Name _____ Index No. _____

Candidate's Signature _____

Date _____

233/1
CHEMISTRY
PAPER 1
THEORY
JULY / AUGUST 2014
2 HOURS

KIBWEZI DITRICT FORM 4 INTER-SCHOOLS EXAMINATION 2014
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 1
2 HOURS

INSTRUCTIONS TO CANDIDATES

- Answer ALL questions in the spaces provided.
- All working MUST be clearly shown.
- Electronic calculators and KNEC Mathematical tables may be used.

FOR EXAMINER'SUSE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1 – 28	80	

This paper consists of 11 printed pages

Turn Over

1. Phosphorus element smoulders in air to form two oxides

(a) Name the two oxides. (2 marks)

(i) _____

(ii) _____

(b) State the nature of the solution when the above mentioned oxides are dissolved in water. (1 mark)

_____

_____

_____

2. (a) What is meant by the terms: (2 mark)

(i) Atom

_____

_____

_____

(ii) Mass number

_____

_____

_____

(b) The formula of element T is TCl_3. What is the formula of its sulphate? (1 mark)

_____

_____

_____

3. Diamond is an allotrope of carbon.

(a) Name two other elements which exhibit allotrophy. (1 mark)

_____

_____

_____

_____

(b) Explain why diamond is used in making ornaments. (2 marks)

_____

_____

_____

_____

4. Distinguish between neutralization and esterification. (3 marks)

_____

_____

_____

_____

5. Ethanol and pentane are miscible liquids.
(a) Name the method that can be used to separate the two liquids. (1 mark)

_____

_____

_____

(b) Explain why solubility of pentane in water is lower than that of ethanol. (2 marks)

_____

_____

_____

_____

6. The pressure of oxygen gas in $2dm^3$ cylinder at -183^0C was 10^7 pascals. Calculate the
(a) volume of the gas at 25^0C and 10^5 pascal. (2 marks)

(b) mass of oxygen gas (molar gas volume is $24dm^3$ O = 16) (2 marks)

7. Hydrogen sulphide is highly toxic and flammable gas. It is normally prepared in a fume chamber.
(a) Name two reagents that can be used to prepare hydrogen sulphide gas. (2 marks)

_____

_____

_____

_____

(b) State the method used to collect the gas. (1 mark)

_____

_____

_____

8. Hydrogen is not commonly used as a fuel. State two reasons why it is not used. (2 marks)

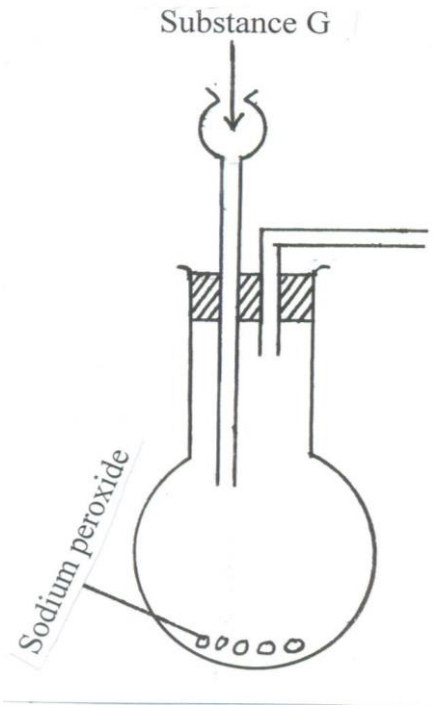
_____

_____

_____

_____

9. The apparatus shown below was set up to prepare and collect oxygen gas.



(a) Name substance G _____ (1 mark)

(b) Complete the set up to show how dry sample of oxygen gas is collected. (2 marks)

10. Element K has an atomic number of 7 while element M has an atomic number of 1
(a) Write down the electron arrangement of ion of K. (1 mark)

_____

_____

_____

(b) Draw dot (•) and cross (x) diagram to show the bonding between K and M. (2 marks)

11. A mixture contains aluminium chloride, copper (II) oxide and potassium chloride.
Describe how each of the substances can be obtained from the mixture. (3 marks)

_____

_____

_____

_____

_____

12. Study the reactions below and answer the questions that follow.

I) Sodium metal $\xrightarrow[\text{water}]{\text{cold}}$ sodium hydroxide + hydrogen gas

II) Concentrated sodium chloride $\xrightarrow{\text{Process B}}$ Sodium hydroxide + hydrogen gas + chlorine gas

(a) Name one precaution that needs to be taken in reaction I. (1 mark)

_____

_____

(b) Name process B. (1 mark)

_____

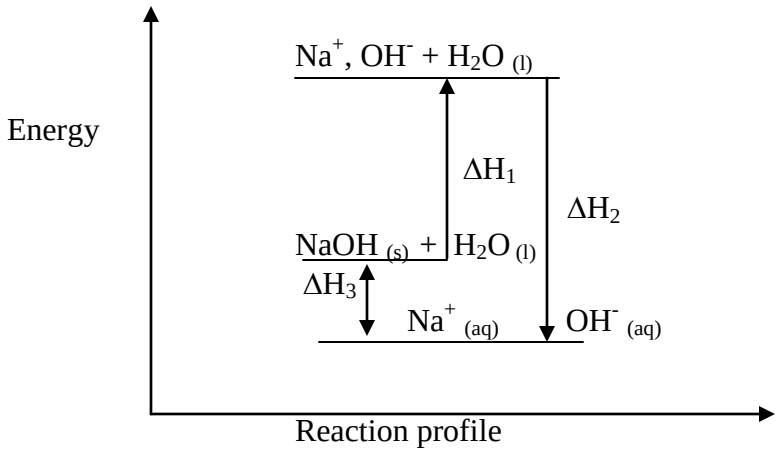
_____

(c) Give one use of sodium hydroxide. (1 mark)

_____

_____

13. Study the diagram below and answer the questions that follow.



(a) What does ΔH_1 and ΔH_2 represent? (2 marks)

_____

_____

_____

_____

(b) Write an expression relating ΔH_1, ΔH_2 and ΔH_3. (1 mark)

_____

_____

_____

14. Both chlorine and iodine are halogens.
(a) What are halogens? (1 mark)

_____

_____

_____

_____

(b) In terms of structure and bonding explain why the boiling point of chlorine is lower than iodine. (2 marks)

_____

_____

_____

_____

_____

15. When aluminium oxides was electrolysed, 1800kg of aluminium metal were obtained.
(a) Write an equation for the formation of aluminium metal. (1 mark)

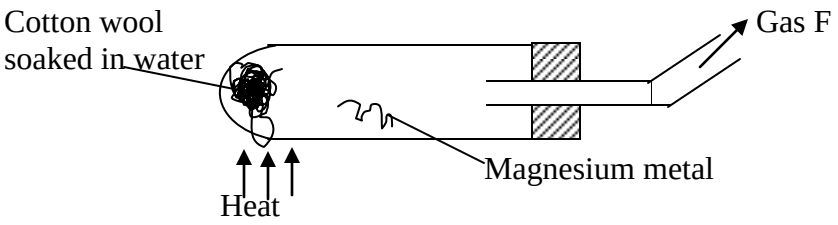
_____

_____

_____

(b) Calculate the quantity of electricity in faradays used. (Al = 27) (2 marks)

16. A student used the set up shown in the diagram inorder to study the reaction of some metals with steam. The experiment was carried out for ten minutes.



(a) What observation would be made if gas F is ignited? (1 mark)

_____

_____

_____

_____

(b) State the precaution to be taken during the experiment. Explain why. (2 marks)

_____

_____

_____

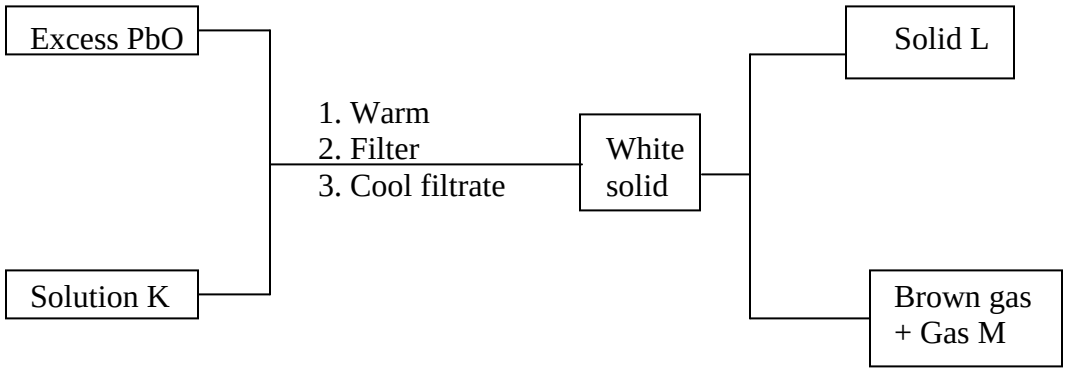
_____

_____

17. Classify the following processes as either chemical or physical. (3 marks)

Process	**Type of change**
(a) Heating of lead (II) oxide	_____
(b) Obtaining kerosene from crude oil	_____
(c) Souring of milk	_____

18. Study the flow chart below and answer the questions that follow.



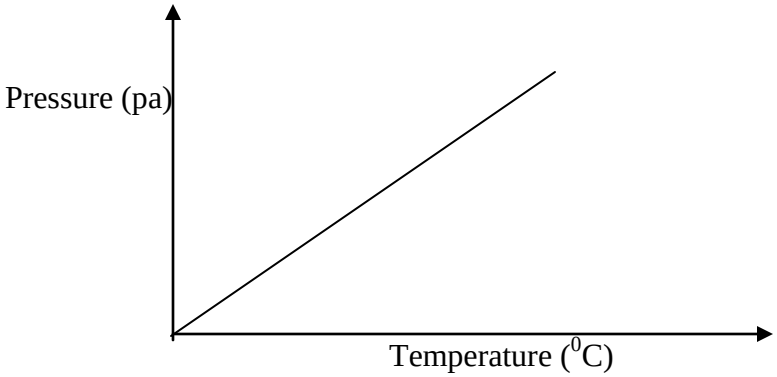
Identify: (3 marks)

(a) Solution K _____

(b) Solid L _____

(c) Gas M _____

19. The graph below shows the relationship between pressure and temperature of a gas in a fixed volume container.



(a) State the relationship between pressure and temperature that can be deduced from the graph. (1 mark)

_____

_____

_____

_____

(b) Using kinetic theory, explain the relationship. (2 marks)

_____

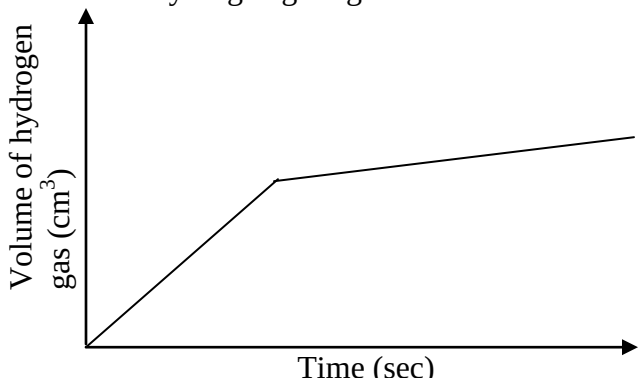
_____

_____

_____

_____

20. In an experiment to prepare hydrogen gas, magnesium metal and dilute hydrochloric acid, a student plotted the volume of hydrogen gas against time as shown in the sketch below.



(a) On the same axis, sketch the curve that would be obtained if a few crystals of copper (II) sulphate are added and label it curve C. (1 mark)

(b) What would be the function of copper (II) sulphate in the reaction. (1 mark)

_____

_____

_____

(c) Write a word equation for the above reaction. (1 mark)

_____

_____

_____

_____

21. (a) Distinguish between a chemical reaction and nuclear reaction. (2 marks)

_____

_____

_____

_____

_____

(b) 100g of radioactive substance was reduced to 12.5g in 15.6 years. Calculate the half-life of the substance. (1 mark)

22.. The half equations involved in a cell are

$4OH^-_{(aq)} \rightleftharpoons 2H_2O_{(l)} + O_{2(g)} + 4e^-$ $\quad E^\theta = + 0.40V$

$H_{2(g)} + 2OH^-_{(aq)} \rightleftharpoons 2H_2O_{(l)} + 2e$ $\quad E^\theta = -0.80V$

(a) Write the overall equation for the electrochemical cell. (1 mark)

_____

_____

_____

_____

(b) Calculate the e.m.f generated by a battery consisting of ten cells. (2 marks)

23. Study the information in the table below and answer the questions that follow.

Salt	Solubility (g/100g water)	
	At 30^0C	at 70^0C
$CuSO_4$	28	38
$AgNO_3$	79	98

A mixture containing 36g of $CuSO_4$ and 78g of $AgNO_3$ in 100g of water at 70^0C was cooled to 30^0C.

(a) Which salt crystallized out? Give a reason. (2 marks)

_____

_____

_____

_____

(b) Calculate the mass of the salt that crystallized. (1 mark)

24. (a) Name two cations that are present in hard water. (1 mark)

_____

_____

_____

_____

(b) State two advantages of hard water. (2 marks)

_____

_____

_____

_____

25. Concentrated nitric (V) acid was added to iron (II) sulphate acidified with dilute sulphuric (VI) acid and the mixture heated. The solution turned from pale green to yellow with evolution of a brown gas. Explain the observation. (2 marks)

_____

_____

_____

_____

_____

26. (a) What are acid-base indicators? (1 mark)

_____

_____

_____

_____

(b) Give two acid-base indicators and state the colour changes in acid and base solutions. (2 marks)

Name of indicator	**Colour in acid**	**Colour in base**
(i) _____	_____	_____
(ii) _____	_____	_____

27. Calcium oxide can be used to dry ammonia gas.

(a) Explain why calcium oxide is NOT used to dry hydrogen chloride gas. (2 marks)

_____

_____

_____

_____

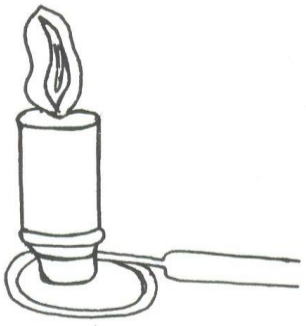
(b) Name one drying agent for hydrogen chloride gas. (1mark)

_____

_____

_____

28. The diagram below shows an apparatus used in the laboratory.



(a) Give the name of the apparatus. (1 mark)

_____

_____

_____

(b) State its use in the laboratory. (1 mark)

_____

_____

_____

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Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 1

MARKING SCHEME

1. (a) (i) Phosphorus (III) oxide
(ii) Phosphorus (V) oxide
(b) Acidic

2. (a) (i) Smallest particle of an element that can take part in a chemical reaction.
(ii) Number of protons and neutrons in the nucleus of an atom.

(b) $T_2(SO_4)_3$

3. (a) (i) Sulphur
(ii) Carbon

(b) Carbon atoms are arranged in tetrahedral structure with high refractive index. Hence making it transparent and shinny.

4. Neutralisation is a process in which an acid reacts with base to form salt and water only.
Esterification is a process in which a carboxylic acid reacts with an alkanol form ester and water only.

5. (a) Fractional distillation.
(b) Ethanol forms hydrogen bond with water while pentane does not.

6. (a) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{2 \times 10^7}{90} = \frac{10^5 \times V_2}{298}$

$V_2 = \frac{2 \times 10^7 \times 298}{10^5 \times 90}$

$V_2 = \frac{2 \times 10^2 \times 298}{90}$

$= 662.22dm^3$

This paper consists of 4 printed pages

Turn Over

(b) Moles of oxygen

$$\frac{662.22}{24}$$

= 27.59 moles

Mass of oxygen
If 1 mole = 32g

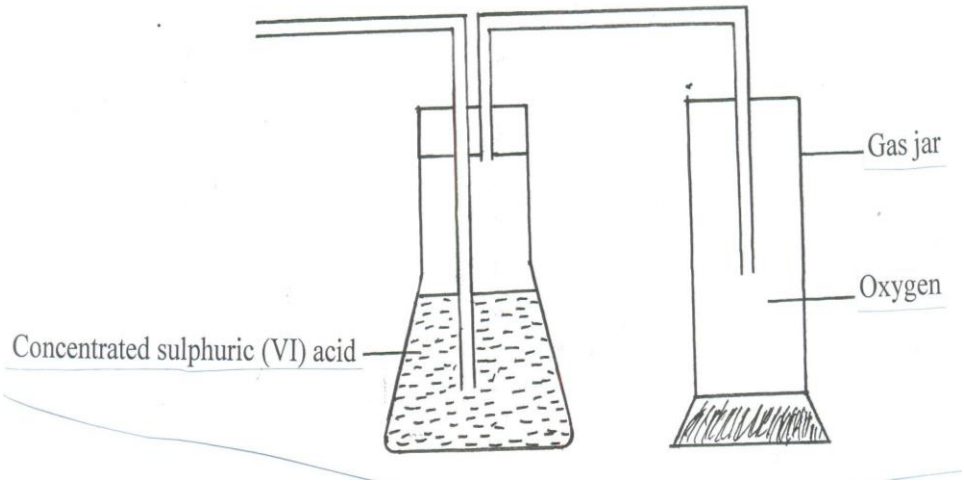
$$27.5925 = \frac{32 \times 27.59}{1}$$

= 882.88g

7. (a) Iron (II) sulphide // zinc sulphide // lead sulphide // hydrochloric acid
(b) Over warm water

8. It is expensive
It is explosive
It is difficult to store

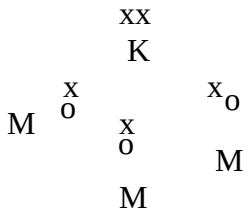
9. (a) Water



Note
(i) Drying agent √ ½
(ii) Method of collecting gas √ ½
(iii) Workable diagram √1

10. (a) 2:8

(b)



11. (a) Heat √ ½ the mixture, aluminium chloride would sublime √ ½
Add water √ ½ to dissolve potassium chloride √ ½ , copper (II) oxide does not filter √ ½ the mixture and evaporate √ ½ to get potassium chloride

12. (a) Small piece of sodium metal (rice grain size) should be used.
Perform the experiment wearing goggles.
(b) Electrolysis

(c) - Manufacture of soap.
- Used during fractional distillation of liquid air.
- Making herbicides / weed killer.

13. (a) ΔH_1 – Lattice energy
ΔH_2 – Hydration energy

(b) $\Delta H_3 = \Delta H_1 - \Delta H_2$

14. (a) They are group (VII) elements.
(b) Chlorine molecule is smaller and the strength of vander waals forces between molecules of chlorine is weaker as compared to iodine.

15. (a) $Al^{3+}_{(l)} + 3e^- \longrightarrow Al_{(s)}$ OR

$2Al_2O_{3(l)} \longrightarrow 4Al_{(s)} + 3O_{2(g)}$

(b) $3F \longrightarrow 27g$
$? \longrightarrow 1800 \times 1000g$

$$\frac{3 \times 1800 \times 1000}{27}$$

$= 200000F$

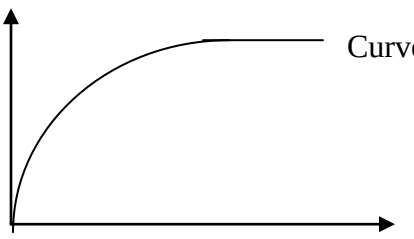
16. (a) Blue flame

(b) - Magnesium, should not be heated before cotton wool soaked in water.
- Avoid air trapped in the boiling tube reacting with magnesium metal.

17. (a) Physical change
(b) Physical change
(c) Chemical change

18. (a) Dilute nitric (V) acid // $HNO_{3(aq)}$
(b) Lead metal / $Pb_{(s)}$
(c) Oxygen gas // $O_{2(g)}$

19. (a) Temperature and pressure are directly proportional
(b) When temperature increase the gas particles gain more kinetic energy. They move faster and collide with the walls of the container more frequently hence increasing pressure.

20. (a) 
Curve C

Curve C is steep levels faster

(b) Acts as catalyst

(c) Magnesium metal + hydrochloric acid $\longrightarrow$ Magnesium chloride + hydrogen gas

21. (a) A chemical reaction involves transfer of electrons in energy levels of an atom.
A nuclear reaction involves protons / neutrons in nucleus of an atom releasing large amount of energy.

(b) 100g $\longrightarrow$ 50g $\longrightarrow$ 25g $\longrightarrow$ 12.5g
4 half-life

$\frac{15.6 \text{ yrs}}{4}$ = 3.65 yrs

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

(b) e.m.f $= E^o\text{red} - E^o\text{oxid}$
$= + 0.40 - {}^{-}0.80V$
$= 0.40 + 0.8$
$= 1.2V \times 10$
$= 12\ V$

23. (a) $CuSO_4$
Only 28g of $CuSO_4$ can dissolve at 30^0C or
79g of $AgNO_3$ can dissolve and only 78g were used at 30^0C.

(b) 38g – 28g = 10g

24. (a) Magnesium ion
Calcium ion

(b) - Calcium ions present are used in bone formation.
- Formation of scale in lead pipes prevent wearing out of the pipe.

25. Iron (II) ions which is green are oxidized to iron (III) ions which are yellow.
Nitric (V) acid is reduced to nitrogen (IV) oxide which is brown in colour.

26. (a) A substance that has one colour in acidic solution and different colour in a basic solution.

(b)

Indicator	Colour in acid	Colour in base
(i) Litmus paper	red	blue
(ii) Phenolphthalein	colourless	pink

27. (a) Calcium oxide is basic hydrochloride gas is acid they will react together.
(b) Concentrated sulphuric (VI) acid.

28. (a) Bunsen burner.
(b) Heating substances in the laboratory.

Name _____ Index No. _____

Candidate's Signature _____

Date _____

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KIBWEZI DITRICT FORM 4 INTER-SCHOOLS EXAMINATION 2014
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 2
2 HOURS

INSTRUCTIONS TO CANDIDATES

(a) Write your name and index number in the spaces above.
(b) Sign and write the date of examination in the spaces provided above.
(c) Answer all 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.

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QUESTION	Maximum Score	Candidate's Score
1	12	
2	12	
3	13	
4	10	
5	10	
6	10	
7	13	
Total Score	**80**	

This paper consists of 13 printed pages

Turn Over

1. Use the table below to answer the questions that follow.
(The letters are not the actual symbols of the elements)

Element	Atomic number	Melting point (^{0}C)
A	11	97.8
B	13	660
C	14	1410
D	17	-101
E	19	63.7

(a) Write the electronic arrangement for the ions formed by the elements B and D

B _____ (½ mark)

D _____ (½ mark)

(b) Select an element which is

(i) a poor conductor of electricity _____ (½ mark)

(ii) most reactive metal _____ (½ mark)

(c) Explain briefly how the atomic radii of element B and C compare. (2 marks)

_____

_____

_____

_____

(d) Use dots (•) and crosses (x) to represent outermost electrons and show the bonding in the compound formed between C and D. (2 marks)

(e) Explain why the melting point of element B is higher than that of element A. (2 marks)

_____

_____

_____

_____

(f) Write an equation for the reaction that takes place between element A and water. (1 mark)

_____

_____

_____

(g) Describe how a solid mixture of the sulphate of element E and lead (II) sulphate can be separated into solid samples. (3 marks)

2. (a) (i) State Hess's law. (1 mark)

(ii) Use the thermochemical equations given below to calculate the enthalpy of formation of ethane. (3 marks)

$C_2H_{6\,(g)} + 7/_2\ O_{2\,(g)} \longrightarrow 2CO_{2\,(g)} + 3H_2O_{\,(g)}$ $\Delta H = -1560\ kJmol^{-1}$

$C_{\,(graphite)} + O_{2\,(g)} \longrightarrow CO_{2\,(g)}$ $\Delta H = -394\ kJmol^{-1}$

$H_{2(g)} + ½\ O_{2\,(g)} \longrightarrow H_2O_{\,(g)}$ $\Delta H = -286\ kJmol^{-1}$

(b) The table below gives the volumes of oxygen gas produced at different times when hydrogen peroxide solution decomposed in the presence of a catalyst.

Time in seconds	0	10	20	30	40	50	60
Volume of oxygen (cm^3)	0	66	98	110	119	120	120

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

(ii) Write the chemical equation for the decomposition of hydrogen peroxide. (1 mark)

(iii) On the grid provided, draw the graph of the volume of oxygen gas (vertical axis) against time. (3 marks)

(iv) Using the graph, determine the rate of decomposition of hydrogen peroxide between 24^{th} second and 34^{th} second. (2 marks)

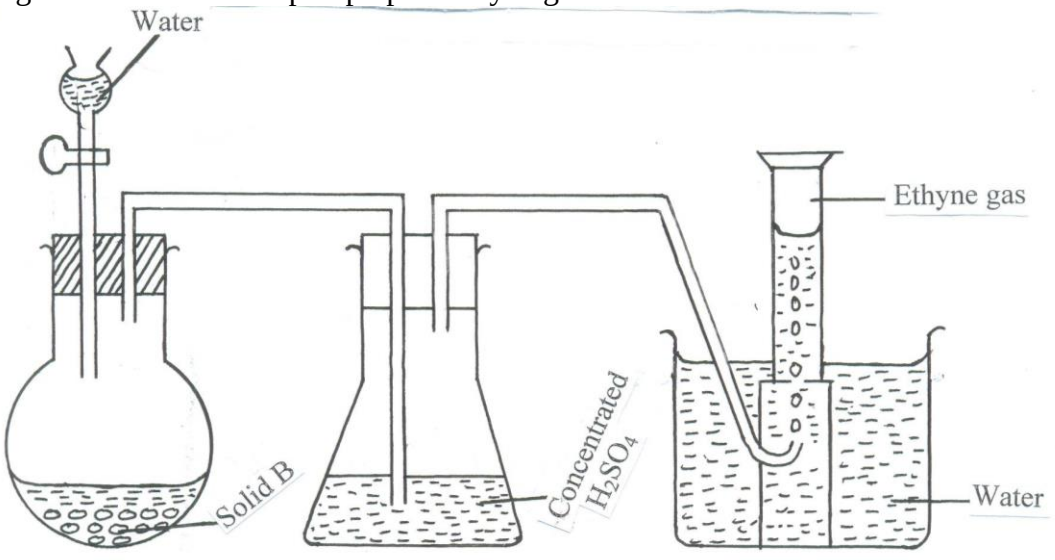
(v) Give a reason why the total volume of oxygen gas produced after 50 seconds remain constant. (1 mark)

_____

_____

_____

3. (a) The diagram below is a set-up to prepare ethyne gas.



(i) Name solid B _____ (1mark)

(ii) Write an equation for the reaction taking place between solid B and water. (1 mark)

_____

_____

_____

_____

(iii) State the property that makes the gas to be collected by the method shown in the diagram. (1mark)

_____

_____

_____

_____

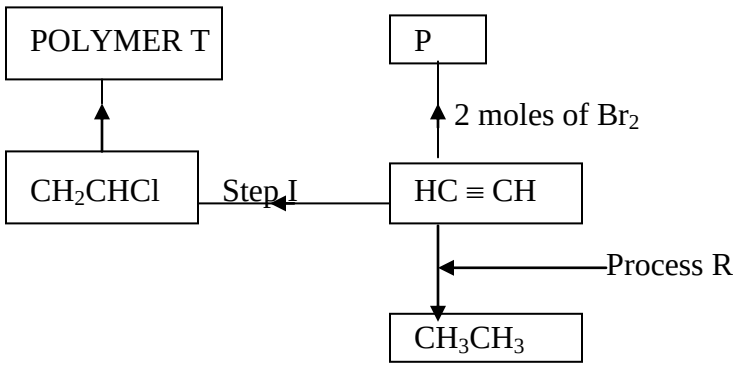
(iv) State the main commercial use of ethyne. (1 mark)

_____

_____

_____

(b) The scheme below represents some reactions of ethyne. Study it and answer the questions that follow.



(i) Name compound P and draw it's structural formula. (1 mark)

_____

_____

_____

_____

(ii) Name the reagents used in:

I) Process R _____ (½ mark)

II) Step I _____ (½ mark)

(iii) Draw the repeating unit in polymer T. (1 mark)

(iv) Name polymer T _____ (1 mark)

(v) Give one use of T (1 mark)

_____

_____

_____

_____

(c) Ethanol and ethanoic acid react according to the following equation under condition M and process N to form product Z.

$$CH_3\,CH_2\,OH_{(l)} + CH_3\,COOH_{(aq)} \longrightarrow Z_{(l)} + H_2O_{(l)}$$

Name:

(i) Condition M _____ (½ mark)

(ii) Product Z _____ (½ mark)

(iii) Draw the structural formula of product Z. (1 mark)

(iv) State any 2 differences between the above reaction and that of an hydroxide and an acid. (1 mark)

_____

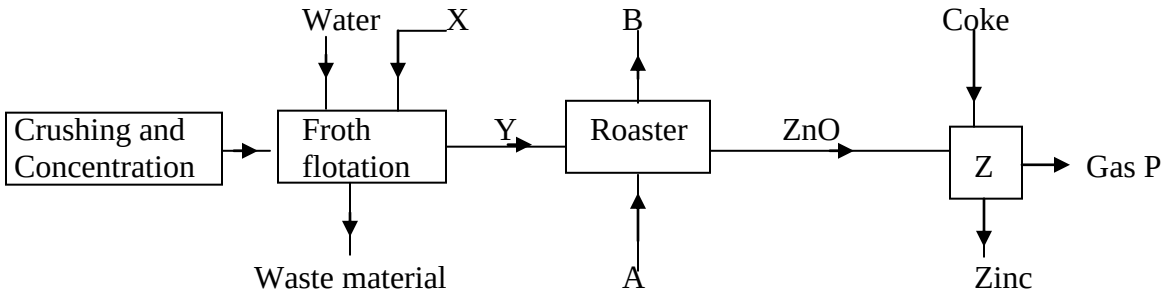
_____

_____

_____

(v) Butane is often used as the main component in domestic gas fuels. Calculate it's heating value (H = 1, C = 12, $\Delta H^{\theta}C$ (C_4H_{10}) = 2877.0 k $Jmol^{-1}$) (1 mark)

4. The flow chart below shows the extraction of zinc. Study it and answer the questions that follow.



(a) (i) Identify substance X _____ (1 mark)

(ii) Give one waste material of the froth flotation process. (1 mark)

_____

_____

_____

(iii) Identify substances A and B.

A _____ (½ mark)

B _____ (½ mark)

(iv) Write equation for the reaction taking place in the roaster. (1 mark)

_____

_____

_____

_____

(v) Identify gas P and write an equation for it's formation. (1 ½ marks)

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

Half reactions	Electrode potential, E^{θ} (V)
$D^{+}_{(aq)} + e^{-} \longrightarrow D_{(s)}$	+ 0.80
$E^{2+}_{(aq)} + 2e^{-} \longrightarrow E_{(s)}$	+ 0.34
$F^{2+}_{(aq)} + 2e^{-} \longrightarrow F_{(s)}$	-0.13
$G^{2+}_{(aq)} + 2e^{-} \longrightarrow G_{(s)}$	-0.76

(i) Construct an electrochemical cell that will produce the lowest emf. (3 marks)

(ii) Calculate the emf of the cell constructed in (i) above. (1 mark)

(iii) From the half reactions listed in the table in (b) above select strongest oxidizing agent. (½ mark)

5. (a) Fractional distillation of liquid air is mainly used to obtain nitrogen and oxygen.

(i) Name one substance that is used to remove carbon (IV) oxide from the air before it is changed into liquid. (1 mark)

_____

_____

_____

(ii) Describe how nitrogen gas is obtained from the liquid air.
(Boiling points nitrogen = -196^0C, Oxygen = -183^0C) (3 marks)

_____

_____

_____

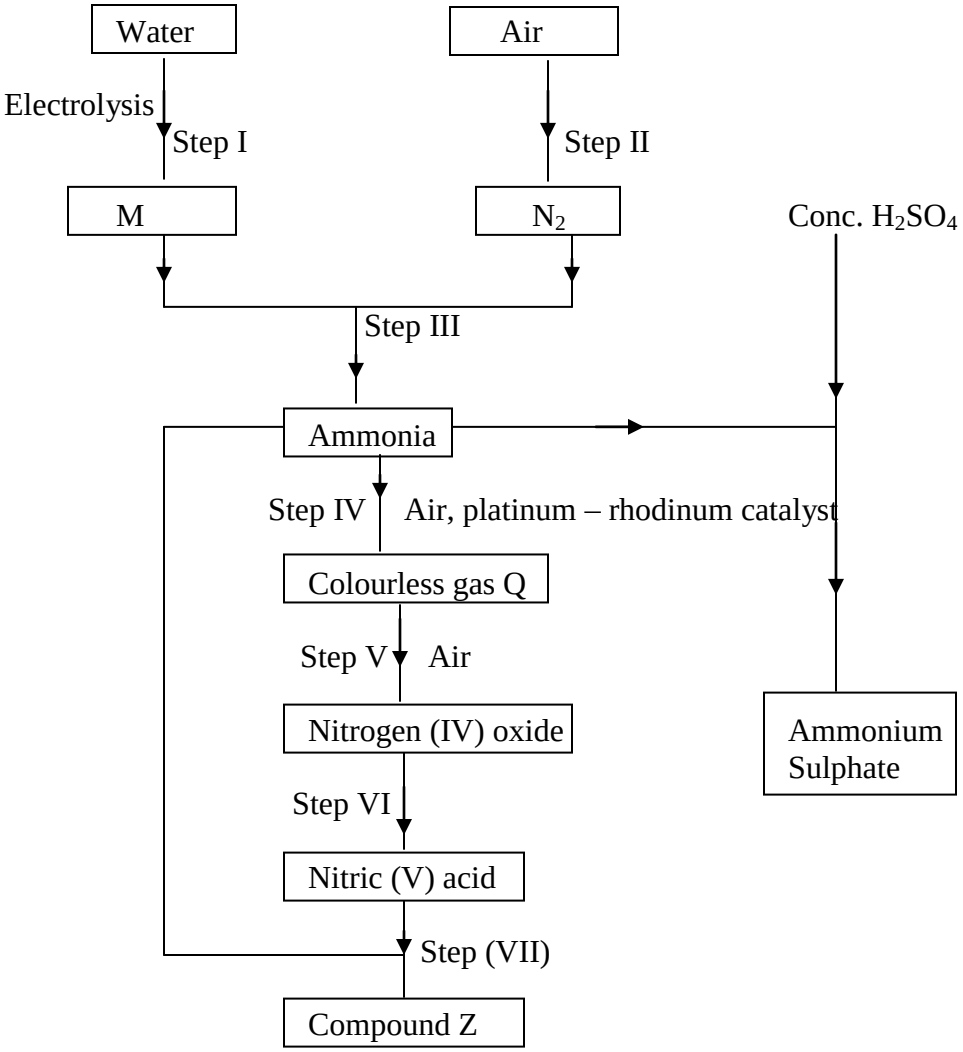
_____

_____

_____

_____

(b) Study the flow chart below and answer the questions that follow.



(i) Name substance M _____ (1 mark)

(ii) Identify gas Q _____ (1 mark)

(iii) State one use of compound Z (1 mark)

_____

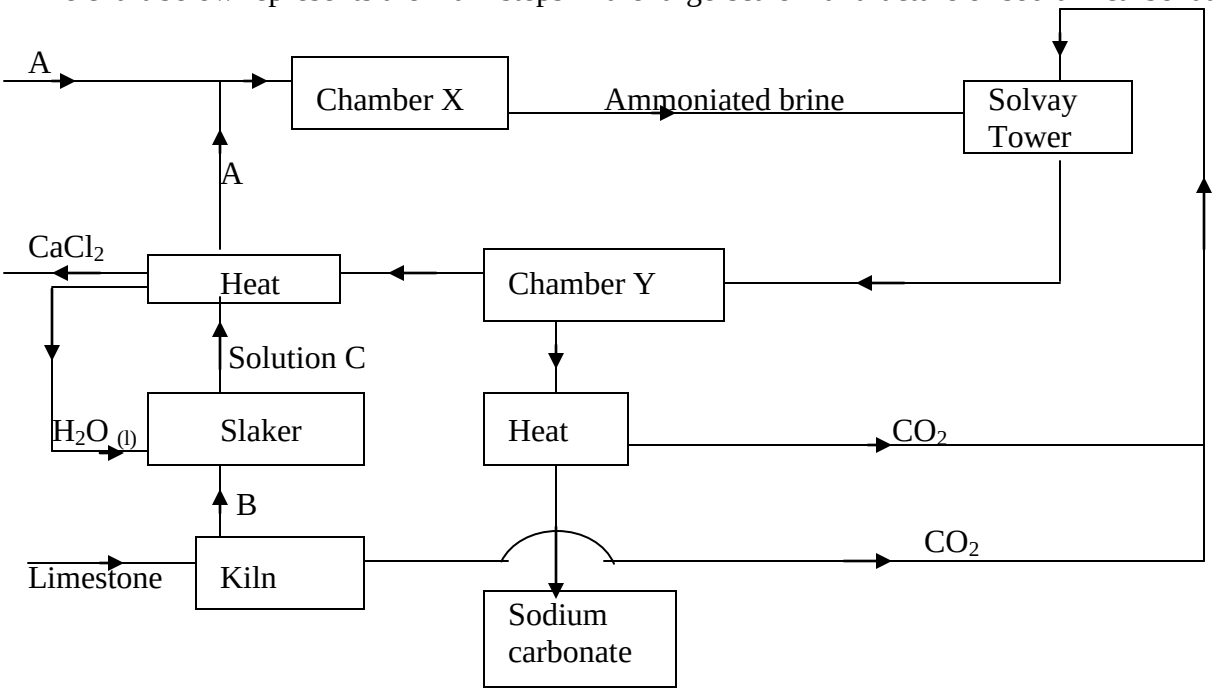
_____

_____

_____

(iv) A fertilizer manufacturing industry uses 1400dm^3 of ammonia gas per hour to produce ammonium sulphate. Calculate the amount of ammonium sulphate produced in kg for one day if the factory operates for 18 hours.
(N = 14, H = 1, S = 32, O = 16, 1 mole of gas = 24dm^3) (3 marks)

6. The chart below represents the main steps in the large-scale manufacture of sodium carbonate.



(a) Name substances A and B.

A _____ (1 mark)

B _____ (1 mark)

(b) Write down the chemical equation leading to formation of C. (1 mark)

(c) A stream of cold water is made to circulate around chamber X. What does this suggest about the reaction taking place. (1 mark)

(d) Name the process that takes place in chamber Y. (1 mark)

(e) State any 2 by-products recycled in the process. (2 marks)

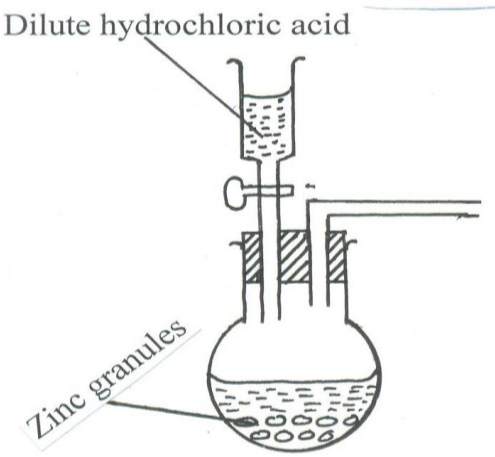
(f) In an experiment, wood charcoal was mixed with concentrated sulphuric (VI) acid in a test-tube. The mixture was then placed over a Bunsen-burner flame for sometime.

(i) Write down the chemical equation of the reaction that takes place. (1 mark)

(ii) State the property of concentrated sulphuric (VI) acid investigated in (i) above. (1 mark)

(g) Mention any 2 uses of sodium carbonate. (1 mark)

7. The set up below shows the reagents that can form hydrogen gas in a laboratory.
(a) Complete the diagram to show how a dry sample of hydrogen gas can be collected. (3 marks)



(b) Write the chemical equation for above reaction. (1 mark)

_____

_____

_____

_____

(c) Why is it not advisable to use calcium in this method to prepare hydrogen? (1 mark)

_____

_____

_____

_____

(d) Why is it advisable to discard the first jar of the gas collected. (1 mark)

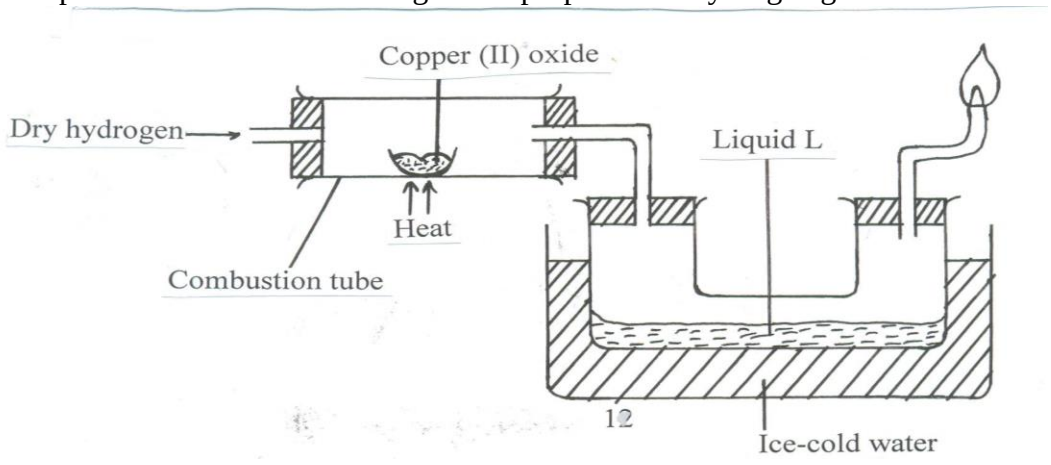
_____

_____

_____

_____

(e) The set-up below was used to investigate the properties of hydrogen gas.



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

_____

_____

_____

_____

(ii) Write down the equation leading to formation of liquid L. (1 mark)

_____

_____

_____

_____

(iii) What property of hydrogen is being investigated. (1 mark)

_____

_____

_____

_____

(iv) Why is potassium oxide not used to investigate this property of hydrogen gas. (1 mark)

_____

_____

_____

_____

(v) Hydrogen gas is used in hydrogenation of oils. What do you understand by the term hydrogenation? (1 mark)

_____

_____

_____

_____

(vi) Give any 2 other industrial uses of hydrogen gas. (2 marks)

_____

_____

_____

_____

233/2
CHEMISTRY
PAPER 2
THEORY
JULY / AUGUST 2014

KIBWEZI DITRICT FORM 4 INTER-SCHOOLS EXAMINATION 2014
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 2

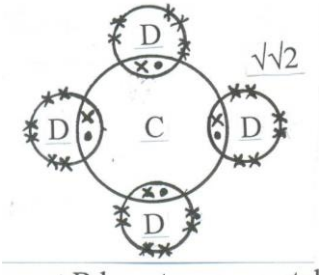
MARKING SCHEME

1. (a) B – 2 : 8 √ ½
D – 2 : 8 : 8 √ ½

(b) (i) D √ ½
(ii) E √ ½

(c) Atomic radius of B is larger √1 than that of C. C has more protons. The outer energy level electrons are pulled √1 strongly to the nucleus reducing the atomic size.

(d)



(e) Element B has stronger metallic √1 bond (has more delocalized electrons) than A, hence higher amount of heat √1 energy is needed to break the bond.

(f) $2A_{(s)} + 2H_2O_{(l)} \longrightarrow 2AOH_{(aq)} + H_{2(g)}$ √1
- Reject fully if unbalanced
- Award ½ mk if states are missing or any one state is wrong.

(g) Add water √ ½ to the mixture and stir.
Filter √ ½ to obtain lead (II) sulphate as √ ½ residue and sulphate of E as filtrate
Dry the residue √ ½ to obtain lead (II) sulphate.
Evaporate √ ½ the filtrate to dryness √ ½ to obtain the solid sulphate of E.

2. (a) (i) The energy change in converting reactants to products is the same regardless of the route by which chemical change occur.

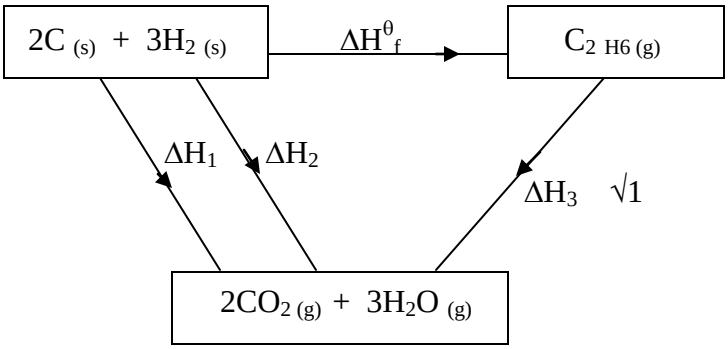
(ii)

	$2CO_{2(g)} + 3H_2O_{(g)} \longrightarrow$	$C_2H_{6(g)} + {}^7/_2\ O_{2(g)}$	$\Delta H = +1560\ kJmol^{-1}$
	$2C_{(s)} + 2O_{2(g)} \longrightarrow$	$2CO_{2(g)}$	$\Delta H = -788\ kJmol^{-1}$ √1
+	$3H_{2(g)} + {}^3/_2\ O_{2(g)} \longrightarrow$	$3H_2O_{(g)}$	$\Delta H = -858\ kJmol^{-1}$ √1
	$2C_{(s)} + 3H_{2(g)} \longrightarrow$	$C_2H_{6(g)}$	$\Delta H^{\theta}f = -86\ kJmol^{-1}$ √1

This paper consists of 6 printed pages

Turn Over

OR



$\Delta H^{\theta}_{f}(C_2H_6) = 2\Delta H_1 + 3\Delta H_2 - \Delta H_3$

$= 2(-394) + 3(-286) - (-1560)$ √1

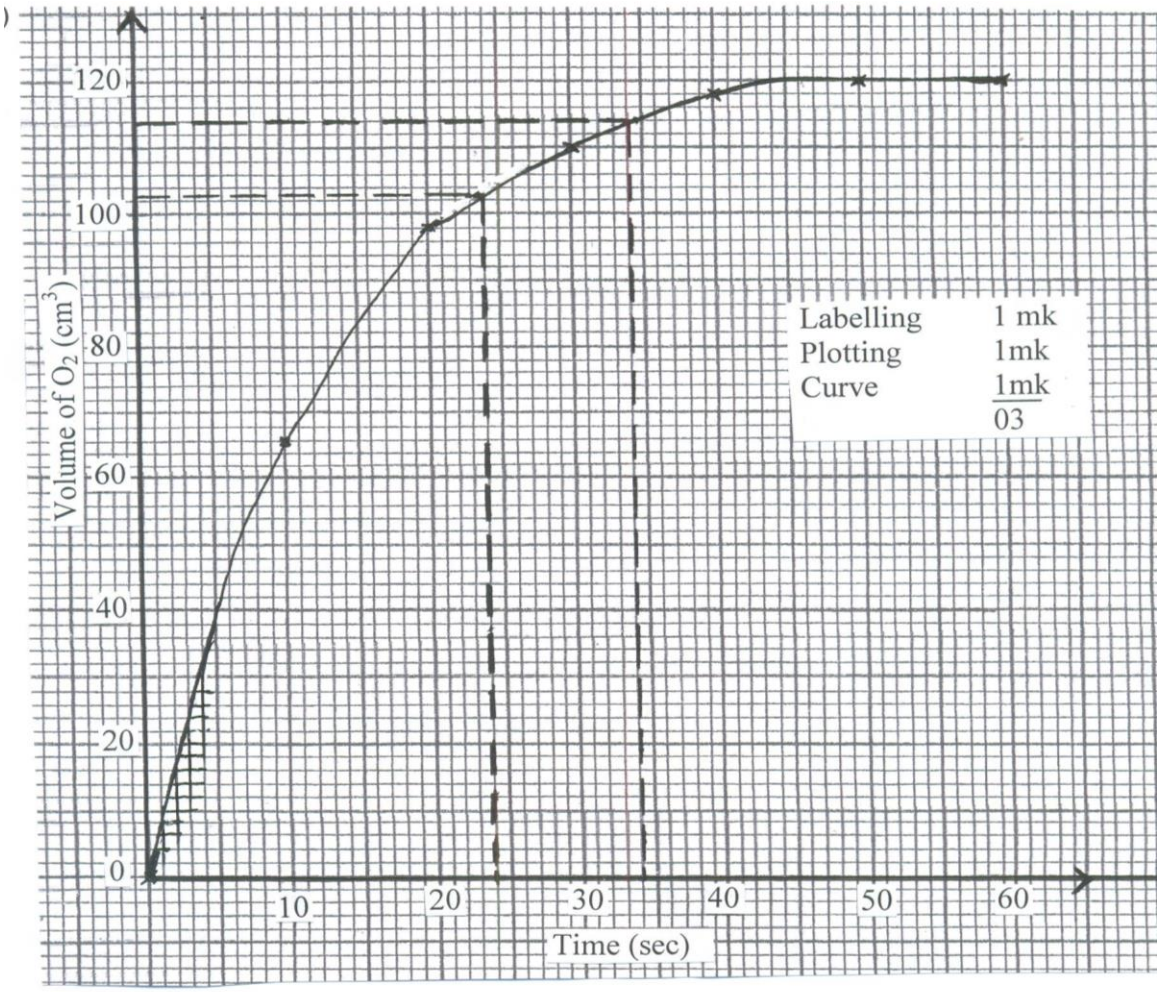
$= -788 - 858 + 1560$

$= -86\ kJmol^{-1}$ √1

(b) (i) Manganese (IV) oxide √1

(ii) $2H_2O_{2\,(aq)} \longrightarrow 2H_2O_{(l)} + O_{2\,(g)}$ √1

(iii)



(iv) Average rate = $\frac{114 - 103}{34 - 24}$ √1 = $\frac{11}{10}$ = 1.1 ± 0.1cm^3 s^{-1} √1

Missing units in the answer penalize ½ mk on correct answer.

(v) The reactant have been used up √1

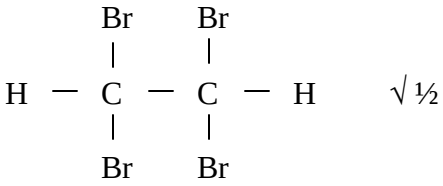
3. (a) (i) Calcium (II) carbide √ ½

(ii) $CaC_{2\,(s)} + 2H_2O_{\,(l)} \longrightarrow Ca(OH)_{2\,(aq)} + C_2H_{2\,(g)}$ √1

(iii) Ethyne gas is insoluble in water √1

(iv) A mixture of oxygen and ethyne gas forms oxyacetylene flame used for welding and cutting of metals √1

(b) (i) 1,1,2,2-tetrabromoethane √ ½

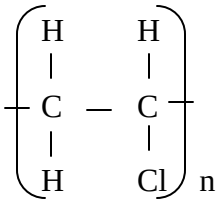


√ ½

(ii) I) Hydrogen gas √ ½

II) Hydrogen chloride (HCl) √ ½

(iii)



√1

(iv) Polychloroethane √1

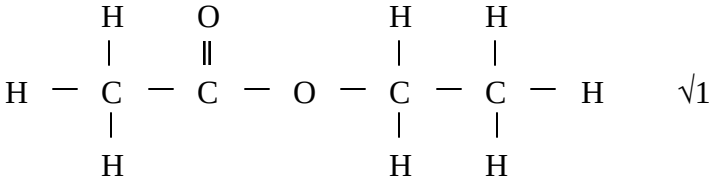
(v) - Making crates and boxes
- Making plastic ropes
- Making water pipes
- Insulation for electrician wires

Any 1 correct use

(c) (i) Concentrated sulphuric (VI) acid √ ½ Reject sulphuric (VI) acid

(ii) Ethylethanoate √ ½

(iii)



√1

(iv)

Esterification	Neutralization
- Reaction is slow	- Reaction is fast
- Reaction is reversible	- Reaction is irreversible
- Forms esters (molecular)	- Forms salts (ionic)

Any 2 correct each ½ mark

(v) Heating value = $\frac{\text{molar enthalpy of combustion}}{\text{Molar mass of compound}}$

$= \frac{2877 \text{ kJmol}}{58\text{g}}$ √ ½

$= 49.603 \text{ kJ g}^{-1}$ √ ½

4. (a) (i) Frothing agent / vegetable oil √1

(ii) Sand / clay or galena (PbS) or slurry √1

(iii) A – Air √ ½

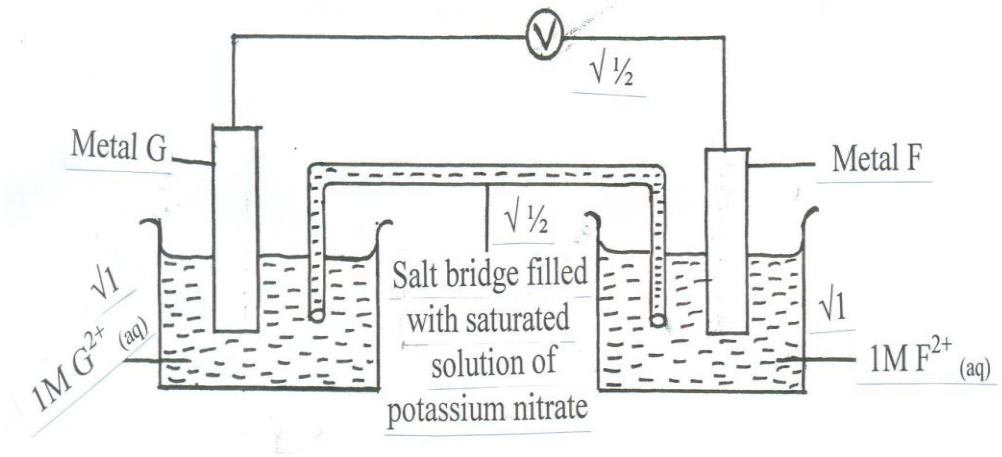
B – Sulphur (IV) oxide √ ½

(iv) $2ZnS_{(s)} + 3O_{2(g)} \longrightarrow 2ZnO_{(s)} + 2SO_{2(g)}$ √1

(v) Carbon (II) oxide √ ½

$ZnO_{(s)} + C_{(s)} \longrightarrow Zn_{(s)} + CO_{(g)}$ √1

(b) (i)



(ii) Emf of cell = 0 - 0.13 – (-0.76)

= -0.13 + 0.76 √ ½

= + 0.63V √ ½

(iii) $Ag^{+}_{(aq)}$ √ ½

5. (a) (i) Potassium hydroxide solution √1 (KOH) or sodium hydroxide solution (NaOH) √1

(ii) - Heat / boil √1 the liquid air // warm / raise √1 the temperature of liquid air.

- Nitrogen comes √1 out first because it has a lower boiling √1 point than oxygen.

NB: If word heating / boiling / warming not mentioned penalize fully.

(b) (i) Hydrogen (H_2) √1

(ii) Nitrogen (II) oxide √1 Reject nitrogen monoxide

(iii) Fertilizer √1 Reject manufacture of fertilizers

(iv) $2NH_{3(g)} + H_2SO_{4(l)} \longrightarrow (NH_4)_2SO_{4(s)}$ √ ½

Number of moles of NH_3 used per day $= \frac{1400}{24} \times 18 = 1{,}050$ √1

Mole ratio $NH_3 : (NH_4)_2SO_4 = 2 : 1$

Moles of $(NH_4)_2SO_4$ produced $= \frac{1050}{2} = 525$ √ ½

Mass of $(NH_4)_2SO_4$ produced per day = $\frac{525 \times 132}{1000}$ = 69.3kg √1

6. (a) A – Ammonia √1
B – Calcium oxide √1

(b) $CaO_{(s)} + H_2O_{(l)} \longrightarrow Ca(OH)_{2\,(aq)}$ √1

(c) Reaction is exothermic √1

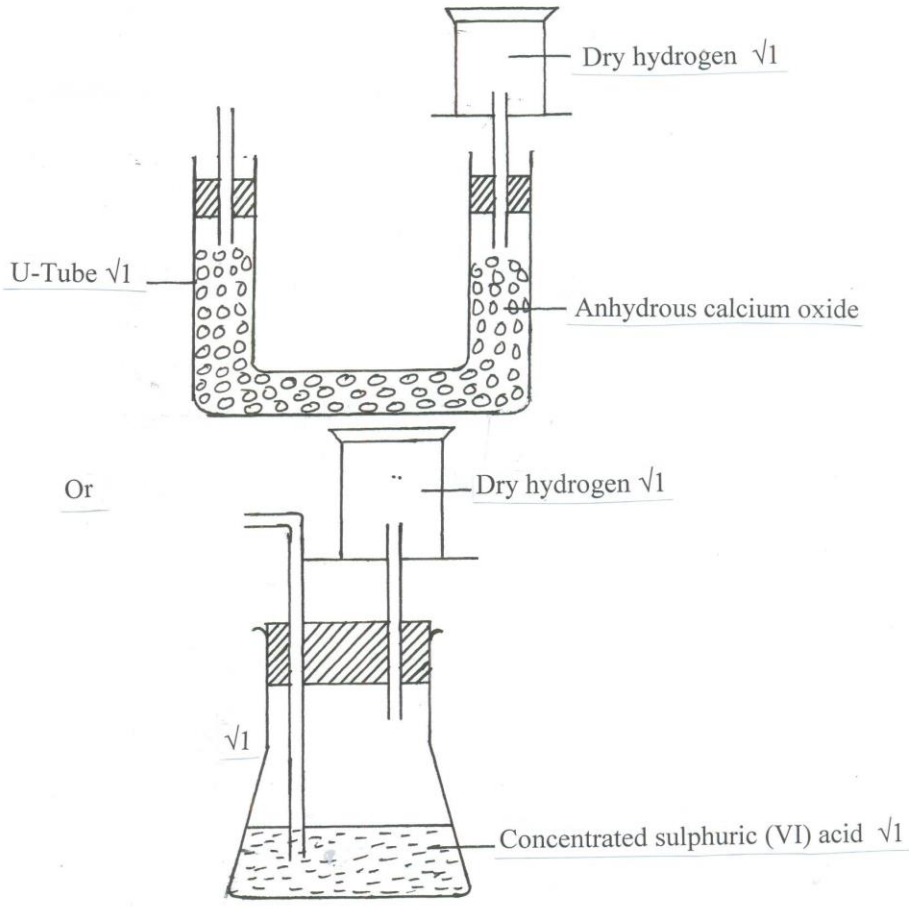
(d) Filtration √1

(e) - Ammonia √1
- Carbon (IV) oxide √1

(f) (i) $C_{(s)} + 2H_2SO_{4\,(l)} \longrightarrow CO_{2\,(g)} + 2H_2O_{(l)} + 2SO_{2\,(g)}$ √1
(ii) Oxidising property √1

(g) - Manufacture of glass √
- Softening of hard water √
- Making of soaps and detergents √
- For making sodium hydrogen carbonate used in baking soda and fire extinguishers √
Any 2 correct answers each ½ mk

7. (a)



(b) $Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$ √1

(c) Reaction between calcium and acid is explosive and dangerous. √1

(d) It contains impurities i.e. other gases e.g nitrogen, neon present in air √1

(e) (i) Copper (II) oxide changes from black √ ½ to brown solid √ ½ .

(ii) $CuO_{(s)} + H_{2(g)} \longrightarrow Cu_{(s)} + H_2O_{(l)}$ √1

(iii) Reducing property √1

(iv) Potassium cannot √ ½ be displaced from it's oxide by hydrogen because it is high √ ½ in the reactivity series.

(v) It is hardening of oils to form fats √1 by passing hydrogen gas in presence of nickel catalyst.

(vi) - A mixture of oxygen and hydrogen burns to produce oxy-hydrogen flame used in welding and cutting of metals.
- Manufacture of ammonia is haber process.
- Manufacture of hydrochloric acid
- As a fuel cells
- As a fuel in rockets

Any 2 each 1 mark

Name _____ Index No. _____

Candidate's Signature _____

Date _____

233/3
CHEMISTRY
PAPER 3
PRACTICAL
JULY / AUGUST 2014
2 ¼ HOURS

KIBWEZI DITRICT FORM 4 INTER-SCHOOLS EXAMINATION 2014
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 3
2 ¼ HOURS

INSTRUCTIONS TO CANDIDATES

(a) Write your name and Index number in the space provide above.
(b) Answer ALL the questions in the spaces provided.
(c) This paper has 2 questions. You have 2 ¼ hours for the paper. The first ¼ hours will be used to check the apparatus.
(d) Mathematical tables and silent calculators may be used.
(e) All working MUST be clearly shown where necessary.

FOR EXAMINER'SUSE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1	22	
2	18	
TOTAL SCORE	**40**	

This paper consists of 7 printed pages

Turn Over

1. You are provided with:
   - Solid A, 2.0g of dibasic acid, H_2X
   - Solution B, 0.5M solution of the dibasic acid, H_2X.
   - Solution C, sodium hydroxide solution.
   - Solution D, 0.02M acidified potassium manganate (VII) solution.

You required to determine:

(a) The heat of reaction of solid A H_2X with sodium hydroxide solution.

(b) The number of moles of solution E that reacts with 2 moles of acidified potassium manganate (VII) solution.

Procedure 1 (a)

Place $40cm^3$ of distilled water into 100ml beaker. Measure the initial temperature of water and record in table **1 below**. Add all the solid A provided at once. Stir the mixture carefully with the thermometer until **all** the solid dissolves. Measure the final temperature and record in table 1.

Table 1

Temperature (^0C)	
Initial temperature (^0C)	

(1½ marks)

(a) Determine the change in temperature, ΔT. (1 mark)

(b) Calculate the:

(i) heat change when H_2X dissolves in water. (Assume the heat capacity of the solution is 4.2 $J/g/^0C$ and density of the solution is $1g/cm^3$) (1 mark)

(ii) the molar heat of solution, $\Delta H1$ solution of the acid H_2X.
(Molar mass of the acid H_2X is 126g. (2 marks)

Procedure 1 (b):

Place 40cm^3 of solution B into 100ml beaker. Measure the initial temperature and record in **table II** below. Measure 40cm^3 of sodium hydroxide, solution C. Add all the 40cm^3 of solution C at once to solution. Stir the mixture carefully with the thermometer. Measure the final temperature reached and record in table II. (Keep remaining solution B for use in procedure II). Table II

Temperature (^{0}C)	
Initial temperature (^{0}C)	

(1 ½ marks)

(a) Determine the change in temperature, ΔT. (1 mark)

(b) Calculate the:

(i) heat change for the reaction. (Assume the heat capacity of the solution is 4.2 J/g/^{0}C and density of the solution is 1gcm^3) (1 mark)

(ii) heat for the reaction of one mole of the acid H_2X with sodium hydroxide, ΔH_2. (2 marks)

(c) Given that the $H_2X_{(s)} + 2OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + X^{2-}_{(aq)}$

Determine ΔH_3 using an energy cycle diagram. (2 marks)

Procedure II

Measure exactly 15cm^3 of solution B and put in a 250ml volumetric flask. Add water as you shake up to the mark. Labelled as solution E. Using a pipette filler, pipette 25cm^3 of solution E and place in a conical flask. Warm solution E to boiling. Fill the burette with solution D and titrate with hot solution E. Stop just when a permanent change in colour. Record your results in the **table III** below. Repeat the procedure to complete the table **III below**.

TABLE III

	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution D used (cm^3)			

(4 marks)

(a) Calculate the average volume of solution D used. (1 mark)

(b) Calculate the number of moles of solution D reacting. (1 mark)

(c) Calculate the number of moles of solution E used. (1 ½ marks)

(d) Calculate the number of moles of E which react with 2 moles of potassium manganate (VII) (2 marks)

2. (a) You are provided with a solution F in a conical flask.
Carry out the following tests and record your observations and inferences in the spaces provided.

(i) Add $20cm^3$ of 2M sodium hydroxide solution to solution F in the flask; shake well, filter the mixture into a clean boiling tube. Retain the filtrate and the residue.

Observation	Inferences
(½ mark)	(½ mark)

(ii) i) Place about $2cm^3$ of the filtrate in a test tube. Add 2M nitric acid drop wise until in excess. Retain the mixture.

Observation	Inferences
(½ mark)	(½ mark)

(iii) Divide the mixture in (ii), I above into two portions. To one portion add 2M sodium hydroxide solution drop wise until in excess.

Observation	Inferences
(1 mark)	(1 mark)

(iv) To portion two, add 2M ammonia solution drop wise until in excess.

Observation	Inferences
(1 mark)	(1 mark)

(v) Place about $2cm^3$ of the filtrate in a test tube. Add 3 drops of acidified barium chloride.

Observation	Inferences
(1 mark)	(1 mark)

(vi) To the residue add about $5cm^3$ of 2M nitric (V) acid and allow it to filter into a test tube. Place about $2cm^3$ of this filtrate in a test tube. Add 2M ammonia solution drop wise until in excess.

Observation	Inferences
(1 mark)	(1 mark)

(b) You are provided with solid G. Carry out the test below and record your observations and inferences in the spaces provided.

(i) Using a metallic spatula heat half spatula endful of solid G in a non-luminous flame. Remove it when it ignites.

Observation	Inferences
(1 mark)	(1 mark)

(ii) Put the remaining solid G in a boiling tube. Add about $5cm^3$ of distilled water and shake vigorously. (Keep the content for the next test)

Observation	Inferences
(½ mark)	(½ mark)

(iii) Divide the resulting solution into two portions. To the first portion add two drops of acidified potassium manganate (VII) solution and shake vigorously.

Observation	Inferences
(½ mark)	(½ mark)

(iv) Test pH of the second portion using pH indicator paper.

Observation	Inferences
(1 mark)	(1 mark)

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CHEMISTRY
PAPER 3
PRACTICAL
JULY / AUGUST 2014

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PAPER 3

MARKING SCHEME

Procedure 1 (a) – Table 1
(a) Complete table (½ mark)
- Final temperature must be lower than initial temperature otherwise penalize fully.
- For initial temperature values $\geq 40^0$ or $\leq 10^0$ are treated as unrealistic values 0^00 penalize (½ mark)

(b) Complete table (½ mark)
- Accept all readings in whole numbers or 1 d.p either '0' – '5' used consistently.
- Reject inconsistently.

(c) Accuracy (½ mark)
- Compare students value (initial value) with S.V. and if within $\pm 2^0$C award (½ mk) otherwise award zero.

(a) ΔT = Final temperature – initial temperature.
NB: (Insist on the correct answer as per the table).

(b) (i) $\Delta H = MC\Delta T$
$= 40 \times 4.2 \times \Delta T$
= C.A.J

Conditions
- Accept an error of ± 2 units in the 3rd digit if answer is in J or 3rd d.p if in KJ, otherwise penalize (½ mark).
- Award 1 mark for correct substitution and ignore the formular.
- Penalizde (½ mark) for wrong units shown, otherwise ignore units.
- Don't penalize if ΔH sign is missing or omitted.

(b) (ii) 2g ⟶ ans c (i) above.
126g ⟶ ?
$= \frac{\text{Ans c (i)} \times 126}{2}$
= C.A. J/mol

Conditions
- If wrong units are given or omitted in final answer, penalize (½ mark)
- Accept arithmetic error of ± 2 units in the 4th digits if in joules OR 2nd d.p if in KJ.
- Correct sign (+ve) must be shown for ΔH_1, otherwise penalize (½ mark)
- Do not penalize of ΔH sign is missing or not shown.

This paper consists of 5 printed pages

Turn Over

Procedure II (b) – Table II

NB: The marking of table II is done as that of table I except for complete table, the final temperature must be higher than the initial temperature.

Calculations

(a) ΔH = Final temperature – initial temperature

(b) (i) $\Delta H = 80 \times 4.2 \times \Delta T$
= C.A.J

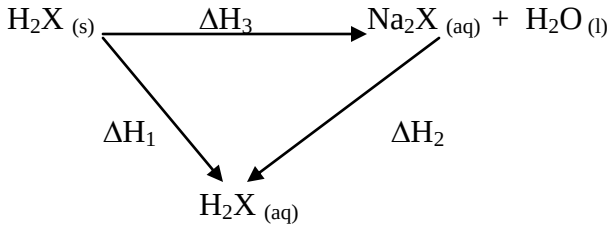
Conditions

Accept an error of ± 2 units in the 4th digit if answer is in joules or 3rd d.p if answer is in KJ. Other conditions remains as for b(i) in procedure (a)

(ii) Moles reacting $= \frac{0.5 \times 40}{1000} = 0.02$ moles

$$\Delta H_2 = \frac{\text{Ans b (i)} \times 1}{0.02}$$
= C..AJ

(c) $\Delta H_3 = \Delta H1 - \Delta H_2$
= C.A.J



Conditions

- Negative (-ve) value must be shown on correct answer otherwise penalize (½ mark).
- Correct units must be used i.e J/mol OR KJ/mol otherwise penalize (½ mark).
- Penalize (½ mark) for wrong answer.
- For correct substitution without formula, you will credit (1 ½ marks) as step II.

NB: Capital J and small k MUST be used

Procedure II – Table III

(i) TITRATION

Consider the table below.

	I	II	III
Final burette reading	15.2	30.4	45.8
Initial burette reading	0.0	15.4	31.0
Titre volume (cm^3)	15.2	15.0	14.8

Marks are awarded as follows:

A. Complete table award 1 mark

(i) Complete table with 3 titrations done award 1 mark
(ii) Incomplete table with two titrations done – award ½ mark
(iii) Incomplete table with only one titration done – award 0 mark

Penalties

(i) Wrong arithmetic
(ii) Inverted table
(iii) Burette readings beyond 50.0cm^3 unless explained
(iv) Unrealistic titre values i.e below 1.0cm^3 or in hundreds

NOTE: Penalize ½ mark each to a maximum of ½ mark i.e penalize ½ mark once.

B. Decimal place award 1 mark

(i) Accept only 1 or 2 d.p used consistently, otherwise penalize FULLY i.e. award zero.
(ii) If 2 d.p are used the 2nd d.p. MUST be either "0" or "5" otherwise penalize fully.
(ii) Accept inconsistently in the use of zeros as initial burette e.g 0.0, 0.00,0.000 etc

NB: Decimal place is tied to 1st and 2nd rows ONLY of the table.

C. Accuracy award 1 mark

Compare the candidates titre values with the school values (S.V) and tick the chosen value if it earns a mark.

Conditions

(i) If at least is within ± 0.1 of the S.V award – 1 mark
(ii) If no value is within ± 0.1 of the S.V but at least one value is within ± 0.2 of the S.V award ½ mark
(iii) Otherwise award zero mark.

NOTE: If there is arithmetic error in the table, compare the S.V with the correctly worked out titre value and award accordingly.

D. Principles of averaging – 1 mark

Values averaged must be shown and must be within ± 0.1 of each other

Conditions

(i) If 3 consistent titrations are done, are consistent and averaged – award 1 mark.
(ii) If 3 titrations are done but only 2 are possible and are averaged – award 1 mark.
(iii) In only 2 titrations are done, are consistent and averaged – award 1 mark
(iv) If 3 titrations are possible and only 2 are averaged – award 0 mark.
(v) If only 3 titrations are done, are inconsistent and are averaged – award 0 mark.
(vi) If only 2 titrations are done, are inconsistent and are averaged – award 0 mark.
(vii) If only 1 titration done – award 0 mark

Penalties

(i) Penalize ½ mark for wrong arithmetic in average titre value if error is outside ±2 units in the second decimal place.
(ii) Penalize 1/2mark if no working is shown but correct answer is given.
(iii) Penalize fully if no working and if answer shown is wrong.
(iv) Accept rounding off value (average titre value) to 2 d.p otherwise penalize ½ mark for rounding off to 1 d.p or whole number.

NOTE: (i) Accept answer (average titre) to 1 d.p or whole number if it works out exactly and credit fully.

E. Final answer – 1 mark

(Tied to correctly averaged titre value)

Compare the candidates correct average titre value with S.V and

(i) If within ± 0.1 of S.V – award 1 mark

(ii) If within ± 0.2 of S.V – award ½ mark

(iv) If beyond ± 0.2 of S.V – award 0 mark

NOTE:

(a) Where there are two possible pairs of titres that can be averaged, use the pair that is closest to the S.V and credit accordingly.

(b) If wrong values are averaged pick the correct vales if any following the principles of averaging, average and award accordingly.

(b) **Calculations**

$$\frac{0.2 \times \text{average titre}}{1000} \quad \surd ½$$

$$= \text{C.A.} \quad \surd ½$$

Penalties

- For wrong transfer of average titre, penalize ½ mark
- If an arithmetic error which is beyond ± 2 units in the 5^{th} d.p is omitted penalize ½ mark.
- Accept rounding off to 4^{th} or 5^{th} d.p.
- If units are not shown

NB: Ignore if units are not shown

(c) Moles of B in $15cm^3$ = $\left(\frac{15}{1000} \times 0.5\right)$ $\surd ½$

$= 7.5 \times 10^{-3} mol$

$250cm^3 \rightarrow 7.5 \times 10^{-3} mol$

$25cm^3 \rightarrow ?$

$= \frac{7.5 \times 10^{-3} \times 25}{250}$ $\surd ½$

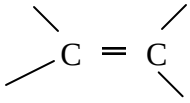
$= 7.5 \times 10^{-3}$ mol $\surd ½$ 1 ½

(d) $\frac{\text{Ans (c)}}{\text{Ans (b)}}$ $\surd ½$ = C.A $\surd 1$ 2

Conditions / Penalties

- For wrong transfer if ans (c) or (b) penalize ($\surd ½$ mark)
- If strange values are used / is used award zero.
- The answer must be rounded off to a whole number, otherwise penalize fully.

Question 2 (a)

	Observation	Inferences
2 (a) (i)	Blue ppt / residue, colourless filtrate ½ mark	Cu^{2+} present Condition: - Each inference tied to the observation penalize full for any contradiction ½ mark
(ii)	No white ppt formed / no effervescence / no bubbles 1 mark	Absence of SO_3^{2-} or CO_3^{2-} ½ mark
(iii)	White ppt, soluble in excess ½ mark	Zn^{2+}, Pb^{2+} or Al^{3+} √ ½ For all 3 give 1 mk, 2 give ½ mk
(iv)	White ppt insoluble in excess 1 mk	Pb^{2+} or Al^{3+} Accept Zn^{2+} absent ½ mk
(v)	No white ppt formed - Accept filtrate remains colourless - Rej. No observable change No ppt formed – No change ½ mk	Al^{3+} present Accept, Pb^{2+} absent ½ mark
(vi)	White ppt formed Colourless filtrate ½ mark	SO_4^{2-} present penalize if SO_3^{2-} or CO_3^{2-} mentioned as absent ½ mark
	Blue ppt dissolve Dissolve blue solution Penalize ½ mk if solution not mentioned ½ mk	Cu^{2+} present ½ mark
(b) (i)	Burns with a luminous / sooty / smoky flame ½ mark	Unsaturated hydrocarbon Accept C ≡ C— or —C—C= Rej C ≡ C , C = C 1 mark
(ii)	Partially soluble in water ½ mark	Polar hydrocarbon ½ mark
(iii)	$KMnO_4$ solution remain purple Rej: solution turns purple, solution remains purple	 , C ≡ C— Absent
(iv)	pH = 5.0 Penalties Reject pH value below 4.0 Reject value in words Accept pH value range 4.0 – 6.5	Weak acid 1 mark Accept – COOH Reject words such as acid / acidic / organic acid / H^+ ions If the term 'weak is not mentioned penalized fully.

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CHEMISTRY
PAPER 3
PRACTICAL
JULY / AUGUST 2014

KIBWEZI DITRICT FORM 4 INTER-SCHOOLS EXAMINATION 2014
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 3
CONFIDENTIAL

A. Each candidate should have the following:

1. Solid A- Measure exactly 2.0g of oxalic acid.
2. Solution B – 60cm^3 of 0.5M oxalic acid.
3. Solution C – 50cm^3 of 0.25M sodium hydroxide solution.
4. Solution D – 100cm^3 of 0.02M acidified $KMnO_4$ solution.
5. Burette – 50ml.
6. 25 ml pipette.
7. Pipette filler.
8. 250cm^3 volumetric flask.
9. 50ml measuring cylinder.
10. Thermometer (-10^{0}C – 110^{0}C).
11. 2 – conical flasks.
12. 100ml plastic beaker.
13. Accessible to about 500cm^3 of distilled water.
14. Means of labeling.
15. 10cm^3 of solution F.
16. Solid G – 0.5g of oxalic acid.
17. A boiling tube.
18. Test tube holder
19. 6 test tubes.
20. 10cm^3 measuring cylinder.
21. Filter paper and filter funnel.
22. Metallic spatula.
23. Boiling tube.

B. Accessible to the following:

1. Source of heat.
2. 2M sodium hydroxide solution.
3. 2M ammonia solution.
4. 2M Nitric acid.
5. 2M hydrochloric acid solution.
6. Universal indicator paper and a chart.

NB:

- All the bench solution above be supplied with a dropper.
- Solution F is a mixture of $Al_2(SO_4)_3$ and $Cu(NO_3)_2$ in the ratio 1 : 1.

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