NAME _____ INDEX NO. _____

SIGNATURE _____

DATE _____

233/2
CHEMISTRY
PAPER 2
(THEORY)
JULY, 2017
TIME: 2 HOURS

END OF TERM II FORM FOUR EXAMINATION, 2017

Kenya Certificate of Secondary Education (K.C.S.E)

233/2
CHEMISTRY
PAPER 2
(THEORY)
TIME: 2 HOURS

INSTRUCTIONS:

- Write your name, school and index number in the spaces provided above.
- Sign and write the date of the examination in the spaces provided above.
- Answer **ALL** the questions in the spaces provided.
- Mathematical tables and silent electronic calculators may be used.
- All working must be clearly shown where necessary.
- This paper consists of **12** printed pages.
- Candidates should check to ensure that all pages are printed as indicated and no questions are missing.

FOR EXAMINER'S USE ONLY

Question	Maximum score	Candidate's score
1	12	
2	12	
3	8	
4	12	
5	15	
6	12	
7	9	
Total score	**80**	

1. Study the table below and answer the questions that follow.

Element	Atomic number	Relative atomic mass	Melting point (°C)
Aluminum	13	27.0	
Calcium	20	40.0	850
Carbon	__	12.0	3730
Hydrogen	__	1.0	- 259
Magnesium	12	24.0	650
Neon	__	20.0	- 249
Phosphorous	15	31.0	44.2 white 590 red
sodium	__	23	97.8

a) Complete the table by filling in the missing atomic numbers. (2 marks)

b) Write the electron arrangement for the following ion. (2 marks)

i) Ca^{2+}

_____

ii) P^{3-}

_____

c) What is the melting point of hydrogen in Kelvin? (1 mark)

_____

d) Which of the allotropes of phosphorous has a higher density? Explain. (2 marks)

_____

_____

e) The mass numbers of three isotopes of magnesium are 24, 25 and 26.
What is the mass number of the most abundant isotope of magnesium? Explain. (2 marks)

_____

_____

_____

_____

f) Give the formula of the compound formed between aluminum and carbon. (1 mark)

_____

g) Explain the difference in the melting points of magnesium and sodium. (2 marks)

_____

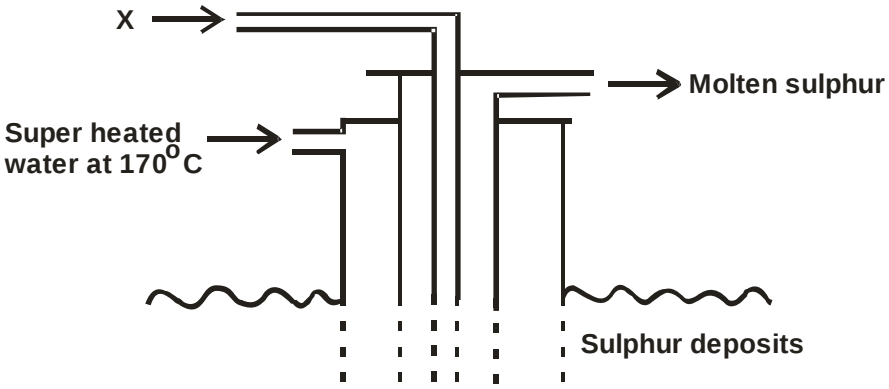
_____

_____

_____

2. a) The diagram below shows the Frasch process used for extraction of sulphur.

Use it to answer to answer the questions that follow.



i) Identify X. (1 mark)

_____

ii) Why is it necessary to use super-heated water in this process? (1 mark)

_____

_____

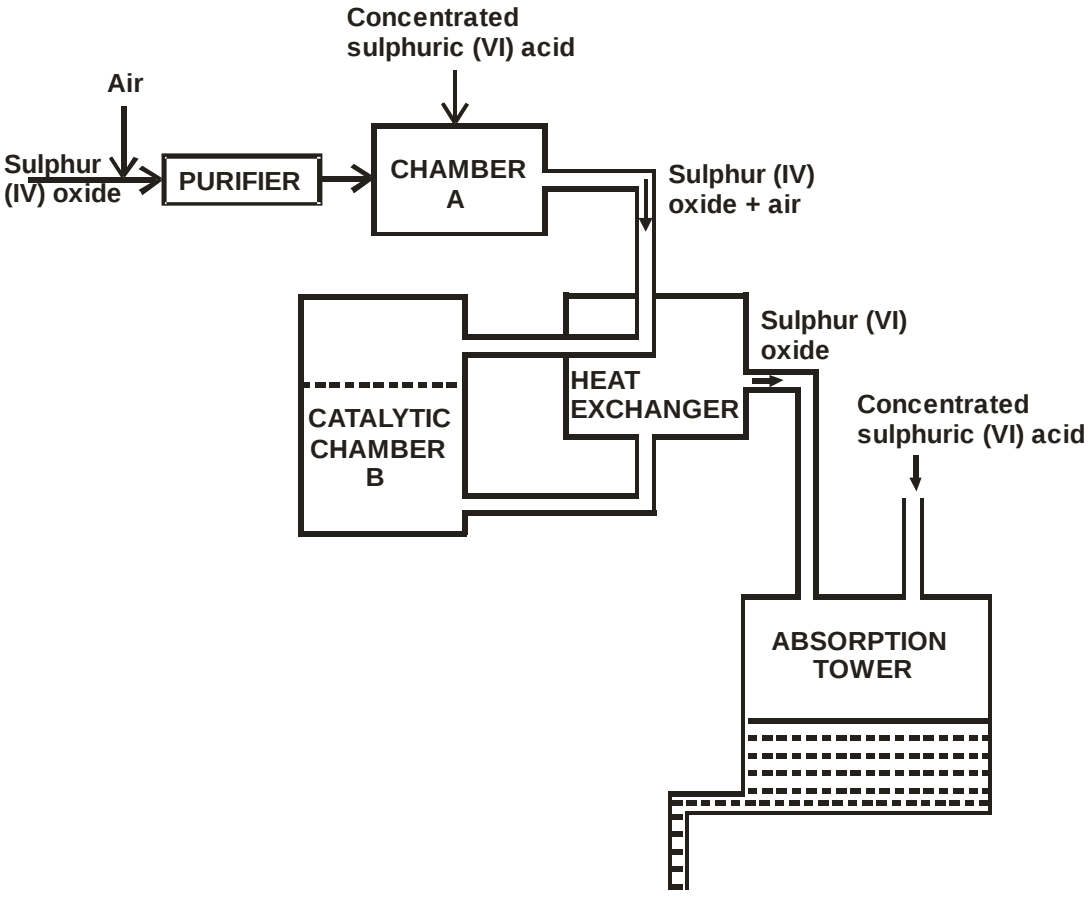
iii) State **two** physical properties of sulphur that makes it possible for it to be extracted by this method. (2 marks)

_____

_____

b) The diagram below shows part of the process in the manufacture of suphuric (VI) acid.

Study it and answer the questions that follow.



i) Write an equation for the formation of sulphur (IV) oxide from sulphur. (1 mark)

ii) What it the role of concentrated sulphuric (VI) acid in chamber A? (1 mark)

iii) Name **two** catalysts that can be used in the catalytic chamber B. (1 mark)

iv) State **two** roles of the heat exchanger. (2 marks)

c) Explain **one** way in which sulphur (IV) oxide is a pollutant. (1 mark)

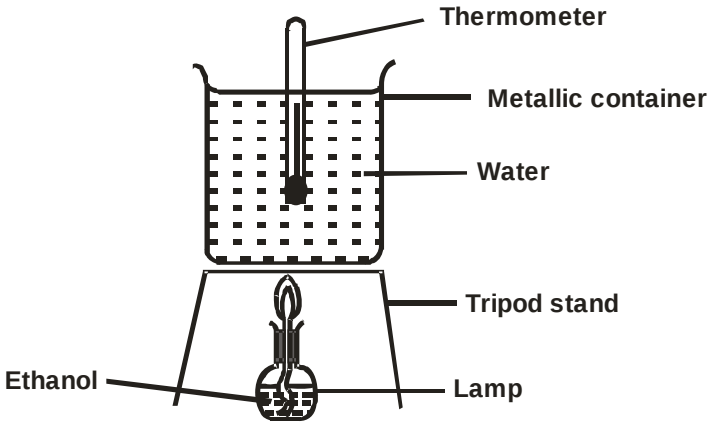
d) What observation will be made when a few drops of concentrated sulphuric (VI) acid are added to crystals of sugar? Explain your answer. (2 marks)

3. a) State **two** factors that should be considered when choosing a fuel for cooking. (2 marks)

_____

_____

b) The diagram below represents a set-up that was used to determine the molar heat of combustion of ethanol.



During the experiment the data given below was recorded.

Volume of water = $450cm^3$

Initial temperature of water = 25^oC

Final temperature of water = 46.5^oC

Mass of ethanol + lamp before burning = 125.5g

Mass of ethanol + lamp after burning = 124.0g

Calculate the:

i) Heat evolved during the experiment.
(Density of water = $1g/cm^3$ specific heat capacity of water = $4.2Jg^{-1}K^{-1}$). (2 marks)

_____

_____

_____

_____

_____

ii) Molar heat of combustion of ethanol (C = 12, O = 16, H = 1). (2 marks)

_____

_____

_____

_____

_____

c) Write the equation for the complete combustion of ethanol. (1 mark)

_____

d) The value of the molar heat of combustion of ethanol obtained in b (ii) above is lower than the theoretical value. State **one** source of error in the experiment. (1 mark)

_____

4. a) Crude oil is a source of many compounds that contain carbon and hydrogen only.

i) Name the process used to separate the components of crude oil. (1 mark)

_____

ii) State **two** physical properties of the above components that determine the separation. (2 marks)

_____

_____

_____

b) Under certain conditions, Heptane can be converted to two products.
The formula of one of the products is C_3H_8.

i) Write the formula of the other product. (1 mark)

_____

ii) Determine a simple chemical reaction to show the difference between the two products formed in b(i) above. (2 marks)

_____

_____

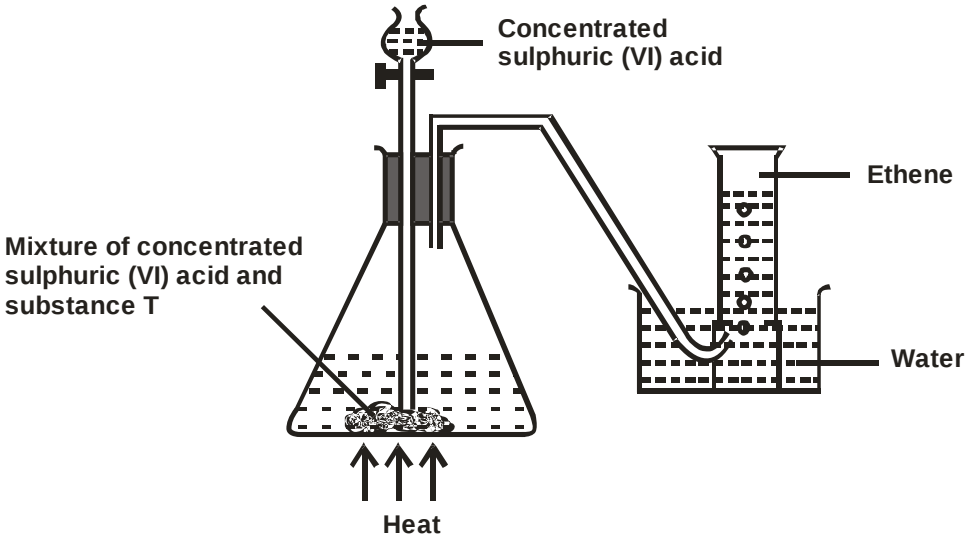
_____

_____

c) Butyne C_4H_6 is another compound found in crude oil. One mole of butyne was reacted with one mole of hydrogen chloride gas and a product P1 was formed. P1 was then reacted with excess hydrogen gas to form P2. Draw the structure of P1 and P2. (2 marks)

d) The set up below was used to prepare and collect ethene gas.

Study it and answer the questions that follow.



i) Name substance T. (1 mark)

_____

ii) Give the property of ethene that allows it to be collected as shown in the set-up. (1 mark)

_____

e) One of the reactions undergone by ethene is addition polymerization.

Give the name of the polymer and **one** disadvantage of the polymer it forms. (2 marks)

Name _____

Disadvantage _____

5. a) The standard electrode potentials for the elements chloride and magnesium are:

$Cl_{2\,(aq)} + 2e^- \rightarrow 2Cl^-_{(aq)}$ $E^\theta = +1.36V$

$Mg^{2+}_{(aq)} + 2e^- \rightarrow Mg_{(s)}$ $E^\theta = -2.36V$

i) Which one for the two elements will act as an oxidizing agent? Explain your choice. (2 marks)

_____

_____

_____

ii) Calculate the electromotive force of a cell where the overall reaction is:

$Cl_{2\,(aq)} + Mg_{\,(s)} \rightarrow MgCl_{2\,(aq)}$ (1 mark)

_____

_____

_____

_____

b) The table below gives the standard electrode potentials for divalent metals represented by the letters P, Q, R and S (not their symbols of elements). Use it to answer the question that follow.

Metal	E^{θ} (volts)
P	+1.50
Q	+0.44
R	+0.34
S	–0.76

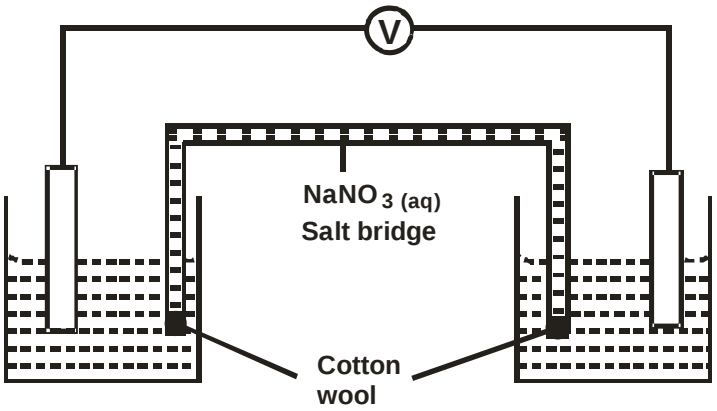
i) Which one of the metals cannot be displaced from a solution of its ions by any other metals in the table? Explain. (2 marks)

_____

_____

_____

ii) Metals P and Q were connected to from a cell as shown in the diagram below.



I. On the diagram label the metals P and Q and indicate the ions in solution. (2 marks)

II. Write equations (half equations) of the reactions taking place at the electrodes.

Electrode P (1 mark)

_____

Electrode Q (1 mark)

_____

III. State **two** functions of the salt bridge. (2 marks)

_____

_____

IV. What must be observed about the choice of a salt bridge? (1 mark)

_____

_____

iii) A metallic couple of the metal S and Z produced a voltage of +1.71volts.
(Assume that S has the higher negative electrode potential)

I. Calculate the standard electrode potential (S.E.P) for metal Z. (1 mark)

_____

_____

_____

_____

II. Arrange the metals P, Q, R and Z in their decreasing order of reactivity. (2 marks)

_____

6. a) Define the term solubility. (1 mark)

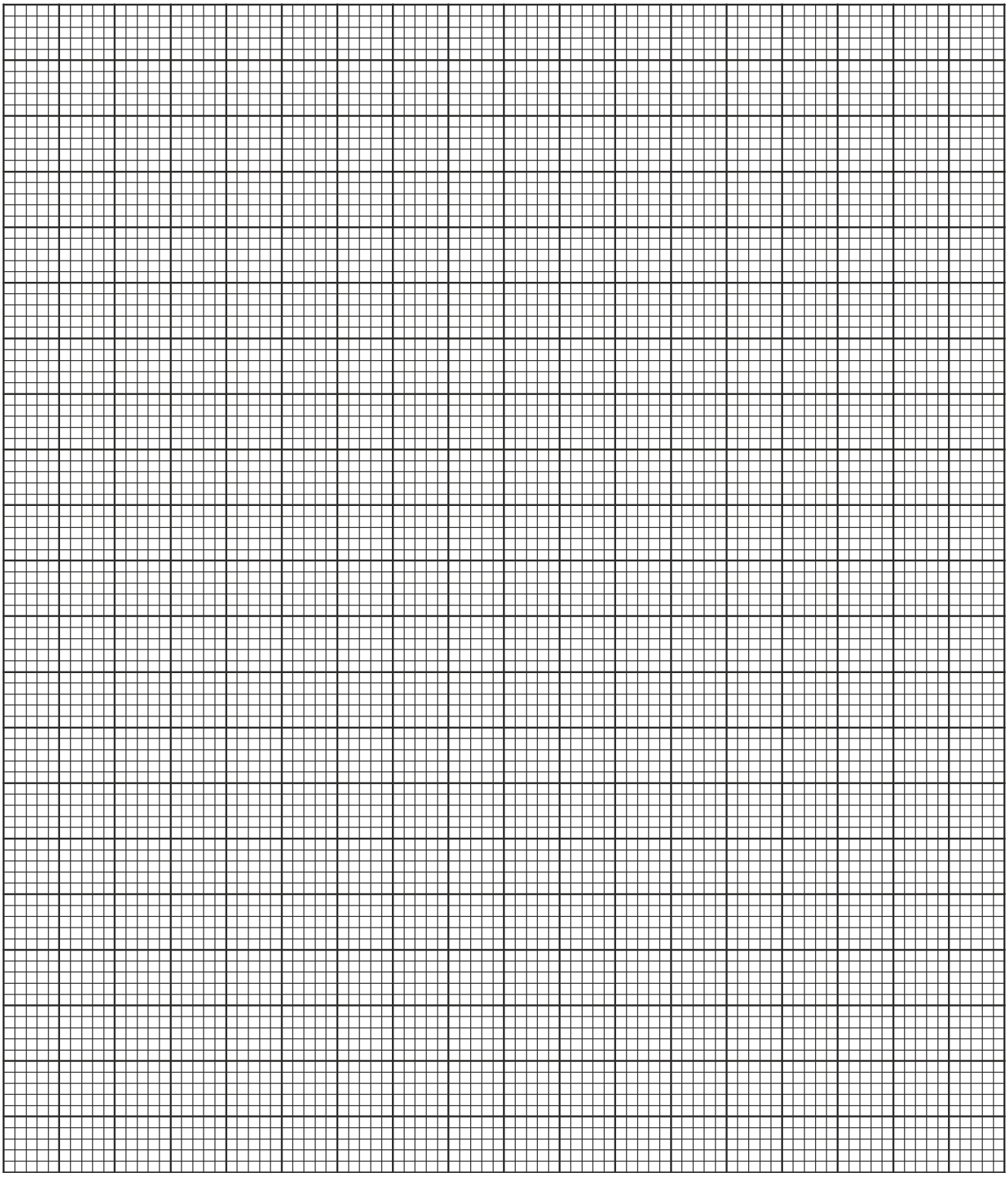
_____

_____

b) In an experiment to determine the solubility of two salts X and Y at different temperatures, a candidate recorded her observations as shown below.

Temperature (°C)	0	10	20	30	40	50	60	70	80	90
Solubility of X in g/100g of H_2O	14.3	17.4	20.7	25.0	28.5	33.3	40.0	47.0	55.0	64.0
Solubility of Y in g/100g of H_2O	25.0	27.5	30.0	32.5	35.0	37.6	40.1	42.4	45.0	48.0

On the same axes plot the solubility curves of X and Y against temperature. (5 marks)



c) From the graph determine;

i) Solubility of X and Y at 47°C.

Solubility of X. (½ mark)

Solubility of Y. (½ mark)

ii) The temperature at which the two salts have the same solubility in water. (1 mark)

d) If 60g of X is dissolved in 100g of water and heated to 90°C, calculate the amount of salt that crystallized out if cooled to 20°C. (1 mark)

e) State what would happen if a mixture of salt X in 100g of water and 30g of Y in 100g of water were cooled from 90°C to 70°C. (2 marks)

f) State **one** application of solubility. (1 mark)

7. In an experiment, a piece of magnesium ribbon was cleaned with steel wool. 2.4g of the clean magnesium ribbon was placed in crucible and completely burnt in oxygen.
After cooling, the product weighed 4.0g.

a) Explain why it is necessary to clean the magnesium ribbon. (1 mark)

b) What observation was made in the crucible after burning? (1 mark)

c) Why was there an increase in mass? (1 mark)

d) Write the equation for the reaction which took place in the crucible. (1 mark)

e) The product in the crucible was shaken with water and filtered.

Explain the observation which was made when blue and red litmus papers were dropped into the filtrate. (2 marks)

_____

_____

_____

f) Calculate the volume of oxygen gas used during the burning.

(O = 16, molar volume of gas = 24000cm^3 at room temperature) (3 marks)

_____

_____

_____

_____