PRINCIPAL EXAMINER'S REPORT

BOTSWANA
EXAMINATIONS
COUNCIL

BGCSE CHEMISTRY

2024

Advancing learning, certifying your future

PAPER 1: MULTIPLE CHOICE

General Comments

The 2024 candidates performed much better than the 2023 cohort as the mean increased by 3.46. Unlike in the previous year, the candidates did not find the questions targeting the lowest levels of cognitive scales difficult. It is worrisome that the candidates as in the previous year's find the questions on dilution difficult, they seem to calculate the final volume well but never subtract the initial volume from the final volume. There were two (2) questions in which the candidates struggled with selecting the correct answer, where the proportion correct is less than 45%, while there are 14 questions in which the proportion correct is above 90%.

Generally, Multiple-Choice items have a guessing factor that is considered to be the lowest proportion of getting an item correct without knowing the answer. For a Multiple-Choice item with four options, the guessing factor is 25% and any item which has the proportion of candidates who got the item correct lower than the guessing factor is a cause for concern. Candidates should be encouraged to always read the question for understanding before they select an answer. The report is mainly in table format showing the number and percentage of candidates at each of the options. The key for reading the table:

N	the number of candidates who selected each of the options
%	percentage of candidates who selected each of the options
Key	the option that was taken as the answer

Comments on Individual Items

Item 1

Option	N	%	Key	Comment
A	1864	0.97	A	The item was well done. Most candidates were able to deduce what is common within the isotopes of chlorine.
B	43	0.02		
C	1	0.00		
D	5	0.00		

Item 2

Option	N	%	Key	Comment
A	1810	0.95	A	The item was well done. Though most candidates were able to recall how the Relative Molecular mass of gaseous substances affect the rate at which they diffuse, a handful number of them went for option D.
B	24	0.01		
C	4	0.00		
D	75	0.04		

Item 3

Option	N	%	Key	Comment
A	1000	0.52	A	The item was averagely attempted. Almost half in the cohort could not come up with an apparatus which could be used to accurately measure 25.4 cm^3 of a solution. Therefore, Centres are encouraged to expose their candidates to most of their laboratory equipment.
B	454	0.24		
C	210	0.11		
D	249	0.13		

Item 4

Option	N	%	Key	Comment
A	375	0.20	B	The item was fairly done. Though most candidates were able to determine the element which is a liquid at –50°C, a good number of them chose option A. Centres are encouraged to give enough of these exercises to their candidates for practice.
B	1353	0.71		
C	168	0.09		
D	17	0.01		

Item 5

Option	N	%	Key	Comment
A	2	0.00	B	The item was well attempted as majority in the cohort managed to identify a substance that conduct electricity and used to as a lubricant too.
B	1806	0.94		
C	86	0.04		
D	19	0.01		

Item 6

Option	N	%	Key	Comment
A	5	0.00	D	The item was well done as almost all of the candidates manged to deduce a change that will results in the highest rate when calcium carbonate lumps are reacted with 0.5 mol/dm^3 hydrochloric acid at 23°C.
B	6	0.00		
C	29	0.02		
D	1873	0.98		

Item 7

Option	N	%	Key	Comment
A	110	0.06	B	The item was well done as majority in the cohort were to identify an organic compound that is saturated among the molecular formulas given.
B	1789	0.94		
C	3	0.00		
D	11	0.01		

Item 8

Option	N	%	Key	Comment
A	1434	0.75	A	The item was well attempted as most candidates showed knowledge on the constituents elements of steel.
B	48	0.03		
C	155	0.08		
D	276	0.14		

Item 9

Option	N	%	Key	Comment
A	8	0.00	B	The item was well done as almost all of the candidates were able to recall the gas produced when sodium reacts with cold water.
B	1852	0.97		
C	4	0.00		
D	49	0.03		

Item 10

Option	N	%	Key	Comment
A	253	0.13	D	The item was fairly done. A good percentage in the cohort managed to identify the two oxides which both react with sodium hydroxide.
B	206	0.11		
C	126	0.07		
D	1328	0.69		

Item 11

Option	N	%	Key	Comment
A	263	0.14	D	The item was fairly done. Though most candidates were able to recall the colour of copper(II) sulphate after heating to dryness hydrated copper(II) sulphate, a good percentage went for option B.
B	434	0.23		
C	27	0.01		
D	1189	0.62		

Item 12

Option	N	%	Key	Comment
A	925	0.48	A	The item was somehow fairly done. The question proved to be more demanding as the candidates' responses shows guessing. Centres are encouraged to work on simple cells.
B	193	0.10		
C	409	0.21		
D	386	0.20		

Item 13

Option	N	%	Key	Comment
A	958	0.50	D	The item was poorly done. Most candidates could not recall the percentage composition of bronze, instead they went for option A.
B	164	0.09		
C	66	0.03		
D	725	0.38		

Item 14

Option	N	%	Key	Comment
A	1196	0.63	A	The item was fairly attempted. Most candidates were able to come up with substances produced at electrodes S and T in the electrolysis of aqueous sodium chloride.
B	662	0.35		
C	42	0.02		
D	13	0.01		

Item 15

Option	N	%	Key	Comment
A	398	0.21	C	The item was fairly attempted. Though most candidates were able to identify an element which forms more than one positive ion, 28% went for non-transition metals.
B	85	0.04		
C	1378	0.72		
D	52	0.03		

Item 16

Option	N	%	Key	Comment
A	1889	0.99	A	The item was well done as almost all of the candidates managed to calculate the number of moles present in 5.6 g of CaO.
B	10	0.01		
C	3	0.00		
D	11	0.01		

Item 17

Option	N	%	Key	Comment
A	24	0.01	B	The item was well done. Majority in were able to balance the equation given.
B	1857	0.97		
C	24	0.01		
D	8	0.00		

Item 18

Option	N	%	Key	Comment
A	237	0.12	C	The item was poorly done. Though 40% of the candidates were able to calculate the volume of water required to dilute 20.0 cm^3 of 0.50 mol/dm^3 of sodium hydroxide to 0.1 mol/dm^3, 44% in the cohort did not subtract the original volume of the solution, hence, choosing option D.
B	80	0.04		
C	757	0.40		
D	839	0.44		

Item 19

Option	N	%	Key	Comment
A	159	0.08	B	The item was well attempted. Majority in the cohort managed to calculate the empirical formula of a compound containing 50% by mass of sulphur and 50% by mass of oxygen.
B	1695	0.89		
C	47	0.02		
D	12	0.01		

Item 20

Option	N	%	Key	Comment
A	1558	0.81	A	The item was well done. Majority in the cohort recalled a gas that leads to the formation of hardness of water in limestone areas.
B	141	0.07		
C	105	0.05		
D	109	0.06		

Item 21

Option	N	%	Key	Comment
A	35	0.02	C	The item was well attempted. Almost all of the candidates were able to come up with formula of an oxide compound using the electron configuration of the pseudo element.
B	17	0.01		
C	1836	0.96		
D	25	0.01		

Item 22

Option	N	%	Key	Comment
A	1657	0.87	A	The item was well done. Most of the candidates managed to calculate the energy change for the reaction between with chlorine and hydrogen.
B	27	0.01		
C	175	0.09		
D	54	0.03		

Item 23

Option	N	%	Key	Comment
A	193	0.10	D	The item was well done as most of the candidates identified the type of rection based on the equation given between ethane and fluorine. for.
B	24	0.01		
C	12	0.01		
D	1684	0.88		

Item 24

Option	N	%	Key	Comment
A	100	0.05	D	The item was well done. Majority of the candidates related the amount or volume of soap added to make permanent lather in different water samples before and after boiling with the concentration of calcium sulphate in the samples.
B	60	0.03		
C	212	0.11		
D	1541	0.81		

Item 25

Option	N	%	Key	Comment
A	26	0.01	D	The item was well done as 91% of the candidates were able to relate the conditions shown with the equation that required such conditions.
B	34	0.02		
C	119	0.06		
D	1734	0.91		

Item 26

Option	N	%	Key	Comment
A	203	0.11	B	The item was fairly attempted. Though most candidates were able to match sulphur dioxide with its use, there is 18% of them who showed a miss conception between the use of concentrated sulphuric acid and that of sulphuric acid.
B	1321	0.69		
C	345	0.18		
D	44	0.02		

Item 27

Option	N	%	Key	Comment
A	147	0.08	C	The item was well done as most of the candidates were able to identify a substance produced from the reaction of ethanol and atmospheric oxygen at r.t.p.
B	28	0.01		
C	1697	0.89		
D	41	0.02		

Item 28

Option	N	%	Key	Comment
A	31	0.02	C	The item was well done as majority of the candidates proved to have an understanding on stochiometric reactions. Majority managed to calculate the volume of the gas needed for complete combustion of propane in air.
B	57	0.03		
C	1792	0.94		
D	33	0.02		

Item 29

Option	N	%	Key	Comment
A	1173	0.61	A	The item was fairly done. Though this question expected the cohort to identify an element used to trap solar energy, many of them seem not to know such element.
B	192	0.10		
C	427	0.22		
D	121	0.06		

Item 30

Option	N	%	Key	Comment
A	318	0.17	D	The item was well done. Majority of the candidates were able to determine an ion which acts as an oxidising agent in the redox reaction between iron(II) and iodide ions. A few went for some products instead of choosing one of the reactants.
B	52	0.03		
C	90	0.05		
D	1453	0.76		

Item 31

Option	N	%	Key	Comment
A	49	0.03	C	The item was averagely attempted as half of the cohort managed to apply the periodic trends to deduce that phosphorus has the smallest atomic radius as compared to the elements given. But 44% went for option B, showing a misconception that needs to be addressed.
B	847	0.44		
C	955	0.50		
D	62	0.03		

Item 32

Option	N	%	Key	Comment
A	20	0.01	D	The item was well attempted as the majority of the candidates determined the charge in Coulombs used when a current of 2.5 A is passed through dilute hydrochloric acid for 60 minutes and 20 seconds. Centres are commended for making their cohort to be efficient in this concept.
B	13	0.01		
C	12	0.01		
D	1868	0.98		

Item 33

Option	N	%	Key	Comment
A	1241	0.65	A	The item was fairly attempted as most of the candidates managed to identify a change that could be made in the reaction of the production of ammonia which will increase the rate at which equilibrium is achieved. However, 20% went for option D.
B	147	0.08		
C	143	0.07		
D	382	0.20		

Item 34

Option	N	%	Key	Comment
A	120	0.06	C	The item was fairly attempted done. Majority of the candidates were able to determine a product of thermal decomposition of potassium nitrate.
B	286	0.15		
C	1303	0.68		
D	204	0.11		

Item 35

Option	N	%	Key	Comment
A	1830	0.96	A	The item was well done as almost all candidates were able to recall a metal commonly used to make aircrafts.
B	22	0.01		
C	36	0.02		
D	25	0.01		

Item 36

Option	N	%	Key	Comment
A	63	0.03	B	The item was well done. Though the question required the cohort to process data, indeed they managed to identify a pair of equations in which the products from the reactions change the colour of the universal indicator to orange and green.
B	1651	0.86		
C	159	0.08		
D	39	0.02		

Item 37

Option	N	%	Key	Comment
A	156	0.08	C	The item was fairly done. Almost half of the cohort determined an element which has two electrons in the outer shell that are not used in forming bonds. However, options B and D got a larger share too.
B	346	0.18		
C	974	0.51		
D	434	0.23		

Item 38

Option	N	%	Key	Comment
A	473	0.25	B	The item was poorly done. Though 40% of the candidates were able to identify a term in which a compound exists in two structural forms with the same molecular formula, a good number of them went for options A and C.
B	760	0.40		
C	550	0.29		
D	127	0.07		

Item 39

Option	N	%	Key	Comment
A	311	0.16	B	The item was well done. Most candidates were able to recall the term used to describe a compound that exists in two structural forms but with same molecular formula.
B	1541	0.81		
C	44	0.02		
D	9	0.00		

Item 40

Option	N	%	Key	Comment
A	48	0.03	B	The item was well attempted as most candidates were able to identify a macromolecule with the same linkage as nylon.
B	1771	0.94		
C	13	0.01		
D	53	0.03		

PAPER 3: WRITTEN THEORY

General Comments

Candidates showed good mathematical skills as shown by the calculations done well with few mistakes and Centres are commended for the good work. There were cases of candidates failing to answer questions that do not have spaces left for answers like where they have to complete a graph. Centres are advised to emphasise that candidates should read all parts of the question paper. Candidates showed good knowledge of organic chemistry. Candidates showed challenges when dealing with definitions and Centres are advised to emphasise them.

Comments on Individual Questions

1 The question required candidates to show knowledge about organic compounds and was fairly done by most candidates. Most candidates showed lack of understanding about use of fuels.

(**a**) The question was done well by most candidates. Candidates showed knowledge of the formula of ethanol and that ethanol and pentane are liquids at room temperature. Candidates were also expected to provide methods of preparing pentane, which was fairly done as most candidates scored 1 out of the possible 2 marks as they gave fractional distillation which did not score since it is a separation technique used to obtain pentane from petroleum. (Hydrogenation of pentene and cracking of longer alkane).

(b) Candidates were required to realise that combustion is exothermic and show understanding of energy changes in relation to bond breaking and formation. The part question was fairly done. Most candidates recognised that the reaction is exothermic but could not score all the marks. Common responses that did not score were energy for bond breaking and bond formation, energy used by products and reactants or energy required or needed by both reactants and products. Candidates were to state that the energy absorbed during bond breaking is less than the energy released during bond formation. Centres are advised to stress the relationship between energy change to bond breaking and formation.

(c) This part question was poorly done. A few candidates were able to state that ethanol is renewable, causes less pollution and burns easily. Common responses given were it is easy to find and releases more energy.

2 This question required candidates to show understanding of reversible reactions and apply Le Chateliers' principle when changes are introduced to a reversible reaction at equilibrium. Most candidates failed to note that the question was talking about the equilibrium mixture but instead answered the question about yield.

(a) **(i)** This part question was fairly done. Most candidates were able to name the compound as sulphur trioxide.

(ii) This part question was fairly done. Candidates were required to explain dynamic equilibrium and was fairly done. Some candidates lost marks because they wrote rates were constant instead of rates were the same.

(b) Candidates were required to calculate the oxidation number of sulphur in sulphur dioxide and sulphur trioxide in order to explain why the conversion of sulphur dioxide to sulphur trioxide is considered an oxidation process. The question was poorly done by most candidates as they showed lack of knowledge to calculate oxidation numbers given chemical formulae. Candidates lost marks for not performing any calculation while those who calculated did not show any sign for the values, determining the oxidation number of sulphur dioxide instead of sulphur, answering the question in terms of electron loss or gain of oxygen. Centres are advised to emphasise calculation of oxidation numbers and the use of oxidation numbers instead of oxidation states as required by the question.

(c) The question is about the application of Le Chatellier's principle to predict the effect of changes made on the position of equilibrium. The part question was poorly done by the majority of candidates because the common responses were about the yield instead of mentioning the shift to the right or left.

(i) Increasing pressure shifts the equilibrium to the right to favour the side with fewer molecules. This was poorly done as candidates did not answer the question about equilibrium position.

(ii) The delta H for the reaction is negative indicating that an increase in temperature will favour the forward reaction hence shifting the equilibrium to the right to favour the endothermic reaction.

(iii) This part question was done well as candidates were able to realise that a catalyst only speeds up the reaction to reach equilibrium without affecting the equilibrium position. Some candidates lost a mark for failing to provide an explanation.

(d) The question was done well and candidates showed knowledge of preparation of sulphuric acid.

(i) Candidates were able to realise that dissolving sulphur triode in water is highly exothermic leading to acid splashes, but few candidates wrote that it is dangerous without elaborating.

(ii) Majority of candidates were able to give the correct pH value of sulphuric acid, but few candidates lost marks writing pH 5/10/12 as common wrong responses.

(e) **(i)** This part question was fairly done. Candidates were expected to write an ionic equation for the reaction of zinc oxide with sulphuric acid. Some candidates lost marks for not writing an ionic equation, using wrong formulae such as H_2^+, Zn, Zn^+ or writing the ionic equation for neutralisation.

(ii) The part question required candidates to outline the steps required to prepare pre crystals of zinc sulphate starting with zinc oxide and sulphuric acid. Most candidates scored 2 out of the 4 marks. Candidates lost marks for failing to recognise that the acid needs to be warmed and reacted with excess zinc oxide which will then require filtering. Some candidates lost marks for using filtrating instead of filtering. Most candidates showed understanding that the filtrate needs to be heated to concentrate it and then cooled for crystallization to occur. Most candidates could not provide all steps for purifying the crystals (filtering and washing with a little cold distilled water). Some candidates could not provide

the correct order of the steps; hence centres are advised to emphasise steps for preparing salts.

3 The question dealt with the decomposition of hydrogen peroxide using a catalyst and was fairly done. Candidates showed knowledge of catalysis and energy level diagrams. The question also assessed graph interpretation skills which was fairly done.

(a) Candidates were to draw energy level diagram which required the understanding of delta in relation to energy change. Most candidates recognise that the reaction is endothermic and drew the correct energy level diagram. However, some candidates lost marks for incorrect labelling of activation energy hence, majority scored 3 out of the 4 possible marks. Centres are advised to emphasise different types of reactions and the proper labelling of energy level diagrams.

(b) Most candidates failed to write the correct formula of manganese(IV) oxide. Common wrong responses included MnO_4, Mn_2O_4 or Mg used instead of Mn. Centres are advised to emphasise formulae of transition metal compounds.

(c) **(i)** Most candidates gave 40 cm^3 instead of 39 cm^3 which led to loss of marks. Centres are advised to emphasise taking readings from graphs.

(ii) The question required candidates to use the graph to get the volume of gas produced in order to perform a calculation. The part question was done well but some candidates lost marks for using wrong units and recording the volume as 60 dm^3 instead of cm^3, some did not covert the volume during the calculation while some multiplied the volume by the molar gas volume instead of dividing.

(iii) The question required the cohort to calculate the number of moles of hydrogen peroxide using the stoichiometric equation and it was well done as majority were able to use the mole ratios from the equation given to derive the correct answer.

(iv) Majority of the candidates showed understanding of the concept by correctly calculating the concentration of hydrogen peroxide as 0.02 mol/dm^3 even though few candidates multiplied the moles by the volume instead of dividing.

(v) Candidates were expected to show understanding of the effect of reducing concentration on the rate of a chemical reaction and show it graphically in comparison to another experiment carried out using different conditions. Most candidates scored 1 out of the 2 possible marks for a graph showing a slower reaction but were not able to realise that the two experiments will not produce the same volume due to the reduction in the number of moles of the hydrogen peroxide decomposing. Marks were also lost for having graphs showing experiments ending at the same time, reaction finishing quicker than first one and having the same initial rate for both experiments.

(vi) The question required candidates to show understanding that a catalyst does not take part in any reaction was fairly done. Candidates gave responses such as 0.2 g, 0.5 g, 0.15 g which indicated lack of knowledge of catalysis. Centres are advised to emphasise application of concepts like catalysis.

Answers: **(c)(i)** 38.5 s **(c)(ii)** 0.0025 moles **(c)(iii)** 0.0050 **(c)(iv)** 0.2 mol/dm^3 **(c)(iv)** 0.25 g

4 The question was fairly done as candidates showed understanding of polymerisation and chromatography.

(a) This part question was poorly done. Most candidates defined a polymer hence, lost marks.

(b) The question required candidates to show understanding of hydrolysis of nylon to produce a diacid and dialkanol. The question was done well but few candidates lost marks for swapping the structures, incorrect bonding of hydrogen in OH leading to H with two bonds, use of NH_3 or NH_2OH instead of NH_2.

(c) **(i)** The question was fairly done. Candidates showed understanding that non-biodegradable means not being decomposed by bacteria, however some candidates lost marks for referring to a process as a compound while others wrote an incomplete definition.

(ii) Majority of the candidates were able to recognise that nonbiodegradable polymers cause pollution.

(d) The part question dealt with the use of chromatographic techniques in identifying products of hydrolysis.

(i) This question was fairly done. A locating agent makes the colourless spots visible, but some candidates lost marks for giving responses such as to identify the monomers or identify dyes.

(ii) Most candidates correctly gave A, C and D as the monomers that were not identified from the chromatogram.

(iii) This part question was poorly done. Candidates lost marks for use of wrong formula where they reversed the formula or measured a wrong distance travelled by either the solvent or component. Centres are advised to emphasise calculation of Rf values.

5 The question dealt with a simple cell used to rank metals in order of reactivity and was done well by most candidates.

(a) Majority of the candidates recognised that the negative voltage is an indication that metal A is less reactive than copper, but some candidates failed to refer to copper as a reference metal.

(b) The question was fairly done. Candidates lost marks for using metals such as magnesium, aluminium or potassium that do not appear in the question.

(c) **(i)** The question required candidates to state observations that would be made during the reaction of copper metal and silver nitrate solution and was done well by most candidates while some lost marks for giving responses such as silver metal produced instead of solid or greyish solid instead of grey solid. Centres are commended for the good performance.

(ii) The reaction between silver nitrate and copper was correctly identified as displacement by majority of the candidates while few candidates gave exothermic, reduction and substitution which led to loss of marks.

(iii) Candidates were to write a word equation for the reaction between copper and aqueous silver nitrate. The question was poorly done. Candidates lost marks for writing chemical equation, writing copper nitrate not showing the valency or copper(II) metal instead of copper. Centres are advised to emphasise the difference between word and chemical equations.

6 The question deals with organic chemistry and was fairly done.

(a) This part question was poorly done as candidates lost marks for either not answering the question or choosing alkenes. (C_2H_6, C_4H_{10})

(b) Candidates showed knowledge of the functional group COOH in alkanoic acids

(c) **(i)** The reaction was identified as cracking by most candidates.

(ii) Test for unsaturation was correctly identified as using bromine water which will remain brown in C_6H_{14} while changing from brown to colourless in C_4H_8. However, some candidates used C_2H_6 instead of C_6H_{14}, writing responses such as it will not react, use bromide water, swapping colour changes and colour changing to red which did not score.

(iii) Structural isomers were fairly drawn with many candidates scoring 2 out of 3 because some candidates lost marks for repeating structures, using $C4H_{10}$ and carbon bonding with 5 electrons.

PAPER 4: PRACTICAL TEST

General Overview

1 All Centres are encouraged to perform the experiments in paper 4 and send their reports. This will help the examiners to mark the candidates according to the results obtained by their supervisors. Centres that did the experiments and send the supervisors values are commended. Those Centres that provided the report, answered all questions on the question paper, make the marking easy and also help their candidates because the candidates would not be penalised unnecessary.

2 The Centres are commended for taking note of the previous year's comments on some problems associated with scientific reporting and the use of a calculator. Centres did report the supervisors value clearly, this was a good improvement from the previous years. Some Centres did report their values to two (2) decimal points. **Centres are encouraged to give their titre values to one decimal point**. Candidates must be encouraged to continue using values on their calculators rather than to round of the values. This practise helps candidates to use the most accurate value during calculations and also to be able to score marks on the subsequent questions not by error carried forward. Working must also be shown. There was an improvement from the previous cohort especially on titration. Question 1 (quantitative analysis, titration) was well done compared to question 2 (qualitative analysis). Reporting on solubility of precipitates was still a challenge for some centres.

3 The quality of answers in almost all Centres for the 2024 cohort was very satisfactory on significant figures. Centres are still encouraged to emphasize on significant figures and also to give more practises on significant figures because in quantitative analysis (question 1, titration) accuracy is very important.

4 This cohort, just like in previous years, failed to score maximum points on high order questions for example 1(e), (f), 2(e)(i), (ii), 2(f)(i), (ii). Centres are encouraged to give more practises on questions such as calculation from stock solution, in order to give the candidates, the skills on how to solve such problems. Centres are also encouraged to emphasis testing and **identify any gas produced**, for instance at 2(d)(i).

5 Centres are advised to continue encouraging the candidates to answer questions at the space given under each and every question. Candidates this year unlike the previous year, did match the observation they made with the test they did. Centres should explain to candidates why excess alkaline solution is added, [be it for solubility or and amphoteric].

6 Candidates must be encouraged to follow instructions on the question paper especial, "you should test and identify any gas produced", at question 2.

This year's cohort displayed good mathematical and computational skills in calculations. Centres are commended for imparting those skills to the candidates

General comments

Majority of the candidates in the 2024 cohort have shown great skills in data presentation in the table and also good reporting skills on qualitative analysis. The candidates have shown knowledge and understanding of accuracy of the burette. However, the candidates have shown deficiency on calculating the moles from a stock solution. This is evident because of question 1(e). This year candidates did not use the pipette volume instead of the burette volume of acid. Centres are commended for that.

Treatment of results on the table was well understood by majority of the candidates. However, few candidates did not quote the correct significant figures as demanded by the questions and the syllabus. Candidates that obtained an answer at 1 significant figure from the calculator should be aware of the expectation by inspecting the question.

Comments on Individual Questions

1 The question was on titration. The majority of the candidates across the centres did very well in the question.

(a) The question assessed the candidates in accuracy, concordance and average. The majority of the candidates across the Centres did very well in this part question. Data presentation and treatment of results was well done.

Accuracy: Majority of the candidates scored maximum marks on accuracy of the titres. Centres are encouraged to continue performing their experiments for each session to advantage the candidates. Solutions may change with time so each session may have its supervisors value.

Concordance: Most candidates scored maximum marks. The 2024 cohort, just like the previous candidates showed great skills on treatment of results. There were minimal errors on subtraction and decimal point.

Average: The average mark was also scored by most candidates.

Ticking or treating results: Most candidates ticked the values correctly. This indicates that majority of the candidates understood the rationale behind ticking the values. Centres are still encouraged to continue explaining and emphasizing the importance of treating titres in quantitative analysis. [**The closer the titres the more likely the values are accurate]**.

(b) As majority in the cohort managed to score the concordance mark, they also managed to calculate the average titre, which is commendable too to the centres for imparting the skills for dealing with the titration results.

(c) This part question was well done. Majority of the candidates scored the mark showing good understanding of stoichiometry. Those who failed to score the mark mostly it was due to significant figures albeit a few. Significant figures were penalised once and as a result if penalised in (c), candidates scored a mark in subsequent part questions.

(d) This part question was well done. Candidates were comfortable with mole ratio and the ratio was 3:1 from the equation given to make this mark easily accessible.

(e) This part question was fairly done. Candidates realised the number of moles needed was the moles in given stock solution. This shows a great improvement compared to previous years.

Those Centres whose candidates did not do well in this part question, was due to fact that the candidates used the number of moles that reacted and then could not work back to the original solution.

(f) The question was not well done. Candidates did not realise that 3.10 g is the mass of impure lithium hydroxide. They multiplied the number of moles with 3.10 g instead of molar mass of lithium hydroxide and lost a mark.

(g) The candidates were to subtract the mass of lithium hydroxide from (f) from 3.10 g. The part question was well done.

(h) Candidates who did not get this part correct are those who did not realise that 3.10 g was the mass of impure sample. Generally, the question was well done.

Answers: **(c)** 0.00126 **(d)** 0.00378 **(e)** 0.0756 **(f)** 1.8144 g **(g)** 1.2856 g **(h)** 41.47%

2 This question tested the candidates on qualitative analysis skills. The candidates were provided with solid **T** (a mixture of iron(III) sulphate, $Fe_2(SO_4)_3$ and calcium carbonate, $CaCO_3$) and solid **S** (potassium iodide , KI) to identify the cations in the mixture and eventually identify the reaction that occurred in one of the tests. The question was fairly done. The majority of candidates made correct observations, but some candidates failed to record them in a scientific language. The reporting led to candidates either contradicting themselves for instance reporting formation of solution and precipitate at the same time or reporting everything for the same observation for examples formation of precipitate and solubility. Just like in the previous years, candidates lost marks on solubility of precipitates as a result of recording solubility too early e.g. at (b)(i) instead of at (b)(ii).

(b) **(i)** Some candidates reported brown precipitate in this part question. That resulted in the candidates scoring just one mark for the precipitate and loose a mark for the colour. The expected response was white ppt.

(ii) This part question was on solubility of the precipitate. It was well done. Most candidates reported 'insoluble ppt' and scored a mark. In cases where they lost the mark, they had reported on solubility at (b)(i). Most candidates this year did not confuse residue with a precipitate. Centres are commended for a good job done.

(c) This part question on forming a white ppt of barium sulphate. Most candidates scored the mark.

(d) **(i)** The part question was fairly done. Candidates did test for carbon dioxide gas correctly. Candidates that lost a mark had failed to identify the gas. Candidates that lost the 2 marks had failed to state that the solid dissolved or bubbles were formed and just tested the gas without identifying. Some stated the gas without a positive test with lime water.

(ii) This part question was also on formation of a precipitate The part question was well done. The candidates reported a brown precipitate and scored a mark.

(e) **(i)** The part question was poorly done. The candidates that lost a mark because they reported that S dissolved instead of the intensity of the colour of the solution.

(ii) This part question was well done. The candidates reported yellow precipitate.

(f) **(i)** This part question was on poorly done. The candidates were looking for t6he cations or salts in T, instead of what is formed at the reaction. Centres are encouraged to motivate candidates to always read the question and understand why a test is done.

(ii) This part question was poorly done. Most candidates reported displacement instead of redox.

PAPER 5: ALTERNATIVE TO PRACTICAL

General comments

The majority of the Centres did fairly well on this paper. Data presentation was somehow well done. The candidates showed great improvement on the application of significant figures. The candidates recorded correctly the accuracy of the burette. The reporting on qualitative analysis and conclusions has improved compared to the previous years.

Comments on Individual Questions

1 The question examined the candidates on quantitative analysis skills, where they were to determine the percentage mass of impurities. Generally, the question was fairly answered by this cohort.

(a) The part question was on titration and candidates recording the burette readings from the diagrams given. Centres are commended for a good job done in training their candidates. Most of the candidates showed that they were well equipped with skills on data presentation and results treatment. The candidates showed proper skills in dealing with the results as they correctly ticked titres that are closest to each other. Centres are encouraged to continue advising their candidates on why ticking is important, it is not just done randomly but done for a purpose. Ticking results is not for calculating the average volume of acid used to neutralise 25.0 cm^3 of alkali but treating results to obtain accurate findings.

(b) This part question was well done. Majority of the candidates scored the mark showing good understanding of stoichiometry. Those who failed to score the mark mostly it was due to significant figures albeit a few. Significant figures were penalised once and as a result if penalised in (b), candidates will scored a mark in subsequent sub questions irrespective of their significant numbers.

(c) The part question was well done. Candidates were comfortable with mole ratio and in this question it was 3:1 which makes the mark easily accessible.

(d) Candidates were to find the number of moles in stock solution. This part question was fairly done. Candidates that did not do well in this part question, was due to fact that the candidates divided could not realise that the moles in (c) are in 25.0 not stock solution.

(e) This part question was not well done. Candidates did not realise that 3.10 g is the mass of impure lithium hydroxide. They multiplied the number of moles with 3.10 g instead of molar mass of lithium hydroxide and lost a mark.

(f) Candidates were to subtract the mass of lithium hydroxide from (e) from 3.10 g, the part question was well done.

(g) This part question was well done. Percentage purity was a skill most Centres mastered.

(h) Most candidates at least scored a mark on possible sources of errors. Well done.

Answers: **(b)** 0.00126 **(c)** 0.00378 **(d)** 0.00756 **(e)** 1.8144 g **(f)** 1.29 g **(g)** 41.6%

2 This question tested the candidates on qualitative analysis skills. The candidates were provided with solid **T** (a mixture of iron(III) sulphate, $Fe_2(SO_4)_3$ and calcium carbonate and $CaCO_3$) and solid **S** (potassium iodide, KI). The candidates were requested to give observations and possible tests given some information and conclusions made on the sample. This question was well done.

(a) In this part question the candidates were to give the conclusion based on the observation given (brown solid). The mark was easily accessible. Transition metal suspected.

(b) **(i)** The part question was well done. The majority of the candidates gave the expected observation that is white ppt. Centres are encouraged to coach their students on colour of precipitates.

(ii) Most candidates talked about solubility before even adding excess alkali hence lost the mark.

(c) This part question was fairly done. Most candidates reported either 'sulphate ions and they scored a mark.

(d) **(i)** The part question was fairly done. Candidates did test for carbon dioxide gas correctly. Candidates that lost a mark had failed to conclude that the carbonate is present. Candidates that lost the 2 marks had failed to state that the solid dissolved or bubbles were formed and just tested the gas.

(ii) The candidates had to write then add sodium hydroxide, but they wrote excess hydroxide. It was well done. Those who lost a mark did not report brown ppt at observation.

(e) **(i)** This part was on identification of the redox reaction. The part question was poorly done. Most candidates reported brown ppt.

(ii) The candidates had to identify solid **S** which was potassium iodide (KI). The part question was poorly done.

(f) This part question was poorly done. Candidates failed to recognize its redox.

(g) This part question was fairly done. Candidates managed to state the name of at least one compound in the mixture.

3 **(a)** This question was on rates of reaction. The candidates displayed lack of knowledge on this subject matter. Centres performed poorly in this question. Most candidates did not measure time or mass. Rate is all about recording time. Candidates either score 3 or less.

(b) Candidates were to sketch the graph expected from the experiment done at (a). candidates performed poorly. Centres are encouraged to emphasise the purposes of the experiments on theory.