CHEMISTRY FACILITITATION

PRESENTATION ON

OPTIMIZING CHEMISTRY PRACTICAL PERFORMANCE

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A JOURNERY THROUGH THE MIND OF EXAMINER

TEACHERS EDITION

CONTENT OF PRESENTATION

1. Examinable areas (in-depth analysis)
2. Anomalies and gaps between practical and theory
3. Currents dynamics and emerging trends in setting and marking of paper chemistry 3
4. Common errors by students
5. Teachers effects in handling practical examinations
6. Advise to Teachers

KCSE 2019 FEED BACK

1. Moi high school kabaraka 9.9
2. Alliance high school 9.78
3. Strathmore 9.6
4. Alliance girls 9.4
5. Moi tea girls 9.4
6. Mangu high sch 9.32
7. Kiage tumaini academy 9.2
8. Memon academy 9.02

SCHOOLS WITH MORE THAN 100 A PLAINS

ALLIANCE HIGH SCH 143

ALLIANCE GIRLS HIGH 105

KABARAKA 102

PILLARS OF CHEMISTRY

1. Reactivity Series
2. First 20 Elements
3. Solublity Of Salts
4. The Mole
5. Organic Chemistry

ANALYSIS OF KCSE PERFORMANCE FROM 2006

year	P1	P2	**P3**	total
2006	20.78	17.56	**11.48**	49.52
2007	19.67	19.22	**11.87**	50.78
2008	18.28	15.74	**11.46**	45.49
2009	12.49	14.93	**10.86**	38.23
2010	18.78	16.19	**14.87**	49.79
2011	18.43	16.99	**11.91**	47.31
2012	22.36	17.18	**16.34**	55.86
2013	16.68	18.31	**14.67**	49.00
2014	25.44	21.33	**17.57**	64.31
2015	25.83	22.07	**20.37**	68.27
2016	19.15	14.66	**13.63**	47.42
2017	17.03	17.97	**14.10**	48.09

PRACTICAL EXAM IN CHEMISTRY CLEARLY AIMS AT TESTING WHETHER THE LEARNER HAS ACQUIRED THE FOLLOWING:

- Appropriate manipulative skills.
- Skills in making accurate observations and accurate recording of results.
- Ability to analyze and interpret scientific data.
- Ability to follow a sequence of instructions and carry out experiments
- Ability to **RECALL AND DESCRIBE** a sequence of instructions and carry out experiments

THE FOLLOWING ARE THE MAJOR AREAS WHICH CAN BE TESTED IN CHEMISTRY PRACTICAL.

1. Heating/cooling curve e.g. heating naphthalene refer KCSE 2005
2. Qualitative analysis-test for cations/anions (a must)
3. Qualitative analysis-Organic test(a must)
4. Rate of reaction refer to KCSE1992,1999, 2002, 2012,2016
5. Thermochemistry1989,1994,1995,1997,2000,2001, 2003,2004,2005,2007,2008,2010,2013,2014,2017,2018
6. Solubility 2006,2015
7. Titration (a must) except 1995,2002.2005 and 2016

233/3 ANALYSIS

P3 ANALYSIS	
Year	TOTAL MARKS ON TABLES, GRAPHS AND CORRECT OBSERVATIONS
2000	23
2001	24
2002	19
2003	$15^{1}/_{2}$
2004	22
2005	22
2006	23
2007	$22^{1}/_{2}$

2008	20
2009	21
2010	23
2011	22
2012	24
2013	22
2014	21
2015	23
2016	23
2017	22

TITRATION

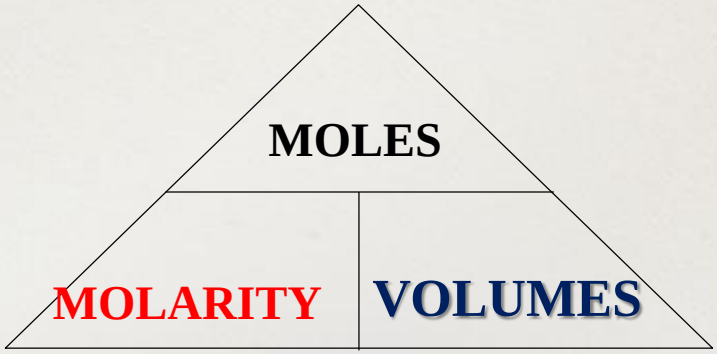
TYPES OF TITRATION:

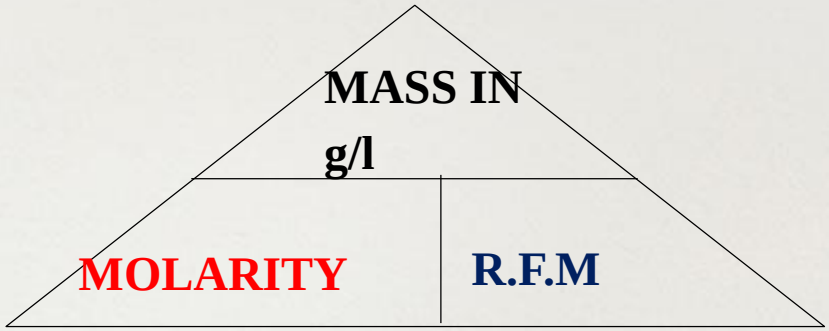
a) **Direct Titration:** Substance is directly titrated with titrant by using simple indicator.
Example: titration of strong acid (HCl, HNO_3) with strong base (NaOH, KOH).

b) **Indirect Titration:** Substance is not directly titrated but precipitated or removed from the reaction and the product formed has to be titrated

c) **Back Titration** A titration analysis which involves the **reaction of a given amount of a sample with a given volume of known concentration (or Molarity) which is in excess then the excess is titrated against a standard solution** is referred to as back titration. Refer to **KCSE** 2011

FORMULAE FOR CALCULATING MOLES





Any formula can be derived from the formula above as shown below

REACTION	MOLE RATIO
$NaOH + HCl$	1:1
$2NaOH + H_2SO_4$	2:1
$3NaOH + H_3PO_4$	3:1
$2NaOH + H_2A$	2:1
$3NaOH + H_3A$	3:1
$Ca(OH)_2 + 2HCl$	1:2
$Ca(OH)_2 + H_2SO_4$	1:1
$MCO_3 + 2HCl$	1:2
$Na_2CO_3 + 2\ HCL$	1:2
$Na_2CO_3 + H_2SO_4$	1:1
$Na_2G.10H_2O + 2HCl$	1:2
$Na_2G.10H_2O + H_2SO_4$	1;1
$Na_2B_4O_{7.}10H_2O + 2HCl$	1;2
$2NaOH + H_2C_2O_4$	2;1

FILLING TITRATION TABLE 1.....5MKS

THE MARKS ARE DISTRIBUTED AS FOLLOWS

a) COMPLETE TABLE..... 1 MK

b) USE OF DECIMALS…….. 1 MK

c) ACCURACY …….. 1 MK

d) PRINCIPLE OF AVERAGING….. 1 MK

e) FINAL ACCURACY …….. 1 MK

NOTES:

- Calculations involving moles should be given in at least 4 decimal places
- Calculations for molarity should be given in at least 3 decimal places
- Units are not necessary but if given they must be correct ,wrong units penalized $\frac{1}{2}$ a mark
- R.F.M and R.A.M have no units (this is a common mistake with most students stating them in grams]
- Units mass in grams per litre is g/l NOT g/ L

PRACTICAL SUMMARY NOTES QUALITATIVE ANALYSIS

QUALITATIVE ANALYSIS

In qualitative analysis this practical will require a candidate to be able to identify or test for cations and anions in inorganic qualitative analysis. In qualitative analysis you look for;

a) What **you hear** i.e the sound produced e.g. a cracking sound.

b) What **you see**; the colour of the product, precipitate, colour of filtrate, colour of residue, colour of the gas produced, Colour of the sublimate, the colour of the liquid formed when a vapour condenses, effervescence, effect on red and blue litmus papers/universal indicator, glass rod dipped in 2MHCl. Effect on burning or glowing wooden splint,anhydrous colbalt (II) chloride paper, colour of solution

c) What **you smell;** e.g. a choking irritating smell, a pleasant smelling compound, odourless gas etc.

d) Describe the tests to test for cations (the emerging trends)

PRELIMINARY TESTS

These are the initial test in a chemistry practical question. The initial test on chemistry practical are summarized below

a)Heating – in a boiling tube; here you look for gas produced, its color, smell, and effect on blue and red litmus paper. You also look for the sound produced, does the solid melt, the colour of the residue, you look for water of crystallization. Or even a sublimate

NB

a) When told to heat gently you are only looking for the water of crystallization (which can be tested using blue dry cobalt (II) chloride paper which turns pink)

b) When told to heat strongly you are looking for gases evolved (test them with litmus papers or wooden splint), colour of residue, sublimate etc.

POSSIBLE RESULTS

Observations	Inferences
A colourless vapour that condenses on the cooler parts of test-tube to form a colourless liquid, or blue dry cobalt (II) chloride paper turns pink	Hydrated salt/water of crystallization present
A gas that that turns a moist red litmus paper blue and no effect on blue litmus paper	NH_4^+ present
A gas that that turns a moist red litmus paper blue and a blue litmus paper red, White sublimate formed on cooler parts of the test-tube	NH_4^+ present Reasoning NH_4Cl decomposes on heating to NH_3 and HCl gases,NH_3 is lighter and diffuses faster Hence the litmus first turns from red to blue, and later the HC l reaches the upper end of test-tube and turns blue litmus red

POSSIBLE RESULTS.....Contd

The solid melts, brown gas is evolved, Cracking sound, yellow residue remained	**NO_3^-, Pb^{2+}**
A colourless gas is evolved which relights a glowing splint and no effect on both red and litmus papers	**ClO_3^-,NO_3^-,MnO_4^-,O^{2-} Neutral substance** **✓ Tied to no effects on litmus paper** **✓ Tied to a gas that relights a glowing splint**
A colourless ,odourless gas that extinguishes a burning splint is produced	**CO_3^{2-} produced**
A colourless gas is evolved the will turn a filter paper soaked in potassium chromate (VI) from orange to green	**SO_4^{2-} present**

b)Put a portion of the solid provided in a boiling tube add distilled water: here you look for whether the solid dissolves and the colour of the resulting solution.

Possible observations	Correct Inferences
The solid dissolves to form a colourless solution	Solid is a soluble salt/substance Fe^{2+},Cu^{2+},Fe^{3+}absent
Dissolves to form a green solution	Fe^{2+} ,Cu^{2+}, Solid is a soluble salt/substance present
Dissolves to form a blue solution	Cu^{2+} , Solid is a soluble salt/substance present
Dissolves to form a brown or yellow solution	Fe^{3+} , Solid is a soluble salt/substance present.

NOTE

- ✓ Check for guided observations ,marks dictates the number of observations mostly each observation is 1/2mark refer KCSE 2005,2008,2009,2011
- ✓ Read instructions carefully ,for half ,a third ,e.t.c
- ✓ Check also for negative observations KCSE 2012

d)You can also be told to place the solid provided in a boiling tube then add distilled water and shake and then filter. In such a case you have to mention the colour of residue and colour of filtrate.

Observation	Inference
Colourless filtrate, White residue	Solid is a mixture of soluble and insoluble salt Fe^{2+},Cu^{2+},Fe^{3+} absent(tied to colourless filtrate)
green filtrate	*Fe^{2+}* Cu^{2+}
Blue filtrate	Cu^{2+}

❑ NOTE

Common mistake is that the students write a white precipitate instead of white residue which is penalized

- ✓ **There is a wrong assumption that only Fe2+ salts are green ,that is a misnomer as some copper (II) salts are green e.g copper (II) chloride and copper (II) carbonate ,**
- ✓ **So if you add dilute HCl to a green solid or black solid and you get a green solution the correct inference for such is Fe2+ ,Cu2+ present, the ions can be further differentiated by adding aqueous ammonia dropwise till excess, whereby green ppt insoluble confirms presence of Fe2+and blue ppt soluble in excess ammonia to form deep blue solution confirms presence of Cu2+**

e)**You can also be told to describe the appearance of a solid, and the following are possible observations.**

Observations
A colourless crystalline solid
A white powder
A white crystalline solid
A blue crystalline solid
A brown crystalline solid
A green crystalline solid

TEST FOR CATIONS

CONCEPT MAPPING

- Fe^{2+},Cu^{2+},Fe^{3+} (CuFeFe)
- Na^{+} , K^{+} , $NH4^{+}$ (POS0AM -)
- Pb^{2+} Zn^{2+} andAl^{3+} (ZAP)
- Mg^{2+} and Ca^{2+} (CaM)
- Pb^{2+} Mg^{2+} andAl^{3+} (PAM)
- Pb^{2+} Ca^{2+} and Ba^{2+} (CaLeB)

TEST FOR CATIONS

The cations tested are group into four major groups

- **Coloured ions - Fe^{2+},Cu^{2+},Fe^{3+} (CuFeFe)**
- **Na^{+} , K^{+} , $NH4^{+}$ (POS0AM - this cations don't form any precipitate with all the reagents(NaOH,NH_4OH)**
- **Pb^{2+} Zn^{2+} andAl^{3+} (ZAP)these cations ions will form a white precipitate with NaOH soluble in excess this is due to the amphoteric nature**
- **Mg^{2+} and Ca^{2+} (CaM)these ions form a white precipitate with NaOH insoluble in excess**
- **Pb^{2+} Mg^{2+} andAl^{3+} (PAM)these forms a white ppt insoluble in aqueous ammonia**
- **Pb^{2+} Ca^{2+} and Ba^{2+} (CaLeB)these forms a white ppt with a soluble sulphate eg, Sulphuric (VI) acid, sodium sulphate e.t.c**

NOTE

The only solution you are supposed to mention effect of addition drop wise and in excess is only NaOH and NH_4OH but not any other reagent.

REAGENTS USED TO TEST FOR CATIONS

- ✓ Aqueous ammonia NaOH / ....test for most cations
- ✓ Sodium sulphate/sulphuric (VI) acid ;test Ca^{2+} Pb^{2+} & Ba^{2+}
- ✓ HCl/ NaCl test for Pb^{2+} and Ag^{+}
  Potassium iodide test for Pb^{2+} and Fe^{3+}
- ✓ hydrogen peroxide to test for Fe^{2+}
- ✓ universal indicator Fe^{3+} and Al^{3+}

2.How to differentiate Mg^{2+} and Ca^{2+} ions.

Both ions will form a white precipitate with NaOH insoluble in excess.

E.g. of a question; you are provided with solid Q carry out the tests below to determine the ions present.

Place all the solid Q in boiling tube and add 10mls of distilled water and shak divide the resulting solution into four portions.

Observations	Inference
Dissolves to form a colourless solution	Solid Q is soluble substance Fe^{2+} Fe^{3+} ,Cu^{2+} absent

QUALITATIVE ANALYSIS INVOLVING COLOURED IONS

- Fe^{2+}, Cu^{2+} are usually tested together as they give a **green solution** , the ions can be further differentiated by adding aqueous ammonia dropwise till excess, whereby green ppt insoluble confirms presence of **$Fe^{2+}$and blue precipitate soluble in** excess ammonia to form **deep blue solution confirms presence of Cu^{2+}**
- If the substance being tested contained Fe^{2+} ions , the it can further be subjected to oxidation reaction whereby an oxidizing agent like concentrated nitric (V) acid or hydrogen peroxide can added , the exected observation will be ,green solution turns yellow,and if aqueous ammonia or aqueous sodium hydroxide is added then a brown precipitate is formed, the correct inference for such test **is Fe^{2+} oxidized to Fe^{3+}** ,not Fe^{3+} present . refer to **KCSE 1999 and 2011 question 2**

Continued…….

- If the substance being tested contained Cu^{2+} ions,then it can further be subjected to further test like displacement involving using zinc metal/iron metal powdwer ,the expected observations are effervescence and brown solid is deposited . **refer to KCSE 2008 question 2**
- If the substance being tested contained Fe^{3+} ions it will form a brown precipitate insoluble in both aqueous ammonia and aqueous sodium hydroxide ,it can further be subjected to further tests like test for pH whereby being acidic will give pH 1, also sodium carbonate can be added ,and the expected observation is bubbles/effervescence , Fe^{3+} are oxidizing agent and a reducing agent like **potassium iodide** can be added of which the expected observation will be brown solution formed /black solid deposited , the correct inference will be I^- oxidized to I/iodide ions oxidized to iodine. Refer **KCSE 2007 question 2**

COMMON ERRORS IN CHEMISTRY PRACTICAL

Wrong, penalized	Correct	Reasoning
No observable change	No white precipitate	The candidate should know the expected change
No colour change	State the colour that does not change; e.g. in case of $KMnO_4$ the purple persists/does not turn colourless, orange colour does not turn green	The candidate should know the expected change
White solution	White precipitate	Precision of language

COMMON ERRORS IN CHEMISTRY PRACTICAL

Wrong/penalized	Correct	Reasoning
Colourless liquid condenses	Colourless vapour condenses	A liquid cannot condense
A vapour condenses to form a white solid/sublimate	A colourless vapour cools to form a white sublimate on the cooler parts	This contradicts the concept of sublimation
Clear solution	Colourless solution	Clear in this context implies transparent or can see through but Coloured solution can also be clear
Solution decolourised	Mention the initial and final colour of the reagent, in case the colour doesn't change, write that the colour (original) does not change to,….(expected final colour)	The candidate should know the expected change of reagents

COMMON ERRORS IN CHEMISTRY PRACTICAL

Wrong/penalized	Correct	Reasoning
Dissolve solid in dilute acid	React the solid with dilute acid	Substance only dissolve in water
The solid disappears	The solid dissolves	Precision of language
A red litmus paper turns blue and blue one turns red	A red litmus paper turns blue and blue litmus paper turns red	The student should not be economical with words
Unsaturated hydrocarbon	Unsaturated organic compound	Not all organic compounds are hydrocarbons

COMMON ERRORS IN CHEMISTRY PRACTICAL

Wrong/penalized	Correct	Reasoning
The solution is an acid /strong acid	The solution is acidic/strongly acidic	Not all acidic substances are acid
White solution /white precipitate soluble	White precipitate	
Sweet smell /fruity sweet smell	Pleasant smell	

INORGANIC LAB CHECKLIST

- ✓ Carbonates,sulphates,chlorides and nitrates of Magnesium ,Ca,Na,K,Cu Zinc,Fe(II) and Fe(III)
- ✓ Sulphates,chlorides and nitrates Carbonates,acetates and nitrates of Pb
- ✓ Hydrogen carbonates of K and Na
- ✓ Sodium tatraborate (borax salt) $Na_2B_4O_7.10H_2O$
- ✓ hydrated Ammonium Aluminium Sulphate,($NH_4)Al(SO_4)_2.12H_2O$)
- ✓ Hydrated Ammonium iron (II) sulphate) $(NH_4)_2Fe(SO_4)_2.\ 6H_2O$
- ✓ Sodium hydrogen sulphite
- ✓ Starch indicator
- ✓ NaOH
- ✓ Ammonia

Continued.....

- ✓ Sodium sulphite
- ✓ Potassium iodide
- ✓ Hydrogen peroxide
- ✓ Potassium iodide
- ✓ Iodine solution
- ✓ Phenopthalein
- ✓ Litmus indicator
- ✓ Methyl orange

- ✓ Magnesium ribbon/powder
- ✓ Iron fillings and powder
- ✓ Zinc granules and powder
- ✓ Sulphuric,HCl and nitric acid
- ✓ Wooden splint
- ✓ Potassium iodate
- ✓ Magnesium ribbon and turnings
- ✓ Calcium and Barium hydroxide
- Acidified potassium manganate (VII)
- acidified potassium dichromate (VI)

TEST FOR ANIONS : CHECK LIST

- Lead (II) nitrate
- Barium nitrate/barium chloride
- Dilute HCl/HNO_3
- Hydrogen peroxide
- Aluminium foil and NaOH
- Wooden splint (glowing or burning)
- Heating
- Litmus paper /universal indicator/indicator
- Acidified Potassium manganate (VII)
- Acidified potassium dichromate (VI)
- describe the appearance

TEST FOR ANIONS

The most commonly tested are SO_3^{2-}, SO_4^{2-}, CO_3^{2-}, Cl^-, S^{2-}, and NO_3^-, HCO_3^-, OH^- tested using barium nitrate ,and lead (ii) nitrate ,dilute acids, indicators acidified $KMnO_4$ or potassium dichromate (VI) and heating

USE OF LEAD (II) NITRATE

Add lead(II) nitrate(if not specified as acidified it means it is not acidified	
White precipitate	SO_3^{2-},SO_4^{2-},CO_3^{2-}, Cl^-, present
Yellow precipitate	I^- present
Black precipitate	S^{2-} present
No white precipitate	SO_3^{2-},SO_4^{2-},CO_3^{2-}, Cl^-, absent

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

Observation	Inference
✎ White residue/solid/substance ✎ Colourless filtrate 👉 **REJECT** white precipitate (1mark)	✎ Slightly soluble/sparingly soluble(1mark)

TO THE FIRST PORTION, ADD 2 DROPS OF PHENOLPHTHALEIN INDICATOR

Observation	Inference
✎ Indicator turns pink (1 mark)	✎ OH^- CO_3^{2-} HCO_3^-

To the second portion, add $2cm^3$ of dilute hydrochloric acid

Observation	Inference
✎ No effervescence/no bubbles (1 mark)	✎ OH^- presentt (1 mark)
✎ No effervescence/no bubbles (1 mark)	CO_3^{2-}, HCO_3^- presentt (1 mark)

TEST FOR NITRATES

One can use the brown ring test or Devarda's test

a) In **brown ring test** –(APPLICABLE IN THEORY)Freshly prepared iron (II) sulphate is added followed by Conc. sulphuric acid formation of brown ring indicates presence of NO_3^-

b) In **Dervada's alloy** test: NaOH solution is added to the test solution followed by Aluminium foil and warm.

Observations	**Inference**
✎ Effervescence ½ /Bubbles of Colourless gas with a pungent produced ½ Turns red litmus blue ½ ✎ Blue litmus remained blue ½ ✎ *Accept no effect on blue litmus paper* (2 marks)	✎ NO_3^- present ✎ (tied to red litmus turning blue) ✎ Penalize fully for any contradictory ion 1 mark

CONTRADICTORY IONS

1) ***Place solid X in a boiling tube and add 12cm^3 of distilled water, divide the resulting solution into five portions***

Observations	Inferences
dissolves to form a colourless solution(1mk)	x is a soluble salt, colored fe^{2+},cu^{2+}, fe^{3+}, ions absent (1mk)

II. To the first portion add lead (II) nitrate

observations	inferences
white precipitate (1mk)	$\mathbf{so_4^{2-}}$,$\mathbf{so_3^{2-}}$,$\mathbf{co_3^{2-}}$, $\mathbf{cl^-}$ present (1mk)

II. To the second portion add dilute Nitric (V) acid

Observations	Inferences
No effervescence/no bubbles (1mk)	SO_4^{2-}, Cl^- present

II. To the third portion add 2 drop of barium chloride solution.

Observations	Inferences
No white precipitate(1mk)	Cl^- present

II. To the forth portion add sodium hydroxide drop wise till in excess

Observations	Inferences
White precipitate soluble in excess (1mk)	Al^{3+}, Zn^{2+} present 2mks penalize 1mk for any contradictory ion including Pb^{2+} .*Pb^{2+} is contradictory because X contains Cl^- ions and $PbCl_2$ is insoluble and X dissolved in water hence ruling out possibility of Pb^{2+} being present in X.*

ORGANIC QUALITIVE TESTS

Most organic test will test your understanding on:

a) **Saturated and unsaturated compounds.**

b) **How the organic compounds react with bromine water.**

c) **How they burn- Colour of flame, sooty or non sooty.**

d) **Effect on acidified $KMnO_4$,$K_2Cr_2O_7$,**

e) **The test on esterification.**

f) **Action on $NaHCO_3$/Na2CO_3 if a carbonate is added you look for effervescence**

g) **pH is also tested using either universal indicator solution or pH reel (paper).**

h) **Solubility of the compounds.**

ORGANIC CHECK LIST :

1. **ADD WATER/ETHANOL**
2. **BURN**
3. **Add BROMINE water**
4. **Add Add $NaHCO_3$/Na_2CO_3**
5. **Add acidified $K_2Cr_2O_7$**
6. **Add acidified $KMnO_4$**
7. **ESTERIFICATION**
8. **Add mg ribbon**
9. **Test pH**
10. **Add NaOH**

COMMON MISTAKES IN QUALITATIVE ANALYSIS, CHANGES IN MARKING TRENDS AND EMERGING ISSUES IN P3

COMMON MISTAKES…….

- Many students infer that acidified potassium chromate (VI) test for R-OH and -*C* ≡*C*-

- This is wrong as acidified $K_2Cr_2O_7$ is ***only used to test for R-OH*** and **does not test for unsaturation**, the candidate loses all the marks for contradictory functional group

- Bromine water is **not brown or red brown** but the correct acceptable colour is yellow ,if a candidates commits herself to brown as colour of bromine he/she loses all the marks . ***The most suitable colour for bromine water is yellow.***

- pH students must give a **specific pH and not pH range** , the current accepted pH for strongly acidic is 1 or 2

COMMON MISTAKES…….. CONTD

- When inferring for nature of solution correct terms to use **is strongly acidic/alkaline/basic** not strong acid/base/alkali, weakly acidic not weak acid as shown in the table below
- Test for hydrogen gas —***hydrogen puts off /extinguishes a burning splint with a pop sound***, but it does not burn with a pop sound.
- Always mention the initial colour and final colour of reagent, e.g acidified $K_2Cr_2O_7$ changes from ORANGE TO GREEN, NOT ***acidified $K_2Cr_2O_7$ turns green or SOLUTION TURNS GREEN, acidified $K_2Cr_2O_7$ is NOT yellow***
- **Ester has a pleasant smell NOT SWEET SMELL**, *this is because the term sweet is only invoked when referring to sense of taste whereby you use the tongue. And* ***is NEVER tested in examinations.***

CURRENT DYNAMICS IN SETTING OF KCSE PRACTICAL

- You may be required to describe the procedure for testing a particular cation and anion and then carry out the procedure to confirm presence or absence of cation, anion or both in a compound.
- in such a case candidates are required to read and understand practical notes and use the knowledge of salt analysis in order to be able to handle such questions.
- important to note is that the first step is key to scoring in subsequent parts of the question. for instance if you are provided with a solid salt you first have to dissolve it in water to make the ions (cations and anions) available so that you can add the test reagents.
- If the compound being analyzed is insoluble **you first have to dissolve it in an acid** the use the portions of the **resulting solution** to carry out the various test.
- Elimination method must be ,starter reagent should gives possibilities of several ions then follow with the other that gives less/fewer

SAMPLE QUESTIONS

1. You are provide with solid V which is suspected to be iron (II) carbonate

Using the reagents below, describe two consecutive tests you can confirm its presence

- Dilute HCl
- Wooden splint
- Aqueous ammonia

Test 1	Expected observations
to solid V in a test-tube add dilute hydrochloric acid ,test the gas produced with a burning splint .divide the resulting solution into two portions 1mks	**Effervescence of a colourless gas that puts off a burning splint, Green solution formed 2mks**
Test 2	**Expected observations**
Add aqueous ammonia to the resulting solution drop wise till in excess	**A blue precipitate which dissolves in excess to form a deep blue solution**

2. You are provide with solution A which is suspected to be aqueous magnesium chloride. Using the reagents below, describe how you can confirm its presence

NaOH, Dilute sulphuric (VI) acid , Acidified lead (II) nitrate , Barium chloride solution

Test 1	**Expected observations**
To a portion of solution A add NaOH dropwise till in excess	**White precipitate insoluble in excess**
Test 2	Expected observations
To a potion of A dilute Sulphuric (VI) acid	**,no precipitate**
Test 3	Expected observations
To a portion of solution A add acidified lead (II) nitrate	**White precipitate**
Test 4	Expected observations
To a portion of solution A add barium nitrate	**No precipitate**

Carry out the test above

Test 1	Expected inferences
Observations	**Inference**
Effervescence of a colurless gas that puts off a burning splint, Green solution formed 2mks	CO_3^{2-}, Fe^{2+} Cu^{2+},present (tied to green solution) 1mark
Test 2	
Observations	**Inference**
Blue precipitate soluble in excess ammonia to form a deep blue solution 2marks	Cu^{2+} confirmed present 1mark

NOTE THAT

- You can be told to carry out a test to show a substance is **unsaturated , is this kind of test you can burn , add bromine water ,or use acidified potassium dichromate and potassium manganate (VII)**
- You can also be told to carry out a test to show a substance is an **alkanol (use potassium dichromate (VI)**

Note , always first dissolve the substance (If it is not a solution) in water and use a portion of the resulting solution to carry out the tests.
You are provided with solid P ,which is suspected to be maleic acid
Use the reagents below to.

MISCONCEPTIONS

a) There is also a wrong assumption that only concentrated sulphuric acid can be used during esterification , this is not factual because dilute sulphuric acid can also be used hence dilute is acid is being preferred due to safety purposes

b) There is a misplaced assumption that all organic acids are weak acids, this is not true as some acids like oxalic acid and maleic acid are strong acids and have a pH of 1.

IMPORTANT CHECKS

* Knowledge on practical being tested (KCSE 2013 and KCSE 2016 and 2017)
* Reversed qualitative gaining ground (have solubility in your fingertips)
* Application of theory also very important (KCSE 1997 on test for oxygen
* Iron(II) is reducing agent likely going to be oxidized by hydrogen peroxide KCSE 2011
* Iron (III) is acidic and is an oxidizing agent and likely going to be used with reducing agent like potassium iodide KCSE 2007

ortant checks…….. contd

Copper salts likely going to be tested $CuCl_2$ or $CuCO_3$ KCSE 2008

displacement reactions

Organic role of solvent when eacting with either Mg/carbonate /HCO_3 use of water and ethanol KCSE 2009

Differentiate test for ammonia and test for nitrates (darvadas alloy test

Reversed qualitative KCSE 2010

Guided observations… don't be blinded by them

No observvation/no colour change/no ppt

Clear solution

Water formed

Yellow colur for didcromate (VI)

COMMON MISTAKES IN ORGANIC QUALITATIVE ANALYSIS

Wrong statement	Correct
Alkanol present/ethanol present, - -- -OH present	R-OH
Carboxylic/alkanoic acid present	present
Double bond/triple bond/alkene/alkyne	-*C* ≡*C*- *present*
C = *C* *C* ≡*C*	-*C* ≡*C*- *each carbon should have four Bonds*
Solution /bromine/discoloured/decolourised, solution turns colourless	$KMnO_4$ turns from purple to colourless $KMnO_4$ decolorized Yellow bromine water decolorized/ changes from yellow to colourless

COMMON MISTAKES IN ORGANIC QUALITATIVE ANALYSIS

WRONG/PENALIZED	CORRECT
pH 1-3	pH= 1,pH=2,pH =3 *don't give pH range but give specific pH*
Brown/red- brown bromine water	yellow is the most suitable colour of bromine water
Sweet smell/ fruity sweet smell	Pleasant smell
Yellow for dichromate (VI)	Orange

COMMON MISTAKES IN ORGANIC QUALITATIVE ANALYSIS

WRONG, PENALIZED	CORRECT	REASONING
No observable change	No white precipitate	The candidate should know the expected change
No colour change	State the colour that does not change; e.g. in case of $KMnO_4$ the purple persists/does not turn colourless,	The candidate should know the expected change
White solution	White precipitate	Precision of language
Colourless liquid condenses	Colourless vapour condenses	A liquid cannot condense
A vapour condenses to form a white solid/sublimate	A colourless vapour cools to form a white sublimate on the cooler parts	This contradicts the concept of sublimation

COMMON MISTAKES IN ORGANIC QUALITATIVE ANALYSIS

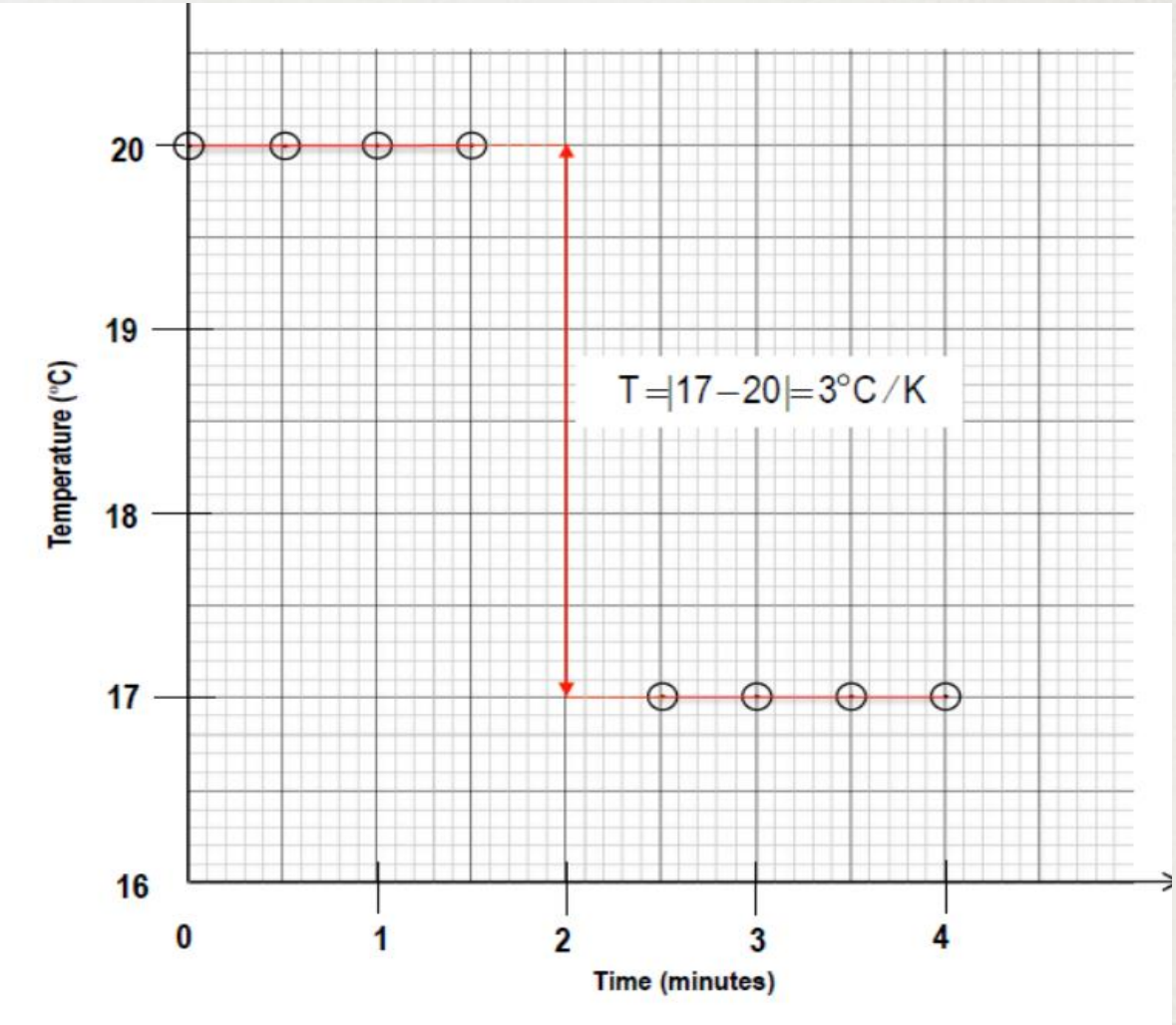
WRONG	CORRECT	REASONING
Clear solution	Colourless solution	Clear in this context implies transparent or can see through but Coloured solution can also be clear
Dissolve solid in dilute acid	React the solid with dilute acid	Substance only dissolve in water
The solid disappears	The solid dissolves	Precision of language
A red litmus paper turns blue and blue one turns red	A red litmus paper turns blue and blue litmus paper turns red	The student should not be economical with words

THERMOCHEMISTRY : CONCEPT MAP

- ✓ HEAT OF NEUTRALIZATION
- ✓ HEAT OF SOLUTION
- ✓ HEAT OF REACTION
- ✓ HEAT OF DISPLACEMENT
- ✓ HESS LAW 1995, 2003
- ✓ GRAPH ….. SIX POSSIBLE GRAPHS
- ✓ COMPARISON OF STRENGTH OF ACIDS, DIBASIC ACIDS VS MONOBASIC,
- ✓ STRONG VS WEAK ACIDS/BASES , REACTIVITY OF METALS

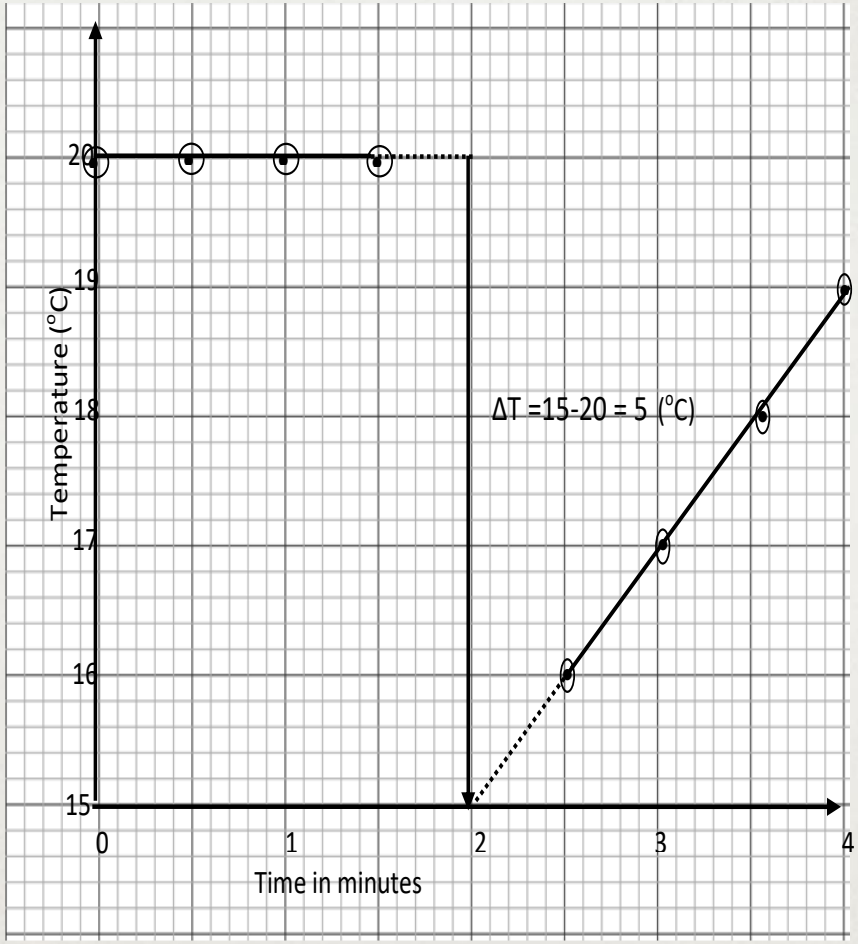
THERMOCHEMISTRY

Time in minutes	0	$^1/_2$	1	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4
Temperature (^oC)					**X**				



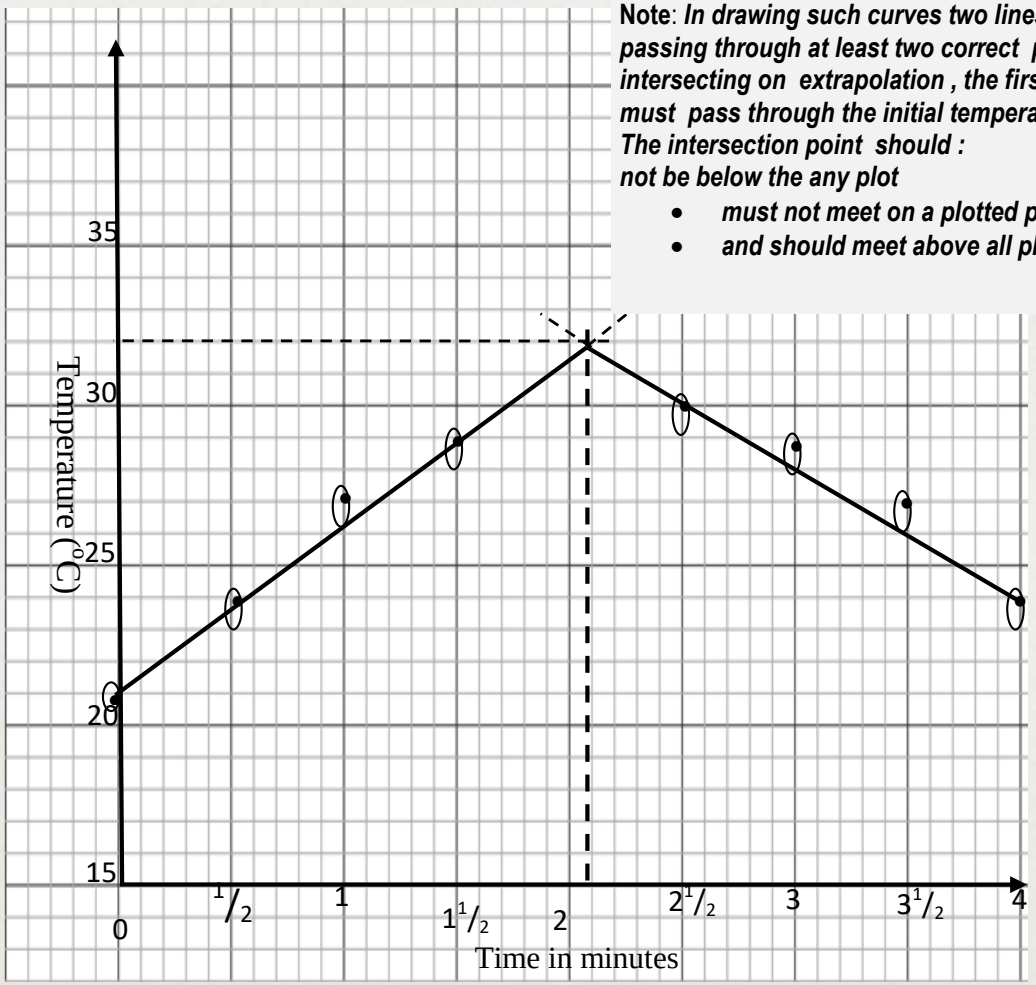
THERMOCHEMISTRY

Time in minutes	0	$^1/_2$	1	$1^1/_2$	2	2^1_2	3	$3^1/_2$	4
Temperature (^oC)	20	20	20	20	**X**	16	17	18	19



THERMOCHEMISTRY

Time in minutes	0	$^1/_2$	1	$1^1/_2$	2	2^1_2	3	$3^1/_2$	4
Temperature (^oC)									

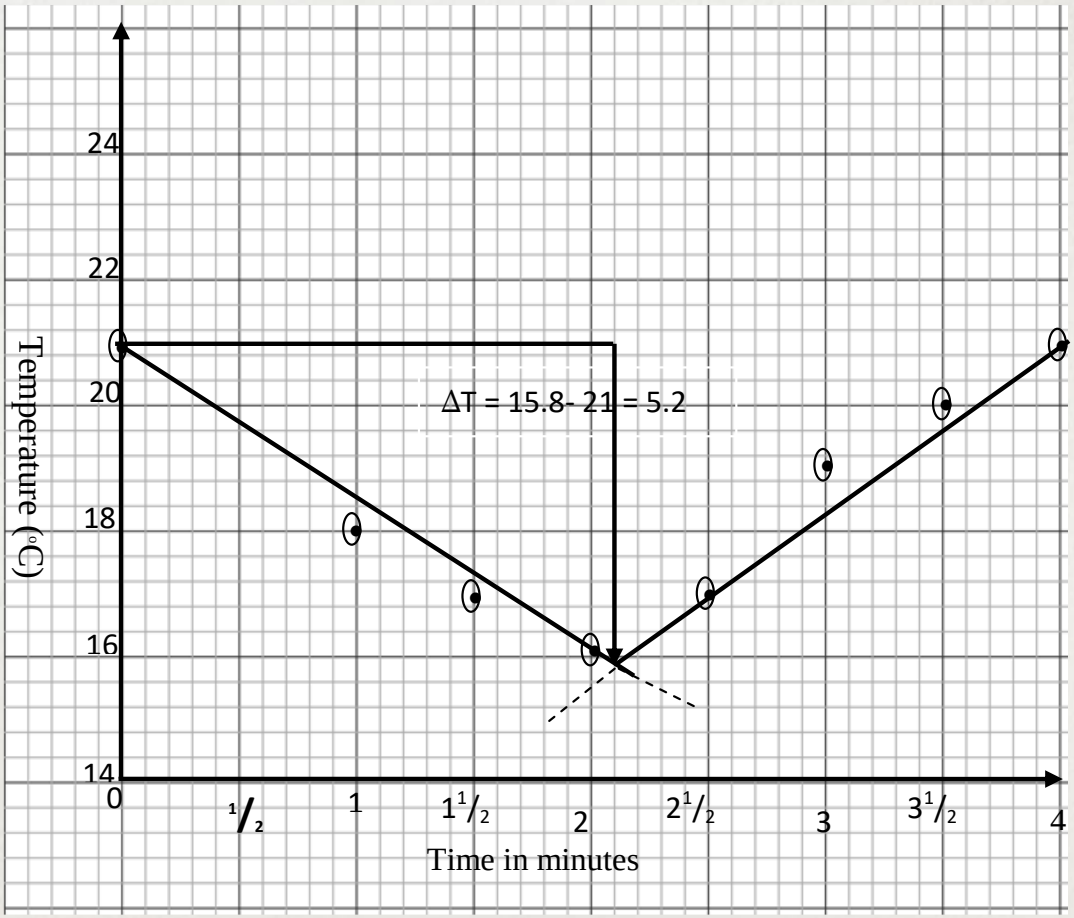


Note: *In drawing such curves two lines of best fit passing through at least two correct plots and intersecting on extrapolation , the first line of best fit must pass through the initial temperature .*
The intersection point should :
not be below the any plot

- *must not meet on a plotted point*
- *and should meet above all plotted points*

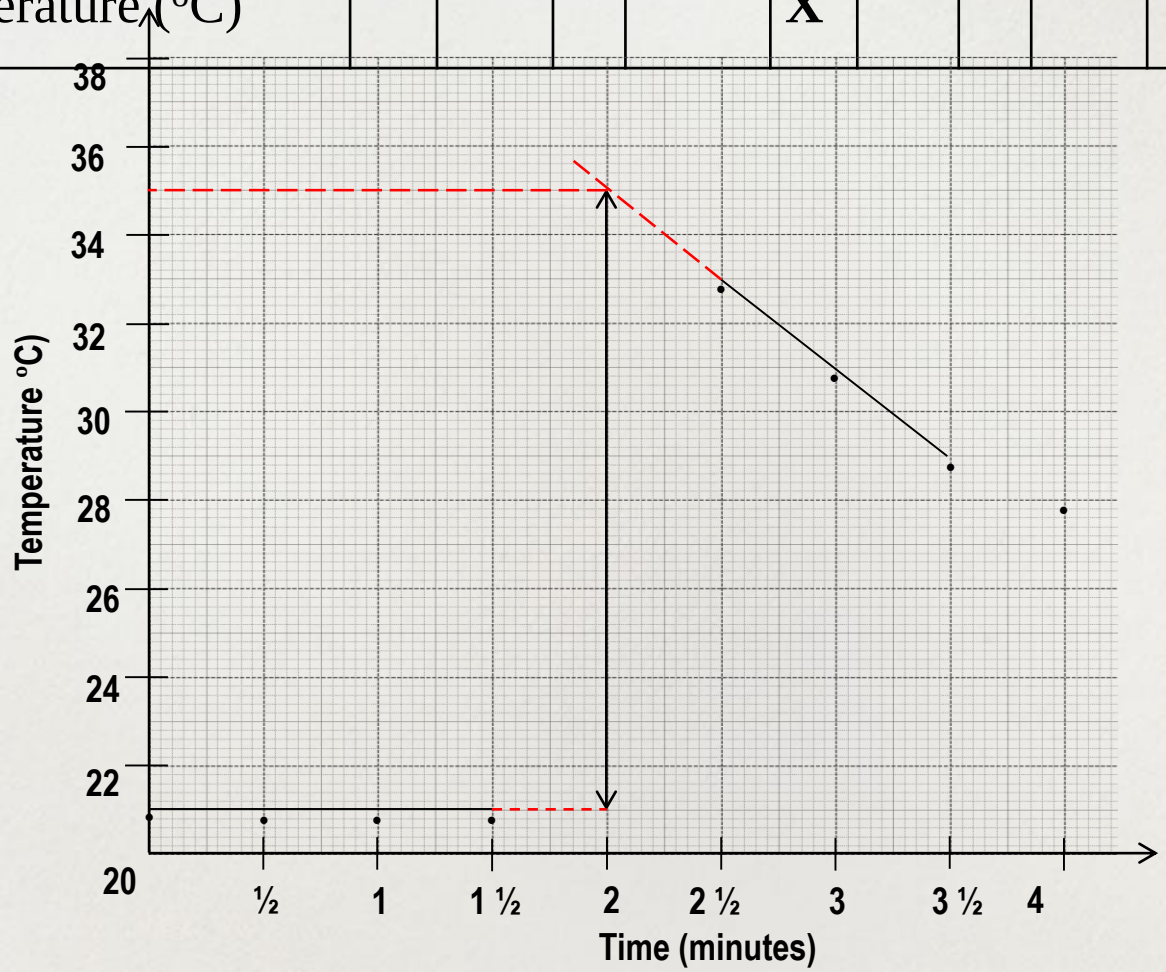
THERMOCHEMISTRY

Time in minutes	0	$^1/_2$	1	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4
Temperature (^oC)									



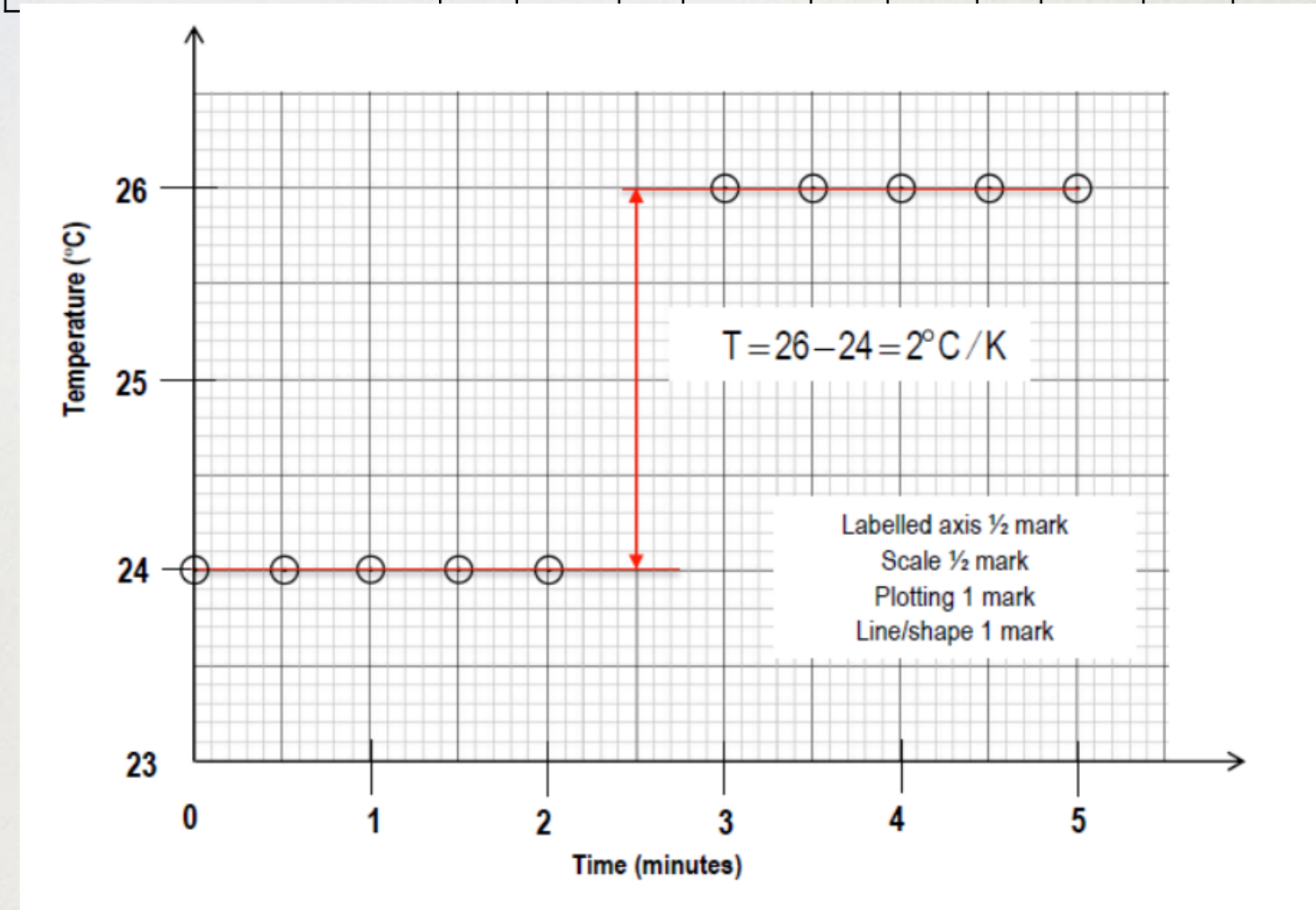
THERMOCHEMISTRY

Time in minutes	0	$^1/_2$	1	$1^1/_2$	2	2^1_2	3	$3^1/_2$	4
Temperature (°C)					**X**				



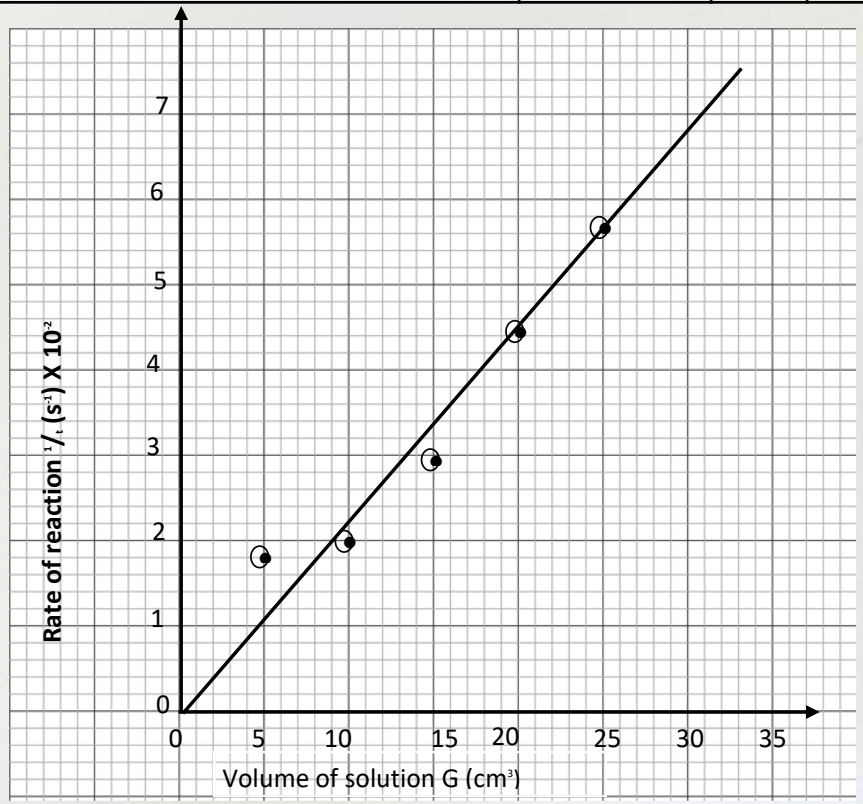
THERMOCHEMISTRY

Time in minutes	0	$^1/_2$	1	$1^1/_2$	2	2^1_2	3	$3^1/_2$	4
Temperature (^oC)					**X**				



THERMOCHEMISTRY

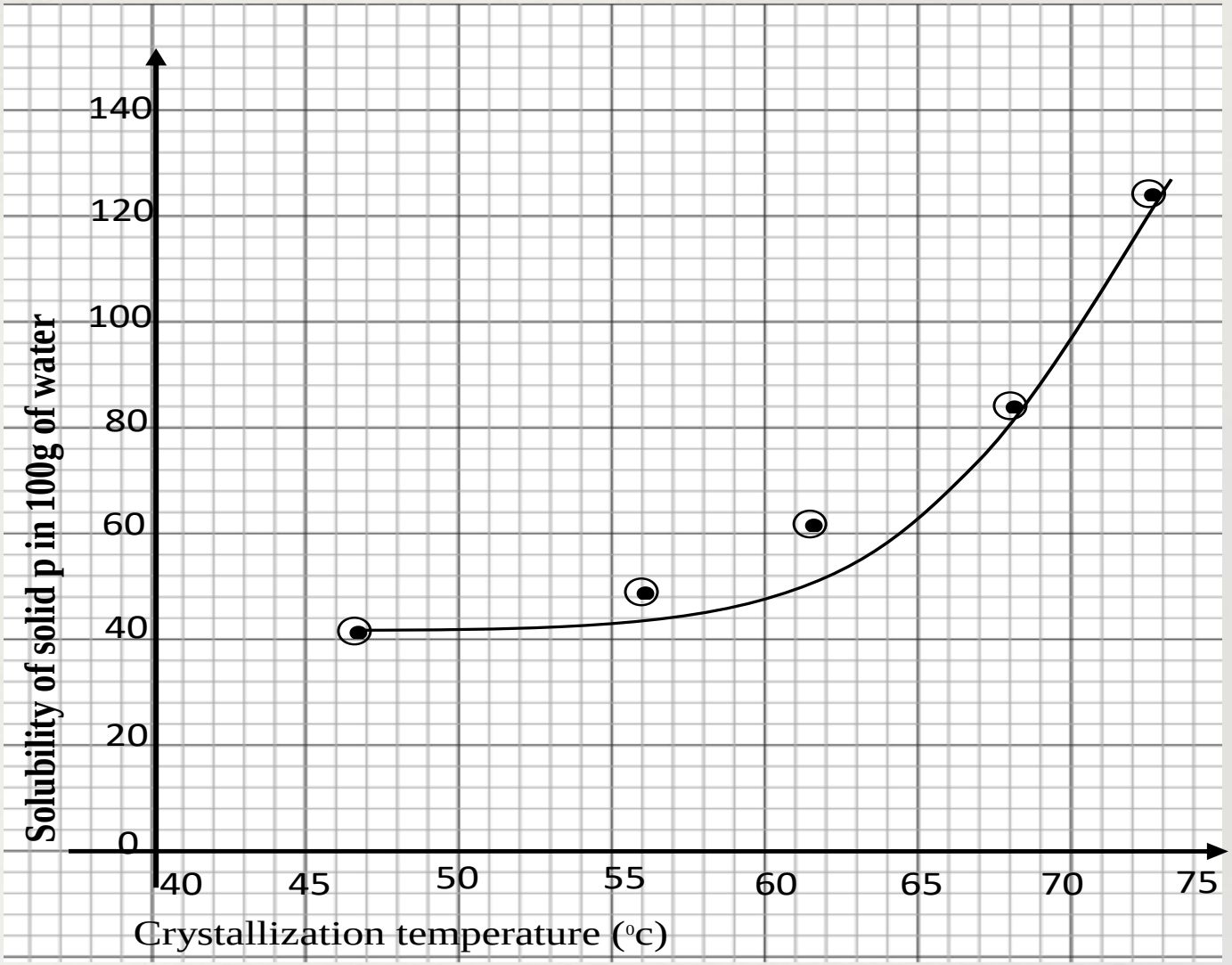
Experiment number	1	2	3	4	5
Vol. of solution G (cm^3)	**25**	**20**	**15**	**10**	**5**
Vol. of water (cm^3)	0	5	10	15	20
Vol. of solution F (cm^3)	10	10	10	10	10
Time for cross to be obscured t(sec)					
Reciprocal of time $^1/_t$ (s^{-1})					



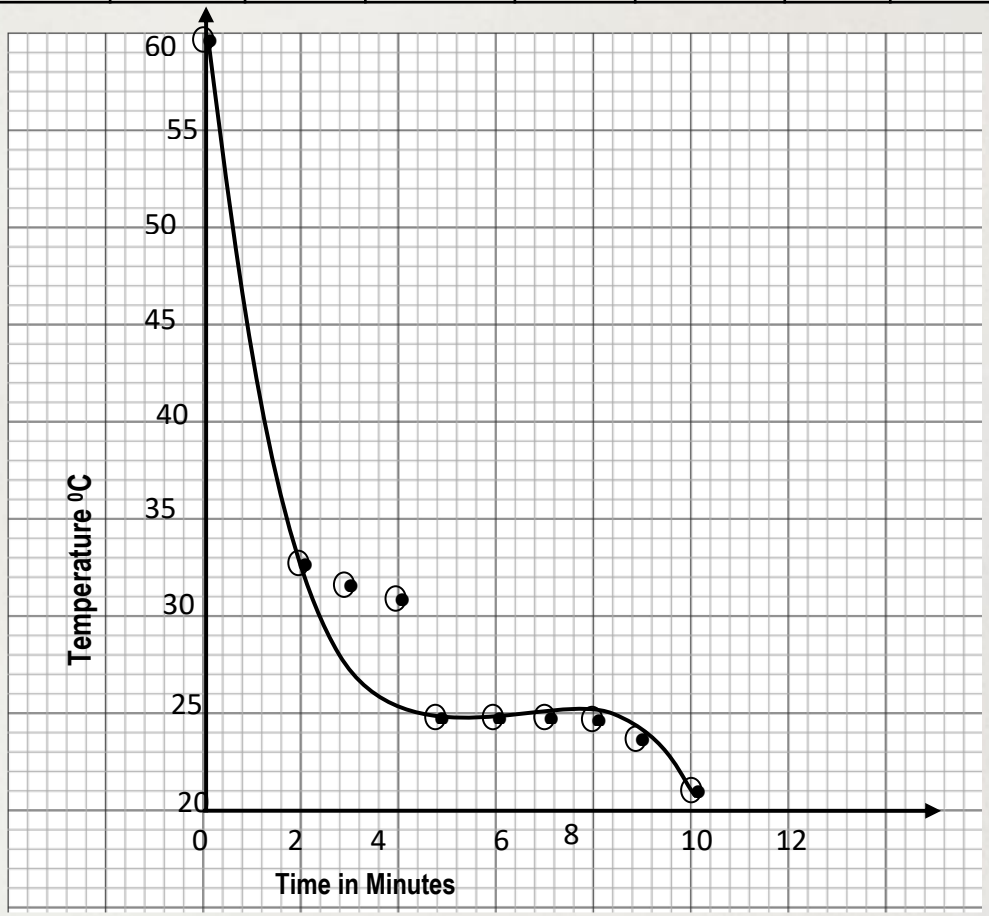
SOLUBILITY

Volume of distilled water (cm^3)	Temperature ^0C at which crystals first appear	Solubility of solid Q in g/100g of water
4	66	
6	60	
8		
10		
12	6	

SOLUBILITY


Solubility of solid p in 100g of water
140
120
100
80
60
40
20
0
40
45
50
55
60
65
70
75
Crystallization temperature (°c)

Time (minutes)	0	2	3	4	5	6	7	8	9	10
Temperature ^{o}C	60	33	32	31	25	25	25	25	24	21



COMMON MISTAKES TEACHERS MAKE WHEN HANDLING PRACTICALS

- ✓ Using DEFFERENT brand /make of apparatus .eg thermometer, burette
- ✓ Always solutions for thermochemistry should be prepared at least one day to the examinations
- ✓ Ethanol/hydrogen peroxide should be prepared AND supplied on the day of examinations
- ✓ Use of EXPIRED POTASSIUM IODIDE and FeSO4
- ✓ Solids should be put in a stoppered container
- ✓ Standardize thermometers by putting then in cold water mercury or ethanol/acetone for alcohol thermometers

COMMON MISTAKES TEACHERS MAKE WHEN HANDLING PRACTICALS

- ✓ Practical involving use of oxidising agents should be prepared at maximum 12 hours to the day of examinations
- ✓ Advice your students to start the questions involving thermochemistry at the same time (Bunsen burners must be put off)
- ✓ Avoid placing stations in area exposed to sunlight
- ✓ Carry out all experiments in each shift even if they are four shifts.
- ✓ Give dry test-tubes
- ✓ Measuring chemicals

“IN ALL THINGS,FOR SUCCESS TO BE ACHIEVED ,IT DEPENDS ON PREVIOUS PREPARATIONS AND IF THERE IS NO SUCH PREPARATIONS THERE US SURE TO BE FAILURE.”

Thank you

THADDEAUS .M MBALUKA

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