

# CHEMISTRY PRACTICAL GUIDE; 2018 SERIES

## SPECIFIC OBJECTIVES OF CHEMISTRY PRACTICAL;

- To test if the student is able to select & handle apparatus for use in an experimental work
- To test if the student is able to use his/her theoretical understanding of chemistry to make accurate observations and draw conclusions from those observations
- To test if the student is able to make accurate measurements

## AREAS COMMONLY TESTED IN PRACTICAL;

- Qualitative analysis (organic & inorganic)
- Quantitative analysis
- Graphical work

### A) QUALITATIVE ANALYSIS

Refers to the process of carrying out chemical tests on substances with the sole aim of identifying them

### TO BE ABLE TO GET GOOD RESULTS;

- Accurately identify the test reagents
- Identify what these reagents test
- Predict the expected results

## I. INORGANIC

Test for cations (12 cations involved;  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{NH}_4^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Fe}^{2+}$  &  $\text{Fe}^{3+}$ )

### 1) Addition of NaOH drop wise until in excess

Observation	Inference
<ul style="list-style-type: none"><li>White precipitate, soluble in excess</li></ul> OR	$\text{Zn}^{2+}$ , $\text{Al}^{3+}$ , $\text{Pb}^{2+}$ <span style="float: right;"><del>ZAP</del></span>
<ul style="list-style-type: none"><li>White precipitate, insoluble in excess</li></ul> OR	$\text{Mg}^{2+}$ , $\text{Ca}^{2+}$
<ul style="list-style-type: none"><li>No white precipitate</li></ul> OR	$\text{Na}^+$ , $\text{K}^+$ , $\text{NH}_4^+$ present $\text{Zn}^{2+}$ , $\text{Al}^{3+}$ , $\text{Pb}^{2+}$ , $\text{Mg}^{2+}$ , $\text{Ca}^{2+}$ absent

<ul style="list-style-type: none"> <li>• Blue precipitate, insoluble in excess OR</li> <li>• Green precipitate, insoluble in excess OR</li> <li>• Brown precipitate, insoluble in excess</li> </ul>	<p><math>\text{Cu}^{2+}</math></p> <p><math>\text{Fe}^{2+}</math></p> <p><math>\text{Fe}^{3+}</math></p>
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**2) Addition of aq. Ammonia drop wise, until in excess**

Observation	Inference
<ul style="list-style-type: none"> <li>• White precipitate, soluble in excess OR</li> <li>• White precipitate, insoluble in excess OR</li> <li>• No white precipitate formed</li> </ul> <p>OR</p>	<p><math>\text{Zn}^{2+}</math></p> <p><math>\text{Al}^{3+}, \text{Pb}^{2+}, \text{Mg}^{2+}</math></p> <p><math>\text{Na}^+, \text{K}^+, \text{Ca}^{2+}</math></p> <p><math>\text{Zn}^{2+}, \text{Al}^{3+}, \text{Pb}^{2+}, \text{Mg}^{2+}</math> Absent</p>
<ul style="list-style-type: none"> <li>• Light blue precipitate, soluble in excess to give a deep blue solution OR</li> <li>• Green precipitate, insoluble in excess OR</li> <li>• Brown precipitate, insoluble in excess</li> </ul>	<p><math>\text{Cu}^{2+}</math></p> <p><math>\text{Fe}^{2+}</math></p> <p><math>\text{Fe}^{3+}</math></p>

**3) Dip a nichrome wire into the solution and burn in a non luminous flame (Flame test for cations)**

Observation	Inference
<ul style="list-style-type: none"> <li>• Burns with a yellow flame</li> </ul> <p>OR</p>	<p><math>\text{Na}^+</math></p>

<ul style="list-style-type: none"> <li>Burns with a red flame</li> </ul> <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> <li>Burns with a purple flame</li> </ul> <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> <li>Burns with a white flame</li> </ul>	$\text{Ca}^{2+}$  $\text{K}^{+}$  $\text{Mg}^{2+}$
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**4) Addition of three drops of  $\text{H}_2\text{SO}_4/\text{Na}_2\text{SO}_4/\text{K}_2\text{SO}_4$**

Observation	Inference
<ul style="list-style-type: none"> <li>White precipitate</li> </ul>	$\text{Ca}^{2+}$ , $\text{Ba}^{2+}$ , $\text{Pb}^{2+}$

**5) Addition three drops of  $\text{HCl}/\text{NaCl}/\text{KCl}$**

Observation	Inference
<ul style="list-style-type: none"> <li>White precipitate</li> </ul>	$\text{Pb}^{2+}$ , $\text{Ag}^{+}$

**6) Addition of two drops of potassium iodide**

Observation	Inference
<ul style="list-style-type: none"> <li>Yellow precipitate</li> </ul>	$\text{Pb}^{2+}$

TEST FOR ANIONS (SIX ANIONS;  $\text{SO}_4^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{CO}_3^{2-}$ ,  $\text{Cl}^-$ ,  $\text{NO}_3^-$  &  $\text{HCO}_3^-$ )

1) Addition of two drops of barium nitrate

Observation	Inference
<ul style="list-style-type: none"> <li>White precipitate</li> </ul>	$\text{SO}_4^{2-}$ , $\text{SO}_3^{2-}$ , $\text{CO}_3^{2-}$

2) Addition of two of drops of barium nitrate followed by five drops of nitric (V) acid

Observation	Inference
<ul style="list-style-type: none"> <li>White precipitate, dissolves upon addition of nitric (V) acid</li> <li>Bubbles of colourless gas produced</li> <li>OR</li> <li>White precipitate, insoluble upon addition of nitric (V) acid</li> </ul>	$\text{SO}_3^{2-}$ , $\text{CO}_3^{2-}$  $\text{SO}_4^{2-}$

3) Addition of two drops of acidified barium nitrate

Observation	Inference
<ul style="list-style-type: none"> <li>White precipitate.</li> </ul>	$\text{SO}_4^{2-}$

**4) Addition of three drops of lead (II) nitrate**

<b>Observation</b>	<b>Inference</b>
<ul style="list-style-type: none"><li>White precipitate.</li></ul>	$\text{SO}_4^{2-}$ , $\text{SO}_3^{2-}$ , $\text{CO}_3^{2-}$ , $\text{Cl}^-$

**5) Addition of two drops of lead (II) nitrate followed by five drops of nitric (V) acid**

<b>Observation</b>	<b>Inference</b>
<ul style="list-style-type: none"><li>White precipitate, soluble on addition of nitric (V) acid.</li></ul>	$\text{SO}_3^{2-}$ , $\text{CO}_3^{2-}$
<ul style="list-style-type: none"><li>Bubbles of colourless gas</li></ul> <p style="text-align: center;">OR</p> <ul style="list-style-type: none"><li>White precipitate, insoluble upon addition of nitric (V) acid</li></ul>	$\text{SO}_4^{2-}$ , $\text{Cl}^-$

**6) Addition of two drops of lead (II) nitrate, followed by worming**

<b>Observation</b>	<b>Inference</b>
<ul style="list-style-type: none"><li>White precipitate, soluble upon worming</li></ul> <p style="text-align: center;">OR</p>	$\text{Cl}^-$
<ul style="list-style-type: none"><li>White precipitate, insoluble upon worming</li></ul>	$\text{SO}_4^{2-}$ , $\text{SO}_3^{2-}$ , $\text{CO}_3^{2-}$

**7) Addition of two drops of acidified lead (II) nitrate**

<b>Observation</b>	<b>Inference</b>
<ul style="list-style-type: none"><li>• White precipitate</li></ul>	$\text{SO}_4^{2-}$ , $\text{Cl}^-$

**8) Addition of two drops of acidified potassium dichromate (VI)**

<b>Observation</b>	<b>Inference</b>
<ul style="list-style-type: none"><li>• Bubbles of colourless gas,</li><li>• Colour of <math>\text{H}^+/\text{K}_2\text{Cr}_2\text{O}_7</math> turns from orange to green</li></ul> <p style="text-align: center;">OR</p> <ul style="list-style-type: none"><li>• Bubbles of colourless gas</li><li>• <math>\text{H}^+/\text{K}_2\text{Cr}_2\text{O}_7</math> retains its orange colour</li></ul>	$\text{SO}_3^{2-}$  $\text{CO}_3^{2-}$

9) Take about  $\frac{1}{2}$  of the solid provided into a dry test tube and heat it gently then strongly

Observation	Inference
<ul style="list-style-type: none"> <li>Colourless liquid formed on upper cooler parts of the test tube</li> </ul>	The solid is hydrated
<ul style="list-style-type: none"> <li>Blue litmus paper turns red and red litmus paper remains red</li> </ul>	Acidic gas produced
<ul style="list-style-type: none"> <li>Red litmus paper turns blue &amp; blue litmus paper remains blue</li> </ul>	$\text{NH}_4^+$
<ul style="list-style-type: none"> <li>Bubbles of colourless gas that blows of a burning splint</li> </ul>	$\text{CO}_3^{2-}/\text{HCO}_3^-$
<ul style="list-style-type: none"> <li>Brown fumes</li> </ul>	$\text{NO}_3^-$
<ul style="list-style-type: none"> <li>Relights a glowing splint</li> </ul>	$\text{NO}_3^-$
<ul style="list-style-type: none"> <li>Residue white when cold &amp; yellow when hot</li> </ul>	ZnO formed
<ul style="list-style-type: none"> <li>White solid formed on cooler parts of test tube</li> </ul>	Contains a solid that sublime

10) Put the solid into a boiling tube, add about 10ml of distilled water and shake

Observation	Inference
<ul style="list-style-type: none"> <li><b><u>Dissolves</u></b> to form a <b><u>colourless</u></b> solution</li> </ul>	The solid is <b>soluble</b> in water $\text{Cu}^{2+}$ , $\text{Fe}^{2+}$ , $\text{Fe}^{3+}$ absent

11) Put the solid into a boiling tube, add water, shake then filter

Observation	Inference
<ul style="list-style-type: none"> <li>Partially dissolves to form a <b>white residue</b> and a <b>Colourless</b> filtrate</li> </ul>	<p>The solid is a mixture of <b>soluble</b> and <b>insoluble</b> salts.</p> <p><math>\text{Cu}^{2+}</math>, <math>\text{Fe}^{2+}</math>, <math>\text{Fe}^{3+}</math> absent both in the residue &amp; in the filtrate</p>

12) Transfer the residue from filter paper using a spatula into a boiling tube, add about 2 ml of nitric (V) acid

Observation	Inference
<ul style="list-style-type: none"> <li>Bubbles of colourless gas</li> <li>The solid dissolves</li> </ul>	$\text{SO}_3^{2-}$ , $\text{CO}_3^{2-}$

## II. ORGANIC

1) Put the solid in a metallic spatula and burn it in a Bunsen burner flame

Observation	Inference
<ul style="list-style-type: none"> <li>Melts,</li> <li>Burns with a blue non sooty flame</li> </ul> <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> <li>Melts,</li> <li>Burns with a yellow/sooty flame</li> </ul> <p><b>NB;</b> Melts is not a must to be observed, only if it is observed</p>	$\begin{array}{c}   \quad   \\ \text{C}=\text{C} \\   \quad   \end{array} / \begin{array}{c} \text{C} \\ \text{C} \\   \end{array}$ absent  $\begin{array}{c}   \quad   \\ \text{C}=\text{C} \\   \quad   \end{array} / \begin{array}{c} \text{C} \\ \text{C} \\   \quad   \end{array}$



2) Put 4 drops of the liquid on a watch glass and burn it

Observation	Inference
<ul style="list-style-type: none"> <li>Burns with a blue non sooty flame</li> </ul> <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> <li>Burns with a yellow sooty flame</li> </ul>	$\begin{array}{c}   \quad   \\ \text{C}=\text{C} / \quad \text{C}\equiv\text{C} \text{ absent} \\   \quad   \quad   \quad   \\ \text{C}=\text{C} / \quad \text{C}\equiv\text{C} \\   \quad   \quad   \quad   \end{array}$

3) Put the liquid in a boiling tube, add water then shake

Observation	Inference
<ul style="list-style-type: none"> <li>Miscible, forming uniform solution</li> </ul>	Polar organic compound

4) Put the solid into a boiling tube, add about 10 ml of distilled water and shake

Observation	Inference
<ul style="list-style-type: none"> <li><u>Dissolves</u> to form a <u>colourless</u> solution</li> </ul>	Polar organic compound

5) Put the solid into a boiling tube, add ethanol & shake

Observation	Inference
<ul style="list-style-type: none"> <li><u>Dissolves</u> to form a <u>colourless</u> liquid</li> </ul>	Polar organic compound

6) Determine the pH of the solution provided (Use of universal indicator)

Observation	Inference
<ul style="list-style-type: none"> <li>• pH=6.5</li> </ul>	Weakly acidic
<b>OR</b>	
<ul style="list-style-type: none"> <li>• pH=7</li> </ul>	Neutral
<b>OR</b>	
<ul style="list-style-type: none"> <li>• pH=2</li> </ul>	Strongly acidic
<b>OR</b>	
<ul style="list-style-type: none"> <li>• pH=8</li> </ul>	Weakly alkaline
<b>OR</b>	
<ul style="list-style-type: none"> <li>• pH=14</li> </ul>	Strongly alkaline
	<p><b>NB;</b> 4 to 6.5 is weakly acidic, 1 to 3 is strongly acidic, 8 to 10 is weakly alkaline &amp; 11 to 14 is strongly alkaline. This will help you with other pH values that have not been included under the observation column</p>

7) Add 4 drops of acidified potassium manganate (VII)

Observation	Inference
<ul style="list-style-type: none"> <li>• Purple potassium manganate (VII) is decolorized</li> </ul>	$\begin{array}{c}   \quad   \\ \text{C}=\text{C} \\   \quad   \end{array} / \begin{array}{c} \text{C}\equiv\text{C} \\   \quad   \end{array}, \text{R-OH}$

**8) Add 4 drops of acidified potassium dichromate (VI)**

Observation	Inference
<ul style="list-style-type: none"><li>Potassium dichromate (VI) turns from orange to green</li></ul>	R-OH  NB; used for testing for R-OH, not for double and triple bonds

**9) Addition of 4 drops of bromine water**

Observation	Inference
<ul style="list-style-type: none"><li>Bromine water is decolorized</li></ul>	$\begin{array}{c}   &   \\ \text{C}=\text{C} & / & \text{C}\equiv\text{C} \\   &   &   &   \end{array}$

**10) Add the solid Na<sub>2</sub>CO<sub>3</sub>/NaHCO<sub>3</sub> provided into the solution**

Observation	Inference
<ul style="list-style-type: none"><li>Bubbles of colourless gas produced</li></ul>	H <sup>+</sup> /R-COOH

# CURRENT TRENDS IN SETTING

1) (Compiled from Nyakach girls Chemistry contest 2018 edition)

**You are provided with;**

- Solid Q suspected to be **Zinc Sulphate**
- 2 M Sodium hydroxide solution
- 2 M Aqueous ammonia
- 2 M Nitric (V) acid
- 0.5 M Barium Chloride solution
- Distilled water

(a) Using the provided chemicals, write down three tests and expected observations to completely confirm the identity of solid Q

**(i) Test 1**

Put solid Q into a boiling tube, add 10 ml of distilled water, then shake to dissolve solid Q. Divide the solution formed into 3 portions; To the 1<sup>st</sup> portion, add sodium hydroxide drop wise until in excess

**Expected observation(s)**

White precipitate, soluble in excess

**(ii) Test 2**

To the 2<sup>nd</sup> portion, add aqueous ammonia drop wise until in excess

**Expected observation(s)**

White precipitate, soluble in excess

**(iii) Test 3**

To the 3<sup>rd</sup> portion, add two drops of barium chloride, followed by about 10 ml of nitric (V) acid

**Expected observation(s)**

White precipitate formed upon adding barium chloride, the white precipitate do not dissolve when acid is added

**2) You are provided with;**

- Solid R suspected to be **Aluminium Chloride**
- 2 M Sodium hydroxide solution
- Sodium Carbonate solution
- 0.5 M Lead (II) nitrate
- 0.2 M Barium Nitrate
- Distilled water

(b) Using the provided chemicals, write down four tests and expected observations to completely confirm the identity of solid R

**(i) Test 1**

Put solid R into a boiling tube, add 10 ml of distilled water, then shake to dissolve solid R. Divide the solution formed into 4 portions; To the 1<sup>st</sup> portion, add sodium hydroxide drop wise until in excess

**Expected observation(s)**

White precipitate, soluble in excess

**(ii) Test 2**

To the 2<sup>nd</sup> portion, add two drops of Sodium carbonate

**Expected observation(s)**

No white precipitate formed

**(iii) Test 3**

To the 3<sup>rd</sup> portion, add two drops of Lead (II) nitrate

**Expected observation(s)**

White precipitate is formed

**(iv) Test 4**

To the 4<sup>th</sup> portion, add two drops of barium nitrate

**Expected observation(s)**

No white precipitate is formed

**3) You are provided with;**

- Solid S suspected to be **Zinc Sulphate**
- 2 M Aqueous ammonia
- Lead (II) nitrate solution
- 2 M Nitric (V) acid
- Barium Nitrate solution
- Distilled water

(a) Using the provided chemicals, write down three tests and expected observations to completely confirm the identity of solid S

**(i) Test 1**

Put solid S into a boiling tube, add 10 ml of distilled water, then shake to dissolve solid S. Divide the solution formed into 3 portions; To the 1<sup>st</sup> portion, add aqueous ammonia drop wise until in excess

**Expected observation(s)**

White precipitate, soluble in excess

**(ii) Test 2**

Add two drops of lead (II) nitrate

**Expected observation(s)**

White precipitate

**(iii) Test 3**

Add two drops of barium nitrate followed by about 10 ml of nitric (V) acid

**Expected observation(s)**

White precipitate, insoluble when acid is added

**4) You are provided with;**

- Solid T suspected to be **Lead (II) nitrate**
- 2 M Sodium hydroxide solution
- Sodium Chloride solution
- Aluminium foil
- Red and blue litmus papers
- Distilled water
- Test tube holder
- Source of heat

(a) Using the provided chemicals, write down three tests and expected observations to completely confirm the identity of solid T

**(i) Test 1**

Put solid T into a boiling tube, add 10 ml of distilled water, then shake to dissolve solid T. Divide the solution formed into 3 portions; To the 1<sup>st</sup> portion, add sodium hydroxide drop wise until in excess

**Expected observation(s)**

White precipitate, soluble in excess

**(ii) Test 2**

To the 2<sup>nd</sup> portion, add two drops of sodium chloride

**Expected observation(s)**

White precipitate formed

**(iii) Test 3**

To the 3<sup>rd</sup> portion, add 6 drops of NaOH, drop a piece of aluminium foil into the mixture then heat to boil and test any gas produced using litmus papers

**Expected observation(s)**

Bubbles of colourless gas. Red litmus paper turns blue and blue litmus remains blue

**NB; The theory behind test 3; aluminium foil reduces  $\text{NO}_3^-$  to  $\text{NH}_4^+$  then  $\text{NH}_4^+$  formed reacts with NaOH to produce  $\text{NH}_3$  (KCSE 2012)**

**5) You are provided with;**

- Solid U suspected to be **Magnesium Sulphate**
- 2 M Sodium hydroxide solution
- 2 M Aqueous ammonia
- 0.5 M Barium Nitrate solution
- 2 M Nitric (V) acid
- Distilled water

(a) Using the provided chemicals, write down three tests and expected observations to completely confirm the identity of solid U

**(i) Test 1**

Put solid U into a boiling tube, add 10 ml of distilled water, then shake to dissolve solid U. Divide the solution formed into 3 portions; To the 1<sup>st</sup> portion, add sodium hydroxide drop wise until in excess

**Expected observation(s)**

White precipitate, insoluble in excess

**(ii) Test 2**

To the 2<sup>nd</sup> portion, add aqueous ammonia drop wise until in excess

**Expected observation(s)**

White precipitate, insoluble in excess

**(iii) Test 3**

To the 3<sup>rd</sup> portion, add 2 drops of barium nitrate followed by addition of about 10 ml of nitric (V) acid

**Expected observation(s)**

White precipitate formed which do not dissolve when the acid is added

NB; Forget about barium when using NaOH and aqueous ammonia drop wise until in excess, a mention of  $Ba^{2+}$  will be treated as a contradictory ion (Refer KCSE 2015). This will help test 1 be easier to understand.

6) (Compiled from KCSE 2017)

**You are provided with;**

- Solid V suspected to be **Lead (II) carbonate**
- Aqueous sodium sulphate
- 2 M Aqueous ammonia
- 2 M Nitric (V) acid
- Wooden splint

(a) Using the provided chemicals, write down three tests and expected observations to completely confirm the identity of solid V

**(i) Test 1**

To solid V in a boiling tube, add about 5 ml of nitric (V) acid and test for any gas produced using a burning splint. Divide the solution formed into 2 portions for tests 2 and 3 below

**Expected observation(s)**

Bubbles of colourless gas produced,  
Burning splint goes off

**(ii) Test 2**

To the 1<sup>st</sup> portion, add ammonia solution drop wise until in excess

**Expected observation(s)**

White precipitate insoluble in excess

**(iii) Test 3**

To the 2<sup>nd</sup> portion, add 2 drops of sodium sulphate

**Expected observation(s)**

White precipitate formed

7). (An exam sample; for inorganic compounds)

**You are provided with**

- Solid Y, 0.5 g
- Sodium hydroxide
- Aqueous ammonia
- Solution F; aqueous lead (II) Nitrate
- Distilled water in wash bottle
- Source of heat

a) Describe the appearance of solid Y

(1 mk)

- ✓ Colourless crystals

b) Add about 10 cm<sup>3</sup> distilled water to substance Y in a boiling tube and shake

Observation	Inference
Dissolves to form a colourless solution (1/2 mk)	Solid Y is soluble in water (1/2 mk)

c) Substance Y is suspected to be **calcium chloride**

From the reagents provided and results in procedure (b) above select and describe **three** tests that could be carried out consecutively to confirm whether substance Y is indeed calcium chloride. Write the tests and expected observations in the spaces provided.

**Test 1**

Description of test	Expected observation
Divide the solution formed in (b) into 3 portions; To the 1 <sup>st</sup> portion, add sodium hydroxide drop wise until in excess (1mk)	White precipitate, insoluble in excess  (1mk)

**Test 2**

Description of test	Expected observation
To the 2 <sup>nd</sup> portion, add ammonia solution drop wise until in excess  (1mk)	No white precipitate is formed  <b>NB; Don't think about barium ions when using NaOH &amp; Aq. Ammonia solutions until in excess</b>  (1mk)

**Test 3**

Description of test	Expected observation
To the 3 <sup>rd</sup> portion, add 2 drops of lead (II) nitrate followed by warming  (1mk)	White precipitate that dissolves upon warming  (1mk)



- d) Carry out the tests described in (c) above using substance Y and record the observations and inferences in the spaces provided.

**NB;** Remember that you were told that the solid is **suspected** to be  $\text{CaCl}_2$ , this gives room for it to be something else as well. Let's therefore assume that the actual salt that was provided was  $\text{MgCl}_2$

i) **Test 1**

Observation	Inference
White precipitate, insoluble in excess (1 mk)	$\text{Mg}^{2+}$ , $\text{Ca}^{2+}$ (1mk)

ii) **Test 2**

Observation	Inference
White precipitate, insoluble in excess (1 mk)	$\text{Mg}^{2+}$ (1mk)

iii) **Test 3**

Observation	Inference
White precipitate that dissolves upon warming (1mk)	$\text{Cl}^-$ (1mk)

**8). You are provided with the following to use in this question;**

- Solid X
- Bromine water
- Distilled water
- Acidified potassium dichromate (VI) solution

Solid X is suspected to be a **polar saturated alkanol**

- a) Describe three consecutive tests you would carry out to confirm whether solid X is a polar saturated alkanol

**(i) Test 1**

Place solid X into a boiling tube, add 5ml of distilled water and shake

**(ii) Test 2**

To a portion of the solution formed in test 1, add 4 drops of bromine water

**(iii) Test 3**

To another portion of the solution formed in test 1, add 4 drops of acidified potassium dichromate (VI) solution

**Expected observation(s)**

Solid X dissolves forming a colourless solution

**Expected observation(s)**

Bromine water is not decolorized

**Expected observation(s)**

Acidified potassium dichromate (VI) solution turns from orange to green

**9). You are provided with the following to use in this question;**

- Solid W
- Bromine water
- Distilled water
- Solid sodium carbonate

Solid W is suspected to be a **polar unsaturated alkanolic acid**

b) Describe three consecutive tests you would carry out to confirm whether solid W is a polar unsaturated alkanolic acid.

**(i) Test 1**

Place solid W into a boiling tube, add 5ml of distilled water and shake

**(ii) Test 2**

To a portion of the solution formed in test 1, add 4 drops of bromine water

**(iii) Test 3**

To another portion of the solution formed in test 1, add solid sodium carbonate

**Expected observation(s)**

Solid W dissolves forming a colourless solution

**Expected observation(s)**

Bromine water is decolorized

**Expected observation(s)**

Bubbles of colourless gas produced

**10). (Full exam format. Compiled from KISIOMI Chemistry joint examinations; 2018)**

**You are provided with the following to use in this question;**

- Solid Z
- Bromine water
- Distilled water
- Acidified Potassium manganate (VII) solution

Solid Z is suspected to be a **polar unsaturated organic compound**

(a) Describe three consecutive tests you would carry out to confirm whether solid Z is polar and unsaturated.

i) **Test 1**

Description of Test	Expect Observation
Place solid Z into a boiling tube, add 5ml of distilled water and shake (1/2mk)	Solid Z dissolves forming a colourless solution (1/2mk)

ii) **Test 2**

Description of Test	Expect Observation
To a portion of the solution formed in test 1, add 4 drops of acidified potassium manganate (VII) (1mk)	potassium manganate (VII) is decolourized (1mk)

iii) **Test 3**

Description of Test	Expect Observation
To another portion of the solution formed in test 1, add 4 drops of bromine water (1/2mk)	Bromine water is decolourized (1/2mk)

(b) Carry out the tests outlined in part (a) and record the observations and inferences

i)

Test 1	Observation	Inferences
	Solid Z dissolves forming a colourless solution (1/2mk)	Polar organic compound (1/2mk)

(ii)

Test 2	Observation	Inferences
	Potassium manganate (VII) decolourizes (1/2mk)	$\begin{matrix}   &   \\ \text{C}=\text{C} & / & \text{C}^{\ominus}=\text{C}, \text{R-OH} \end{matrix}$ (1mk)

(iii)

Test 3	Observation	Inferences
	Bromine water decolourized  (1mk)	$\begin{array}{c}   &   \\ \text{C}=\text{C} & / & \text{C}=\text{C} \\   &   &   &   \end{array}$ (1mk)

## QUANTITATIVE ANALYSIS

### CALCULATIONS

#### CONDITIONS;

- Students **MUST** transfer the values intact, that is, if the answer above is to 4 d.p. and should be used in the subsequent working, therefore the student cannot round it off in the air and use it when it is now 3 d.p
- Answers to at least 4 decimal places is OK either rounded off or truncated (chopped off)
- Presenting two **different** workings attracts full penalty on that particular question
- RAM & RFM should not have units on the answer

### GRAPH WORK

#### CONDITIONS;

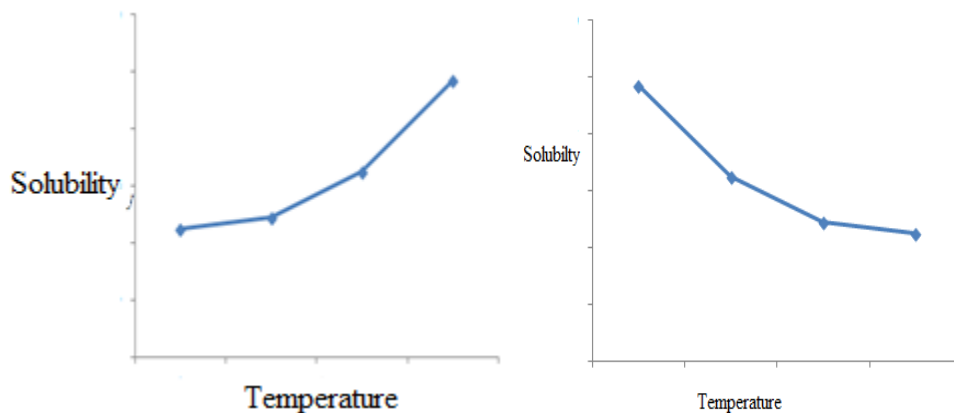
- The scale chosen should be able to accommodate all the points in the table and it should have consistent scale intervals
- Label, units are not necessary as units would attract penalties e.g., just stating Time is sufficient, not a must to state Time (**seconds**)
- Scale should be big enough to cover at least  $\frac{1}{2}$  of the grid provided, that is, the student should ensure that he/she uses at least  $\frac{1}{2}$  of the big boxes on the vertical & on the horizontal axes
- Students should avoid committing zero at the origin; it is safer that way
- Total coincidence of ruler with grid lines when doing y- and x-axes lines, extra keenness.
- Points should be plotted intact ie, as they appear on the table
- The curve/line should pass through the initial plot, as this was the first experiment done under a lot of purity.
- Use broken lines when reading from a graph
- Temperature graphs (temperature axis) are normally broken but not  $\Delta T$  graphs.

# SOLUBILITY & SOLUBILITY CURVES

**Solubility;** Maximum mass of solute required to saturate 100 g of solvent at a given temperature

Solubility curve; a graph of solubility against temperature for a particular solute

## EXPECTED SHAPES FOR SOLUBILITY CURVES;



### NB;

- i. Do a curve of best fit, don't use a ruler & don't look for points
- ii. No extrapolation of a curve (don't extend a curve)
- iii. Temperature values in the table of whole numbers are better than 1dp

# ENERGY CHANGES (THERMOCHEMISTRY)

## TABLE FOR THERMOMETER READINGS

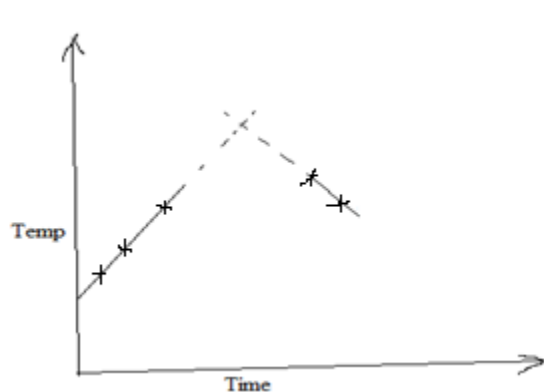
- Thermometer readings of whole numbers are convenient and safe

### 1) ENTHALPY OF SOLUTION

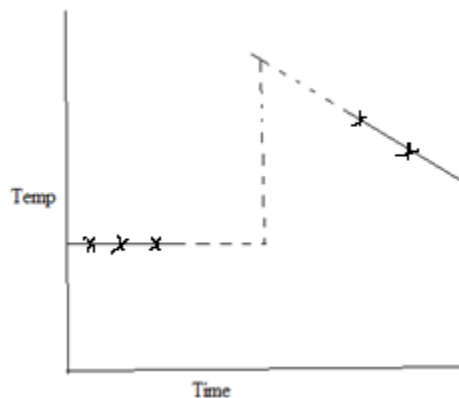
**Definition;** the enthalpy change that occurs when one mole of a substance completely dissolves in water

## EXPECTED SHAPES FOR ENTHALPY OF SOLUTION

### a) For exothermic processes



When no break in temperature readings



When there is break in temperature readings

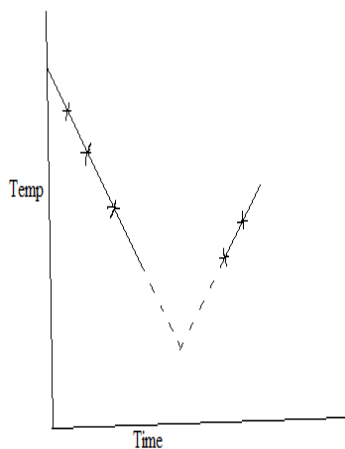
### TABLE WITH A BROCKEN READING

Time (Min)	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Temp (°C)	26	26	26	26	<del>26</del>	29	30	31	32	33	33	32	31

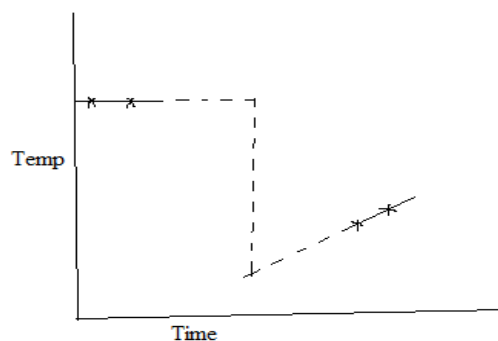
### TABLE WITHOUT A BROCKEN READING

Volume of solution B (cm <sup>3</sup> )	0	5	10	15	20	25	30	35	40	45	50
Temp (°C)	24.0	24.5	25.0	25.5	26.0	26.5	26.5	26.5	26.0	25.5	25.0

### b) For endothermic processes



When no break in temperature readings



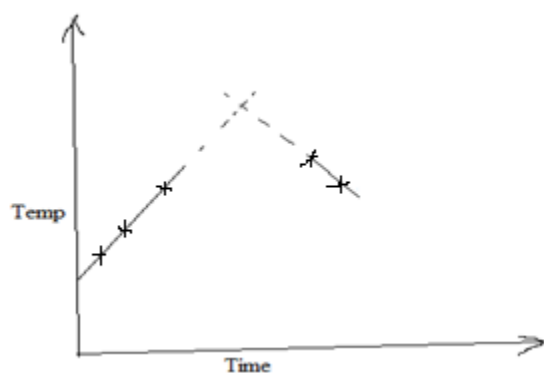
When there is a break in temperature readings

## 2) ENTHALPY OF DISPLACEMENT

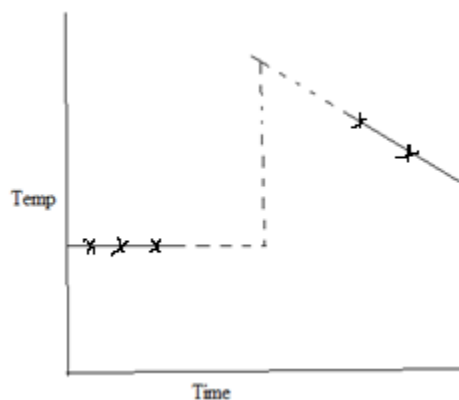
**Definition;** the enthalpy change that occurs when one mole of a substance is displaced from a solution of its ions

## EXPECTED SHAPES FOR ENTHALPY OF DISPLACEMENT

### a) For exothermic processes

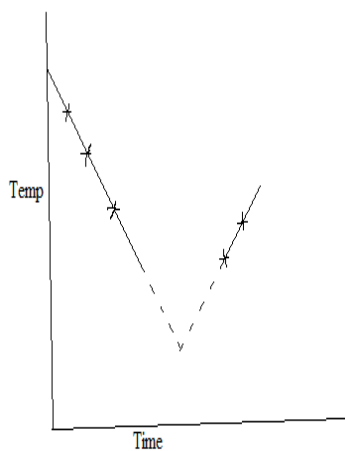


When no break in temperature readings

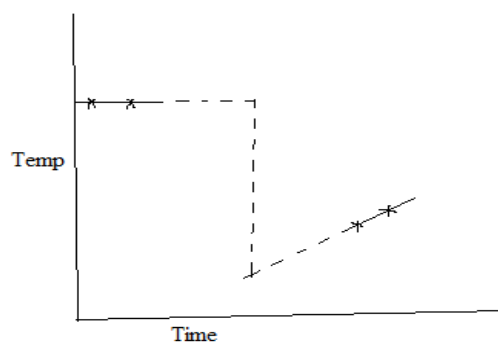


When there is break in temperature readings

### b) For endothermic processes



When no break in temperature readings

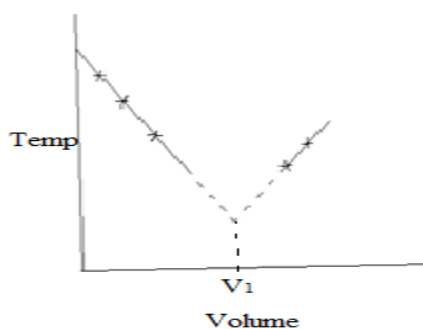
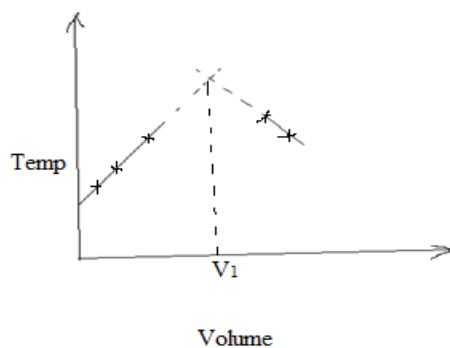


When no break in temperature readings

## 3) ENTHALPY OF NEUTRALIZATION

**Definition;** the enthalpy change that occurs when one mole of  $H^+$  ion from an acid is completely neutralized by an alkali to form one mole of water

## EXPECTED SHAPES FOR ENTHALPY OF NEUTRALIZATION



For exothermic processes

For endothermic processes

**NB;**  $V_1$  is the volume of the acid/base that completely neutralize the other

$$\Delta H = mc\Delta T$$

## RATES OF REACTION;

**Definition;** Change in concentration of reactants/products per unit time

### RATES TABLE

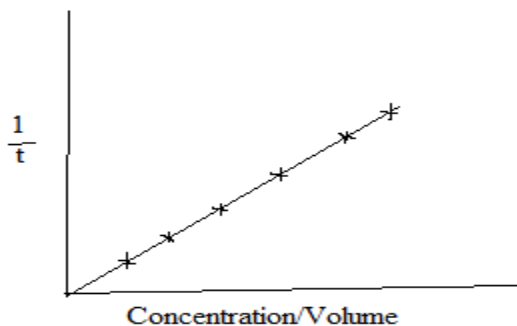
- Time readings of whole numbers are better than 1 or 2 dp readings
- $\frac{1}{t}$  values should be to 3 dp & consistent unless for cases where values work out to less than 3 dp
- Temperature or time readings in the table must either increase or decrease continuously

### EXPECTED SHAPES FOR RATES

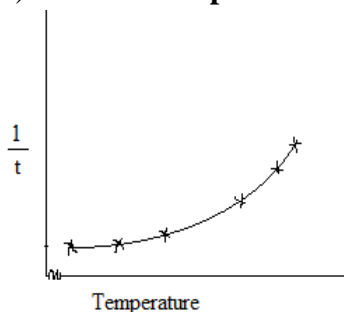
The shape can either be a straight line or a smooth curve depending on the quantities being plotted

e.g,

- (i) **Effect of concentration on the rate of reaction is a straight line from origin**



- (ii) **Effect of temperature on the rate of reaction is a smooth curve**



COMPILED BY ABUNA O. D