Name _____

Candidate's signature _____

Date _____

233/1
CHEMISTRY
THEORY
PAPER 1
JULY / AUGUST 2011
2 HOURS

FORM IV MID YEAR ASSESSMENT TEST
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 1
2 HOURS

INSTRUCTIONS

- Answer all the questions in the spaces provided.
- Electronic calculators may be used
- All working must clearly be shown where necessary

FOR EXAMINER'S USE ONLY

QUESTIONS	MAXIMUM SCORE	STUDENT'S SCORE
1 – 29		

This paper consists of 14 printed pages

Turn Over

1. Use the information in the table below to determine the relative atomic mass of copper. (2 marks)

Isotope	Fractional abudance
$^{65}_{29}Cu$	0.31
$^{63}_{29}Cu$	0.69

2. Study the arrangement below and answer the question that follows.

Lighted candle

Explain what will be observed after some time. (3 marks)

_____

_____

_____

_____

3. Briefly explain industrial application of the following processes.

(a) Crystallisation. (1 ½ marks)

_____

_____

_____

_____

(b) Fractional distillation. (1 ½ marks)

4. Four solutions of pH 7, 2, 8.5 and 13 respectively were each reacted with calcium turnings.
In which of the solutions would hydrogen gas be produced. Explain each case. (3 marks)
(i)

(ii)

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

Ion	Electronic arrangement	Ionic radius (nm)
Na^+	2.8	0.095
K^+	2.8.8	0.133
Mg^{2+}	2.8	0.065

(a) Explain why the ionic radius of K^+ is greater than that of Na^+. (1 mark)

(b) Account for the difference in ionic radius of Mg^{2+} and Na^+. (2 marks)

6. Use the following equations to determine the heat evolved when aluminium metal is reacted with iron (III) oxide. (3 marks)

$2Al_{(s)} + {}^{3}/_{2}O_{2(g)} \longrightarrow Al_2O_{3(s)}$; $\Delta H, = -1673.6 jKmol^{-1}$

$2Fe_{(s)} + {}^{3}/_{2}O_{2(g)} \longrightarrow Fe_2O_{3(s)}$; $\Delta H_2 = -836.8 kJmol^{-1}$

7. Describe how you would prepare a dry sample of zinc carbonate in the laboratory starting with zinc chloride solid. (3 marks)

_____

_____

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8. The solubility of salt Y at 60^0C is 40g/100g of water and 48g/100g of water at 100^0C.
(i) How much salt of Y would satulate 190g of water at 100^0C. (1 ½ marks)

(ii) 150g of saturated solution of Y at 100^0C is cooled to 60^0C. Calculate the mass of Y that crystallizes out. (1 ½ marks)

9. Below are the bond dissociation energies of some elements.

Bond	Bond dissociation energy
C – C	343 $kJmo^{-1}$
C – H	414 $kJmo^{-1}$
H – H	435 $kJmo^{-1}$
$C_{(s)} \longrightarrow C_{(g)}$	711 $kJmo^{-1}$

Use this information to calculate the heat of reaction for:-

$2C_{(s)} + 3H_{2(g)} \longrightarrow C_2H_{6(g)}$ (3 marks)

10. (I) An oxide of carbon contains 42.8g by mass of carbon and has R.M.M. of 28. What is its molecular formular? (3 marks)
(C = 12; O = 16)

(II) Sulphur dioxide gas was bubbled into acidified potassium dichromate and iron (iii) sulphate solutions respectively. Explain the observations made in each case.

(i) With potassium dichromate. (1 ½ marks)

_____

_____

_____

_____

(ii) With iron (III) sulphate. (1 ½ marks)

_____

_____

_____

_____

12. A known volume of ozonised oxygen diffuses through a small hole in 55 seconds; whereas the same amount of oxygen mixed with chlorine takes 67 seconds under the same conditions. Determine the molecular mass of ozone. (Cl = 35.5 ; O = 16) (3 marks)

13. (a) Give the name of the following compound $CH_3CH = CHCH_2CH_3$. (1 mark)

_____

(b) Ethane and ethene react with bromine according to the equations given below.

(i) $C_2H_{6(g)} + Br_{2(g)} \xrightarrow{\text{u.v light}} C_2H_5Br_{(l)} + HBr_{(g)}$

(ii) $C_2H_{4(g)} + Br_{2(g)} \longrightarrow C_2H_4Br_{2(l)}$

Name the type of bromination reaction that takes place in:-

(i) _____

(ii) _____ (2 marks)

14. An organic compound with the formular $C_4H_{10}O$ reacts with potassium metal to give hydrogen gas and a white solid.

(a) Write the structural formular of the compound. (1 mark)

(b) To which homologous series does the compound belong. (1 mark)

_____

_____

(c) Write the equation for the reaction between the compound and potassium metal. (1 mark)

_____

_____

_____

15. In the Haber process, the optimum yield of ammonia is obtained when a temperature of 450^0C, a pressure of 200 atmospheres and an iron catalyst are used.

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ $\Delta H = -92kJ.$

(a) How would the yield of ammonia be affected if the temperature was raised to 600^0C. Explain. (2 marks)

_____

_____

_____

_____

_____

(b) Explain the effect on the yield of lowering the pressure below 200 atmospheres. (1 ½ marks)

_____

_____

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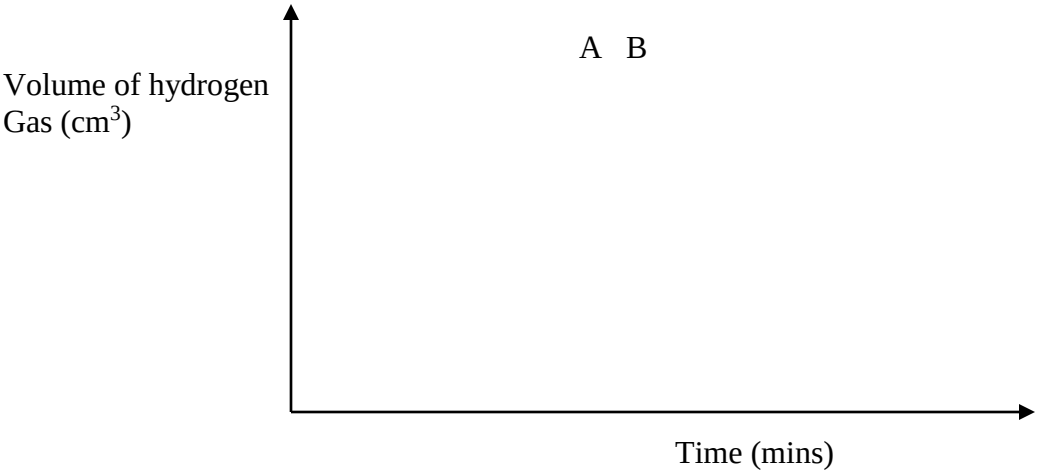
_____

16. Two experiments were carried out as follows and the volume of hydrogen gas evolved measured at intervals of 10 seconds for 100 seconds.

(i) 8cm of magnesium ribbon was added to 1M $HCl_{(aq)}$

(ii) 8cm of magnesium ribbon was added to 0.5M $HCl_{(aq)}$.

Graphs of volume of hydrogen gas evolved against time were plotted as shown below.



(a) Which of the graphs was obtained for reaction (i). Explain. (2 marks)

_____

_____

_____

_____

(b) Explain the general shape of the graphs. (1 mark)

_____

_____

_____

_____

17. The set-up below was used to prepare hydrogen chloride gas and react it with iron powder. Study it and answer the questions that follow.
Concentrated sulphuric acid Combustion tube Iron powder Glass wool Heat To pump
Sodium chloride Sodium hydroxide solution

At the end of the reaction, the iron powder turned into light green solid.
(a) Identify the light green solid. (1 mark)

_____

(b) At the beginning of the experiment; the pH of the solution in container 'L' was about 14; at the end; the pH was found to be 2. Explain. (2 marks)

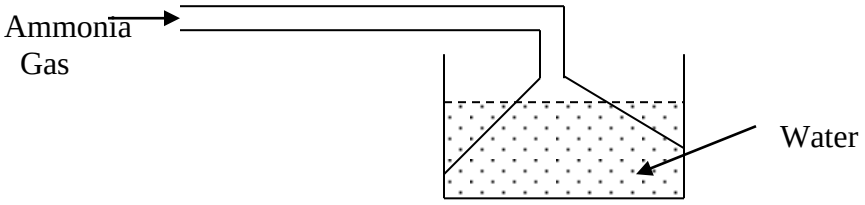
_____

_____

_____

_____

18. Ammonia gas was passed into water as shown below.



(a) When a red litmus paper was dropped into the resulting solution; it turned blue. Give a reason to this observation. (1 mark)

_____

_____

(b) What is the function of the funnel. (1 mark)

_____

_____

19. During purification of copper by electrolysis, 1.48g of copper were deposited when a current was passed through aqueous copper (II) sulphate for 2 ½ hours. Calculate the amount of current that was passed.
(Cu = 63.5; IF = 96500C) (3 marks)

20. Draw a dot (.) and cross (x) diagram to show bonding in carbon (II) oxide. (2 marks)

21. Write the discharge equations (half equations) for the electrode reactions when molten sodium chloride is electrolysed using graphite electrodes.

Anode (1 mark)

_____

_____

_____

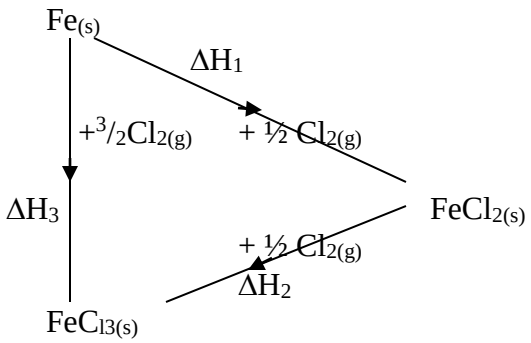
Cathode (1 mark)

_____

_____

_____

22. Study the energy diagram and then answer the questions that follow.



(a) What does ΔH_1 and ΔH_3 represent

(i) ΔH_1 _____ (1 mark)

(ii) ΔH_3 _____ (1 mark)

(b) Write down the relationship between $\Delta H_{1(l)}$, ΔH_2, and ΔH_3. (1 mark)

_____

_____

_____

23. Complete the diagram below to show how particles from a radioactive source can be distinguished from each other. Label your diagram clearly.

24. The diagram below represents a set-up that was used to react iron with water. Study it and answer the questions that follow.

(a) Write the equation for the reaction that takes place. (1 mark)

_____

_____

_____

(b) Why should it not be advisable to use potassium in place of iron in the above set-up. (1 mark)

_____

_____

_____

(c) The glass wool is heated prior to heating of iron. Explain this procedure. (1 mark)

_____

_____

_____

25. The following diagrams show the structure of two allotropes of carbon. Study them and answer the questions that follow.

X Y

(i) Name allotropes (1 mark)

X _____

Y _____

(ii) Give ONE use of X. (1 mark)

_____

_____

(iii) Which allotrope conduct electricity? Explain. (1 mark)

_____

_____

_____

_____

26. The formula below represent the active ingredients in a soap and a detergent respectively.

(i) $CH_3(CH)_{16}\ COO^-\ Na^+$

(ii) $CH_3\ (CH_2)_6\ CH\ CH_3\ CH_2\ SO_3^-\ Na^+$

(a) Explain why 1 is not suitable for washing using water from a river. (1 mark)

_____

_____

_____

_____

(b) Give one advantage and one disadvantage of II. (2 marks)

_____

_____

_____

_____

27. Use the following standard electrode potentials to answer the questions that follow.

$Zn^{2+}_{(aq)} + 2e^- \longrightarrow Zn_{(s)}$ $E^{\theta}V = -0.76$
$Cl_{2(g)} + 2e^- \longrightarrow 2Cl^-_{(aq)}$ $E^{\theta}V = +1.36$

(a) Calculate the e.m.f of the following cell:
$Zn_{(s)} / Zn^{2+}_{(aq)} // 2Cl^-_{(aq)} / Cl_{2(g)}$ (2 marks)

(b) Write down the equation for the overall cell reaction. (1 mark)

_____

_____

_____

28. (a) Suppose $180cm^3$ of a 2.0M solution is diluted to $1.0dm^3$. What will be the concentration of the resulting solution. (2 marks)

(b) Why is water not used to put off oil fires ? (1 mark)

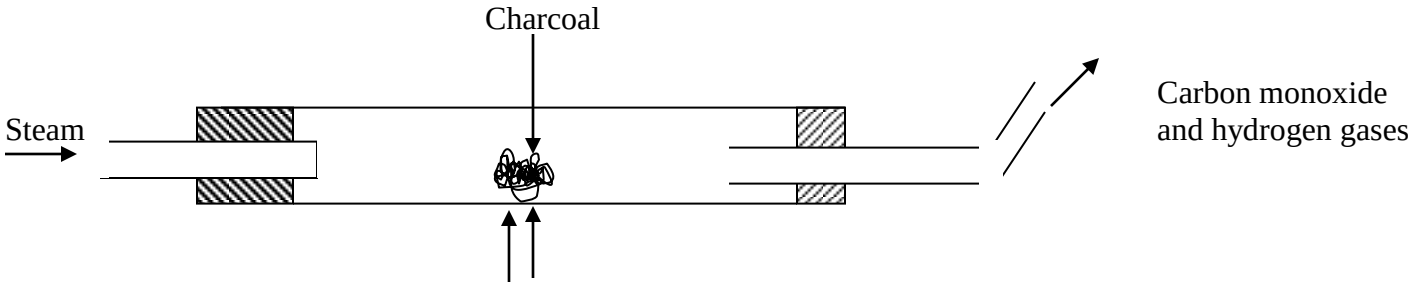
_____

_____

_____

_____

29. When steam was passed over heated charcoal as shown in the diagram below hydrogen and carbon monoxide gases were formed.



(a) Write the equation for the reaction which takes place. (1 mark)

_____

_____

_____

_____

(b) Name one use of carbon monoxide gas which is also a use of hydrogen gas. (1 mark)

_____

_____

_____

_____

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FORM IV MID YEAR ASSESSMENT TEST
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CHEMISTRY
PAPER 1

MARKING SCHEME

1. 65 x 0.31 √ ½ + 63 x 0.69 √ ½
= 63.62 √1

2. Candle goes off √ ½
Carbon (IV) oxide √ ½ produced turns lime water white √ // formation of a white precipitate due to the reaction √ between CO_2 and limewater.

3. (a) Extraction of salt √ ½ at L. Magadi by evaporating water till saturation √1 to form crystals √1 // Extraction of salt from sea water √

   (b) - Distillation of crude oil √ ½ based on boiling point // liquidification of liquid air to get nitrogen and oxygen.

4. (i) pH 7 √ ½ it is water that reacts with calcium to form calcium hydroxide and hydrogen √1 // Ca is above hydrogen in reactivity series.

   (ii) pH_2 √ ½ - It is acidic solution √ ½ from which hydrogen can be displaced by a more reactive metal Ca.

5. (a) K^+ has more energy levels than Na^+ √1

   (b) Both are in the same period √ ½
   Na^+ radius is larger than Mg^{2+} √ ½ because additional electrons in Mg^{2+} are added to same √ ½ energy level and there is increase in number of protons in the nucleus leading to more force √ ½ of attraction between the protons and electrons making Mg^{2+} smaller than Na^+.

6. (i) $2Al_{(s)} + {}^3/_2O_{2(g)} \longrightarrow Al_2O_3$ $\Delta H = -1673.6$ kJ mol

   (ii) $Fe_2O_{3(s)} \longrightarrow 2Fe_{(s)} + {}^3/_2O_{2(g)}$ $\Delta H = +836.8$kJ mol

   $2Al_{(s)} + Fe_2O_{3(s)} \longrightarrow Al_2O_{3(s)} + 2Fe_{(s)}$ √

   $-1673.6 + 836.8 = -836.8$ kJmol^{-1} √

   $\therefore \Delta H_{Hn} = -836.8$ kJmol^{-1} √

This paper consists of 5 printed pages

Turn Over

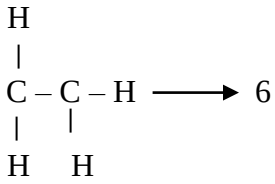
Making points

- Attempt to manipulate equation (i) and (ii) √1
- Overal equation √ ½
- Attempt to add ΔH values √ ½
- Correct answer with negative sign √ ½

7. - Add distilled water to $ZnCl_2$ solid √ ½ and shake until all solid dissolves √ ½
   - Add $NaHCO_{3(aq)}$ √ ½ or Na_2CO_3 solution to form white √ ½ precipitate of $ZnCO_{3(s)}$
   - Filter √1 and wash the residue with a lot of water √ ½

8. (i) At 100^0C 100g water ⟶ 48g of y
   190g water ⟶ ?
   $\frac{190}{100}$ x 48 √ = 91.2 g of y √ ½

   (ii) In 150g of saturated solution at 100^0C mass of y = 50g
   At 60^0C – mass of y in solution = 40g √1
   ∴ Mass that crystallizes = 50 – 40 = 10g √ ½
   Attempt to subtract √1

9. $3(H-H) + 2(C-C) \longrightarrow$  $\longrightarrow 6(C-H)$

   $6(C-H) - \{3(H-H) + 2(C-C)\}$

   $= (6 \times 414 \surd ½) - \{(3 \times 435 \surd ½) + (2 \times 343 \surd ½)\}$
   $= -957$ kJ √ ½
   Attempt to subtract √ ½

10.

C	O
42.8	57.2
12	16
$\frac{42.8}{12}$	$\frac{57.2}{16}$ √ ½
$\frac{3.567}{3.567}$	$\frac{3.575}{3.575}$ √ ½
1	1.002

EF C O √ ½
$MF = (EF)_n$
$n \longrightarrow \frac{RMM}{REF} = \frac{28}{28}$

n = 1√
MF = CO √ ½

11. (i) Orange √ ½ potassium dichromate turns green √ ½ due reduction process √ ½ // SO_2 is a reducing agent where it reduces chromate (VI) ions to chromium (III) ions.

(ii) Brown √ ½ iron (III) sulphate solution turns green √ ½ due to reduction √ ½ of $Fe^{3+}_{(aq)}$ to $Fe^{2+}_{(aq)}$

12. $\frac{55}{67} = \sqrt{\frac{MO_2}{71}}$ √ ½

$0.8209 = \sqrt{\frac{MO_3}{71}}$ √ ½

$(0.8209)^2 = \frac{MO_3}{71}$ √

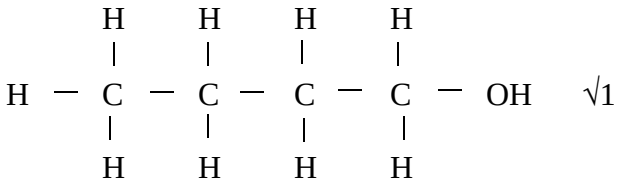
$MO_3 = 71 \times 0.6739$ √ ½

$= 47.85$ √ ½

13. (a) Pent-2-ene √1

(b) (i) Substitution √1
(ii) Addition √1

14. (a)



√1

Bonds should not be joined to symbols

(b) Alcohol √1 // Alkanols

(c) $C_4H_{10}O_{(l)} + K_{(s)} \longrightarrow C_4H_9OK_{(l)} + N_{2(g)}$ √1

15. (a) Yield decreases √ ½ reaction is exothermic √ ½ therefore it favoured by low temperatures √ ½

(b) Yield decreases √ ½ since the process is favoured by √ ½ high pressure due Boyle's law √ ½

16. (a) B √1 – Acid had higher concentration √1
(b) The reaction rate is initially high √1 because of high concentration but decreases steadily as concentration also decreases.

17. (a) $FeCl_2$ // Iron (II) chloride
(b) $HCl_{(g)}$ √ ½ reacted with $NaOH_{(aq)}$ to form $NaCl_{(aq)}$ and $H_{2(g)}$. The excess √ $HCl_{(g)}$ dissolved making the solution acidic.

18. (a) Ammonia dissolves √ ½ in water to form ammonia solution which is basic √ ½
(b) Increase surface area to avoid sucking back of the gas. √1

19. Equation for deposition of Cu
$Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$

63.5g of $Cu_{(s)}$ require (2 x 96500) C = 193000C √ ½

1.48g of Cu require ⟶ ?C

$$\left(\frac{1.48}{63.5} \times 193000 \right) C$$

= 4498.2C √1

Q = It
4498.2C = I x (150 x 60)S √ 12
4498.2C = 9000I

$$\frac{4498.2}{9000} = I$$

= 0.4998 ampheres ≃ 0.5 amps √ ½

20. Atomic No. C = 6 ⟶ 2.4
O = 8 ⟶ 2.6

√2 C O

21. Anode equation

$2Cl^-_{(l)} \longrightarrow Cl_{2(g)} + 2e^-$ √1

Cathode equation

$2Na^+_{(l)} + 2e^- \longrightarrow 2Na_{(s)}$ √1

22. (a) ΔH_1 - Molar enthalpy of formation of iron (II) chloride √1
ΔH_3 – Molar enthalpy of formation of iron (III) chloride √1

(b) $\Delta H_3 = \Delta H_1 + \Delta H_2$ √

23. Paper Metal foil Thick block of lead

24. (a) $Fe_{(s)} + H_2O_{(g)} \longrightarrow FeO_{(s)} + H_{2(g)}$ √ Correct balanced eqn – ½ mark
State symbols – ½ mark

(b) Potassium is very reactive √ ½ , therefore its reaction with water is explosive √ ½

(c) To prevent reaction of iron with air which would result to iron oxide √ (1 mark)

25. (i) X – Diamond √ 1 mark
Y – Graphite √ 1 mark

(ii) Uses of X
- Drilling of metals
- Jewellery
(Any other correct)

(iii) Y √ ½ - Existence of delocalized electrons √ ½

26. (i) River water contains $Ca^{2+}_{(aq)}$ and / or $Mg^{2+}_{(aq)}$ √ ½ which react with soap to form scum √ ½

(ii) <u>Advantage</u>
Forms lather quickly with water √ 1 mark

<u>Disadvantage</u>
It's non-biodegradable √ ½ therefore causes environmental pollution e.g froth in sewage plants. √ ½

27. (a) $E_{cell} = E_{red} - E_{oxidised}$
$= +1.36 - (-0.76)$ √ 1 mark
$= + 2.12V$ √ 1 mark
(Reject if sign is missing)

(b) $Zn_{(s)} + 2Cl^-_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Cl_{2(g)}$ √1

28. (a) In $1000cm^3$ ⟶ 2 moles of solute

$180cm^3$ ⟶ ? moles √ ½

$= \frac{180 \times 2}{1000}$ √ ½

$= 0.36$ moles √ ½

$12m^3 = 1000cm^3 = 1$ litre

∴ concentration of new solution = 0.36M √ ½

(b) Oil is less dense than water ; therefore would float on √ ½ the water and burning would continue √ ½

29. (a) $C_{(s)} + H_2O_{(g)} \longrightarrow CO_{(g)} + H_{2(g)}$
Correct balanced equation with state symbols (1 mark)

(b) Reducing property √ 1 mark

Name _____

Candidate's signature _____

Date _____

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CHEMISTRY
PAPER 2
2 HOURS

INSTRUCTIONS

- Attempt all questions in the spaces provided.
- All working must be shown where necessary
- Electronic calculators and Mathematical tables may be used.

FOR EXAMINER'S USE ONLY

QUESTION	MAX SCORE	CANDIDATES SCORE
1	14	
2	12	
3	10	
4	11	
5	10	
6	10	
7	13	
TOTAL	80	

This paper consists of 11 printed pages

Turn Over

1. The grid given below represents part of the periodic table. Study it and answer the questions that follow. The letters are not the actual symbols of the elements.

								A
B				G		H	E	
	J		I	L				C
D							M	
Y								

(i) What name is given to the family of elements to which A and C belong? (1 mark)

_____

_____

_____

(ii) Write the chemical formula of the sulphate of element D. (1 mark)

_____

_____

_____

(iii) Which letter represents the most reactive (2 marks)

(a) Metal _____

(b) Non-metal _____

(iv) Name the bond formed when B and H react. Explain your answer. (2 marks)

_____

_____

_____

(v) Select one element that belong to period 4. (1 mark)

_____

_____

(vi) Ionic radius of element E is bigger than the atomic radius. Explain. (2 marks)

_____

_____

_____

_____

(vii) The electron configuration of a divalent anion of element N is 2.8.8. Induce the position of element N on the periodic table drawn above. (1 mark)

(viii) The oxide of G has a lower melting point than the oxide of L. Explain. (1 mark)

_____

_____

_____

(ix) How do the atomic radii of I and C compare. Explain. (2 marks)

_____

_____

_____

_____

(x) Explain the trend in the 1st ionization energies of the elements J, I and L. (1 mark)

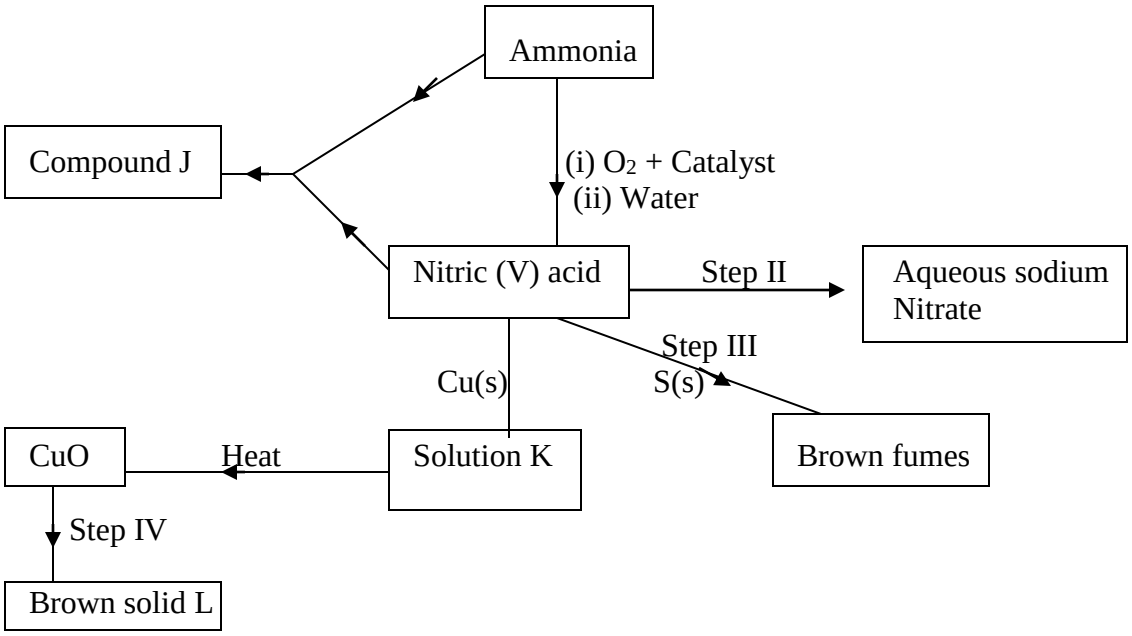
_____

_____

_____

_____

2. (a) The scheme below shows various reactions starting with ammonia. Study it and answer the questions that follow.



(i) List the raw materials used in the manufacture of ammonia. (1 mark)

_____

_____

_____

(ii) What catalyst is used in step I ? (1 mark)

_____

_____

_____

(iii) Write an equation for the reaction that occurs between ammonia and oxygen in presence of the catalyst. (1 mark)

_____

_____

_____

(iv) Identify the process in step II _____ (1 mark)

(v) Using an appropriate equation, explain how the reaction in step III occurs ? (2 marks)

_____

_____

_____

_____

(vi) What should be added to solution K to form solid L ? (1 mark)

_____

_____

_____

(vii) (a) (i) Write the formula of compound J. (1 mark)

_____

_____

_____

(ii) Calculate the mass of compound J that would contain 14g of nitrogen (H = 1, N = 14, O = 16) (2 marks)

(b) State two advantages of ammonium phosphate over ammonium nitrate. (2 marks)

_____

_____

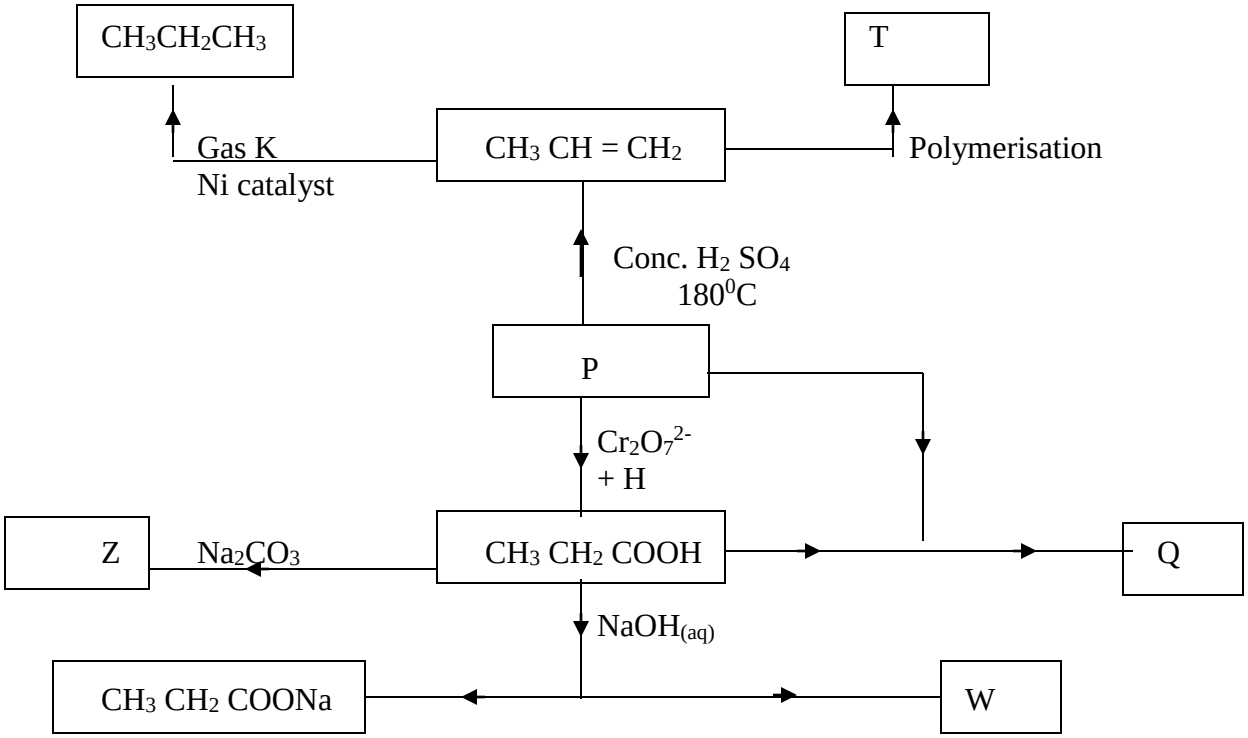
_____

3. (a) Give the IUPAC names of the following compounds. (2 marks)

(i) HCC CH_2 CH_3 _____

(ii) H_2 $CCHCH_2$ CH_3 _____

(b) Study the following diagram and answer the questions that follow.



(i) Identify substances (2 marks)

Q _____

P _____

W _____

Gas K _____

(ii) Draw the structure of compound P and state one use. (2 marks)

_____

_____

_____

_____

(iii) Write the equation for the reaction leading to the formation of the products in Z. (1 mark)

_____

_____

_____

(iv) Show the general structure of polymer T and give its name. (2 marks)

_____

_____

_____

(v) To which class of organic compounds does compound Q belong to ? (1 mark)

_____

_____

_____

4. The set-up below represents electrolysis of dilute sulphuric (VI) acid.

M N

(a) Identify gases M and N (1 mark)

M _____

N _____

(b) Write an ionic equation for the production of gas M. (1 mark)

_____

_____

_____

(c) At what electrode does reduction take place. Explain your answer. (2 marks)

_____

_____

_____

_____

_____

(d) State the most suitable electrodes that can be used in this experiment.
Explain your answer. (2 marks)

_____

_____

_____

_____

(e) The standard electrode potentials for some half cells are given below.

$Ag^{+}_{(aq)} + e \longrightarrow Ag_{(s)}$ + 0.80

$Cl_{2(g)} + 2e \longrightarrow 2Cl^{-}_{(aq)}$ + 1.36

$Zn^{2+}_{(aq)} + 2e \longrightarrow Zn_{(s)}$ -0.76

$Ba^{2+}_{(aq)} + 2e \longrightarrow Ba_{(s)}$ -2.90

(i) Arrange the metals in order of reactivity. (1 mark)

_____

_____

_____

(ii) Calculate the E.m.f of the cell
$Ag/Ag^{+}_{(aq)}$ and $Ba / Ba^{2+}_{(aq)}$ (2 marks)

(iii) What would happen if a cell with chlorine and zinc ions, the anode was made of zinc. Explain your answer. (2 marks)

_____

_____

_____

_____

_____

_____

5. A piece of marble chip (calcium carbonate) is put in a beaker containing excess of dilute hydrochloric acid which is placed on a reading balance. The mass of the beaker and its contents is recorded every two minutes, as shown in the table.

Time (min)	0	2	4	6	8	10	12
Mass(g)	126.4	126.3	126.2	126.1	126.0	126.0	126.0

(a) Why is there a continuous loss of mass of the reaction mixture. (1 mark)

_____

_____

_____

(b) Write an equation for the reaction taking place. (1 mark)

_____

_____

_____

(c) State two different ways by which the reaction could have been made more rapid. (2 marks)

_____

_____

_____

(d) Why does the mass remain constant after 8 minutes. (1 mark)

_____

_____

_____

(e) State the observations that would be made if a few drops of silver nitrate solution was added to $1cm^3$ of the resulting solution followed by ammonia solution. (2 marks

_____

_____

_____

_____

(f) State one environmental effect that excess carbon (IV) oxide in the air causes. (1 mark)

_____

_____

(g) State two uses of carbon (IV) oxide. (2 marks)

_____

_____

_____

6. In an experiment to determine the molar heat of neutralization of hydrochloric acid with sodium hydroride, students of Furaha Secondary school reacted $100cm^3$ of 1M hydrochloric acid with $50cm^3$ of 2M sodium hydroxide solution. They obtained the following results.

Initial temperature of acid = 25.0^0C
Initial temperature of base = 25.0^0C
Highest temperature reached
With the acid – alkali mixture = 34.0^0C

(a) Define the term molar heat of neutralization. (1 mark)

_____

_____

_____

(b) Write an ionic equation for the neutralization reaction between hydrochloric acid and sodium hydroxide. (1 mark)

_____

_____

_____

(c) Calculate :

(i) The change in temperature. (ΔT) (1 mark)

(ii) The amount of heat produced during the reaction.
(Specific heat capacity of solution = 4.2 $kJkg^{-1}k^{-1}$) (2 marks)

(iii) The molar heat of neutralization of sodium hydroxide. (2 marks)

(d) Write the thermochemical equation for the reaction. (1 mark)

_____

_____

_____

(e) Draw an energy level diagram for the reaction. (2 marks)

7. Aluminium is extracted from its ore by electrolysis method. The current required in the process is 4,000 amperes. Study the diagram and answer the questions that follow.

A B C D E

(a) Name: (3 marks)

(i) Electrolyte A _____

(ii) Substance D _____

(iii) Electrode E _____

(b) Name the material from which the electrodes are made. (1 mark)

_____

_____

_____

(c) (i) Write the equation that produces aluminium metal. (1 mark)

_____

_____

_____

(ii) Explain why E has to be replaced from time to time. (1 mark)

_____

_____

_____

(iii) Why is cryolite added to the electrolyte before the process of electrolysis ? (1 mark)

_____

_____

_____

(d) Name the ore from which aluminium is extracted.

_____

_____

_____

(e) A current of 25 amps was passed through molten aluminium oxide for 36 hrs.
Calculate the amount of aluminium deposited in kg.
(Al = 27, IF = 96500C) (3 marks)

(f) Give two industrial uses of aluminium. (2 marks)

_____

_____

_____

_____

233/2
CHEMISTRY
PAPER 2
THEORY
JULY / AUGUST 2011

FORM IV MID YEAR ASSESSMENT TEST
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 2

MARKING SCHEME

1. (i) Noble gases √1

(ii) D_2SO_4 √1

(iii) (a) Y √1

(b) E √1

(iv) Ionic bond √1 – Because B reacts by losing an electron (s) which are gained by H. √1

(v) D//M √1 Any one, one mark

(vi) Because E reacts by gaining an extra electron which reduces √1 the electrostatic pull by the positive nucleus making the ionic radius increase. wtte

(vii) At Period III Group IV

(viii) Because of the increase in the strength of the molecular bonds in the oxide of L as compared to that of G. √1 w.t.t.e

(ix) C has a smaller atomic √1 radius than I because of the increase in the strength of the nucleus on the valency electrons in C as the number of protons increase √1 w.t.t.e

(x) 1st ionization energies increases from J – L across the period due to addition of an extra proton in the nucleus increasing the attraction of the valency electrons √1

2. (a) (i) Nitrogen √ ½ and hydrogen √ ½

(ii) Platinum √1

(iii) $4NH_{3(g)} + 5O_{2(g)} \xrightarrow{\text{Platinum}} 4NO_{(g)} + 6H_2O_{(g)}$ √1

(iv) Neutralization √1

(v) The concentrated nitric acid oxidizes sulphur to sulphuric VI acid. The acid is reduced to nitrogen (IV) oxide √1

$S_{(s)} + 6HNO_{3(l)} \longrightarrow H_2SO_{4(aq)} + 6NO_{2(g)} + 2H_2O_{(l)}$ √1

This paper consists of 4 printed pages

Turn Over

(vi) Any metal above copper but below sodium in the reactivity series. √1

(vii) (i) J – NH_4NO_3 √1

(ii) Molar mass NH_4NO_3 = 28 + 4 +48 = 80g √ ½

Therefore 80g of NH_4NO_3 contain 28g of nitrogen

14g of nitrogen would be contained in $^{14}/_{28}$ x 80 √

= 40g of NH_4NO_3 √ ½

(b) $(NH_4)_3 PO_4$ is less soluble √ hence it is less easily leached from the soil √

- $(NH_4)_3 PO_4$ provides the plant with nitrogen and phosphorous √1.

3. (a) (i) But-1-yne √1

(ii) But-2-ene √1

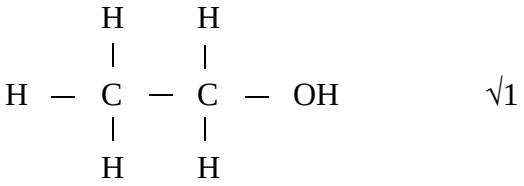
(b) (i) Q – Ethylpropanoate √ ½

R – Ethanol √ ½

W – Carbon (IV) oxide √ ½ each ½ mark

K – Hydrogen gas √ ½

(ii)

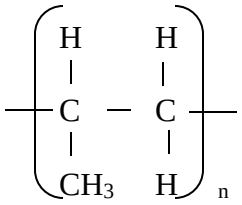


√1

As a fuel √1

(iii) $2CH_3CH_2 COOH_{(aq)} + Na_2CO_{3(aq)} \longrightarrow CH_3CH_2 COONa_{(aq)} + H_2O_{(l)} + CO_{2(g)}$ √1

(iv)



Poly propene √1

(v) Esters √1

4. (a) M – Oxygen √ ½

N – Hydrogen √ ½

(b) $4OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + 4e$ √1

(c) Cathode, √1 since H^+ which has an oxidation number of +1 is reduced to H_2 which has an oxidation number of O. √1

(d) Platinum √1 / graphite since they are inert and therefore do not react with the electrolyte or the products √1

(e) (i) Ba, Zn, Ag √1
Decreasing reactivity

(ii) E.M.F = E^{θ} reduced – E^{θ} oxidized
= -0.76 - $^{-}$2.90 √1
= + 2.14V √1

(iii) The chlorine gas formed √1 would react with zinc anode. √1

5. (a) Carbon (IV) oxide formed is escaping √1

(b) $CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$ √1

(c) - Increasing the temperature √1
- Increasing the concentration of hydrochloric acid √1
- Using powdered calcium carbonate instead of marble chips

Any two, 2 marks

(d) All the marble chips have been used up √1 // the reaction has come to an end.

(e) White precipitate formed √1 which dissolves in ammonia solution √1

(f) - Causes global warming √1
- Causes acid rain.

(g) - In fire extinguishers √1
- In aerated drinks √1
- Making artificial rain

Any two, 2 marks

6. (a) Enthalpy change when 1 mole of water is formed from the reaction between hydrogen and hydrogen ions √1 (a base and an acid)

(b) $H^{+}_{(aq)} + OH^{-}_{(aq)} \longrightarrow H_2O_{(l)}$ √1

(c) (i) $\left(\frac{25.0 + 25.0}{2} \right) = \left(\frac{50}{2} \right)^{0}C = 25^{0}C$ √ ½

$\Delta T = (34 – 25)^{0}C$
$= 9.0^{0}C$ √ ½

(ii) $\Delta H = Mc \Delta T$
Total volume = $(100 + 50)cm^3$
$= 150cm^3$

Mass = $150cm^3 \times 1gcm^{-3}$
= 150g

$\Delta H = \frac{150}{1000} kg \times 4.2\ kJkg^{-1}k^{-1} \times 9k$ √
= 5.67 kJ √

(iii) The molar heat of neutralization of sodium hydroxide

If $1000cm^3 = 2M$
$50cm^3 = ?$

$= \frac{1}{\frac{50}{1000} \times 2} = \frac{1}{10} = 0.1$ moles

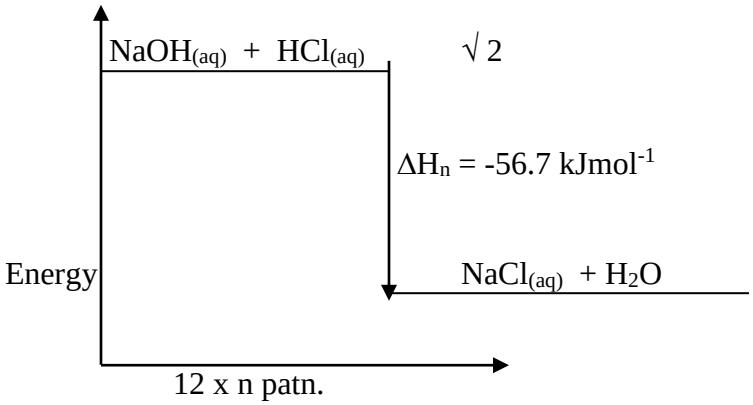
If 5.67kj is liberated when 0.1 moles are neutralized then to neutralize 1 mole we have

$\frac{1}{0.1} \times 5.67kJ$ √

$= 5.67$ kJ mol √

(d) $H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$ √ $\quad \Delta H_{neut} = -56.7\ kJmol^{-1}$

(e)



7. (a) (i) Molten aluminium oxide √1 (reject formula)
(ii) Aluminium metal √1
(iii) Anode √1

(b) Carbon √1

(c) (i) $Al^{3+} + 3e^- \longrightarrow Al_{(s)}$ √1

(ii) Oxygen gas evolved at E √1 reacts with the carbon electrode to form $CO_{2(g)}$. Hence it is consumed.

(iii) To lower the melting point √1 of Al_2O_3 so as to conserve energy

(d) Bauxite √1

(e) $Al^{3+} + 3e \longrightarrow Al$ √1
$27g$ 1 mole $\longrightarrow 3F = 3 \times 96500$ √ ½

$Q = It$ √ ½
$= 25 \times 36 \times 60 \times 60$

$\frac{27 \times 25 \times 36 \times 60 \times 60}{3 \times 96500 \times 1000}$
$= 0.3022kg$ √

(f) - Making cooking pans √
- Making electric cables √
- When alloyed its used in making body pans √ of air crafts (buralumium)
- Making packaging foils e.g cigarette packs √ etc

Any 2 x 1 = 2

Name _____

Candidate's signature _____

Date _____

233/3
CHEMISTRY
PAPER 3
PRACTICAL
JULY / AUGUST 2011
2 ¼ HOURS

FORM IV MID YEAR ASSESSMENT TEST
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 3
2 ¼ HOURS

INSTRUCTIONS

(a) Write your name, and index number in the space 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) Mathematical tables and electronic calculators may be used.
(e) All working MUST clearly be shown where necessary
(f) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

FOR EXAMINER'S USE ONLY

QUESTION	MAX SCORE	CANDIDATES SCORE
1	14	
2	17	
3	09	
TOTAL SCORE	40	

This paper consists of 7 printed pages

Turn Over

1. You are provided with:
   - Solution A – 0.1M hydrochloric acid
   - Solution B – Containing 19.1g 1L of a basic compound $B_2X.10H_2O$.

   You are required to determine the relative atomic mass of metal B in the formula $B_2X.10H_2O$

Procedure
- Fill the burette with solution A upto the zero mark.
- Using a pipette and a pipette filler, place $25cm^3$ of solution B into a $250cm^3$ conical flask.
- Add three drops of methyl orange indicator and titrate.
- Record your results in the table below.
- Repeat the procedure two more times and complete table I.

(a) (i) TABLE I

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

(5 marks)

(ii) Calculate the average volume of solution A used. (1 mark)

(b) Given that one mole of $B_2X.10H_2O$ reacts with 2 moles of hydrochloric acid, calculate the:

(i) Moles of $B_2X.10H_2O$ in the volume of solution B used. (2 marks)

(ii) Concentration of solution B in moles per litre. (2 marks)

(iii) Relative formula mass of $B_2X.10H_2O$. (2 marks)

(iv) Relative atomic mass of metal B in $B_2X.10H_2O$ (Relative formula mass of X = 156, H = 1.0, O = 16.0) (2 marks)

2. You are provided with:
- 2g of solid C – Oxalic acid ($H_2C_2O_4.2H_2O$)
- Solution D – 0.5M solution of oxalic acid (dibasic acid)
- Solution E – Sodium hydroxide solution.

You are required to determine

(a) (i) The molar heat of solution of solid C.

(ii) The enthalpy of neutralization between oxalic acid solution D and sodium hydroxide solution E

(b) Calculate the heat of reaction of solid C with aqueous sodium hydroxide by applying Hess' law.

Procedure I:

- Place $30cm^3$ of distilled water into a 100ml plastic beaker.
- Measure the initial temperature of the water and record it in table II below. Add all the solid C at once.
- Stir the mixture carefully with the thermometer until all the solid dissolves. Do not break the thermometer.
- Measure the final temperature reached and record it in table II below.

(a) (i) Table II

Final temperature (^0C)	
Initial temperature (^0C)	

(ii) Determine the change in temperature, ΔT_1. (1 mark)

(b) Calculate the:

(i) Heat change when solid C dissolves in water. (Assume the heat capacity of the solution is $4.2kJkg^{-1}k^{-1}$ and density is $1gcm^{-3}$) (2 marks)

(ii) Moles of solid C oxalic acid ($H_2C_2O_4.2H_2O$) used (H = 1.0, C = 12.0, O = 16.0) (2 marks)

(iii) Molar heat of solution, ΔH_1 of solid C (oxalic acid). (1 mark)

Procedure II:

- Place $30cm^3$ of solution D into a clean 100ml plastic beaker.
- Measure its temperature and record it in table III below.
- Measure $30cm^3$ of solution E and measure its temperature; record it in table III below.
- Add all the solution E at once to solution D in the beaker.
- Stir the mixture gently with the thermometer.
- Measure the final temperature reached and record it in table III below.

Table III

(c) (i)

Temperature of solution D, T1(^{0}C)	
Temperature of solution E, T_2(^{0}C)	
Initial temperature $\frac{T_1 + T_2}{2}$ (^{0}C)	
Final temperature of mixture (^{0}C)	

(2 marks)

(ii) Determine the change in temperature, ΔT_2. (1 mark)

(d) Determine the:

(i) Heat change for the reaction (Assume heat capacity of solution = $4.2kJkg^{-1}k^{-1}$ and density of solution is $1gcm^{-3}$) (2 marks)

(ii) Number of moles of oxalic acid, solution D used. (1 mark)

(iii) Heat of reaction, ΔH_2, of one mole of oxalic acid with sodium hydroxide. (1 mark)

(iv) Molar enthalpy of neutralization between oxalic acid and sodium hydroxide. (1 mark)

(e) Given that:

ΔM_1 is the molar heat of solution of solid oxalic acid; reaction:

$$H_2C_2O_{4(s)} \xrightarrow{\text{Water}} 2H^+_{(aq)} + C_2O_4^{2-}{}_{(aq)}$$

ΔM_2 is the heat of reaction of one mole of oxalic acid with sodium hydroxide; reaction

$$2M^+_{(aq)} + 2OH^-_{(aq)} \longrightarrow 2H_2O_{(l)}$$

Calculate ΔH_3, for the reaction:

$$H_2C_2O_{4(s)} + 2OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + C_2O_4^{2-}{}_{(aq)}$$ (2 marks)

3. You are provided with solid F which is a mixture of two salts. Put all the solid F provided in a boiling tube and add a about $10cm^3$ of distilled water. Shake to dissolve. Divide the resulting solution into four portions.

(a) To the first portion, add 5 drops of aqueous sodium hydroxide and heat. Test for any gases produced using a blue and red litmus papers.

Observations	Inferences

(b) To the second portion, dip a clean glass rod and vaporize a drop of the solution on a non-luminous flame.

Observations	Inferences

(c) To the third portion, add 3 drops of acidified potassium manganate (VII) (KMnO4) solution.

Observations	Inferences

(d) To the fourth portion, add about 5 drops of Barium chloride followed by dilute hydrochloric acid.

Observations	Inferences

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CHEMISTRY
PAPER 3
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PAPER 3

MARKING SCHEME

TABLE I

	I	II	III
Final burette reading (cm^3)	25.0	25.0	35.0
Initial burette reading (cm^3)	0.0	0.0	10.0
Volume of solution A used (cm^3)	25.0	25.0	25.0

Complete table (converted) √1
Correct arithmetic √1
Decimal place √1
Consistency √1
Accuracy √1
5m

(ii) Average volume of solution A used

$$\frac{25.0 + 25.0 + 25.0}{3} \quad \surd ½$$

$= 25.0cm^3$ √ ½

(b) (i) Moles of HCl used = $0.1 \times {}^{25}/_{1000}$
$= 0.0025$ mol √ ½

Moles ratio of acid : $B_2X.10H_2O = 2 : 1$ √ ½
∴ Moles of $B_2X.10H_2O$ used = ½ x 0.0025 √ ½
= 0.00125 mol √ ½

(ii) $25cm^3$ of $B_2X.10H_2O$ contains 0.00125 mol
$1000cm^3$ of $B_2X.10H_2O$ contains ${}^{100}/_{25} \times 0.00125$ √1
= 0.05M √1
Penalise ½ m for missing or wrong units

This paper consists of 4 printed pages

Turn Over

(iii) 0.05 mol of $B_2X.10H_2O$ weighs 19.1g √ ½

1 mol of $B_2X.10H_2O$ weighs $\frac{1}{0.05}$ x 19.1 √ ½

= 382g

R.F.M of $B_2X.10H_2O$ = 382 √1

Penalise ½ m if units are used

(iv) $B_2X.10H_2O$ = 382 √ ½

2B + 156 + 180 = 382 √ ½

2B = 382 – 336

2B = 46 √ ½

B = 23 √ ½

2. (a) TABLE II

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

Complete table √ ½

Trend and accuracy √ ½

(ii) ΔT_1 = Final temperature – initial temperature = -ve value

(b) (i) ΔH = MCΔT

= $\frac{30}{1000}$ x 4.2 x ΔT_1

= +ve value in kJ

Penalize ½ m for missing or wrongly written units

(ii) 1 mol of $H_2C_2O_4.2H_2O$ = 126g √ ½

∴ 2g of $H_2C_2O_4.2H_2O$ = $\frac{2}{126}$ √ ½ x 1 √ ½

= 0.015873 mol √ ½

(iii) 0.015873 mol of acid absorbs kJ in (b) (i) above

1 mol of acid absorbs $\frac{1}{0.015873}$ √ ½ x kJ in b(i)

= +ve value in $kJmol^{-1}$ √ ½

Penalize the ½ m for answer if units are missing or wrongly written.

TABLE III

(c) (i)

Temperature of solution D, T_1 (^{0}C)	
Temperature of solution E, T_2 (^{0}C)	
Initial temperature $\frac{T_1 + T_2}{2}$ (^{0}C)	
Final temperature of mixture (^{0}C)	

Complete table = 1 mark
Trend and accuracy = 1 mark

(ii) ΔT_2 = Final temperature – initial temperature = +ve value ^{0}C √1

(d) (i) = $\Delta H = MC\Delta T$

= $\frac{60}{1000} \times 4.2 \times \Delta T_2$ √1

= -ve value of kJ

Penalize ½ mark if units are missing or wrongly written.

(ii) Moles of oxalic acid in solution D used

= $\frac{30}{1000} \times 0.5$ √ ½

= 0.015 mol √ ½

(iii) ΔH_2 (Heat of reaction of one mole of oxalic acid with sodium hydroxide)

= $\frac{1}{0.015}$ √ ½ x volume – d(i) above

= -ve value of kJ. √ ½

(iv) Oxalic acid $H_2C_2O_4.2H_2O$ is dibasic

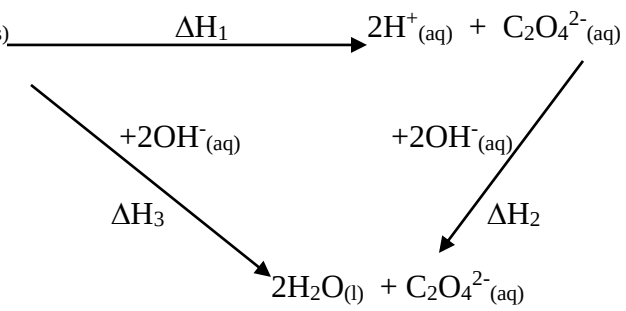
Thus:

$2H^+_{(aq)} + 2OH^-_{(aq)} \longrightarrow 2H_2O_{(l)}$; ΔH_2 = -ve value in d (iii) above in kJ. √ ½

Hence

$H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$ ΔH_{Neutr} = $\frac{\text{-ve value in d(ii) above}}{2}$

(e)



$\Delta H_3 = \Delta H_1 + \Delta H_2$ √1

= -ve value in kJ √1

Penalize ½ mark if units are missing or wrongly written.

3.

(a) OBSERVATIONS	INFERENCES
- Colourless gas evolved with pungent chocking smell √ ½ - Gas turns red litmus paper blue √ ½ - Blue litmus paper remains blue √ ½ (1 ½ marks)	- Gas evolved in basic √ ½ - NH_3 gas evolved √ ½ (1 mark)
(b)	
- Burns with a golden yellow flame. √1 (1 mark)	Na^+ ions present √1 (1 mark)
(c)	
Purple acidified √ $KMnO_4$ decolorised Rej. Colour disappears Colourless solution formed (1 mark)	SO_3^{2-} ions present √ ½ / presence of a reducing agent √1 (1 ½ marks)
(d)	
White precipitate formed √ ½ which dissolves in dilute HCl acid. √ ½ (1 mark)	SO_3^{2-} ions present √1 (1 mark)

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CHEMISTRY
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FORM IV MID YEAR ASSESSMENT TEST
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CONFIDENTIAL

INSTRUCTIONS TO SCHOOLS

- The information contained in this paper is to enable the head of the school and the teacher in charge to Chemistry to make adequate preparations for the Mid-Year Continuous Assessment Test. NO ONE ELSE should have access to this paper or acquire knowledge of its contents.
- Great care MUST be taken to ensure that the information here in does not reach the candidates either directly or indirectly.
- The teacher in charge of Chemistry should NOT perform any of the experiments in the same room as the candidates nor make the results of the experiments available to the candidates or give any other information related to the experiments to the candidates. Doing so will constitute as examination irregularity which is punishable.

This paper consists of 2 printed pages

Turn Over

In addition to the apparatus and fittings found in a Chemistry laboratory, each candidate will require the following.

1. About 100cm^3 of solution A.
2. About 100cm^3 of solution B.
3. About 60cm^3 of solution D.
4. About 60cm^3 of solution E.
5. 2g of solid C (weigh accurately).
6. About 1.0g of solid F.
7. One burette – 50.0 ml.
8. One pipette – 25 ml.
9. Three conical flasks.
10. One pipette filler.
11. About 500cm^3 of distilled water.
12. A 50ml measuring cylinder .
13. One thermometer – 10^0C – 110^0C.
14. Four clean test tubes in a rack.
15. One 100ml measuring cylinder.
16. A 10ml measuring cylinder.
17. One boiling tube.
18. Blue an red litmus papers.
19. One test tube holder.
20. Glass rod.
21. Piece of tissue paper

ACCESS TO;

1. Methyl orange indicator.
3. 2M hydrochloric acid.
3. 2M sodium hydroxide solution.
4. Means of heating.
5. A cidified potassium manganate (VII) solution.
6. Aqueous barium chloride solution.

NOTES

1. Solution A – 0.1M HCl made by dissolving 8.6cm^3 of conc. HCl (1.18cm^3/g) in 1 litre of solution.

2. Solution B is made of 19.1 gl^{-1} of disodium tetraborate decahydrate (Dissolve 19.1g in 600cm^3 of distilled water, warm to increase solubility)

3. Solid C is oxalic acid ($H_2C_2O_4.2H_2O$). It should be presented to students in a stoppered container.

4. Solution D is 0.5M solution of oxalic acid (63g/l)

5. Acidified potassium manganate (VII) is prepared by dissolving 3.16g of solid $KMnO_4$ in 500cm^3 of $2MH_2SO_4$ and diluting to one litre solution.

6. Solid F is a mixture of solid NH_4NO_3 and Na_2SO_3 (sodium sulphide) at a ratio of 1 : 1.
Place the mixture in stoppered containers.