DIGITAL CONTENT
CHEMISTRY PRACTICAL PREPARATIONS

K.C.S.E
STUDY PACK

CHEMISTRY
PRACTICAL

1989 – 2016

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- COORDINATED MARK SCHEMES
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QUANTITATIVE ANALYSIS

SETTING TRENDS TABLE

Year and Question No.( )							
The mole: Formulae and chemical equations TESTED in all years EXCEPT 2002							
Acids, Bases and salts	**90** (c)	**06** (1)	**09** (1)				
Energy changes in chemical and physical processes	**89** (III)	**94**(1)	**95**(1)	**97**(1)	**00** (2)	**01**(III)	**03** (2)
	04 (1)	**05**(1)	**07** (1)	**08** (1)	**10** (1)	13(1)	
Reaction rates and reversible reactions	**92** (1)	**99** (1)	**02** (1)	12(1)			

Questions	Mark schemes	Practical Requirements

Introduction

The main aim of Chemistry Practical examination is to test a candidates ability to:
a). Follow instructions
b). Handle apparatus and chemicals

c). Make accurate observations and deductions/inferences

This book contains 26 practical examinations from 1989 - 2013 as they appeared in during the respective examinations periods. The requirements and preparation procedures for each practical has been provided.

The teacher should give minimal assistance to candidates when carrying experiments to build confidence and enable them make their own observations and inferences. Confidence is only built with constant practice. Candidates are also advised to write the observations as they 'observe' during the practical but not the literature they have read from the books.

In experiments involving quantitative analysis the readings show slight variations from the ones given in the answer scheme and also from region to region. Therefore in the calculations and plotting of graphs, the teachers are required to use their school values. Teachers are advised to use the scheme as a guide not as the final correct answer.

Charles Otieno
Publishing Editor & Examinations Co-ordinator

QUANTITATIVE AND QUALITATIVE ANALYSIS

The chemistry practical mainly tests the candidates on two parts. Qualitative analysis and quantitative analysis. Students should be exposed to various types of experiments during teaching. Where it is not possible to carry out experiments individually, a well designed demonstration should be undertaken. Teachers should avoid theoretical

teaching as this has been manifested many times during the marking of this paper.

Language used to communicate the observations and results must be checked after each practical experiment. Discussion of the results and clear explanations should be given after every experiment. Apparatus must be cleaned to avoid contamination and must be assembled correctly if accurate observations are to be obtained.

Introduction to Quantitative Analysis

Quantitative analysis in chemistry practical examination mainly involves the volumetric analysis. Volumetric analysis is a means of estimating quantities of certain substances (often acids or alkalis) by an analytical process which involves measurement of volumes of liquids using pipettes, burettes and measuring cylinders. Weighing is also involved. It involves the use of the following apparatus

i). Thermometer
ii). Stop-watch/stop-clock
iii). Other common apparatus found in a laboratory

In the K.C.S.E Chemistry practical examination this section requires the candidate to carry out an experiment, record and interpret the data. The interpretation involves calculations and drawing graphs after a candidate has collected the data.

A candidate who is not sure with the calculations after collecting the data is advised to record all his data in the table (s) provided and finally do the calculations. About half of the total marks awarded in this section is mainly from the recording of the data.

It is important for the candidate to spend sometime reading the instructions and the procedure to ensure that all the apparatus and reagents are present and the procedure is clear. After that, the candidate can start going through the procedure step by step and recording the data

In the procedure the key words are normally written in bold letters so that the candidate does not make any mistake.

The common areas in chemistry tested in this section of the practical examination are;

a). Moles and molar solution
b). Titration
  i). Acid-base titration
  ii). Redox titration
  iii). Back titration
c). Solubility and drawing solubility curves
d). Determining melting, freezing, and boiling points
e). Molar heats of reaction e.g. solution, displacement, precipitation,, neutralization and Hess's law
f). Rates of reactions and reversible reactions

Possible errors made in quantitative analysis

1. Errors made when weighing the substance by the lab. Technician or teacher
2. Contaminated solutions due to use of apparatus, which are not clean. All apparatus e.g. burettes, measuring cylinders, beakers etc should be rinsed thoroughly before using them and after use
3. Candidates not able to read the stop- watch or thermometers properly when taking measurement of time and temperature respectively
4. Candidates not able to identity the end – point accurately during titrations

Interpretation of data and calculations

To score maximum marks, candidates are required to be perfect in drawing of graphs
The mole concept is important to all the calculations involved in the practical examination.

As observed earlier (from the trends table) the topic on energy changes is not properly understood. Questions on energy changes are repeated yearly. More time should be allocated to its teaching and students allowed to carry out experiments on heat changes. Heats of displacement, solution are quite easy to determine. Students should be allowed to determine them. More examples on calculations involving energy changes should be given to students for practice.

Introduction to Qualitative Analysis

This involves the identification of various ions in a substance. The tests in this section have been kept as simple as possible to enable the learner understand he/she is doing. To avoid these complex reacts the scheme has been restricted to the detection of the following ions;

NH_4^+, K^+, NA^+, LI^+, Ca^{2+}, Pb^{2+},$Cu^{2+,}$ CO_3^{2-}, HCO_3-,
$Ba^{2+,}$ Al^{3+}, Zn^{2+}, Fe^{2+}, $Fe^{+3,}$ $SO^{2-}{}_3$, NO_3^-, Cl^-, Br^- and I^-.

This section also tests candidates on identification of organic compounds and their characteristics. When doing the practical examination. Work systematically through the

experiments, in the order they are given, writing your observations and deductions as you go along.

If you are unable to make sense of a particular reaction, leave it after recording your observations and move on to the next test or experiment. Do not waste time. You should have time at the end to go over your work, correcting mistakes and checking for anything you think you have missed. Follow the instructions and the procedure carefully.

How to make observations and deductions

Observations are changes you see when you carry out a test or experiment. Observations are;

i). Colour changes
ii). Formation of precipitate
iii). Gases evolved, including colour, smell.
iv). Sound, heat or light produced

Tests for gases

Do not waste time testing for gases unless you know a gas is being produced or unless its indicated in the instructions that test for and identify any gas being produced.

Gases can be detected by:

i). Colour
ii). Effervescence (bubbling of gas)
iii). Smell
iv). Effect on moist litmus papers

Deductions/Inferences

Deductions are something you can say about the unknown substances. This can be:

i). Anions and cations present in the unknown substance (e.g. SO_4^{2-}, or Fe^{2+} ions)
ii). the substance is an oxidizing or reducing agent
iii). the substance is saturated or unsaturated (incase of organic substances)

Deductions must be specific.

- ✓ A common mistake is to simply write; "Cu^{2+}. You should write Cu^{2+} present
- ✓ Do not forget that even tests that show no precipitate formed often have a

deduction. For example; you might add $Ba(NO_3)_2$ solution to a solution of a substance and see no precipitate. From this you can deduce that there is no sulphate, SO_4^{2-}, present (otherwise a white precipitate would be seen)

- ✓ Another common fault is to give the identity of gases as deduction. Your

deduction is what type of a substance has produced the gas. For example,

if you add acid to a solid and observe carbon (iv) oxide then a carbonate is present.

- ✓ Deductions must be written as soon as you have recorded your observations.
- ✓ Do not leave all the deductions until you have completed all the tests. If you do

this, you may miss important observations and deductions in other tests, often need the deductions from earlier test to make sense of later tests.

Identification of cations (metallic ions)

The two common reagents used in the identification of cations are:

i). Sodium hydroxide solution
ii). Aqueous ammonia

However, other reagents like dilute hydrochloric acid or an aqueous solution of soluble chloride e.g. sodium chloride and dilute sulphuric acid or an aqueous solution sulphate e.g. sodium sulphate are use to identify some cations.

In most cases candidates are required to prepare small quantities of solution in a boiling tube or test tube for the unknown substance. If the substance is being tested is insoluble in water, dilute hydrochloric acid is added to the substance. If the solids still will not dissolve it is probably a lead salt and dilute nitric acid must be used.

For the identification of ions to be done the compound must be in aqueous form. The alkali is first added drop wise while the candidate records the observation and then in excess again and observation recorded.

Addition of Sodium Hydroxide Solution to a Solution in a Test Tube

Test	Observation	Inference
Add a few drops of NaOH solution drop wise until in excess	a). No precipitate formed	Zn^{2+}, Al^{3+}, Pb^{2+}, Mg^{2+}, or Ca^{2+} absent.
	b). White precipitate , insoluble in excess of $NaOH_{(aq)}$	Ca^{2+} or Mg^{2+} present
	c). White precipitate, soluble in excess $NaOH_{(aq)}$ forming a colourless solution.	Pb^{2+},Al^{3+} or Zn^{2+} present
	d). Green precipitate which turns brown on exposure to air.	Fe^{2+} present

	e). Brown precipitate insoluble in excess $NaOH_{(aq)}$	Fe^{3+} present
	f). A blue precipitate is formed insoluble in excess NaOH	Cu^{2+} ions present

Addition of aqueous ammonia to a salt solution in a test tube

Test	Observation	Inference
Add a few drops of $NH_{3(aq)}$ solution until in excess	a). No white precipitate formed	Ca^{2+} present/ Na^{+}, K^{+}, NH_4^{+}
	b). White precipitate , insoluble in excess of $NH_{3(aq)}$	Mg^{2+},Pb^{2+} or Al^{3+} present
	c). White precipitate, soluble in excess $NH_{3(aq)}$.	Zn^{2+} present
	d). Green precipitate insoluble in excess	Fe^{2+} present
	e). Brown precipitate insoluble in excess	Fe^{3+} present
	f). Pale blue precipitate; which dissolves to form a deep-blue solution in excess $NH_{3(aq)}$	Cu^{2+} present

Addition of Dilute Hydrochloric Acid or Sodium Chloride Solution

Test	Observation	Inference
Add a few drops or (a known volume) of dilute HCl or $NaCl_{(aq)}$ to a solution in a test tube. „ „ „ „ „	a). White precipitate formed	$Pb^{2+,}$ Ag^{2+} ions present.
	b). No white precipitate formed	Pb^{2+} and Ag^{+} ions absent

Addition of Dilute H_2SO_4 acid or Sodium Sulphate Solution

Test	Observation	Inference
Add a few drops or (known volume) of dilute H_2SO_4 or $NaSO_4$ to a solution in a test tube. „ „ „ „ „	a). White precipitate formed	Ca^{2+}, Pb^{2+} or Ba^{2+} present.
	b). No white precipitate formed	Ba^{2+}, Pb^{2+},or Ca^{2+}, absent

Identification of Cations Using the Flame Test

The presence of some metallic ions can be identified by heating the substance in a flame using a platinum wire or a glass rod

The Bunsen burner flame should be non-luminous for correct observation to be made

Test	Observation	Inference
Dip a clean platinum wire or a	a). Lilac or purple	K^{+} present.

glass rod into a solution of salt	/orange flame	
	b). Golden yellow flame	Na^+ present
	c). Crimson flame	Li^+ present
	d).Brick-red flame	Ca^{2+} present
	e).Green-blue flame	Cu^{2+} present

Identification of Anions

The substances to be identified must be in aqueous form before the reagents are added The anions are commonly identified by the use of dilute acids e.g. HCl acid. Precipitation reactions with reagents listed in the table below are used as confirmatory tests.

Test	Observation	Inference
1). Add dilute acid e.g. HCl to a solution in a test tube	Effervescence /bubbles of a gas are produced.	CO_3^{2-} or HCO_3^- SO^{2-}_3 present
2). Add barium Chloride or Barium nitrate solution to a solution in a test tube followed by dilute HCl acid	White precipitate formed which is insoluble in dilute HCl acid	SO_4^{2-} present
3). Add barium Chloride or Barium nitrate solution to a solution in a test tube followed by dilute nitric acid or dil. HCl respectively	White precipitate is formed which dissolves on the addition of the acid	SO_3^{2-} or CO_3^{2-} present
4).Acid lead (II) nitrate to a solution in a test tube followed by dilute HNO_3 acid	White precipitate formed which dissolved on boiling	Cl^- present
	b).White precipitate insoluble on boiling	SO_4^{2-} or CO_3^{-2} present
	c).Pale cream precipitate formed.	Br^- present
	d).Yellow precipitate formed	I^- present
5).Add a small quantity of cold, iron (II) sulphate solution. Gently pour concentrated H_2SO_4 acid down the side of the tube.	A brown ring forms in the junction of the two layers	NO_3^- present
6). Add dilute acid to a substance in test tube Test with acidified $KMnO_4$ solution or acidified $K_2Cr_2O_7$	A gas with a smell of rotten egg evolved Gas blackens the lead ethanoate paper or lead (II) nitrate solution.	S^{2-} present
7). Add dilute acid to a substance in test tube Test with acidified $KMnO_4$ solution or acidified K_2 Cr_2 O_7	Effervescence (bubbles of a colourless gas Pungent smell $KMnO_4$ turn from purple to colourless	SO_3^{2-} present

	$K_2Cr_2O_7$ turn from orange to green	

Action of Heat

When heating solid substances always makes sure that the test-tube is clean and dry.

Test	Observation	Inference
Heat a small amounts of the solid in a clean and dry test tube and test for any gas or gases evolved	a). Colourless liquid formed on cooler part or upper part of test tuber OR vapour condenses to a colourless liquid	Hydrated salt or a hydrogen -carbonate or hydroxide
	b). Colourless gas which gives a white precipitate with lime water	CO_3^{2-} /HCO^-_3 present
	c).Colourless gas that relights glowing splint	Nitrate of potassium or sodium
	d).Pungent smell; dark brown gas which turns moist blue litmus red	NO_3^- present (except those of Na and K)
	e). Pungent smelling gas which turns red litmus blue.	NH_4^+ present
	f).Sublimation	Possibly NH_4^+

Test for oxidizing and reducing agents

The usual method of testing for an oxidizing agent is to mix it with a substance which is easily oxidized (i.e. a reducing agent) and which gives a visible change when the reaction takes place. Similarly, a suspected reducing agent is added to an oxidizing agent which undergoes a visible change when reduced.

Test	Observation	Inference
1. <u>Oxidising agents</u> a). Test with moist starch-potassium iodide paper	Papers turns blue-black	I^- ions are oxidized to I_2: which then react with starch
b). Warm with Conc. HCl	Cl_2(smell, bleaches moist litmus paper	Cl^- Oxidised to Cl_2
2. Reducing agents a).Add acidified $KMnO_4$ solution	Purple solution is decolorized	Purple $MnO_4^-{}_{(aq)}$ reduced to colourless $Mn^{2+}{}_{(aq)}$ ions
b). add acidified $K_2Cr_2O_{7(aq)}$	Orange solution turns green	$Cr_2O_7^{2-}$ ions are reduced to green $Cr^{3+}{}_{(aq)}$ ions
c). Add a solution of an Iron(III)salt	Yellow solution turns pale Green	$Fe^{3+}{}_{(aq)}$ ions reduced to Fe^{2+} ions

Test	Observation	Inference
Add acidified $KMnO_4$ solution to a solution in a test-tube	The purple $KMnO_4$ turns colourless or decolourised	SO_3^{2-} ions present OR unsaturated organic compound OR a reducing agent

Add acidified $K_2Cr_2O_7$ solution to a solution in a test tube	It turns green or colour changes from orange to green	SO_3^{2-} ions present OR unsaturated organic compound OR a reducing agent
Add bromine water to a solution in a test tube	It is decolourised or turns colourless	SO_3^{2-} ions present OR unsaturated Organic compound OR a reducing agent
Add chlorine water to a solution in a test tube.	Brown solution/yellow solution	Br^- of I^- present
Add bromine water to a solution in a test tube	Brown solution/black precipitate	I^- present

Candidates are advised that MARKS are only earned if observation is correct and the scientific language used to describe that observation. It should be known that if the observation is wrong or correct scientific language is not used, then all the marks will be lost.

OCTOBER - NOVEMBER 1989

1. You are provided with;

- *Aqueous hydrochloric acid, solution **W**$_9$ in a burette.*
- *Solution sodium **W**$_{11}$ containing 6.3g of a dibasic acid $H_2CO_4.2H_2O$ per litre*
- *Aqueous sodium hydroxide, solution **W**$_{12}$.*
- *Phenolphthalein indicator*
- *A pair of scissors or a sharp blade*

You are required to;

- Standardize the sodium hydroxide solution **W**$_{11}$
- Use the standardized solution **W**$_{11}$ to determine the concentration of **W**$_9$

React the hydrochloric acid solution **W**$_9$ with metal **M** and determine the mass per unit length of metal **M**.

Procedure

I Fill a burette with solution **W**$_{11}$, pipette 25.0cm^3 of solution **W**$_{12}$ into a conical flask. Titrate using phenolphthalein indicator. Record your results in Table A below;

Table A.

	1st	2nd	3rd
Final Burette Reading			
Initial Burette Reading			
Titre (cm^3)			

(5 marks)

i) Average volume of solution $\mathbf{W}_{11}$ used (1 mark)

ii) Calculate the concentration of the dibasic solution W_{11} in mol^{-1} (*C*=12, *H*=1, *O*=16) (1 mark)

iii) Calculate the concentration of the sodium hydroxide solution $\mathbf{W}_{12}$ in $mol/^{1}$ (2 marks)

II. Using a $100cm^3$ measuring cylinder measure $90cm^3$ of distilled water and place it into a $250cm^3$ beaker then add $10cm^3$ of solution $\mathbf{W}_9$ ($\mathbf{W}_9$ is supplied in a burette). Mix the solution well and label it $\mathbf{W}_{10}$.

Fill a burette with solution W_{10}, pipette $25.0cm^3$ of solution W_{12} into a conical flask. Titrate using phenolphthalein indicator. Record your results in Table B below.

Table B.

	1st	2nd	3rd
Final Burette Reading			
Initial Burette Reading			
Titre (cm^3)			

(5 marks)

i). Average volume of solution W_{10} used. (1 mark)

ii). Calculate the concentration of the diluted hydrochloric acid solution W_{10} in mol l_{-1}. (2 marks)

iii). Determine the concentration of the original hydrochloric acid solution W9 in mol l^{1} (1 mark)

III. Cut three pieces each of length 2cm from the metal **M** provided. From the burette containing $\mathbf{W}_9$ measure $10cm^3$ of $\mathbf{W}_9$ into a boiling tube. Wrap the boiling tube with tissue paper. Measure the temperature of this solution and record it in **Table C** below. Place one of the 2cm pieces of metal **M** into the hydrochloric solution **W9** in the boiling tube and measure the temperature. Record the highest temperature in table C below. Repeat this procedure using the other two, 2cm, pieces of M.

Table C.

	1st	2nd	3rd
Piece of metal M			
Highest temperature			
Initial temperature			

Change in temperature, ΔT			

(5 marks)

i). Average change in temperature ΔT…….^{0}C (1 mark)

ii). Calculate the heat of the reaction between metal **M** and hydrochloric acid using the expression below; heat of reaction = 42 x ΔT Joules (1 mark)

iii). Given that the heat of the reaction is 440Kj per mole of **M**. Calculate the number of moles of **M** used in this reaction. (2 marks)

iv). Calculate the mass per unit length of metal M (M=24). (2 marks)

2. (10 Marks). You are provided with a solid Y. Carry out the tests in Table D below on Y. Record your observations and deductions in the table. Identify any gas evolved.

		Observation	Deduction
a).	Place half a spatula end ful in a dry test-tube and heat gently first and then strongly	(1 mark)	(1 mark)
b).	To about half a spatula endful in a test tube add about 1cm^3 of dilute hydrochloric acid	(1 mark)	(1 mark)
c).	Place a half a spatula end-ful in a test tube and about 6cm^3 of distilled water and shake well. Divide the solution into two portions.		
i).	To the first portion add dilute sodium hydroxide dropwise until in excess. Warm the resulting mixture gently then strongly.	(2 marks)	(2 marks)
ii).	To the second portion add aqueous ammonia dropwise until in excess.		

		(1 mark)	(1 mark)

OCTOBER /NOVEMBER 1990

1. (24 marks)

You are provided with;

- *A monobasic acid **solid D***
- *Sodium hydroxide, solution **S1***
- *0.01 M solution S2 of a dibasic acid H_2A.*

You are required to:

(I) Prepare a saturated solution of **solid D**

(II) Standardize the sodium hydroxide solution **S1** using solution **S2**.

(III) Determine the solubility of **Solid D** in water at room temperature.

Procedure

(A) Place all the **solid D** provided into a dry conical flask. measure out 100cm^3 of distilled water using a measuring cylinder and add it to the **Solid D**. Shake thoroughly and leave it to stand.

(B) Fill a burette with **solution S1**. Pipette 25cm^3 of **solution S2** into a conical flask. Titrate with **Solution S1**. Using a phenolphthalein indicator record the readings in the table below. Repeat to obtain three accurate readings.

Table A

	Trial	1st	2nd	3rd
Final Burette reading				
Initial burette reading				
Titre (cm^3)				

Average titre =……cm^3

(Show the value s being averaged) (1 mark)

Calculations:

i). Write the equation for the reaction of the dibasic acid H_2A with sodium hydroxide…… (1 mark)

ii). Calculate the concentration of sodium hydroxide Solution **S1** in moles per litre…… …… (3 marks)

(C) Measure the temperature of the solution of **solid D**. Using **a dry filter** paper and **a dry filter** funnel. Filter the solution into **a dry conical** flask. Pipette 10cm^3 of the filtrate into a conical flask, add 25cm^3 of distilled water using a measuring cylinder. Shake well and then titrate with the sodium hydroxide **solution S1**, using phenolphthalein indicator.

Record the readings in the table below.
Repeat to obtain three accurate readings.

Temperature of solution of **Solid D** =……^{o} C (1 mark)

Table B.

	Trial	1st	2nd	3rd
Final burette reading				
Initial burette reading				
Titre (Cm^3)				

(6 marks)

Average titre=……
(Show the values being averaged) (1 mark)

Calculation;

i). Calculate the number of moles of **acid D** in $10cm^3$ of the filtrate, (1 mark)

ii). Calculate the number of moles of **acid D** in $100cm^3$ of solution of **acid D.** (1 mark)

iii). Given that the molecular formula of **acid D** is $C_7H_6O_2$, calculate the solubility of the acid in grammes per $100cm^3$ of water (C=2, H=1, O=16). (2 marks)

2. **(16marks)**

You are provided with a **solid Q**. Carry out the tests below and record your observations and inferences in the spaces provided on the table below. Test for any gas (es) produced.

Table

	Test	Observations	Inferences
a).	Place a spatula endful of Solid Q in a boiling tube and add about $20cm^3$ of distilled water. Shake well. Use about $2cm^3$ portions of the solution for the tests below	(1 mark)	(1 mark)
i).	Test the pH with a pH paper	(1 mark)	(1 mark)
ii)	Add a spatula endful of sodium hydrogen carbonate	(1 mark)	(1 mark)
iii).	Add two drops of potassium manganate (VII)solution	(1 mark)	(1 mark)
iv).	Add two drops of bromine water and warm the solution then shake it well	(1 mark)	(1 mark)
b).	Place a little of solid Q in a crucible (a crucible lid or a		

	metallic spatula) and ignite it.	(1 mark)	(1 mark)
c).	Place about $4cm^3$ of ethanol in a test tube, add two drops of concentrated sulphuric acid then add a spatula endful of Solid Q. Warm the mixture carefully. Shake well and pour the mixture into about $20cm^3$ of cold water in a boiling tube. Note any smell	(1 mark)	(1 mark)

OCTOBER / NOVEMBER 1992

1. (15 Marks)

You are provided with:

- *Solution C_2, Potassium iodate solution*
- *Solution C_3, acidified sodium hydrogen sulphite solution*
- *Solution C_4, starch indicator*
- *A stop watch/stop clock*

You are required to find out the effect of the concentration of potassium iodate, **C_2**, on the **rate** of reaction with acidified sodium hydrogen sulphite**, C_3**.

NB: *The end-point for the reaction of potassium iodate with acidified sodium hydrogen sulphite is detected by the formation of a blue- coloured complex using starch indicator.*

Procedure

a). Place solution **C_2** in a burette and measure out the volumes of **C_2** shown in table 1 into six dry test-tubes. Using a $10cm^3$ measuring cylinder, add distilled water to the test-tubes as shown in table 1.

Test-tube	Volume of **C_2** and water
i).	$10cm^3$ of **C_2** +0 cm^3 distilled water
ii).	$8cm^3$ of **C_2** + 2 cm^3 distilled water
iii).	$6cm^3$ of **C_2** + $4cm^3$ distilled water
iv).	$4cm^3$ of **C_2** + 6 cm^3 distilled water
v).	$3cm^3$ of **C_2** + 7 cm^3 distilled water
vi).	$2cm^3$ of **C_2** + 8 cm^3 distilled water

b). Using a clean $10cm^3$ measuring cylinder, place $10cm^3$ of solution **C_3** into a $100cm^3$ beaker, add 3 drops of solution **C_4** and shake well. To this mixture add quickly the contents of test-tube (i) and start the stop watch/stop clock immediately. Shake the mixture and note the time taken (in seconds) for the blue colour to appear.

Record the time in Table II
Repeat this procedure using the other solutions prepared in (a) above and complete Table II

TABLE II.

Volume of C_3 (cm^3)	Volume of C_4 (drops)	Volume of C (cm^3)	Volume of distilled water (cm^3)	Time taken for blue colour to appear (seconds)
10	3	10	0	
10	3	8	2	
10	3	6	4	
10	3	4	6	
10	3	3	7	
10	3	2	8	

(6 Marks)

c). On the grid below plot a graph of volume (vertical axes) of solution C_2 used versus time. (5 Marks)

d). From your graph determine the time taken for the blue colour to appear using a mixture of $7cm^3$ of C_2 and $3cm^3$ of distilled water. (2 marks)

e). How does the concentration of potassium iodate, C_2, affect its rate of reaction with acidified sodium hydrogen sulphite, C_3? Explain your answer. (2 marks)

2. (15 marks)

You are provided with:

- *Solution C5, 0.11M hydrochloric acid*
- *Solution C6, containing 19.2g/l of basic compound $Na_2B_4O_7.nH_2O$*

You are required to determine the value of n in compound C_6 $Na_2B_4O_7.nH_2O$.

Procedure

a). Place solution C_5 in the burette. Pipette $25.0cm^3$ (or $20.0cm^3$) of C_6 into a $250cm^3$ conical flask and titrate using methyl orange indicator. Record your results in Table III below and repeat the titration carefully to achieve consistent results

Volume of pipette……..cm^3
Burette readings

Table III

Titration number	I	II	III
Final reading (cm^3)	28.5		
Initial reading (cm^3)	00.00		
Volume of C_4 use (cm^3)	28.5		

(5 marks)

Average volume of C_5 used = ……..cm^3 (1 mark)

b). **Calculations;**

Given that the ionic equation for the reaction is

$B_4O_7^{2-}{}_{(aq)} + 2H^+{}_{(aq)} + 5H_2O_{(l)} \longrightarrow 4H_3BO_{3(aq)}$

(1 mole of the base reacts with two moles of the acid)

i). Calculate the concentration of C6 in moles per litre. (4 marks)

ii). Calculate the relative molecular mass of the basic compound C_6. (2 marks)

iii). Calculate the value of **n** in the formula $Na_2B_4O_7nH_2O$
(B=10.8, H=1.0, Na=23.0, and O = 16.0). (3 marks)

3. **(10 marks).**

You are provided with solid C7. Carry out the following tests and record your Observations and inferences in the spaces provided in table IV.

Table IV

	Test	Observations	Inferences
a).	Place a little of solid C_7 in a dry test-tube and heat gently.	(1 mark)	(1 mark)
b).	Place the remainder of the solid C_7 in a boiling tube. Add about 10cm^3 of distilled water and shake well to dissolve the solid. Divide the solution into four positions for tests (i) to (iv) below	(½ mark)	(1 mark)
i).	To the first portion add a few drops of dilute sulphuric acid.	(½ mark)	(1 mark)
ii).	To the second portion add dropwise aqueous sodium hydroxide until in excess	(½ mark)	(1 mark)
iii).	To the third portion add one to two drops of aqueous lead nitrate	(½ mark)	(1 mark)
iv).	To the fourth portion add a few drops of barium chloride solution	(½ mark)	(1 ½ marks)

OCTOBER /NOVEMBER 1993

1. (26 MARKS)

You are provided with:

- *Sodium hydroxide, solution A*
- *1.0 g of an ammonium salt, solid B*
- *0.01M monobasic acid, solution C*

You are required to:

- Dilute solution **A** with distilled water,
- Standardize the diluted solution **A** with solution C
- Determine the relative formula mass of the ammonium salt **B**

Procedure I

Pipette 25cm$^{3\ of}$ solution **A** into a 250cm^3 conical flask, measure 175cm^3 of Distilled water using 100cm^3 measuring cylinder and add it to solution **A** in the beaker. Shake well. Label this as solution D. Pipette 25cm^3 of solution **D** into a 250cm^3 conical flask and then titrate with solution **C** using 1 or 2 drops of Phenolphthalein indicator. Record your results in table I below. Repeat the procedure to obtain accurate values.

Table I

Table I	1st	2nd	3rd
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution C used (cm^3)			

Calculations:

a). Determine the average volume of solution C used. (1 mark)

b) Calculate the concentration in moles per litre, of sodium hydroxide in solution D. (1 mark)

c). Calculate the concentration, in moles per litre of sodium hydroxide in solution A. (1 mark)

In the process described below, sodium hydroxide reacts with the ammonium Salt B and on boiling the mixture, ammonia gas is expelled. The excess sodium hydroxide is then determined by titrating the monobasic acid, solution C.

Procedure II

Place all the 1.0g of ammonium salt, solid **B** into 250cm^3 conical flask. Pipette 25cm^3 of the sodium hydroxide solution **A** into the conical flask containing solid **B**. Shake well until all the solid dissolve. Heat the mixture and let it boil for about 10 minutes. Add 50 cm^3 of distilled water to the boiled mixture and shake well. Transfer the solution into a 100cm^3 measuring cylinder then add distilled water up to the 100cm^3 mark. Pour this solution back into the conical flask and label it as solution **E**. Pipette 25cm^3 of solution **E** into a 250 cm^3 conical flask and titrate with solution **C** using 1 or 2 drops phenolphthalein indicator. Record the results in the **table II** below. Repeat the procedure to obtain accurate value and complete **Table II**

Table I	1st	2nd	3rd
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution C used (cm^3)			

Calculations:

a). Determine the average volume of **C** used. (1 mark)

b). Calculate:

i) The number of moles of the monobasic acid, Solution **C**, used (2 marks)

ii). The number of moles of hydroxide in 25cm^3 of solution **E**. (1 mark)

iii). The number of moles of sodium hydroxide in 100cm^3 of solution **E**. (1 mark)

c). Using concentration of sodium hydroxide solution, obtained in (e) above calculate the moles of sodium hydroxide in 25cm^3 of solution **A** (this gives the number of moles of sodium hydroxide added to the ammonium salt **B**) (2 marks)

d). Using the values obtained in *(e)* (iii) and *(f)* above determine the number of moles sodium hydroxide that reacted with the ammonium salt. (2 marks)

e). Given that one mole of sodium hydroxide reacts with one mole of the ammonium Salt **B**, what is the number of moles of salted in 1.0g of Solid **B**. (2 marks)

f). Calculate the relative formula of mass of the ammonium salt. (2 marks)

2. (14 marks)

You are provided with solid **F**. You are required to carry out the tests below and write your observation and inferences in the spaces provided. Identify the gas or gases produced.

Table

	Test	Observations	Inferences
	Place all the solid **F** provided into a boiling tube and add distilled water with shaking until the boiling tube is half full. Use about 3cm^3 portions of the solution for tests *(a)* to *(d)* below.	(1 mark)	(1 mark)
a)	To the 1st portion add sodium hydroxide solution drop wise until in excess	(1 mark)	(1 mark)
b)	To the 2nd portion add about six drops of barium chloride solution	(1 mark)	(1 mark)
c)	To the 3rd portion add three drops of iodine solution	(1 mark)	(1 mark)
d)	Dip one end of the filter paper strip provided into potassium dichromate solution and remove it. To the 4th portion add about 1cm^3 of dilute hydrochloric acid, shake well, and observe for about 2 minutes. Place the dipped end of the filter paper at the mouth of the test tube and warm the contents of the test tube gently.	(3 marks)	(3 marks)

OCTOBER / NOVEMBER 1994

1. You are provided with:

- 0*.2M sodium hydroxide, solution* **D**
- *0.1M solution of a carboxylic acid C_3H_5O (COOH) n solution* **E**

You are required to determine the value of n in the formula C_3H_5O (COOH)n of the carboxylic acid E

Procedure

a). Place solution **D** in the burette. Pipette 25.0cm^3 (or 20.0cm^3) of solution E into a conical flask and titrate with solution **D** using phenolphthalein indicator. Record your

results in **table I** below and repeat the titration to achieve consistent results.

Results

Volume of pipette ……cm^3

Table I

Burette readings

Titration number	I	II	III
Final reading (cm^3)			
Initial reading (cm^3)			
Volume of D used (cm^3)			

4 marks

b). Average volume of D……
(Show how you arrive at your answer)

c). Calculate the number of moles of sodium hydroxide used. 2 marks

d). Calculate the number of moles of E in the 25.0cm^3 (or 20.0cm^3) used

2 marks

e). i). Calculate the number of moles of sodium hydroxide required to react with one mole of $C_3H_5O(COOH)_n$ 3 marks

ii). What is the value of n 1 mark

2. **You are provided with;**

1.0M Sodium hydroxide solution F

0.63M solution of an acid solution G

You are required to determine the molar heat of neutralization of sodium hydroxide with acid **G.**

Procedure

a). Place six test-tubes on a test-tube rack. Using a 10cm^3 measuring cylinder, measure 5cm^3 portions of solution **G** and place them into each of the six test-tubes.

Measure 25.0cm^3 of solution **F** using a measuring cylinder and place it into a 100cm^3 beaker. Measure the temperature of this solution F to the nearest 0.5^{0}C and record it in **table II.**

Pour the first portion of the 5cm^3 of solution **G** from the test-tube into the beaker containing 25cm^3 of solution **F**, stir the mixture carefully and record the highest temperature of the mixture in **table II.**

Pour the second portion of solution **G immediately** into the mixture in the beaker, stir carefully and record the highest temperature of this mixture in **Table II**. Continue this procedure using the remaining portions of solution G to Complete **table II.**

Table II

Total volume of G added (cm^3)	0	5	10	15	20	25	30

Volume of F (cm^3)	25	25	25	25	25	25	25
Temperature (^0C)							

4 marks

b). On the grid provided below, plot a graph of temperature (vertical axes) versus volume of solution G added 4 marks

c). From the graph determine:

i). The volume of the solution G required to neutralize $25cm^3$ sodium hydroxide solution F 1 mark

ii). The highest temperature change, ΔT, 1 mark

d). Calculate the heat change for the reaction. (Heat change = mass x temperature change x $4.2Jg^{-1}\ ^0C^{-1}$. Assume density of each solution to be $1gm\ cm^{-3}$) 2 marks

e). Calculate the number of moles of sodium hydroxide, solution F, used. 1 mark

f). Calculate the molar heat of neutralization of the sodium hydroxide solution F. 1 mark

3. a). You are provided with the following solids:
Sodium chloride, potassium chloride, calcium chloride and solid H
Note: Solid H will also be required for Question 3 (b)

You are required to carry out flame tests on the above solids to identify the flame colour of the **cations** present in each of them.

Procedure:
Clean a metallic spatula and rinse it with distilled water. Dry the spatula on a Bunsen flame for about 1 minute. Allow it to cool. Place a little of sodium chloride solid of the flame as the solid burns and record it in **Table III** below. Clean the spatula thoroughly using steel wool, and repeat the procedure using each of the other solids and complete the **Table III.**

i). **Table III**

Solid	Colour of flame
Sodium chloride	
Potassium chloride	
Calcium chloride	
Solid H	

4 marks

ii). What cation is present in solid H? 1 mark

b). You are provided with solid H. Carry out the tests in table IV below and record your observations and inferences in the spaces provided. Identify

any gas (es) produced.

Table IV

	Test	Observation	Inferences
i).	Place a little of solid H in a dry test-tube and heat strongly	(1 mark)	(1 mark)
ii).	Place the remainder of the solid H in a boiling tube. Add about $10cm^3$ of distilled water and shake well. Divide the mixture into three portions for tests (I to III) below		
	I. To the first portion add aqueous sodium hydroxide until in excess	(1 mark)	(1 mark)
	II. To the second portion add aqueous ammonia until in excess	(1 mark)	(1 mark)
	III. To the third portion add about $1cm^3$ aqueous sodium chloride	(1 mark)	(1 mark)

October /November 1995

1. (22 Marks).

You are provided with

- *2.0g of potassium hydrogen carbonate solid J*
- *1.0g of magnesium carbonate, solid K*
- *2.0M Hydrochloric acid*

You are required to determine the enthalpy change for the reaction between

a). Potassium hydrogen carbonate and hydrochloric acid
b). Magnesium carbonate and hydrochloric acid
c). Aqueous magnesium chloride and aqueous potassium hydrogen carbonate.

Procedure

1. By means of a burette place $15.0cm^3$ of the 2.0M hydrochloric acid in a $100cm^3$ beaker. Stir gently and take the temperature of the acid at every half-minute. Record your readings in table 1. at exactly 2½ minutes add all solid J to the acid, stir gently and continue taking the temperature every half-minute 5 record your

readings in table I.

Table

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	5
Temperature (0^C)											

On the grid provided plot a graph of temperature against time and determine from it the fall in temperature ΔT_1. Show the change ΔT_1 on the graph (3 marks)

Fall in temperature ΔT_1 (1 mark)

Calculations; use the following information where necessary
(H=1, C=12, O=16, Mg=24, k=39) Assume density of the solutions to be $1.0gcm^3$

a). **Calculate;**

i). The number of moles, n_1, of potassium hydrogen carbonate ($KHCO_3$) used during procedure I (1 mark)

ii). The enthalpy, change ΔH_2 for the reaction between potassium hydrogen carbonate and hydrochloric acid. Show the sign. Use the following expression (2 marks)

$$\Delta H_1 = \frac{\text{Mass of solution} \times 4.2 \times \Delta T_1}{n_1 \times 1000} \quad Kjmol^{-1}$$

b). Calculate;

i). The number of moles N_2, of magnesium carbonate ($MgCO_3$) used in procedure II (1 mark)

ii). The enthalpy change ΔH_2, for the reaction between magnesium carbonate and hydrochloric acid. Show the sign. Use the following expression.

$$\Delta H_2 = \frac{\text{Mass of solution} \times 4.2 \times \Delta T_2}{n_2 \times 1000} \ Kjmol^{-1}$$

(2 marks)

c). The equations for the reactions taking place in procedures I and II are;

$KHCO_{3(s)} + HCl_{(aq)} \longrightarrow KCl_{(aq)} + CO_{2(q)} + H_2O_{(l)}$

and $MgCO_{4(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2\,(aq)} + CO_{2(q)} + H_2O_{(l)}$

Given that the enthalpy change, ΔH_3 for the process.
$KHCO_{3\,(s)} \longrightarrow KHCO_{3(aq)}$ = 121 $kjmol^{-1}$ determine the Enthalpy change ΔH_4 for the reaction represented by the equation

$MgCl_{2(aq)} + 2KHCO_{3(aq)} \longrightarrow MgCO_{3(s)} + 2KCl_{(aq)} + H_2O_{(l)} + CO_{2(g)}$

Use the following expression
$\Delta H_4 = 2\Delta H_1 - \Delta H_2 - 2\Delta H_3$ (2 marks)

2. ***(9 Marks)***

You are provided with solid L. You are required to carry out the tests below and write your observations and inferences in the spaces provided.

Identify any gases evolved

a). Describe the appearance of solid L (1 mark)

b). Place a little of solid L, in a dry clean test tube and heat strongly

Observations	Inferences

(1 mark)

c). Place a little L in a dry clean test tube then add about $2cm^3$ of distilled water. Shake well then warm the mixture

Observations	Inferences

(1 mark)

d). Place a little solid L in a dry clean test tube then add about $2cm^3$ of dilute hydrochloric acid

Observations	inferences

(1 mark)

e). place about $2cm^3$ of lead nitrate solution in a clean test tube, add a little of solid L Shake well and allow to settle for about 5 minutes

Observations	Inferences

(1 mark)

3. *(9 marks)*

You are provided with solid N. You are required to carry out the tests below and record your observations and inferences in the spaces provided. Identify any gases evolved using a glowing splint and litmus paper

a). Describe the appearance of Solid N. (1 mark)

b). Place a little of Solid N on a clean metallic spatula and burn it in a Bunsen flame (1 mark)

c). Place a little of Solid N in a dry clean test tube and heat strongly

Observations	inferences
	(1 mark)

d). Place the remaining solid N in a boiling tube and add about $20cm^3$ of distilled water. Shake well until all the solid dissolves. Use about $2cm^3$ portions of this solution for the tests below.

i). Test the 1st portion with red and blue litmus papers

Observations	Inferences
	(1 mark)

ii). To the 2nd portion add a few drops of dilute sodium hydroxide shake well after every drop

Observations	Inferences
	(1 mark)

iii). To the 3rd portion add a few drops of dilute lead nitrate. Shake well after every drop

Observations	Inferences
	(1 mark)

iv). To the 4th portion add about $1cm^3$ of dilute sodium hydroxide followed by a small piece of aluminium foil. Warm the mixture gently and carefully

Observations	Inferences
	(1 mark)

OCTOBER /NOVEMBER 1996

1. You are provided with:

- Acidified aqueous potassium manganate (VII) $KMnO_4$, solution A.
- Solution **B**, containing 23.5g of ammonium Iron (II) Sulphate $(NH_4)_2Fe(SO_4)_2 6H_2O$, per litre.
- Solution **C**, Containing 5.0g of a dibasic acid, $H_2X\ 2H_2O$, per litre

You are required to:

- Standardize the potassium manganate (VII), solution A, using the ammonium iron (II) sulphate, solution **B.**
- Use the standardized potassium manganate (VII), solution A, to determine the concentration of the dibasic acid, $H_2X\ 2H_2O$, solution **C** and then the formula mass of **X.**

Procedure I:

Fill the burette with solution A.
Pipette 25.0cm^3 of solution B into a conical flask. Titrate solution **B** with solution A until a permanent pink colour just appears. Record your results in table I below. Repeat this procedure to complete table I.

a). **Table I**

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

4 marks

b). Record average volume of solution A used, V1……cm^3
(Show how you arrive at your answer) 1 mark

c). Calculate the concentration of the ammonium iron (II) sulphate, solution B, in moles per litre. (RFM of $(NH_4)2\ Fe\ (SO_4)_2\ .6H_2O$ = 392 1 mark

d). Calculate the number of moles of iron (II) ions in the 25.0cm^3 of solution B
1 mark

e). Using the ionic equation for the reaction between manganate (VII) and iron (II) ions, given below, calculate the concentration of manganate (VII) ions in solution A in moles per litre.

$$MnO_{4(aq)} + 5Fe^{2+}_{(aq)} + 8H^{+}_{(aq)} \longrightarrow Mn^{2+}_{(aq)} + 5Fe^{3+}_{(aq)} + 4H_2O_{(l)}$$

Procedure II
Pipette 25.0cm^3 of solution **C** into a conical flask. Heat this solution to about 70^0C and titrate the hot solution **C** with solution **A** until a permanent pink colour just appears. Shake the thoroughly during the titration. Record your results in **table II.** Repeat this procedure to complete **Table II.**

f). **Table II.**

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

4 marks

g). Record average volume of solution A used V_2=…….. cm^3
Show how you arrive at your answer.

h). Calculate the number of moles of the manganate (VII) ions in volume V_2
1 mark

i). Given that 2 moles of the manganate (VII) ions react with 5 moles of the dibasic acid, $H_2X.\ 2H_2O$, calculate the number of moles of the dibasic acid, $H_2X\ 2H_2O$, in the $25cm^3$ of solution C. 2 marks

j). Calculate the concentration of the dibasic acid, $H_2X.\ 2H_2O$ in moles per litre 1 mark

k). Calculate the formula mass of x in the dibasic acid $H_2X.\ 2H_2O$
(H = 1.0 O=16.0) 3 marks

2. **(8 marks)** You are provided with solid D. Carry out the tests below.
Record observations and inferences in the table. Identify any gas (es) evolved.

Divide solid D into portions

a). i). To one portion of D in a dry test-tube add about $1cm^3$ of 6M hydrochloric acid and warm gently for about one minute

Observation s	Inferences
2 marks	1 mark

ii). Add distilled water to the mixture in (a) (i) above until the test-tube is about half-full. Shake well and filter into a boiling tube. To about $1cm^3$ of the filtrate in a test-tube add about $1cm^3$ of 2M sodium hydroxide drop wise

Observations 2 marks

b). Place the remaining portion of D in a dry test-tube and about $1cm^3$ of 20 volume hydrogen peroxide

Observations	Inferences
1 mark	2 marks

3. **(11marks)** You are provided with solid E. Carry out the tests below and record the observations and inferences in the spaces provided. Identify any gas (es) produced.

a). Place a little of E on a clean metallic spatula and ignite with a bunsen flame.

Observations	inferences

1 mark	1 mark

b). Add a little of solid E to about $2cm^3$ of distilled water in a test-tube and shake well. Test the mixture with litmus paper.

Observations	inferences
2 marks	1 mark

c). Add a little of solid E to about $2cm^3$ of 2M aqueous sodium hydroxide in a test-tube and shake well

Observations	inferences
1 mark	1 mark

d). Place the remaining portion of E in a boiling tube, add about $10cm^3$ of distilled water and heat the mixture. Divide the mixture, while still hot, into two portions:

i). Add a little of solid sodium hydrogen carbonate to the first portion

Observations	inferences
1 mark	1 mark

ii). Add about 2-3 drops of concentrated sulphuric acid to the second portion. Shake well, and then add about $1cm^3$ of ethanol. Warm the mixture.

Observations	inferences
1 mark	1 mark

OCTOBER /NOVEMBER 1997

1. You are provided with;
   - *Sulphuric acid, solution F*
   - *0.5M sodium hydroxide, solution G*
   - *Magnesium turnings, solid H*

   You are required to determine the concentration of sulphuric acid in moles per litre

Procedure I

Measure $50cm^3$ of solution **F** using a measuring cylinder and place it in a 100 cm^3 beaker. Stir the solution gently with a thermometer and take its temperature after every half-minute. Record your results in **Table I.**

After one and half minutes, add all of solid **H** at once. Stir the mixture gently with the thermometer and record the temperature of the mixture after every half-minute in table **I**

up to the sixth minute. Keep the solution for use in procedure **II**

a). Table I

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	5	5 ½	6
Temperature (^{0}C)													

(5 marks)

b). Using the results in table I, determine the highest change in temperature, ΔT for the reaction
ΔT……. (1 mark)

c). Calculate the heat change for the reaction using the expression
Heat change = Mass of solution x 4.2 x ΔT Joules
(Assume density of solution = 1.0g/cm^3) (3 marks)

d). Given that the molar heat of reaction of sulphuric acid with solid H is 323KJ mol^{-1}, calculate the number of moles of sulphuric acid that were used during the reaction (2 marks)

Procedure II

Place **all** the solution obtained in procedure **I** in a clean **100m^3 measuring cylinder.** Add distilled water to make 100cm^3 of solution. Transfer all the solution. Transfer all the solution into a beaker and shake well. The resulting solution is 'solution **K'**.

Fill a burette with solution **G**. Pipette 25.0cm^3 of solution **K** into a conical flask. Add 2- 3 drops of phenolphthalein indicator and titrate with solution **G**. Record your results in table II. Repeat the titration two more times.

Table II.

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

(6 marks)

e). Determine the average volume of solution **G** used (1 mark)

f). Calculate the number of moles of sodium hydroxide, solution **G** that were used. (2 marks)

g). Determine;

i). The number of moles of sulphuric acid in 25.0cm^3 of solution **K.** (1 mark)

ii). The number of moles of sulphuric acid in 100cm^3 of solution K. (1 mark)

iii). Using the results from (d) and g (ii) above, calculate the total number of moles of sulphuric acid in $50cm^3$ of solution F.
(1 mark)

2. You are provided with solid L. Carry out the tests below. Write your observations and inferences in the spaces provided.

a).	Place all of solid **L** in a dry test-tube and heat it until it just turns reddish-yellow at the bottom. Test the gas with a glowing wooden splint. Keep the residue for tests in (b) Observations inferences (2 marks)
b). i).	Allow the residue from (a) above to cool for about three minutes. Add 5-6 drops of concentrated nitric acid, then add distilled water until the test-tube is three quarters full. Filter the mixture into a boiling tube then add more distilled water to the filtrate until the boiling tube is half-full. Shake well. Use the solution obtained for the tests below Observations (1 mark)
ii).	To about $2cm^3$ portion of the solution in a test-tube, add 2M of sodium hydroxide dropwise until in excess Observations inferences (3 marks)
iii).	To another $2cm^3$ of the solution in a test-tube, add aqueous ammonia dropwise until in excess Observations Inference (2 marks)
iv).	To a third $2cm^3$ of the solution, add a few drops of 2M sulphuric acid Observations Inferences 1mark 1 mark

3. You are provided with an organic compound, solid **M**. Carry out the tests below. Write your observations and inferences in the spaces provided

Place all solid M in a boiling tube. Add distilled water until the boiling tube is half-full. Shake the mixture thoroughly until all the solid dissolves. Use the solution for the tests below.

a).	To about $2cm^3$ portion of the solution in a test-tube, add 2-3 drops of

	acidified potassium permanganate then warm gently Observations | Inferences (3 marks)
b).	To another $2cm^3$ portion of the solution, in a test-tube, add two drops of 1% bromine water and warm Observations | Inferences (2 marks)
c).	To a third $2cm^3$ portion of the solution in a test-tube, add half-spatula end full of sodium carbonate Observations | Inferences (2 marks)

OCTOBER /NOVEMBER 1998

1. ***(20 marks)*** **You are provided with:**

- Solution M, hydrochloric acid
- Solution N, containing 8.8g per litre of sodium hydroxide
- 0.5g of an impure carbonate, solid P

You are required to determine the:

a). Concentration of solution M in moles per litre
b). Percentage purity of the carbonate, solid P.

Procedure I.

Fill the burette with sodium hydroxide, solution N. Pipette $25.0cm^3$ of hydrochloric acid, solution M into a conical flask. Add 2-3 drops of screened methyl orange indicator and titrate. (The colour of the indicator changes from pink to green) record your results in table I below. Repeat the titration two more times and complete the table.

Table	1	2	3
Final burette reading			
Initial burette reading			
Volume of solution N used (cm^3)			

(4 marks)

What is the average volume of solution N used? (1 mark)
Determine;

a). The concentration of solution N in moles per litre. (Na=23.0, O=16.0, H=1.0) (1 mark)

b). Concentration of solution M in moles per litre (1 mark)

Procedure II

Using a measuring cylinder, measure out 100cm^3 of solution M into a 250cm^3 beaker. Add all of solid P into the beaker containing solution M. Swirl the mixture and allow the reaction to proceed for about 4 minutes.
Label the solution with sodium hydroxide, solution N. Pipette 25.0cm^3 of solution Q into a conical flask. Add 2-3 drops of screened methyl orange indicator and titrate. Record your results in table II below. Repeat the titration two more times and complete the table.

Table II	1	2	3
Final burette reading			
Initial burette reading			
Volume of solution N (cm^3)			

(4 marks)

What is the average volume of solution N Used?

a). Calculate the:
- i). Moles of hydrochloric acid in 25.0cm^3 of solution Q (2 marks)
- ii). Moles of hydrochloric acid in 100cm^3 of solution Q (1 mark)
- iii). Moles of hydrochloric acid in 100cm^3 of the original hydrochloric acid solution M. (1mark)
- iv). Moles of hydrochloric acid that were used up in the reaction with solid P. (1 mark)
- v). Moles of the carbonate that reacted with hydrochloric acid (1 mark)

b). Given that the relative formula mass of the carbonate is 72, calculate the;
- i). Mass of the carbonate that reacted (1 mark)
- ii). Percentage purity of the carbonate, solid P (1 mark)

2. ***(12 marks)***

You are provided with solid S. Carry out the tests below and record your observations and inferences in the spaces provided.

a). Place about one third of solid S in a dry test-tube. Heat the solid gently and then strongly. Test any gases produced with red and blue litmus papers.

Observations	Inferences
(2 marks)	(1 mark)

b). Dissolve the remaining portion of solid S in 8cm^3 of distilled water. Divide the solution into four portions.
- i). To the first portion, add aqueous sodium hydroxide dropwise until

in excess

Observations | Inferences

(1 mark) | (2 marks)

ii). To the second portion, add aqueous ammonia dropwise until in excess

Observations | Inferences

(1 mark) | (1 mark)

iii). To the third portion, add 10cm^3 of barium chloride solution.

Observations | Inferences

(1 mark) | (1 mark)

iv). To the fourth portion, add 1 cm^3 of lead (II) nitrate solution.

Observations | Inferences

(1 mark) | (1 mark)

3. ***(8 marks)***

You are provided with solid L. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Place about half of solid L in a dry test-tube and heat it strongly. Test any gases produced with red and blue litmus papers and also with a burning splint.

Observations	Inferences
(2 marks)	(1 mark)

b) Place the rest of solid L in a boiling tube and add about 10cm^3 of distilled water. Shake well to dissolve all the solid.

i). To about 1cm^3 of the solution, add 3 drops of universal indicator solution and find its pH

Observations	Inferences
(1 mark)	(1 mark)

ii). To the rest of the solution, add about 5cm^3 of 2M dilute hydrochloric acid dropwise. Filter the mixture and retain the residue for test(c) below.

Observations	Inferences
	(1 mark)

c). Transfer the residue from b (ii) above into a boiling tube. Add about 10cm^3 of distilled water. Warm the mixture and add a little solid sodium carbonate

Observations | Inferences

(1 mark) (1 mark)

OCTOBER / NOVEMBER 1999

1. You are provided with:

- *Solution **E** 0.099M hydrochloric acid*
- *Solution **F** containing 15.3g per litre of a basic compound,*
- *$G_2X10H_2O \rightarrow 14.3gNa_2CO_310H_2O$*

You are required to determine the relative atomic mass of G.

Procedure:

Place solution **E** in a burette.

Pipette 25cm^3 of solution **F** into a 250cm^3 conical flask. Add two 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).

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

(3 marks)

Table I

ii). What is the average volume of solution **E**?

b). Given that one mole of **F** reacts with 2 moles of **E**. Calculate the:

i). Number of moles of the basic compound, $G_2X.10H_2O$ in the volume of solution F used.

ii). Concentration of solution F in moles per litre.

iii). Relative formula mass of the basic compound, G_2X10H_2O.

iv). Relative atomic mass of G. (relative formula masses of X= 60 atomic masses of H=10, O=16.0)

2. **You are provided with:**
   - *Magnesium ribbon labeled solid **K***
   - *2.0M hydrochloric acid labeled solution **L***
   - *Stop clock /watch*

   You are required to determine the rate of reaction between magnesium and hydrochloric acid at different concentrations

Procedure.

1. Place the five test tube on the test tube rack and label them 1,2,3,4,and 5. Using a $10cm^3$ measuring cylinder ,measure out the volumes of 2.0M hydrochloric acid shown, solution **L** as shown in table II and pour them into the corresponding test tube. Wash the measuring cylinder and use it to measure the volumes of water as indicated in the table and pour into the corresponding test tubes.
2. Cut out five pieces each of exactly 1cm length of magnesium ribbon.
3. Transfer all the solution in the test tube 1 into a clean $100cm^3$ beaker. Place one piece of magnesium into the beaker and start a stop clock/watch immediately. Swirl the beaker continuously ensuring that the magnesium is always inside the solution. Record in the table the time taken for the magnesium ribbon to disappear. Wash the beaker each time.

4. Repeat procedure III for each of the solutions in the test-tube 2, 3, 4 and 5 and complete the table.

a).

Test-tube Number	1	2	3	4	5
Volume of solution L (cm^3)	10	9	8	7	6
Volume of water (cm^3)	0	1	2	3	4
Time taken (sec)					
Rate of reaction = $^1/_{time}$					

Table II

b). i). Plot a graph of rate of reaction $^1/_{time}$ (y-axis) against volume of solution L (3 marks)

ii). Use the graph to determine the time that would be taken for a 1cm length of magnesium ribbon to disappear if the volume of the acid was $7.5cm^3$ (2 marks)

iii). In terms of rate of reaction, explain the shape of your graph. (1 ½ marks)

3. You are provided with solid H. Carry out the tests below and write your observation an d inferences in the spaces provided.

a). Place about half of the solid H in a clean dry test tube. Heat the solid gently and then strongly. Test for any gas produced using both blue and red litmus papers

Observations Inferences

(4½ marks)

b). Dissolve the remaining portion of Solid H in about 8cm^3 of distilled water contained in a boiling tube. Divide the solution into three portions.

i). To the first portion ,add aqueous sodium hydroxide drop wise until in excess.

Observations Inferences

(2½ marks)

ii). To the second portion, add two drops of concentrated nitric acid then add aqueous sodium hydroxide drop wise until in excess

Observations Inferences

(1½ marks)

iii). I. To the third portion, add 2-3 drops of barium chloride solution

Observations Inferences

(1½ marks)

II. To the mixture obtained in (iii) I above, add about 2cm^3 of 2M aqueous hydrochloric acid.

Observations Inferences

(2 marks)

OCTOBER / NOVEMBER 2000

1. You are provided with:

- *Solution* **L** *containing 5.6g per litre of anhydrous sodium carbonate*
- *Solution* **M***: Hydrochloric acid*
- *Phenolphthalein indicator*
- *Methyl orange indicator*

You are required to standardize the hydrochloric acid, solution **M**.

Procedure

Fill the burette with solution **M**. Pipette 25cm^3 of solution **L** into a conical flask. Add three drops of phenolphthalein indicator and titrate with solution M. Record the readings

in **table I** below. Add 3 drops of methyl orange indicator to the contents of the conical flask and continue titrating with solution M. Record the readings in **table II** below. Repeat the procedure and complete **tables I** and **II**.

a). i). **Table I** (Using phenolphthalein indicator)

	1st	2nd
Final burette reading		
Initial burette reading		
Titre (cm^3)		

(3 marks)

Find average titre t_1 (½ mark)

……..

Table II (Using methyl orange indicator)

	1st	2nd
Final burette reading		
Initial burette reading		
Titre (cm^3)		

(3 marks)

Find average titre t_2 (½ mark)

……..

ii). Total volume of solution M used = $t_1 + t_2$ = …….

(1 mark)

iii). Calculate the:

I Concentration of sodium carbonate in moles per litre (Relative formula mass of Na_2CO_3 = 106) (2marks)

II Moles of sodium carbonate in $25cm^3$ of solution (1 mark)

III Moles of hydrochloric acid in the total volume of solution M used. (1 mark)

IV Concentration of hydrochloric acid in moles per litre. (2 marks)

2. You are provided with 3.0g of Potassium nitrate labeled solid **G**. You are required to determine the enthalpy of solution of solid **G**.

Procedure

Using a measuring cylinder, place $30cm^3$ of distilled water into a $100cm^3$ beaker. Stir the

water gently with a thermometer and take its temperature after every half minute. Record the readings in table III below. At exactly two minutes, add all solid **G** to the water at once. Stir well and take the temperature of the mixture after every half minute up to the fourth minute

Record your results in **table III.**

Table III

a).

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4
Temperature (^{0}C)									

(3marks)

b). On the grid provided, plot a graph of time against temperature

c). On the graph, show the change in temperature, ΔT (1 mark)

Calculate:

i). The number of moles of solid G used in the experiment.
(K=39.0, N=14.0, O=16.0) (1 mark)

ii). The enthalpy of solution, ΔH_{soln} and show the sign of ΔH_{soln}
(Assume density of solution = 1.0g/cm^3
Specific heat capacity of solution = 4.2jg^{-1} k^{-1}) (3 marks)

3. You are provided with 10 cm^3 of solution **P** in a conical flask. Solution **P** contains two cations and one anion. Carry out the test below and record your observations and inferences in the spaces provided.

a). Add 20cm^3 of 2M aqueous sodium hydroxide to all solution **P** provided. Shake well. Filter the mixture into a conical flask. Retain both the filtrate and the residue.

Observations (2 marks) Inferences (1 mark)

b). i). To about 2cm^3 of the filtrate, add 2M nitric acid dropwise until in excess (i.e. about 1cm^3 of the acid). Retain the mixture.

Observations (2 marks) Inferences (1 mark)

Divide the mixture in (b) (i) above into two portions

ii). To the first portion, add aqueous sodium hydroxide dropwise until in excess

Observations (2 marks) Inferences (2 marks)

iii). To the second portion, add aqueous ammonia dropwise until the excess (i.e. about 1.5cm^3 of aqueous ammonia)

Observations (1 mark) Inferences (1 mark)

c). To 2cm^3 of the filtrate, add 3 drops of 2M hydrochloric acid.
Observations (1 mark) Inferences (1 mark)

d). To 2cm^3 of the filtrate, add 3 drops of acidified chloride acid.
Observations (1 mark) Inferences (1 mark)

e). To the residue, add about 5cm^3 of dilute nitric acid and allow it to filter into a test-tube. To 2cm^3 of this filtrate, add aqueous ammonia dropwise until in the excess then filter into a clean test-tube.
Observations (1 mark) Inferences (1 mark)

OCTOBER / NOVEMBER 2001

1. You are provided with:

- *Sodium hydroxide labeled solution **A***
- *0.128M hydrochloric acid labeled solution **B**.*
- *Carboxylic acid labeled solution **C**.*

Solution **D** prepared by diluting 25cm^3 of solution A with distilled water to 150cm^3 of solution. You are required to:

a). Standardise solution **D** with solution **B**

b). Determine the:

i). Reaction ratio between sodium hydroxide, solution A and the carboxylic acid solution **C**

ii). Concentration of solution **C** in moles per litre.

Procedure I

Fill a burette with solution B. Pipette 25cm^3 of solution D into a 250cm^3 conical flask. Add 2 drops of phenolphthalein indicator and titrate with solution **B**. Record your results in table 1. Repeat the titration two more times and complete the table.

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

(4 marks)

a). Determine the average volume of the solution B used (1 mark)
b). Calculate the concentration in moles per litre of sodium hydroxide in:
i). solution **D** (2 marks)
ii). solution **A** (1 mark)

Procedure II

Using a clean burette, place 16cm^3 of solution **C** into a boiling tube. Take the initial temperature of the solution in the boiling tube and record it in table II. Using a clean measuring cylinder, measure 4cm^3 of solution A into 100cm^3 beaker and add it to a solution **C** in the boiling tube. Stir the mixture immediately with a thermometer and record in table II the maximum (final) temperature reached. Repeat the experiment with the other sets of volumes of **C** and **A** in the table and complete it. (Rinse the thermometer and the boiling tube with distilled water after each experiment)

Table II

Volume of solution C(cm^3)	16	12	8	6	4	2
Volume of solution A (cm^3)	4	8	12	14	16	18
Final temperature (^{O}C)						
Initial temperature (^{0}C)						
Change in temperature , (ΔT)						

(6 marks)

a). On the grid provided ,plot a graph of ΔT (vertical axis)against the volume of sodium hydroxide ,solution **A** (3 marks)
b). From the graph, determine the volume of sodium hydroxide solution a required to neutralize the carboxylic acid. (1 mark)
c). Calculate the volume of carboxylic acid, solution C used for neutralization. (1 mark)
d). Calculate the:
i). Ratio between the volumes of solutions **A** and **C.** (1 mark)
ii). Concentration in moles per litre of carboxylic acid, solution **C.** (assume that the volume ratio is the same as the mole ratio)
(2 marks)

2. You are provided with solid **E**. carry out the tests below and record your observation and inference in the spaces provided.
Divide solid E into two halves.

a). Place one half of solid E in a clean dry test-tube. Heat it gently then strongly Observations Inferences (3 marks)
b). Place the other half of Solid **E** in a boiling tube, add 10cm^3 of distilled water and shake well until all the solid dissolves. i). To about 1cm^3 of the solution, add 2M sodium hydroxide drop wise until in excess. Observations Inferences (2 marks) ii). Place 1cm^3 of the solution in a test-tube and add 2 to 3 drops of 2M sulphuric acid Observations Inferences (2 marks) iii). To about 1cm^3 of the solution, add 4-5 drops of 2M lead (II) nitrate solution and heat to boiling Observations Inferences (3 marks)

3 You are provided with Solid **F**. carry out the tests below and record your observation and inferences in the spaces provided. Place all the Solid **F** into a boiling tube. Add 10cm^3 of distilled water and shake well. Use 2cm^3 portion of the mixture for the following reactions.

a). Test the first portion with both blue and red litmus papers Observations Inferences (2 marks)
b). To the second portion, add three drops of bromine water Observations Inferences (2 marks)
c). To the third portion, add 2 drops of acidified potassium permanganate and shake well Observations Inferences (2 marks)
d). Warm the fourth portion slightly and add a little solid G, sodium hydrogen carbonate observations inferences (2 marks)

OCTOBER / NOVEMBER 2002

1. You are provided with the following;

- *Hydrogen peroxide labeled solution A*
- *Dilute sulphuric acid labeled solution B*

- *Sodium thiosulphate labeled solution C*
- *Potassium iodide labeled solution D*
- *Starch solution labeled solution E*
- *Distilled water in a wash bottle*

You are required to determine how the rate of reaction of hydrogen peroxide with potassium iodide varies with the concentration of hydrogen peroxide.

Procedure

Experiment I.

Label two 200ml or 250ml beakers as beaker 1 and beaker 2.
Using a burette, place 25.0cm^3 of solution A into beaker 1. Into the same beaker, add 20cm^3 of solution B using a 50ml or 100ml measuring cylinder. Shake the contents of beaker 1.

Using a 10ml measuring cylinder, place 5cm^3 of solution C into beaker 2 followed by 5cm^3 of solution D then 2cm^3 of solution E. shake the contents of beaker 2. Pour the contents of beaker 2 into beaker 1 and start a stop clock/watch immediately. Swirl the mixture and let it stand. Note the time taken for the blue colour to appear. Record the time in the space provided for experiment 1 in the table below.

Clean beaker 1. Repeat the procedure with the volumes of water below. Clean beaker 1. Repeat the procedure with the volumes of water, solutions A, B, C, D and E as shown in the table for experiments 2 to 5.
Complete the table by computing $\frac{1}{\text{Time}}$ sec^{-1} 7 ½ marks)

a).

	BEAKER 1			BEAKER 2				
Experiment	Volume of water (cm^3)	Volume of hydrogen peroxide, solution A (cm^3)	Volume of dilute sulphuric acid, solution B (cm^3)	Volume of sodium thiosulphate, solution C (cm^3)	Volume of potassium iodide, solution D (cm^3)	Volume of starch, solution E (cm^3)	Time (sec)	$\frac{1}{\text{Time}}$ sec^{-1}
1	0	25	20	5	5	2		
2	5	20	20	5	5	2		
3	10	15	20	5	5	2		
4	15	10	20	5	5	2		
5	20	5	20	5	5	2		

b). Plot a graph of $(^1/_{time})$ sec^{-1} (y-axis) against volume of hydrogen peroxide used (solution A). (4 marks)

c). From your graph determine the time that would be taken if the contents of beaker 1 were 17.5cm^3 water 7.5cm^3 solution A and 20cm^3 solution B. (2 marks)

d). How does the rate of reaction of hydrogen peroxide with potassium iodide vary with the concentration of hydrogen peroxide (2 marks)

2. You are provided with solution F, solid G and sodium sulphate solution. Carry out the tests below. Write your observations and inferences in the spaces provided.

a). Place 10cm^3 of solution F in a boiling tube. Add all of solid G to solution F at once. Warm the mixture for one minute then shake vigorously for about five minutes. Filter the mixture into a test-tube and use the filtrate for tests (b) to (e) below.

Observations	Inferences
(1 mark)	(1 mark)

b). To 2cm^3 of the filtrate in a test-tube, add five drops of barium nitrate solution

Observations	Inferences
(1 mark)	(1 mark)

c). To 2cm^3 of the filtrate in a test-tube, drop wise of aqueous sodium hydroxide dropwise until in excess solution

Observations	Inferences
(1 mark)	(1 mark)

d). To 2cm^3 of the filtrate in a test-tube, add five drops of 2M hydrochloric acid and warm the mixture to boiling

Observations	Inferences
(1 ½ marks)	(1 mark)

e). To the remaining filtrate, add 5cm^3 of the sodium sulphate solution provided then filter into a clean test-tube using a clean funnel. Retain the filtrate for test (f) below.

Observations	Inferences
(1 mark)	(1 mark)

f). To 2cm^3 of the filtrate obtained in (e) above, add aqueous ammonia dropwise until in excess

Observations	Inferences
(2 marks)	(1 mark)

3. You are provided with solid H. Carry out the tests below. Write your observations and inferences in the spaces provided.

a). Using a clean metallic spatula, heat about one third of solid H in a Bunsen burner flame.

Observations	Inferences

(2 marks) (1 mark)

b). Dissolve the remaining portion of solid H into about $10cm^3$ of distilled water and divide the solution into 3 portions.

i). To the first portion, add two drops of acidified potassium permanganate solution

Observations Inferences

(1 mark) (1 mark)

ii). To the second portion, add two drops of bromine water

Observations Inferences

(1 mark) (1 mark)

iii). Determine the pH of the third portion using universal indicator paper

Observations Inferences

(1 mark) (1 mark)

OCTOBER / NOVEMBER 2003

1. You are provided with solution **P** and **Q**.
   - *Solution P is acidified potassium permanganate (the same solution will be used for question 3)*
   - *Solution Q was prepared by dissolving 4.18g of solid Q in distilled water to make $250cm^3$ of solution.*

   You are required to determine the number of moles of Q that react with one mole of potassium permanganate.

Procedure

Place the solution P in a burette. Pipette $25cm^3$ of solution Q into a $250cm^3$ conical flask. Titrate solution **Q** with solution P until a permanent pink colour just appears. Record your results in table I below. Repeat the above procedure two more times.

a). **Table I**

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

(4 marks)

b). Calculate the average volume of solution **P** used. (1 mark)

c). Given that the concentration of solution **P** is 0.02M, calculate the number of moles of potassium permanganate used. (2 marks)

d). Calculate the concentration of solution **Q** in moles per litre. (Relative formula mass of ***Q*** is 278) (2 marks)

e). Calculate the number of moles of **Q**:

i) In 25.0cm^3 of solution. (2 marks)

ii) Which react with one mole of potassium permanganate? (1 mark)

2. **You are provided with:**

- *1.9g of solid S. solid S is a dibasic acid, H_2A*
- *0.5M solution of the dibasic acid H_2A solution T*
- *Sodium hydroxide, solution R.*

You are required to determine:

a) i) The molar heat of solution of solid **S.**

ii) The heat of reaction of one mole of the dibasic acid with sodium hydroxide.

b) Calculate the heat of reaction of solid H_2A with aqueous sodium hydroxide.

Procedure 1

Place 30cm^3 of distilled water into a 100ml beaker. Measure the initial temperature of the water and record it in the table II below. Add the entire solid S at once. Stir the mixture carefully with the thermometer until all the solid dissolves. Measure the final temperature reached and record it in the table II.

Table II

a).

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

(1½ marks)

b). Determine the change in temperature, ΔT_1 (½ mark)

Calculate the:

c). i). Heat change when H_2A dissolves in water .assume the heat capacity of the solution is 4.2$jg^{-1}0c^{-1}$ and density is 1g/cm^3 (2 marks)

ii). Number of moles of the acid that were used. (Relative formula mass of H_2A is 126. (1 mark)

iii). Molar heat of solution H1 solution of the acid H_2A. (1 mark)

Procedure II

Place 30cm^3 of solution **T** into 100ml beaker. Measure the initial temperature and record

it in the Table III below. Measure 30cm^3 of sodium hydroxide, solution **R**. Add al the 30cm^3 of solution **R** at Once to the solution in the beaker.

Stir the mixture with the thermometer. Measure the final temperature and record it in Table III.

TABLE III

a).

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

b). Determine the change in temperature ΔT_2

c). Determine the:

i) Heat change for the reaction (assume the heart capacity of the solution is $4.2jg^{-1}\ ^{0}C^{-1}$ and density is $1g/cm^3$) (2 marks)

ii). Number of moles of the acid H_2A used. (1 mark)

iii). Heat of reaction H_2 of one mole of the acid H_2A with sodium hydroxide. (1 mark)

d). Given that

ΔH_1 is the heat for the reaction $H_2A(s) \xrightarrow{Water} 2H^+_{(a(aq)}+A^{2-}_{(aq)}$

ΔH_2 is the heat for the reaction $2H+_{(aq)} + 2OH_{-(aq)} \longrightarrow 2H_2O_{(l)}$

Calculate ΔH_3 for the reaction $H_2A(s)+2OH^-_{(aq)} \longrightarrow 2H_2O(l)=A_{2-(aq)}$

3. You are provided with solid V. Carry out tests below. Write your observations and inference in the Spaces provided.

a). dissolve solid V in about $20cm^3$ of distilled water in boiling tube. Into 5 separate test-tubes, put $2cm^3$ portions of the solutions and use it for tests(b)to(f) below

Observations Inferences

(1 mark)

b). To the first portion, add 5 drops of 2M sodium hydroxide solution.

Observations Inferences

(3 marks)

c). To the second portion, add 2 or 3 drops of lead (II) nitrate solution.

Observations Inferences

(3 marks)

d). To the third portion, add all of the barium (II)chloride solution

provided followed by 2cm^3 of 2M hydrochloric acid then shake the mixture.

Observations Inferences

(3 marks)

e). To the fourth portion, add 3 drops of acidified potassium permanganate, solution P

Observations Inferences

(2 marks)

f). to the fifth portion, add 5 drops of acidified potassium dichromate, solution W

Observations Inferences

(2 marks)

OCTOBER / NOVEMBER 2004

1. **You are provided with:**
   - *Magnesium ribbon, solid A*
   - *0.7M hydrochloric acid, solution B*
   - *0.3M sodium hydroxide, solution C*
   - *Distilled water.*

You are required to determine the:

i). Temperature change when magnesium reacts with excess hydrochloric acid.
ii). Number of moles of hydrochloric acid that remain unreacted
iii). Number of moles of magnesium that reacted
iv). Molar heat of reaction between magnesium and hydrochloric acid

Procedure I

Using a burette, measure 50cm^3 of solution **B** and place it in a 100 ml beaker. Measure the temperature of solution **B** in the 100ml beaker and record the value in table 1. Put the magnesium ribbon in the 50cm^3 of solution B in the 100ml beaker **immediately**, start a stop Clock or watch. Stir the mixture continuously with the thermometer making sure that the Magnesium ribbon remains inside the solution as it reacts. Measure the temperature after Every 30 seconds and record the values in table1. Continue stirring and measuring the temperature to complete table 1.

Keep the resulting solution for use in procedure 2

Table 1

(a)

Time (sec)	0	30	60	90	120	150	180	210	240	270	300
Temperature (^{0}C)											

(5 marks)

i). Plot a graph of temperature (y-axis) against time on the grid provided (3 marks)

ii). On the graph, show the maximum change in temperature, ΔT, and determine its value. Value of ΔT (1 mark)

Procedure 2

Transfer all the solution obtained in 1 into a 250ml. conical flask. Clean the burette and use it to place 50cm^3 of distilled water into the beaker used in procedure 1. Transfer al the 50cm^3 of water into the 250ml conical flask containing the solution from procedure1. Label this as solution **D**. empty the burette and fill it with solution **C**. Pipette 25cm^3 of solution **D** and place it into an empty 250ml conical flask. Add two drops of phenolphthalein indicator and titrate solution **C** against **D**. Record the results in table two. Repeat the titration of solution **C** against solution D and complete the table 2

b). Table 2

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

(4 marks)

i). Calculate the average volume of solution **C** used (1 mark)

ii). Calculate the number of moles of:

I 0.3M sodium hydroxide used (1 mark)

II Hydrochloric acid in 25cm^3 of solution D (1 mark)

III Hydrochloric acid in 100cm^3 of solution D (1 mark)

IV hydrochloric acid in 50cm^3 of solution B (1 mark)

V hydrochloric acid that reacted with magnesium (1 mark)

VI magnesium that reacted (2 marks)

c). Using your answer in VI above, determine the molar heat of reaction between magnesium and hydrochloric acid (assume the heat capacity of the solution is 4.2 jg^{-1}deg^{-1} and density is 1.0g/cm^3

2 a). You are provided with solution H, carry out the tests below. Record your observation and inferences in the spaces provided. Place $3cm^3$ of the solution H in the boiling tube. Add $12cm^3$ of distilled water and shake.

Retain the remainder of solution H for use in 2(b).

i). Use about $2cm^3$ portions of diluted solution H for tests I and II.

I. To the first portion ,add drop wise about $1cm^3$ of sodium hydroxide

Observations Inferences

(2 marks)

II. To the second portion, add 2 to 3 drops of barium chloride Solution

Observations Inferences

(2 marks)

ii). To $3cm^3$ of the diluted solution **H**, add drop wise all the chlorine water (source of chlorine) provided

Observations Inferences

(2 marks)

iii). To $2cm^3$ the diluted solution H, add all the bromine water (source of bromine) provided.

Observations Inferences

(2 marks)

iv). To $2cm^3$ of the diluted solution H, add 2 or 3 drops of lead (II) nitrate solution

Observations Inferences

(2 marks)

b). **You are provided with;**

- *Solution **E** containing barium ions*
- *Solution **F** containing potassium ions*
- *Solution **G** containing sodium ions*

Carry out the tests on solutions **E**, **F, G** and **H** in order to identify the cation present in the solution **H.**

Procedure

Clean one end of glass rod thoroughly. Dip the clean end of the glass rod in solution **E**.

Remove the end and heat it in the non-luminous part of the Bunsen burner flame. Note the colour of the flame and record it in table 3. Allow the glass rod to cool for about two minutes. Repeat the procedure with solutions **F**, **G** and **H** complete the table 3.

Table 3

i).

Solution	Colour of the flame
E	
F	
G	
H	

ii). Identify the cation present in solution H.

OCTOBER / NOVEMBER 2005

1. You are provided with solid M in the test tube

- *You are required to determine the freezing point of solid M.*

Procedure

Place 150cm^3 of tap water in a 200ml or 250ml, beaker. Heat the water to near boiling. Using a test tube holder, immerse the test tube containing solid M into hot water (ensure that half of the test tube is immersed in water) continue heating the water until the solid starts to melt. insert a thermometer into the liquid being formed in the test tube and note the temperature when **all** the solid has just melted. Record the temperatures in table 1. Remove the test tube from the water and **immediately** start the stopwatch clock /watch and record the temperature of the contents of the test tube after every half a minute and complete the table. Dip the thermometer into the hot bath to clean it then wipe it with tissue paper.

Table 1

Time (Min)	0	½	1	1 ½	2	2 ½	3	3 ½
Temperature (^{0}C)								

a). On the grid provided on page 3, plot a graph of time(Horizontal axis) against temperature.

b). From the graph determine the freezing point of solid M (1 mark)

2. You are provided with:

- Sodium hydroxide solution Labeled K
- Solution L, containing 60.0g of acid L per litre of solution

You are required to determine the relative formula mass of acid L

Procedure
Using a burette, transfer 25.0cm^3 of solution **K** into a 100ml beaker. Measure the temperature T1 of the solution **K** and record it in table 2. Pipette 25.0 cm^3 of solution **L** into another 100ml beaker. Measure the temperature T_2, of solution **L** and record it in table two add all the solution **K** at once to solution **L**. Stir carefully with the thermometer. Measure the highest temperature, T3 of the mixture and record it in table 2. Repeat the procedure and complete table 2.

TABLE 2

	I	II
Initial temperature of solution K T_1(^{0}C)		
Initial temperature of solution L t2(^{0}C)		
Highest temperature of mixture T3 (^{0}C)		
Average initial temperature (^{0}C)		
Change in temperature ΔT (^{0}C)		

(5 marks)

Calculate the
a). Average T value. (1 mark)
b). Heat change for reaction
(Assume density of solution is 1g/cm^3 and the specific heat capacity is 4.2jg^{-1}K^{-1})
(2 marks)
c). Number of moles of acid **L** used given that the heat change for the one mole of acid **L** reacting with sodium hydroxide solution is 134.4Kj.
(2 marks)
d). Concentration of acid **L** in moles per litre. (2 marks)
e). Relative formula mass of acid **L** (2 marks)

3. (a) You are provided with solid **N**. Carry out the tests below. Write your observations and inferences in the spaces provided.

i). Heat about one third of solid **N** in a clean dry test-tube. Test the gases produced with both blue and red litmus papers Observations Inferences (3 marks)
ii). Using a boiling tube, dissolve the rest of solid N in about 10cm^3 of distilled water and use the solution for the tests below.

I. To about $2cm^3$ of the solution, add aqueous ammonia drop wise until in excess

Observations Inferences

(2 marks)

II. To $2cm^3$ of the solution, add about $5cm^3$ of solution P(aqueous sodium chloride)

Observations Inferences

(2 marks)

III. To $2cm^3$ of the solution, add about $4cm^3$ of aqueous barium nitrate

Observations Inferences

(1mark)

IV). To the mixture obtained in III above, add $2cm^3$ of dilute hydrochloric acid.

Observations Inferences

(2 marks)

b). You are provided with solid **Q**. Carry out the tests below. Write your observation and inferences in the spaces provided.

i). Place solid Q in a boiling tube. Add about $6cm^3$ of distilled water and shake. Retain the solution for tests (ii) and (iii) below.

Observations Inferences

(2 marks)

ii). To about $2cm^3$ of the solution obtained in (b) (i) above, add a small amount of solid sodium hydrogen carbonate.

Observations Inferences

(2 marks)

iii). To the remaining solution obtained in b(i) above, add $3cm^3$ of dilute hydrochloric acid. Shake and filter the mixture. Wash the residue by pouring 6 cm^3 of distilled water to the residue while it is still on the filter paper and dry the residue between filter papers. Using a spatula, transfer the residue into a test-tube and add $5cm^3$ of distilled water. Shake the mixture.

To about $3cm^3$ of the mixture, add a small amount of sodium hydrogen carbonate

Observations Inferences

(2 marks) (2 marks)

OCTOBER / NOVEMBER 2006

1. You are provided with:
   - *4.5g of solid A in a boiling tube*
   - *Solution B 0.06M acidified potassium manganate (VII)*

You are required to determine:

1. The solubility of solids A at different temperatures
2. The number of moles of water of crystallization in solid A

Procedure

a). Using a burette add $4cm^3$ of distilled water to solid **A** in the boiling tube . Heat the mixture while stirring with the thermometer to about 70^0c .When **all** the solid has dissolved allow the solution to cool while stirring with the thermometer. Note the temperature at which crystals of solid A first appear. Record this temperature in table 1.

b). Using the burette, add $2cm^3$ of distilled water to the contents of the boiling tube warm the mixture while stirring with the thermometer until **all** the solid dissolves. Allow the mixture to cool while stirring. Note and record the temperature at which crystals of solid **A** first appear.

c). Repeat procedure (b) two more times and record the temperature in the table 1. **Retain the contents of the boiling tube** for use in the procedure (e).

d). i). Complete table 1 by calculating the solubility of solid **A** at the different temperature. The solubility of a substance is the mass of that substance that dissolves in $100cm^3$ (100g) of water at a particular temperature.

Table 1

Volume of water in the boiling tube (cm^3)	Temperature at which crystals of solid A first appear (^0C)	Solubility of solid A (g/100 g water)
4		
6		
8		
10		

ii). On the grid provided, plot a graph of solubility of solid A (vertical axis) against temperature.

iii). Using your graph, determine the temperature at which 100g of solid **A** would dissolve in $100cm^3$ of water. (1 mark)

e) i). Transfer the contents of the boiling tube into a 250ml volumetric flask,

rinse both the boiling tube and the thermometer with distilled water and add to the volumetric flask. Add more distilled water to make up to the mark. Label this solution **A**. fill a burette with solution **B**. Using the pipette and pipette filter, place 25.0cm^3 of solution A into a conical flask. Warm the mixture to about 60^{0}C. Titrate the hot solution **A** with solution

B until a permanent pink colour persists. Record your readings in table 2. Repeat the titration two more times and complete the table2.

(Retain the remaining solution B for use in question 3 (b) (i)

Table 2

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

ii). Calculate the:

I. average volume of solution b used (1 mark)

II. Number of moles of potassium manganate (VII) used (1 mark)

III. Number of moles of A in 25cm^3 of solution A given that 2 moles of potassium manganate (VII) react completely with 5 moles of A (1 mark)

IV. Relative formula mass of A, (1 mark)

iii). The formula of **A** has the form **D**.XH_2O. Determine the value of x in the formula given that the relative mass of **D** is 90.0 and atomic masses of oxygen and hydrogen are 16.0 and 1.0 respectively. (2 marks)

2. You are provided with the solid **E**. carry out tests below. Write your observations and inferences in the spaces provided.

a). Place about one third of solid E in a clean dry test-tube and heat it strongly

Observations Inferences (3 marks)

b). Place the remaining solid E in a boiling tube. Add about 10cm^3 of distilled water. Shake the mixture thoroughly for about one minute. Filter and divide the filtrate into four portions

Observations Inferences (2 marks)

i). To the first portion, add 2 drops of phenolphthalein indicator.

Observations Inferences (2 marks)

ii). To the second portion, add 2cm^3 of dilute hydrochloric acid

Observations Inferences

(2 marks)

iii). To the third portion, add 5cm^3 of aqueous sodium sulphate

Observations Inferences

(3 marks)

iv). To the fourth portion, add dilute sodium hydroxide dropwise until in excess

Observations Inferences

(2 marks)

3. You are provided with solid **F.**

Carry out the following tests and record your observation and inferences in the spaces provided.

a). Using a metallic spatula, take one-third of solid F and ignite it using a Bunsen burner flame

Observations Inferences

(2 marks)

b). Place the remaining solid F in a boiling tube ,add about 10cm^3 of distilled water, shake the mixture until all the solid dissolves.

i). To the first 4cm^3 solutions, add two to three drops of acidified potassium manganate (VII), solution B.

Observations Inferences

(2 marks)

ii). To about 4cm^3 of the solution add 2 to 3 drops of bromine Water. Warm the mixture.

Observations Inferences

(2 marks)

OCTOBER / NOVEMBER 2007

1. **You are provided with;**
   - *Aqueous sulphuric acid labeled solution A*
   - *Solution B containing 8.0 g per litre of sodium carbonate*
   - *An aqueous solution of substance C labeled solution C.*

You are required to determine the;

Concentration of solution **A**

Enthalpy of reaction between sulphuric acid and substance **C**

A. Procedure

Using a pipette and a pipette filler, place 25.0cm^3 of solution **A** into a 250ml.

volumetric flask. Add distilled water to make 250cm^3 of solution. Label this solution **D**.

Place solution **D** in a burette. Clean the pipette and use it to place 25.0cm^3 of solution **B** into a conical flask. Add 2 drops of methyl orange indicator provided and titrate with solution **D.** record your results in table 1. Repeat the titration two more times and complete the table.

Table 1

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

(3 marks)

Calculate;

i). Average volume of solution **D** used (1 mark)

ii). Concentration of sodium carbonate in solution **B** (Na=23; 0; O=16; 0, C= 12.0) (1 mark)

iii). Concentration of sulphuric acid in solution **D** (2 marks)

iv). Concentration of sulphuric acid in solution **A** (1 mark)

B. Procedure

Label six test-tubes as 1, 2,3,4,5 and 6. Empty the burette and fill it with solution **A.** From the burette, place 2cm^3 of solution A into test-tube number 1. From the same burette, place 4 cm^3 of solution A in test-tube number 2. Repeat the process for test-tube numbers 3, 4, 5 and 6 as shown in table 2.

Clean the burette and fill it with solution **C**. From the burette, place 14cm^3 of solution **C** into a boiling tube. Measure the initial temperature of solution **C** to the nearest 0.5^{0}C and record it table 2. Add the contest of test-tube number **1** to the boiling tube containing solution **C**. stirs the mixture with the thermometer. Note and record the highest temperature reached in **table 2**. Repeat the process with the other volumes of solution C given in **table 2** and complete the table.

Table 2

Test-tube number	1	2	3	4	5	6
Volume of solution A(cm^3)	2	4	6	8	10	12
Volume of solution C(cm^3)	14	12	10	8	6	4
Initial temperature of solution C(^{0}C)						
Highest temperature of solution C(^{0}C)						
Change in temperature ΔT(^{0}C)						

(6 marks)

i). On the grid provided, draw a graph of ΔT (vertical axis) against volume of solution A used (3 marks)

ii). From the graph, determine;

I. The maximum change in temperature (1 mark)

II. The volume of solution A required to give the maximum change in temperature (1 mark)

iii). Calculate the;

I. Number of moles of sulphuric acid required to give the maximum change in temperature (1 mark)

II. Molar enthalpy of reaction between sulphuric acid and substance C (in kilojoules per mole of sulphuric acid).
Assume the specific heat capacity of the solution is $4.2jg^{-1}\ K^{-1}$ and density of solution is $1.0\ gcm^{-3}$. (2 marks)

2. You are provided with solid E. Carry out the tests below. Write your observations and inferences in the spaces provided.

a).	Place one half of solid E in a clean dry test-tube and heat it strongly. Test any gases produced with blue and red litmus papers. Observations inferences (2 marks) (1 mark)
b).	Place the other half of solid E in a boiling tube. Add about $10cm^3$ of distilled water and shake until all the solid dissolves. (Use the solution for tests (i), (ii), (iii) and (iv).
i).	Place two or three drops of the solution in a test-tube. Add $3cm^3$ of distilled water. Add two drops of universal indicator to the mixture obtained and then determine the pH of the mixture Observations inferences (1 mark) (1 mark)
ii).	To about $1cm^3$ of the solution a test-tube, add aqueous ammonia drop-wise until in excess Observations inferences (1 mark) (1 mark)
iii).	To $2cm^3$ of the solution in a test-tube, add three or four drops of solution G (aqueous potassium iodide) Observations inferences (1 mark) (1 mark)
iv).	To about $1cm^3$ of the solution a test-tube, add four or five drops of barium nitrate solution. Shake the mixture then add about $1cm^3$ of dilute nitric acid and allow the mixture to stand for about 2 minutes. Observations inferences (1 mark) (1 mark)

3. You are provided with liquid F. carry out the tests below. Record your observations and inferences in the spaces provided.

a).	Place three or four drops of liquid F on watch glass. Ignite the liquid using a Bunsen burner Observations inferences (1 mark) (1 mark)
b).	To 1cm^3 of liquid F in a test-tube, add about 1cm^3 of distilled water and shake thoroughly. Observations inferences (1 mark) (1 mark)
c).	To 1cm^3 of liquid F in a test-tube, add a small amount of solid sodium carbonate Observations inferences (1 mark) (1 mark)
d).	To 2cm^3 of liquid F in a test-tube, add about 1cm^3 of solution H (acidified potassium dichromate (VI). Warm the mixture gently and allow it to stand for about one minute of distilled water and shake thoroughly. Observations inferences (1 mark) (1 mark)

OCTOBER / NOVEMBER 2008

1. You are provided with:
   - *Solid A*
   - *M hydrochloric acid, solution B*
   - *0.1M sodium hydroxide*

You are required to determine the enthalpy change ΔH, for the reaction between solid A and one mole of hydrochloric acid.

Procedure A

Using a burette, place 20.0cm^3 of 2.0M hydrochloric acid, solution **B** in a 100ml. Beaker. Measure the temperature of the solution after every half-minute and record the values in table 1. At exactly 2 ½ minutes, add **all** of solid **A** to the acid. Stir the mixture gently with the thermometer. Measure the temperature of the mixture after every half-minute and record the values in table 1. **(Retain the mixture for use in procedure B)**.

Table 1.

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	5
Tem (^{0}C)											

(4 marks)

i). Plot a graph of temperature (Y= axis) against time (3 marks)
ii). Using the graph, determine the change in temperature ΔT (1 mark)
iii). Calculate the heat change for the reaction (assume that the specific heat capacity of the mixture is $4.2jg^{-1}K^{-1}$ and the density of the mixture is $1g/cm^3$ (2marks)

Procedure B

Rinse the burette thoroughly and fill it with sodium hydroxide. Transfer **all** the contents of the 100ml. beaker used in procedure **A** into a 250ml. volumetric flask. Add distilled water to make up to the mark. Label this solution **C**. Using a pipette and a **pipette filler**, place indicator and titrate against sodium hydroxide. Record your results in table 2. Repeat titration two more times and complete table 2.

Table 2

	I	II	III
Final burette reading			
Initial burette reading			
Titre (cm^3)			

Calculate the:
i). Average volume of sodium hydroxide used (1 mark)
ii). The number of moles of
- I. Sodium hydroxide used (1 mark)
- II. Hydroxide acid in $25cm^3$ of solution **C** (1 mark)
- III. Hydrochloric acid in $250cm^3$ of solution **C** (1 mark)
- IV. Hydrochloric acid in $20.0cm^3$ of solution **B** (1 mark)
- V. Hydrochloric acid that reacted with solid **A** (1 mark)

iii). Calculate the enthalpy of reaction between solid A and one mole of hydrochloric acid (show the sign ΔH) (2 marks)

2. You are provided with solid **D**. Carry out the tests below. Write your observations and inferences in the spaces provided.

a).	Place all of solid **D** in a clean dry-test-tube and heat it strongly

	until no further change occurs. Test any gases produced with both blue and red litmus papers. Allow the residue to cool and use it for test (b). Observations inferences (2 marks) (1 mark)
b).	Add about $10cm^3$ of 2M hydrochloric acid to the residue and shake for about three minutes. **Keep the mixture for test (c)** Observations inferences (1 mark) (1 mark)
c). i).	Place about $1cm^3$ of the mixture in a test-tube and add aqueous ammonia dropwise until in excess Observations inferences (1 mark) (1 mark)
ii).	To the rest of the mixture, add all of solid E provided and shake the mixture well. Observations inferences (1 mark) (1 mark)

3. You are provided with solid F. Carry out the tests below. Write your observations and inferences in the spaces provided

a).	Place about one third of solid F on a metallic spatula and burn it using a Bunsen burner Observations inferences (½ mark) (½ mark)
b).	Place the remaining of solid F in a test-tube. Add about $6cm^3$ of distilled water and shake the mixture well. (Retain the mixture for use in test (c) Observations inferences (1 mark) (1 mark)
c). i).	To about $2cm^3$ of the mixture, add a small amount of solid sodium hydrogen carbonate Observations inferences (1 mark) (1 mark)
ii).	To about $1cm^3$ of the mixture, add $1cm^3$ of acidified potassium

	dichromate (VI) and warm Observations inferences (1 mark) (1 mark)
iii).	To about $2cm^3$ of the mixture, add two drops of acidifies potassium manganate (VII) Observations inferences (1 mark) (1 mark)

OCTOBER / NOVEMBER 2009

1. You are provided with;

- *Solid A, a metal carbonate M_2CO_3*
- *Solution B, hydrochloric acid for use in question 1 and 2*
- *Solution, C 0.3M sodium hydroxide*
- *Methyl orange indicator*

You are required to:
Prepare a dilute solution of hydrochloric acid and determine its concentration
Determine the solubility of solid A in water

Procedure I
Dry conical flask for use in step 4)

Step 1 Place all of solid A in a 250ml dry beaker. Add $100cm^3$ of distilled water to solid A in the beaker. Using a glass rod, stir the mixture thoroughly for about two minutes. Leave the mixture to stand and proceed with steps 2 and 3.

Step 2 Using a pipette filler, place $25.0cm^3$ of solution B in a 250ml volumetric flask. Add about $200cm^3$ of distilled water. Shake the mixture well and add distilled water to make up to the mark. Label this as solution D.

Step 3 Fill a burette with solution C. Using a pipette and pipette filler, place $25.0cm^3$ of solution D into a 250ml conical flask. Add two drops of the indicator provided and titrate solution D with solution C. Record your results in table 1. Repeat the titration two more times and complete the table 1. Retain the remaining solution D for use in step 5.

Step 4 Filter the mixture obtained in step 1 using filter funnel into a dry conical flask. Lable the filtrate as solution

Step 5 Clean the burette and fill it with solution D. using a pipette and a pipette filler, place 25.0cm^3 of solution A into a 250ml conical flask. Add two drops of the indicator provided and titrate solution with solution D. record your results in table 2. Repeat the titration two more times and complete table 2.

Table 1

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

a). Calculate;
- i). The average volume of solution C
- ii). Moles of sodium hydroxide in the average volume of solution C used
- iii). Moles of hydrochloric acid in 25.0cm^3 of solution D
- iv). The morality of hydrochloric acid, solution D

Table 2

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

b). Calculate;
- i). The average volume of solution D used
- ii). Moles of hydrochloric acid in the average volume of solution D used
- iii). Moles of the metal carbonate, solid A in 25.0cm^3 of solution A
- iv). The solubility of the metal carbonate, solid A in water
(Relative formula mass of metal carbonate = 74, assume density of solution =1g/cm^3)

2. You are provided with solid E. Carry out the following tests and write your observations and inferences in the spaces provided.

a). Place about one-half of solid E in a dry test-tube. Heat it strongly and test any gas produced using hydrochloric acid, solution B on a glass rod.

Observations (2 marks) | Inferences (1 mark)

b). Place the rest of solid E in a boiling tube. Add about 10cm^3 if distilled water. Shake well and use 2cm^3 portions for each of the tests below.

i). To one portion, add aqueous ammonia dropwise until in excess

Observations (1 mark) Inferences (1 mark)

ii¬). To a second portion, add about 1cm^3 of hydrochloric acid solution B.

Observations (1 mark) Inferences (1 mark)

iii). To a third portion, add two drops of aqueous lead (II) nitrate and heat the mixture to boiling;

Observations (1 mark) Inferences (1 mark)

3. You are provide with solid F. Carry out the following tests and record your observations and inferences in the spaces provided.

a). Place about one half of solid F in a dry test-tube. Retain the other half of solid F for use in (b). Add all of the absolute ethanol provided to solid F in the test-tube. Shake the mixture.

Observations (1 mark) Inferences (1 mark)

Divide the mixture into two portions

i). Determine the pH of the first portion using universal indicator solution and pH chart.

Observations (1 mark) Inferences (1 mark)

ii). To the second portion, add one half of the solid sodium hydrogen carbonate provided.

Observations (1 mark) Inferences (1 mark)

b). Place the remaining amount of solid F in a boiling tube. Add 10cm^3 of distilled water and shake. Boil the mixture and divide it into three portions while still warm.

i). To the first portion, add the remaining amount of solid sodium hydrogen

Observations (1 mark) Inferences (1 mark)

ii). To the second portion, add three drops of acidified potassium

dichromate (VI) solution and warm

Observations — Inferences

(1 mark) — (1 mark)

iii). To the third portion, add five drops of bromine water
Observations — Inferences
(1 mark) — (1 mark)

OCTOBER /NOVEMBER 2010

1. You are provided with;

- *Acid A labeled solution A*
- *M sodium hydroxide solution labeled solution B*
- *Solutions C containing 25.0 g per litre of an alkanoic acid*

You are required to:

a). Prepare a dilute solution of solution hydroxide, solution B

b). Determine the:

i). Molar mass of the alkanoic acid

ii). Reaction ratio between sodium hydroxide and acid A

Procedure I

Using a pipette and a pipette filler, place 25.0cm^3 of solution B into a 250.0ml volumetric flask. Add about 200cm^3 of distilled water. Shake well. Add more distilled water to make upto the mark. Label this solution D. Retain the remaining solution B for use in procedure II.

Fill a burette with solution C. using a clean pipette and a pipette filler, place 25.0cm^3 of solution D into a 250ml conical flask. Add two drops of phenolphthalein indicator and titrate with solution C. record your results in table

I. Repeat the titration two more times and complete the table.

Table	1st	2nd	3rd
Final burette reading			
Final burette reading			
Volume of solution C used (cm^3) added			

(4 marks)

Determine the:

i). Average volume of solution C used (1 mark)

ii). Concentration of solution D in moles per litre (1 mark)

iii). Concentration of the alkanoic acid in solution C in moles per litre (1 mole of the acid reacts with 3 moles of the base) (1 mark)

iv). Molar mass of the alkanoic acid (1 mark)

Procedure II

Fill a clean burette with solution A. place 5cm3 of solution A into a 100ml beaker. Measure the initial temperature of solution A in the beaker record it in table II. Using a 10ml or a 100ml measuring cylinder, measures 25cm^3 of solution B. add it to solution A in the beaker and immediately stir the mixture with the thermometer. Record the maximum temperature reached in table II. Repeat the experiment with other sets of volumes of solutions A and B complete the table.

Table II

Volume of solution A (cm^3)	5	9	13	17	21	25
Volume of solution B (cm^3)	25	21	17	13	9	5
Maximum temperature (^{0}C)						
Initial temperature (^{0}C)						
Change in temperature, ΔT						

(6 marks)

a) On the grid provided, plot a graph of ΔT (Vertical axis) against the volume of solution A (3 marks)

b) From the graph, determine the volume of solution A which gave the maximum change in temperature (1 mark)

c) Determine the volume of solution B that reacted with the volume of solution A in (b) above (1 mark)

d) Calculate the:

i). Ratio between the volumes of solutions A and B that neutralized one another. (1 mark)

ii). Concentration in moles per litre of the acid in solution A. (assume that the volume ratio is the same as the mole ratio). (1 mark)

2. You are provide with solids E, F and G.

Cary out the tests below and write your observations and inferences in the spaces provided

a). Place all of solid E in a boiling tube. Add 20cm^3 of distilled water and shake until all the solid dissolves. Label this as solution E.

i). To about 2cm^3 of solution E in a test-tube, add 4 drops of 2M sulphuric (VI) acid.

Observations (1 mark) Inferences (2 marks)

ii). To about 2cm^3 of solution E in a test-tube, add 2M sodium hydroxide dropwise until in excess.

Observations (1 mark) Inferences (1 mark)

iii). Place one half of solid F in a test-tube. Add 2cm^3 of distilled water

and shake well. Add 4 drops of this solution to about $2cm^3$ of solution E in a test-tube.

Observations (1 mark) Inferences (1 mark)

iv). To about $2cm^3$ of solution E in a test tube, add 2 drops of aqueous potassium iodide.

Observations (1mark) Inferences (1 mark)

II. To about $2cm^3$ of the solution obtained in (ii) above, add 3 drops acidified potassium manganate (VII).

Observations (1 mark) Inferences (1 mark)

III. To about $2cm^3$ of the solution obtained in (ii) above, add 2 drops of bromine water.

Observations (1 mark) Inferences (1 mark)

IV. To the remaining solution G in the boiling tube, add the other half of solid F.

Observations (1 mark) Inferences (1 mark)

OCTOBER /NOVEMBER 2011

1. You are provided with:

- *1.60g of solid **A** , dibasic acid*
- *Solution **B** containing 4.75g per litre of salt **B**.*
- *Aqueous sodium hydroxide, solution **C**.*
- *Phenolphthalein indicator.*

You are required to prepare a solution of solid A and use it to determine the:-

- Concentration of sodium hydroxide, solution **C**
- React salt **B** with excess sodium hydroxide and then determine the relative molecular mass of salt **B**.

Procedure I

(a) Using a burette, place $25.0cm^3$ of solution B in each of two 250ml conical flasks. Using a pipette and a pipette filler, add $25.0cm^3$ of solution **C** to each of the two conical flasks. The sodium hydroxide added is in excess). Label the conical flasks 1 and 2.

(b) Heat the contents of first of the first conical flask to boiling and then let the mixture boil for five minutes. Allow the mixture to cool.

(c) Repeat procedure (b) with second conical flask. While the mixtures are cooling, proceed with procedure II.

Procedure II

(a) Place **all** solid **A in** a 250ml volumetric flask. Add about 150cm^3 of distilled water, shake well dissolve the solid and then add water to make up to the mark. Label this as solution A.

(b) Place solution A in a clean burette. Using a pipette and a pipette filler, place 25.0cm^3 of solution C in a 250ml conical flask. Add 2 drops of phenolphathein indicator and titrate with solution A. Record your results in Table 1. Repeat the titration two more times and complete the table.

Table 1

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

(4 marks)

Calculate the:

(i) Average volume of solution A used: (½ mark)

(ii) Concentration in moles per litre of the dibasic acid in solution A; (Relative molecular mass of A is 126) (2 marks)

(iii) Moles of the dibasic acid used; (1 mark)

(iv) Moles of sodium hydroxide in 25.0cm^3 of solution **C**. (1 mark)

(v) Concentration of sodium hydroxide in moles per litre (2 marks)

Procedure III

Add 2 drops of phenolphthalein indicator to the contents of the first conical flask prepared in procedure I and titrate with solution A. Record your results in Table 2. Repeat the procedure with the contents of the second conical flask and complete the table.

Table 2

	1st Conical flask	2nd Conical Flask
Final burette reading		
Initial burette reading		
Volume of solution A used (cm^3)		

(3 marks)

Calculate the: -

(i) average volume of solution A used; (½mark)

(ii) Moles of the dibasic acid used; (1 mark)

(iii) Moles of sodium hydroxide that reacted with the basic acid. (1 mark)

(iv) Moles of sodium hydroxide that reacted with 25.0cm^3 of salt **B** in solution **B;** (2 marks)

(v) Given that 1 mole of salt B reacts with 2 moles of sodium hydroxide . Calculate the : -

I. Number of moles of salt **B** in 25.0cm^3 of solution **B;** (1 mark)

II. Concentration in moles per litre of salt **B** in solution **B** ; (1 mark)

III. Relative molecular mass of salt **B**; (2 marks)

2. (a) (i) You are provided with solid **D.** Carry out the following tests and write **your** observations and inferences in the spaces provided

Observations (2 marks)	Inferences (1 mark)

(ii) Place the rest of solid D in a boiling tube. Add about 10cm^3 of distilled water. Shake well.

To a 2cm^3 portion of the solution, add about 1cm^3 of hydrogen peroxide and shake well. To the resulting mixture, add aqueous sodium hydroxide drop wise until in excess.

Observations (1 mark)	**Inferences** (1 mark)

(b) You are provided with solution E. Carry out the following tests and write your observations and inferences in the spaces provided.

Divide solution **E** into **two** observations.

(i) To one portion of solution E in a test tube, add 3 drops of barium nitrate. **Retain the mixture for use in test (ii) below.**

Observations (1 mark)	**Inferences** (2 marks)

(ii) To mixture obtained in (i) above, add about 5cm^3 of 2M nitric (V) acid

Observations (1 mark)	**Inferences** (1 mark)

OCTOBER /NOVEMBER 2012

1. **You are provided with:**
   - *Solution **A** containing an oxidising agent **A**;*
   - *Solution **B**, 0.05M aqueous sodium thiosulphate;*
   - *Solution **C** , containing a reducing agent **C**;*
   - *Aqueous potassium iodide;*
   - *Solution **D**, starch solution.*

   You are required to determine the:
   - Concentration of solution A
   - Rate of reaction between the oxidising agent A and the reducing agent **C**.

Procedure 1

1. Using a pipette and a pipette filler, place 25.0cm^3 of solution **A** into a 250ml conical flask.
2. Measure 10cm^3 of aqueous potassium iodide and add it to solution **A in** the conical flask. Shake the mixture. Add 10cm^3 of 2M sulphuric (VI) acid to the mixture and shake.
3. Fill a burette with solution **B** and use it to titrate the mixture **in the conical flask until** it just turns orange – yellow. Add 2cm^3 of solution **D** to the mixture in a conical flask. Shake thoroughly. Continue titrating until the mixture just turns colourless. Record your results in **table 1** below.
4. Repeat the procedure and complete table 1. **Retain the remainder** of solution A and solution **D** for use in procedure II.

Table 1

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

(4 marks)

(a) Calculate the:
   (i) Average volume of solution B used; (1mark)
   (ii) Number of moles of sodium thiosulphate . (1mark)

(b) Given that one mole of A reacts with six moles of sodium thiosulphate, calculate the;
   (i) Number of moles of A that were used; (1mark)
   (ii) Concentration of solution A in moles per litre. (2marks)

Procedure II

1. Label six test tubes as 1, 2, 3, 4, 5 and 6 and a place them in test- tube rack.
2. using a clean burette, measure the volumes of distilled water shown n table 2 into the labelled test tubes
3. Using a burette, measure the volumes of solution A shown in table 2 into each of the test tubes
4. Clean the burette and rinse it with about 5cm^3 of solution C.
5. Using the burette, measure 5cm^3 of solution C and place it into a 100ml beaker.
6. Using a 10ml measuring cylinder, measure 5 cm^3 of solution D and add it to the beaker containing solution C. Shake the mixture
7. Pour the contents of test – tube number 1 to the mixture in the beaker and immediately start a stop watch. Swirl the contents of the beaker. Record the time taken for a blue colour to appear in table 2.

8. Repeat steps 5 to 7 using the contents of test- tube numbers 2,3,4,5 and 6.
9. Complete table 2 by computing Rate = 1/Time (S^{-1})

Table 2

Test-tube number	1	2	3	4	5	6
Volume of distilled water (cm^3)	0	2	3	5	6	7
Volume of solution A (cm^3)	10	8	7	5	4	3
Time (seconds)						
Rate = 1/Time (S^{-1})						

a). Plot a graph of rate (y-axis) against volume of solution A. (3 marks)

b). What time would be taken for the blue colour to appear if the experiment was repeated using 4 cm^3 of distilled water and 6 cm^3 of solution A? (2 marks)

2. You are provided with solid E. carry out the experiments below. Write your observations and inferences in the spaces provided.

Place all of solid E in a boiling tube. Add 20 cm^3 of distilled water and shake until all the solid dissolves, label the solution as solution E. Use solution E for experiments (i) and (ii).

i). To 2cm^3 of solution E, in a test-tube in each of experiments I, II, III and IV, add;

I. Two drops of aqueous sodium sulphate;

Observations **Inferences**

(1 mark) (1 mark)

II. Five drops of aqueous sodium chloride;

Observations **Inferences**

(1 mark) (1 mark)

III. Two drops of barium nitrate;

Observations **Inferences**

(1 mark) (1 mark)

IV. Two drops of lead (II) nitrate;

Observations **Inferences**

(1 mark) (1 mark)

ii). To 2cm^3 of solution E, in a test-tube, add 5 drops of aqueous sodium hydroxide. Add the piece of aluminium foil provided to the mixture and shake. Warm the mixture and test any gas produced with both blue and red litmus papers. (1 mark)

Observations **Inferences**
(2 marks) (1 mark)

3. You are provided with solid F. Carry out the following tests. Write your observations and inferences in the spaces provided.

a). Place all of solid F in a boiling tube. Add about 20 cm^3 of distilled water and shake until all the solid dissolves. Label the solution as solution F.
Add about half of the solid sodium hydrogen carbonate provided to 2cm^3 of solution F.
Observations **Inferences**
(1 mark) (1 mark)

b). i). Add about 10cm^3 of dilute hydrochloric acid to the rest of solution F in the boiling tube. Filter the mixture. Wash the residue with about 2cm^3 of distilled water. Dry the residue between filter papers. Place about one third of the dry residue on a metallic spatula and burn it in a Bunsen burner flame

Observations **Inferences**

(1 mark) (1 mark)

ii). Place all the remaining residue into a boiling tube. Add about 10cm^3 of distilled water and shake thoroughly. Retain the mixture for the tests in (C).

Observations **Inferences**

(½ mark) (½ mark)

c). Divide the mixture into two portions:

i). To the first portion, add the rest of the solid sodium, hydrogen

carbonate

Observations **Inferences**

(1 mark) (1 mark)

ii). To the second portion, add two drops of bromine water

Observations **Inferences**

(1 mark) (1 mark)

OCTOBER / NOVEMBER 2013

You are provided with:

- *Solution A, aqueous copper (II) sulphate:*
- *Solid B, iron powder:*
- *0.02 m acidified potassium manganate (VII), solution C.*
- *You are required to determine the molar heat of displacement of copper by iron.*

Procedure I.

Using a burette, place 50.0cm^3 of solution A in a 100ml beaker. Measure

PROCEDURE I.

Using a burette, place 50.0cm^3 of solution A in a 100 ml beaker. Measure the temperature of the solution and record it in table I below. Add all of solid B provided at once and start a stop watch. Stir the mixture thoroughly with the thermometer and record the temperature of the mixture after every one minute in the table. Retain the mixture for use in procedure II below.

Table I.

Time (Min.)	0	1	2	3	4	5	6	7
Temperature (^{0}C)								

a) i). Plot a graph of temperature (vertical axis) against time in the grid provided.

ii). From the graph, determine the:

I. Highest change in temperature, $\triangle$ T: (1 mark)

II. Time taken for reaction to be completed (½ mark)

III. Calculate the heat change for the reaction. (Specific heat capacity of solution is 4.2Jg-1 K-1; Density of the solution is 1 gcm^3). (2 marks)

PROCEDURE II

Carefully decant the mixture obtained in procedure I into a 250ml volumetric flask. Add

about 10cm^3 of distilled water to the residue in the 100 ml beaker. Shake well, allow the mixture to settle and carefully decant into the volumetric flask. Immediately, add about 50cm^3 of 2M sulphuric (VI) acid to the mixture in the volumetric flask. Add more distilled water to make 250.0 cm^3 of solution. Label this as solution D.
Fill a burette with solution C. Using a pipette and pipette filler, place 25.0cm^3 of solution D into a 250 ml conical flask. Titrate solution D against solution C until the first permanent pink colour is obtained. Record your results in table 2 below. Repeat the titration two more times and complete the table. Retain the remaining solution C for use in question 3.

Table 2

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

(4 marks)

a). Determine the average volume of solution C used (1 mark)

i). Transfer about half of the dry residue into a dry test-tube. Heat the residue strongly and test any gas produced using a burning splint

Observations	Inferences
(1 mark)	(1 mark)

ii). Place the rest of the residue in a dry test-tube. Add 4cm^3 of 2M hydrochloric acid. Retain the mixture for test (iii) below.

Observations	Inferences
(1 mark)	(1 mark)

iii). To 2cm^3 of the solution obtained in (ii) above, add 6cm^3 of aqueous ammonia dropwise.

Observations	Inferences
(1 mark)	(1 mark)

b). i). To 2cm^3 of the filtrate obtained in (a) above, add about 3cm3 of aqueous ammonia (Excess).

Observations	Inferences
(1 mark)	(1 mark)

ii). To 2cm^3 of the filtrate, add about 2cm^3 of 2M hydrochloric acid.

Observations	Inferences
(1 mark)	(1 mark)

iii). To 2cm^3 of the filtrate, add one or two drops of barium nitrate solution.

Observations	Inferences
(1 mark)	(1 mark)

3. You are provided with solid G. Carry out the tests in (a) and (b) and write your observations and inferences in the spaces provided. Describe the method used in part (c).

a). Place about one third of solid G on a metallic spatula and burn it in a Bunsen burner flame

Observations	Inferences
(1 mark)	(1 mark)

b). Dissolve all of the remaining solid G in about 10cm^3 of distilled water in a boiling tube. Use the solution for tests (b) (i), (ii) and (c).

i). Place 2 cm^3 of the solution in a test-tube and add 2 drops of acidified potassium manganate (VII); solution C.

Observations	Inferences
(1 mark)	(1 mark)

ii). To 2cm^3 of the solution, add all of solid sodium hydrogen carbonate provided.

Observations	Inferences
(1 mark)	(1 mark)

c). Determine the p H of the solution obtained in (b) above

Observations	Inferences
(1 mark)	(1 mark)

CO-ORDINATED MARK SCHEMES

NOVEMBER 1995
MARK SCHEME

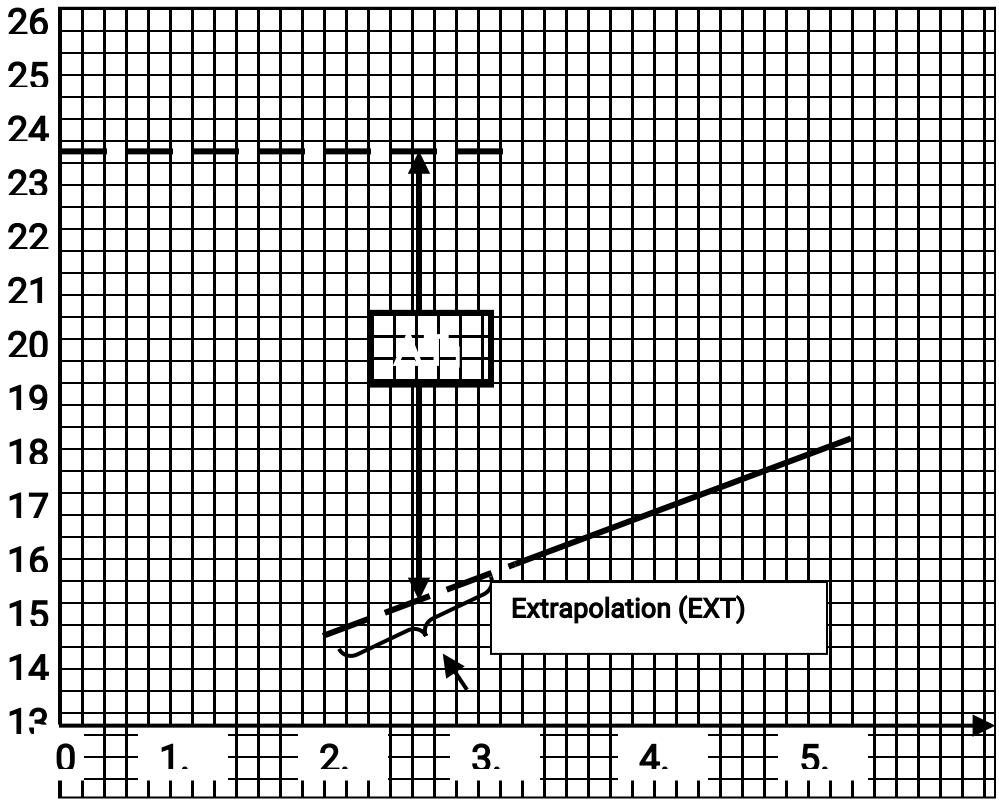
1.

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	5
Temperature (0^C)	23.5	23.5	23.5	23.5	23.5	X	15.5	16.0	16.5	17.0	17.5

Table I (3 Marks)

- *Complete with 10 readings; if 1st reading ≥ 40 or ≤10 then unrealistic (award 0)*
- *Decimal (D) – ½ - Accept whole numbers and or decimals to 1.d.c.p only c 1st d.c.p value as 0 or 5 only*
- *Accuracy – ½ - 1st reading should be within $+2^0$ of school value*
- *Trends – 1 – (1/2, ½) as i).Readings betweens 0 -2 minutes should be constant (½)*
  ii).Readings between 3 -5 min should use continuously (½)

NB; *Reaction is endothermic hence temperature must drop in minute 3. If not penalize ½ mark*



Fall in temperature ΔT1=…… 15 – 0 – 23.5 = - 8.5^{0}C

(1 mark)

Graph I *(3 Marks)*

Scale (sc) – ½ - plots should cover (4 ½ x 3 ½ squares) or more

Plots (Pt) – 1 – if 3 readings incorrect give ½ but if more than 3 incorrect (award 0) If correct scale intervals correct only.

Lines (Lns) – 1 – ½ (for each line) lines should pass through at least three points for each line

Xtrapolation (ext) – ½ - for the second line extended downwards

Δ T_1 = 1 – a). show ΔT_1 on graph at 2 ½ minute (½ mark)

b). Ignore sign of ΔT value

a). i). $n_1 = {}^{2}/_{100} = 0.02$

Penalize ½ mark for wrong units i.e. m or M. Accept figure continuous units.

If wrong RFM used but shown how found, penalize ½ and mark answer if correct (using wrong RFM)

ii). $\Delta H_1 = \frac{\text{Mass of solution x 4.2 x } \Delta T_1}{n_1 \text{ x } 1000}$ $Kjmol^{-1}$

Same as for graph I *For correct substitution of ΔT_1 and n_1*

Size 3 ½ x 3 ½ sq

Correct answer

Correct answer should

Be within +2 units correct in the 1st D.C.P (otherwise penalise ½)

Have correct sign (+ve) (otherwise per ½ mark)

Penalized ½ if wrong units used – accept lack of units (on second line only)

b) i). $n_2 = {}^{1}/_{84}v = 0.0119$

$= 0.012$

Accept answer to 3 or 4 D.C.P only (Not 2 d.c.p)

If RFM is wrong (but shown it was calculated) Penalize ½ mark and mark answer if correct using the wrong RFM

ii). For correct subt of $n_2 + \Delta T_2 =$ Correct answer

Answer should be correct to within 12 units in 1st D.C.P

Answer should bear correct sign (-ve) otherwise penalize ½ mark

Accept units missing otherwise penalize ½ mark for wrong units used.

c). *1 Mark - for correct substitution of ΔH_1, ΔH_2 and ΔH_3 including their respective signs*

e.g $\Delta H_4 = 2(26.8) – (-43.8) – 2(121)$

$= -144.6$ kj/mol

1 mark – for correct answer

Penalize ½ mark for wrong sign on answer

Award 0 marks for wrong substitution or wrong sign transferred with ΔH in the substitution.

Penalise ½ mark for wrong units used

Penalize ½ mark for wrong transfer of any of the ΔH values

9 marks

2 (a)	Silvery / shiny grey/ metallic luster silvery white / shining metal Reject shiny, wrong colour etc, silvery white etc	
	Observations	Inferences
(b)	turns black/grey/white	L reacts with oxygen in air to form oxide or L is oxidize
(c)	Effervescence/bubbles/ gas produced / burns with a pop sound	metal L is above hydrogen in the reactivity series/ or mention any metal above H in reactivity series OR just metal up in the series
(d)	Effervescence/bubbles/ gas produced/ gas burns with a pop sound.	metal L is above hydrogen in the reactivity series/ or mention any metal above H in reactivity series OR just metal up in the series
(e)	Black/grey/dark coating OR deposit or ppt or substance	Metal L is above Lead in reactivity series OR Lead is displaced by L

9 marks

3 (a)	White Crystalline solid/white powder /white solid	
(b)	Burns with Lilac /purple/ violet flame / Reject blue flame	
(c)	Gas relights burning splint Solid melts forming colourless liquid If melts to colourless solution (Reject if just melts)	Oxygen/O_2 evolved possibly KNO_3 Accept $NaNO_3$ if not scored in (b)
(d)(i)	No visible change no effect on litmus paper	Neutral solution
(ii)	No Precipitate / reject no observable change	Zn^{2+}, $Al^{3+,}$ $Pb^{2+,}$ Ca^{2+}, Mg^{2+} (Any 3 absent) Or K^+ , Na^+ Present
(iii)	No precipitate.	CO_3^{2-}, SO_4^{2-} OR Cl^- absent (Any two mentioned)
(iv)	- Colourless fumes/gas/effervescence which turns moist red litmus blue - Grey / black mixture/solid precipitate	- NH_3 evolved - Solid contains Nitrogen or NO_3^- ions

NOVEMBER 1996
MARK SCHEME

Principles of averaging
Values averaged must be shown and must be within + 0.20cm^3 of each other

1. c). Concentration of solution $B = \frac{23.5}{392}$ Mol^{-1}
$= 0.05995$ Mol^{-1}

Note: (i) Accept answer given as 0.060 mol^{-1} but reject 0.06 mol^{-1}
(ii) Units need not be shown but if wrong units are given penalize ½ mk
(iii) Penalise ½ mark for wrong arithmetic

d). No of moles of iron (II) ions in 25cm^3 of solution B = $\frac{25}{}$ x Ans. in (c)

1000
= correct answer

Conditions

i). Accept rounding off of answer to 4 d.p
ii). penalize ½ mark if answer is rounded off to the 3rd d.p
iii). If wrong units are given, penalize ½ mark

Use of 1st Principle

e). 5 moles of Fe^{2+} = 1mole of MnO_4^-
No of moles of A (in litres) used
= $^1/_5$ x ans in (d)
No of moles of A in $1000cm^3$
= $^1/_5$ x ans in (d) x $^{1000}/_{titre}$
Correct answer

Use of Formula Method

$\frac{M_1V_1}{M_2V_2} = \frac{5}{1}$

$\frac{\text{ans (a) x pipette}}{M_2 \text{ x titre}} = \frac{5}{1}$

$M_2 = \frac{\text{Ans in © x Pipette}}{5 \text{ x titre}}$

Correct answer

Conditions

i). If step 1 not sown but correct mole ratio used in step 2, credit 1 mark
ii). Penalise ½ mark for wrong arithmetic
iii). Penalize ½ mark for wrong units given
iv). Accept rounding of to the 3rd and 4th d.p

Note

a). If steps (i) and (ii) are not shown but step (iii) and ans are correct max 1 ½ marks
b). if step (ii) and (iii)are combined to make M_2 the subject award 1 mark for the combined step

Procedure II

h). No of moles of manganate (VII) ions in V_2 = $\frac{\text{Ans in (e) x Titre}}{1000}$
= correct answer

Conditions

i). Accept rounding off of answer to the 4th d.p
ii). Penalise ½ mark if the mark is rounded off to the 3rd d.p
iii). If wrong units are given, penalize ½ mark

i). 2 moles of MnO_4^- ions = 5 moles of dibasic acid
No of moles of the dibasic acid in $25cm^3$ of sol C = $^5/_2$ x ans in (h)

Conditions

i). Penalise ½ mark for wrong units used
ii). Penalise ½ mark for wrong arithmetic if not within 2 units in the 4th decimal place

j). Concentration of the dibasic acid in mol l-1 = $\frac{\text{Ans in (i) x 1000}}{\text{Pipette}}$

Conditions

i). Penalise ½ mark for wrong arithmetic if not within +2 units in the decimal place
ii). Answer should be written to at least 3 decimal places, unless it divides exactly. Otherwise penalize ½ mark
iii). Penalise ½ mark for wrong units used

k). RFM of the dibasic acid = $\frac{5.0}{\text{ans in (j)}}$ *½ mark*
= correct answer *½ mark*
X + 2 + 36 = RFM of dibasic acid *½ mark*
X + 38 = RFM of dibasic acid *½ mark*
Formula mass of X = RFM of dibasic acid – 38 *½ mark*
Correct answer

	Observations	Inferences
2a (i)	Effervescence that increases with heating Green – yellow gas evolved Gas changes moist blue litmus paper red and then bleaches it	Gas evolved is chlorine D is an oxidizing Agent Note: Chlorine is tied to either greenish – yellow Colour of gas or the Bleaching action of the gas
(ii)	Colourless filtrate obtained brown ppt that is insoluble in excess alkali formed	Fe^{3+} ions present
b	Effervescence/bubbles/gas evolved gas has no effect on moist litmus paper. Produced gas relights a glowing split	oxygen gas D is a catalyst D is probably MnO_2
Note In (a) (i) and (b) above credit ½ mark for 'gas' given in place of effervescence /bubbles so long as properties of the gas given in the observation column are not contradictory, otherwise no mark for the 'gas'		

3	Observations	Inferences
a)	Melts to a colourless liquid. And burns with a smoky /sooty. Flame *Note: accept melts on its own without Mentioning of colourless liquid. Unless contradictory colour given Accept –yellow sooty flame. But not yellow flame*	E is an unsaturated organic compound Note:- credit either E has C: H ratio or E contains C=C or –C≡C- in place of ''unsaturated'' unsaturated tied to smoky flame Organic tied to melting & burning
b)	Solid E does not dissolve readily solid E is sparingly partially soluble /solid E dissolves $H^+_{(aq)}$ ions present red.	E is an organic acid E is an acidic compound hydrated hydrogen ions $H^+_{(aq)}$ ions present
c)	Solid E dissolved readily in aqueous NaOH	E is organic acid/or E is a carboxylic acid Or Acidic Compound / H^+ ions present.
d)(i)	Effervescence/bubbles/ gas evolved colourless gas evolved extinguishes a burning / glowing Splint changes moist blue litmus paper Faint red / pink	Organic acid or carboxylic aid or Acidic compound/ H^+ ions present
(ii)	A sweet smelling substance is formed / fruity smell/ pleasant smell	Ester is formed E is a carboxylic acid/ R – COOH / - C(=O)-OH alkanoic acid

NOVEMBER 1997
MARK SCHEME

1. a).

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	5	5 ½	6
Temperature (^{0}C)	20	20	20	X	25	29	31	31	33	34	34	34	34

½ max for each entry
Maximum 5 marks

b). $\Delta T = 34 - 20 = 14^0C$ *1 mark*

c). Energy change = 50 x 4.2 x 14 *(1)*
= 2940 Joules *(1)* *2 marks*

d). Moles = $\frac{2940}{}$ *(1)*

323 x 1000
= 0.009 moles *(1)* *2 marks*

	I	II	III
Final burette reading (cm^3)	32.8	15.9	31.9
Initial burette reading (cm^3)	15.8	0.0	16.0
Volume of solution G used (cm^3)	17.0	15.9	15.9

(6marks)

e). $\frac{15.9 + 15.9}{2}$ *(½)*
= $15.9cm^3$ *(½)* *1 mark*

f). $\frac{15.9 \times 0.5}{1000}$ *(1)*
= 0.008 moles *(1)* *2 marks*

g). i). Moles of sulphuric acid = $\frac{0.008}{2}$
= 0.004 moles *(½)* *1 mark*

ii). $25cm^3$ = 0.004 (½)
$100cm^3$ = 0.016 moles *(½)* *1 mark*

iii). Total moles of F = 0.009 + 0.016 *(½)*
= 0.025 moles *(½)* *1 mark*

iv). $50cm^3$ = 0.025 moles
$1000cm^3 = \frac{0.025 \times 1000}{50}$ *(½)*
= 0.5M *(½)* *1 mark*

2		Observations	Inferences
	(a)	Colourless gas that relights a glowing splint *(1)*is produced	oxide present also allow chlorate nitrate, permanganate *(1)*
	(b) (i)	Residue turns black Colourless solution after filtration *1 mark*	
	(ii)	White Ppt (½) Soluble in excess *(½)* *3 marks*	Al^{3+} Pb^{2+} or Zn^{2+} *(2)*
	(iii)	White Ppt *(½)* insoluble in excess *(½)*	Pb^{2+} or Al^{3}- *(1)*
	(iv)	White ppt	Pb^{2+}
3	a)	Decolourise *(1)*	- C = C – (1) or –OH*(1)*
	b)	Decolourise *(1)*	- C = C – present *(1)*
	c)	Vigorous effervescence *(1)*	Solid M is an acid or ROOH *(1)*

NOVEMBER 1998
MARK SCHEME

1. Table 1

	I	II	III
Final burette reading	25.40	48.00	24.40
Initial burette reading	1.30	24.10	0.40
Volume of solution N(cm^3)	24.10	23.90	24.0

1 mark for accuracy; 1 table ; 1 use of decimal; 1 averaging; 1 final

Total marks 4 marks

Average of solution N = $\frac{24.10 + 23.90 + 24.0}{3}$ *(½ mark)*

= $24.00cm^3$ *1 mark*

a). Concentration of solution N = $\frac{8.8}{40}$ = 0.22M *(½)* *1 mark*

b). 24.0 x 0.22 = 25M (½) M = $\frac{24 \times 0.22}{25}$

= 0.21M (*½)* *1 mark*

Table 2

	I	II	III
Final burette reading	12.50	12.50	29.40
Initial burette reading	0.00	0.0	17.0
Volume of solution N(cm^3)	12.50	12.50	12.40

1 mark for accuracy; 1 table ; 1 use of decimal; 1 averaging; 1 final

Total marks 4 marks

Average of solution N= $\frac{12.50 + 12.50 + 12.4}{3}$ *(½ mark)*

= $12.47cm^3$ (½) *1 mark*

i). $\frac{12.47 \times 0.22}{1000}$ *(1)* = 0.00274 moles *(1)* *2 marks*

ii). 0. 00274 x 4 (½)

= 0.00100 = ans a (i) x $^{100}/_{25}$ *1 mark*

iii). $\frac{0.21 \times 100}{1000}$ = ans (b) x $^{100}/_{1000}$

= -0.021 moles *(½)* = ans a (iii) *1 mark*

iv). 0.02 – 0.0109 *(½)*

= 0.01 *(½)* = ans (ii) - ans (ii)

= ans a (iv) *1 mark*

v). $\frac{0.01}{2}$ *(½)* = ans a (i) / 2

= 0.005 (½) = ans a (v) *1 mark*

c). i). 72 x 0.005 *(½)* = 0.36g (½)

= 72 x ans a (iv) = ans b (i)

ii). $\frac{0.36}{0.5}$ x 100 *(½)*

= ans $\frac{\text{b (i) x 100}}{0.5}$

= 72 % (½) = ans (ii) *1 mark*

a).	Observations	Inferences
	Hissing sound White fumes with choking smell that changes Moist blue litmus paper red and red litmus paper remains red	hydrated salt present (3 marks)

	Colourless liquid condenses on cool parts of test tube *(½)*	
i).	white precipitate *(½)* soluble in excess *(½)*	$Al^{3+}_{(aq)}$ $Pb^{2+}_{(aq)}$ or $Zn^{2+}_{(aq)}$ *(2marks) for all three 1 mark for two)* (3 marks)
ii).	white precipitate *(½)* Insoluble in excess *(½)*	Al^{3+} *(½)* or Pb^{2+} *(½)* *OR Penalise ½ mark each contradiction* (2 marks)
iii).	No white precipitate *(1)* Reject no observable change	Absence of $SO_4^{2-}{}_{(aq)}$ $CO_3^{2-}{}_{(aq)}$ or $SO_3^{2-}{}_{(aq)}$ *(1 mark for all 3 correct ½ mark for 2 correct)Penalize ½ mark each contradiction.* (2 marks)
iv).	White precipitate (1)	$Cl_{(aq)}$ present (2 marks)

3.

a).	Observations	Inferences
	Hissing /sound White fumes with choking smell changing moist red litmus blue Melts into a colourless liquid White sublimate Extinguishes a burning splint *(2 marks for any four observations correct)*	NH_4^+ *(1)* Tied to litmus changing to blue (3 marks)
b).	i). Turns from colourless to green - yellow OR pH 7 -8	Weekly alkaline *(1)* Accept neutral (2 marks)
	ii) White precipitate	L is acidic
c)	- White ppt dissolves on warming - Effervescence	Carboxylic acid; COOH , H^+ Accept acidic compound.

NOVEMBER 1999
MARK SCHEME

1 (a) (i) Table I
Table (T) = 2mks
Decimal (D) = 1mk
Accuracy (A) = 1mk
Principle of Av (PA) = 1mk
Final answer (F) = 1mk

Note: - 3 titration consistent = 2mks
2 titration consistent = 1 ½ mks
2 titrations inconsistent 1mk
1 titration done = 1mk

(ii) Average volume of solution E

(b) (i) No. of moles of basic compound $G_2X.10\ H_2O$
No. of moles of E = $\frac{\text{titre} \times 0.099}{1000}$
No. of moles of F = $\frac{\text{titre} \times 0.099 \times ½}{1000}$
= Ans (4 d.p)

(ii) Conc. of solution F in moles per litre
$25cm^3$ of F = Answer in (b) (i)
$1000cm^3$ of F = $\frac{\text{Ans (b) (I) x 1000}}{25}$
= Ans (3 dp)

(iii) Relative formula mass of basic compound $G_2X.10\ H_2O$
$\frac{15.3}{RFM}$ = Molarity (Ans. (b) (ii)
RFM = $\frac{15.3}{\text{Ans in (b) (ii)}}$ = Ans

(iv) Mass of 10 moles of H_2O = 10 (16 + 2) = 180
2G + 180 + 155 = Ans (b) (iii)
2G = Ans (b) (iii) - 335
G = $\frac{\text{Ans (b) (iii)} - 335}{2}$
= Ans (± 0.5)

2. (a) Table III
T = 5 mks
D = ½
A = 1mk (± 5 secs)
T = 1

(b) (i) S = 1 mk
C = 1 mk
P = 1 mk

(ii) Showing on the graph = ½ mk
Stating correct values ½ mk
Expression t = $\frac{1}{\text{Correct value}}$ = ½ mk
Rate at $7.5cm^3$ (½ mk)

(iii) - Straight line (+ve gradient) = ½ mk
- Rate of reaction increases as concentration
OR
- Rate is directly proportional to concentration
- Straight line (+ ve gradient) = ½ mk

3a).	Observations	Inferences
	- Light green solid turns brown - Colourless liquid/moisture/ vapour condenses on cooler part of test tube - Pungent gas with irritating smell which changes moist blue litmus paper turns red - Red litmus paper remains 2½mks)	- Fe^{2+} present - Hydrated salt/ water of crystallization
bi).	- Green precipitate which is insoluble in excess (1mk)	- Fe^{2+} present (½ mk)
ii).	Yellow /brown/Reddish brown solution	- Fe^{2+} Oxidised to F^{3+}

	Brown ppt. Insoluble in excess(1½ marks)	
iv)	- White precipitate	- SO_3^{2-}, SO_4^{2-}, CO_3^{2-}
II	- White ppt remains	- SO_4^{2-}

NOVEMBER 2000
MARK SCHEME

Table I
- 2 titrations consistent = 1 ½ marks
- 2 titration inconsistent = 1
- 1 titration = 1
- Penalise maximum (- ½ mark) for wrong amounts > 50.0 or 1.0cm^3

Table II

Decimal (D) = ½ mark.
Accuracy (A) = ½ mark
- School value (SV) ± 0.2 cm^3
- If more or less that value = 0 mark.

(iii) I Conc. of Sodium carbonate in moles per litre (RFM Na_2CO_3 = 106)

$\frac{5.6}{106}$ = 0.05283M.

Answer given to at least 3 dp. If not, do not award for answer.
Wrong units ½ mark

II Moles sodium carbonate in 25cm^3 of solution

$\frac{25 \times \text{Ans I}}{1000}$ = Ans

$= \frac{25 \times 0.0528}{1000}$

= 0.0013207mol . (at least 4d.p)

III Moles of hydrochloric acid in total volume of solution used

$NaCO_3$ (aq) + 2 HCl ⟶ 2NaCl (aq) + H_2O + CO_2(g)

Ans (II) x 2 = Ans.

IV Concentration of hydrochloric acid in moles per litre
Total titre in (a) (ii) = Ans in III
Therefore in 1000cm^3 =

$= \frac{\text{Ans III} \times 1000}{\text{Total titre}}$ = Ans 3 d.P

Table III

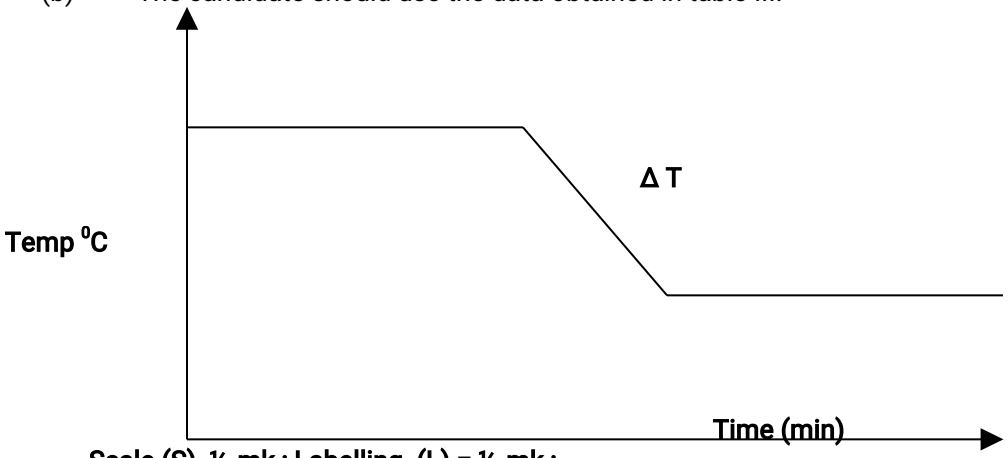
Table (T) = 1 mark
- 8 readings = 1 mk
- 6 readings = ½
- Less than = 0 mk
- Values > 40^0C or < 10^0C (from t = 0 to t = 1 ½) = - ½ mk
  Decimals (D) = ½ mk
  Accuracy (A)
- Compare with school values (SV) at t = 1 ½ if ± 2^0 c = ½ mk ; If not = 0mk
  Trend (T) = 1 mark
- Trend - t = 0 to t = 1 ½ being constant = ½ mk
  OR
- -t = ½ to t 1 ½ being = ½ mk

2^{nd} Trend - t = 2 ½ to t= 4 being constant and lower than between t = 0 to t = 1 ½ = ½ mk.

OR

-t = 3 to t = 4 being constant and lower than between t = 0 to t = 1 ½ = ½ mk

(b) The candidate should use the data obtained in table III.



Scale (S) ½ mk ; Labelling (L) = ½ mk ;
Plotting (P) ½ mk ; Shape (S) = ½ mk

(c) See graph in b above of Temperature change Δ **T**

(d) (i) No. of moles of solid G used. (K = 39.0, N = 14.0, O = 16) 1 mark
RFM of KNO_3 = 101
Moles of G = $^3/_{101}$ = 0.0297(4 d.p)

(ii) Enthalpy of Solution Δ H_{soln} and show sign of Δ H_{soln}
Heat absorbed = 30 x 4.2 x Δ T = Ans.
Heat absorbed by 1 mole = Ans. Above = Ans J/mol
Ans C
Ans in Kj / mol

3	Observation	Inferences
(a)	- Blue residue /solid ppt (1mk) - Colourless filtrate	Cu^{2+} ions present
(b) (i)	- White ppt (1mk) - Dissolves in excess (1mk)	
(ii)	- White ppt (1mk) - Dissolves in excess (1mk)	Al^{3+}, Zn^{2+}, Pb^{2+} present
(iii)	- White ppt (½ mk) - Insoluble in excess	- Pb^{2+} , or Al^{3+} - Zn^{2+} absent
(c)	- No white precipitate is formed	Al^{3+} present Pb^{2+} absent
(d)	- White Precipitate	SO_4^{2-}
(e)	- Blue precipitate - Dissolve in excess to form deep blue solution	- Cu^{2+} present

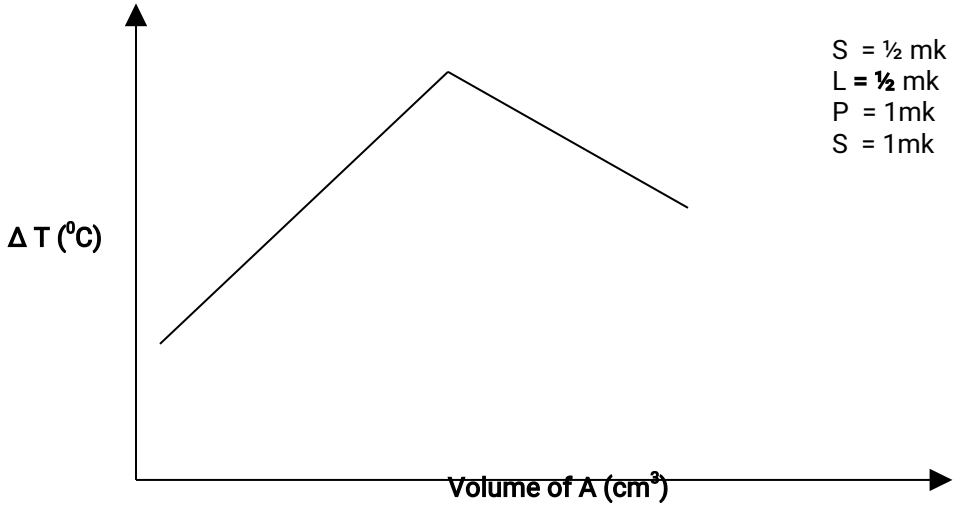
NOVEMBER 2001
MARK SCHEME

1. (a) T = 1mk; AC = 1mk; FA = 1mk, D = 1mk; PA = 1mk

(b) Solution D
Conc. of NaOH
Moles of HCl = Moles of NaOH
Molarity = $\frac{\text{titre} \times 0.128 \times 1000}{1000 \times 25}$
= Ans

Solution A
Molarity of A = $\frac{\text{Ans in (a) above} \times 150}{25}$
= Ans
Or
Ans in (a) above x 6

Procedure II, Table II



S = ½ mk
L = ½ mk
P = 1mk
S = 1mk

(b) From the graph determine the volume of sodium hydroxide, solution A required to neutralize the carboxylic acid
(c) Calculate the volume of carboxylic acid, solution C used for neutralization
(= 20 - Ans (b) above)
(d) (i) = A:C = Ans (b) : Ans (c) = 2: 1
(ii) Conc. In moles per litre of the carboxylic acid solution C
Moles of A = $\frac{\text{Ans. b (ii)} \times \text{Ans (b) above}}{1000}$
Moles of C = ½ x moles of A

Molarity = $\frac{½ \times \text{Ans. b (ii)} \times \text{Ans (b)} \times 1000}{1000 \times \text{Ans (c)}}$

2.	Observations	Inferences
(a)	- Cracking sound - Colourless liquid forms on cooler	- Hydrated salt - Neutral substance

	Parts of test tube. - NO effect on both red and blue litmus papers	
b(i)	- White precipitate	Ca^{2+}, Mg^{2+} or Ba^{2+} present
(ii)	- White Precipitate	Ca^{2+}, Mg^{2+} or Ba^{2+} present OR Mg^{2+} absent ½ mark
(iii)	- White precipitate which dissolves on warming	Cl^- present

3	**Observations**	**Inferences**
a	- Moist blue litmus paper changes to red - Moist on red litmus paper	- Acidic substance / or H^+ present
b	- Brown bromine water is not decolourised	C = C or C = C - **absent** **OR** Saturated compound present ½ C = C or - C = C - **absent** **OR** Saturated compound present ½ Alkene / alkyne absent **½**
c	Purple or $KMnO_4$ is not decolorized Purple $KMnO_4$ colour persists	Absence of C = C or R – OH absent
d	Effervescence or bubbles of gas OR Fizzing / Hissing sound	Acidic Compound present Or H^+ ions

NOVEMBER 2002
MARK SCHEME

a).

Vol of A H_2O_2	Vol. H_2O	Vol of B. H_2SO_4	Vol of C $Na_2S_2O_3$	Vol of D KI	Vol of E Starch		Time (sec)	$^1/_{time}$ sec
25	0	20	5	5	2		18	$56x10^{-2}$
20	5	20	5	5	2		22.5	$4.4x10^{-2}$
15	10	20	5	5	2		29	$3.4x10^{-2}$
10	15	20	5	5	2		43.5	$2.3X10^{-2}$
5	20	20	5	5	2	90.5	90.5	$1.1X10^{-2}$

b). ½ for each axis
2 marks for plotting 5p/s correctly
1 mark for best straight line 4 marks

c). $^1/_{time} = 1.7 \times 10^{-2(l)}$
Time = 58.82sec 2 marks

d). Rate decreases – with the decrease in the concentration of hydrogen peroxide 2 marks

2	Observations	inferences
a	Shiny metal is coated with a Black/grey substance (½)Colourless filtrate obtained (½)	metal G is more reactive than metal whose ions are In solution F (I) OR displacement reaction Occurred
b	No white ppt(1) Or Rej no observable change	Absence of SO_4^{2-} CO_3^{2-} or SO_3^{2-}(ions) award 2 marks for all 3 Award 1 mark for 2 Award ½ mark for 1
c	White PPt (½) Soluble in excess (½)	Pb^{2+}, Al^{3+} or Zn^{2+} as in (b) above 3 marks
d	White PPt (½) which dissolves on boiling (I)	Pb^{2+} (I) present 2 ½ marks
e	White PPt (½) colourless filtrate (½)	Pb^{2+} confirmed (I) 2 marks
f	White PPt (I) Soluble in excess (I)	Zn^{2+} present (I) 3 marks

3	Observations	inferences
a	Melts (½) into colourless liquid (½) burns with a smoky flame (1)	unsaturated organic compound accept long chain hydrocarbon or aromatics
b(i)	The purple $KMnO_4$ decolourised/changes to colourless. The colour of $KmnO_4$ changes from purple to colourless (I) 3 marks	Could be an alcohol or unsaturated compound (I) R – OH , - C = C - C ≡ C - 2 marks
(ii)	Brown bromine is decolorized/ changes t colourless Decolourised (I)	Unsaturated (I) compound 2 marks
(iii)	Turns orange (½) pH = 5 ½ 2 marks	compound is a weak acid (I) 2 marks

NOVEMBER 2003
MARK SCHEME

1. (a) Volume of solution P = 15.0cm^3

(b) Average volume of solution P $\frac{15.0 + 15.0}{2}$ = 15.0cm^3

(c) $\frac{15.0 \times 0.02}{1000}$ = 0.0003 moles

(d) gdm^3 = $\frac{4.18 \times 1000}{250}$

= 16.72gdm^3

$\frac{16.72}{278}$ from (d) above = 0.060M

(e) Moles of Q in 25.0cm^3

$\frac{0.06 \times 25}{1000}$ = 0.0015 moles

(ii) 0.003 moles rxts 0.0015 of Q

1 mole = $\frac{1 \times 0.0015}{0.0003}$

= 5 moles

2. **Procedure I**

(a) Table II Table - ½ mk , Decimal – ½ mk ; Accuracy = ½ mk

(b) Final temp – Initial temp

(c) (i) Heat change when H_2A dissolve in water (assume heat capacity of the solution is 4.2)

$30 \times 4.2 \times \Delta T$ = Ans in J. Or $\frac{30 \times 4.2 \times \Delta T}{1000}$ = kJ

(ii) Number of moles of acid used (RFM of H_2A is 126)

$\frac{1.9}{126}$ = 0.01508 moles

(iii) Molar heat of solution ΔH_1 soln of the acid H_2A

$\Delta H \frac{c\ (i)}{c\ (ii)}$ = J/mole Or Kj/mole

Procedure II

(a) and (b) as in procedure 1

(c) (i) Heat change. (heat capacity 4.2 J/g/^{0}C and density 1 g/cm^3

$60 \times 4.2 \times \Delta T$ = Ans in J or kJ

(ii) Number of moles of the acid H_2A used

$\frac{0.5 \times 30}{1000}$ = 0.015

(iii) Heat of reaction ΔH_2 of one mole of the acid H_2A with Sodium hydroxide

$\Delta H_2 = \frac{C\ (i)}{C\ (ii)}$ = Ans

Or

$\frac{60 \times 4.2 \times \Delta T}{C\ (ii)}$ = Ans. (in J or KJ)

(d) ΔH_3 for the reaction $H_2A\ (s) + 2\ OH^-\ (aq) \longrightarrow 2H_2O\ (l) + A^{2-}\ (aq)$

$\Delta H_3 = \Delta H_2 + \Delta H_2$ = Ans (-ve kJ /mole)

3	Observations	Inferences
(a)	Colourless solution formed	Coloured ions absent e.g Cu^{2+}, Fe^{2+}, or Fe^{3+} absent
(b)	No white precipitate formed	Pb^{2+}, Al^{3+}, Zn^{2+}, Mg^{2+} Or Ca^{2+} absent
(c)	White precipitate formed	Cl^-, SO_4^{2-}, SO_3^{2-}, or CO_3^{2+} present
(d)	White precipitate formed dissolves in HCl (aq)	SO_3^{2-} or CO_3^{2-} present
(e)	Purple $KMnO_4$ is (aq) decolorized or changes to colourless	SO_3^{2-} present Or Reducing
(f)	Green solution formed OR Colour changes Orange to green	SO_3^{2-} present Or Reducing

NOVEMBER 2005
MARK SCHEME

1. (a)

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½
Temp (^{0}C)	82	73	69	68	68	68	66	65

1 Mark fore the two axis
1 mark for all points correctly plotted
1 mark for plot occupying ¾ of the grid provided

b). 68^0C

2

	I	II
Initial temperature of solution KT_1 (^0C)	26	26
Initial temperature of solution L T_2 (^0C)	25	26
Highest temperature of mixture T_3 (^0C)	30.5	31
Average initial temperature (^0C)	25.5	26
Change in temperature ΔT (^0C)	5	5

(5 marks)

Table 1
½ mark for each entry

a). Average $\frac{5 + 5}{2} = 5$ (1 mark)

b). Heat change = 50 x 4.2 x 5 (1)
= 1050 Joules (2 marks)

c). Number of moles of acid L

$$\frac{1050}{143.4 \times 1000}$$

= 0.0078125 (2 marks)

d). $25cm^3$ = 0.0078125 moles

$$= \frac{0.0078125 \times 1000}{25}$$

= 0.3125M (2 marks)

e). Relative formula mass of acid L
60 = 0.3125 – (L)
R.F.M
R.F.M = 192 (l)
(2 marks)

3	Observations	Inferences
(a) (i)	Cracking sound Colourless liquid Gas with pungent smell Colourless gas is produced which changes moist red litmus paper blue (2 marks for four correct observations	N is hydrated a basic gas is formed (½ mark for each) (correct inference)
(i)	White Ppt (½)	Al^{3+} or Pb^{2+} ions, $Mg^{2}+$ ions present
(ii)	No white precipitate is formed	Al^{3+} ion ; Mg^{2+} ion present; Pb^{2+} ions absent
(iii)	White Ppt	SO_4^{2-}, SO_3^{2-} CO_3^{2-} Cl^- 1 mark for two (2 marks)
(iv)	White Ppt	

	persists (l)	SO_4^{2-} ion present –(l) (2 marks)
b(i)	A clear colourless solution (l)	Salt is soluble (l) (2 marks) Acid solution is formed (1)
(ii)	No effervescence (l)	(H^+ absent (l) (2 marks)
(iii)	White solid formed (l) Slightly soluble in excess (½) On addition of $NaHCO_3$ There is effervescence (½) Colourless gas (½) Give maximum 2 marks for observations) (3 marks)	Acid solution is formed (1)

NOVEMBER 2006
MARK SCHEME

1. Table 1

(i)

Volume of water in the boiling tube (cm^3)	Temperature at which crystals of solid A first appear (^0C)	Solubility of solid A (g/100g water
4	66 - 67	112.5
6	56 – 57	75
8	49 – 50	56
10	44 – 45	45

1 mark for temp value within range
½ mark for each value ± 2^0C
½ mark for each value of solubility correctly calculated

(ii) - S – 1; P – 1; C – 1

(iii) 63 ± 0.5 ^0C

	I	II	III
Final burette reading	24.40	48.60	26.20
Initial burette reading	0.00	24.40	26.40
Volume of solution B used (cm^3)	24.40	24.40	24.20

(Award for each titre value ± of the teachers value

I $\frac{24.20 + 24.20}{2}$ = $24.20cm^3$

II $\frac{0.06 \times 24.20}{1000}$ = 1.45×10^3 moles

III $\frac{1.45 \times 10^{-3} \times 5}{2}$ = 3.63×10^{-3} moles

IV $3.63 \times 10^{-3} \times 10$

$= 3.63 \times 10^{-2}$ moles

$= \frac{4.5}{x\ 10^{-2}}$

$= 124$

(iii) DxH_2O

$90 + 18x = 124$

$X = 34$

$= 1.9$

$= 2$

2.

Observations	**Inferences**
(a) Colourless liquid condenses on cool parts of test tube. White solid remains	Probably hydrated salt/ compound (1) present
(b) - Colourless filtrate (½) - White residue	Compound sparingly soluble
(i) Solution turns pink (ii) No effervesnce (iii) White ppt formed (iv) No white ppt	Compound is basic OH^-, HCO_3 or CO_3^{2-} present OH^- present or HCO_3 or CO_3^{2-} absent. Ca^{2+}, Ba^{2+}, Pb^{2+} present (2mks for all three 1 mk for 2 Ba^{2+} present or Ca^{2+} or Pb^{2+}

3.

(a) Burns with luminous (yellow, smoky) flame	Unsaturated compound OR Long chain hydrocarbon - $-\overset{|}{C}=\overset{|}{C}-$ / $-C\equiv C-$ Or Hydrocarbon with high C: H ratio Or aromatic cpd - NB – Each these tied to burning with smoky/sooty flame
(b) (i) Purple Potassium manganate (VII) is Decolourised (changes from purple to colourless	Alkene or alcohol present - $-\overset{|}{C}=\overset{|}{C}-$ or R – OH
(ii) Brown bromine water is decolorized (Changes from red to Colourless)	Alkene present // $-\underset{|}{C}=\underset{|}{C}-$ present

NOVEMBER 2007
MARK SCHEME

1. a).

	I	II	III
Final burette reading	21.8	21.6	43.6
Initial burette reading	0.0	0.0	22.0
Volume of D used (cm^3)	21.8	21.6	21.6

(3 marks)

i). $\frac{21.6 + 21.6}{2} = 21.6cm^3$ (1 mark)

ii). R.F.M of Na_2CO_3 = 106

Conc. $\frac{8}{106}$ = 0.075M

iii). Moles of Na_2CO_3 $\frac{25 \times 0.075M}{1000}$

= 0.001875

Moles of H_2SO_4 = 0.001875

Conc. of H_2SO_4 = $\frac{0.001875 \times 1000}{21.6}$

= 0.0868M

(2 marks)

iv). 0.0868 x 10 = 0.868M

(1 mark)

b). i).

Test-tube number	1	2	3	4	5	6
Volume of solution A (cm^3)	2	4	6	8	6	4
Volume of solution C (cm^3)	14	12	10	8	10	12
Initial temperature of solution C (^0C)	20.5	20.5	20.5	20.5	20.5	20.5
Highest temperature of mixture (^0C)	23	25.5	28.0	29.5	26.5	24.5
Change in temperature ΔT	2.5	5.0	7.5	9.0	6.5	4.5

ii). Graph

(3 marks)

iii). I $\Delta t = 9.5 + 0.1^0C$ (1 mark)

II Maximum volume of A = $7.6cm^3 + 0.1$

iv). I Moles of sulphuric acid = $\frac{7.6 \times 0.868}{1000}$

= 0.0066 moles (1 mark)

II Heat evolved = 16 x 4.2 x 9.5

= 638.4 joules

Molar Heat = $\frac{638.4}{0.0066}$

= $96.727272KJ\ mol^{-1}$ (2 marks)

2	Observations	Inferences
(a)	Gas with pungent/irritating/choking smell is produced which changes moist blue litmus paper turns red Colourless liquid formed on cool part of test tube Solid turns reddish brown	hydrated salt acidic gas evolved
(b) (i (ii)	Reddish brown solution pH 1, 2, 3 Brown precipitate insoluble in excess Brown /Black solid formed or solution	strongly acidic Fe^{3+}

(iii) (iv)	Changes from yellow to brown White precipitate settles at the bottom of the test tube	Iodide ions/ I^- ions present

3	Observations	Inferences
(a)	Clear blue flame	saturated low carbon organic compound (2marks)
(b)	No separation or forms a solution two liquids are miscible	Mixture is miscible or polar organic compound (1 mark)
(c)	No effervescence	Liquid not acidic or absence of H^+ (2 marks)
(d)	Solution changes from orange to green	F is likely to be Alcohol or R-OH (2 marks)

NOVEMBER 2008
MARK SCHEME

1. PROCEDURE

TABLE 1 **(4 Marks)**

Award a total of 4 marks distributed as follows

i). Complete table (1mark)
ii). Table with 10 readings (1mark)

a). Penalties

i). Penalize ½ km once for any space not filled subject to at least 5 readings being given otherwise penalize fully

ii). Penalize ½ mark for unrealistic temperature reading (i.e. from t=o min to t =2m if reading of T40^{0}C or T> 40^{0}C) for the whole table once.

iii). If temperature reading are all constant from t=o to t=5 min penalize ½ mark on complete table

iv). Penalise ½ mark on complete table if temperature reading at t=30min is either the same on greater higher than the temperature reading at t=2 min

v). If 2 or more rows of temperature reading are given, penalize ½ mark on complete table and mark table based on the row used to plot the graph. However, if the graph is not drawn then mark the first row of readings.

b). Use of decimals *(1 mark)*

i). accept temperature readings and award 1 mark only. If consistency given either aswhole numbers a to 1 decimal place otherwise penalize fully

ii). Reflect and ward 0 mark if decimal place has other values other than a '0' or '5' e.g. 20.2, 18.9

c). Accuracy

Compare the S.V. to the candidates temperature reading at 2 min and award 1 mark if the reading is within +2.0^{0}C of the S.V. otherwise award zero mark

Note

S.V refers to the teacher's temperature readings at t = 0 min where all the five initial temperature reading are the same or the temperature reading at t=2 minutes in case the 5 initial temperature readings are not the same

d). Trends **(1 mark)**

Award two halves as follows

i). If temperature reading from 0 to 2 min are constant award ½ mark or at least from E-1

ii). Award ½ mark if temperature readings from t=3 min to t=5 min shows a rise after the initial drop without another drop

Note

i). The reaction is endothermic a hence temperature must drop if not penalize ½ (in 3 minutes) on trend. i.e. to award the 2nd ½ mark for the trend there must have been a drop in temperature after 2 ½ minutes

ii). Reject trend in the 2nd part of the table the addition of solid A to the acid otherwise accept a minimum of two readings if they are lower and show a rise

- Show the tick accuracy on the table

GRAPH

Award a total of 3 marks distributed as follows

a). Labeling of axes …… ½ mark

award ½ mark only if both axes are correct labeled (i.e. temperature on vertical and time on horizontal)

Penalties

i). Penalise fully for inverted axes

ii). Penalise fully if wrong units are used otherwise ignore if units are omitted /not used

iii). Penalise fully if one axis is correctly labeled

b). Scale …… ½ mark

Conditions

i). Area covered by plots should be at least half the provided on both axes i.e. at least 5 big squares on vertical and 4 ½ big squares on horizontal

ii). Scale intervals must be consistent

iii). Scale chosen must be able to accommodate all points or plots whether plotted or not check range of readings on the axes.

Note

Penalise fully if any of the above conditions are not met

c). Plotting ……1 mark

i). If 10 or 9 points are correctly plotted award 1 mark

ii). If 8 or 7 points correctly plotted award ½

iii). If less than 7 points are correctly plotted award 0 marks

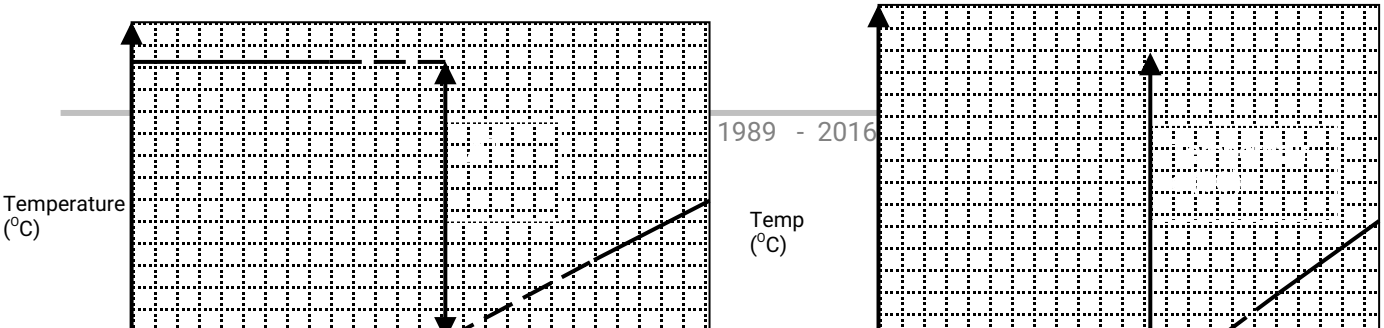
2. If scale interval changes mark plots (if any) within the first scale interval and treat to rest of the plots even if the axes are inverted or interchanged and award accordingly

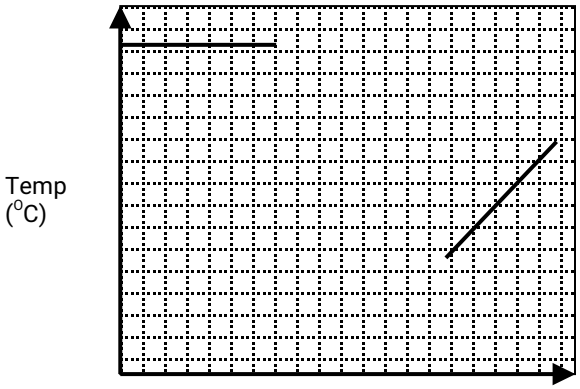
d). The lines and extrapolation ……(1 mark)

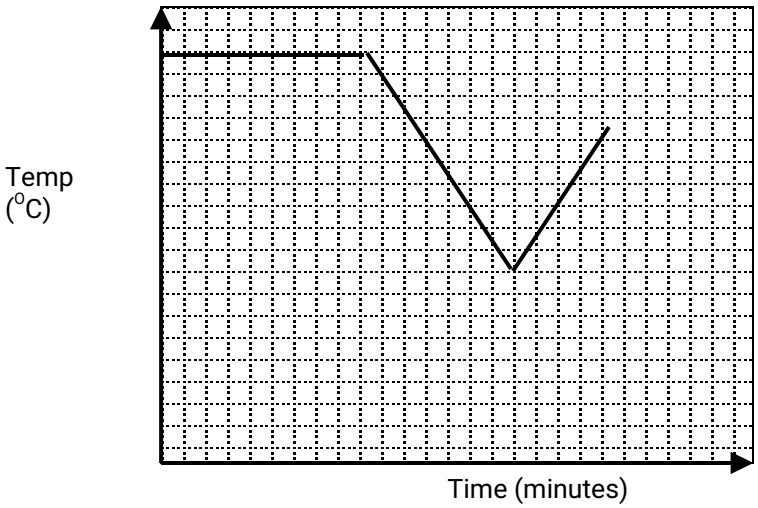
i). Award ½ mark if the plots are joined by two straight lines, accept the lines of best fit

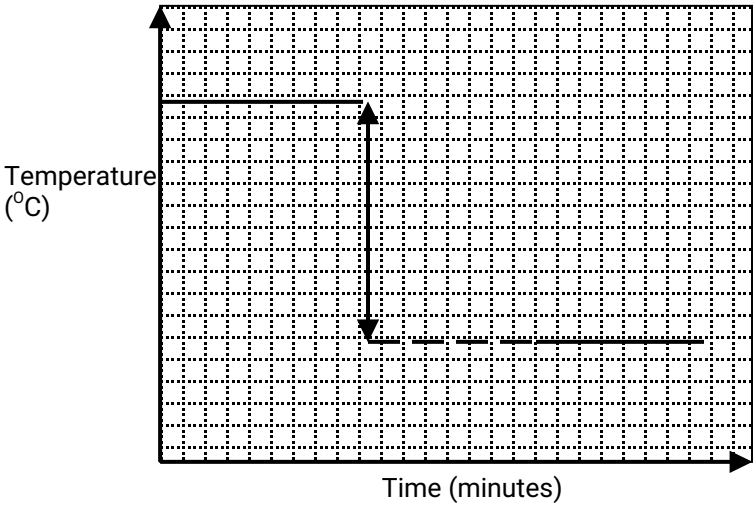
ii). Award another ½ marks if for extrapolation where each of the two lines is extended to the 2 ½ minutes mark

iii). Accept lines and extrapolation even if the axes are inverted









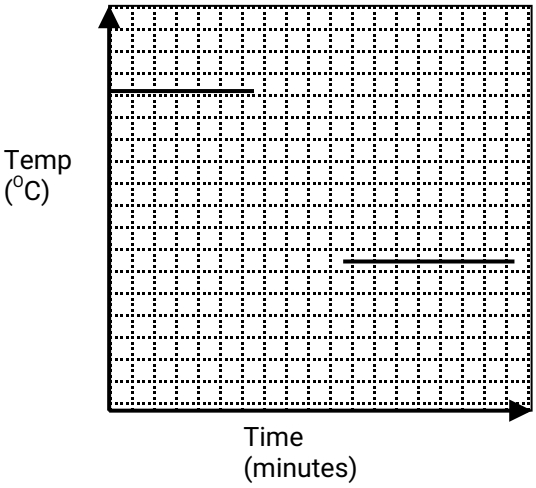


Table 1

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	5
Temp (^{0}C)	18.0	18.0	18.0	18.0	18.0	X	13.0	13.0	13.5	13.5	14.0

ii). ΔT = Correct reading 6^0C 1 mark

Conditions

a). Accept the correct value of ΔT from an extrapolated correct graph with or without showing on the graph for 1 mark

b). award ½ mark for correct showing on an extrapolated correct graph if reading for ΔT is wrong or missing

c). Ignore sign for ΔT

d). Penalise ½ mark for wrong units used otherwise ignore if no units are used/shown

e). Reject readings/showing from a wrong graph and award 0 mark for ΔT reject ΔT if coming from the table or wrong graph but accept in (iii) below if used correctly

f). Reject ΔT if from the table or wrong graph but accept if it is used correctly otherwise penalize fully if ΔT is strange

iii). $\Delta H = MC\Delta T$ √(expression)

= 20 x 4.2 x Answer (ii) above(6)

= 504 joules

Or

$\Delta H = MC\Delta T$

$= \frac{20 \times 4.2 \times \text{Answers (ii) above}}{1000}$

= Correct Answer

Table 2

	I	II	III
Final burette reading	16.50	32.20	32.20
Initial burette reading	0.00	16.00	16.00
Titre (cm^3)	16.50	16.20	16.20

Award a total of 5 marks distributed as follows

(i) Average Titre = $\frac{16.20 + 16.20}{2}$ = 16 .20cm^3

(ii) The number of moles of:

I Moles of NaOH used = $\frac{0.1 \times \text{Titre}}{1000}$

II Moles of NaOH: HCl = 1 :1

Moles of HCl = Ans I above Or Moles of HCl in 25cm^3 of soln = Ans I above.

III Ans $\frac{\text{II} \times 250}{25}$ = correct answer

Or

Ans II x 10 = Correct Ans

Conditions

i). Penalise ½ mark for wrong transfer of answer (II)

ii). Penalise fully for strange figure

iii). Answer as expected otherwise penalize ½ mark (don't work at accuracy, d.p) for wrong answer

Notes

i). Award fully if correct answer given is based on statement implying multiplication of ten

IV). $\frac{2 \times 20}{}$

1000 = 0.04

Answer as expected otherwise penalize ½ mark

V) Moles of HCl reacted with solid A = Ans IV – Ans III

= Correct Ans

Conditions

Answer (IV) III must be transferred intact otherwise penalize ½ mark for wrong transfer of either of item or both. However for strange figures penalize fully.

Note

i. If soluble or dissolve is not given but blue ppt mentioned accept and award 1 mark for blue solution

ii. If ppt and dissolve are not mentioned but a candidate mentions deep blue solution in excess credit ½ mark and reject the inference.

c). Ans (iii) Procedure A = Correct ans

ANS v UNITS j Mol- OR Kj Mot

Or

Ans v = Ans iii procedure A

: I Mole of HCl = $\frac{\text{Ans (iii) Procedure A}}{\text{Ans V}}$

$= \frac{\text{Correct Ans}}{\text{JMol}^{-1}}$

Or

Ans v = Ans (i) Procedure A (Joules)

; 1 Mole of HCl = $\frac{\text{Ans (iii) Procedure A}}{\text{Ans V x 1000}}$

Jmol^{-1} or KJ mol^{-1}

2	Observations	Inferences
a	Green solid turns black/ Green solid forms black solid/ residue ; Colourless liquid forms on the cooler part of the test tube/ Colourless vapour condenses on the cooler part of the test tube ; Blue litmus turns red; Red litmus remains red/ the same colour. Penalise fully for contradiction on colour properties *Rej. Colourless liquid condenses / colourless vapour forms/moisture condenses/No effect on red litmus/Red litmus remains the same colour*	- Hydrated salt/compound or contain water of crystallization (Tied to colourless vapour condensing) Acidic gas produced (Tied to blue litmus turning red.
b	Black solid / residue reacts dissolves to form green solution Or Green solution formed Ignore – No effervescence Rej. Blue solution/ No change/ reaction	Black solid/ residue is basic/ Colored ion present / or Cu^{2+}, Fe^{2+} ions present
c (i)	Blue ppt/ suspension /solid formed / Blue ppt dissolves in excess aqueous ammonia to form a deep blue solution	Cu^{2+} Present (tied to blue ppt and deep blue solution Must
(ii)	Effervescence occurs / bubbles formed/ Fizzing; Rej hissing/ Brown/ reddish brown solid deposited/ Green solution turns colourless / Test tube becomes warm /hot	E is a metal above copper in the ECS / Metal E displaces copper/ metal E is more reactive than cooper / metal E reduced Cu^{2+} ions to Cu (Tied to brown solid deposit)

3	Observations	Inferences
a	Burns with a yellow sooty smoky flame ½ mark Burns with a luminous sooty/smoky flame	– long chain/ unsaturated organic/ hydrocarbon with a high C: H ratio C = C or - C = C ½ marks ***Reject*** *C = C, C = C* *Carbon to carbon double or triple bond in words* *Alkaline /alkaline*
b	Dissolves/ soluble to form a colourless solution	Polar organic compound Note Accept soluble /substance/salt/compound present
c (i)	Effervesnce occurs or bubbles are formed	R – COOH / H^+/ H_3O^+ *Accept - Acidic compound /solution* *Organic compound ; Carboxylic acid*
(ii)	Orange colour $K_2Cr_2O_7$ solution persists / remain the same / orange / orange colour *Rej – Yellow used in place of orange* *$K_2Cr_2O_7$ not decolourised*	R – OH absent *Note : Penalise fully if any other functional groups are mentioned*
(iii)	Purple $KMnO_4$ soln is decolorized or $KMnO_4$ soln changes from purple to colourless *Note : Rej Solution remains / becomes / turns colourless*	- C=C- / C ≡ C - present *Accept for unsaturated organic compound present*

NOVEMBER 2009
MARK SCHEME

1.

	I	II	III
Final burette reading	22.20	21.50	22.50
Initial burette reading	0.00	0.00	1.00
Volume of solution C used (cm^3)	22.20	21.50	21.50

(4 marks)

a). i). Average volume of solution C used

$= \frac{21.50 + 21.50}{2}$

= 21.50 (1 mark)

ii). Moles of sodium hydroxide in the average volume of solution C used.

$100cm^3$ of sodium contains 0.3 moles of NaOH

$21.50cm^3$ of solution contains $\frac{0.3 \times 21.5}{1000}$

= 0.00645 moles (1 mark)

iii). Moles of hydrochloric acid in $25.0cm^3$ of solution D

= 0.00645 moles (1 mark)

iv). Morality of hydrochloric acid in solution D.

$25cm^3$ of solution contains 0.00645 moles Hcl

$100cm^3$ of solution contains $\frac{0.00645 \times 1000}{25}$

= 0.25M (1mark)

Table 2

	I	II	III
Final burette reading	21.50	20.90	20.90
Initial burette reading	0.00	0.00	0.00
Volume of solution D used (cm^3)	21.50	20.90	20.90

(4 marks)

b). i). Average volume of solution D used

$$\frac{20.90 + 20.90}{2} = 20.90cm^3$$ (1 mark)

ii). Moles of hydrochloric acid in average volume of solution D used $1000cm^3$ of solution contains 0.258 moles of HCl

$20.90cm^3$ of solution contains $\frac{0.258 \times 20.90}{1000}$ moles

= 0.0054 moles (1 mark)

iii). Moles of the metal carbonate, solid A in $25.0cm^3$ of solution A.

Mole ratio of acid to carbonate 2: 1 (1 mark)

½ x 0.0054

= 0.0027 moles (1 mark)

iv). The solubility of the metal carbonate in g/100g of solution

mass of carbonate = 0.0027 x 74

in $25.0cm^3$ of solution = 0.1998g

100g of solution will contain $\frac{0.1998 \times 100g}{25}$ of carbonate

= 0.7992g/100g of solution (1 mark)

2. a).

Observations	**Inferences**
Colourless liquid Condenses on the cooler parts of test tube Gas produced forms white fumes with fumes HCl. (2 marks) Or solid sublimes/forms a white sublimate white solid formed on the cooler parts of the test tube	hydrated salt/ compound or contains water of crystallization (Tied to Colourless liquid forming after condensation Ammonia gas (NH_4^+) present (tied to gas forming with HCl

b). i).

Observations	**Inferences**
White ppt. insoluble in Excess aqueous ammonia (1 mark) for each	Pb^{2+} or Al^{3+} Present (1 mark) Note: Ignore Mg^{2+} if mentioned as as present. Penalise ½ mark Contradictory ion given to a max penalty of ½ mk.

ii).

Observations	Inferences
No white ppt / No white solid No white suspension or Al^{3+} present tied to white ppt Rej. No observable change No ppt / change/reaction No white substance Colourless soln formed Soln remains colourless No colour change	Pb^{2+} absent No effervescence/ No bubbles Note: if a candidate mentions Place of Al^{3+} present credit ½ CO_3^{2-} and SO_3 absent Tied to no Effervescence. (2 marks) *NB. To award 'Al^{3+} present it must have been credited in b (i) ; To award Pb^{2+} absent it must have been mentioned as present in b (i); Ignore mention of Ag^{+} absent*

Pb^{2+} in

iii).

Observations	Inferences
White ppt /solid/suspension which does not dissolve on boiling (1 mark)	- SO_4^{2-} present - If a candidate mentions Cl^- without giving SO_4^{2-} present award ½ mark *Penalise fully for any contradictory ion* *Formulae of the ion must be given correctly in all the above inferences.* *Rej ions given in words only (2 marks)*

3. a).

Observations	Inferences
White solid dissolves to form a colourless solution (1 mark) *Accept a colorless solution formed* *Without mention of dissolve or soluble* *For 1 mark* *Forms a solution / clear solution without* *Mention of dissolve or soluble for 1 mk*	F is a non polar compound (1 mark)

i)

Observations	Inferences
P^H = 7 (1 mark) *Note: Ignore mention of colour of mixture; Reject pH range*	Neutral solution (1 mark) *Accpt: Soln neither acidic nor alkaline* *Rej basic used in place of alkaline*

ii).

Observations	Inferences
No effervescence/ No bubbles (1 mark)	H^+ absent *Accept soln not acidic for ½ mk in the absence of H^+ absent* *Ignore R – COOH absent*

b). i).

Observations	Inferences
Effervescence giving off a Colourless solution formed *Accept Fizzing used in place of Effervescence or bubbles for* (1 mark)	Carboxylic/alkanoic acid preset Or – COOH present/ H^+/ H_3O^+ (1 mark)

ii)

Observations	Inferences
Does not turn green. Orange Color of $K_2Cr_2O_7$ (1 mark) *Note both initial colour and Final colour must be given Otherwise penalize fully* Accpt: Orange colour of *$K_2Cr_2O_7$ solution persists / remains;* Rej: Yellow used in place of orange	Alcohol absent / R - OH Rej – OH (2 marks)

iii).

Observations	Inferences
Bromine water not decolourised Accept yellow/ Orange / red colour of bromine water persists / remains (1 mark)	C = C / - C = C - absent Accept unsaturated organic compound absent for ½ mk. Penalise fully for any contradictory / functional groups (1 mark)

NOVEMBER 2010
MARKSCHEME

Q1. Table 1…… 5 marks

a). Complete table ……. 1 mark

NOTE; i). In case there was wrong arithmetic /substration in the table, use the correct values in averaging for the final answer.

ii). Where there are two possible average titles use the value which gives the candidates maximum credit.

iii). If wrong values are averaged, pick the correct values (if any) following the principles of averaging, average and award accordingly.
e.g. 1 S.V = 15.80cm^3
Conditions values are 15.4cm^3, 15,6cm^3, 15.8cm^3

Candidates working

Either $\frac{15.4 + 15.6 + 15.8}{3}$ = 15.60cm^3 (1 mark)

OR $\frac{15.4 + 15.6}{2}$ = 15.5cm^3 (1 mark)

Examiner to pick = $\frac{15.6 + 15.8}{2}$ = 15.7cm^3 (1 mark)

2 S.V = 15.50cm^3

Candidates values are 15.8, 15.6, 15.6

Candidates working

$\frac{15.6 + 15.6}{2}$ = 15.6cm^3 ½ mark

3 S.V = 15.90cm^3

Candidate's values are 16.0, 15.8, and 15.6

Candidates working

$\frac{15.8 + 15.6}{2}$ = 15.70cm^3

And award 1 mark instead of ½ mark if the candidates value are used

CT – 1; D - 1; A – 1; PA – 1; FA - 1

CALCULATIONS

i). No. of moles of NaOH in 25cm^3 of solution B = $\frac{2 \times 25}{1000}$

Moles of NaOH in 250cm^3 of solution D = $\frac{2 \times 25}{1000}$

Hence Conc. of solution D = $\frac{2 \times 25}{1000} \times \frac{1000}{250}$

= 0.200 mols

Or

Conc of solution D = $\frac{2 \times 25}{1000} \times \frac{1000}{250}$

= 0.200 mol L

Or

$M_c V_c = M_d V_d = M_1 V_1 = M_2 V_2 / M_g V_g = M_d V_d$

Md (Or M_2) or md = $\frac{2 \times 25}{100}$

Or

Conc of solution D = $\frac{2 \times 1}{10}$

= 0.200 mol-1

iii). Moles of NaOH in 25cm^3 of solution D used

= $\frac{\text{Ans (II)} \times 25}{1000}$

Moles of alkanoic acid used = $^1/_3$ x ans (II) x $\frac{25}{1000}$

Hence conc of solution C = $^1/_3 \times \frac{\text{ans (II)} \times 25}{1000} \times \frac{1000}{\text{Titre}}$

= correct ans.

OR

Conc of solution C = $^1/_3 \times \frac{\text{ans (II)} \times 25}{\text{Titre}}$

= Correct ans.

OR

$\frac{M_a V_a}{M_b V_b} = \frac{^1/_3}{} = M_a = {}^1/_3 \times \frac{\text{ans (II)} \times 25}{\text{Titre}}$

= correct answer

iv). Molar mass of the alkanoic acid

= 25.0
Ans (III)
= Correct answer

Note: i). Penalise ½ mark for wrong transfer of ans (III) otherwise penalize fully for strange figures used.
ii). Penalise ½ mark for wrong answer if arithmetic error is outside +5 units in the 1st d.p
iii). Penalise ½ mark for either omission of the (g) units or for wrong units used

Procedure

Table II…… 6 marks

GRAPH

a). Labelling of axes …… ½ mark
to award the ½ mark both axes must by correctly labelled

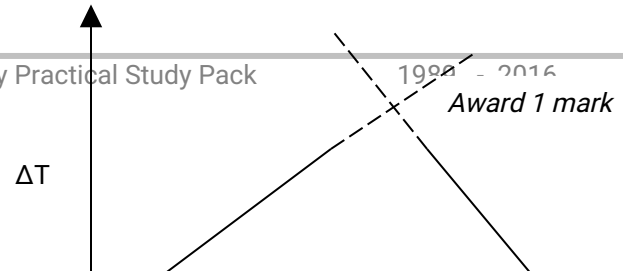
Conditions
i). Penalise fully for wrong units used otherwise accept correct labeling even if no units are shown
ii). Penalise fully if only one axis is correctly labelled
iii). Change in temperature (ΔT) must appear on the vertical axis and volume of solution A on horizontal axis, otherwise penalize fully for inverted Axes
iv). Reject labeling of axes if temperature alone is used instead of change in temperature (ΔT) in vertical axis.

b). Scale …… ½ mark
i). Area covered by the actual plots must be at least 3 ½ big square (vertical axis) by 4 ½ big square (horizontal axis)
ii). The scale internal must be constant on each axis
iii). Scale chosen must be able to accommodate the plots, whether plotted or not (chalk the range of values on both axes)
NB: i). Penalise fully if any of the above conditions is not met
ii). Award for the scale even if the axes are in interchanged so long as the above conditions are met

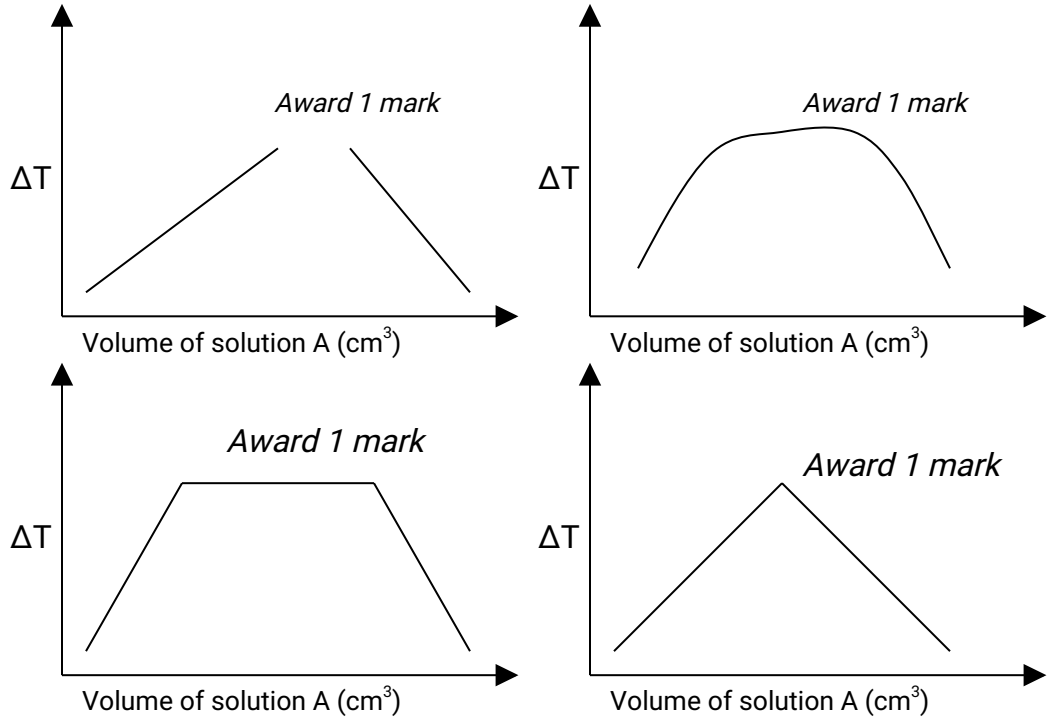
c). Plotting …….. ½ mark
i). For 5 or 6 points plotted correctly award 1 mark
ii). If 4 or 3 points are correctly plotted award ½ mark
iii). For less than 3 points correctly plotted award 1 mark
iv). If the scale interval changes, make the plots (if any) in the first scale interval only. Consider the rest of the plots (If any) as wrong plots
v). Accept the correct plots even if the axis are inverted /interchanged

d). The line/shape…….. 1 mark

Conditions
i). Award ½ mark for straight line showing a risk
ii). Award another ½ mark for an extrapolated line showing a drop
NB: *Accept lines of best fit*
iii). If the axes, are interchanged /inverted reject the lines and the readings from the graph in (b) but accept the reading in subsequent workings in (c) and (d)



iv). Accept any one of the following for ½ mark



b). Volume of solution A= V cm

NB:

i). Accept correct reading of V with or within showing on extrapolated graph for 1 mark

ii). If shown on the graph correctly but reading is wrong or not given award only ½ mark for correct showing on the graph

iii). Penalise ½ mark for wrong units otherwise ignore if units not given

iv). If value of V > 25cm^3 reject and award

vi). Reject showing and reading of V from a wrong graph but accept in (c) below if need correct

c). Volume of B = 30 – Ans (b) above (30 –v)
correct ans.

NB; i). V of 30cm^3 is unrealistic and unacceptable and hence penalize fully and consequently. Reject working in both d (i) and d (ii) below and award o mark in each case

ii). Penalise ½ mark for wrong units and another ½ mark if working not shown

d). i). Ratio of volume A and B
= Ans (b); Ans (c)
Or
Ans (c); Ans (b)
= 1: 1

NB: If ratio is not 1: 1 penalise ½ mark but accept the ratio in d (ii) if used correctly

Moles of acid used = Moles of NaOH

Molarity of acid $= \frac{2 \times \text{Ans (c)}}{1000} \times \frac{1000}{\text{Ans (b)}}$

= corr. Ans

OR

Conc of solution A $= \frac{2 \times \text{Ans (c)}}{\text{Ans b}}$

= Correct Ans

OR

$M_A V_A = M_B V_B$

$M_A = \frac{2 \times \text{Ans}}{\text{Ans(b)}}$

= Corr. Ans

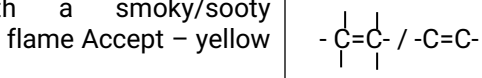
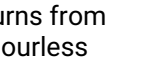
Conditions

i). Accept answer tied correct arithmetic otherwise penalise ½ mark for arithmetic error outside +2 marks in the 1st d.p

ii). Penalise ½ mark for wrong transfer of ans in (c) or (b) in both otherwise penalise fully for strange figure in either

NB: Penalise fully for any calculation noted beyond the expected ans.

2	**Observation**	**Inferences**
a (i)	White ppt	$B^{2+}Ca^{2+,}Ba^{2+,}$ If all the 3 given 2 marks If only 2 given – 1 mark If only 1 given – ½ mark ***Note***: for any contradictory mark out of 1 ½ ,penalize ½ mark for any contradictory
ii)	White ppt which dissolves in excess. reject residue Suspension Accept white solid	Pb^{2+}, NB: Credit Pb^{2+} only if mention in (i) above, penalize fully for any contradiction
iii)	White PPt	-F contains SO_4^{2-}, Cl^-, $SO_3^{2-,}$ Cl^-, or $SO_4^{2-,}$ Cl^-, SO_3^{2-}, CO_3^{2-}, 4 ions given – 1 mark 3 or 2 ions given – ½ mark ions given – 0 mark Penalties

		Penalise fully if candidate E contains the above ions – penalize ½ mark for contradictory ions
iv)	Yellow PPt	Pb^{2+} Penalise fully for any contradictory ions
bi)	Burns with a smoky/sooty flame/sooty flame Accept – yellow sooty	 Accept ; long chain hydrocarbon, carbon; hydrogen ratio *Penalise fully for any contradictory functional group.*
(ii) **I**	I pH is 1 or 3 accept red for ½ mk but reject inference given but reject inference given on its strength *Reject PH range, penalize Fully for colour and correct* *PH NB: If a wrong colour*	strongly acidic Reject – acidic given alone G – is a strong acid ignore – carboxylic acid
II	$KMnO_4$ decolourised Or $KMnO_4$ turns from Purple to colourless Reject $KMnO_4$ turns colourless Solution turns colourless Solution decolourised Solution discolurised	 R – OH ½ Reject the groups in words – OH Penalise ½ mk for each contractor functional group
iii	Effervescence /bubbles /fizzing odourless gas odourless to differentiate between SO_2 & CO_2 *Reject ; Hissing* *Odourless mentioned alone*	CO_3^{2-} present in F (tied to part (a) (iii) Ignore mention of acid ii). Penalise fully for contradiction iii).The inference is tied to effervescence bubbles and odourless

NOVEMBER 2011
MARKSCHEME

Conditions (ii)

a) Value 1.60 must be intact otherwise penalize fully
b) Ans. Should be at least 3 dec. place
c) Penalise ½ mark for arithmetic error if outside + 2 units in the 3rd depth

d) Units may not be given but if given must be correct penalize ½ mark for errors units used

	1	**2**	**3**
Final burette reading	29.70	33.40	44.60
Initial burette reading	0.00	4.00	15.30
Volume of solution A used (cm^3)	29.70	29.40	29.30

ii). **Concentration in moles per litre of the dibasic acid in solution A**

Relative molecular mass of A is 126.

$\frac{1.60 \times 1000}{250} = 6.4$ $\quad \frac{1.60}{126} = 0.0127$ moles in a litre $\quad \frac{1.60 \times 1000}{126 \quad 126} \quad \frac{1.60 \times 4}{126}$ $= 0.051M$

126 = 0.05 $\frac{0.0127 \times 1000}{250}$

= 4 x 0.00127

= 0.051

2 marks

iii). Moles of the dibasic acid used;

$\frac{\text{Answer in (ii) above x litre}}{1000}$

= correct answer 1 mark

iv). Moles of sodium, hydroxide in 25.0cm^3 of solution C

Ans in (iii) above x 2

=correct answer

1 mark

v). Concentration of sodium hydroxide in moles per litre

$\frac{\text{Answer (iv) above x 1000}}{25}$ Answer (iv) above x 40

Correct answer Or $\frac{Mb = \text{Ans (iv) above x titre x 2}}{25}$

Correct answer

Or Ans (iv) x titre

Mb x 25

= Correct answer

i). Calculate the;

i). Average volume of solution A used;

	1st Conical flask	**2nd Conical Flask**
Final burette reading	21.20	33.60
Initial burette reading	9.70	21.20
Volume of solution A used (cm^3)	11.50	11.40

ii). Moles of the dibasic acid used:

Ans (ii) procedure II x titre (table 2)

1000

= Correct ans

1 mark

iii). Moles of sodium hydroxide that reacted with the dibasic acid

= Ans (ii) above x 2

= Correct ans

1 mark

iv). Moles of sodium hydroxide that reacted with 25.0cm^3 of salt B in solution B;

=Ans (iv) procedure II = Ans (iii) above

=Correct ans.

2 marks

v). **Given that I mole of salt B reacts with 2 moles of sodium hydroxide, calculate the;**

I. Number of moles of salt B in 25.0cm3 of solution B

$\frac{\text{Ans (iv) above}}{2}$

Correct ans

1 mark

II. Concentration in moles per litre of salt B in solution B

Ans I above x 1000

25

Ans I above x 40
= Correct ans

1 mark

III. Relative molecular mass of salt B;
= $\frac{4.75}{\text{Ans in II above}}$
= Correct answer > and > 140 penalise ½ mark for ans

2. a).i).

Observation	**Inferences**
Gas that turns moist litmus paper Blue given off	NH_4^+ present (tied to red litmus turning blue)
Condenses on the cooler parts of The tube to form colourless liquid Droplets	Solid D is hydrated /Solid D contains water of crystallisation (tied to idea of condensation)
White sublimate formed solid Sublimes to form white sublimate	
A gas given off that turns moist blue Litmus paper red	
A brown residue /solid formed	

NB: Ignore mention of any other ions present

ii).

Observations	**Inferences**
Yellow /brown solution formed	Fe^{2+} oxidized to Fe^{3+}
On addition of H_2O_2 solution	or
Brown ppt formed which is in soluble	Fe^{3+} formed
In excess NaOH solution NB: ignore	Accept Fe^{3+} present in
Mention of initial colour of solution unless It contradictory	mixture of Fe^{2+} in solution

NB: Reject Fe^{3+} present /solid or solution D contains Fe^{3+}

b). i).

Observations	**Inferences**
A white ppt formed	SO_4^{2-}, SO_3^{2-} CO_3^{2-} present

NB: Penalise ½ mark for each contradictory ions for a max of (1 ½ mark)

ii). To the mixture obtained in (i) above, add about 5 cm^3 of 2M nitric acid (V) acid

Observations	**Inferences**
Effervesces occurs /bubbles of Gas seen	SO_3^{2-} presents
The white ppt dissolves disappears	*NB: credit only if correctly inferred*

Correct inference tied to either observation or both
Penalise ½ mark for each contrition to a max of 1 mark
Ignore SO_4^{2} mentioned as absent

iii). To portion two of solution E in a test-tube, add 2 drops of acidified potassium dichromate (VI) and warm the mixture

Observations	**Inferences**
Acidified $K_2Cr_2O_7$ solution	SO_3^{2-} presents
Changes from orange to green	*NB: credit only if correctly inferred*

Correct inference tied to either observation or both
Penalise ½ mark for each contrition to a max of 1 mark
Ignore SO_4^{2} mentioned as absent

3 **a).** **Observations** **inferences**

Burns with a blue flame — Reject C = C / C C absent

Saturated organic compound/organic
Compound with low C: H ratio
Absence of unsaturated organic compound
Ignore R-OH if mentioned

b). **Observations** — **Inferences**

No of effervescence /No bubbles /No of fizzing — Absence of H^+ or liquid is not acidic

Ignore does not dissolved — Absence of R- COOH

No reaction — Ignore H_3O^+ if mentioned

Reject: No hissing on it's own

c). **Observations** — **Inferences**

$K_2Cr_2O_7$ changes from orange to green/solution changes from orange to green — R - OH

Reject; 1 – alcohol written in words 2-OH

Reject: soln turns green, NB: Penalise fully for any contradicting functional groups

NOVEMBER 2012
MARKSCHEME

1. Question I – Procedure

a). i). Moles of Sodium thiosulphate (Solution B)

$$\frac{0.05 \times \text{Average titre}}{1000}$$

= Correct answer

Conditions

b). i). Moles of solution A in $25.0cm^3$

Moles ratio moles of A : Moles of $Na_2S_2O_3 . 5H_2O$

1 : 6

Moles of A = 1

Moles of Na_2SO_3 SH_2O

Moles of A = $\frac{\text{ans a (ii) moles}}{6}$ = Correct answer

ii). Concentration of A in moles per litre

$25cm^3$ of A contains ans b(i) above

$1000\ cm^3$ of A contains

$$\frac{\text{Ans b(i)} \times 1000}{25}$$

= correct answer

OR

Ans b(i) x 40

= Correct answer

OR $\frac{M_A V_A}{M_B V_B} = \frac{1}{6}$

$M_A = \frac{0.05 \times \text{Average titre}}{6 \times 25}$

= Correct answer

OR

$\frac{\text{Answer (b) (i)} \times 1000}{25}$ = Correct answer

Conditions

a). Penalise ½ mark fro wrong transfer of ans b(ii) or average titre otherwise penalise fully for strange figure

b). Answer must be given to at least 3 d.p unless it works out exactly to less than 3 d.p otherwise penalise ½ mark

c). Penalise ½ mark for answer if arithmetic error is outside +2 units in the 3rd d.p

d). Units may not be given but if given must be correct otherwise penalise ½ mark for wrong units used

e). When formula is wrongly given in the formula method penalise fully

NB: *Penalise ½ mark for the answers in calculation a (i) and b (ii) if candidate work beyond the expected answer*

PROCEDURE II
Table 2 – 6 marks
Distribution of marks
Complete table ……. (3 marks)

A. ACCURACY

Compare the candidates 1st time reading to the S.V if within +2s award 1mk otherwise penalise fully

Note:

i). The S.V is the teacher first time reading

ii). Put a tick (√) on the candidate value if right

B. TREND (Tied to the time row)

Award (1 mark) for time reading increasing continuously otherwise penalise fully

Graph

A. Labelling

Conditions

i). Accept labeling even if no units are shown, otherwise penalise fully if wrong units are shown

ii). Penalise fully for inverted axis

iii). Penalise fully if only one axis is correctly labeled

B. Scale

i). Area covered by the actual plots (including the origin) must be at least 4 x 4 large squares (½ the grid) otherwise penalise fully

ii). The scale internal must be consistent on each axis

iii). The scale chosen must accommodate all the plots

Note:

Penalise fully if any of the above is not met
Award for the scale even if the axis are inverted

C. Plotting

Conditions

If 5 or 6 points are correctly plotted …… (1 mark)
If 3 or 4 points are correctly plotted …… (½ mark)
If less than 3 points …… (0 marks)

D. Line

Accept a straight line passing through at least 2 points correctly plotted and through the origin on extrapolation otherwise penalise fully

Calculations

i). For correct showing of $^{i}/_{t}$ on the graph ½ mark
ii). For stating the correct reading
e.g R = 0.003
iii). For t = 1/correct value
v). Correct value ½ (Must have units)

Conditions

i). Accept correct readings without showing
ii). Award ½ mark for showing on the graph and 1 mark. If applied correctly in the expression and ½ mark for the answer
iii). Answer must be at at least 1 d.p or whole no (if it works out) otherwise penalise
iv). Allow showing of reading for the candidates graph irrespective of the line as long as the scale is correct(Intervals)
v). Award where not shown not stated but correct reading if done for him/her (do it)

Penalise

Penalise ½ mark for W.A if the answer is not within +2 units in the 1st d.p
Correct units must be shown otherwise penalise ½ mark

2. a).i). I).

Observations	**Inferences**
A white precipitate	Presence of Pb^{2+}, Ba^{2+}, Ca^{2+} Only 2 – ½ mark Penalise ½ mark for each contradictory ion

II).

Observations	**Inferences**
No white ppt	Presence of Ba^{2+}, Ca^{2+} Pb^{2+} absent ½ where the above Not mentioned penalise ½ mark for each contradictory ions

III).

Observations	**Inferences**
No white precipitate	Cl- absent Penalise fully for any contradictory ion Ignore mention of SO_4^{2-}, SO_3^{2} of CO_3^{2-} as absent

ii).

Observations	
Effervescence/bubbled	Solid contain NO_3
Colourless gas/pungent choking	(Tied to red litmus turning blue)

Smell
Red Litmus – blue
Blue – remains blue

3. a). **Observations** | **Inferences**
No effervescence/no bubbles | Solid F is not acidic
No fizzing | OR
Absence of H+/H30+

b). i). **Observations** | **Inferences**
Burns with a sooty flame | Unsaturated /long chain /high C-H organic cpd organic cpds ratio present
Smoky flame or luminous | Flame / Carbon –carbon double/triple
Yellow flame | bond written in words or aromatic cpds

ii). **Observations** | **Inferences**
White suspensions | Compound is slightly soluble
Or | Or
White solid remains undissolved | Cpd is partially soluble
or
cpd is insoluble/cpd is nonpolar

c). i). **Observations** | **Inferences**
Effervescence /Bubbles /fizzing | The mixture is acidic
Or | Or
Accept colorless gas given off | RCOOH or H^+/H_3O present

ii). **Observations** | **Inferences**
Bromine water is not decolourised | Carbon – carbon double/triple
Or | bond absent
Yellow/orange/brown/red | Or
Remains persists | Compound is saturated
Bromine water remain yellow

NOVEMBER 2013
MARKSCHEME

Procedure I.
Table 1.

I. Complete table (All readings recorded) …….
i). Penalise ½ mark once for any space not filled, subject to at least 4 readings beings given otherwise penalize
ii). Penalise ½ mark for unrealistic temperature reading either below 10^0C or more than 40^0C at t=0
iii). Penalise ½ mark for temperature reading, they should all be constant from t=0 to t=7
iv). If two or more rows of temperature readings are given, penalize ½ mark for complete table based on the rows used to plot the graph. However if the graph is not drawn then mark the first rows of the temperature reading.
v). If two or more graphs are plotted, mark the complete table based on the first row.

II. Use of decimals (tied to at least two readings) accept the temperature reading for ½ mark only if consistently given as either 1 o
i). Whole number ii). 1 decimal point of either '0' or '5'
Otherwise penalize fully

III. Accuracy…….

Compare the candidate temperature reading at t=0 with the school value (S.V) and award ½ mark. If the reading is within +2C of the S.V otherwise penalize fully
Trend …..

Awarded as follows;

i). ½ mark for continuous rise upto the maximum
ii). 2nd ½ mark for temperature being either content at maximum or constant followed by a continuous drop or continuous drop after maximum.

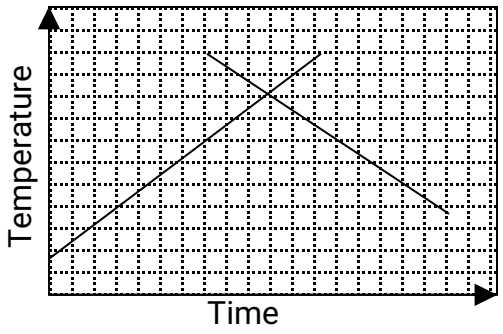
Graph……
Distribution as follows.

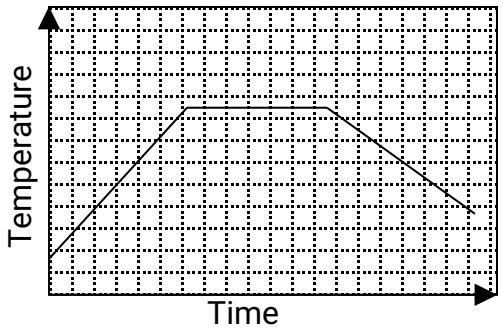
I. correct labeling of both axes ……..
Penalties
i). Penalise fully for inverted axes
ii). Penalise fully for wrong units used other ignore if units are omitted
iii). Penalise fully if only one axis labeled

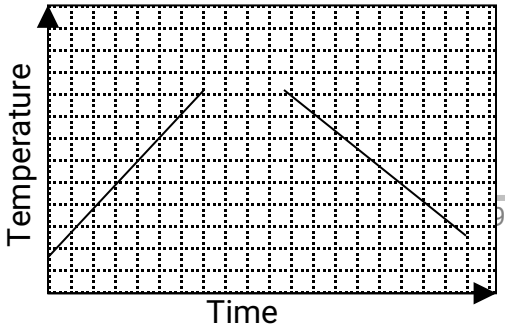
II. Scale…….
i). Area covered by plot should be atleast half of grid provided i.e 4 ½ by 3
ii). Scale interval should be consistent each axis
iii). All plots/points whether plotted or not (check the range of reading on the note. Penalise fully if any of the above conditions is not met

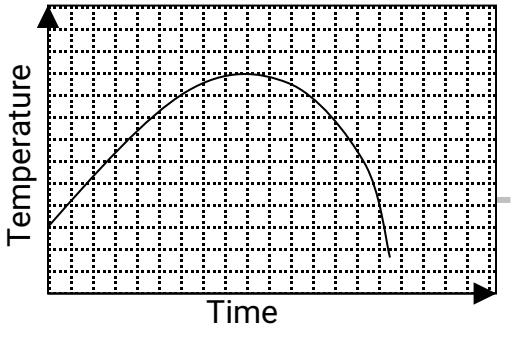
III. Plotting……..
Conditions
i). If 8 or 7 correctly plotted ……
ii). If only 6 to 4 points correctly plotting
iii). If less than 4 points correctly plotted ….
Note:
i). If the scale interval changes mark plots if any within the first scale interval and the first as wrong
ii). Accept correct plots even if the axes are inverted and award accordingly
iii). Mark all plots on the graph to verify the award

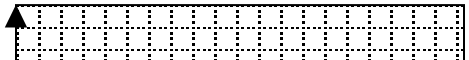
IV. Line/Shape……..
i). Accept 2 straight lines intersecting on extrapolation for ……
ii). Accept 2 straight lines not extrapolated whether joined or not for…
iii). Accept 1st line of best fit only if it passes through the initial temperature the following are the versions accepted even if the axes are inverted.











Highest change in temperature, OT.

I. i). Accept correct value of OT from correctly extrapolated graph with/without showing ……. Provided 1st line passes through the plot at t=0 i.e limited temperature.
ii). Award ½ mark for correct showing on a correctly DT value is wrong or missing
iii). Award 0 max for DT stated from a wrong graph
Note: a). Ignore +ve or –ve sign on the DT value
b). Penalise ½ mark for wrong units otherwise ignore if omitted

II. Time taken for reaction to be completed
Accept correct time reading from correctly extrapolated with or without showing for ….
If wrong units of time are given penalize fully, otherwise ignore omission of units

Conditions

i). Ignore the formula for working DH, but if given MUST be correct otherwise penalize ½ mark where wrong formula is given
ii). Penalise ½ mark for wrong units or omission of units on the answer
iii). Accept correct transfer of DT even if rejected in a(iii) I above
iv). Penalise ½ mark for wrong arithmetic on answer if it is outside + 200 joules or + 0.2 KJ
iv). Ignore if no sign is given on the answer otherwise penalize ½ mark for positive sign (+)

Procedure II

Table 2 …….

A. Complete table ……

Conditions

i). Complete table with 3 titrations done
ii). Incomplete table with 2 titrations done ……..
iii). Incomplete table with only one titration ……..

Penalties

i). Wrong arithmetic when determining the titre values
ii). Inverted tables
iii). Burette readings beyond 50ml unless explaining
iv). Unrealistic titre values below 1 ml or in hundreds
v). Penalise ½ mark for each to a maximum of ½ mark

B. TABLE 2 ……

Use of decimals …. Tied to 1st row and 2nd row only

Conditions

i). Accept 1 dp or 2 dp used consistently; otherwise penalize fully
ii). If 2 dpts are used the second decimal value must be 'O' or 'S' otherwise penalize fully
iii). Accept inconstancy in the use of zero's used as initial burette reading i.e o,0.0 0.00

C. Accuracy (Tied to correct titre value …..

Compare the candidate's titre values with the S.V and award marks as follows

i). If at least one is within +0.1 of S.V award …
ii). If none is within + 0.1 but at least one is within + 0.2 of S.V award
iii). If no value is within +0.2 award 0 marks

Note:
If there is;

i). wrong arithmetic or subtraction in the table, then compare the worked out. Correct value and award accordingly.
ii). Where there are two possible S.V's from the Teacher's results, indicate both values on the script and use one which is closer to the candidate value to award for accuracy and final answer
iii). If no S.V is given or can't be worked out from teacher's value as per principles of averaging
  a). All candidates correct average tutors should be written down and close values picked for averaging per session
  b). If candidates average values are too varied ignore them and use KNEC value

Compare the candidate's average titre with S.V

i). If within $^{+}$0.1 of S.V award
ii). If not within $^{+}$ 0.1, but within + 0.2 of S.V award….. ½ mark
iii). If not within + 0.2 of S.V award …… 0 mark

Note;

i). If there are 2 possible average titre values use the one that is closer to the S.V and credit accordingly
ii). if wrong litre values are averages by candidates, pick correct values (if any) average them and award accordingly

b). i). Moles of MnO_4^- = $\frac{0.02 \times AV. \text{ Titre}}{1000}$ =Correct Ans.

ii). Moles of FE^{2+} in $25cm^3$
Fe^{2+} : Mn04- = 5: 1
= 5 x Ans b(i) above
= Correct Ans.

iii). Moles of iron (i) ions in $250cm^3$ = $\frac{\text{Ans b(ii)} \times 250cm^3}{25cm^3}$

Or Ans b(ii) x 10
= Correct Ans

D. PRINCIPLES OF AVERAGING

Conditions

i). If 3 consistent values averaged …..
ii). If 3 titrations done, but only2 are consistent and averaged
iii). If only 2 titrations done, are consistent and averaged
iv). If 3 titrations done, but are inconsistent are averaged……

v). If 3 titrations done, and all can be averaged but only 2 are averaged
vi). If only 2 titrations are done, are inconsistent and averaged ….

Penalties
i). Penalise ½ mark for wrong arithmetic if the error is outside +2 units in the 2nd d.p
ii). Penalise ½ mark for no working shown but correct answer is written /stated
iii). If wrong answer is stated with no working
iv). If wrong working shown with correct answer however accept

Note:
i). Accept rounding off/truncation of answer to 2d.p e.g 17.666 = 17.67 or 17.66
Otherwise penalize rounding off to 1 dp or to a whole number
ii). Accept answer if it works out exactly to 1 d.p or to a whole number

E. FINAL ACCURACY *(Tied to correct average titre)*
Penalties/Conditions
i). Penalise ½ mark for wrong units used in part b(i)- b(ii) otherwise ignore omission of units
ii). Penalise ½ mark for wrong transfer in b(i) – b(ii) otherwise penalize fully for strange figure in each case
iii). Answer in b(i)- b(iii) should be at least unless it works out exactly to less than 4 d.ps otherwise penalize ½ mark on the answer
iv). Penalise ½ mark for wrong arithmetic in ans b(i) if the error on the answer is outside 2 units in the 5th d.p
v). Answer in b(ii) – b(iii) must be as expected, otherwise penalize ½ mark on the answer

C. Molar heat of displacement of CU^{2+} ions
CU^{2+}: Fe = 1:1
= Ans a(iii) / b(iii)
= correct ans.

Penalties/conditions
i). Penalise ½ mark for wrong transfer of either a(iii) or b(iii) otherwise penalize fully for strange figure
ii). Penalise 1 mark for arithmetic error outside 200 units of expected answer if the answer is in joules or outside 0.2 units if answer is in k
iii). Penalise ½ mark on correct answer if either the correct sign (-ve) or correct unit is missing or both are wrong/missing
iv). Penalise fully for unrealistic answer i.e beyond 200 KJ/mole or 200,000 J/Mole

Note:
For continued working, mark only the 1st correct areas.

1. Procedure I.
a). i).

ii). I). extrapolated graph showing/without showing 1 mark
II). from extrapolated graph – wrongly stated but shown on the graph ½ mark
iii). DH = MCDT

= 50 x 4.2 x DT
= Correct answer Joules J.j
Or = $\frac{50 \times 4.2 \times D.J}{1000}$
= Correct answer (Kilo joules K.J)
-Ignore formula for working DH. Given must be correct otherwise penalize ½ mark for wrong formula.
- Penalise ½ mark for wrong units or omission
-Ignore if no sign is given otherwise if no sign is given otherwise penalize ½ markf or (+) sign

1 ½ mark

2. Procedure II.

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

4 marks

a). $\frac{1 + 11 + 1}{3}$ = ans

1 mark

i).

Observations	Inferences
-Colourless -Odourless gas produced -Gas extinguishes a burning splint -White residue or solid turns yellow when heated and turns white on cooling (1 mark)	-CO_3^{2-} (Extinguishes burning splint) -Zn^{2+}/ZnO formed (turned to white on cooling) (1 mark)

Award ½ mark upto a maximum of 1 mark
Penalise ½ mark for each contradictory low in each case
Reject; ZnO present.

ii).

Observations	Inferences
-Colourless -Odourless gas produced -Gas extinguishes a burning splint -White residue /solid turns yellow when heated and turns white on cooking (1 mark)	-CO_3^{2-} present Penalize fully for any contradictory ion Zn^{2+} present (1 mark)

Reject ; Hissing /Fizzing

iii).

Observations	Inferences
-White ppt -soluble in excess (1 mark)	-Zn^{2+}/Zno formed (turned to white) (1 mark)

Penalise fully for contradictory ions

b). i).

Observations	Inferences
-White ppt -ignore if ppt is insoluble in excess (1 mark)	-Al^{3+}, $Pb^{2+,}$ Mg^{2+} present Note (1 mark)

Penalize fully for ppt dissolves

ii).

Observations	Inferences
- No effervescence -No white ppt (1 mark)	-CO_3^{2-}, SO_3^{2-} absent (both ½ mark) -Al^{3+}, Mg^{2+} present (1 mark)

Accept : No ppt
½ mark – colourless solution formed
- *Solution remains colourless*

iii).

Observations	Inferences
-White ppt formed -penalise fully if ppt dissolves (1 mark)	-Pb^{2+} ions absent penalized ½ mark for any contradictory ion $SO4^{2-}$ present (1 mark)

Penalise fully for any contradictions ions
Accept if ions are written in words

3. a).

Observations	Inferences
- melts and burns with a sooty/luminous / yellow smoky flame (1 mark)	-'C=C'/ C=C- -Organic compound with high C;L -Long chain organic compound - Unsaturated organic (1 mark)

Melts on its own for ½ mark
Carbon – carbon dissolves
C=C/C=C
Alkalines/alkynes
Long chain hydrocarbon

Note:
Penalise fully for any contradictory ion

b). i).

Observations	Inferences
-$KMNO_4/H^+$ is not decolouress colour of $KMN0_4/H^+$ remains purple/purple colour of $KMNO_4/H^+$ persists or remains the same (1 mark)	-H^+/H_3O+ or 4 – COOH or carboxyli growing in words/solutions in acidic 1 mark

Saturated organic compound present for ½ mark

Observations	Inferences
-Effervescence /bubbles /fizzing (1 mark)	- H^+/H_3O^+ or 4 –COOH or carboxyli growing in words /solution is acidic (1 mark)

Accept : Colourless gas for ½ mark
Reject : Hissing/fizzling

c).

Observations	Inferences
-Dip the p H /universal paper into the solution from (b) above -match the colour obtained with the p H chart and not the p H= 1 or 2 (1mark)	-Solution is strongly acidic (1 mark)

Reject: p H range (p H = 1 -2)

CONFIDENTIAL AND PREPARATION INSTRUCTIONS TO SCHOOLS

October - November 1989

Instructions to Schools.

This is information that enables the Head of the school and the teacher in charge of Chemistry to make adequate preparations for Chemistry Practical Examination.

In addition to the fittings and substances ordinarily contained in a chemical laboratory, the following should be provided.

Requirements per Candidate

Each candidate will require the following:

- About 75cm^3 of solution **W9**
- About 150cm^3 of solution **W11 (oxallic acid)**
- About 1g of solid **Y**
- About 10cm of metal **M (magnesium ribbon)**
- 1 pipette of 25.0cm^3
- 3 conical flasks
- 1 burette
- 1 measuring cylinder of 100cm^3
- 1 beaker of 250cm^3
- Tissue paper
- 1 boiling tube
- 1 thermometer (accuracy 0.5^{0}C)
- 1 ruler
- 1 spatula
- 5 test-tubes
- A sharp blade or pair of scissors
- A small funnel

Access to

- 250cm^3 of distilled water
- Dilute hydrochloric acid
- Phenolphthalein indicator
- Dilute sodium hydroxide
- Aqueous ammonia

Preparations

i. Solution W9 is made by dissolving 90cm^3 of concentrated hydrochloric acid in distilled water and making it to one litre of solution. This solution MUST be supplied in a burette placed at a central position where it should be accessible to 5 to 10 candidates.
ii. Solution W11 is made by dissolving 6.30g of solid W11 in distilled water and making it up to one litre of solution.
iii. Solution W12 is made by dissolving 3.20g of sodium hydroxide pellets in distilled water and making it up to one litre of solution.
iv. Metal M should be cleaned with sand-paper the day before the examination.

October /November 1990.

Requirements for Candidates

In addition to the fittings, substances and apparatus ordinarily found in a chemistry laboratory each candidate will require the following;

- Between 1.0g and 1.5g of solid D,

- About 250cm^3 of solution S1, (Sodium hydroxide)
- About 150cm^3 of solution S1,
- About 1.0g of solid Q
- About 400cm^3 of distilled water
- One burette
- One 25cm^3 of pipette
- One 10cm^3 pipette
- One 100cm^3 measuring cylinder
- One filter funnel
- One filter paper
- conical flasks (250cm^3)
- One thermometer (0-10^{0}C – 0-110^{0}C)
- One crucible or crucible lid or a metallic spatula
- One spatula
- One test tube holder
- test tubes
- Two boiling tubes
- One dropper

Access to:

- Phenolphthalein indicator
- pH paper (range 1-14)
- Solid sodium hydrogen carbonate
- 1% potassium manganate (VII) solution
- 1% bromine water
- Burner
- Concentrated sulphuric acid supplied with a dropper pipette
- About 6cm^3 of ethanol

Preparations

(i) Solids D and Q will be provided by the Kenya National Examinations Council.

(ii) Preparations of solution S1:

I). Dissolves 4.0g of sodium hydroxide in distilled water and make it up to one litre of solution

II). Take 200cm^3 of the sodium hydroxide solution prepared in (i) above and dilute with distilled water to make up one litre of solution (SI)

(iii) Preparation of solution S2:

I) Dissolve 56cm^3 of concentrated sulphuric acid in about 500cm^3 of distilled water.

II). Take 10cm^3 of the sulphuric acid solution prepared in (i) above and dilute it by adding distilled water to make it up to one litre of solution (S2).

October / November 1992

Requirements for Candidates

In addition to fittings and apparatus found in a chemistry laboratory, each candidate will require:

- 60cm^3 of solution C2,
- 100cm^3 of solution C3
- 150cm^3 of solution C5
- 150cm^3 of solution C6
- About 1g of solid C7

- One, 50cm^3 burette
- One, 100cm^3 beaker
- One, 25cm^3 (or 20cm^3) pipette,
- One, 10cm^3 measuring cylinder
- Three, 250cm^3 conical flasks
- Seven, clean dry test-tubes placed in a rack
- One, stop watch / stop clock,
- One, boiling tube
- One, spatula.

Access to:

- Methyl orange indicator solution,
- 0.5M lead nitrate solution
- 0.5M barium chloride solution
- About 10cm^3 of solution C4
- Dilute sulphuric acid
- Dilute sodium hydroxide solution,
- Source of heat (Bunsen burner)
- 300cm^3 of distilled water
- Note: all the solutions should be freshly prepared and supplied accompanied by droppers.

Preparations

i. Solution C2 is prepared by dissolving 2g of solid C2 in distilled water and making it up to one litre
ii. Solution C3 is prepared by dissolving 0.40g of solid C3 in about 200cm^3 of distilled water, adding 20cm^3 of 1M sulphuric acid, shaking well and making it up to one litre with distilled water.
iii. Solution C4 is prepared by placing 1.0g of solid C4 in 100cm^3 beaker, adding 2cm^3 of distilled water to make a paste and pouring the paste into 100cm^3 of boiling distilled water, boiling the mixture for about one minute and allowing it to cool. Solution C4 is to be prepared on the morning of the examination.
iv. Solution C5 is peppered by adding 10cm^3 of concentrated hydrochloric acid (specific gravity of 1.18 or 1.9) in 500cm^3 of distilled water and making it up to one litre.
v. Solution C6 is prepared by dissolving 19.2 of solid C6 in about 500cm^3 of warm distilled water, cooling the solution, transferring it into a volumetric flask and making it up to one litre with distilled water.

October /November 1993

Requirements for Candidates

In addition to the equipments, apparatus and chemicals found in an ordinary chemistry laboratory, each candidate will require the following;

- 75cm^3 of solution A
- 1.0cm^3 of solid B
- 200cm^3 of solution C
- About 1g of solid F

- One, 50cm^3 burette
- One 25cm^3 pipette
- Five 25cm^3 conical flasks
- One, 100 cm^3 measuring cylinder
- One, filter funnel
- Six, test tubes
- One, spatula
- One boiling tube
- One filter paper cut into small strips of about 1cm and at least 5cm long

Access to:

- Phenolphthalein indicator
- About 500cm^3 of distilled water
- 0.05M iodine solution
- 2 M hydrochloric acid solution
- 2M sodium hydroxide solution
- 0.24M barium dichromate solution
- A wall clock placed in a position visible for all candidates
- Two labels

Preparations

i). Solution A is prepared by dissolving 40g of sodium hydroxide pellets in about 500cm^3 of distilled water then making it up to one litre of solution

ii). Solution C is prepared by dissolving 9.7g of solid C in about 500cm^3 of distilled water and making it up to one litre of solution

iii). The 1.0g solid B should be weighed accurately for each candidate and supplied in a dry weighing bottle or test tube or any other small dry container

iv). 0.05M iodine solution is prepared by dissolving 20g of potassium iodide crystals in 600cm^3 of water then adding 12.7g of iodide crystals dissolving and making it up to one litre solution

October / November 1994

Requirements for Candidates.

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

- 200cm^3 of solution D
- 150cm^3 of solution E
- 50cm^3 of solution F
- 50cm^3 of solution G
- About 1.5g of solid H
- One, 50cm^3 burette
- One, 100cm^3 beaker
- One, 10cm^3 measuring cylinder
- One 100cm^3 measuring cylinder
- One 25cm^3 (or 20cm^3) pipette
- Three, 250cm^3 conical flasks
- Eight, clean dry test-tubes.
- One thermometer (-10^{0}C to 110^{0}C
- One metallic spatula
- About 0.5g of solids - Sodium chloride
  - Potassium chloride
  - Calcium chloride
- One boiling tube
- Stirring rod
- About 1g of steel wool

Access to.

- Phenolphthalein indicator
- 2M sodium hydroxide.
- 2M aqueous ammonia
- 2M sodium chloride
- Bunsen burner (heat source)
- Distilled water
- Each of the above solutions should be supplied with a dropper.

Preparations

i) Solution D is prepared by dissolving 8.0g of sodium hydroxide pellets in distilled water and making it up to one litre.
ii) Solution E is prepared by dissolving 19.2g of solid E in distilled water and making it up to one litre.
iii) Solution F is prepared by dissolving 40.0g of sodium hydroxide pellets in distilled water and top it up to one litre.
iv) Solution G is prepared by dissolving 79.4g of solid G in distilled water and making it up to one litre.

October /November 1995

Requirements for Candidates

In addition to the equipment, apparatus and chemicals found in an ordinary chemistry laboratory, each candidate will require the following;

- 2.0g of solid J, weighed accurately
- 1.0g of solid K, weighed accurately
- About 0.2g of solid L
- About 0.8g of solid N
- 100cm^3 of 2.0M hydrochloric acid
- One, 50cm^3 burette
- One, thermometer
- One, stopwatch/stopclock/watch with a second hand
- One, 100cm^3 beaker
- Two pieces of aluminium foil (2cm^3 each)
- Six test-tubes
- Two wooden splints
- Three blue and three red litmus papers
- One metallic spatula
- One boiling tube
- One 10cm^3 measuring cylinder
- One glass rod

Access to:

- About 500cm^3 of distilled water
- 2.0M hydrochloric acid (labeled as dilute)
- 2.0M sodium hydroxide (labeled as dilute)
- Bunsen burner
- About 50cm^3 of 0.1M lead nitrate solution

Preparations

The 2.0M hydrochloric acid should be prepared accurately by adding 175cm^3 of concentrated hydrochloric acid to about 700cm^3 of distilled water. Shake well and make it up to the one litre

October /November 1996

Candidates requirements

In addition to the apparatus and chemicals found in an ordinary Chemistry laboratory, each candidate will require the following:

- 150cm^3 of solution A
- 100cm^3 of solution B
- 100cm^3 of solution C
- One 50cm^3 burette
- One 25cm^3 pipette
- One thermometer (0^0C to 100^0C)
- One filter funnel
- About 0.5g of solid D
- Six clean dry test-tubes on a test-tube rack
- Two boiling tubes
- One metallic spatula
- Two filter papers
- Wooden splint
- Four red and four blue litmus papers

- One teat pipette dropper
- About 0.5g of solid E
- About half a spatula full of solid sodium hydrogen carbonate
- One conical flask

Access to

- Bunsen burner
- About 500cm^3 of distilled water
- 20 volume hydrogen peroxide
- 2M sodium hydroxide
- 6M hydrochloric acid
- Concentrated sulphuric acid
- Ethanol

NB: Each of the above reagents should be supplied with a dropper.

Preparations

i). Solution A is prepared by dissolving 3.16g of solid A in 400cm^3 of 2M sulphuric acid and making it up to one litre of solution with distilled water.

ii). Solution B is prepared by dissolving 23.5g of solid B in 200cm^3 of 2M sulphuric acid and making it up to one litre of solution with distilled water. This solution should be prepared in the morning of the examination.

iii). Solution C is prepared by dissolving 5.0g of solid C in 600cm^3 of distilled water and making it up to one litre of solution with the distilled water

October / November 1997

Requirements to Candidates.

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

A

- 120cm^3 of solution F, sulphuric acid.
- 100cm^3 of solution G, 0.5M sodium hydroxide
- 0.2g of solid H weighed accurately – mg
- One 50cm^3 burette
- One 25.0cm^3 pipette
- One 100cm^3 measuring cylinder
- One 100cm^3 beaker
- Two conical flasks
- One thermometer 0^0C – 110^0C
- One 250cm^3 beaker
- One label
- One stopwatch/ stopclock or a watch with seconds hand
- About 0.5g of solid L
- 6 clean dry test-tubes
- One wooden splint
- One filter funnel
- One spatula
- Two blue and two red litmus papers
- About 0.5g of solid M
- About 0.5g of sodium carbonate
- One boiling tube
- One test-tube holder

- One filter paper.

B. Access to.
- Concentrated nitric acid
- 2M sulphuric acid
- 2M NaOH
- Phenolphthalein indicator
- 2M aqueous ammonia
- 1% Bromine water
- Acidified potassium permanganate
- Distilled water in a wash bottle
- Bunsen burner

NB/ Each of the solutions in Bottle should be supplied with a dropper.

Preparations

a) Solution F is prepared by accurately adding 27.8cm^3 of con. H_2SO_4 (s.g. 1.84) to about 400cm^3 of distilled H_2O then making it to one litre of solution.
b) Solution G is prepared by dissolving 10.0g of NaOH pellets in 600cm^3 of distilled H_2O then making it to one litre of solution
c) Acidified potassium permanganate is prepared by dissolving 31.6g of solid $KMnO_4$ in 400cm^3 of 1M H_2SO_4 acid and making it to one litre of solution.
d) 1% Bromine water is prepared by adding 1cm^3 (CARE) of liquid Bromine to 100cm^3 of distilled H_2O in a fume cupboard and shaking thoroughly

October / November 1998

Requirements to Candidates.

In addition to the fittings and apparatus found in a chemistry laboratory, each candidate will require.
- 250cm^3 of hydrochloric acid, solution M.
- 150cm^3 of sodium hydroxide, solution N
- 0.50g of solid P weighed accurately
- Burette 0 – 50cm^3
- Pipette 25cm^3

Means of labeling.
- 100cm^3 measuring cylinder
- 250cm^3 beaker
- Two conical flasks
- About 0.3g of solid L
- Six dry test-tubes
- 2 red and 2 blue litmus papers
- 2 boiling tubes
- One wooden splint
- Filter paper
- Filter funnel
- About 0.2g of Na_2CO_3
- about 0.3g of solid S
- A spatula
- A test-tube holder.

Access to:

- $10cm^3$ measuring cylinder
- Distilled water
- Universal indicator solution supplied with a dropper
- pH chart
- 2M hydrochloric acid supplied with a dropper
- 2M aqueous ammonia supplied with a dropper
- Wall clock
- 2M aqueous sodium hydroxide supplied with a dropper
- 0.2M barium chloride supplied with a dropper
- Bunsen burner
- 1M lead(II) nitrate solution supplied with a dropper
- Screened methyl orange indicator supplied with a dropper.

Preparations

1. Solution M is prepared by adding $18.0cm^3$ (S.G = 1 = 1.18) of concentrated hydrochloric acid into $600cm^3$ of distilled water contained in a one litre volumetric flask and diluting to one litre of solution.
2. Solution N is prepared by dissolving 8.80g of sodium hydroxide in $600cm^3$ of distilled water contained in a one litre volumetric flask and diluting to one litre of solution.
3. Screened methyl orange is prepared by dissolving 0.10g of solid R in $100cm^3$ of distilled water and labelled screened methyl orange indicator.

October / November 1999

Requirements to Candidates.

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

- One burette 0 – $50cm^3$
- One pipette $25cm^3$
- About $100cm^3$ of solution E
- About $120cm^3$ of solution F
- Two conical flasks) $250cm^3$
- 8 clean dry test-tubes
- About 0.4g of solid H (supplied on the morning of examination)
- One boiling tube
- One spatula
- Both blue and red litmus papers
- Stop clock/ watch
- Ruler
- $10cm^3$ measuring cylinder
- Cutting blade / scissors
- $6cm^3$ length of magnesium ribbon, labelled solid K
- About $50cm^3$ of 2.0M hydrochloric acid, labelled solution L
- Means of labeling test-tube holder
- One $100cm^3$ beaker
- Test-tube rack.

Access to:

- Distilled water
- Methyl orange indicator

- Bunsen burner
- Concentrated nitric acid supplied with a dropper
- 2M hydrochloric acid supplied with a dropper
- 1M barium chloride solution supplied with a dropper
- 2M sodium hydroxide solution.

Preparations

1. Solution E is prepared by accurately measuring 10.0cm^3 of concentrated hydrochloric acid (1.18gm/cm^3) using a burette and adding it to about 500cm^3 of distilled water and diluting to one litre of solution.
2. Solution F is prepared by accurately adding 15.3g of solid F in about 800cm^3 of distilled water and diluting to one litre of solution.
3. Solution L is prepared by accurately adding 172cm^3 of concentrated hydrochloric acid (1.18g/cm^3) to about 500cm^3 of distilled water and diluting to one litre of solution.

October / November 2000

Requirements to Candidates

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

- About 90cm^3 of solution L
- About 150cm^3 of solution M
- One burette 0 – 50cm^3
- One pipette 25cm^3
- One thermometer 0 – 110^{0}C
- Two conical flasks
- One filter funnel
- 3 filter papers
- 10cm^3 of solution P contained in a conical flask
- 6 clean dry test-tubes
- 50 or 100cm^3 measuring cylinder
- 3 g of solid G
- 100cm^3 beaker
- Stop clock / watch
- 30cm^3 of 2M sodium hydroxide in a beaker
- One 10cm^3 measuring cylinder.

Access to

- Methyl orange indicator – supplied with dropper
- Phenolphthalein indicator – supplied with dropper
- Distilled water
- 2M sodium hydroxide – supplied with dropper
- 2M aqueous ammonia – supplied with dropper
- 2M nitric acid – supplied with dropper
- 2M hydrochloric acid – supplied with dropper
- 1 M acidified barium chloride – supplied with dropper.

Preparations

1. Solution L is prepared by dissolving 5.6g of solid L in 600cm^3 of distilled water and diluting to one

litre of solution.
2. Solution M is prepared by accurately adding 9cm^3 of concentrated hydrochloric acid (density 1.18g/cm^3) to about 500cm^3 of distilled water and diluting to one litre of solution.
3. Solution P is prepared by mixing 80g of solid Q and 20g of solid R and dissolving the mixture in about 800cm^3 of distilled water then diluting to one litre of solution.

October / November 2001

Requirements to Candidates.

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

- About 20cm^3 of solution A.
- about 100cm^3 of solution B
- About 60cm^3 of solution C
- About 100cm^3 of solution D.
- One burette
- One pipette
- Two conical flasks (250cm^3)
- One filter funnel
- One boiling tube
- One thermometer 0 – 110^{0}C
- One 10cm^3 measuring cylinder
- 50 or 100cm^3 measuring cylinder
- 1g of solid E
- 4 clean dry test-tubes
- One test-tube holder
- 2 blue and 2 red litmus papers
- 0 – 3 g of solid F
- 0 – 2g of solid G
- 100cm^3 beaker
- One spatula.

Access to.

- Distilled water
- Phenolphthalein indicator
- 2M sodium hydroxide – supplied with a dropper
- 2M sulphuric acid - supplied with a dropper
- 2M lead (II) nitrate - supplied with a dropper
- Bromine water - supplied with a dropper
- Acidified potassium permanganate
- Bunsen burner.

Preparations.

1. A is prepared by dissolving 24g of sodium hydroxide pellets in about 800cm^3 of distilled water and diluting to one litre of solution
2. B is prepared by adding 12cm^3 of hydrochloric acid (specific gravity 1.18g/cm^3) (measured

accurately) in about 500cm^3 of distilled water and diluting to one litre of solution.
3. C is made by dissolving 75.6g of solid C in about 900cm^3 of distilled water and diluting to one litre of solution.
4. D is prepared by adding 167cm of solution A to 600cm^3 of distilled water and diluting to one litre of solution
5. Bromine water is prepared by adding 2ml of liquid bromine to 100cm^3 of distilled water and the mixture stirred well in a fume cupboard
6. Acidified potassium permanganate is made by adding 3.16g of solid potassium permanganate to 400cm^3 of 2M sulphuric acid and diluting to one litre of solution using distilled water.

October / November 2002

Requirements to Candidates.

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

A

- about 120cm^3 of solution A
- about 150cm^3 of solution B
- about 40cm^3 of solution C supplied with a dropper
- about 40cm^3 of solution D supplied with a dropper
- about 150cm^3 of distilled water in a wash bottle
- about 0.2g of solid G
- about 0.5g of solid H
- 10cm of sodium sulphate solution
- about 15cm^3 of solution E supplied with a dropper
- two 200ml or 250ml beaker
- one 10cm^3 measuring cylinder
- one burette 0 – 50ml
- one 50ml or 100ml measuring cylinder
- 15cm^3 of solution F
- one boiling tube
- one filter funnel
- two pieces of filter paper (whatman no.1 size 11.0cm)
- 6 clean dry test-tubes
- one test-tube holder
- one clean metallic spatula
- two labels
- one stopwatch / clock
- Atleast 6cm length of universal indicator paper (full range) pH 1 – 14.

B. Access to

- Bunsen burner (in good working condition).
- Barium nitrate solution supplied with a dropper
- 2M sodium hydroxide – supplied with a dropper
- 2M hydrochloric acid - supplied with a dropper
- 2M aqueous ammonia - supplied with a dropper
- pH chart pH 1 - 14
- bromine water - supplied with a dropper
- acidified potassium permanganate supplied with a dropper

Preparations

1. Solution A is prepared by adding 200cm^3 of fresh 20 volume hydrogen peroxide to about 600cm^3

of distilled water and diluting to one litre of solution. (This solution should be prepared one day before the day of examination, stored in Stoppard container and supplied on the morning of the examination).
2. Solution B is 2M sulphuric acid
3. Solution C is prepared by dissolving 12g of solid C in about 800cm^3 of distilled water and diluting to one litre of solution.
4. Solution D is prepared by adding 10g of solid D in about 700cm^3 of distilled water and diluting to one litre of solution.
5. Solution E is prepared by dissolving 10g of solid E in about 600cm^3 of warm distilled water and diluting with warm water to one litre of solution.
6. Solution F is prepared by dissolving 30g of solid F in about 900cm^3 of distilled water and diluting to one litre of solution.

October / November 2003

Requirements to Candidates.
In addition to the fittings and apparatus found in a chemistry laboratory, each candidate will require.

A.

- about 80cm^3 of solution P
- about 120cm^3 of solution Q
- one burette 0 – 50ml
- one pipette 25ml
- two conical flasks 250ml
- 1.9g of solid S weighed accurately
- 35cm^3 of solution T
- one thermometer 0 – 110^oC
- one 100ml beaker
- one 50ml or 100ml measuring cylinder
- about 200ml of distilled water in a wash bottle
- 0.3g of solid V
- one 10ml measuring cylinder
- one boiling tube
- one spatula
- 6 clean dry test-tubes
- 1ml of 0.5M barium chloride supplied in a test-tube and labelled 0.5M$BaCl_2$
- 2cm^3 of 2M hydrochloric acid supplied in a test-tube and labelled 2MHCl
- About 35cm^3 of solution R.

B. Access to

- 2M sodium hydroxide
- 1M lead (II) nitrate solution
- Solution W
  These solutions should be supplied with droppers.

Preparations

1. Solution P is prepared by dissolving 3.2g of solid P in 400cm^3 of 1M sulphuric acid and diluting to one litre of solution using distilled water.
2. Solution Q is prepared by dissolving 16.7g of solid Q in 400cm^3 of 1M sulphuric acid and diluting to one litre of solution using distilled water. This solution is to be prepared in the morning of the examination and supplied to candidates in containers sealed with aluminum foil. (The solid should be dissolved in the sulphuric acid immediately after weighing).
3. Solution W is prepared by dissolving 5g of solid W in 500cm^3 of 1M sulphuric acid and diluting to one litre of solution using distilled water.

4. Solution R is prepared by dissolving exactly 40.0g of sodium hydroxide pellets in about 800cm^3 of distilled water and diluting to one litre of solution and allowed to cool to room temperature.
5. Solution T is prepared by dissolving 63g of solid T in about 900cm^3 of distilled water and diluting to one litre of solution and allowed to attain room temperature.

NB/ The quantities in the above preparations will depend on the number of candidates in a centre.

October / November 2004

Requirements to Candidates.

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

A.

- Exactly 3cm^3 length of solid A.
- About 80cm^3 of solution B
- About 120cm^3 of solution C
- one burette (0 – 50ml)
- one pipette 25ml
- one thermometer (0 – 110^0) C
- one 100ml beaker
- two 250ml conical flasks
- one stopwatch / clock
- 6 clean dry test-tubes
- one boiling tube
- about 200cm^3 of distilled water in a wash bottle.
- one label
- about 5cm^3 of solution E in a test-tube
- about 5cm^3 of solution F in a test tube
- about 5cm^3 of solution G in a test tube
- about 6cm^3 of solution H in a test tube
- one clean glass rod
- one 10ml measuring cylinder
- 1 ml of chlorine water supplied in a -tube and sealed with aluminium foil
- 2 ml of 1% bromine water supplied in a test-tube and sealed with aluminum foil.

B. Access to

- 2M sodium hydroxide supplied with a dropper
- phenolphthalein indicator
- 0.5M barium chloride supplied with a dropper
- 0.05M lead (II) nitrate solution supplied with a dropper
- Bunsen burner in good working condition.

Preparations

1. Solution B is prepared by dissolving 60.2 cm^3 of concentrated hydrochloric acid density 1.18g/cm^3 in about 600cm^3 of distilled water and diluting to one litre of solution.
2. Solution C is prepared by dissolving 12g of solid sodium hydroxide pellets in about 800cm^3 of distilled water and diluting to one litre of solution.
3. Solution E is prepared by dissolving 60g of solid E in about 900cm^3 of distilled water and diluting to one litre of solution.
4. Solution F is prepared by dissolving 30g of solid F in about 500cm^3 of distilled water and diluting to one litre of solution.
5. Solution G is prepared by dissolving 30g of solid G in about 700cm^3 of distilled water and diluting

to one litre of solution.

6. Solution H is prepared by dissolving 60g of solid H in about 600cm^3 of distilled water and diluting to one litre of solution.
7. Chlorine H_2O is prepared by dissolving 250cm^3 of 5% chlorine H_2) (5% sodium hypochloric) to 750cm^3 of distilled H_2O.
8. 1% bromine H_2O is prepared by adding 1cm^3 of liquid bromine to 100 of distilled H_2O and shaking one mixture well to dissolve (This mixture will dissolve (this should be done in the same chamber)

October / November 2005

Requirements to Candidates.

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

A.

- About 100cm^3 of solution K
- About 75cm^3 of solution L
- One burette 0 – 50 ml.
- one pipette 25ml
- 1.5g of solid M accurately weighed and supplied in a clean dry test-tube.
- one tripod stand with a wire gauze
- one 200ml or 250ml beaker
- one Bunsen burner
- one thermometer 0 – 110^{0}C
- one stopwatch / clock
- one test-tube holder
- about 0.5g of solid N
- 5 clean and dry test-tubes
- one boiling tube
- one 10ml measuring cylinder
- about 10cm^3 of solution P
- about 0.5g of solid Q
- about 1g of solid sodium hydrogen carbonate.
- one blue and one red litmus paper
- 5 pieces of filter paper
- one spatula
- about 150cm^3 of distilled water supplied in a wash bottle
- two 100ml beakers
- one filter funnel
- one 100ml measuring cylinder
- a small roll of tissue paper (approximately 25cm^3 long)

B. Access to

- 2M aqueous ammonia
- 0.5M barium nitrate solution
- 2M hydrochloric acid.

Preparations

1 Solution K is prepared by dissolving 37.32g of sodium hydroxide pellets in about 600cm^3 of distilled water and diluting to one litre of solution.

2. Solution L is prepared by dissolving 60.0g of solid L in about 600cm^3 of distilled water and

diluting to one litre of solution.

3. Solution P is prepared by dissolving 50g of solid P in about 700cm^3 of distilled water and diluting to one litre of solution.

October / November 2006

Requirements to Candidates.

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

- 4.5g of solid A supplied in a boiling tube
- 110cm of solution B
- about 450cm^3 of distilled water supplied in a wash bottle
- about 0.5g of solid E supplied in a dry stoppered container
- about 0.5g of solid F supplied in a dry stoppered container
- about 10cm^3 of aqueous sodium sulphate supplied in
- one burette 0 – 50mls
- one pipette 25ml
- one pipette filler
- one thermometer -10 ^oC – 110 o C
- one 250ml volumetric flask
- two 250mls conical flask
- one Bunsen burner
- one tripped sled and wire gauge
- 5 dry test tubes
- one boiling tube
- 2 filter papers (whatman no.1 125mm)
- one filter funnel
- one filter holder
- one metallic spatula
- one 10ml measuring cylinder
- means of labeling
- one clean dropper.

Access to:

- 2M NaOH supplied with a dropper
- 2M HCl
- Bromine H_2O supplied with a dropper
- Phenolphthalein indictor supplied with a dropper
- Wall clock.

Preparations

1. Solution B is prepared by dissolving 9.48g of solution B in about 400cm of 2M sulphuric acid and diluting to one litre of solution with distilled water.
2. Aqueous sodium sulphate is prepared by dissolving 10g of solid Na SO_4 Diluting with distilled water to one litre of solution
3. Bromine water is prepared by diluting 1ml of liquid bromine with 100cm^3 of distilled water in a fume cupboard
4. Solid A should be weight accurately in a fume clipboard or a well ventilated room.

October / November 2007

Requirements to Candidates.

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

- About 120cm^3 of solution A.
- about 120cm^3 of solution B
- About 100cm^3 of solution C.
- one pipette 25.0ml
- one pipette filler
- one volumetric flask 250ml
- one burette 0 – 50ml
- two conical flasks
- 8 clean dry test-tubes
- test-tube rack
- one thermometer – 10^0C – 110^0C
- two boiling tubes
- about 0.5g of solid E in a stoppered container
- one blue and one red litmus paper
- one 10ml measuring cylinder
- about 500ml of distilled water in a wash bottle
- one test-tube holder
- one PH chart paper range 1 to 14
- about 2cm^3 of solution G
- 1g of sodium carbonate (solid)
- one watch glass
- about 5cm^3 of solution H
- about 10cm^3 of ethanol (absolute) in a Stoppard container labelled liquid F
- spatula
- two clean dropper
- Means of labeling.

Access to:

- Methyl orange indicator supplied with a dropper
- Bunsen burner
- universal indicator supplied with a dropper
- 2M aqueous ammonia supplied with a dropper
- 0.5M barium nitrate solution
- 2M nitric acid
- Wall clock.

Preparations

1. Solution A is prepared by dissolving 50.0cm^3 of 1.84g/cm (98%) concentrated sulphuric acid in about 600cm^3 of distilled water and diluting to one litre of solution.
2. Solution B is prepared by dissolving 8.0g solid B in about 500cm^3 of distilled water and diluting to one litre of solution.
3. Solution C is prepared by dissolving 60.0g of sodium hydroxide pellets in about 700cm of distilled water and diluting to one litre of solution.
4. Solution G is prepared by dissolving 100g of solid G in about 400cm^3 of distilled water and diluting to one litre of solution.
5. Solution H is prepared by dissolving 25g solid H in about 600cm^3 of 2M sulphuric acid and diluting to one litre of solution.

NB/ The test-tubes provided should have a capacity of at least 15cm^3.

October / November 2008

Requirements to candidates.

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

- 2.1g of solid A weighed accurately and supplied in a dry stoppered container
- about 60cm^3 of solution B
- about 130cm of sodium hydroxide solution
- one thermometer – 10 ^oC – 110 ^oC
- one stop watch/clock
- one 100ml beaker
- one burette 0 – 50ml
- one pipette 25ml
- one bolometric flask 250ml
- about 500cm^3 of distilled water supplied in a wash bottle
- one label or means of labeling
- one pipette filler
- two conical flasks
- about 0.5g of solid D supplied in a stoppered container
- 0.2g of solid E supplied in a stoppered container.
- about 0.5g of solid F supplied in a stoppered container
- six clean dry test-tubes
- one blue and one red litmus paper
- one 10ml measuring cylinder
- one metallic spatula
- about 0.3g of sodium hydrogen carbonate (solid)
- one test-tube holder
- 15cm^3 of 2M hydrochloric acid.

Access to.

- Bunsen burner
- 2M aqueous ammonia supplied with a dropper
- acidified potassium dichromate (IV) supplied with a dropper
- acidified potassium manganate (VII) supplied with a dropper
- Phenolphthalein indicator supplied with a dropper.

Preparations

1. Solution B is prepared by adding 172.0cm^3 (1.18g/cm) of concentrated hydrochloric acid to about 500cm^3 of distilled water and diluting to one litre of solution.
2. Acidified potassium dichromate (VI) is prepared by dissolving 25g of solid potassium dichromate (VI) in about 600cm^3 of 2M sulphuric acid and diluting to one litre of solution.
3. Acid $KMnO_4$ 3.16 g in 500cm^3 of 2M H_2SO_4 dilute to 1l.
4. NaOH_____ 4.0g _____700cm^3 H_2O _____ diluting to 1 litre

October / November 2009

Requirements to Candidates.

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

- 1.8g of solid a weighed accurately and supplied in a stopperd container.
- about 60cm^3 of solution G
- one 250ml volumetric flask
- one pipette, 250ml and a pipette filler

- one burette 0 – 50ml
- 2 labels
- about 120cm^3 of solution C
- three dry conical flasks (250ml)
- one dry filter funnel
- one 250ml dry beaker
- one filter paper whatman 125mm no.1
- 0.5g of solid E supplied in a stoppered container
- six dry test tubes
- one 100ml measuring cylinder
- one 10ml measuring cylinder
- about 500cm^3 of distilled water supplied in a wash bottle
- one oiling tube
- one glass rod
- 0.5g solid F supplied in a stoppered container.
- 5cm^3 of absolute ethanol supplied in a stoppered container on the day of examination.
- 0.2g of solid sodium hydrogen carbonate
- spatula
- one test-tube holder

Access to:

- Bromine water supplied with a dropper
- acidified potassium dichromate (VI) supplied with a dropper
- 2M aqueous ammonia supplied with a dropper
- Bunsen burner
- tissue paper
- aqueous lead (II) nitrate supplied with a dropper
- universal indicator solution pH 1 – 14 supplied with a dropper
- pH chart range 1 – 14
- freshly prepared methyl orange indicator supplied with a dropper

Preparations

1. Solution B is prepared by dissolving 215cm^3 of conc. HCl of density 1.18g/cm^3 in abut 500cm^3 of distilled water and making to one litre of solution using distilled water and labelled solution B.
2. Solution C is prepared by dissolving 12.0g of NaOH pellets in about 800cm^3 of distilled water and making to one litre of solution using distilled water and labelled solution C.
3. Acidified potassium dichromate (VI) is prepared by dissolving 25g of solid potassium dichromate (VI) in about 400cm^3 of 2M H_2SO_4 acid and making to one litre of solution using distilled water and labelled acidified potassium dichromate (VI) solution.
4. Bromine water is prepared by adding 1cm of liquid bromine to 100cm^3 of distilled water and stirring well in a well in an efficient fume clipboard.
5. Lead (II) nitrate is prepared by adding 30g of solid lead (II) nitrate in about 700cm^3 of distilled water and making up to one litre of solution using distilled water and labelled lead (II) nitrate solution.

October /November 2010

Candidates Requirements

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

- About 150cm^3 of solution A labeled solution A
- About 150cm^3 of solution B labeled solution B
- About 80cm^3 of solution C labeled solution C
- One pipette 25.0ml
- One pipette filler
- One volumetric flask (250.0ml)
- Four labels
- About 500cm^3 of distilled water
- One burette 50.0ml
- Three conical flasks
- One 10ml measuring cylinder
- One 100ml measuring cylinder
- Two boiling tubes
- One thermometer -10^0 C to 110^0C
- About 0.5 g of solid E supplied in a stopper container
- Six clean dry test-tubes
- About 0.1g of solid F supplied in a stopper container
- About 0.5g of solid G supplied in a stopper container
- pH chart 1-14; and universal indicator solution supplied with a dropper
- One 100ml beaker
- One metallic spatula
- One clean dropper

Access to

- Phenolphthalein indicator supplied with a dropper
- 2 M sulphuric (VI) acid supplied with a dropper
- 2 M sodium hydroxide supplied with a dropper
- 0.5M potassium iodide supplied with a dropper
- Bromine water supplied with a dropper
- Acidified potassium manganate (VII) supplied with a dropper

- Bunsen burner

Preparations

1. Solution A is prepared by taking 190.0cm^3 of concentrated hydrochloric acid (Specific gravity 1.18) adding it to 600cm^3 of distilled water in a 1 litre volumetric flask and diluting it to the mark. Label this solution as solution A.

2. Solution B is prepared by dissolving 80.0g of sodium hydroxide pellets in 800cm of distilled water and diluting it to the mark. Label it as solution B.

3. Solution C is prepared by dissolving 25g of solid C in 600cm^3 of distilled water and diluting it to the mark. Label this as solution C

4. Bromine water is prepared by taking 1cm^3 of liquid bromine and dissolving it in 100cm^3 of distilled water in a fume cupboard. This must be fleshly prepared and supplied in a dropper battle

5. Acidified potassium manganate (VII) is prepared by dissolving 3.16g of solid potassium manganate (VII) in about 600cm^3 of 2M Sulphuric (VI) acid and adding distilled water to make 1 litre.

October /November 2011

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

A.

1. 1.60g of solid A weighed accurately and supplied in a stoppered container.
2. About 80cm^3 of solution B.
3. about 200cm^3 of solution C
4. One burette 0 – 50ml
5. One pipette 25.0ml
6. One pipette filler
7. One 250ml volumetric flask
8. Three 250ml conical flasks
9. 4 labels
10. About 0.5g of solid D in a stoppered container
11. one spatula
12. Six clean dry test – tubes
13. One boiling tube
14. one red and one blue litmus papers
15. 4cm^3 of solution E in a test tube and labeled solution **E.**
16. about 500cm^3 of distilled water in a wash bottle
17. about 10cm^3 of liquid F supplied in a stoppered test tube and labeled liquid **F.**
    (Liquid F is absolute ethanol)
18. One clean and dry watch glass
19. 0.2gm of solid sodium hydrogen carbonate
20. one test – tube holder
21. one stop watch
22. One 10ml measuring cylinder

B. ACCESS TO:

1. Bunsen burner
2. Phenolphthalein indicator supplied with a dropper
3. 2M sodium hydroxide supplied with a dropper.
4. 20V hydrogen peroxide supplied with a dropper

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In addition to the apparatus and reagents found in a chemistry laboratory, each candidate will require the following:

1. about 150cm^3 of solution A
2. about 100cm^3 of solution B
3. about 45cm^3 of solution C
4. about 50cm^3 aqueous potassium iodide
5. about 60cm^3 of solution D
6. about 50cm^3 of 2M sulphuric (vi) acid
7. one pipette 25.0ml
8. One pipette filler
9. One burette 0 – 50ml
10. two 250ml conical flasks
11. One 10ml measuring cylinder
12. Six dry test tubes
13. One stop watch or clock
14. Test – tube rack
15. about 0.5g of solid E supplied in a stoppered container
16. two boiling tubes
17. one red and one blue litmus papers
18. test – tube holder
19. 3 x1 cm piece of aluminium foil
20. about 0.5 of solid F in a stoppered container
21. about 0.2g of solid sodium hydrogen carbonate
22. about 20cm^3 of 2M hydrochloric acid
23. three 12.5cm whatman No. 1 filter papers
24. one filter funnel
25. one metallic spatula
26. about 500cm^3 of distilled water
27. one 100ml beaker
28. 8 small labels

Access to:

1. aqueous sodium sulphate supplied with a dropper
2. aqueous sodium chloride supplied with a dropper
3. aqueous barium nitrate supplied with a dropper
4. aqueous lead (II) nitrate supplied with a dropper
5. 2M sodium hydroxide supplied with a dropper
6. Bunsen burner
7. Bromine water supplied with a dropper

NB: Solids A, C, D, E and F will be supplied by the Kenya National Examination Council

1. Solution **A is** prepared by dissolving 1.20g of solid A in about 600cm^3 of distilled water and diluting to one litre of solution. Label this solution as solution A.
2. Solution **B** is prepared by dissolving 12.40g of solid sodium thiosulphate ($Na_2S_2O_3.5H_2O$) in about 800cm^3 of distilled water and diluting to one litre of solution. Label this as solution B.
3. Solution **C** is prepared by dissolving 0.40g of solid **C** in about 800cm^3 of distilled water and diluting to one litre of solution. Label this as solution **C.**
4. Potassium iodide is prepared by dissolving 5gm of solid potassium iodide in about 800cm^3 of distilled water and diluting to ne litre of solution. Label this as potassium iodide.
5. Solution **D** is prepared by placing 10g of solid **D** in 1000cm^3 of distilled water. Heating the mixture to boiling and allowing it to cool to room temperature. Label this as solution **D**
6. Sodium sulphate solution is made by dissolving 14.2g of solid sodium sulphate in about 800cm^3 of distilled water and diluting to one litre of solution. Label this as aqueous sodium sulphate.
7. Sodium chloride solution is made by dissolving 5.85g of solid sodium chloride in about 800cm^3 of distilled water and diluting to one litre of solution. Label this as aqueous sodium chloride.
8. Barium nitrate solution is prepared by dissolving 26.0gm of solid barium nitrate in about 800cm^3 of distilled water and diluting to one litre of solution. Label this as aqueous barium nitrate.
9. Lead (II) nitrate is prepared by dissolving 33.0gm of solid lead (II) nitrate in about 800cm^3 of distilled water and diluting to one litre of solution. Label this as aqueous lead (II) nitrate.
10. Bromine water is prepared by adding 1cm^3 of liquid bromine in 100cm^3 of distilled water and shaking well in a fume cupboard. Label this as bromine water.

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In addition to the apparatus and reagents found in a chemistry laboratory, each candidate will require the following:

1. about 80cm^3 of solution A
2. 1.60g of solid B weighed accurately and supplied in a stoppered container
3. about 100cm^3 of solution C
4. one burette 0 – 50.0 ml;
5. one 100ml beaker
6. one thermometer - 10^0 – 110^0C
7. One stop watch/ clock;
8. one 250ml volumetric flask
9. One 10ml measuring cylinder
10. about 70cm^3 of 2M sulphuric acid (VI) acid
11. about 500cm^3 of distilled water supplied in a wash bottle

12. two labels
13. one 25.0ml pipette
14. one pipette filler
15. two 250ml conical flasks;
16. 2.0g of solid E supplied in a stoppered container
17. two boiling tubes
18. 3 filter papers (whatman no 1 125mm)
19. One filler funnel
20. six dry test tubes
21. One burning splint
22. 0.5g of solid G supplied in a stoppered container
23. One metallic spatula
24. 0.2g of solid sodium hydrogen carbonate supplied in a stoppered
25. Fresh universal indicator
26. pH chart range 1- 14
27. One test tube holder

Access to:

1. Bunsen burner
2. 2M hydrochloric acid
3. 2M aqueous ammonia supplied with a dropper
4. 0.5 barium nitrate supplied with a dropper

Preparations

1. Solution A is prepared by dissolving 125.2g of hydrated copper (II) sulphate is about 800cm^3 of distilled water and diluting tone litre of solution and labeled solution A.
2. Solution C is prepared by placing 3.2g of solid C in one litre volumetric flask, adding 100cm^3 of 2M sulphuric (VI) acid followed by 700cm^3 of distilled water shaking to dissolve then diluting to the mark. Label this as solution C.
3. Solid E is prepared by weighing 0.5 of solid E_1 and 0.5 g of zinc carbonate putting both of them in one stoppered container and labeled solid E