

# 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  $H_2CO_4 \cdot 2H_2O$  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  $25.0\text{cm}^3$  of solution  $W_{12}$  into a conical flask. Titrate using phenolphthalein indicator. Record your results in Table A below;

## Table A.

	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Final Burette Reading			
Initial Burette Reading			
Titre (cm <sup>3</sup> )			

(5 marks)

- i) Average volume of solution **W**<sub>11</sub> used (1 mark)
- ii) Calculate the concentration of the dibasic solution **W**<sub>11</sub> in mol<sup>-1</sup> (C=12, H=1, O=16) (1 mark)
- iii) Calculate the concentration of the sodium hydroxide solution **W**<sub>12</sub> in mol l<sup>-1</sup> (2 marks)

- II. Using a 100cm<sup>3</sup> measuring cylinder measure 90cm<sup>3</sup> of distilled water and place it into a 250cm<sup>3</sup> beaker then add 10cm<sup>3</sup> of solution **W**<sub>9</sub> (**W**<sub>9</sub> is supplied in a burette). Mix the solution well and label it **W**<sub>10</sub>.

Fill a burette with solution **W**<sub>10</sub>, pipette 25.0cm<sup>3</sup> of solution **W**<sub>12</sub> into a conical flask. Titrate using phenolphthalein indicator. Record your results in Table B below.

**Table B.**

	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Final Burette Reading			
Initial Burette Reading			
Titre (cm <sup>3</sup> )			

(5 marks)

- i). Average volume of solution **W**<sub>10</sub> used. (1 mark)
- ii). Calculate the concentration of the diluted hydrochloric acid solution **W**<sub>10</sub> in mol l<sup>-1</sup>. (2 marks)
- iii). Determine the concentration of the original hydrochloric acid solution **W**<sub>9</sub> in mol l<sup>-1</sup> (1 mark)

- III. Cut three pieces each of length 2cm from the metal **M** provided. From the burette containing **W**<sub>9</sub> measure 10cm<sup>3</sup> of **W**<sub>9</sub> 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 **W**<sub>9</sub> 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.**

	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Piece of metal <b>M</b>			
Highest temperature			
Initial temperature			

Change in temperature, $\Delta T$			
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(5 marks)

- i). Average change in temperature  $\Delta T$ ..... $^{\circ}\text{C}$  (1 mark)
- ii). Calculate the heat of the reaction between metal **M** and hydrochloric acid using the expression below; heat of reaction =  $42 \times \Delta T$  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 endful 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 $1\text{cm}^3$ of dilute hydrochloric acid	(1 mark)	(1 mark)
c).	Place a half a spatula endful in a test tube and about $6\text{cm}^3$ of distilled water and shake well. Divide the solution into two portions.	X	X
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)
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## 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:

- Prepare a saturated solution of **solid D**
- Standardize the sodium hydroxide solution **S1** using solution **S2**.
- Determine the solubility of **Solid D** in water at room temperature.

#### Procedure

- Place all the **solid D** provided into a dry conical flask. measure out  $100\text{cm}^3$  of distilled water using a measuring cylinder and add it to the **Solid D**. Shake thoroughly and leave it to stand.
- Fill a burette with **solution S1**. Pipette  $25\text{cm}^3$  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	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Final Burette reading				
Initial burette reading				
Titre ( $\text{cm}^3$ )				

Average titre = ..... $\text{cm}^3$

(Show the value s being averaged)

(1 mark)

Calculations:

- Write the equation for the reaction of the dibasic acid  $H_2A$  with sodium hydroxide..... (1 mark)
- Calculate the concentration of sodium hydroxide Solution **S1** in moles per litre..... (3 marks)

- 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  $10\text{cm}^3$  of the filtrate into a conical flask, add  $25\text{cm}^3$  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** = ..... ° C (1 mark)

**Table B.**

	Trial	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Final burette reading				
Initial burette reading				
Titre (Cm <sup>3</sup> )				

(6 marks)

Average titre=.....

(Show the values being averaged)

(1 mark)

**Calculation;**

- Calculate the number of moles of **acid D** in 10cm<sup>3</sup> of the filtrate, (1 mark)
- Calculate the number of moles of **acid D** in 100cm<sup>3</sup> of solution of **acid D**. (1 mark)
- Given that the molecular formula of **acid D** is C<sub>7</sub>H<sub>6</sub>O<sub>2</sub>, calculate the solubility of the acid in grammes per 100cm<sup>3</sup> of water (C=12, 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 <sup>3</sup> of distilled water. Shake well. Use about 2cm <sup>3</sup> 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 <sup>3</sup> 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 <sup>3</sup> 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<sub>2</sub>, Potassium iodate solution
- Solution C<sub>3</sub>, acidified sodium hydrogen sulphite solution
- Solution C<sub>4</sub>, starch indicator
- A stop watch/stop clock

You are required to find out the effect of the concentration of potassium iodate, C<sub>2</sub>, on the **rate** of reaction with acidified sodium hydrogen sulphite, C<sub>3</sub>.

**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<sub>2</sub> in a burette and measure out the volumes of C<sub>2</sub> shown in table 1 into six dry test-tubes. Using a 10cm<sup>3</sup> measuring cylinder, add distilled water to the test-tubes as shown in table 1.

Test-tube	Volume of C <sub>2</sub> and water
i).	10cm <sup>3</sup> of C <sub>2</sub> + 0 cm <sup>3</sup> distilled water
ii).	8cm <sup>3</sup> of C <sub>2</sub> + 2 cm <sup>3</sup> distilled water
iii).	6cm <sup>3</sup> of C <sub>2</sub> + 4cm <sup>3</sup> distilled water
iv).	4cm <sup>3</sup> of C <sub>2</sub> + 6 cm <sup>3</sup> distilled water
v).	3cm <sup>3</sup> of C <sub>2</sub> + 7 cm <sup>3</sup> distilled water
vi).	2cm <sup>3</sup> of C <sub>2</sub> + 8 cm <sup>3</sup> distilled water

b). Using a clean 10cm<sup>3</sup> measuring cylinder, place 10cm<sup>3</sup> of solution C<sub>3</sub> into a 100cm<sup>3</sup> beaker, add 3 drops of solution C<sub>4</sub> 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 $C_3$ ( $\text{cm}^3$ )	Volume of $C_4$ (drops)	Volume of $C$ ( $\text{cm}^3$ )	Volume of distilled water ( $\text{cm}^3$ )	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  $7\text{cm}^3$  of  $C_2$  and  $3\text{cm}^3$  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  $C_5$ , 0.11M hydrochloric acid
- Solution  $C_6$ , containing 19.2g/l of basic compound  $\text{Na}_2\text{B}_4\text{O}_7 \cdot n\text{H}_2\text{O}$

You are required to determine the value of n in compound  $C_6 \text{Na}_2\text{B}_4\text{O}_7 \cdot n\text{H}_2\text{O}$ .

**Procedure**

a). Place solution  $C_5$  in the burette. Pipette  $25.0\text{cm}^3$  (or  $20.0\text{cm}^3$ ) of  $C_6$  into a  $250\text{cm}^3$  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..... $\text{cm}^3$

Burette readings

**Table III**

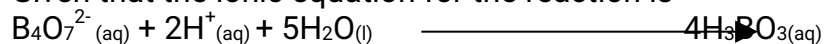
Titration number	I	II	III
Final reading (cm <sup>3</sup> )	28.5		
Initial reading (cm <sup>3</sup> )	00.00		
Volume of C <sub>4</sub> use (cm <sup>3</sup> )	28.5		

(5 marks)

Average volume of C<sub>5</sub> used = .....cm<sup>3</sup> (1 mark)

b). **Calculations;**

Given that the ionic equation for the reaction is



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

i). Calculate the concentration of C<sub>6</sub> in moles per litre. (4 marks)

ii). Calculate the relative molecular mass of the basic compound C<sub>6</sub>.

(2

marks)

iii). Calculate the value of **n** in the formula Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub>nH<sub>2</sub>O

(B=10.8, H=1.0, Na=23.0, and O = 16.0).

(3 marks)

3. **(10 marks).**

You are provided with solid C<sub>7</sub>. 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 <sub>7</sub> in a dry test-tube and heat gently.	(1 mark)	(1 mark)
b).	Place the remainder of the solid C <sub>7</sub> in a boiling tube. Add about 10cm <sup>3</sup> 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<sup>3</sup> of solution A into a 250cm<sup>3</sup> conical flask, measure 175cm<sup>3</sup> of Distilled water using 100cm<sup>3</sup> measuring cylinder and add it to solution A in the beaker. Shake well. Label this as solution D. Pipette 25cm<sup>3</sup> of solution D into a 250cm<sup>3</sup> 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	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Final burette reading (cm <sup>3</sup> )			
Initial burette reading (cm <sup>3</sup> )			
Volume of solution C used (cm <sup>3</sup> )			

Calculations:

- Determine the average volume of solution C used. (1 mark)
- Calculate the concentration in moles per litre, of sodium hydroxide in solution D. (1 mark)
- 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<sup>3</sup> conical flask. Pipette 25cm<sup>3</sup> 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<sup>3</sup> of distilled water to the boiled mixture and shake well. Transfer the solution into a 100cm<sup>3</sup> measuring cylinder then add distilled water up to the 100cm<sup>3</sup> mark. Pour this solution back into the conical flask and label it as solution **E**. Pipette 25cm<sup>3</sup> of solution **E** into a 250 cm<sup>3</sup> 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	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Final burette reading (cm <sup>3</sup> )			
Initial burette reading (cm <sup>3</sup> )			
Volume of solution C used (cm <sup>3</sup> )			

### Calculations:

- Determine the average volume of **C** used. (1 mark)
- Calculate:
  - The number of moles of the monobasic acid, Solution **C**, used (2 marks)
  - The number of moles of hydroxide in 25cm<sup>3</sup> of solution **E**. (1 mark)
  - The number of moles of sodium hydroxide in 100cm<sup>3</sup> of solution **E**. (1 mark)
- Using concentration of sodium hydroxide solution, obtained in (e) above calculate the moles of sodium hydroxide in 25cm<sup>3</sup> of solution **A** (this gives the number of moles of sodium hydroxide added to the ammonium salt **B**) (2 marks)
- 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)
- 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)
- 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 <b>F</b> provided into a boiling tube and add distilled water with shaking until the boiling tube is half full. Use about 3cm <sup>3</sup> portions of the solution for tests (a) to (d) below.	(1 mark)	(1 mark)
a)	To the 1 <sup>st</sup> portion add sodium hydroxide solution drop wise until in excess	(1 mark)	(1 mark)
b)	To the 2 <sup>nd</sup> portion add about six drops of barium chloride solution	(1 mark)	(1 mark)
c)	To the 3 <sup>rd</sup> 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 4 <sup>th</sup> portion add about 1cm <sup>3</sup> 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<sub>3</sub>H<sub>5</sub>O (COOH) *n* solution **E**

You are required to determine the value of *n* in the formula C<sub>3</sub>H<sub>5</sub>O (COOH)*n* of the carboxylic acid **E**

### Procedure

a). Place solution **D** in the burette. Pipette 25.0cm<sup>3</sup> (or 20.0cm<sup>3</sup>) 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<sup>3</sup>

### Table I

Burette readings

Titration number	I	II	III
Final reading (cm <sup>3</sup> )			
Initial reading (cm <sup>3</sup> )			
Volume of D used (cm <sup>3</sup> )			

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<sup>3</sup> (or 20.0cm<sup>3</sup>) used

2 marks

- e). i). Calculate the number of moles of sodium hydroxide required to react with one mole of C<sub>3</sub>H<sub>5</sub>O(COOH)<sub>n</sub> 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<sup>3</sup> measuring cylinder, measure 5cm<sup>3</sup> portions of solution G and place them into each of the six test-tubes.

Measure 25.0cm<sup>3</sup> of solution F using a measuring cylinder and place it into a 100cm<sup>3</sup> beaker. Measure the temperature of this solution F to the nearest 0.5°C and record it in **table II**.

Pour the first portion of the 5cm<sup>3</sup> of solution G from the test-tube into the beaker containing 25cm<sup>3</sup> 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

Volume of F (cm <sup>3</sup> )	25	25	25	25	25	25	25
Temperature (°C)							

- 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: 4 marks
- i). The volume of the solution G required to neutralize 25cm<sup>3</sup> sodium hydroxide solution F 1 mark
- ii). The highest temperature change,  $\Delta T$ , 1 mark
- d). Calculate the heat change for the reaction. (Heat change = mass x temperature change x 4.2Jg<sup>-1</sup> °C<sup>-1</sup>. Assume density of each solution to be 1gm cm<sup>-3</sup>) 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 <sup>3</sup> 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 <sup>3</sup> 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

- Potassium hydrogen carbonate and hydrochloric acid
- Magnesium carbonate and hydrochloric acid
- Aqueous magnesium chloride and aqueous potassium hydrogen carbonate.

### Procedure

- By means of a burette place 15.0cm<sup>3</sup> of the 2.0M hydrochloric acid in a 100cm<sup>3</sup> 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°)											

On the grid provided plot a graph of temperature against time and determine from it the fall in temperature  $\Delta T_1$ . Show the change  $\Delta T_1$  on the graph

(3

marks)

Fall in temperature  $\Delta T_1$

(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  $1.0\text{gcm}^3$

a). **Calculate;**

i). The number of moles,  $n_1$ , of potassium hydrogen carbonate ( $\text{KHCO}_3$ ) used during procedure I (1 mark)

ii). The enthalpy, change  $\Delta H_2$  for the reaction between potassium hydrogen carbonate and hydrochloric acid. Show the sign. Use the following expression (2 marks)

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

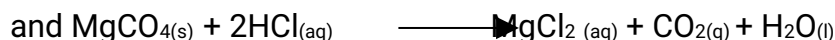
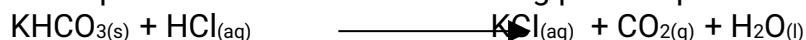
b). **Calculate;**

i). The number of moles  $N_2$ , of magnesium carbonate ( $\text{MgCO}_3$ ) used in procedure II (1 mark)

ii). The enthalpy change  $\Delta H_2$  for the reaction between magnesium carbonate and hydrochloric acid. Show the sign. Use the following expression.

$$\Delta H_2 = \frac{\text{Mass of solution} \times 4.2 \times \Delta T_2}{n_2 \times 1000} \text{ KJmol}^{-1} \quad (2 \text{ marks})$$

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



Given that the enthalpy change,  $\Delta H_3$  for the process.

$\text{KHCO}_{3(s)} \longrightarrow \text{KHCO}_{3(aq)} = 121 \text{ kJmol}^{-1}$  determine the Enthalpy change  $\Delta H_4$  for the reaction represented by the equation



Use the following expression

$$\Delta H_4 = 2\Delta H_1 - \Delta H_2 - 2\Delta H_3 \quad (2 \text{ marks})$$

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

c). Place a little L in a dry clean test tube then add about 2cm<sup>3</sup> of distilled water. Shake well then warm the mixture (1 mark)

Observations

Inferences

d). Place a little solid L in a dry clean test tube then add about 2cm<sup>3</sup> of dilute hydrochloric acid (1 mark)

Observations

inferences

e). place about 2cm<sup>3</sup> 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 (1 mark)

Observations

Inferences

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 <sup>3</sup> of distilled water. Shake well until all the solid dissolves. Use about 2cm <sup>3</sup> portions of this solution for the tests below.		
i).	Test the 1 <sup>st</sup> portion with red and blue litmus papers		
	Observations	Inferences	(1 mark)
ii).	To the 2 <sup>nd</sup> portion add a few drops of dilute sodium hydroxide shake well after every drop		
	Observations	Inferences	(1 mark)
iii).	To the 3 <sup>rd</sup> portion add a few drops of dilute lead nitrate. Shake well after every drop		
	Observations	Inferences	(1 mark)
iv).	To the 4 <sup>th</sup> portion add about 1cm <sup>3</sup> 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)  $\text{KMnO}_4$ , solution A.
- Solution **B**, containing 23.5g of ammonium Iron (II) Sulphate  $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ , per litre.
- Solution **C**, Containing 5.0g of a dibasic acid,  $\text{H}_2\text{X} \cdot 2\text{H}_2\text{O}$ , 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<sub>2</sub>X · 2H<sub>2</sub>O, solution C and then the formula mass of X.

**Procedure I:**

**Fill the burette with solution A.**

Pipette 25.0cm<sup>3</sup> 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 <sup>3</sup> )			
Initial burette reading (cm <sup>3</sup> )			
Volume of solution A (cm <sup>3</sup> )			

4 marks

- b). Record average volume of solution A used, V1 .....cm<sup>3</sup>  
(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<sub>4</sub>)<sub>2</sub> Fe (SO<sub>4</sub>)<sub>2</sub> · 6H<sub>2</sub>O = 392 1 mark
- d). Calculate the number of moles of iron (II) ions in the 25.0cm<sup>3</sup> 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.



**Procedure II**

Pipette 25.0cm<sup>3</sup> of solution C into a conical flask. Heat this solution to about 70°C 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 <sup>3</sup> )			
Initial burette reading (cm <sup>3</sup> )			
Volume of solution A (cm <sup>3</sup> )			

- g). Record average volume of solution A used  $V_2 = \dots\dots\dots \text{cm}^3$  4 marks  
 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,  $\text{H}_2\text{X} \cdot 2\text{H}_2\text{O}$ , calculate the number of moles of the dibasic acid,  $\text{H}_2\text{X} \cdot 2\text{H}_2\text{O}$ , in the  $25\text{cm}^3$  of solution C. 2 marks
- j). Calculate the concentration of the dibasic acid,  $\text{H}_2\text{X} \cdot 2\text{H}_2\text{O}$  in moles per litre 1 mark
- k). Calculate the formula mass of x in the dibasic acid  $\text{H}_2\text{X} \cdot 2\text{H}_2\text{O}$  3  
 (H = 1.0 O=16.0)

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  $1\text{cm}^3$  of 6M hydrochloric acid and warm gently for about one minute

Observations	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  $1\text{cm}^3$  of the filtrate in a test-tube add about  $1\text{cm}^3$  of 2M sodium hydroxide drop wise

Observations	2 marks
--------------	---------

- b). Place the remaining portion of D in a dry test-tube and about  $1\text{cm}^3$  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  $2\text{cm}^3$  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  $2\text{cm}^3$  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  $10\text{cm}^3$  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  $1\text{cm}^3$  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  $50\text{cm}^3$  of solution F using a measuring cylinder and place it in a  $100\text{cm}^3$  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 (°C)													

(5 marks)

b). Using the results in table I, determine the highest change in temperature,  $\Delta T$  for the reaction

$\Delta T$ ..... (1 mark)

c). Calculate the heat change for the reaction using the expression

Heat change = Mass of solution  $\times$  4.2  $\times$   $\Delta T$  Joules

(Assume density of solution = 1.0g/cm<sup>3</sup>) (3 marks)

d). Given that the molar heat of reaction of sulphuric acid with solid H is 323KJ mol<sup>-1</sup>, 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<sup>3</sup> measuring cylinder**. Add distilled water to make 100cm<sup>3</sup> 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<sup>3</sup> 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 <sup>3</sup> )			
Initial burette reading (cm <sup>3</sup> )			
Volume of solution G used (cm <sup>3</sup> )			

(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<sup>3</sup> of solution K. (1

mark)

ii). The number of moles of sulphuric acid in 100cm<sup>3</sup> 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  $50\text{cm}^3$  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 $2\text{cm}^3$ portion of the solution in a test-tube, add 2M of sodium hydroxide dropwise until in excess Observations	inferences (3 marks)
iii).	To another $2\text{cm}^3$ of the solution in a test-tube, add aqueous ammonia dropwise until in excess Observations	Inference (2 marks)
iv).	To a third $2\text{cm}^3$ of the solution, add a few drops of 2M sulphuric acid  Observations 1mark	Inferences 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 $2\text{cm}^3$ 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 <sup>3</sup> 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 <sup>3</sup> 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:

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

### Procedure I.

Fill the burette with sodium hydroxide, solution N. Pipette 25.0cm<sup>3</sup> 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 <sup>3</sup> )			

(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<sup>3</sup> of solution M into a 250cm<sup>3</sup> 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<sup>3</sup> 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 <sup>3</sup> )			

(4 marks)

What is the average volume of solution N Used?

- a). Calculate the:
- Moles of hydrochloric acid in 25.0cm<sup>3</sup> of solution Q (2 marks)
  - Moles of hydrochloric acid in 100cm<sup>3</sup> of solution Q (1 mark)
  - Moles of hydrochloric acid in 100cm<sup>3</sup> of the original hydrochloric acid solution M. (1 mark)
  - Moles of hydrochloric acid that were used up in the reaction with solid P. (1 mark)
  - 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;
- Mass of the carbonate that reacted (1 mark)
  - 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<sup>3</sup> of distilled water. Divide the solution into four portions.
- 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 <sup>3</sup> of barium chloride solution.	
	Observations	Inferences
	(1 mark)	(1 mark)
iv).	To the fourth portion, add 1 cm <sup>3</sup> 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<sup>3</sup> of distilled water. Shake well to dissolve all the solid.

- i). To about 1cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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  $25\text{cm}^3$  of solution F into a  $250\text{cm}^3$  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 ( $\text{cm}^3$ )			

(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:
- Number of moles of the basic compound,  $G_2X.10H_2O$  in the volume of solution F used.
  - Concentration of solution F in moles per litre.
  - Relative formula mass of the basic compound,  $G_2X10H_2O$ .
  - 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<sup>3</sup> 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<sup>3</sup> 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 <sup>3</sup> )	10	9	8	7	6
Volume of water (cm <sup>3</sup> )	0	1	2	3	4
Time taken (sec)					
Rate of reaction = $\frac{1}{\text{time}}$					

**Table II**

- b).
  - i). Plot a graph of rate of reaction  $\frac{1}{\text{time}}$  (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<sup>3</sup> (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 and 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 <sup>3</sup> 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 <sup>3</sup> 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<sup>3</sup> 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)

	1 <sup>st</sup>	2 <sup>nd</sup>
Final burette reading		
Initial burette reading		
Titre (cm <sup>3</sup> )		

(3 marks)

Find average titre  $t_1$

(½ mark)

.....

**Table II** (Using methyl orange indicator)

	1 <sup>st</sup>	2 <sup>nd</sup>
Final burette reading		
Initial burette reading		
Titre (cm <sup>3</sup> )		

(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  $\text{Na}_2\text{CO}_3 = 106$ ) (2marks)

II Moles of sodium carbonate in 25cm<sup>3</sup> 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<sup>3</sup> of distilled water into a 100cm<sup>3</sup> 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 (°C)									

(3marks)

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

c). On the graph, show the change in temperature,  $\Delta T$  (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,  $\Delta H_{\text{soln}}$  and show the sign of  $\Delta H_{\text{soln}}$

(Assume density of solution =  $1.0\text{g/cm}^3$ )

Specific heat capacity of solution =  $4.2\text{Jg}^{-1}\text{K}^{-1}$  (3 marks)

3. You are provided with  $10\text{cm}^3$  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  $20\text{cm}^3$  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  $2\text{cm}^3$  of the filtrate, add 2M nitric acid dropwise until in excess (i.e. about  $1\text{cm}^3$  of the acid). Retain the mixture.

Observations  
(2 marks)

Inferences  
(1 mark)

ii). Divide the mixture in (b) (i) above into two portions  
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  $1.5\text{cm}^3$  of aqueous ammonia)

- |  |                          |                        |
|--|--------------------------|------------------------|
|  | Observations<br>(1 mark) | Inferences<br>(1 mark) |
|--|--------------------------|------------------------|
- c). To 2cm<sup>3</sup> of the filtrate, add 3 drops of 2M hydrochloric acid.
- |  |                          |                        |
|--|--------------------------|------------------------|
|  | Observations<br>(1 mark) | Inferences<br>(1 mark) |
|--|--------------------------|------------------------|
- d). To 2cm<sup>3</sup> of the filtrate, add 3 drops of acidified chloride acid.
- |  |                          |                        |
|--|--------------------------|------------------------|
|  | Observations<br>(1 mark) | Inferences<br>(1 mark) |
|--|--------------------------|------------------------|
- e). To the residue, add about 5cm<sup>3</sup> of dilute nitric acid and allow it to filter into a test-tube. To 2cm<sup>3</sup> of this filtrate, add aqueous ammonia dropwise until in the excess then filter into a clean test-tube.
- |  |                          |                        |
|--|--------------------------|------------------------|
|  | Observations<br>(1 mark) | Inferences<br>(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<sup>3</sup> of solution A with distilled water to 150cm<sup>3</sup> 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<sup>3</sup> of solution D into a 250cm<sup>3</sup> 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 <sup>3</sup> )			

(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  $16\text{cm}^3$  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  $4\text{cm}^3$  of solution A into  $100\text{cm}^3$  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( $\text{cm}^3$ )	16	12	8	6	4	2
Volume of solution A ( $\text{cm}^3$ )	4	8	12	14	16	18
Final temperature ( $^{\circ}\text{C}$ )						
Initial temperature ( $^{\circ}\text{C}$ )						
Change in temperature , ( $\Delta T$ )						

(6 marks)

- a). On the grid provided, plot a graph of  $\Delta T$  (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 <sup>3</sup> of distilled water and shake well until all the solid dissolves.	
i). To about 1cm <sup>3</sup> of the solution, add 2M sodium hydroxide drop wise until in excess.	
Observations	Inferences (2 marks)
ii). Place 1cm <sup>3</sup> 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 <sup>3</sup> 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<sup>3</sup> of distilled water and shake well. Use 2cm<sup>3</sup> 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<sup>3</sup> of solution A into beaker 1. Into the same beaker, add 20cm<sup>3</sup> of solution B using a 50ml or 100ml measuring cylinder. Shake the contents of beaker 1.

Using a 10ml measuring cylinder, place 5cm<sup>3</sup> of solution C into beaker 2 followed by 5cm<sup>3</sup> of solution D then 2cm<sup>3</sup> 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  $\frac{1}{\text{Time}} \text{ sec}^{-1}$  (7 ½ marks)

a).

Experiment	BEAKER 1			BEAKER 2			Time (sec)	$\frac{1}{\text{Time}} \text{ sec}^{-1}$
	Volume of water (cm <sup>3</sup> )	Volume of hydrogen peroxide, solution A (cm <sup>3</sup> )	Volume of dilute sulphuric acid, solution B (cm <sup>3</sup> )	Volume of sodium thiosulphate, solution C (cm <sup>3</sup> )	Volume of potassium iodide, solution D (cm <sup>3</sup> )	Volume of starch, solution E (cm <sup>3</sup> )		
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  $(\frac{1}{\text{time}}) \text{ sec}^{-1}$  (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<sup>3</sup> water 7.5cm<sup>3</sup> solution A and 20cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of the filtrate in a test-tube, add five drops of barium nitrate solution

Observations	Inferences
--------------	------------

(1 mark)	(1 mark)
----------	----------

- c). To 2cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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  $10\text{cm}^3$  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  $250\text{cm}^3$  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  $25\text{cm}^3$  of solution Q into a  $250\text{cm}^3$  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 ( $\text{cm}^3$ )			

(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**:
- In 25.0cm<sup>3</sup> of solution. (2 marks)
  - 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:

- The molar heat of solution of solid **S**.
  - The heat of reaction of one mole of the dibasic acid with sodium hydroxide.
- Calculate the heat of reaction of solid  $H_2A$  with aqueous sodium hydroxide.

**Procedure 1**

Place 30cm<sup>3</sup> 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(°C)	
Initial temperature(°C)	

(1½ marks)

- b). Determine the change in temperature,  $\Delta T_1$  (½ mark)

**Calculate the:**

- Heat change when  $H_2A$  dissolves in water .assume the heat capacity of the solution is  $4.2\text{Jg}^{-1}\text{0c}^{-1}$  and density is  $1\text{g/cm}^3$  (2 marks)
  - Number of moles of the acid that were used. (Relative formula mass of  $H_2A$  is 126. (1 mark)
  - Molar heat of solution  $H_1$  solution of the acid  $H_2A$ . (1 mark)

**Procedure II**

Place 30cm<sup>3</sup> of solution **T** into 100ml beaker. Measure the initial temperature and record

it in the Table III below. Measure 30cm<sup>3</sup> of sodium hydroxide, solution **R**. Add al the 30cm<sup>3</sup> 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 ( $^{\circ}\text{C}$ )	
Initial temperature ( $^{\circ}\text{C}$ )	

b). Determine the change in temperature  $\Delta T_2$

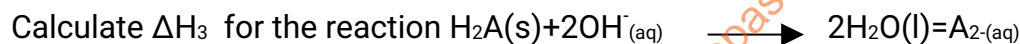
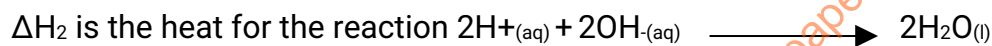
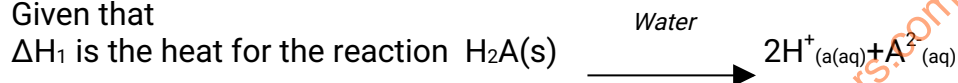
c). Determine the:

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

ii). Number of moles of the acid  $\text{H}_2\text{A}$  used. (1 mark)

iii). Heat of reaction  $\Delta H_2$  of one mole of the acid  $\text{H}_2\text{A}$  with sodium hydroxide. (1 mark)

d). Given that



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 $20\text{cm}^3$ of distilled water in boiling tube. Into 5 separate test-tubes, put $2\text{cm}^3$ 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 <sup>3</sup> 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:

- Temperature change when magnesium reacts with excess hydrochloric acid.
- Number of moles of hydrochloric acid that remain unreacted
- Number of moles of magnesium that reacted
- Molar heat of reaction between magnesium and hydrochloric acid

### Procedure I

Using a burette, measure 50cm<sup>3</sup> 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<sup>3</sup> 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 ( $^{\circ}\text{C}$ )											

(5 marks)

- Plot a graph of temperature (y-axis) against time on the grid provided (3 marks)
- On the graph, show the maximum change in temperature,  $\Delta T$ , and determine its value. Value of  $\Delta T$  (1 mark)

**Procedure 2**

Transfer all the solution obtained in 1 into a 250ml. conical flask. Clean the burette and use it to place  $50\text{cm}^3$  of distilled water into the beaker used in procedure 1. Transfer all the  $50\text{cm}^3$  of water into the 250ml conical flask containing the solution from procedure 1. Label this as solution **D**. empty the burette and fill it with solution **C**. Pipette  $25\text{cm}^3$  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 ( $\text{cm}^3$ )			

(4 marks)

- Calculate the average volume of solution **C** used (1 mark)
- Calculate the number of moles of:
  - 0.3M sodium hydroxide used (1 mark)
  - Hydrochloric acid in  $25\text{cm}^3$  of solution **D** (1 mark)
  - Hydrochloric acid in  $100\text{cm}^3$  of solution **D** (1 mark)
  - hydrochloric acid in  $50\text{cm}^3$  of solution **B** (1 mark)
  - hydrochloric acid that reacted with magnesium (1 mark)
  - magnesium that reacted (2 marks)

- 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  $4.2\text{Jg}^{-1}\text{deg}^{-1}$  and density is  $1.0\text{g/cm}^3$ )



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

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

i). Use about $2\text{cm}^3$ portions of diluted solution H for tests I and II.	
I. To the first portion, add drop wise about $1\text{cm}^3$ 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 $3\text{cm}^3$ of the diluted solution H, add drop wise all the chlorine water (source of chlorine) provided	
Observations	Inferences
	(2 marks)
iii). To $2\text{cm}^3$ the diluted solution H, add all the bromine water (source of bromine) provided.	
Observations	Inferences
	(2 marks)
iv). To $2\text{cm}^3$ 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
<b>E</b>	
<b>F</b>	
<b>G</b>	
<b>H</b>	

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<sup>3</sup> 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 (°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<sup>3</sup> of solution K into a 100ml beaker. Measure the temperature T<sub>1</sub> of the solution K and record it in table 2. Pipette 25.0 cm<sup>3</sup> of solution L into another 100ml beaker. Measure the temperature T<sub>2</sub>, 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, T<sub>3</sub> 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 <sub>1</sub> (°C)		
Initial temperature of solution L t <sub>2</sub> (°C)		
Highest temperature of mixture T <sub>3</sub> (°C)		
Average initial temperature (°C)		
Change in temperature ΔT (°C)		

(5 marks)

### Calculate the

- Average T value. (1 mark)
- Heat change for reaction  
(Assume density of solution is 1g/cm<sup>3</sup> and the specific heat capacity is 4.2Jg<sup>-1</sup>K<sup>-1</sup>) (2 marks)
- 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)
- Concentration of acid L in moles per litre. (2 marks)
- 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 <sup>3</sup> of distilled water and use the solution for the tests below.		

I.	To about 2cm <sup>3</sup> of the solution, add aqueous ammonia drop wise until in excess	Observations	Inferences (2 marks)
II.	To 2cm <sup>3</sup> of the solution, add about 5cm <sup>3</sup> of solution P(aqueous sodium chloride )	Observations	Inferences (2 marks)
III.	To 2cm <sup>3</sup> of the solution, add about 4cm <sup>3</sup> of aqueous barium nitrate	Observations	Inferences (1 mark)
IV).	To the mixture obtained in III above, add 2cm <sup>3</sup> 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 <sup>3</sup> of distilled water and shake. Retain the solution for tests (ii) and (iii) below.	Observations	Inferences  (2 marks)
ii).	To about 2cm <sup>3</sup> 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 <sup>3</sup> of dilute hydrochloric acid. Shake and filter the mixture. Wash the residue by pouring 6 cm <sup>3</sup> 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 <sup>3</sup> of distilled water. Shake the mixture.		
	To about 3cm <sup>3</sup> of the mixture, add a small amount of sodium hydrogen carbonate	Observations	Inferences  (2 marks)

## OCTOBER / NOVEMBER 2006

- 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:

- The solubility of solids A at different temperatures
- The number of moles of water of crystallization in solid A

### Procedure

- Using a burette add 4cm<sup>3</sup> of distilled water to solid A in the boiling tube. Heat the mixture while stirring with the thermometer to about 70°C. 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.
- Using the burette, add 2cm<sup>3</sup> 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.
- 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).
- 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<sup>3</sup> (100g) of water at a particular temperature.

**Table 1**

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

- On the grid provided, plot a graph of solubility of solid A (vertical axis) against temperature.
  - Using your graph, determine the temperature at which 100g of solid A would dissolve in 100cm<sup>3</sup> of water. (1 mark)
- Transfer the contents of the boiling tube into a 250ml volumetric flask,

and the conical flask. 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.

rinse both the boiling tube and the thermometer with distilled water add to the volumetric flask. Add more distilled water to make up to mark. Label this solution **A**. fill a burette with solution **B**. Using the pipette and pipette filter, place 25.0cm<sup>3</sup> of solution A into a conical flask. Warm the mixture to about 60°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 <sup>3</sup> )			

- 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<sup>3</sup> 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<sub>2</sub>O. 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 <sup>3</sup> 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 <sup>3</sup> of dilute hydrochloric acid	Observations	Inferences (2 marks)
iii). To the third portion, add 5cm <sup>3</sup> 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 <sup>3</sup> of distilled water, shake the mixture until all the solid dissolves.		
i). To the first 4cm <sup>3</sup> solution, add two to three drops of acidified potassium manganate (VII), solution B.	Observations	Inferences (2 marks)
ii). To about 4cm <sup>3</sup> 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<sup>3</sup> of solution A into a 250ml.

volumetric flask. Add distilled water to make  $250\text{cm}^3$  of solution. Label this solution **D**.

Place solution **D** in a burette. Clean the pipette and use it to place  $25.0\text{cm}^3$  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 ( $\text{cm}^3$ )			

(3 marks)

Calculate;

- Average volume of solution **D** used (1 mark)
- Concentration of sodium carbonate in solution **B**  
(Na=23; O=16; C= 12.0) (1 mark)
- Concentration of sulphuric acid in solution **D** (2 marks)
- 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  $2\text{cm}^3$  of solution A into test-tube number 1. From the same burette, place  $4\text{cm}^3$  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  $14\text{cm}^3$  of solution **C** into a boiling tube. Measure the initial temperature of solution **C** to the nearest  $0.5^\circ\text{C}$  and record it table 2. Add the content of test-tube number 1 to the boiling tube containing solution **C**. stir 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( $\text{cm}^3$ )	2	4	6	8	10	12
Volume of solution C( $\text{cm}^3$ )	14	12	10	8	6	4
Initial temperature of solution C( $^\circ\text{C}$ )						
Highest temperature of solution C( $^\circ\text{C}$ )						
Change in temperature $\Delta T$ ( $^\circ\text{C}$ )						

(6 marks)

- On the grid provided, draw a graph of  $\Delta T$  (vertical axis) against volume of solution A used (3 marks)
- From the graph, determine;
  - 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  $4.2\text{Jg}^{-1}\text{K}^{-1}$  and density of solution is  $1.0\text{gcm}^{-3}$ . (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 $10\text{cm}^3$ 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 $3\text{cm}^3$ 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 $1\text{cm}^3$ of the solution a test-tube, add aqueous ammonia drop-wise until in excess Observations _____ inferences _____ (1 mark) _____ (1 mark)
iii).	To $2\text{cm}^3$ 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 $1\text{cm}^3$ of the solution a test-tube, add four or five drops of barium nitrate solution. Shake the mixture then add about $1\text{cm}^3$ 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  (1 mark)	inferences  (1 mark)
b).	To 1cm <sup>3</sup> of liquid F in a test-tube, add about 1cm <sup>3</sup> of distilled water and shake thoroughly. Observations (1 mark)	inferences (1 mark)
c).	To 1cm <sup>3</sup> of liquid F in a test-tube, add a small amount of solid sodium carbonate Observations  (1 mark)	inferences  (1 mark)
d).	To 2cm <sup>3</sup> of liquid F in a test-tube, add about 1cm <sup>3</sup> 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  (1 mark)	inferences  (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  $\Delta H$ , for the reaction between solid A and one mole of hydrochloric acid.

### Procedure A

Using a burette, place 20.0cm<sup>3</sup> 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 (°C)											

(4 marks)

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

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  $25\text{cm}^3$  of solution **C** (1 mark)
  - III. Hydrochloric acid in  $250\text{cm}^3$  of solution **C** (1 mark)
  - IV. Hydrochloric acid in  $20.0\text{cm}^3$  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  $\Delta H$ ) (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 <b>D</b> 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  (2 marks)	inferences  (1 mark)
b).	Add about 10cm <sup>3</sup> of 2M hydrochloric acid to the residue and shake for about three minutes. <b>Keep the mixture for test (c)</b> Observations  (1 mark)	inferences  (1 mark)
c). i).	Place about 1cm <sup>3</sup> of the mixture in a test-tube and add aqueous ammonia dropwise until in excess Observations  (1 mark)	inferences  (1 mark)
ii).	To the rest of the mixture, add all of solid E provided and shake the mixture well. Observations  (1 mark)	inferences  (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  (½ mark)	inferences  (½ mark)
b).	Place the remaining of solid F in a test-tube. Add about 6cm <sup>3</sup> of distilled water and shake the mixture well. (Retain the mixture for use in test (c)) Observations  (1 mark)	inferences  (1 mark)
c). i).	To about 2cm <sup>3</sup> of the mixture, add a small amount of solid sodium hydrogen carbonate Observations  (1 mark)	inferences  (1 mark)
ii).	To about 1cm <sup>3</sup> of the mixture, add 1cm <sup>3</sup> of acidified potassium	

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

## OCTOBER / NOVEMBER 2009

### 1. You are provided with;

- *Solid A, a metal carbonate M<sub>2</sub>CO<sub>3</sub>*
- *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<sup>3</sup> 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<sup>3</sup> of solution B in a 250ml volumetric flask. Add about 200cm<sup>3</sup> 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<sup>3</sup> 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. Label the filtrate as solution

- Step 5** Clean the burette and fill it with solution D. using a pipette and a pipette filler, place  $25.0\text{cm}^3$  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 ( $\text{cm}^3$ )			

- a). Calculate;
- The average volume of solution C
  - Moles of sodium hydroxide in the average volume of solution C used
  - Moles of hydrochloric acid in  $25.0\text{cm}^3$  of solution D
  - The morality of hydrochloric acid, solution D

**Table 2**

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution D used ( $\text{cm}^3$ )			

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

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  $10\text{cm}^3$  of distilled water. Shake well and use  $2\text{cm}^3$  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  $1\text{cm}^3$  of hydrochloric acid solution B.

Observations

Inferences

(1 mark)

(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  $10\text{cm}^3$  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 alkanolic acid

You are required to:

- Prepare a dilute solution of solution hydroxide, solution B
- Determine the:
  - Molar mass of the alkanolic acid
  - Reaction ratio between sodium hydroxide and acid A

### Procedure I

Using a pipette and a pipette filler, place 25.0cm<sup>3</sup> of solution B into a 250.0ml volumetric flask. Add about 200cm<sup>3</sup> of distilled water. Shake well. Add more distilled water to make up to 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<sup>3</sup> 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	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Final burette reading			
Final burette reading			
Volume of solution C used (cm <sup>3</sup> ) added			

(4 marks)

Determine the:

- Average volume of solution C used (1 mark)
- Concentration of solution D in moles per litre (1 mark)
- Concentration of the alkanolic 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 alkanolic acid (1 mark)

### Procedure II

Fill a clean burette with solution A. place 5cm<sup>3</sup> 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<sup>3</sup> 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 <sup>3</sup> )	5	9	13	17	21	25
Volume of solution B (cm <sup>3</sup> )	25	21	17	13	9	5
Maximum temperature (°C)						
Initial temperature (°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<sup>3</sup> of distilled water and shake until all the solid dissolves. Label this as solution E.
- i). To about 2cm<sup>3</sup> of solution E in a test-tube, add 4 drops of 2M sulphuric (VI) acid.
- |              |            |
|--------------|------------|
| Observations | Inferences |
| (1 mark)     | (2 marks)  |
- ii). To about 2cm<sup>3</sup> of solution E in a test-tube, add 2M sodium hydroxide dropwise until in excess.
- |              |            |
|--------------|------------|
| Observations | Inferences |
| (1 mark)     | (1 mark)   |
- iii). Place one half of solid F in a test-tube. Add 2cm<sup>3</sup> of distilled water

and shake well. Add 4 drops of this solution to about 2cm<sup>3</sup> of solution E in a test-tube.

Observations (1 mark)	Inferences (1 mark)
--------------------------	------------------------

iv). To about 2cm<sup>3</sup> of solution E in a test tube, add 2 drops of aqueous potassium iodide.

Observations (1mark)	Inferences (1 mark)
-------------------------	------------------------

II. To about 2cm<sup>3</sup> of the solution obtained in (ii) above, add 3 drops acidified potassium manganate (VII).

Observations (1 mark)	Inferences (1 mark)
--------------------------	------------------------

III. To about 2cm<sup>3</sup> 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<sup>3</sup> of solution B in each of two 250ml conical flasks. Using a pipette and a pipette filler, add 25.0cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of solution C in a 250ml conical flask. Add 2 drops of phenolphthalein 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 <b>A</b> used (cm <sup>3</sup> )			

(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<sup>3</sup> 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**

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

(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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of distilled water. Shake well.

To a 2cm<sup>3</sup> portion of the solution, add about 1cm<sup>3</sup> 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<sup>3</sup> of 2M nitric (V) acid

Observations (1 mark)	Inferences (1 mark)
--------------------------	------------------------

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<sup>3</sup> of solution A into a 250ml conical flask.
2. Measure 10cm<sup>3</sup> of aqueous potassium iodide and add it to solution A in the conical flask. Shake the mixture. Add 10cm<sup>3</sup> 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<sup>3</sup> 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 <sup>3</sup> )			

(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 place them in test-tube rack.
2. using a clean burette, measure the volumes of distilled water shown in 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<sup>3</sup> of solution C.
5. Using the burette, measure 5cm<sup>3</sup> of solution C and place it into a 100ml beaker.
6. Using a 10ml measuring cylinder, measure 5 cm<sup>3</sup> 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<sup>-1</sup>)

**Table 2**

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

- 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<sup>3</sup> of distilled water and 6 cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of solution E, in a test-tube in each of experiments I, II, III and IV, add;
  - I. Two drops of aqueous sodium sulphate;
 

<b>Observations</b>	<b>Inferences</b>
(1 mark)	(1 mark)
  - II. Five drops of aqueous sodium chloride;
 

<b>Observations</b>	<b>Inferences</b>
---------------------	-------------------

(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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of solution F.

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

b). i). Add about 10cm<sup>3</sup> of dilute hydrochloric acid to the rest of solution F in the boiling tube. Filter the mixture. Wash the residue with about 2cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of solution A in a 100ml beaker. Measure

**PROCEDURE I.**

Using a burette, place 50.0cm<sup>3</sup> 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 (°C)								

- a) i). Plot a graph of temperature (vertical axis) against time in the grid provided.
- ii). From the graph, determine the:
- Highest change in temperature,  $\Delta T$ : (1 mark)
  - Time taken for reaction to be completed (½ mark)
  - Calculate the heat change for the reaction. (Specific heat capacity of solution is 4.2Jg<sup>-1</sup> K<sup>-1</sup>; Density of the solution is 1 gcm<sup>3</sup>). (2 marks)

**PROCEDURE II**

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



about 10cm<sup>3</sup> 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<sup>3</sup> of 2M sulphuric (VI) acid to the mixture in the volumetric flask. Add more distilled water to make 250.0 cm<sup>3</sup> of solution. Label this as solution D.

Fill a burette with solution C. Using a pipette and pipette filler, place 25.0cm<sup>3</sup> 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 <sup>3</sup> )			

(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<sup>3</sup> of 2M hydrochloric acid. Retain the mixture for test (iii) below.

Observations	Inferences
(1 mark)	(1 mark)

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

Observations	Inferences
(1 mark)	(1 mark)

b). i). To 2cm<sup>3</sup> of the filtrate

obtained in (a) above, add about 3cm<sup>3</sup> of aqueous ammonia (Excess).

Observations	Inferences
(1 mark)	(1 mark)

- ii). To  $2\text{cm}^3$  of the filtrate, add about  $2\text{cm}^3$  of 2M hydrochloric acid.

Observations	Inferences
(1 mark)	(1 mark)

- iii). To  $2\text{cm}^3$  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  $10\text{cm}^3$  of distilled water in a boiling tube. Use the solution for tests (b) (i), (ii) and (c).

- i). Place  $2\text{cm}^3$  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  $2\text{cm}^3$  of the solution, add all of solid sodium hydrogen carbonate provided.

Observations	Inferences
(1 mark)	(1 mark)

- c). Determine the pH of the solution obtained in (b) above

Observations	Inferences
(1 mark)	(1 mark)

# CO-ORDINATED MARK SCHEMES

NOVEMBER 1995  
MARK SCHEME

1.

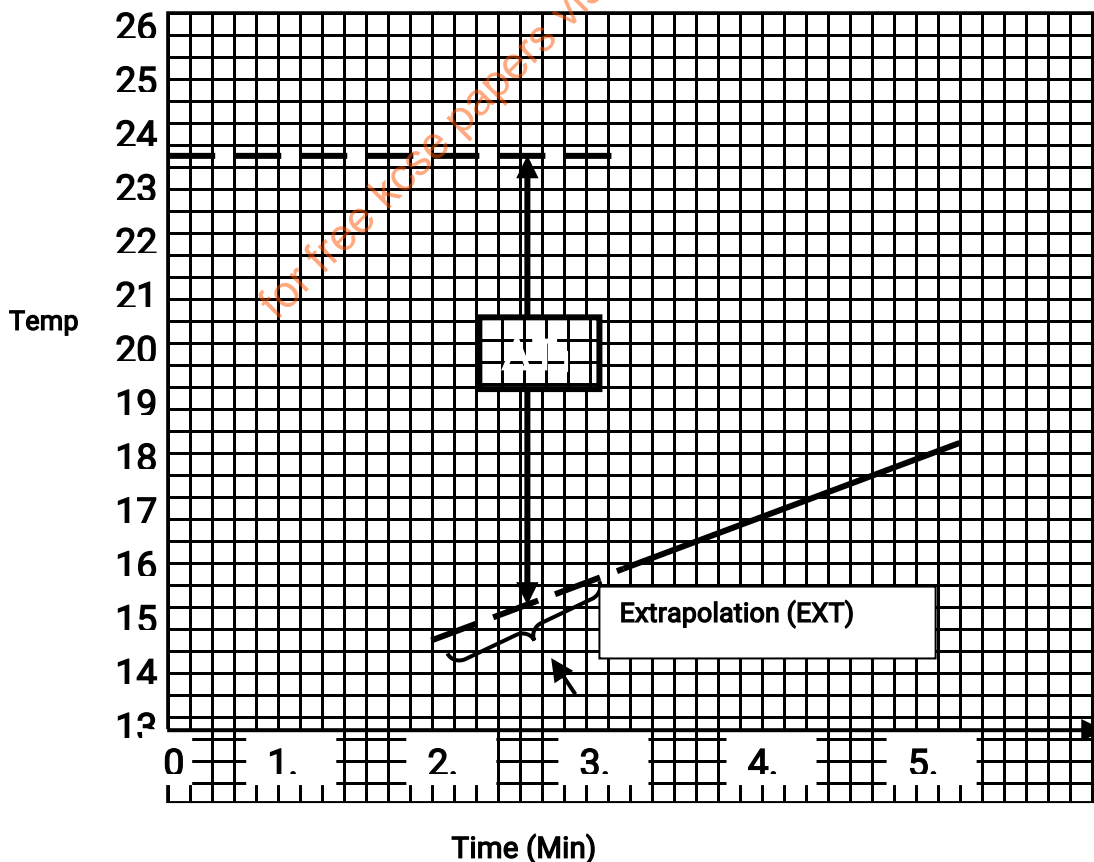
Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	5
Temperature (0 <sup>c</sup> )	23.5	23.5	23.5	23.5	23.5	X	15.5	16.0	16.5	17.0	17.5

**Table I**

(3 Marks)

- Complete with 10 readings; if 1<sup>st</sup> reading  $\geq 40$  or  $\leq 10$  then unrealistic (award 0)
- Decimal (D) - ½ - Accept whole numbers and or decimals to 1.d.c.p only c 1<sup>st</sup> d.c.p value as 0 or 5 only
- Accuracy - ½ - 1<sup>st</sup> reading should be within  $\pm 2^0$  of school value
- Trends - 1 - (1/2, ½) as
  - i). Readings between 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  $\Delta T_1 = \dots\dots\dots 15 - 0 - 23.5 = - 8.5^{\circ}\text{C}$

(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

$\Delta T_1 = 1 -$  a). show  $\Delta T_1$  on graph at 2 ½ minute ( ½ mark)

b). Ignore sign of  $\Delta T$  value

a). i).  $n_1 = \frac{2}{100} = 0.02$

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

Same as for graph I

For correct substitution of  $\Delta T_1$  and  $n_1$

Size 3 ½ x 3 ½ sq

Correct answer

Correct answer should

Be within +2 units correct in the 1<sup>st</sup> 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).  $n_2 = \frac{1}{84V} = 0.0119$   
 $= 0.012$

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 sub of  $n_2 + \Delta T_2 =$  Correct answer

Answer should be correct to within 12 units in 1<sup>st</sup> 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  $\Delta H_1$ ,  $\Delta H_2$  and  $\Delta H_3$  including their respective signs

e.g  $\Delta H_4 = 2(26.8) - (-43.8) - 2(121)$   
 $= -144.6 \text{ kJ/mol}$

1 mark – for correct answer

Penalize ½ mark for wrong sign on answer

Award 0 marks for wrong substitution or wrong sign transferred with  $\Delta H$  in the substitution.

Penalise ½ mark for wrong units used

Penalize ½ mark for wrong transfer of any of the  $\Delta H$  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 <sub>2</sub> evolved possibly KNO <sub>3</sub> Accept NaNO <sub>3</sub> 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 <sup>2+</sup> , Al <sup>3+</sup> , Pb <sup>2+</sup> , Ca <sup>2+</sup> , Mg <sup>2+</sup> (Any 3 absent) Or K <sup>+</sup> , Na <sup>+</sup> Present
(iii)	No precipitate.	CO <sub>3</sub> <sup>2-</sup> , SO <sub>4</sub> <sup>2-</sup> OR Cl <sup>-</sup> absent (Any two mentioned)
(iv)	- Colourless fumes/gas/effervescence which turns moist red litmus blue - Grey / black mixture/solid precipitate	- NH <sub>3</sub> evolved - Solid contains Nitrogen or NO <sub>3</sub> <sup>-</sup> ions

**NOVEMBER 1996  
MARK SCHEME****Principles of averaging**

Values averaged must be shown and must be within + 0.20cm<sup>3</sup> of each other

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

- Note: (i) Accept answer given as 0.060 mol<sup>-1</sup> but reject 0.06 mol<sup>-1</sup>  
(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<sup>3</sup> of solution B = 25 x Ans. in (c)

$$1000$$

$$= \text{correct answer}$$

**Conditions**

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

e). **Use of 1<sup>st</sup> Principle**

5 moles of Fe<sup>2+</sup> = 1 mole of MnO<sub>4</sub><sup>-</sup>

No of moles of A (in litres) used  
 $= \frac{1}{5} \times \text{ans in (d)}$

No of moles of A in 1000cm<sup>3</sup>  
 $= \frac{1}{5} \times \text{ans in (d)} \times \frac{1000}{\text{titre}}$

Correct answer

**Use of Formula Method**

$$\frac{M_1 V_1}{M_2 V_2} = \frac{5}{1}$$

$\text{ans (a)} \times \text{pipette} = 5$

$$M_2 \times \text{titre} = 5$$

$M_2 = \frac{\text{Ans in (a)} \times \text{Pipette}}{5 \times \text{titre}}$

Correct answer

**Conditions**

- i). If step 1 not shown 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 3<sup>rd</sup> and 4<sup>th</sup> 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<sub>2</sub> the subject award 1 mark for the combined step

**Procedure II**

h). No of moles of manganate (VII) ions in V<sub>2</sub> =  $\frac{\text{Ans in (e)} \times \text{Titre}}{1000}$

= correct answer

**Conditions**

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

i). 2 moles of MnO<sub>4</sub><sup>-</sup> ions = 5 moles of dibasic acid

No of moles of the dibasic acid in 25cm<sup>3</sup> of sol C =  $\frac{5}{2} \times \text{ans in (h)}$

**Conditions**

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

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

**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 = 5.0

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 <sup>3+</sup> ions present
b	Effervescence/bubbles/gas evolved gas has no effect on moist litmus paper. Produced gas relights a glowing splint	oxygen gas D is a catalyst D is probably MnO <sub>2</sub>
<p><i>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'</i></p>		

3	Observations	Inferences
a)	Melts to a colourless liquid. And burns with a smoky /sooty. Flame <i>Note: accept melts on its own without Mentioning of colourless liquid. Unless contradictory colour given Accept –yellow sooty flame. But not yellow flame</i>	E is an unsaturated organic compound Note:- credit either E has C: H ratio or E contains $\begin{array}{c}   \\ \text{C}=\text{C} \\   \end{array}$ or $-\text{C}\equiv\text{C}-$ 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 <sup>+</sup> <sub>(aq)</sub> ions present red.	E is an organic acid E is an acidic compound hydrated hydrogen ions H <sup>+</sup> <sub>(aq)</sub> ions present
c)	Solid E dissolved readily in aqueous NaOH	E is organic acid/or E is a carboxylic acid Or Acidic Compound / H <sup>+</sup> 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 acid or Acidic compound/ H <sup>+</sup> ions present
(ii)	A sweet smelling substance is formed / fruity smell/ pleasant smell	Ester is formed E is a carboxylic acid/ R – COOH / - C <sup>O</sup> -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 (°C)	20	20	20	X	25	29	31	31	33	34	34	34	34

½ max for each entry

Maximum 5 marks

b).  $\Delta T = 34 - 20 = 14^{\circ}\text{C}$

c). Energy change =  $50 \times 4.2 \times 14$  (1)  
= 2940 Joules (1)

d). Moles =  $\frac{2940}{42}$  (1)

1 mark

2 marks

$$\frac{323 \times 1000}{1000} = 0.009 \text{ moles } (1)$$

2 marks

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

(6marks)

e).  $\frac{15.9 + 15.9}{2} ( \frac{1}{2} )$

$$= 15.9 \text{ cm}^3 ( \frac{1}{2} )$$

f).  $\frac{15.9 \times 0.5}{1000} (1)$

$$= 0.008 \text{ moles } (1)$$

g). i). Moles of sulphuric acid =  $\frac{0.008}{2}$

$$= 0.004 \text{ moles } ( \frac{1}{2} )$$

ii).  $25 \text{ cm}^3 = 0.004 ( \frac{1}{2} )$

$$100 \text{ cm}^3 = 0.016 \text{ moles } ( \frac{1}{2} )$$

iii). Total moles of F =  $0.009 + 0.016 ( \frac{1}{2} )$

$$= 0.025 \text{ moles } ( \frac{1}{2} )$$

iv).  $50 \text{ cm}^3 = 0.025 \text{ moles}$

$$1000 \text{ cm}^3 = \frac{0.025 \times 1000}{50} ( \frac{1}{2} )$$

$$= 0.5 \text{ M } ( \frac{1}{2} )$$

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 (1/2) Soluble in excess (1/2) 3 marks	$\text{Al}^{3+} \text{ Pb}^{2+} \text{ or } \text{Zn}^{2+} (2)$
(iii)	White Ppt (1/2) insoluble in excess (1/2)	$\text{Pb}^{2+} \text{ or } \text{Al}^{3-} (1)$
(iv)	White ppt	$\text{Pb}^{2+}$
3 a)	Decolourise (1)	$-\overset{ }{\text{C}} = \overset{ }{\text{C}} - (1) \text{ or } -\text{OH}(1)$
b)	Decolourise (1)	$-\overset{ }{\text{C}} = \overset{ }{\text{C}} - \text{present } (1)$
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 <sup>3</sup> )	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<sup>3</sup> 1 mark

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

b).  $24.0 \times 0.22 = 25M$  (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 <sup>3</sup> )	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 =  $\frac{12.50 + 12.50 + 12.4}{3} = 12.47cm^3$  (½) 1 mark

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

ii).  $0.00274 \times 4 = 0.01100 = \text{ans a (i)} \times \frac{100}{25}$  1 mark

iii).  $\frac{0.21 \times 100}{1000} = \text{ans (b)} \times \frac{100}{1000}$   
= -0.021 moles (½) = ans a (iii) 1 mark

iv).  $0.02 - 0.0109 = 0.01$  (½) = ans (ii) - ans (ii)  
= ans a (iv) 1 mark

v).  $\frac{0.01}{2} = \text{ans a (i)}$   
= 0.005 (½) = ans a (v) 1 mark

c). i).  $72 \times 0.005 = 0.36g$  (½) = 72 x ans a (iv) = ans b (i)

ii).  $\frac{0.36 \times 100}{0.5} = \text{ans b (i)} \times \frac{100}{0.5}$   
= 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 ( $\frac{1}{2}$ )	
i).	white precipitate ( $\frac{1}{2}$ ) soluble in excess ( $\frac{1}{2}$ )	$Al^{3+}_{(aq)}$ $Pb^{2+}_{(aq)}$ or $Zn^{2+}_{(aq)}$ (2marks) for all three 1 mark for two) (3 marks)
ii).	white precipitate ( $\frac{1}{2}$ ) Insoluble in excess ( $\frac{1}{2}$ )	$Al^{3+}$ ( $\frac{1}{2}$ ) or $Pb^{2+}$ ( $\frac{1}{2}$ ) OR Penalise $\frac{1}{2}$ 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 $\frac{1}{2}$ mark for 2 correct) Penalize $\frac{1}{2}$ 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	Weakly 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  $\frac{1}{2}$  mks  
2 titrations inconsistent 1mk  
1 titration done = 1mk
- (ii) Average volume of solution E
- (b) (i) No. of moles of basic compound  $G_2X \cdot 10 H_2O$   
No. of moles of E =  $\frac{\text{titre} \times 0.099}{1000}$   
No. of moles of F =  $\frac{\text{titre} \times 0.099 \times \frac{1}{2}}{1000}$   
= Ans (4 d.p)

- (ii) Conc. of solution F in moles per litre  
 $25\text{cm}^3$  of F = Answer in (b) (i)  
 $1000\text{cm}^3$  of F =  $\frac{\text{Ans (b) (i)} \times 1000}{25}$   
= Ans (3 dp)
- (iii) Relative formula mass of basic compound  $G_2X \cdot 10 H_2O$   
 $\frac{15.3}{\text{RFM}}$  = Molarity (Ans. (b) (ii))  
RFM =  $\frac{15.3}{\text{Ans in (b) (ii)}}$  = Ans
- (iv) Mass of 10 moles of  $H_2O$  =  $10(16 + 2) = 180$   
 $2G + 180 + 155 = \text{Ans (b) (iii)}$   
 $2G = \text{Ans (b) (iii)} - 335$   
 $G = \frac{\text{Ans (b) (iii)} - 335}{2}$   
= Ans ( $\pm 0.5$ )

2. (a)

**Table III**

T = 5 mks

D =  $\frac{1}{2}$

A = 1mk ( $\pm 5$  secs)

T = 1

(b)

(i) S = 1 mk

C = 1 mk

P = 1 mk

(ii) Showing on the graph =  $\frac{1}{2}$  mk

Stating correct values =  $\frac{1}{2}$  mk

Expression  $t = \frac{\text{Correct value}}{\text{Rate at } 7.5\text{cm}^3}$  ( $\frac{1}{2}$  mk)

=  $\frac{1}{2}$  mk

(iii) - Straight line (+ve gradient) =  $\frac{1}{2}$  mk

- Rate of reaction increases as concentration

**OR**

- Rate is directly proportional to concentration

- Straight line (+ve gradient)

=  $\frac{1}{2}$  mk

3a).	Observations	Inferences
	<ul style="list-style-type: none"> <li>- Light green solid turns brown</li> <li>- Colourless liquid/moisture/ vapour condenses on cooler part of test tube</li> <li>- Pungent gas with irritating smell which changes moist blue litmus paper turns red</li> <li>- Red litmus paper remains <math>2\frac{1}{2}</math>mks)</li> </ul>	<ul style="list-style-type: none"> <li>- <math>Fe^{2+}</math> present</li> <li>- Hydrated salt/ water of crystallization</li> </ul>
bi).	- Green precipitate which is insoluble in excess (1mk)	- $Fe^{2+}$ present ( $\frac{1}{2}$ mk)
ii).	Yellow /brown/Reddish brown solution	- $Fe^{2+}$ Oxidised to $Fe^{3+}$

	Brown ppt. Insoluble in excess(1½ marks)	
iv)	- White precipitate	- SO <sub>3</sub> <sup>2-</sup> , SO <sub>4</sub> <sup>2-</sup> , CO <sub>3</sub> <sup>2-</sup>
II	- White ppt remains	- SO <sub>4</sub> <sup>2-</sup>

**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<sup>3</sup>

**Table II**

Decimal (D) = ½ mark.

Accuracy (A) = ½ mark

- School value (SV) ± 0.2 cm<sup>3</sup>
- If more or less that value = 0 mark.

(iii) I Conc. of Sodium carbonate in moles per litre (RFM Na<sub>2</sub>CO<sub>3</sub> = 106)  
 $\frac{5.6}{106} = 0.05283\text{M}$ .  
 Answer given to at least 3 dp. If not, do not award for answer.  
 Wrong units ½ mark

II Moles sodium carbonate in 25cm<sup>3</sup> of solution  
 $\frac{25 \times \text{Ans I}}{1000} = \text{Ans}$   
 $= \frac{25 \times 0.0528}{1000}$   
 $= 0.0013207\text{mol}$  (at least 4d.p)

III Moles of hydrochloric acid in total volume of solution used  
 $\text{NaCO}_3(\text{aq}) + 2\text{HCl} \longrightarrow 2\text{NaCl}(\text{aq}) + \text{H}_2\text{O} + \text{CO}_2(\text{g})$   
 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<sup>3</sup> =  

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

**Table III**

Table (T) = 1 mark

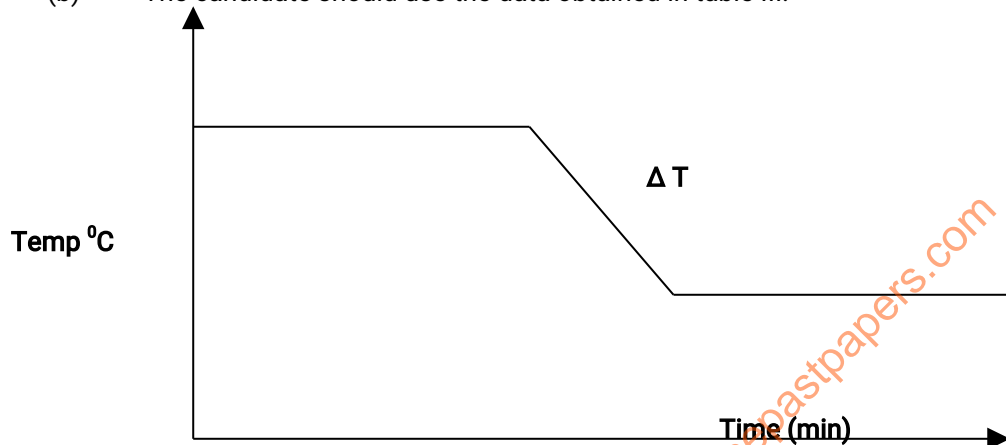
- 8 readings = 1 mk
- 6 readings = ½
- Less than = 0 mk
- Values > 40°C or < 10°C ( from t = 0 to t = 1 ½ ) = - ½ mk
- Decimals (D) = ½ mk
- Accuracy (A)
- Compare with school values (SV) at t = 1 ½ if ± 2° c = ½ mk ; If not = 0mk
- Trend (T) = 1 mark
- Trend - t = 0 to t = 1 ½ being constant = ½ mk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

2<sup>nd</sup> 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  $\Delta T$

(d) (i) No. of moles of solid G used (K = 39.0, N = 14.0, O = 16) 1 mark  
RFM of  $\text{KNO}_3 = 101$   
Moles of G =  $\frac{3}{101} = 0.0297$  (4 d.p)

(ii) Enthalpy of Solution  $\Delta H_{\text{soln}}$  and show sign of  $\Delta H_{\text{soln}}$   
Heat absorbed =  $30 \times 4.2 \times \Delta T = \text{Ans.}$   
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	$\text{Cu}^{2+}$ ions present
(b) (i)	- White ppt (1mk) - Dissolves in excess (1mk)	
(ii)	- White ppt (1mk) - Dissolves in excess (1mk)	$\text{Al}^{3+}$ , $\text{Zn}^{2+}$ , $\text{Pb}^{2+}$ present
(iii)	- White ppt (½ mk) - Insoluble in excess	- $\text{Pb}^{2+}$ , or $\text{Al}^{3+}$ - $\text{Zn}^{2+}$ absent
(c)	- No white precipitate is formed	$\text{Al}^{3+}$ present $\text{Pb}^{2+}$ absent
(d)	- White Precipitate	$\text{SO}_4^{2-}$
(e)	- Blue precipitate - Dissolve in excess to form deep blue solution	- $\text{Cu}^{2+}$ present

**NOVEMBER 2001  
MARK SCHEME**

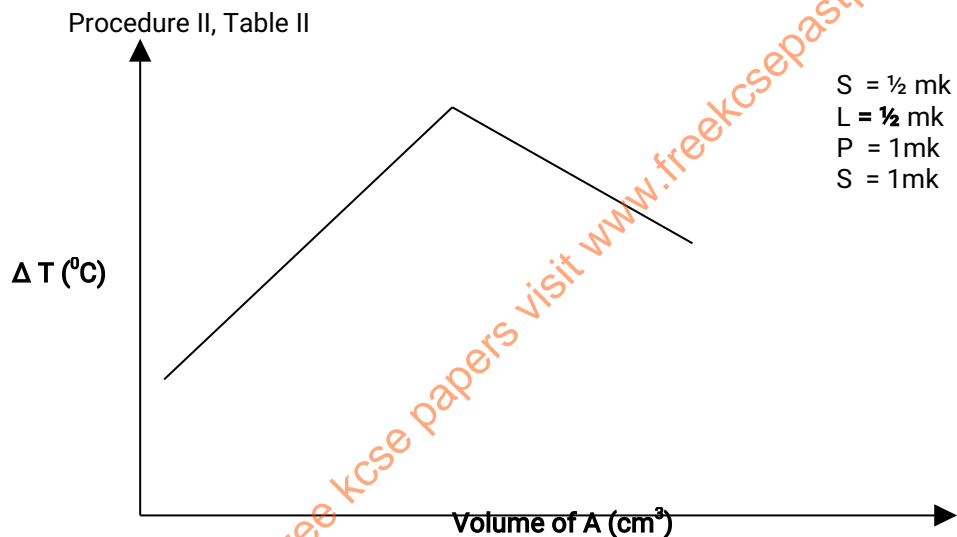
1. (a) T = 1mk; AC = 1mk; FA = 1mk, D = 1mk; PA = 1mk

(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



(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  
 $\text{Moles of A} = \frac{\text{Ans. b (ii)} \times \text{Ans (b) above}}{1000}$

Moles of C = ½ x moles of A

$\text{Molarity} = \frac{1}{2} \times \text{Ans. b (ii)} \times \text{Ans (b)} \times \frac{1000}{1000 \times \text{Ans (c)}}$

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 <sup>2+</sup> , Mg <sup>2+</sup> or Ba <sup>2+</sup> present
(ii)	- White Precipitate	Ca <sup>2+</sup> , Mg <sup>2+</sup> or Ba <sup>2+</sup> present OR Mg <sup>2+</sup> absent ½ mark
(iii)	- White precipitate which dissolves on warming	Cl <sup>-</sup> present

3	Observations	Inferences
a	- Moist blue litmus paper changes to red - Moist on red litmus paper	- Acidic substance / or H <sup>+</sup> present
b	- Brown bromine water is not decolourised	C = C or $\begin{array}{c} \text{C} = \text{C} \\   \quad   \end{array}$ - <b>absent</b>  <b>OR</b> Saturated compound present ½ C = C or - C = C - <b>absent</b> <b>OR</b> Saturated compound present ½ Alkene / alkyne absent ½
c	Purple or KMnO <sub>4</sub> is not decolorized Purple KMnO <sub>4</sub> colour persists	Absence of $\begin{array}{c}   \\ \text{C} = \text{C} \\   \end{array}$ or  R - OH absent
d	Effervescence or bubbles of gas OR Fizzing / Hissing sound	Acidic Compound present Or H <sup>+</sup> ions

**NOVEMBER 2002  
MARK SCHEME**

a).

Vol of A H <sub>2</sub> O <sub>2</sub>	Vol. H <sub>2</sub> O	Vol of B. H <sub>2</sub> SO <sub>4</sub>	Vol of C Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	Vol of D KI	Vol of E Starch		Time (sec)	<sup>1</sup> /time sec
25	0	20	5	5	2		18	56x10 <sup>-2</sup>
20	5	20	5	5	2		22.5	4.4x10 <sup>-2</sup>
15	10	20	5	5	2		29	3.4x10 <sup>-2</sup>
10	15	20	5	5	2		43.5	2.3x10 <sup>-2</sup>
5	20	20	5	5	2	90.5	90.5	1.1x10 <sup>-2</sup>

b). ½ for each axis  
2 marks for plotting 5p/s correctly

1 mark for best straight line

4 marks

c).  $\frac{1}{\text{time}} = 1.7 \times 10^{-2(l)}$

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 (l) OR displacement reaction Occurred
b	No white ppt <sup>(1)</sup> Or Rej no observable change	Absence of SO <sub>4</sub> <sup>2-</sup> CO <sub>3</sub> <sup>2-</sup> or SO <sub>3</sub> <sup>2-</sup> (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 <sup>2+</sup> , Al <sup>3+</sup> or Zn <sup>2+</sup> as in (b) above 3 marks
d	White PPT (½) which dissolves on boiling (l)	Pb <sup>2+</sup> (l) present 2 ½ marks
e	White PPT (½) colourless filtrate ( ½ )	Pb <sup>2+</sup> confirmed (l) 2 marks
f	White PPT (l) Soluble in excess (l)	Zn <sup>2+</sup> present (l) 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 <sub>4</sub> decolourised/changes to colourless. The colour of KmnO <sub>4</sub> changes from purple to colourless (l) 3 marks	Could be an alcohol or unsaturated compound (l) R - OH, - C = C - C ≡ C - 2 marks
(ii)	Brown bromine is decolorized/ changes to colourless Decolourised (l)	Unsaturated (l) compound 2 marks
(iii)	Turns orange ( ½ ) pH = 5 ½ 2 marks	compound is a weak acid (l) 2 marks

### NOVEMBER 2003 MARK SCHEME

1. (a) Volume of solution P = 15.0cm<sup>3</sup>  
 (b) Average volume of solution P  $\frac{15.0 + 15.0}{2} = 15.0\text{cm}^3$   
 (c)  $\frac{15.0 \times 0.02}{1000} = 0.0003 \text{ moles}$   
 (d)  $\text{gdm}^3 = \frac{4.18 \times 1000}{250} = 16.72\text{gdm}^3$   
 $\frac{16.72}{278}$  from (d) above = 0.060M  
 (e) Moles of Q in 25.0cm<sup>3</sup>  
 $\frac{0.06 \times 25}{1000} = 0.0015 \text{ moles}$   
 (ii) 0.003 moles rxts 0.0015 of Q  
 1 mole =  $\frac{1 \times 0.0015}{0.0003} = 5 \text{ moles}$



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<sub>2</sub>A dissolve in water (assume heat capacity of the solution is 4.2)  
 $30 \times 4.2 \times \Delta T = \text{Ans in J. Or } \frac{30 \times 4.2 \times \Delta T}{1000} = \text{kJ}$   
 (ii) Number of moles of acid used (RFM of H<sub>2</sub>A is 126)  
 $\frac{1.9}{126} = 0.01508 \text{ moles}$   
 (iii) Molar heat of solution  $\Delta H_1$  soln of the acid H<sub>2</sub>A  
 $\Delta H \frac{c (i)}{c (ii)} = \text{J/mole Or KJ/mole}$

**Procedure II**

- (a) and (b) as in procedure 1  
 (c) (i) Heat change. (heat capacity 4.2 J/g/°C and density 1 g/cm<sup>3</sup>)  
 $60 \times 4.2 \times \Delta T = \text{Ans in J or kJ}$   
 (ii) Number of moles of the acid H<sub>2</sub>A used  
 $\frac{0.5 \times 30}{1000} = 0.015$   
 (iii) Heat of reaction  $\Delta H_2$  of one mole of the acid H<sub>2</sub>A with Sodium hydroxide  
 $\Delta H_2 = \frac{C (i)}{C (ii)} = \text{Ans}$

Or

$$\frac{60 \times 4.2 \times \Delta T}{C (ii)} = \text{Ans. (in J or KJ)}$$

- (d)  $\Delta H_3$  for the reaction  $\text{H}_2\text{A (s)} + 2 \text{OH}^- \text{ (aq)} \longrightarrow 2\text{H}_2\text{O (l)} + \text{A}^{2-} \text{ (aq)}$   
 $\Delta H_3 = \Delta H_2 + \Delta H_2 = \text{Ans (-ve kJ/mole)}$

3	Observations	Inferences
(a)	Colourless solution formed	Coloured ions absent e.g Cu <sup>2+</sup> , Fe <sup>2+</sup> , or Fe <sup>3+</sup> absent
(b)	No white precipitate formed	Pb <sup>2+</sup> , Al <sup>3+</sup> , Zn <sup>2+</sup> , Mg <sup>2+</sup> Or Ca <sup>2+</sup> absent
(c)	White precipitate formed	Cl <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , SO <sub>3</sub> <sup>2-</sup> , or CO <sub>3</sub> <sup>2+</sup> present
(d)	White precipitate formed dissolves in HCl (aq)	SO <sub>3</sub> <sup>2-</sup> or CO <sub>3</sub> <sup>2-</sup> present
(e)	Purple KMnO <sub>4</sub> is (aq) decolorized or changes to colourless	SO <sub>3</sub> <sup>2-</sup> present Or Reducing
(f)	Green solution formed OR Colour changes Orange to green	SO <sub>3</sub> <sup>2-</sup> present Or Reducing

**NOVEMBER 2005  
MARK SCHEME**

1. (a)

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½
Temp (°C)	82	73	69	68	68	68	66	65

1 Mark for the two axis  
 1 mark for all points correctly plotted  
 1 mark for plot occupying  $\frac{3}{4}$  of the grid provided

2

b).  $68^{\circ}\text{C}$

	I	II
Initial temperature of solution K $T_1$ ( $^{\circ}\text{C}$ )	26	26
Initial temperature of solution L $T_2$ ( $^{\circ}\text{C}$ )	25	26
Highest temperature of mixture $T_3$ ( $^{\circ}\text{C}$ )	30.5	31
Average initial temperature ( $^{\circ}\text{C}$ )	25.5	26
Change in temperature $\Delta T$ ( $^{\circ}\text{C}$ )	5	5

(5 marks)

Table 1

$\frac{1}{2}$  mark for each entry

a). Average  $\frac{5 + 5}{2} = 5$

(1 mark)

b). Heat change =  $50 \times 4.2 \times 5$  (1)  
 = 1050 Joules

(2 marks)

c). Number of moles of acid L

$\frac{1050}{143.4 \times 1000}$

= 0.0078125

(2 marks)

d).  $25\text{cm}^3 = 0.0078125$  moles  
 =  $\frac{0.0078125 \times 1000}{25}$   
 = 0.3125M

(2 marks)

e). Relative formula mass of acid L

$60 = 0.3125 \times (L)$

R.F.M

R.F.M = 192 (l)

(2 marks)

3	Observations	Inferences
(a)	Cracking sound	N is hydrated a basic gas is formed ( $\frac{1}{2}$ mark for each) (correct inference)
(i)	Colourless liquid	
	Gas with pungent smell	
	Colourless gas is produced which changes moist red litmus paper blue (2 marks for four correct observations)	
(i)	White Ppt ( $\frac{1}{2}$ )	$\text{Al}^{3+}$ or $\text{Pb}^{2+}$ ions, $\text{Mg}^{2+}$ ions present
(ii)	No white precipitate is formed	$\text{Al}^{3+}$ ion ; $\text{Mg}^{2+}$ ion present; $\text{Pb}^{2+}$ ions absent
(iii)	White Ppt	$\text{SO}_4^{2-}$ , $\text{SO}_3^{2-}$ $\text{CO}_3^{2-}$ $\text{Cl}^-$ 1 mark for two (2 marks)
(iv)	White Ppt	

	persists (1)	SO <sub>4</sub> <sup>2-</sup> ion present –(1) (2 marks)
b(i)	A clear colourless solution (1)	Salt is soluble (1) (2 marks) Acid solution is formed ( 1)
(ii)	No effervescence (1)	(H <sup>+</sup> absent (1) (2 marks)
(iii)	White solid formed (1) Slightly soluble in excess ( ½ ) On addition of NaHCO <sub>3</sub> 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 <sup>3</sup> )	Temperature at which crystals of solid A first appear (°C)	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°C

½ mark for each value of solubility correctly calculated

(ii) - S - 1; P - 1; C - 1

(iii) 63 ± 0.5 °C

	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 <sup>3</sup> )	24.40	24.40	24.20

**(Award for each titre value ± of the teachers value**

$$\text{I} \quad \frac{24.20 + 24.20}{2} = 24.20 \text{cm}^3$$

$$\text{II} \quad \frac{0.06 \times 24.20}{1000} = 1.45 \times 10^{-3} \text{ moles}$$

$$\text{III} \quad \frac{1.45 \times 10^{-3} \times 5}{2} = 3.63 \times 10^{-3} \text{ moles}$$

$$\begin{aligned}
 \text{IV} & \quad 3.63 \times 10^{-3} \times 10 \\
 & = 3.63 \times 10^{-2} \text{ moles} \\
 & = \frac{4.5}{x} \times 10^{-2} \\
 & = 124
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii)} \quad \text{DxH}_2\text{O} \\
 90 + 18x & = 124 \\
 X & = 34 \\
 & = 1.9 \\
 & = 2
 \end{aligned}$$

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 ( $\frac{1}{2}$ ) - White residue	Compound sparingly soluble
(i) Solution turns pink	Compound is basic $\text{OH}^-$ , $\text{HCO}_3^-$ or $\text{CO}_3^{2-}$ present $\text{OH}^-$ present or $\text{HCO}_3^-$ or $\text{CO}_3^{2-}$ absent.
(ii) No effervesnce	$\text{Ca}^{2+}$ , $\text{Ba}^{2+}$ , $\text{Pb}^{2+}$ present (2mks for all three 1 mk for 2)
(iii) White ppt formed	
(iv) No white ppt	$\text{Ba}^{2+}$ present or $\text{Ca}^{2+}$ or $\text{Pb}^{2+}$

3.

(a) Burns with luminous ( yellow, smoky) flame	Unsaturated compound OR Long chain hydrocarbon - $\begin{array}{c} \text{C} = \text{C} \\   \quad   \end{array}$ - / - $\text{C} \equiv \text{C}$ - 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 - $\begin{array}{c} \text{C} = \text{C} \\   \quad   \end{array}$ - or R - OH
(ii) Brown bromine water is decolorized ( Changes from red to Colourless)	Alkene present // - $\begin{array}{c} \text{C} = \text{C} \\   \quad   \end{array}$ - present

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 <sup>3</sup> )	21.8	21.6	21.6

(3 marks)

i).  $\frac{21.6 + 21.6}{2} = 21.6\text{cm}^3$  (1 mark)

ii). R.F.M of Na<sub>2</sub>CO<sub>3</sub> = 106  
 Conc.  $\frac{8}{106} = 0.075\text{M}$

iii). Moles of Na<sub>2</sub>CO<sub>3</sub>  $\frac{25 \times 0.075\text{M}}{1000}$   
 = 0.001875  
 Moles of H<sub>2</sub>SO<sub>4</sub> = 0.001875  
 Conc. of H<sub>2</sub>SO<sub>4</sub> =  $\frac{0.001875 \times 1000}{21.6}$   
 = 0.0868M

(2 marks)

iv).  $0.0868 \times 10 = 0.868\text{M}$

(1 mark)

b. i).

Test-tube number	1	2	3	4	5	6
Volume of solution A (cm <sup>3</sup> )	2	4	6	8	6	4
Volume of solution C (cm <sup>3</sup> )	14	12	10	8	10	12
Initial temperature of solution C (°C)	20.5	20.5	20.5	20.5	20.5	20.5
Highest temperature of mixture (°C)	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  $\Delta t = 9.5 + 0.1^\circ\text{C}$   
 II Maximum volume of A =  $7.6\text{cm}^3 + 0.1$

(1 mark)

iv). I Moles of sulphuric acid =  $\frac{7.6 \times 0.868}{1000}$   
 = 0.0066 moles

(1 mark)

II Heat evolved =  $16 \times 4.2 \times 9.5$   
 = 638.4 joules

Molar Heat = 638.4  
 0.0066

=  $96.727272\text{KJ mol}^{-1}$

(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 <sup>3+</sup>

(iii)	Changes from yellow to brown	Iodide ions/ I <sup>-</sup> ions present
(iv)	White precipitate settles at the bottom of the test tube	

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 <sup>+</sup> (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=0 min to t =2m if reading of T40<sup>o</sup>C or T> 40<sup>o</sup>C ) for the whole table once.
- iii). If temperature reading are all constant from t=0 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 or 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 as whole numbers a to 1 decimal place otherwise penalize fully
- ii). Reflect and award 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<sup>o</sup>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  $\frac{1}{2}$  mark or at least from E-1
- ii). Award  $\frac{1}{2}$  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  $\frac{1}{2}$  (in 3 minutes) on trend. i.e. to award the 2<sup>nd</sup>  $\frac{1}{2}$  mark for the trend there must have been a drop in temperature after 2  $\frac{1}{2}$  minutes
- ii). Reject trend in the 2<sup>nd</sup> 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 .....  $\frac{1}{2}$  mark  
award  $\frac{1}{2}$  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 .....  $\frac{1}{2}$  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  $\frac{1}{2}$  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

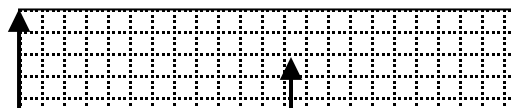
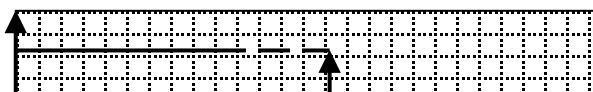
**c). Plotting ..... 1 mark**

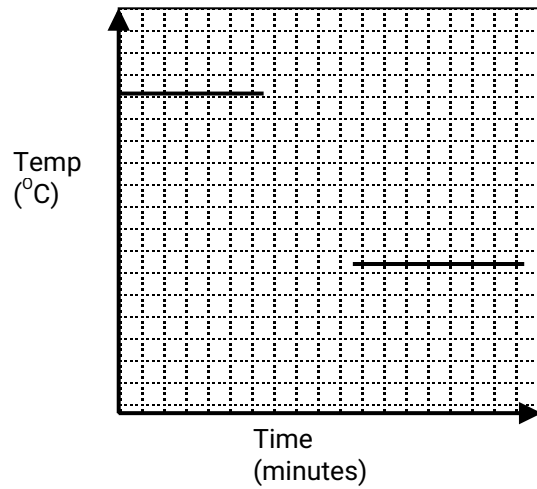
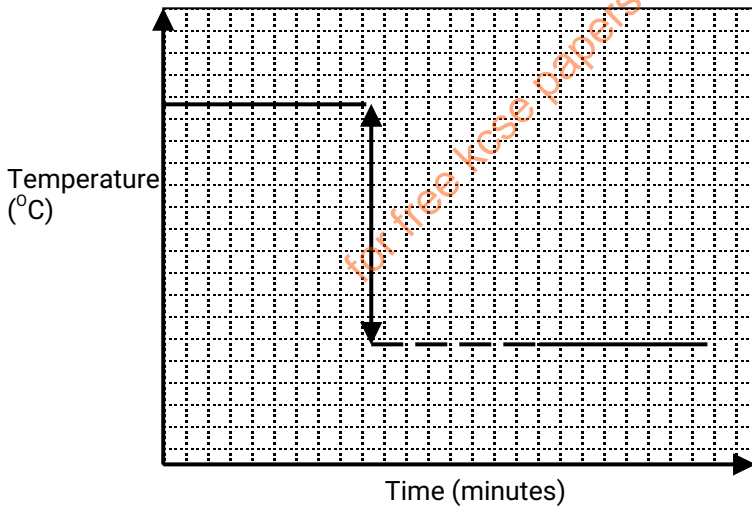
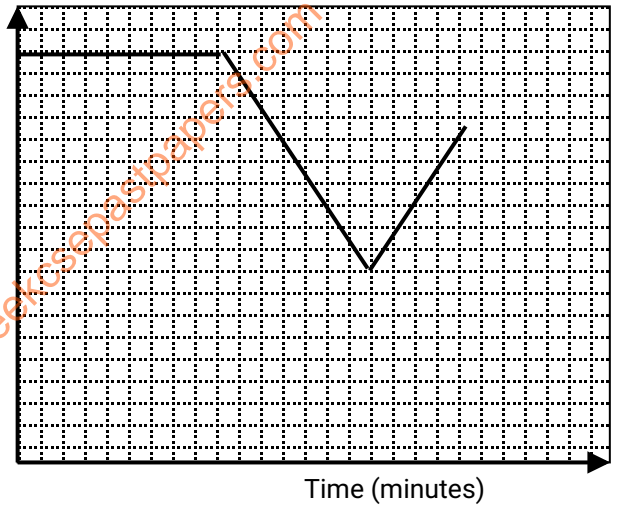
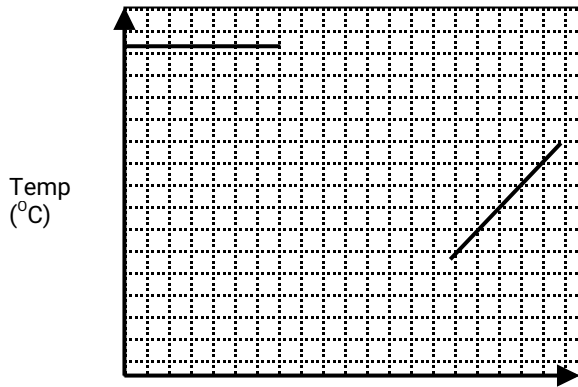
- i). If 10 or 9 points are correctly plotted award 1 mark
- ii). If 8 or 7 points correctly plotted award  $\frac{1}{2}$
- iii). If less than 7 points are correctly plotted award 0 marks

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  $\frac{1}{2}$  mark if the plots are joined by two straight lines, accept the lines of best fit
- ii). Award another  $\frac{1}{2}$  marks if for extrapolation where each of the two lines is extended to the 2  $\frac{1}{2}$  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 (°C)	18.0	18.0	18.0	18.0	18.0	X	13.0	13.0	13.5	13.5	14.0

ii).  $\Delta T = \text{Correct reading } 6^{\circ}\text{C}$

1 mark



### Conditions

- Accept the correct value of  $\Delta T$  from an extrapolated correct graph with or without showing on the graph for 1 mark
- award  $\frac{1}{2}$  mark for correct showing on an extrapolated correct graph if reading for  $\Delta T$  is wrong or missing
- Ignore sign for  $\Delta T$
- Penalise  $\frac{1}{2}$  mark for wrong units used otherwise ignore if no units are used/shown
- Reject readings/showing from a wrong graph and award 0 mark for  $\Delta T$  reject  $\Delta T$  if coming from the table or wrong graph but accept in (iii) below if used correctly
- Reject  $\Delta T$  if from the table or wrong graph but accept if it is used correctly otherwise penalize fully if  $\Delta T$  is strange

iii).  $\Delta H = MC\Delta T$   $\sqrt{(\text{expression})}$   
=  $20 \times 4.2 \times \text{Answer (ii) above} \times 6$   
= 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 ( $\text{cm}^3$ )	16.50	16.20	16.20

### Award a total of 5 marks distributed as follows

(i) Average Titre =  $\frac{16.20 + 16.20}{2} = 16.20 \text{cm}^3$

(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  $25 \text{cm}^3$  of soln = Ans I above.

III Ans II  $\times \frac{250}{25}$  = correct answer

Or  
Ans II  $\times 10$  = Correct Ans

### Conditions

- Penalise  $\frac{1}{2}$  mark for wrong transfer of answer (II)
- Penalise fully for strange figure
- Answer as expected otherwise penalize  $\frac{1}{2}$  mark (don't work at accuracy, d.p) for wrong answer

### Notes

- Award fully if correct answer given is based on statement implying multiplication of ten

IV).  $2 \times 20$



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 <b>Reject</b> <i>C = C, C = C</i> <i>Carbon to carbon double or triple bond in words</i> <i>Alkaline /alkaline</i>
b	Dissolves/ soluble to form a colourless solution	Polar organic compound Note Accept soluble /substance/salt/compound present
c (i)	Effervesence occurs or bubbles are formed	R – COOH / H <sup>+</sup> / H <sub>3</sub> O <sup>+</sup> <i>Accept - Acidic compound /solution</i> <i>Organic compound ; Carboxylic acid</i>
(ii)	Orange colour K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> solution persists / remain the same / orange / orange colour <i>Rej – Yellow used in place of orange</i> <i>K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> not decolourised</i>	R – OH absent <i>Note : Penalise fully if any other functional groups are mentioned</i>
(iii)	Purple KMnO <sub>4</sub> soln is decolorized or KMnO <sub>4</sub> soln changes from purple to colourless <i>Note : Rej Solution remains / becomes / turns colourless</i>	- $\overset{ }{\underset{ }{C}} = \overset{ }{\underset{ }{C}}$ / $C = \overset{ }{\underset{ }{C}}$ present <i>Accept for unsaturated organic compound present</i>

**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 <sup>3</sup> )	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<sup>3</sup> of sodium contains 0.3 moles of NaOH  
21.50cm<sup>3</sup> of solution contains  $0.3 \times \frac{21.5}{1000}$   

$$= 0.00645 \text{ moles}$$
(1 mark)
- iii). Moles of hydrochloric acid in 25.0cm<sup>3</sup> of solution D  
= 0.00645 moles
(1 mark)
- iv). Morality of hydrochloric acid in solution D.  
25cm<sup>3</sup> of solution contains 0.00645 moles Hcl  

$$\frac{0.00645 \times 1000}{25}$$
100cm<sup>3</sup> of solution contains

$$= 0.25M$$

(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 <sup>3</sup> )	21.50	20.90	20.90

(4 marks)

- b). i). Average volume of solution D used  

$$\frac{20.90 + 20.90}{2} = 20.90\text{cm}^3$$
 (1 mark)
- ii). Moles of hydrochloric acid in average volume of solution D used 1000cm<sup>3</sup> of solution contains 0.258 moles of HCl  
 20.90cm<sup>3</sup> 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<sup>3</sup> of solution A.  
 Mole ratio of acid to carbonate 2: 1 (1 mark)  
 $\frac{1}{2} \times 0.0054$   
 $= 0.0027$  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<sup>3</sup> of solution = 0.1998g  
 100g of solution will contain  $\frac{0.1998 \times 100g}{25}$  of carbonate  
 $= 0.7992\text{g}/100\text{g}$  of solution (1 mark)

2. a).

**Observations**

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

**Inferences**

hydrated salt/ compound or contains water of crystallization (Tied to Colourless liquid forming after condensation Ammonia gas (NH<sub>4</sub><sup>+</sup>) present ( tied to gas forming with HCl

b). i).

**Observations**

White ppt. insoluble in Excess aqueous ammonia (1 mark)

**Inferences**

Pb<sup>2+</sup> or Al<sup>3+</sup> Present (1 mark)  
 Note: Ignore Mg<sup>2+</sup> if mentioned as present. Penalise ½ mark

for each

Contradictory ion given to a max penalty of ½ mk.

Pb <sup>2+</sup> in	ii).	<b>Observations</b> No white ppt / No white solid No white suspension or Al <sup>3+</sup> present tied to white ppt	<b>Inferences</b> Pb <sup>2+</sup> absent No effervescence/ No bubbles Note: if a candidate mentions
		Rej. No observable change No ppt / change/reaction No white substance Colourless soln formed Soln remains colourless No colour change	Place of Al <sup>3+</sup> present credit ½ CO <sub>3</sub> <sup>2-</sup> and SO <sub>3</sub> absent Tied to no Effervescence. (2 marks) <i>NB. To award 'Al<sup>3+</sup> present it must have          been credited in b (i); To award          Pb<sup>2+</sup> absent it must have been          mentioned as present in b (i); Ignore          mention of Ag<sup>+</sup> absent</i>

without	iii).	<b>Observations</b> White ppt /solid/suspension which does not dissolve on boiling  (1 mark)	<b>Inferences</b> - SO <sub>4</sub> <sup>2-</sup> present - If a candidate mentions Cl <sup>-</sup> giving SO <sub>4</sub> <sup>2-</sup> present award ½ mark <i>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)</i>
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3.	a).	<b>Observations</b> White solid dissolves to form a colourless solution (1 mark) <i>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</i>	<b>Inferences</b> F is a non polar compound  (1 mark)
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	i).	<b>Observations</b> P <sup>H</sup> = 7  (1 mark) <i>Note: Ignore mention of colour          of mixture; Reject pH range</i>	<b>Inferences</b> Neutral solution  (1 mark) <i>Acpt: Soln neither acidic nor alkaline          Rej basic used in place of alkaline</i>
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	ii).	<b>Observations</b> No effervescence/ No bubbles (1 mark)	<b>Inferences</b> H <sup>+</sup> absent <i>Accept soln not acidic for ½ mk in the          absence of H<sup>+</sup> absent          Ignore R – COOH absent</i>
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b).	i).	<b>Observations</b> Effervescence giving off a Colourless solution formed <i>Accept Fizzing used in place of Effervescence or bubbles for</i> (1 mark)	<b>Inferences</b> Carboxylic/alkanoic acid present Or – COOH present/ $H^+$ / $H_3O^+$  (1 mark)
	ii)	<b>Observations</b> Does not turn green. Orange Color of $K_2Cr_2O_7$ (1 mark) <i>Note both initial colour and Final colour must be given Otherwise penalize fully</i> Accept: Orange colour of $K_2Cr_2O_7$ solution persists / remains; Rej: Yellow used in place of orange	<b>Inferences</b> Alcohol absent / R - OH Rej – OH (2 marks)
	iii).	<b>Observations</b> Bromine water not decolourised Accept yellow/ Orange / red colour of bromine water persists / remains (1 mark)	<b>Inferences</b> $C=C$ / $-C=C-$ 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<sup>3</sup>  
 Candidates values are 15.8, 15.6, 15.6  
 Candidates working

$$\frac{15.6 + 15.6}{2}$$

$$= 15.6\text{cm}^3$$

½ mark

3 S.V = 15.90cm<sup>3</sup>

Candidate's values are 16.0, 15.8, and 15.6  
 Candidates working

$$\frac{15.8 + 15.6}{2}$$

$$= 15.70\text{cm}^3$$

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<sup>3</sup> of solution B =  $\frac{2 \times 25}{1000}$

Moles of NaOH in 250cm<sup>3</sup> of solution D =  $\frac{2 \times 25}{1000}$

Hence Conc. of solution D =  $\frac{2 \times 25 \times 1000}{1000 \times 250}$   
 = 0.200 mols

Or

Conc of solution D =  $\frac{2 \times 25 \times 1000}{1000 \times 250}$   
 = 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<sub>2</sub>) or md =  $\frac{2 \times 25}{100}$

Or

Conc of solution D =  $\frac{2 \times 1}{10}$

= 0.200 mol l

iii). Moles of NaOH in 25cm<sup>3</sup> of solution D used  
 =  $\frac{\text{Ans (II)} \times 25}{1000}$

Moles of alkanolic acid used =  $\frac{1}{3} \times \text{ans (II)} \times \frac{25}{1000}$

Hence conc of solution C =  $\frac{1}{3} \times \frac{\text{ans (II)} \times 25 \times 1000}{1000 \times \text{Titre}}$   
 = correct ans.

OR

Conc of solution C =  $\frac{1}{3} \times \frac{\text{ans (II)} \times 25}{\text{Titre}}$   
 = Correct ans.

OR

$M_a V_a = \frac{1}{3} = M_b V_b = M_a = \frac{1}{3} \times \frac{\text{ans (II)} \times 25}{\text{Titre}}$

= correct answer

iv). Molar mass of the alkanolic acid

= 25.0

Ans (III)

= Correct answer

- Note:
- Penalise  $\frac{1}{2}$  mark for wrong transfer of ans (III) otherwise penalize fully for strange figures used.
  - Penalise  $\frac{1}{2}$  mark for wrong answer if arithmetic error is outside +5 units in the 1<sup>st</sup> d.p
  - Penalise  $\frac{1}{2}$  mark for either omission of the (g) units or for wrong units used

## Procedure

Table II..... 6 marks

### GRAPH

- a). Labelling of axes .....  $\frac{1}{2}$  mark  
to award the  $\frac{1}{2}$  mark both axes must be correctly labelled

#### Conditions

- Penalise fully for wrong units used otherwise accept correct labeling even if no units are shown
- Penalise fully if only one axis is correctly labelled
- Change in temperature ( $\Delta T$ ) must appear on the vertical axis and volume of solution A on horizontal axis, otherwise penalize fully for inverted Axes
- Reject labeling of axes if temperature alone is used instead of change in temperature ( $\Delta T$ ) in vertical axis.

- b). Scale .....  $\frac{1}{2}$  mark

- Area covered by the actual plots must be at least 3  $\frac{1}{2}$  big square (vertical axis) by 4  $\frac{1}{2}$  big square (horizontal axis)
- The scale interval must be constant on each axis
- Scale chosen must be able to accommodate the plots, whether plotted or not (chalk the range of values on both axes)

- NB:
- Penalise fully if any of the above conditions is not met
  - Award for the scale even if the axes are in interchanged so long as the above conditions are met

- c). Plotting .....  $\frac{1}{2}$  mark

- For 5 or 6 points plotted correctly award 1 mark
- If 4 or 3 points are correctly plotted award  $\frac{1}{2}$  mark
- For less than 3 points correctly plotted award 1 mark
- 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
- Accept the correct plots even if the axis are inverted /interchanged

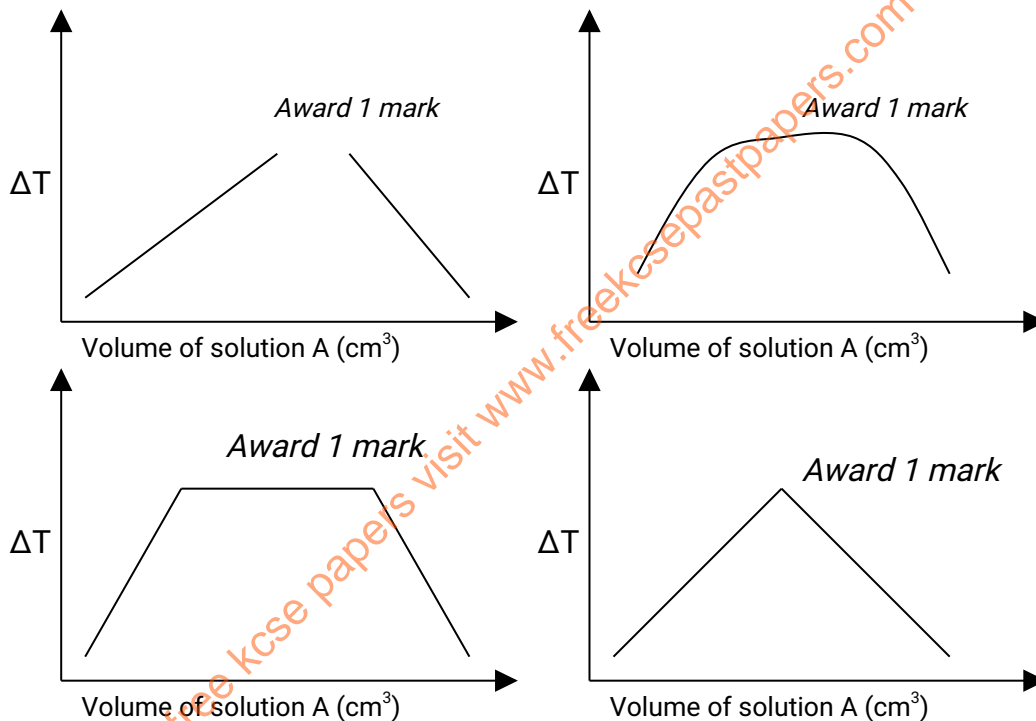
- d). The line/shape..... 1 mark

#### Conditions

- Award  $\frac{1}{2}$  mark for straight line showing a risk
- Award another  $\frac{1}{2}$  mark for an extrapolated line showing a drop  
NB: *Accept lines of best fit*
- 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 =  $V_{C11}$

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  $V > 25\text{cm}^3$  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  $30\text{cm}^3$  is unrealistic and unacceptable and hence penalize fully and consequently. Reject working in both d (i) and d (ii) below and award 0 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

$$\begin{aligned} \text{Moles of acid used} &= \text{Moles of NaOH} \\ \text{Molarity of acid} &= \frac{2 \times \text{Ans (c)}}{1000} \times \frac{1000}{\text{Ans (b)}} \\ &= \text{corr. Ans} \end{aligned}$$

OR

$$\begin{aligned} \text{Conc of solution A} &= \frac{2 \times \text{Ans (c)}}{\text{Ans b}} \\ &= \text{Correct Ans} \end{aligned}$$

OR

$$\begin{aligned} M_A V_A &= M_B V_B \\ M_A &= 2 \times \text{Ans} \\ &\quad \text{Ans(b)} \\ &= \text{Corr. Ans} \end{aligned}$$

### Conditions

- i). Accept answer tied correct arithmetic otherwise penalise ½ mark for arithmetic error outside +2 marks in the 1<sup>st</sup> 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 <sup>2+</sup> Ca <sup>2+</sup> , Ba <sup>2+</sup> , If all the 3 given 2 marks If only 2 given – 1 mark If only 1 given – ½ mark <b>Note:</b> 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 <sup>2+</sup> , NB: Credit Pb <sup>2+</sup> only if mention in (i) above, penalize fully for any contradiction
iii)	White PPt	-F contains SO <sub>4</sub> <sup>2-</sup> , Cl <sup>-</sup> , SO <sub>3</sub> <sup>2-</sup> , Cl <sup>-</sup> , or SO <sub>4</sub> <sup>2-</sup> , Cl <sup>-</sup> , SO <sub>3</sub> <sup>2-</sup> , CO <sub>3</sub> <sup>2-</sup> , 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 <sup>2+</sup> Penalise fully for any contradictory ions
bi)	Burns with a smoky/sooty flame/sooty flame Accept – yellow sooty	$\begin{array}{c}   &   \\ -C & -C- \\   &   \end{array} / -C=C-$ <p>Accept ; long chain hydrocarbon, carbon; hydrogen ratio <i>Penalise fully for any contradictory functional group.</i></p>
(ii) I	I pH is 1 or 3 accept red for ½ mk but reject inference given but reject inference given on its strength <i>Reject PH range, penalize Fully for colour and correct PH NB: If a wrong colour</i>	strongly acidic Reject – acidic given alone G – is a strong acid ignore – carboxylic acid
II	KMnO <sub>4</sub> decolourised Or KMnO <sub>4</sub> turns from Purple to colourless Reject KMnO <sub>4</sub> turns colourless Solution turns colourless Solution decolourised Solution discoloured	- C = C- or – C = C- 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 <sub>2</sub> & CO <sub>2</sub> <i>Reject ; Hissing Odourless mentioned alone</i>	CO <sub>3</sub> <sup>2-</sup> 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)**

- Value 1.60 must be intact otherwise penalize fully
- Ans. Should be at least 3 dec. place
- Penalise ½ mark for arithmetic error if outside + 2 units in the 3<sup>rd</sup> depth
- 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 <sup>3</sup> )	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.

$$\frac{1.60 \times 1000}{250} = 6.4 \quad \frac{1.60}{126} = 0.0127 \quad \frac{1.60 \times 1000}{126 \times 126} = 0.051M \quad \frac{1.60 \times 4}{126}$$

6.4 moles in a litre

$$126 = 0.05 \frac{0.0127 \times 1000}{250}$$

$$= 4 \times 0.00127$$

$$= 0.051$$

2 marks

iii). Moles of the dibasic acid used;

Answer in (ii) above x litre

1000

= correct answer

1 mark

iv). Moles of sodium, hydroxide in 25.0cm<sup>3</sup> of solution C

Ans in (iii) above x 2

=correct answer

1 mark

v). Concentration of sodium hydroxide in moles per litre

Answer (iv) above x 1000

25

Correct answer

Answer (iv) above x 40

Or Mb = 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;

	1 <sup>st</sup> Conical flask	2 <sup>nd</sup> Conical Flask
Final burette reading	21.20	33.60
Initial burette reading	9.70	21.20
Volume of solution A used (cm <sup>3</sup> )	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<sup>3</sup> of salt B in solution B;

=Ans (iv) procedure II = Ans (iii) above

=Correct ans.

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<sup>3</sup> of solution B

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  $\frac{1}{2}$  mark for ans

2. a).i). **Observation**  
Gas that turns moist litmus paper  
Blue given off  
Condenses on the cooler parts of  
The tube to form colourless liquid  
Droplets  
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  
**Inferences**  
 $\text{NH}_4^+$  present (tied to red litmus  
turning blue)  
Solid D is hydrated /Solid D  
contains water of crystallisation  
(tied to idea of condensation)

*NB: Ignore mention of any other ions present*

- ii). **Observations**  
Yellow /brown solution formed  
On addition of  $\text{H}_2\text{O}_2$  solution  
Brown ppt formed which is in soluble  
In excess  $\text{NaOH}$  solution *NB: ignore*  
Mention of initial colour of solution  
unless It contradictory  
*NB: Reject  $\text{Fe}^{3+}$  present /solid or solution D contains  $\text{Fe}^{3+}$*   
**Inferences**  
 $\text{Fe}^{2+}$  oxidized to  $\text{Fe}^{3+}$   
or  
 $\text{Fe}^{3+}$  formed  
Accept  $\text{Fe}^{3+}$  present in  
mixture of  $\text{Fe}^{2+}$  in  
solution

- b). i). **Observations**  
A white ppt formed  
*NB: Penalise  $\frac{1}{2}$  mark for each contradictory ions for a max of ( 1  $\frac{1}{2}$  mark)*  
**Inferences**  
 $\text{SO}_4^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{CO}_3^{2-}$  present

- ii). To the mixture obtained in (i) above, add about  $5\text{ cm}^3$  of 2M nitric acid (V) acid

**Observations**  
Effervesces occurs /bubbles of  
Gas seen  
The white ppt dissolves disappears  
*Correct inference tied to either observation or both*  
*Penalise  $\frac{1}{2}$  mark for each contrition to a max of 1 mark*  
*Ignore  $\text{SO}_4^{2-}$  mentioned as absent*  
**Inferences**  
 $\text{SO}_3^{2-}$  presents  
*NB: credit only if correctly inferred*

- iii). To portion two of solution E in a test-tube, add 2 drops of acidified potassium dichromate (VI) and warm the mixture

**Observations**  
Acidified  $\text{K}_2\text{Cr}_2\text{O}_7$  solution  
Changes from orange to green  
*Correct inference tied to either observation or both*  
*Penalise  $\frac{1}{2}$  mark for each contrition to a max of 1 mark*  
*Ignore  $\text{SO}_4^{2-}$  mentioned as absent*  
**Inferences**  
 $\text{SO}_3^{2-}$  presents  
*NB: credit only if correctly inferred*

- 3 a). **Observations** **inferences**



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  

$$\frac{\text{Answer (b) (i)} \times 1000}{25} = \text{Correct answer}$$

**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 3<sup>rd</sup> 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 1<sup>st</sup> 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  $1/t$  on the graph ½ mark  
ii). For stating the correct reading  
e.g R = 0.003  
iii). For  $t = 1/\text{correct value}$   
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 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 1<sup>st</sup> d.p  
Correct units must be shown otherwise penalise ½ mark

2.	a).i).	I).	<b>Observations</b> A white precipitate	<b>Inferences</b> Presence of $Pb^{2+}$ , $Ba^{2+}$ , $Ca^{2+}$ Only 2 – ½ mark Penalise ½ mark for each contradictory ion
		II).	<b>Observations</b> No white ppt	<b>Inferences</b> Presence of $Ba^{2+}$ , $Ca^{2+}$ $Pb^{2+}$ absent ½ where the above Not mentioned penalise ½ mark for each contradictory ions
		III).	<b>Observations</b> No white precipitate	<b>Inferences</b> Cl- absent Penalise fully for any contradictory ion Ignore mention of $SO_4^{2-}$ , $SO_3^{2-}$ of $CO_3^{2-}$ as absent
ii).	<b>Observations</b> Effervescence/bubbled Colourless gas/pungent choking	<b>Inferences</b> Solid contain $NO_3$ (Tied to red litmus turning blue)		



Smell  
 Red Litmus – blue  
 Blue – remains blue

- |    |     |   |  |
|----|-----|---|--|
| 3. | a). | <b>Observations</b><br>No effervescence/no bubbles<br>No fizzing  | <b>Inferences</b><br>Solid F is not acidic<br>OR<br>Absence of H <sup>+</sup> /H <sub>3</sub> O <sup>+</sup>   |
|    | b). | i). <b>Observations</b><br>Burns with a sooty flame<br><br>Smoky flame or luminous<br>Yellow flame  | <b>Inferences</b><br>Unsaturated /long chain /high C-H<br>organic cpd organic cpds ratio present<br>Flame / Carbon –carbon double/triple<br>bond written in words or aromatic cpds |
|    |     | ii). <b>Observations</b><br>White suspensions<br>Or<br>White solid remains undissolved  | <b>Inferences</b><br>Compound is slightly soluble<br>Or<br>Cpd is partially soluble<br>or<br>cpd is insoluble/cpd is nonpolar  |
|    | c). | i). <b>Observations</b><br>Effervescence /Bubbles /fizzing<br>Or<br>Accept colorless gas given off  | <b>Inferences</b><br>The mixture is acidic<br>Or<br>RCOOH or H <sup>+</sup> /H <sub>3</sub> O present  |
|    |     | ii). <b>Observations</b><br>Bromine water is not decolourised<br>Or<br>Yellow/orange/brown/red<br>Remains persists<br>Bromine water remain yellow | <b>Inferences</b><br>Carbon – carbon double/triple<br>bond absent<br>Or<br>Compound is saturated   |

**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<sup>0</sup>C or more than 40<sup>0</sup>C 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  $\frac{1}{2}$  mark. If the reading is within  $+2C$  of the S.V otherwise penalize fully  
Trend .....

Awarded as follows:

- i).  $\frac{1}{2}$  mark for continuous rise upto the maximum
- ii).  $2^{nd}$   $\frac{1}{2}$  mark for temperature being either constant 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  $4 \frac{1}{2}$  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**

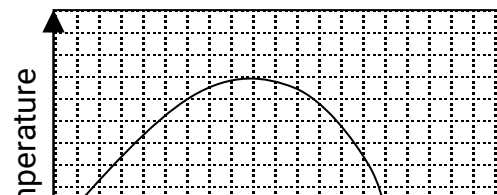
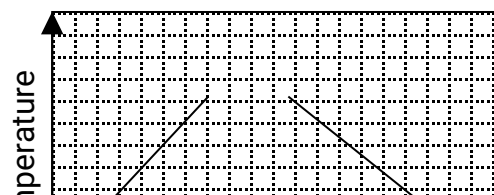
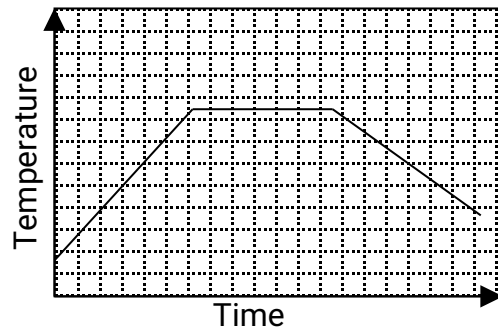
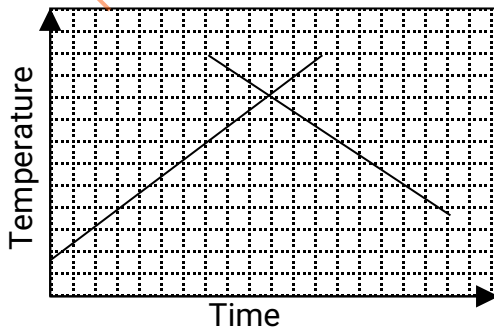
- i). If 8 or 7 correctly plotted .....
- ii). If only 6 to 4 points correctly plotting
- iii). If less than 4 points correctly plotted

**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...
- iii). Accept 1<sup>st</sup> 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 1<sup>st</sup> 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 1<sup>st</sup> row and 2<sup>nd</sup> 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 '0' or 'S' otherwise penalize fully
- iii). Accept inconsistency in the use of zero's used as initial burette reading i.e 0,0.0 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  $\pm 0.1$  of S.V award
- ii). If not within  $\pm 0.1$ , but within + 0.2 of S.V award.....  $\frac{1}{2}$  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 titre values are averages by candidates, pick correct values (if any) average them and award accordingly

b). i). Moles of  $\text{MnO}_4^- = \frac{0.02 \times \text{AV. Titre}}{1000}$   
=Correct Ans.

ii). Moles of  $\text{Fe}^{2+}$  in  $25\text{cm}^3$   
 $\text{Fe}^{2+} : \text{MnO}_4^- = 5: 1$   
= 5 x Ans b(i) above  
= Correct Ans.

iii). Moles of iron (i) ions in  $250\text{cm}^3 = \frac{\text{Ans b(ii)} \times 250\text{cm}^3}{25\text{cm}^3}$

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 only 2 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 2<sup>nd</sup> 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 5<sup>th</sup> 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  $\text{Cu}^{2+}$  ions**

$\text{Cu}^{2+}$ : 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 1<sup>st</sup> 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

$= 50 \times 4.2 \times DT$   
 = 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 <sup>3</sup> )			

4 marks

a).  $\frac{1 + 11 + 1}{3} = \text{ans}$

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 <sub>3</sub> <sup>2-</sup> (Extinguishes burning splint) -Zn <sup>2+</sup> /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 <sub>3</sub> <sup>2-</sup> present Penalize fully for any contradictory ion Zn <sup>2+</sup> present (1 mark)

Reject ; Hissing /Fizzing

iii).

Observations	Inferences
-White ppt -soluble in excess (1 mark)	-Zn <sup>2+</sup> /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 <sup>3+</sup> , Pb <sup>2+</sup> , Mg <sup>2+</sup> present Note (1 mark)

*Penalize fully for ppt dissolves*

ii).

Observations	Inferences
- No effervescence -No white ppt (1 mark)	-CO <sub>3</sub> <sup>2-</sup> , SO <sub>3</sub> <sup>2-</sup> absent (both ½ mark) -Al <sup>3+</sup> , Mg <sup>2+</sup> 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 <sup>2+</sup> ions absent penalized ½ mark for any contradictory ion SO <sub>4</sub> <sup>2-</sup> 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 <sub>4</sub> /H <sup>+</sup> is not decoloured colour of KMNO <sub>4</sub> /H <sup>+</sup> remains purple/purple colour of KMNO <sub>4</sub> /H <sup>+</sup> persists or remains the same (1 mark)	-H <sup>+</sup> /H <sub>3</sub> O <sup>+</sup> 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)*

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**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<sup>3</sup> of solution **W9**
- About 150cm<sup>3</sup> of solution **W11 (oxalic acid)**
- About 1g of solid **Y**
- About 10cm of metal **M (magnesium ribbon)**
- 1 pipette of 25.0cm<sup>3</sup>
- 3 conical flasks
- 1 burette
- 1 measuring cylinder of 100cm<sup>3</sup>
- 1 beaker of 250cm<sup>3</sup>
- Tissue paper
- 1 boiling tube
- 1 thermometer (accuracy 0.5<sup>o</sup>C)
- 1 ruler
- 1 spatula
- 5 test-tubes
- A sharp blade or pair of scissors
- A small funnel

### Access to

- 250cm<sup>3</sup> of distilled water
- Dilute hydrochloric acid
- Phenolphthalein indicator
- Dilute sodium hydroxide
- Aqueous ammonia

### Preparations

- i. Solution W9 is made by dissolving 90cm<sup>3</sup> 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<sup>3</sup> of solution S1, (Sodium hydroxide)
- About 150cm<sup>3</sup> of solution S1,
- About 1.0g of solid Q
- About 400cm<sup>3</sup> of distilled water
- One burette
- One 25cm<sup>3</sup> of pipette
- One 10cm<sup>3</sup> pipette
- One 100cm<sup>3</sup> measuring cylinder
- One filter funnel
- One filter paper
- conical flasks (250cm<sup>3</sup>)
- One thermometer (0-10<sup>0</sup>C – 0-110<sup>0</sup>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<sup>3</sup> of ethanol

**Preparations**

- Solids D and Q will be provided by the Kenya National Examinations Council.
- Preparations of solution S1:
  - Dissolves 4.0g of sodium hydroxide in distilled water and make it up to one litre of solution
  - Take 200cm<sup>3</sup> of the sodium hydroxide solution prepared in (i) above and dilute with distilled water to make up one litre of solution (S1)
- Preparation of solution S2:
  - Dissolve 56cm<sup>3</sup> of concentrated sulphuric acid in about 500cm<sup>3</sup> of distilled water.
  - Take 10cm<sup>3</sup> 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<sup>3</sup> of solution C2,
- 100cm<sup>3</sup> of solution C3
- 150cm<sup>3</sup> of solution C5
- 150cm<sup>3</sup> of solution C6
- About 1g of solid C7

- One, 50cm<sup>3</sup> burette
- One, 100cm<sup>3</sup> beaker
- One, 25cm<sup>3</sup> (or 20cm<sup>3</sup>) pipette,
- One, 10cm<sup>3</sup> measuring cylinder
- Three, 250cm<sup>3</sup> 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<sup>3</sup> of solution C4
- Dilute sulphuric acid
- Dilute sodium hydroxide solution,
- Source of heat (Bunsen burner)
- 300cm<sup>3</sup> of distilled water
- Note: all the solutions should be freshly prepared and supplied accompanied by droppers.

**Preparations**

- Solution C2 is prepared by dissolving 2g of solid C2 in distilled water and making it up to one litre
- Solution C3 is prepared by dissolving 0.40g of solid C3 in about 200cm<sup>3</sup> of distilled water, adding 20cm<sup>3</sup> of 1M sulphuric acid, shaking well and making it up to one litre with distilled water.
- Solution C4 is prepared by placing 1.0g of solid C4 in 100cm<sup>3</sup> beaker, adding 2cm<sup>3</sup> of distilled water to make a paste and pouring the paste into 100cm<sup>3</sup> 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.
- Solution C5 is prepared by adding 10cm<sup>3</sup> of concentrated hydrochloric acid (specific gravity of 1.18 or 1.9) in 500cm<sup>3</sup> of distilled water and making it up to one litre.
- Solution C6 is prepared by dissolving 19.2 of solid C6 in about 500cm<sup>3</sup> 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<sup>3</sup> of solution A
- 1.0cm<sup>3</sup> of solid B
- 200cm<sup>3</sup> of solution C
- About 1g of solid F

- One, 50cm<sup>3</sup> burette
- One 25cm<sup>3</sup> pipette
- Five 25cm<sup>3</sup> conical flasks
- One, 100 cm<sup>3</sup> 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<sup>3</sup> 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**

- Solution A is prepared by dissolving 40g of sodium hydroxide pellets in about 500cm<sup>3</sup> of distilled water then making it up to one litre of solution
- Solution C is prepared by dissolving 9.7g of solid C in about 500cm<sup>3</sup> of distilled water and making it up to one litre of solution
- 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
- 0.05M iodine solution is prepared by dissolving 20g of potassium iodide crystals in 600cm<sup>3</sup> 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<sup>3</sup> of solution D
- 150cm<sup>3</sup> of solution E
- 50cm<sup>3</sup> of solution F
- 50cm<sup>3</sup> of solution G
- About 1.5g of solid H
- One, 50cm<sup>3</sup> burette
- One, 100cm<sup>3</sup> beaker
- One, 10cm<sup>3</sup> measuring cylinder
- One 100cm<sup>3</sup> measuring cylinder
- One 25cm<sup>3</sup> (or 20cm<sup>3</sup>) pipette
- Three, 250cm<sup>3</sup> conical flasks
- Eight, clean dry test-tubes.
- One thermometer (-10<sup>0</sup>C to 110<sup>0</sup>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<sup>3</sup> of 2.0M hydrochloric acid
- One, 50cm<sup>3</sup> burette
- One, thermometer
- One, stopwatch/stopclock/watch with a second hand
- One, 100cm<sup>3</sup> beaker
- Two pieces of aluminium foil (2cm<sup>3</sup> each)
- Six test-tubes
- Two wooden splints
- Three blue and three red litmus papers
- One metallic spatula
- One boiling tube
- One 10cm<sup>3</sup> measuring cylinder
- One glass rod

### Access to:

- About 500cm<sup>3</sup> of distilled water
- 2.0M hydrochloric acid (labeled as dilute)
- 2.0M sodium hydroxide (labeled as dilute)
- Bunsen burner
- About 50cm<sup>3</sup> of 0.1M lead nitrate solution

### Preparations

The 2.0M hydrochloric acid should be prepared accurately by adding 175cm<sup>3</sup> of concentrated hydrochloric acid to about 700cm<sup>3</sup> 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<sup>3</sup> of solution A
- 100cm<sup>3</sup> of solution B
- 100cm<sup>3</sup> of solution C
- One 50cm<sup>3</sup> burette
- One 25cm<sup>3</sup> pipette
- One thermometer (0<sup>0</sup>C to 100<sup>0</sup>C)
- 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<sup>3</sup> 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

- Solution A is prepared by dissolving 3.16g of solid A in 400cm<sup>3</sup> of 2M sulphuric acid and making it up to one litre of solution with distilled water.
- Solution B is prepared by dissolving 23.5g of solid B in 200cm<sup>3</sup> 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.
- Solution C is prepared by dissolving 5.0g of solid C in 600cm<sup>3</sup> 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<sup>3</sup> of solution F, sulphuric acid.
- 100cm<sup>3</sup> of solution G, 0.5M sodium hydroxide
- 0.2g of solid H weighed accurately – mg
- One 50cm<sup>3</sup> burette
- One 25.0cm<sup>3</sup> pipette
- One 100cm<sup>3</sup> measuring cylinder
- One 100cm<sup>3</sup> beaker
- Two conical flasks
- One thermometer 0°C – 110°C
- One 250cm<sup>3</sup> 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  $27.8\text{cm}^3$  of con.  $\text{H}_2\text{SO}_4$  (s.g. 1.84) to about  $400\text{cm}^3$  of distilled  $\text{H}_2\text{O}$  then making it to one litre of solution.
- b) Solution G is prepared by dissolving 10.0g of NaOH pellets in  $600\text{cm}^3$  of distilled  $\text{H}_2\text{O}$  then making it to one litre of solution
- c) Acidified potassium permanganate is prepared by dissolving 31.6g of solid  $\text{KMnO}_4$  in  $400\text{cm}^3$  of 1M  $\text{H}_2\text{SO}_4$  acid and making it to one litre of solution.
- d) 1% Bromine water is prepared by adding  $1\text{cm}^3$  (CARE) of liquid Bromine to  $100\text{cm}^3$  of distilled  $\text{H}_2\text{O}$  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.

- $250\text{cm}^3$  of hydrochloric acid, solution M.
- $150\text{cm}^3$  of sodium hydroxide, solution N
- 0.50g of solid P weighed accurately
- Burette 0 –  $50\text{cm}^3$
- Pipette  $25\text{cm}^3$

**Means of labeling.**

- $100\text{cm}^3$  measuring cylinder
- $250\text{cm}^3$  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  $\text{Na}_2\text{CO}_3$
- about 0.3g of solid S
- A spatula
- A test-tube holder.

**Access to:**



- 10cm<sup>3</sup> 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<sup>3</sup> (S.G = 1 = 1.18) of concentrated hydrochloric acid into 600cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup>
- One pipette 25cm<sup>3</sup>
- About 100cm<sup>3</sup> of solution E
- About 120cm<sup>3</sup> of solution F
- Two conical flasks > 250cm<sup>3</sup>
- 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<sup>3</sup> measuring cylinder
- Cutting blade / scissors
- 6cm<sup>3</sup> length of magnesium ribbon, labelled solid K
- About 50cm<sup>3</sup> of 2.0M hydrochloric acid, labelled solution L
- Means of labeling test-tube holder
- One 100cm<sup>3</sup> 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  $10.0\text{cm}^3$  of concentrated hydrochloric acid ( $1.18\text{g}/\text{cm}^3$ ) using a burette and adding it to about  $500\text{cm}^3$  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  $800\text{cm}^3$  of distilled water and diluting to one litre of solution.
3. Solution L is prepared by accurately adding  $172\text{cm}^3$  of concentrated hydrochloric acid ( $1.18\text{g}/\text{cm}^3$ ) to about  $500\text{cm}^3$  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  $90\text{cm}^3$  of solution L
- About  $150\text{cm}^3$  of solution M
- One burette 0 –  $50\text{cm}^3$
- One pipette  $25\text{cm}^3$
- One thermometer 0 –  $110^\circ\text{C}$
- Two conical flasks
- One filter funnel
- 3 filter papers
- $10\text{cm}^3$  of solution P contained in a conical flask
- 6 clean dry test-tubes
- 50 or  $100\text{cm}^3$  measuring cylinder
- 3 g of solid G
- $100\text{cm}^3$  beaker
- Stop clock / watch
- $30\text{cm}^3$  of 2M sodium hydroxide in a beaker
- One  $10\text{cm}^3$  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  $600\text{cm}^3$  of distilled water and diluting to one

- litre of solution.
2. Solution M is prepared by accurately adding  $9\text{cm}^3$  of concentrated hydrochloric acid (density  $1.18\text{g}/\text{cm}^3$ ) to about  $500\text{cm}^3$  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  $800\text{cm}^3$  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  $20\text{cm}^3$  of solution A.
- about  $100\text{cm}^3$  of solution B
- About  $60\text{cm}^3$  of solution C
- About  $100\text{cm}^3$  of solution D.
- One burette
- One pipette
- Two conical flasks ( $250\text{cm}^3$ )
- One filter funnel
- One boiling tube
- One thermometer  $0 - 110^\circ\text{C}$
- One  $10\text{cm}^3$  measuring cylinder
- 50 or  $100\text{cm}^3$  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
- $100\text{cm}^3$  beaker
- One spatula.

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**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  $800\text{cm}^3$  of distilled water and diluting to one litre of solution
2. B is prepared by adding  $12\text{cm}^3$  of hydrochloric acid (specific gravity  $1.18\text{g}/\text{cm}^3$ ) (measured

- accurately) in about  $500\text{cm}^3$  of distilled water and diluting to one litre of solution.
3. C is made by dissolving 75.6g of solid C in about  $900\text{cm}^3$  of distilled water and diluting to one litre of solution.
  4. D is prepared by adding 167cm of solution A to  $600\text{cm}^3$  of distilled water and diluting to one litre of solution
  5. Bromine water is prepared by adding 2ml of liquid bromine to  $100\text{cm}^3$  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  $400\text{cm}^3$  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  $120\text{cm}^3$  of solution A
- about  $150\text{cm}^3$  of solution B
- about  $40\text{cm}^3$  of solution C supplied with a dropper
- about  $40\text{cm}^3$  of solution D supplied with a dropper
- about  $150\text{cm}^3$  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  $15\text{cm}^3$  of solution E supplied with a dropper
- two 200ml or 250ml beaker
- one  $10\text{cm}^3$  measuring cylinder
- one burette 0 – 50ml
- one 50ml or 100ml measuring cylinder
- $15\text{cm}^3$  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  $200\text{cm}^3$  of fresh 20 volume hydrogen peroxide to about  $600\text{cm}^3$

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<sup>3</sup> of distilled water and diluting to one litre of solution.
4. Solution D is prepared by adding 10g of solid D in about 700cm<sup>3</sup> of distilled water and diluting to one litre of solution.
5. Solution E is prepared by dissolving 10g of solid E in about 600cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of solution P
- about 120cm<sup>3</sup> of solution Q
- one burette 0 – 50ml
- one pipette 25ml
- two conical flasks 250ml
- 1.9g of solid S weighed accurately
- 35cm<sup>3</sup> of solution T
- one thermometer 0 – 110°C
- 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 0.5MBaCl<sub>2</sub>
- 2cm<sup>3</sup> of 2M hydrochloric acid supplied in a test-tube and labelled 2MHCl
- About 35cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> length of solid A.
- About 80cm<sup>3</sup> of solution B
- About 120cm<sup>3</sup> of solution C
- one burette (0 – 50ml)
- one pipette 25ml
- one thermometer (0 – 110<sup>o</sup>) C
- one 100ml beaker
- two 250ml conical flasks
- one stopwatch / clock
- 6 clean dry test-tubes
- one boiling tube
- about 200cm<sup>3</sup> of distilled water in a wash bottle.
- one label
- about 5cm<sup>3</sup> of solution E in a test-tube
- about 5cm<sup>3</sup> of solution F in a test tube
- about 5cm<sup>3</sup> of solution G in a test tube
- about 6cm<sup>3</sup> 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<sup>3</sup> of concentrated hydrochloric acid density 1.18g/cm<sup>3</sup> in about 600cm<sup>3</sup> 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<sup>3</sup> of distilled water and diluting to one litre of solution.
3. Solution E is prepared by dissolving 60g of solid E in about 900cm<sup>3</sup> of distilled water and diluting to one litre of solution.
4. Solution F is prepared by dissolving 30g of solid F in about 500cm<sup>3</sup> of distilled water and diluting to one litre of solution.
5. Solution G is prepared by dissolving 30g of solid G in about 700cm<sup>3</sup> of distilled water and diluting

- to one litre of solution.
- Solution H is prepared by dissolving 60g of solid H in about 600cm<sup>3</sup> of distilled water and diluting to one litre of solution.
  - Chlorine H<sub>2</sub>O is prepared by dissolving 250cm<sup>3</sup> of 5% chlorine H<sub>2</sub> (5% sodium hypochlorite) to 750cm<sup>3</sup> of distilled H<sub>2</sub>O.
  - 1% bromine H<sub>2</sub>O is prepared by adding 1cm<sup>3</sup> of liquid bromine to 100 of distilled H<sub>2</sub>O 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<sup>3</sup> of solution K
- About 75cm<sup>3</sup> 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°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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of distilled water and

- diluting to one litre of solution.
- Solution P is prepared by dissolving 50g of solid P in about 700cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of aqueous sodium sulphate supplied in
- one burette 0 – 50mls
- one pipette 25ml
- one pipette filler
- one thermometer -10 °C – 110 °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<sub>2</sub>O supplied with a dropper
- Phenolphthalein indicator supplied with a dropper
- Wall clock.

#### Preparations

- 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.
- Aqueous sodium sulphate is prepared by dissolving 10g of solid Na SO<sub>4</sub> Diluting with distilled water to one litre of solution
- Bromine water is prepared by diluting 1ml of liquid bromine with 100cm<sup>3</sup> of distilled water in a fume cupboard
- 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  $120\text{cm}^3$  of solution A.
- about  $120\text{cm}^3$  of solution B
- About  $100\text{cm}^3$  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 –  $10^\circ\text{C}$  –  $110^\circ\text{C}$
- 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  $2\text{cm}^3$  of solution G
- 1g of sodium carbonate (solid)
- one watch glass
- about  $5\text{cm}^3$  of solution H
- about  $10\text{cm}^3$  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  $50.0\text{cm}^3$  of  $1.84\text{g/cm}^3$  (98%) concentrated sulphuric acid in about  $600\text{cm}^3$  of distilled water and diluting to one litre of solution.
2. Solution B is prepared by dissolving 8.0g solid B in about  $500\text{cm}^3$  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  $400\text{cm}^3$  of distilled water and diluting to one litre of solution.
5. Solution H is prepared by dissolving 25g solid H in about  $600\text{cm}^3$  of 2M sulphuric acid and diluting to one litre of solution.

NB/ The test-tubes provided should have a capacity of at least  $15\text{cm}^3$ .

## 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<sup>3</sup> of solution B
- about 130cm<sup>3</sup> of sodium hydroxide solution
- one thermometer – 10 °C – 110 °C
- one stop watch/clock
- one 100ml beaker
- one burette 0 – 50ml
- one pipette 25ml
- one volumetric flask 250ml
- about 500cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> (1.18g/cm<sup>3</sup>) of concentrated hydrochloric acid to about 500cm<sup>3</sup> 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<sup>3</sup> of 2M sulphuric acid and diluting to one litre of solution.
3. Acid KMnO<sub>4</sub> 3.16 g in 500cm<sup>3</sup> of 2M H<sub>2</sub>SO<sub>4</sub> dilute to 1l.
4. NaOH \_\_\_\_\_ 4.0g \_\_\_\_\_ 700cm<sup>3</sup> H<sub>2</sub>O \_\_\_\_\_ 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 stoppered container.
- about 60cm<sup>3</sup> of solution G
- one 250ml volumetric flask
- one pipette, 250ml and a pipette filler

- one burette 0 – 50ml
- 2 labels
- about 120cm<sup>3</sup> 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<sup>3</sup> of distilled water supplied in a wash bottle
- one oiling tube
- one glass rod
- 0.5g solid F supplied in a stoppered container.
- 5cm<sup>3</sup> 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<sup>3</sup> of conc. HCl of density 1.18g/cm<sup>3</sup> in about 500cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of 2M H<sub>2</sub>SO<sub>4</sub> 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<sup>3</sup> of distilled water and stirring well in a well in an efficient fume cupboard.
5. Lead (II) nitrate is prepared by adding 30g of solid lead (II) nitrate in about 700cm<sup>3</sup> 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<sup>3</sup> of solution A labeled solution A
- About 150cm<sup>3</sup> of solution B labeled solution B
- About 80cm<sup>3</sup> of solution C labeled solution C
- One pipette 25.0ml
- One pipette filler
- One volumetric flask (250.0ml)
- Four labels
- About 500cm<sup>3</sup> of distilled water
- One burette 50.0ml
- Three conical flasks
- One 10ml measuring cylinder
- One 100ml measuring cylinder
- Two boiling tubes
- One thermometer -10<sup>0</sup> C to 110<sup>0</sup>C
- 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  $190.0\text{cm}^3$  of concentrated hydrochloric acid (Specific gravity 1.18) adding it to  $600\text{cm}^3$  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  $600\text{cm}^3$  of distilled water and diluting it to the mark. Label this as solution C
4. Bromine water is prepared by taking  $1\text{cm}^3$  of liquid bromine and dissolving it in  $100\text{cm}^3$  of distilled water in a fume cupboard. This must be freshly prepared and supplied in a dropper bottle
5. Acidified potassium manganate (VII) is prepared by dissolving 3.16g of solid potassium manganate (VII) in about  $600\text{cm}^3$  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  $80\text{cm}^3$  of solution B.
3. about  $200\text{cm}^3$  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.  $4\text{cm}^3$  of solution E in a test tube and labeled solution E.
16. about  $500\text{cm}^3$  of distilled water in a wash bottle
17. about  $10\text{cm}^3$  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

### October /November 2012

In addition to the apparatus and reagents found in a chemistry laboratory, each candidate will require the following:

1. about 150cm<sup>3</sup> of solution A
2. about 100cm<sup>3</sup> of solution B
3. about 45cm<sup>3</sup> of solution C
4. about 50cm<sup>3</sup> aqueous potassium iodide
5. about 60cm<sup>3</sup> of solution D
6. about 50cm<sup>3</sup> 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<sup>3</sup> of 2M hydrochloric acid
23. three 12.5cm whatman No. 1 filter papers
24. one filter funnel
25. one metallic spatula
26. about 500cm<sup>3</sup> 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<sup>3</sup> 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<sub>2</sub>S<sub>2</sub>O<sub>3</sub> · 5H<sub>2</sub>O) in about 800cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of distilled water and diluting to one litre of solution. Label this as potassium iodide.
5. Solution **D** is prepared by placing 10g of solid **D** in 1000cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of liquid bromine in 100cm<sup>3</sup> of distilled water and shaking well in a fume cupboard. Label this as bromine water.

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### October /November 2013

In addition to the apparatus and reagents found in a chemistry laboratory, each candidate will require the following:

1. about 80cm<sup>3</sup> of solution A
2. 1.60g of solid B weighed accurately and supplied in a stoppered container
3. about 100cm<sup>3</sup> of solution C
4. one burette 0 – 50.0 ml;
5. one 100ml beaker
6. one thermometer - 10<sup>0</sup> – 110<sup>0</sup>C
7. One stop watch/ clock;
8. one 250ml volumetric flask
9. One 10ml measuring cylinder
10. about 70cm<sup>3</sup> of 2M sulphuric acid (VI) acid
11. about 500cm<sup>3</sup> 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 in about 800cm<sup>3</sup> of distilled water and diluting to one 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<sup>3</sup> of 2M sulphuric (VI) acid followed by 700cm<sup>3</sup> 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<sub>1</sub> and 0.5 g of zinc carbonate putting both of them in one stoppered container and labeled solid E