example of solid A. (1 mark)

.....

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



(a) Name substance A. (1 mark)

.....

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

.....

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

.....

.....

10 The atomic number of an element, T is 15.

(a) Write the electronic configuration of the ion  $T^{3-}$ . (1 mark)

.....

(b) Write the formula of an oxide of T. (1 mark)

.....

11 Dilute sulphuric (VI) acid was electrolysed using platinum electrodes. Name the product formed at the anode and give a reason for your answer. (2 marks)

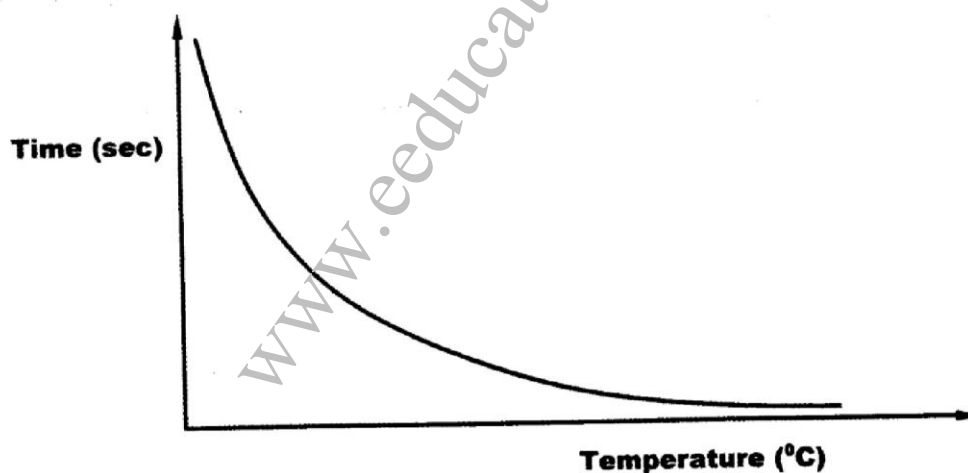
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12 The curve shown below shows the variation of time against temperature for the reaction between sodium thiosulphate and hydrochloric acid.



(a) Write the equation for the reaction between sodium thiosulphate and dilute hydrochloric acid. (1 mark)

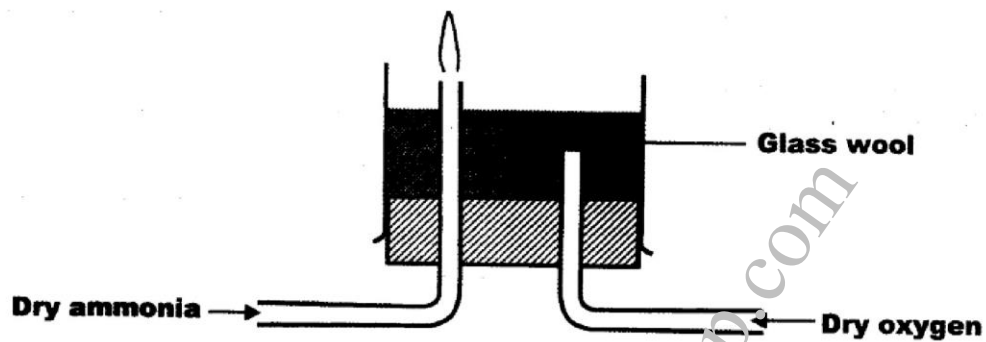
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- (b) Explain the shape of the curve. (2 marks)

.....

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- 13 Dry ammonia and dry oxygen were reacted as shown in the diagram below.



- (a) What is the purpose of the glass wool? (1 mark)

.....

- (b) What products would be formed if red hot platinum was introduced into a mixture of ammonia and oxygen? (1 mark)

.....

- 14 The table below shows behaviour of metals R, X, Y and Z. Study it and answer the questions that follow:

Metal	Appearance on exposure to air	Reaction in water	Reaction with dilute hydrochloric acid
R	slowly tarnishes	Slow	Vigorous
X	Slowly turns white	Vigorous	Violent
Y	No change	Does not react	Does not react
Z	No change	No reaction	Reacts moderately

- (a) Arrange the metals in the order of reactivity starting with the most reactive. (2 marks)

.....

- (b) Name a metal which is likely to be: (1 mark)

(i) X .....

(ii) Y .....

- 15 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)

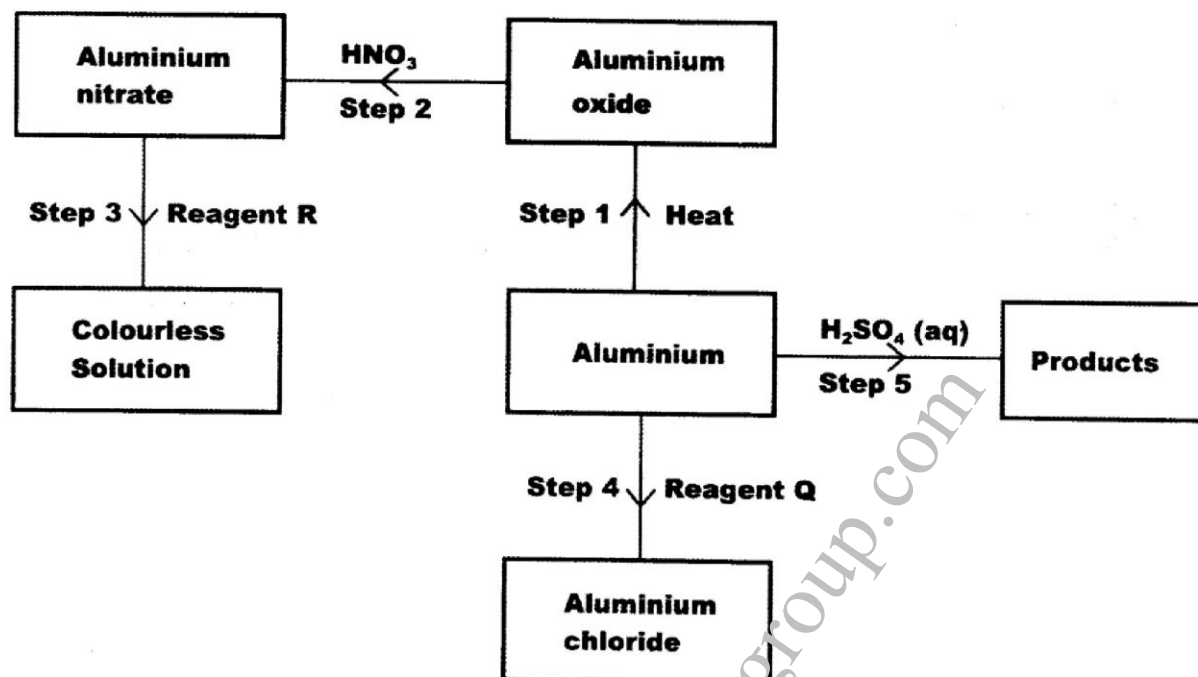
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- (b) Classify the substances in 15(a) above as acids, bases or neutral. (2 marks)

Acid	Base	Neutral



- 16 The flow chart below shows various reactions of aluminium metal. Study it and answer the questions that follow:



- (a) (i) Other than water, name another reagent that could be R. (1 mark)
- .....
- (ii) Write the formula of reagent Q. (1 mark)
- .....
- (b) Write an equation for the reaction in step 5. (1 mark)
- .....

- 17 (a) One of the allotropes of sulphur is rhombic sulphur, name the other allotrope. (1 mark)

.....

- (b) Concentrated sulphuric (VI) acid reacts with ethanol and copper.  
State the property of the acid shown in each case. (2 marks)

(i) Ethanol .....

(ii) Copper .....

- 18 Study the standard electrode potentials in the table below and answer the questions that follow.

	$E^{\ominus}$ volts
$\text{Cu}^{2+}_{(\text{aq})} + 2\text{e} \rightarrow \text{Cu}_{(\text{s})};$	+ 0.34
$\text{Mg}^{2+}_{(\text{aq})} + 2\text{e} \rightarrow \text{Mg}_{(\text{s})};$	- 2.38
$\text{Ag}^{2+}_{(\text{aq})} + \text{e} \rightarrow \text{Ag}_{(\text{s})};$	+ 0.80
$\text{Ca}^{2+}_{(\text{aq})} + 2\text{e} \rightarrow \text{Ca}_{(\text{s})};$	- 2.87

- (a) Which of the metals is the strongest reducing agent? (1 mark)

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- (b) What observations will be made if a silver coin was dropped into an aqueous solution of copper (II) sulphate? Explain (2 marks)

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19 A radioactive substance weighing  $M$  kg took 1900 years for the original mass to reduce to 15 kg. Given that the half life of the radioactive substance is 380 years;

(a) Determine the original mass of the radioactive substance. (2 marks)

.....  
.....

(b) State two uses of radioactivity in medicine. (1 mark)

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.....

20 A crystal of iodine, heated gently in a test tube gave off a purple vapour.

(a) Write the formula of the substance responsible for the purple vapour. (1 mark)

.....

(b) What type of bond is broken when the iodine crystal is heated gently? (1 mark)

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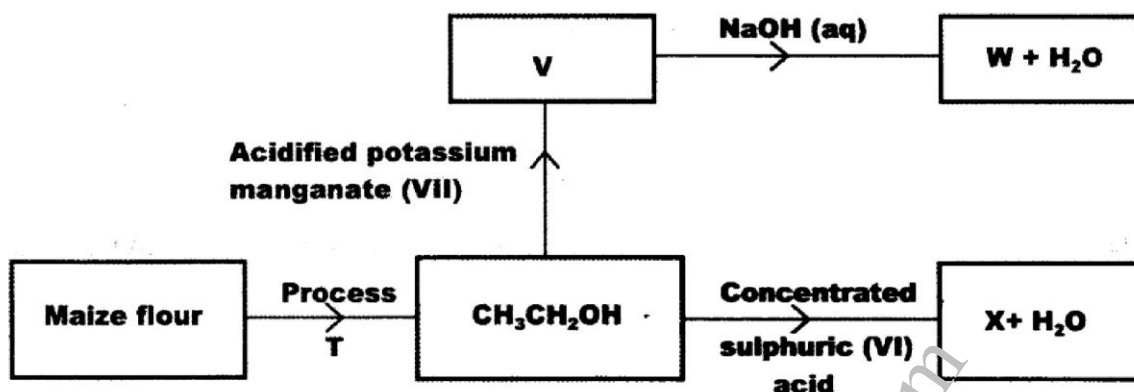
(c) State one use of iodine. (1 mark)

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21 Describe how samples of lead (II) sulphate, ammonium chloride and sodium chloride can be obtained from a mixture of the three. (3 marks)

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- 22 Study the flow chart below and use it to answer the questions that follow.



- (a) Name process T. .... (1 mark)
- (b) Give the formula of W. .... (1 mark)
- (c) State **two** uses of X. .... (1 mark)
- .....
- .....

- 23 The table below is part of the periodic table. The letters are not the actual symbols of the elements. Study it and answer the questions that follow.

					C	D	E	F
G	H						I	

- (a) Select an element which is stored in paraffin in the laboratory. .... (1 mark)
- .....

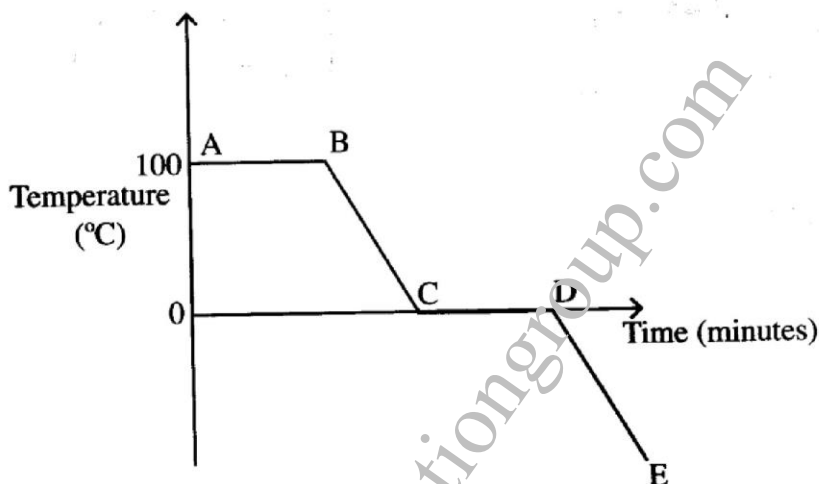
- (b) How do the ionic radii of E and I compare? Explain. (2 marks)

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- 24 The graph below is a cooling curve for water. Study it and answer the questions that follow.



- (a) Explain what happens to the molecules of water in the region BC in terms of kinetic theory. (2 marks)

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- (b) In what state is the water in the region DE? (1 mark)

.....

- 25 Starting with barium nitrate solution, describe how a pure sample of barium carbonate can be prepared in the laboratory. (3 marks)

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- 26 A hydrocarbon contains 14.5% of hydrogen. If the molar mass of the hydrocarbon is 56, determine the molecular formula of the hydrocarbon. (C = 12.0; H = 1.0) (3 marks)

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- 27 (a) Describe how carbon (IV) oxide can be distinguished from Carbon II Oxide using calcium hydroxide solution. (2 marks)

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- (b) What is the role of carbon (IV) oxide in fire extinguishing? (1 mark)

.....

.....

- 28 (a) State **one** source of alkanes. (1 mark)

.....

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- (b) Ethane gas was reacted with 1 mole of bromine gas. State **one** observation made during this reaction. (1 mark)

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- 29 An electric current was passed through several substances and the results obtained recorded in the table below.

Substance	Physical state at room temperature	Conductivity	Products	
			Anode	Cathode
A	Liquid	Does not conduct	-	-
B	Solid	Conducts	-	-
C	Liquid	Conducts	Green gas	Grey solid
D	Liquid	Conducts	Brown gas	Grey solid
E	Liquid	Conducts	-	-

Which of these substances is likely to be:

- (a) magnesium ..... (1 mark)
- (b) hexane ..... (1 mark)
- (c) lead (II) bromide ? ..... (1 mark)

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Name..... Index No...../.....

233/2  
CHEMISTRY  
Paper 2  
(THEORY)  
Oct./Nov. 2015  
2 hours

Candidate's Signature.....

Date.....



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



02325210

**Instructions to candidates**

- Write your name and index number in the spaces provided above.
- Sign and write the date of examination in the spaces provided above.
- Answer **all** the questions in the spaces provided.
- KNEC Mathematical tables and silent electronic calculators may be used.
- All working **must** be clearly shown where necessary.
- This paper consists of 13 printed pages.**
- Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
- Candidates should answer the questions in English.**

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Questions	Maximum Score	Candidate's Score
1	11	
2	12	
3	13	
4	11	
5	10	
6	12	
7	11	
<b>Total Score</b>	<b>80</b>	





- 1 (a) (i) Carbon (IV) oxide is present in soft drinks. State two roles of carbon (IV) oxide in soft drinks. (1 mark)
- .....
- .....
- .....
- (ii) Explain the observation made when a bottle containing a soft drink is opened. (2 marks)
- .....
- .....
- .....
- .....
- (iii) Carbon (IV) oxide dissolves slightly in water to give an acidic solution. Give the formula of the acid. (1 mark)
- .....
- (b) Zinc oxide can be obtained by heating zinc nitrate. A student heated 5.76 g of zinc nitrate.
- (i) Write an equation for the reaction that occurred. (1 mark)
- .....
- .....
- (ii) Calculate the total volume of gases produced. (Molar gas volume is 24 dm<sup>3</sup>; Zn = 65.4; O = 16.0; N = 14.0). (4 marks)
- .....
- .....
- .....
- .....

- (iii) Identify the element that is reduced when zinc nitrate is heated. Give a reason. (2 marks)

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- 2 (a) Draw the structure of the following compounds. (2 marks)

- (i) Butanoic acid;

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- (ii) Pent-2-ene.

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- (b) Explain why propan-1-ol is soluble in water while prop-1-ene is not. (Relative molecular mass of propan-1-ol is 60 while that of prop-1-ene is 42). (2 marks)

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- (c) What would be observed if a few drops of acidified potassium manganate (VII) were added to oil obtained from nut seeds? Explain. (2 marks)

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- (d) State **one** method that can be used to convert liquid oil from nut seeds into solid. (1 mark)
- .....

- (e) Describe how soap is manufactured from liquid oil from nut seeds. (3 marks)
- .....
- .....
- .....
- .....
- .....
- .....

- (f) 0.44 g of an ester **A** reacts with 62.5 cm<sup>3</sup> of 0.08 M potassium hydroxide giving an alcohol **B** and substance **C**. Given that one mole of the ester reacts with one mole of the alkali, calculate the relative molecular mass of the ester. (2 marks)
- .....
- .....
- .....

- 3 (a) Name the method that can be used to obtain pure iron (III) chloride from a mixture of iron (III) chloride and sodium chloride. (1 mark)
- .....

- (b) A student was provided with a mixture of sunflower flour, common salt and a red dye. The characteristics of the three substances in the mixture are given in the table below.

Substance	Solubility in water	Solubility in ethanol
Sunflower flour	Insoluble	Insoluble
Common salt	Soluble	Insoluble
Solid red dye	Soluble	Soluble

The student was provided with ethanol and any other materials needed.  
Describe how the student can separate the mixture into its three components.

(3 marks)

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- (c) The diagram below shows part of a periodic table. The letters do not represent the actual symbols of elements. Use the diagram to answer the questions that follow.

																				Q	
R						T															
				N		V						W									
Y												X									

- (i) Explain why the oxidising power of W is more than that of X. (2 marks)

.....

.....

.....

- (ii) How do the melting points of R and T compare? Explain. (2 marks)

.....

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.....

(iii) Select an element that could be used:

(I) in weather balloons; (1 mark)

.....

(II) for making a cooking pot. (1 mark)

.....

(d) (i) Classify the substances **water, iodine, diamond** and **candle wax** into elements and compounds. (2 marks)

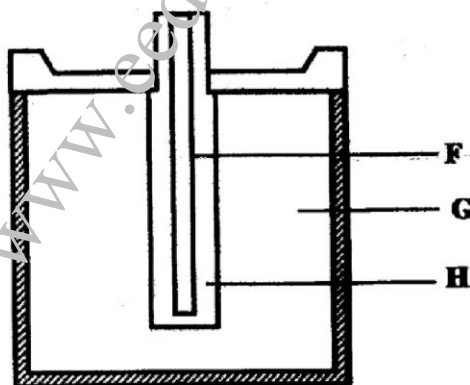
Elements	Compounds

(ii) Give **one** use of diamond. (1 mark)

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4 (a) The diagram below represents a dry cell. Use it to answer the questions that follow.



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233/2

02325210

(i) Which of the letters represent:

(I) carbon electrode?

(1 mark)

.....

(II) the electrolyte?

(1 mark)

.....

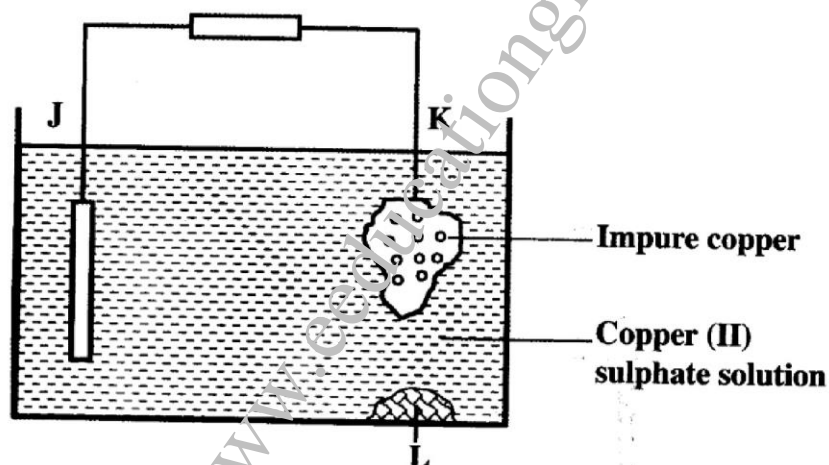
(ii) One of the substances used in a dry cell is manganese (IV) oxide. State **two** roles of manganese (IV) oxide in the dry cell. (2 marks)

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(b) Below is a simplified electrolytic cell used for purification of copper. Study it and answer the questions that follow.



(i) Identify the cathode.

(1 mark)

.....

(ii) Write the equation for the reaction at the anode.

(1 mark)

.....

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*Kenya Certificate of Secondary Education, 2015*

233/2

02325210

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**Turn over**

(iii) What name is given to L? (1 mark)

.....

(iv) A current of 0.6 A was passed through the electrolyte for 2 hours. Determine the amount of copper deposited.  
(Cu = 63.5; 1 Faraday = 96,500 coulombs). (3 marks)

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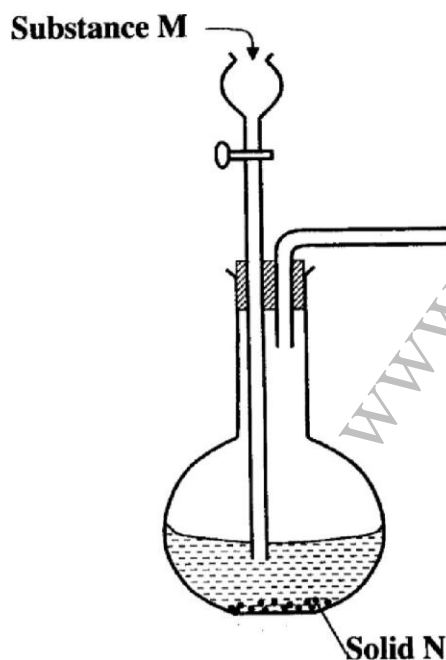
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(v) State two uses of copper metal. (1 mark)

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5 The set-up below can be used to generate a gas without heating. This occurs when substance M reacts with solid N.



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233/2  
02325210

- (a) (i) Complete the table below giving the names of substance **M** and solid **N** if the gasses generated are chlorine and sulphur (IV) oxide. (2 marks)

	Chlorine	Sulphur (IV) oxide
Substance M		
Solid N		

- (ii) Complete the diagram above to show how a dry sample of sulphur (IV) oxide can be collected. (3 marks)

- (b) Describe **two** chemical methods that can be used to test the presence of sulphur (IV) oxide. (3 marks)

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- (c) Other than the manufacture of sulphuric (VI) acid, state **two** uses of sulphur (IV) oxide. (2 marks)

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- 6 (a) Other than concentration, state **two** factors that determine the rate of a reaction. (2 marks)

.....

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- (b) In an experiment to determine the rate of reaction, excess lumps of calcium carbonate were added to 2 M hydrochloric acid. The mass of calcium carbonate left was recorded after every 30 seconds. The results are shown in the table below.

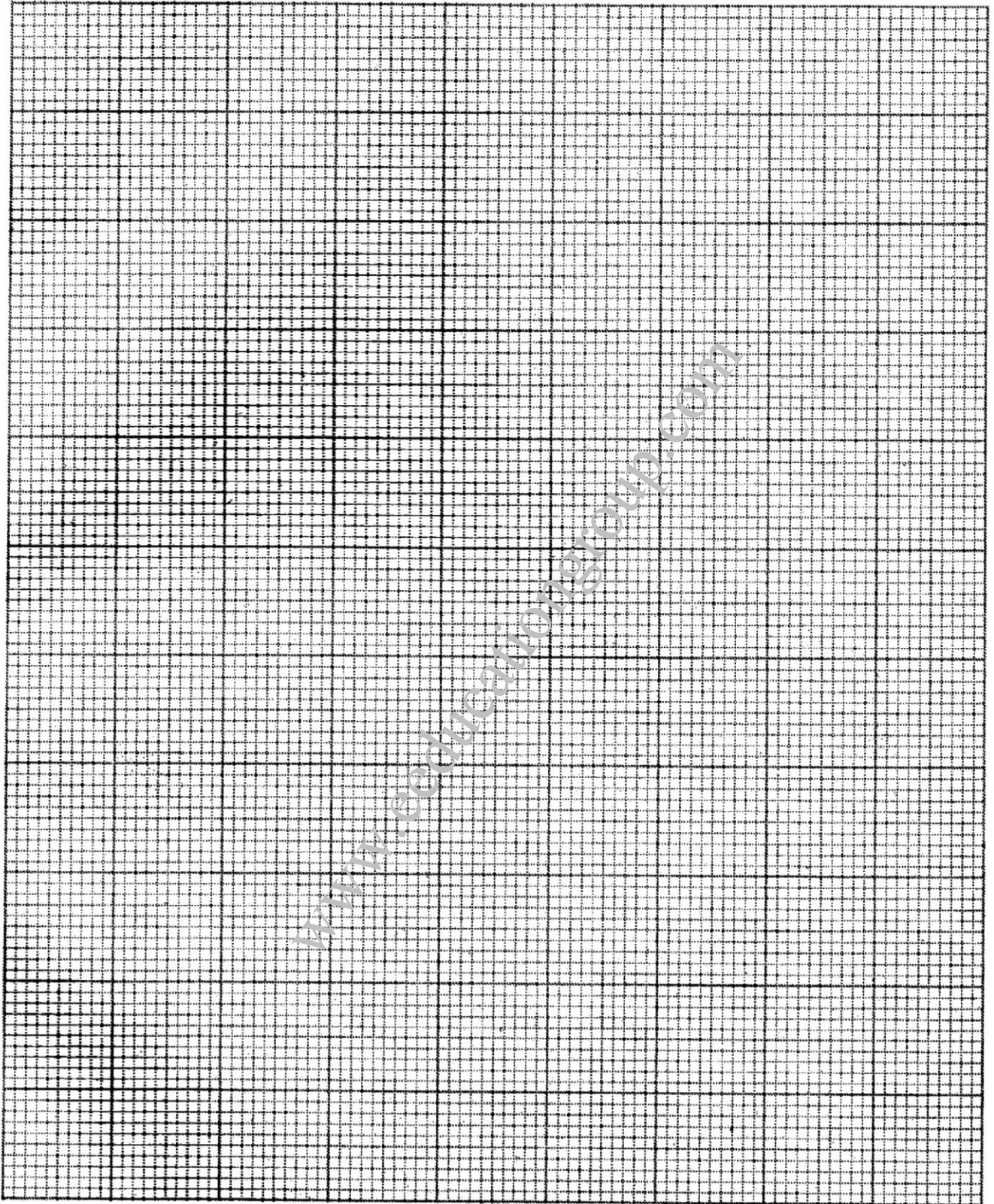
Time (seconds)	0	30	60	90	120	150	180	210
Mass of calcium carbonate left (g)	2.00	1.60	1.30	1.00	0.85	0.8	0.8	0.8

- (i) Write the equation for the reaction that took place. (1 mark)

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.....

- (ii) On the grid provided, plot a graph of mass of calcium carbonate vertical axis against time. (3 marks)



**Kenya Certificate of Secondary Education, 2015**

**233/2  
02325210**

915033

**Turn over**

- (iii) Determine the rate of reaction at the 105<sup>th</sup> second. (3 marks)

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- (c) Why does the curve level off after some time? (1 mark)

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- (d) On the same grid, sketch a curve for the same reaction using 4 M hydrochloric acid and label the curve R. (2 marks)

- 7 (a) Naturally occurring magnesium consists of three isotopes. 78.6% <sup>24</sup>Mg; 10% <sup>25</sup>Mg and <sup>26</sup>Mg. Calculate to one decimal place, the relative atomic mass of magnesium. (2 marks)

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.....

.....

- (b) When magnesium burns in air, it forms a white solid and a grey-green solid. When a few drops of water are added to the mixture, a gas that turns red litmus paper blue is evolved.

Identify the:

- (i) white solid. (1 mark)

.....

- (ii) gas evolved and state its use.

- (I) Name of gas. (1 mark)

.....

- (II) Use of the gas. (1 mark)

.....

*Kenya Certificate of Secondary Education, 2015*

233/2  
02325210

- (c) Two different samples of water (I and II) were tested with soap solution. Sample II was further subjected to two other processes before adding soap. 20 cm<sup>3</sup> of each sample of water was shaken with soap solution in a boiling tube until a permanent lather was obtained. The results are shown in the table below.

Water sample	Volume of soap solution needed (cm <sup>3</sup> )	
	before boiling	after boiling
I	10	5
II	6	6
II after filtering	6	6
II after distilling	2	2

- (i) Identify the water sample that had temporary hardness. Explain your answer. (2 marks)

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- (ii) Explain why the results for sample II are different after distilling but remain unchanged after filtering. (2 marks)

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- (iii) State two disadvantages of using both water samples for domestic purposes. (2 marks)

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233/2

02325210

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

233/3  
CHEMISTRY  
Paper 3  
(PRACTICAL)  
Oct./Nov. 2015  
 $2\frac{1}{4}$  hours

Candidate's Signature .....

Date .....



THE KENYA NATIONAL EXAMINATIONS COUNCIL  
Kenya Certificate of Secondary Education  
CHEMISTRY  
Paper 3  
(PRACTICAL)  
 $2\frac{1}{4}$  hours

02325220

**Instructions to Candidates**

- Write your name and index number in the spaces provided above.
- Sign and write the date of examination in the spaces provided above.
- Answer **all** the questions in the spaces provided in the question paper.
- You are **not** allowed to start working with the apparatus for the first 15 minutes of the  $2\frac{1}{4}$  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.
- All working **must** be clearly shown where necessary.
- KNEC mathematical tables and silent electronic calculators may be used.
- This paper consists of 8 printed pages.
- Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.
- Candidates should answer the questions in English.

**For Examiner's use only**

Question	Maximum Score	Candidate's Score
1	19	
2	13	
3	08	
<b>Total Score</b>	<b>40</b>	



1 You are provided with:

- 2.0 g of substance A, labelled solid A.
- Solution B, 0.05 M hydrochloric acid.
- Methyl orange indicator.

You are required to determine the:

- solubility of substance A in water.
- relative formula mass of substance A.

### PROCEDURE I

- Place 200 cm<sup>3</sup> of tap water in a 250 ml beaker and keep it for use in step (vi).
- Place **all** of substance A in a dry boiling tube.
- Using a burette, measure 10.0 cm<sup>3</sup> of distilled water and add it to the substance A in the boiling tube.
- While stirring the mixture in the boiling tube with a thermometer, warm the mixture using a Bunsen burner, until the temperature rises to 55°C. Stop warming the mixture.
- Allow it to cool while stirring with the thermometer.
- When the temperature drops to 60°C, start the stop watch/clock, place the boiling tube in the beaker with tap water prepared in step (i) above.
- Continue stirring and record the temperature of the mixture after two minutes, then thereafter record the temperature of the mixture after every one minute interval and complete table 1. Retain the mixture with the thermometer inside for use in procedure II below.

Table 1

Time (minutes)	0	2	3	4	5	6	7	8	9	10
Temperature (°C)	60									

(4 marks)

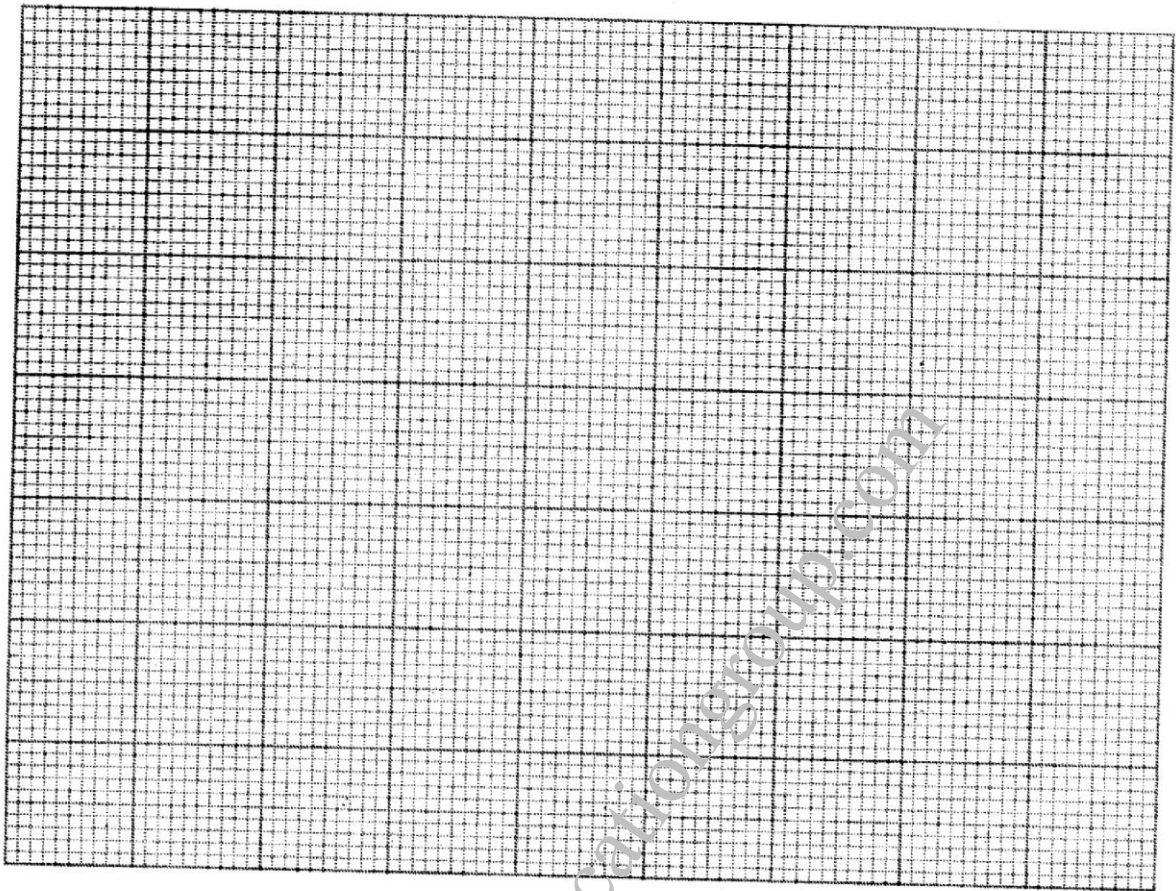
On the grid provided, plot a graph of temperature (vertical -axis) against time.

(3 marks)

*Kenya Certificate of Secondary Education, 2015*

233/3

02325220



- (a) Using the graph, determine the temperature ( $T_s$ ) when 2.0 g of substance A dissolves completely in 10.0 cm<sup>3</sup> of distilled water. (1 mark)

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- (b) Calculate the solubility of substance A in grams per 100 g water at temperature,  $T_s$ . (2 marks)

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**PROCEDURE II**

Using a funnel, transfer all the mixture obtained from Procedure I into a 250 ml volumetric flask. Rinse the boiling tube and the thermometer with about 20 cm<sup>3</sup> of distilled water and add the rinses into the volumetric flask. Repeat the rinsing two more times. Add about 100 cm<sup>3</sup> of distilled water to the volumetric flask. Shake until all the solid dissolves. Add more distilled water to the mark. Label this as solution A. Fill the burette with solution A. Using a pipette and pipette filler, place 25.0 cm<sup>3</sup> of solution B, into a 250 ml conical flask. Add three (3) drops of the indicator provided and titrate using solution A. Record your readings in table 2 below. Repeat the titration two more times and complete the table.

**Table 2**

	I	II	III
Final Burette Reading			
Initial burette Reading			
Volume of solution A (cm <sup>3</sup> ) used.			

(3 marks)

(a) Calculate the:

(i) average volume of solution A used.

(1 mark)

.....

(ii) number of moles of hydrochloric acid, solution B used.

(1 mark)

.....

.....

(b) Given that two moles of acid react with one mole of substance A, calculate:

(i) number of moles substance A used.

(1 mark)

.....

.....

*Kenya Certificate of Secondary Education, 2015*

233/3

02325220



(ii) concentration of solution A in moles per litre; (1 mark)

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(iii) concentration of solution A in g per litre; (1 mark)

.....  
.....

(iv) relative formula mass of substance A. (1 mark)

.....  
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- 2 You are provided with solid C. Carry out the following tests and record your observations and inferences in the spaces provided.

Place **all** the solid C in a boiling tube. Add about 15 cm<sup>3</sup> of distilled water and shake until all the solid dissolves. Use 2 cm<sup>3</sup> portions of the solution in a test-tube, for **each** of the tests in (a), (b), (c), (d), (e) and (f).

- (a) Add aqueous sodium hydroxide dropwise until in excess.

Observations	Inferences
(1 mark)	(1 mark)

- (b) Add aqueous ammonia dropwise until in excess.

Observations	Inferences
(1 mark)	(1 mark)

- (c) Add 2 to 3 drops of solution D, aqueous sodium carbonate.  
(Retain the remaining solution D for use in question 3)

Observations	Inferences
(1 mark)	(2 marks)

- (d) Add 2 to 3 drops of dilute hydrochloric acid.

Observations	Inferences
(1 mark)	(1 mark)

- (e) Add 2 or 3 drops of aqueous barium chloride.

Observations	Inferences
(1 mark)	(1 mark)

- (f) Add 2 or 3 drops of solution E, aqueous lead (II) nitrate.

Observations	Inferences
(1 mark)	(1 mark)

- 3 You are provided with substance L. Carry out the following tests and record your observations and inferences in the spaces provided. Use about 2 cm<sup>3</sup> portions of substance L in a test-tube for **each** of the tests, (a), (b), (c) and (d).

- (a) Add 2 or 3 drops of bromine water.

Observations	Inferences
(1 mark)	(1 mark)

- (b) Add about 1 cm<sup>3</sup> of acidified potassium dichromate (VI). Warm the mixture.

Observations	Inferences
(1 mark)	(1 mark)

- (c) Add about 1 cm<sup>3</sup> of solution D, aqueous sodium carbonate provided.

Observations	Inferences
(1 mark)	(1 mark)

- (d) Add the piece of magnesium ribbon provided.

Observations	Inferences
(1 mark)	(1 mark)

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*Kenya Certificate of Secondary Education, 2015*

233/3

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