L-Università ta' Malta

MATSEC
Examinations Board

Examiners' Report

SEC Chemistry

Main Session 2022

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A. STATISTICAL INFORMATION

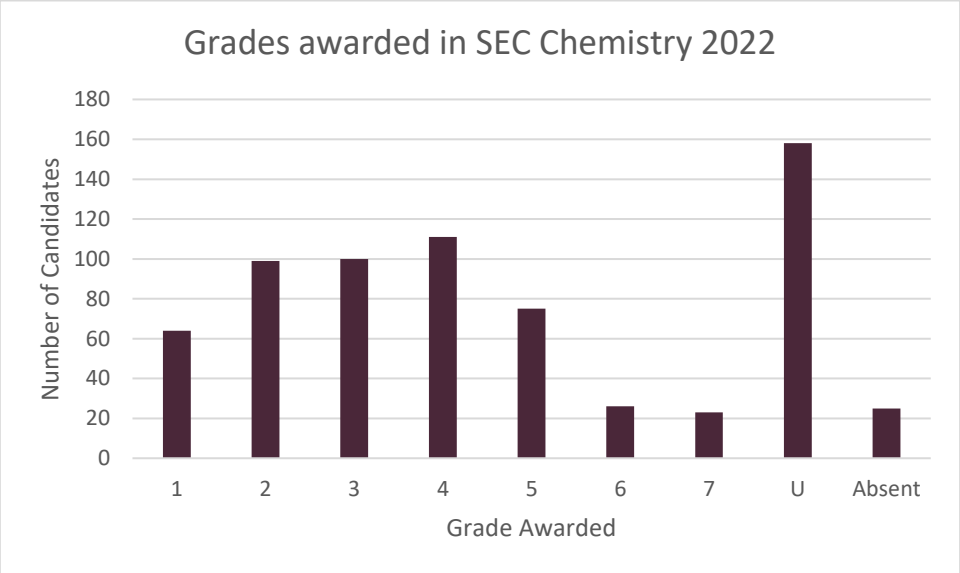
The total number of candidates who registered to sit for SEC Chemistry was **681**, which is **81** candidates less than in 2021. This confirms a trend of decreasing candidate registrations for this subject. Of these registrations, **552** opted for Paper IIA and **129** opted for Paper IIB.

Table 1 shows the distribution of grades for the Main 2022 session of the examination.

GRADE	1	2	3	4	5	6	7	U	ABS	TOTAL
PAPER A	65	100	99	104	67	-	-	110	7	552
PAPER B	-	-	-	6	9	26	23	47	18	129
TOTAL	65	100	99	110	76	26	23	157	25	681
% OF TOTAL	9.5	14.6	14.5	16.2	11.2	3.8	3.4	23.0	3.7	100.0

Table 1: Distribution of grades for SEC Chemistry 2022 Main Session

Figure 1: Distribution of grades for SEC Chemistry 2022 Main Session



B. GENERAL REMARKS

General Remarks on Coursework

The examiners moderated a total of **163** projects in **13** state and church schools. In addition, **16** projects submitted by private candidates were corrected and these private candidates were called for an interview which was held virtually.

Mitigation measures adopted in 2022 meant that candidates had to submit much less laboratory reports as part of their practical component. In addition, candidates could present up to two experiments from each of section a to j. Based on this moderated work, moderators had mostly positive comments and the work was deemed fairly marked by most schools. However, some schools were advised to align practices between different classes and assessors, where relevant. There were a few private candidates who registered as school candidates and, thus, their projects could not be located for moderation in schools. The mark awarded in these cases is 0.

The coursework presented by private candidates was, mostly, of a lower standard than that of school candidates. Many investigations had no or little evidence of planning, some diagrams were with rugged lines or in 3D, and a few interviewed candidates showed no practical knowledge whatsoever of the experiments they claimed to have done.

Statistics for Individual Questions

	Coursework	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Max mark	15	6	6	7	5	6	6	6	7	5	6	20	20
No. of max. marks	107	353	24	74	205	110	296	124	61	214	175	22	33
No. of zeroes	1	0	6	41	33	6	33	19	24	1	2	11	12
Mean (raw)	13.1	5.5	3.2	5.1	3.3	4.0	4.4	4.0	4.2	4.0	4.3	12.0	10.6
Mean (%)	87.2	90.9	53.4	73.5	66.2	66.2	74.0	66.8	60.4	79.9	70.9	60.1	53.0
Median	14.0	6.0	3.0	6.0	4.0	4.0	6.0	4.0	4.0	4.0	4.0	13.0	11.0
Mode	14.0	6.0	3.0	6.0	5.0	3.0	6.0	6.0	6.0	5.0	6.0	18.0	7.0
SD	2.1	0.9	1.3	2.0	1.7	1.5	2.0	1.7	2.0	1.0	1.6	5.6	5.9

Table 2: Paper IIA Candidates Data for Paper I

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
Max mark	6	6	6	7	5	6	7	5	6	6	20	20	20	20
No. of max. marks	25	90	112	31	4	2	179	58	168	37	4	12	1	0
No. of zeroes	101	43	60	31	223	121	48	40	161	147	16	20	20	20
Mean (raw)	2.5	3.9	3.2	3.5	0.9	1.5	3.3	2.7	2.8	2.3	9.8	11.9	8.0	6.7
Mean (%)	41.4	64.4	53.7	49.7	18.7	24.6	46.9	54.3	47.0	38.9	49.0	59.4	40.0	33.5
Median	2.0	4.0	3.0	3.0	1.0	1.0	4.0	3.0	2.0	2.0	10.0	14.0	7.0	7.0
Mode	2.0	4.0	6.0	3.0	0.0	2.0	5.0	3.0	6.0	0.0	13.0	15.0	0.0	0.0
SD	1.7	1.7	2.1	1.8	1.0	1.1	1.7	1.4	2.5	2.0	5.5	5.5	6.1	4.7

Table 3: Paper IIA Candidates Data for Paper II

	Q11	Q12	Q13	Q14
No. of Choices	355	339	178	188
Percentage of Choices	33.5	32.0	16.8	17.7

Table 4: Paper IIA Candidates Choice of Paper II Section B Questions

	Coursework	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Max Mark	15	6	6	7	5	6	6	6	7	5	6	20	20
No. of max. marks	2	26	0	1	1	2	11	2	1	11	0	0	0
No. of zeroes	1	0	9	45	33	12	38	20	35	1	5	22	16
Mean (raw)	10.6	4.4	2.3	2.2	1.1	2.2	1.9	2.0	1.5	3.1	2.4	3.7	3.4
Mean (%)	70.3	72.6	37.6	32.1	21.8	36.7	32.1	34.0	20.8	62.4	39.6	18.4	17.2
Median	12.0	4.0	2.0	2.0	1.0	2.0	1.0	2.0	1.0	3.0	2.0	2.0	2.5
Mode	14.0	6.0	3.0	0.0	1.0	3.0	0.0	2.0	0.0	3.0	2.0	0.0	1.0
SD	3.6	1.3	1.2	2.5	1.1	1.4	2.1	1.5	1.5	1.0	1.1	4.0	3.3

Table 5: Paper IIB Candidates Data for Paper I

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
Max Mark	7	5	6	6	5	6	6	7	6	6	20	20	20	20
No. of max. marks	20	11	4	0	0	0	1	1	6	2	0	0	0	0
No. of zeroes	1	18	20	6	70	9	28	7	35	79	15	10	1	5
Mean (raw)	5.2	2.4	1.9	2.6	0.3	1.7	1.6	3.1	1.8	0.4	3.7	5.3	8.2	5.9
Mean (%)	74.4	47.6	32.1	43.7	5.9	28.9	27.2	44.7	30.5	6.7	18.5	26.4	41.0	29.5
Median	6.0	2.0	2.0	3.0	0.0	1.0	2.0	3.0	1.0	0.0	2.0	5.0	8.0	6.0
Mode	6.0	2.0	1.0	3.0	0.0	1.0	0.0	4.0	0.0	0.0	0.0	0.0	10.0	7.0
SD	1.5	1.7	1.6	1.5	0.5	1.1	1.4	1.7	1.9	1.1	3.8	4.9	3.4	3.6

Table 6: Paper IIB Candidates Data for Paper II

	Q11	Q12	Q13	Q14
No. of Choices	46	42	42	56
Percentage of Choices	24.7	22.6	22.6	30.1

Table 7: Paper IIB Candidates Choice of Paper II Section B Questions

A comparison of the tables above exposes the wide differences between Paper A and Paper B candidates. For instance, while 63.9% of Paper A candidates scored full marks in Paper 1 Question 1, only 20.1% of Paper B candidates did so.

General Remarks on the Written Examination

A good number of candidates showed mastery of chemistry at this level. However, the difference between the high achieving and low achieving candidates in this subject is huge, with a good number of IIB candidates answering most questions incorrectly or leaving a good percentage of the examination paper unanswered.

Some candidates still lack an understanding of basic terms and concepts of chemistry while others seem to be unaware or not knowledgeable of some parts of the syllabus. Questions on laboratory experience or observations seemed to pose a challenge to candidates this year. This was more pronounced if the laboratory practice referred to is not a standard experiment which is carried out in most schools or explained in textbooks. Of course, candidates are expected to be able to understand and apply chemical knowledge to a simple laboratory setup.

In other cases, presentation of diagrams or mathematical calculations was not neat. Although marks will not be deducted for untidy work, work that is illegible cannot be properly marked. As for mathematical calculations, marks for individual steps are awarded to candidates who show these. Obviously, candidates who do not show their working and obtain an incorrect answer can be awarded no marks at all.

C. COMMENTS ON PAPER I AND PAPER II

Paper I Section A

Question 1

Candidates did well in this question with a considerable percentage of Paper A candidates being awarded full marks. However, a number of misconceptions about electrons emerged with some candidates indicating these are found in the nucleus of the atom, are positively charged, and have the same mass as protons.

Question 2

Although candidates did generally well in the first part of this question, few managed to obtain full marks. The commonest mistake was not knowing that a sugar solution is neither acidic nor alkaline. The second part of the question was generally poorly answered with the commonest wrong answer being that methylbenzene is alkaline or otherwise neutralises acids.

Question 3

Parts (a) and (b) of this question were mostly well-answered. The opposite is true for part (c) with candidates referring to several properties of sulfuric acid not related to the question. Very few candidates actually referred to the insoluble calcium sulfate acting as a protective barrier.

Question 4

A considerable number of attempts suggested no difference between a Group I nitrate and other nitrates and stated that nitrogen dioxide would be formed in the reaction. In part (c), a considerable number of candidates simply added the elements together to come up with CuH_2O_2.

Question 5

It was unfortunate to see that many tried to include manganese(IV) oxide in the reaction, suggesting various compounds of manganese as products. Some wrote the symbol of manganese as 'Mg'. Some of the diagrams provided as answers were very untidy. A burette, funnel, and thistle funnel were incorrectly suggested as being Apparatus B.

Question 6

Many attempts to Question 6 were correct. While candidates who showed their working were awarded marks for the various steps even if their final answer was incorrect or included arithmetic error, candidates who did not show working could not be awarded these marks whenever the answer was incorrect.

Question 7

Parts (a) and (b) of this question were generally well-answered. However, several attempts exhibited difficulty in explaining the oxidising nature of chlorine in terms of electrons. A number of attempts explained so in other terms, usually in terms of oxidation states.

Question 8

Most attempts showed awareness of the toxicity of carbon monoxide but fewer explained clean fuels. While attempts to part (c) gave several correct methods of removing carbon dioxide, suggesting using water to do so got no credit. In addition, suggesting the extinguishing of a flame as a definitive test for carbon dioxide was also marked incorrect.

Question 9

Many Paper A candidates obtained full marks in this question. Attempts which were wrong usually contained errors in parts (d) and (e).

Question 10

Incorrect attempts to part (a) included semi-conductor, electrodes, and decomposers. Copper and iron were sometimes suggested as answers to part (b)(i) but other parts of this sub-question were generally correct. Most difficulties were noted in part (c) with mistakes including switching answers to parts (i) and (ii), giving water as the only product in part (ii), and using items from the word bank in part (b) to answer the question.

Paper I Section B

Question 11

Most definitions of a standard solution were correct. A common error was stating that these are solutions of a fixed volume. Other blunders included defining it as a solution which is neutral or that it reacts with an acid or base.

There were several correct answers to part (b) which described adding distilled water to the weighing boat and adding the washings to the beaker. 'Quantitative transfer' gives no indication as to how this is carried out and was awarded no marks. Attempts to part (b)(ii) were varied. Valid answers that were accepted mentioned how some solid sticks in the grooves/pores of the filter paper and the fact that such solid particles cannot be rinsed and washed into the beaker. However, other answers suggested the filter paper would dissolve or react. Part (iii) was generally well answered with incorrect units being the commonest limitation shown.

Part (c)(i) was usually properly answered although quite some attempts suggested using a measuring cylinder (or even a beaker) to measure volume in a titration. The commonest mistake to part (ii) was using all four readings provided to calculate the average. Parts (iii) and (iv) were well-attempted although many attempts could not explain why universal indicator is not used in a titration with some suggesting it would react with either acid or alkali. In the calculation to part (c), answers presented based on first principles usually fared much better than those attempting to solve the question using equations.

Question 12

The answers to this question were typically either very good or poor. Lack of necessary oxidation states in names of compounds with transition elements led to several instances where marks were lost. Quite a few candidates, especially Paper B candidates, were not well-prepared in this topic and just filled up the blanks with irrelevant chemical elements.

In part (a), F and H were often correctly identified while bromine was sometimes suggested as incorrect answer to G. In the subsequent part, silver was often thought to be divalent, suggesting $AgCl_2$ for K. M was often correctly identified in part (c) but a variety of sodium compounds, typically NaCl, were suggested for L. Sulfur and sulfur dioxide were regularly identified for N and O respectively in part (d), but several suggested sulfuric acid as being P. In the final part of this question, several answers left out or incorrectly stated the oxidation state of lead. Other attempts suggested zinc oxide due to the change in colour, although the crackling sound on heating described in the question is typical to lead(II) nitrate.

Paper IIA Section A

Question 1

Part (a) was usually correctly answered. However, explanations suggested for the two components in part (b) were frequently incorrect, suggesting difficulties with understanding of concepts. Attempts could not state that ionic compounds form ions when in aqueous solution, hence it is the ions rather than electrons which carry the current.

Question 2

Answers to both parts of this question were usually correct. However, a considerable number of attempts to part (a) simply stated speed (or similar) to try to define rate while others mentioned the change in concentration of reactant/s or product/s but omitting reference to time.

Question 3

Attempts exhibited little difficulties with this question except those with improvised versions of the experiment.

Question 4

Most difficulties were encountered in parts (c) and (d) of this question. Attempts to part (c) implied difficulties with understanding of concepts. A few attempts also had difficulties with defining a saturated solution in part (a).

Question 5

Many attempts did not seem to realise that both reactants in this reaction are soluble and suggested that the product may be obtained by filtration. Lack of knowledge of the titration method to prepare a soluble salt is shown in most attempts. A few of those which did refer to this method forgot repeating the experiment without the indicator.

Question 6

Many answers to part (a) incorrectly stated that sample Z was soft water or had no hardness at all while in part (b) they failed to refer to both types of hardness present in the sample. Unfortunately, the wording in part (c) on the examination was opposite to that stated in the question's introduction. It was evident that a number of attempts were confused by this and it was decided that all marks would be given to all candidates in this part. Attempts to part (d) failed to refer to the formation of scum with traditional soap as opposed to synthetic detergents.

Question 7

Many answers to part (a) seemed to think that bending a chain will result in a new isomer. This is a common mistake at this level. Marks for naming of isomers were awarded to all candidates as this part was deemed to be out of syllabus.

Question 8

Candidates did generally well in this question.

Question 9

A mediocre number of attempts to part (a) were correct. However, some did not realise that this answer must be used in (b). Others resorted to their perceived stoichiometry of lead oxides rather than working out the question mathematically. This in turn yielded many problems.

Question 10

Attempts to this question were generally either mostly correct or with several errors indicating little knowledge about polymerisation.

Paper IIA Section B

Question 11

Responses to this question were mostly adequate. In part (a) several attempts failed to explain that a large amount of energy is required to break the triple covalent bond present between two nitrogen atoms. In part (b), (c) and (d) candidates showed an overall adequate knowledge of the Haber process and the factors related to it. However, some steps or conditions were omitted in some of the responses. In part (e) candidates should have used ammonia not ammonium hydroxide as it is the ammonia which is present (and reacts) in ammonia solution. In part (f) some attempts made several mistakes related to the exponentials in the question while in part (g) incorrect formulae for ammonium sulfate were used.

Question 12

The quality of responses to this question was similar to that of the previous question. The main hurdles were omitting steps and incorrect conditions for the reactions while in part (e) some attempts gave a use of dilute, rather than concentrated, sulfuric acid.

Question 13

Most attempts showed difficulty with the definition of enthalpy of neutralisation because they did not refer to the formation of one mole of water. In part (b), many candidates drew the apparatus used for other experiments with enthalpy, mainly for the determination of enthalpy of combustion of alcohols (which obviously does not apply). Candidates did generally better in parts (c), (d), and (e).

Question 14

Candidates did generally well in the first parts of the question which targeted the preparation of dry chlorine in the laboratory. One of the major errors was the omission of the water which removes HCl. Another error was the drawing of a thistle funnel whose end was out of the solution. On the other hand, most candidates knew that chlorine is denser than air so it should be collected by downward delivery. In part (b) the test for chlorine was mostly given correctly. The same cannot be said for part (c), as even though some gave the correct equation, very few candidates were able to name the hypochlorite ion as the ion which causes the bleaching effect.

Paper IIB Section A

Question 1

A good number of attempts to this question were of relatively good quality.

Question 2

A large number of attempts did not recognise factors influencing the rate of certain reactions, mainly light intensity and catalysis.

Question 3

Attempts to this question suggest that knowledge of the air, its composition, and experiments related to it is lacking. Many attempts to this simple question were incorrect.

Question 4

Most attempts to this question suggest that candidates are able to read and interpret a graph (solubility curve). However, very few attempts could correctly define a saturated solution.

Question 5

Attempts to this question were, in general, very poor. Some attempts did manage to start the process, by listing one correct or somewhat correct step, however no mastery was shown and a correct procedure to fully prepare and collect any of the salts was rarely written.

Question 6

Attempts to this question were better than those to question 5, suggesting some better understanding of the topic of water hardness. Very few attempts did, however, write down a correct equation for part (c). This is synonymous to the Paper B candidates whereby questions seeking chemical equations are very rarely answered correctly.

Question 7

A number of attempts seem to suggest that bending a carbon chain results in a new isomer. In part (c), many ignored or did not understand the term 'unsaturated'. Marks for naming of isomers were awarded to all candidates as this part was deemed to be out of syllabus.

Question 8

The True or False part of the question resulted in candidates obtaining quite some marks when compared to other questions. Attempts were of a much lower quality when it came to answering other parts of this question.

Question 9

A large number of candidates did not attempt this question at all. Others did not "deduce" a formula for lead oxide from the other parts of the question, but simply stated one oxide of lead and answered part (e) using this invented oxide. However, there were a number of very good attempts to this question suggesting mastery of mathematical concepts in chemistry among some candidates.

Question 10

While most candidates did not attempt this question or parts of it, most of those who did fared badly. This was a simple question about polymerization.

Question 11

In part (a) few attempts stated that a triple bond requires a lot of energy to break, even though most stated the presence of the triple bond. In part (b) many named the wrong process. Parts (c) and (d) were the better answered parts of the question suggesting some knowledge about the Haber process. In part (e) many different pathways for producing ammonium sulfate were suggested, but seldom the correct one. Formulae of compounds were incorrectly written. Attempts showed a somewhat better ability with the mathematical parts of the question among some candidates.

Question 12

Most attempts could state the allotropes of and chemical test of sulfur in parts (a) and (c) respectively. However, they fared poorly at writing chemical equations for either parts (b) and (d).

Question 13

Most attempts to this question did fairly at ordering the jumbled experimental procedure provided in part (b) but performed poorly in all other parts of the question. Most attempts defining the heat of neutralisation did not refer to the formation of one mole of water. Many diagrams provided to part (c) did not tally with the experimental procedure provided. Many included a Bunsen burner. In part (e) and (f) a relatively low number of attempts provided accurate results and very few of the energy level diagrams provided to part (g) were acceptable.

Question 14

There were many attempts to this question when compared to the other three in this section. However, the apparatus provided in part (a) was usually incorrectly assembled while some decided to use different apparatus than that provided. As in the previous question, only attempts to part (b) were of good quality. Again, this involved putting in order a jumbled up experimental procedure. Most of the parts of the other parts of the question were poorly answered except for part (f) where candidates had to state the test for chlorine gas.

D. Concluding Comments

Candidates' performance in Paper I varied drastically between those candidates opting for Paper IIA and those opting for Paper IIB. In general, most attempts provided by IIB candidates were of poor quality and the overall mark obtained by candidates was consequently very low. The tables presented at the beginning of this report illustrate this clearly.

This year's Paper IIB covered the same topics as Paper IIA, however simpler questions with more scaffolding were presented. Nevertheless, the performance of IIB candidates left much to be desired. Given this poor performance, the number of candidates sitting for Paper IIB, and the number of empty responses, a detailed report on each question of this paper was difficult to compose, as evidenced by the length of this section of this report in comparison to the equivalent section for Paper IIA candidates.

Chairperson
Examination Panel 2022