THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

233/2 — **CHEMISTRY** — **Paper 2**

(THEORY)

Nov. 2019 – 2 hours

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

Candidate's Signature ..... **Date** .....

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.*
(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.***

For Examiner's Use Only

Question	Maximum Score	Candidate's Score
1	12	
2	10	
3	12	
4	12	
5	12	
6	11	
7	11	
Total Score	80	

1. (a) Alkanes are said to be saturated hydrocarbons.

(i) What is meant by saturated hydrocarbons. (1 mark)

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(ii) Draw the structure of the third member of the alkane homologous series and name it. (2 marks)

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(b) When the alkane, hexane, is heated to high temperature, one of the products is ethene.

(i) Write the equation for the reaction. (1 mark)

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(ii) Name the process described in (b). (1 mark)

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(c) Study the flow chart in **Figure 1** and answer the questions that follow.

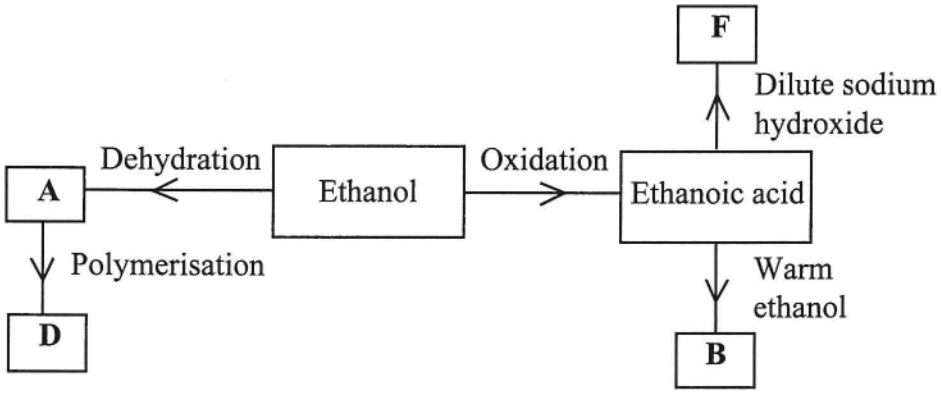

Figure 1

(i) Identify **A**. (1 mark)

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(ii) State **one** physical property of **B**. (1 mark)

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(iii) Draw the structure of **D**. (1 mark)

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(iv) Give a reason why **D** pollutes the environment. (1 mark)

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(v) Write an equation for the formation of **F**. (1 mark)

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(d) Describe an experiment which can be used to distinguish butene from butanol. (2 marks)

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2. (a) Zinc occurs mainly as zinc blende. Name **one** other ore from which zinc can be extracted. (1 mark)

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(b) The flow chart in **Figure 2** shows the various stages in the extraction of zinc metal. Study it and answer the questions that follow.

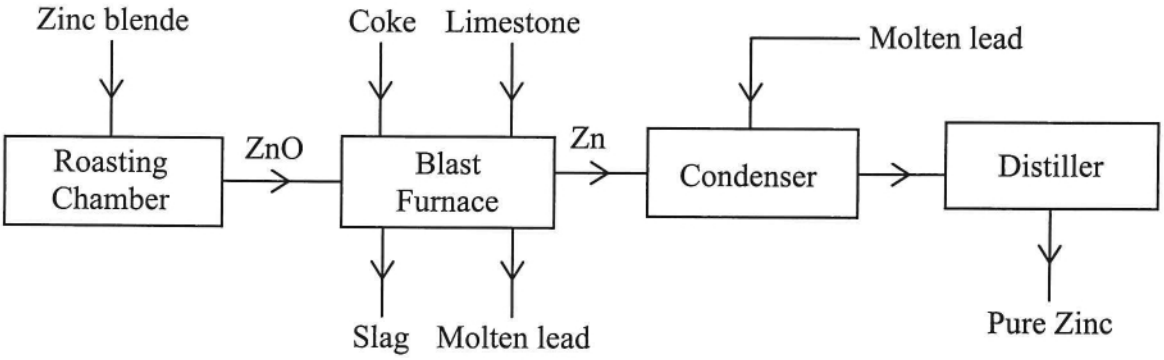

Figure 2

(i) Write an equation for the reaction which occurs in the roasting chamber. (1 mark)

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(ii) Describe the process that takes place in the blast furnace. (3 marks)

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(iii) Explain why molten lead is added to the condenser. (1 mark)

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(iv) State **two** uses of zinc. (1 mark)

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(v) Give **one** reason why the extraction of zinc causes pollution to the environment. (1 mark)

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(c) Explain the observations made when zinc metal is added to hot sodium hydroxide. (2 marks)

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3. **Figure 3** is a flow chart that shows the process that occurs in the manufacture of nitric(V) acid.

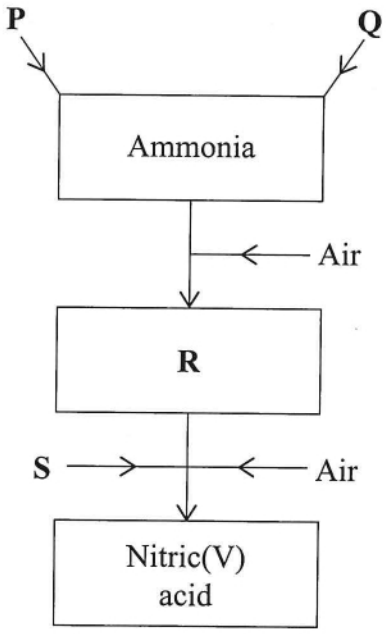

Figure 3

(a) Name substance **P**, **Q**, **R** and **S**.

P .....
(1 mark)

Q .....
(1 mark)

R .....
(1 mark)

S .....
(1 mark)

(b) To obtain substance **R**, ammonia is heated at 900 °C in the presence of air and a catalyst. The product is then cooled in air.

(i) Name the catalyst for the reaction. (1 mark)

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(ii) Write the equations for the two reactions described in (b). (2 marks)

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(iii) Other than nitric(V) acid, name another product that is formed. (1 mark)

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(c) When ammonia is reacted with nitric(V) acid, it produces a nitrogenous fertiliser.

(i) Explain why fertilisers play a major role in food production. (2 marks)

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(ii) State **two** problems associated with the use of nitrogenous fertilisers. (2 marks)

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4. (a) Explain the following observations:

(i) The colour of aqueous copper(II) sulphate fades when a piece of magnesium metal is dropped into the solution. (2 marks)

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(ii) A piece of iron bar is coated with a brown substance when left in the open on a rainy day. (2 marks)

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(b) A sample of water is suspected to contain aluminium ions (Al^{3+}) . Describe a laboratory experiment that can be carried out to show that Al^{3+} ions are present in the water sample. (3 marks)

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(c) In an experiment to determine the number of moles of water of crystallisation of a hydrated compound, $Na_2SO_4 \bullet \mathbf{X}\ H_2O$, 5 g of the compound were heated strongly to a constant mass.

(i) Explain how a constant mass was obtained. (2 marks)

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(ii) During the experiment, the mass of the residue was found to be 2.205 g.
Determine the number of moles of water of crystallisation in the compound.
(Na = 23.0 ; O = 16.0 ; S = 32.0 ; H = 1.0) (3 marks)

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5. (a) What is meant by molar heat of neutralisation? (1 mark)

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(b) In an experiment to determine the molar heat of neutralisation, 50 cm^3 of 1M hydrochloric acid was neutralised by adding 10 cm^3 portions of dilute sodium hydroxide. During the experiment, the data in **Table 1** was obtained.

Table 1

Volume of Sodium hydroxide (cm^3)	0	10	20	30	40	50	60
Temperature of mixture (°C)	25.0	27.0	29.0	31.0	31.0	30.0	29.0

(i) Write the equation for the reaction in this experiment. (1 mark)

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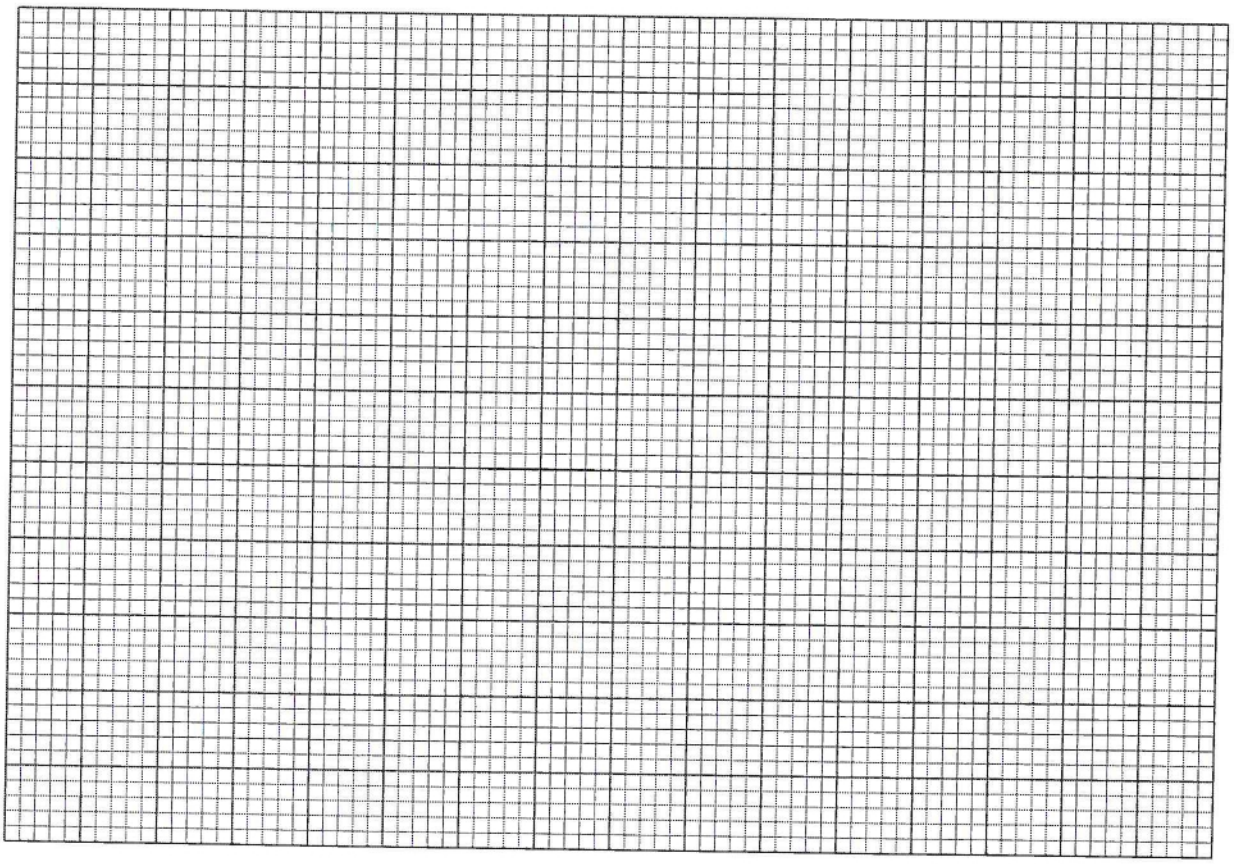
(ii) On the grid provided, plot a graph of temperature (Y-axis) against volume of sodium hydroxide (X-axis) added. (3 marks)



(iii) Determine from the graph the:

I. volume of sodium hydroxide which completely neutralises 50 cm^3 of 1M hydrochloric acid. (1 mark)

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II. change in temperature, ΔT, when complete neutralisation occurred. (1 mark)

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(iv) Calculate:

I. the heat change, ΔH when complete neutralisation occurred.
(Specific heat capacity = 4.2 $Jg^{-1} K^{-1}$, density of solution 1.0 gcm^{-3})
(2 marks)

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II. molar heat of neutralisation of hydrochloric acid with sodium hydroxide. (1 mark)

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(v) How would the value of molar heat differ if 50 cm^3 of 1M ethanoic acid was used instead of 1M hydrochloric acid? Give a reason. (2 marks)

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6. (a) What is meant by standard electrode potential of an element? (1 mark)

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(b) Use the standard electrode potentials given below to answer the questions that follow.

Reactions	E^{θ} **(V)**
$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$	+1.49
$M^{3+}(aq) + e^- \rightarrow M^{2+}(aq)$	+0.77
$N^{2+}(aq) + 2e^- \rightarrow N(s)$	+0.34
$P^{2+}(aq) + 2e^- \rightarrow P(s)$	−0.23
$Q_2(g) + 2e^- \rightarrow 2Q^-(g)$	+2.87
$R_2(g) + 2e^- \rightarrow 2R^-(g)$	+1.36

(i) State whether acidified MnO_4^- can oxidise M^{2+}. Give a reason. (2 marks)

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(ii) Select two half-cells which when combined will give the highest e.m.f. (1 mark)

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(iii) Write the cell representation for the cell formed in b (ii). (1 mark)

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(iv) Calculate the $\mathbf{E^{\theta}}$ value for the cell formed in b (iii). (2 marks)

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(c) A mass of 1.24 g of a divalent metal was deposited when a current of 6A was passed through a solution of the metal sulphate for 12 minutes. Determine the relative atomic mass of the metal. (1 Faraday = 96,500 C mol^{-1}) (3 marks)

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(d) State **two** applications of electrolysis. (1 mark)

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7. (a) What is meant by rate of reaction. (1 mark)

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(b) In the space provided, sketch the diagram of a set-up that can be used to determine the rate of reaction between manganese(IV) oxide and hydrogen peroxide. (3 marks)

(c) A student placed a small amount of liquid bromine at the bottom of a sealed gas jar of air as shown in **Figure 4**.

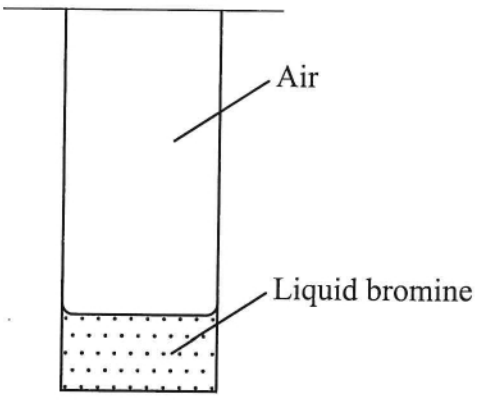

Figure 4

(i) Describe what will be observed: (1 mark)

I. after two minutes .....

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II. after 30 minutes .....

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(ii) Use the Kinetic theory to explain the observations: (2 marks)

I. after 2 minutes .....

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II. after 30 minutes .....

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(d) Some plants have seeds that contain vegetable oil.

(i) Describe how the oil can be obtained from the seeds. (3 marks)

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(ii) Explain how it could be confirmed that the liquid obtained from the seeds is oil. (1 mark)

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