Name: .....Class.....

Candidate's signature..... Date.....

Index number.....

233/2 CHEMISTRY (Theory)
Paper 2
MARCH 2014
2 hours
Kenya Certificate of Secondary Education
MINI MOCK EXAMINATIONS, 2014

Instructions to candidates

*Answer **ALL** questions in the spaces provided.*

Mathematical tables and electronic calculators may be used.

*All working **MUST** be clearly shown where necessary.*

For examiners' use only

Question	MaximumScore	Candidate'sScore
1	10	
2	14	
3	12	
4	14	
5	11	
6	7	
7	12	
Total score	80	

NB: This paper consists of 13 printed pages. Students should check the

question paper to ensure that all pages are printed as indicated and that no questions are missing.

1(a) Sulphur can be converted into sulphuric acid using the following steps.

i. Which step requires a catalyst? Name the preferred catalyst used. (2 marks)

Step

Catalyst used

ii. Use two equations to show how step **C is** carried out on an industrial scale. (2 marks)

iii. Sulphuric (VI) acid obtained in this process has concentration of 18.4 moles/litre. Describe briefly how one would **safely** prepare 2 litres of 2M sulphuric (VI) acid. (3 marks)

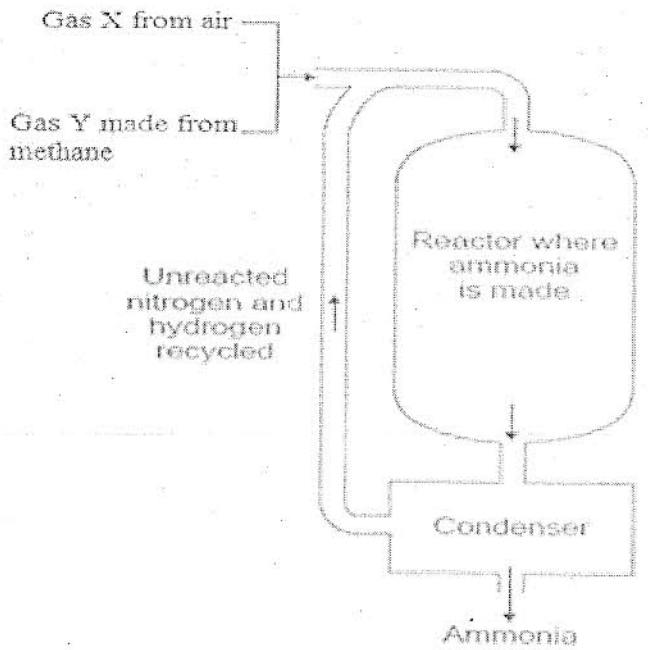
iv. Another large scale source of sulphur (IV) oxide in the contact process is the roasting of metallic sulphides in air. Write a balanced equation showing roasting of zinc sulphide. (1 mark)

b) Other than its use in the manufacture of sulphuric (VI) acid, Sulphur (IV) oxide has other uses. State another use of Sulphur (IV) oxide that depends on each of these properties.

i) Ability to kill bacteria. (1 mark)

ii) Bleaching properties (1mark)

2) a) The flow diagram below shows large scale production of ammonia.



i. Name gas X and gas Y (1 mark)

gas X

gas Y

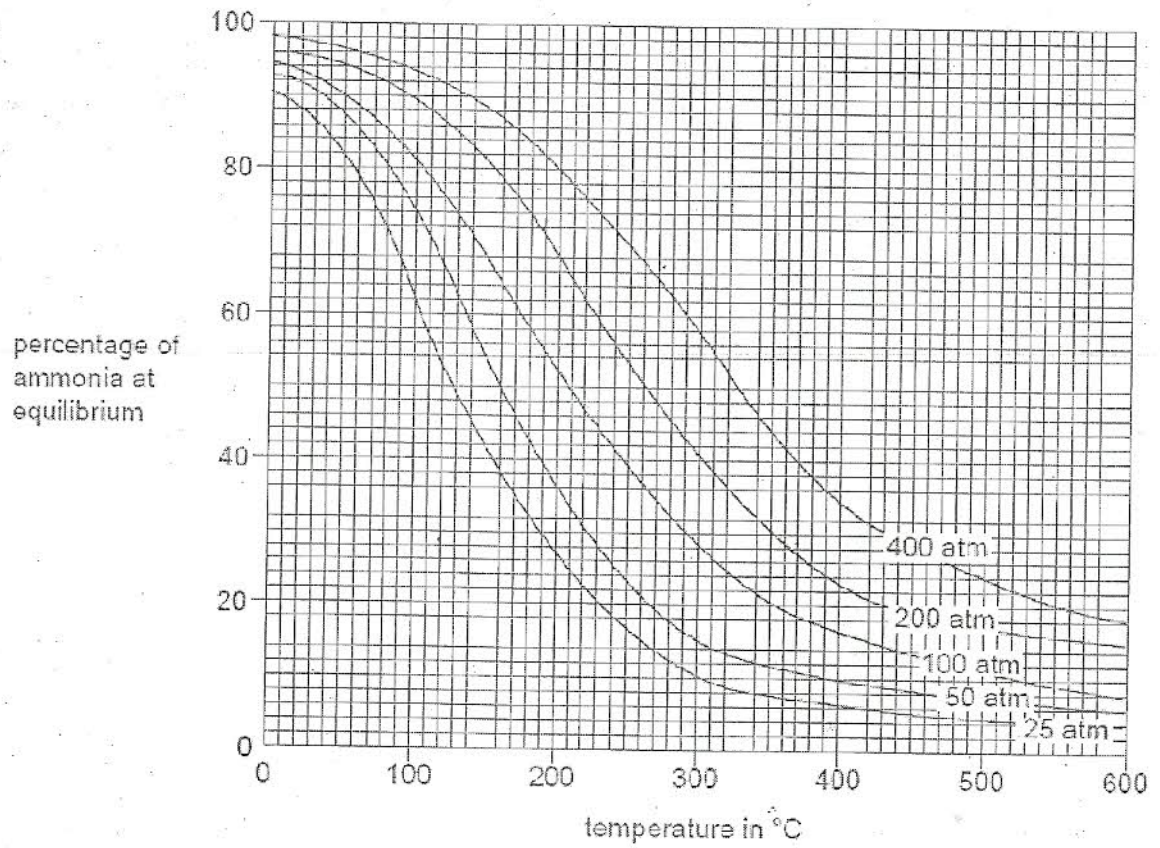
ii. Write the chemical equation to represent production of gas Y from methane. (1 mark)

iii. Name the catalyst used in reactor (1 mark)

iv. Write a balanced equation for the reaction in the reactor. (1 mark)

v. In the condenser, the mixture is cooled to separate ammonia as a liquid.
State one reason why unreacted gases are recycled. (1 mark)

b) The diagram below shows the percentage of ammonia made at different temperature and pressure.



i. Comment on how pressure and temperature affect the yield of ammonia. (2 marks)

pressure

temperature

ii. State the optimum temperature and pressure at which ammonia is usually produced.
(1 mark)

Optimum pressure

Optimum temperature

c) Ammonia produced is used in the manufacture of nitric (v) acid. This process involves the catalytic oxidation of ammonia and occurs in 3 stages. Write equations for the reactions involved in the three stages. (3 marks)

stage 1

stage 2

stage 3

d) A garden lawn fertiliser contains ammonium nitrate.

i. Describe a simple chemical test to show the fertiliser contains ammonium NH_4^+, ions.
(2 marks)

ii. State one environmental or health problem which would occur if excess of the fertiliser is leached out into lakes and rivers. (1 mark)

3 a) The reaction between chlorine and sodium hydroxide solution depends on the concentration and the temperature of sodium hydroxide.

i) State the conditions under which sodium chlorate (V) is formed. (1 mark)

ii) State the observation made when chlorine gas is bubbled through a solution of potassium bromide. (1 mark)

iii) Write an ionic equation to represent the reaction that occurs in b(ii) above.(1 mark)

iv)Use the ionic equation to identify the oxidising agent and give a reason for your answer.

(1 mark)

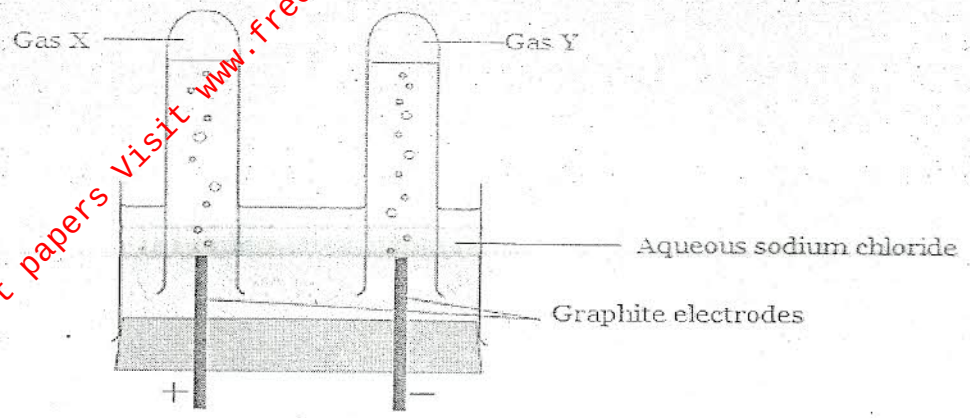
b) Chlorine reacts with sulphite ions in presence of water as shown in the equation

$Cl_{2(g)} + SO_3^{2-}{}_{(aq)} + H_2O_{(l)} \longrightarrow SO_4^{2-}{}_{(aq)} + 2H^+{}_{(aq)} + 2Cl^-{}_{(aq)}$

Use the oxidation numbers of chlorine and sulphur to show that this is a redox reaction.

(2 marks)

c) The diagram below shows apparatus used in a school laboratory for the electrolysis of an aqueous solution of sodium chloride.



i. Write the formula of all the ions present in the electrolyte. (2 marks)

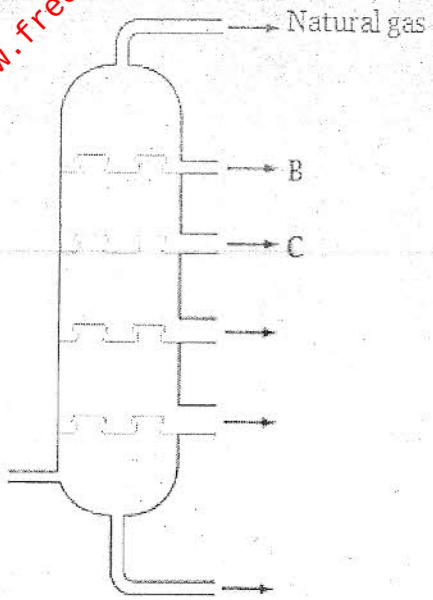
ii. State whether the electrolyte was dilute or a concentrated. (1 mark)

iii. Write an equation for the reaction that occurs at the negative electrode. (1 mark)

iv. What is the effect of this electrolysis on the pH of the resulting solution. Explain.

(2 marks)

4) Crude oil is a mixture of different compounds. Most of the compounds are hydrocarbons. Fractional distillation is used to separate crude oil into fractions such as petrol, kerosene and diesel. The diagram below shows a fractionating column used for separation of crude oil. Study it and answer the questions that follow.



a) What does the term hydrocarbon mean? (1 mark)

b) Name the main gas that is found in the natural gas fraction. (1 mark)

c) State how the following compare.

i. Boiling point of fraction B and C

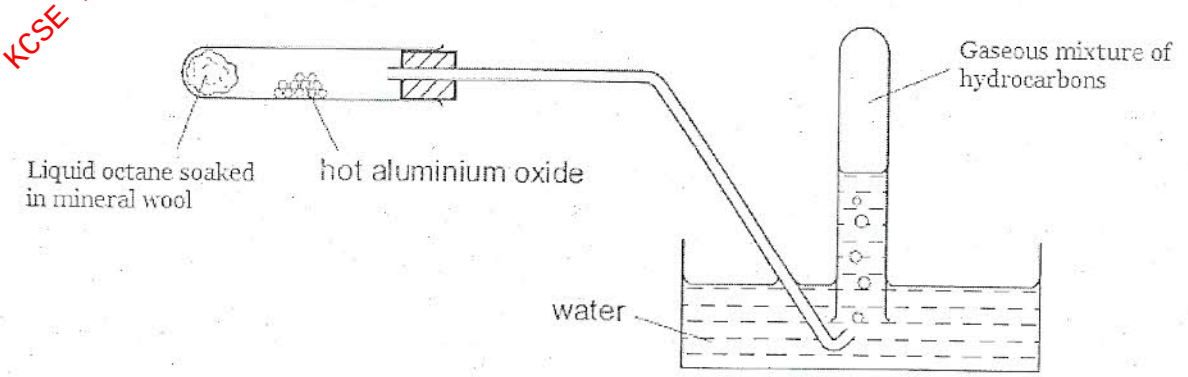
ii. Flammability of fraction B and C

iii. Number of carbon atoms in fraction B and C compare. (3 marks)

d) Octane is a hydrocarbon that belongs to the petrol fraction of the crude oil. It belongs to the homologous series known as alkanes.

i) State two general characteristics of a **homologous series.** (2 marks)

ii) Liquid octane can be cracked in the laboratory using the apparatus below.



I) What is meant by the term 'cracking'?. (1mark)

II) The products formed when a molecule of octane is cracked are two molecules of ethene and one more product X. Identify substance X and write the chemical equation to represent this cracking process. (1mark)

III) Describe a simple chemical test that can be used to distinguish ethene and the substance X. (2 marks)

e) Ethene is industrially used to produce high purity ethanol by reacting it with steam.

State the **three** conditions used. (2 marks)

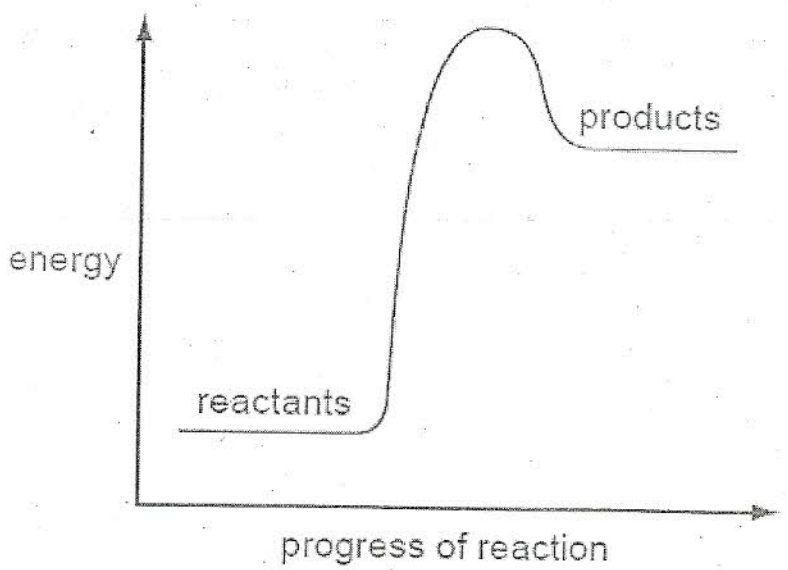
Pressure

temperature

catalyst

f) When petrol is used as a fuel in car engine, the exhaust gases contain nitrogen oxides. Explain how nitrogen oxides are formed. (1 mark)

5 a)The diagram below shows the reaction profile for a certain chemical change.



i) State with a reason whether the change is exothermic or endothermic. (1 mark)

ii) Indicate on the diagram activation energy ΔH_{act} for the forward reaction and the overall energy change ΔH for the reaction. (2 marks)

b) Enthalpy of combustion, bond enthalpy data and Hess' law can be used to determine enthalpy change for some reactions.

i) Define the term standard enthalpy of combustion (1 mark)

ii) State the Hess' law (1 mark)

b) The following data gives some standard enthalpies of formation of a number of chemical substances.

Chemical substance	C_2H_5OH	CO_2	H_2O
Enthalpy of formation ($kJmol^{-1}$)	-277	-394	-286

Use this data and a thermochemical cycle or otherwise to calculate the enthalpy of combustion of ethanol. (3 marks)

d) Hydrogen can be used as a fuel in cars.

i) State one advantage of using hydrogen as a fuel. (1 mark)

ii) The chemical equation for the combustion of hydrogen is

$2H_{2\,(g)} + O_{2\,(g)} \longrightarrow 2H_2O_{(l)}$

Use the bond energies in the table below to calculate the energy change for this reaction.

Bond	Average bond energy, kJmol^{-1}
H-H	436
O-O	146
O-H	464
O=O	497

(2 marks)

6) This question concerns the chlorides of elements sodium to sulphur of the third period of the periodic table. The melting point of these chlorides are given below.

Chloride	Sodium chloride	Magnesium chloride	Aluminium chloride	Silicon (IV) chloride	Phosphorous (V) chloride
Melting point °C	801	712	Sublimes at 183	-70	-80

a) Explain in terms of bonding and structure why sodium chloride has a higher melting point than silicon (IV) chloride. (2 marks)

b) Give the possible pH value of the solution formed when the following chlorides are dissolved in water

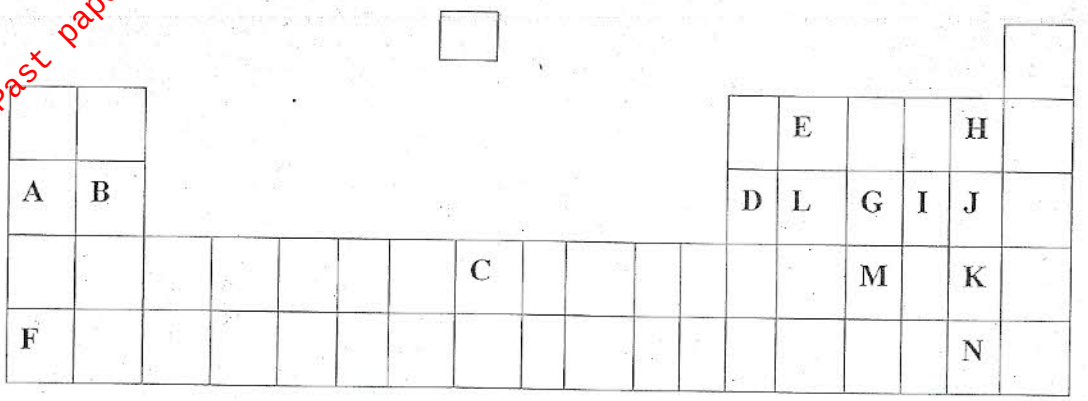
Magnesium chloride ($^1/_2$mark)

Aluminium chloride ($^1/_2$mark)

c) Aluminium chloride has a molecular formula of Al_2Cl_6. Draw the structural formula (not dot and cross diagram) of aluminium chloride and indicate clearly the different types of bonds present. (2 marks)

d) Draw a dot(.) and cross (x) diagram to show bonding in Magnesium chloride. (atomic numbers of Mg=12, Cl=17). (2 marks)

7) The grid below shows a part of the periodic table and the positions of some elements labelled A- N. The letters used do not represent the actual chemical symbols.



Use it to answer questions that follow

a) Which letter represents

i. Aluminium.

ii. An alkaline earth metal.

iii. An element that can form an oxide that is strongly alkaline in water.

iv. An element that can form an ion of a charge of -3 with an electron arrangement of 2:8:8. (2 marks)

b) Use the letters to indicate element(s)

i. With the largest atomic radius. ($^1/_2$mark)

ii. That is magnetic. ($^1/_2$mark)

iii. That are metalloids. (1mark)

c) i) What name is given to the group of elements containing H, J, K and N.
($\frac{1}{2}$mark)

ii) How does the melting point of these elements change as you go down the group? Explain. ($1\frac{1}{2}$marks)

d) State and explain how

i. Ionisation energy of elements A and B compares. ($1\frac{1}{2}$marks)

ii. Reactivity of elements A and F compares. ($1\frac{1}{2}$marks)

iii. Melting point of A and B compares. ($1\frac{1}{2}$marks)

iv. Melting point of A and F compares. ($1\frac{1}{2}$marks)