Province of the EASTERN CAPE EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo
Provinsie van die Oos Kaap: Department van Onderwys
Porafensie Ya Kapa Botjahabela: Lefapha la Thuto

EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
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2025 NSC CHIEF MARKER'S REPORT

SUBJECT	**PHYSICAL SCIENCES**		
QUESTION PAPER	**2**		
DURATION OF QUESTION PAPER	**3 HOURS**		
PROVINCE	**EASTERN CAPE**		
NAME OF THE INTERNAL MODERATOR	**MS. E. L. FILANDER**		
NAME OF THE CHIEF MARKER	**MS. L. VAN HEERDEN**		
DATES OF MARKING	**2 DECEMBER – 12 DECEMBER 2025**		
HEAD OF EXAMINATION:	**MR. E. MABONA**		

SECTION 1: (General overview of Learner Performance in the question paper as a whole)

The Rasch Analysis reveals that the candidates' average score for the paper is 48% based on the 100 scripts sample. The populations size has increased from 35 465 candidates in 2024 to 36 372 in 2025 (2,49%).
The questions that scored the highest % are: Question 3 (Organic molecules: physical properties) with a score of 61%; Question 2 (Organic molecules: nomenclature and structures) with a score of 55%. Question 5 (Reaction rates) with a score of 52%. Poorly answered questions include: Question 9 (Electrochemistry: Electrolytic cells) with a score of 34%. Question 7 (Acids and Bases) with a score of 41%. Question 8 (Electrochemistry: Galvanic cells) with a score of 44%.

The following sub-questions were poorly answered by the candidates:

4.2.2 One change, besides temperature, observed in the reaction mixture (8%).

2.3.2 Calculating V_{total} of gases at the end of the reaction (14%).

7.1.5 Balanced chemical equation: hydrolysis of sodium hydrogen phosphate (21%).

6.1.3 Explanation using Le Chatelier's Principle (22%).

9.2.2 Relative strength of oxidising agent (24%).

8.4 Mass calculation of $Al_2(SO_4)_3$ (26%).

7.2.2 Calculating number of moles of $Ba(OH)_2$ used to prepare $100 cm^3$ solution (27%)

4.1.6 Reaction conditions for an elimination reaction (29%).

9.2.3 Calculating change in mass of electrode R (refining of copper) (29%).

1.9 Galvanic cell: Pt electrode at the cathode (30%).

6.1.2 Application of Le Chatelier's Principle (32%).

5.3.4 Effect of change in concentration on ΔH (33%).

1.6 Energy and change: Endothermic reaction (34%).

4.2.4 Reaction between a halogen and an alkene (35%).

8.2 Galvanic cells: change in concentration (35%).

9.2.1 Change in concentration during refining of copper (38%).

5.2.2 Calculating reaction rate (39%).

1.8 Understanding pH (40%).

1.3 Properties of structural isomers (41%).

4.2.1Definintion of "cracking" (41%).

5.2.3 Reactant in excess (43%).

6.2.2 Application of Le Chatelier's Principle (43%).

1.10 Electrolytic cell: Identifying the anode and the reaction at the cathode (43%).

1.4 Factors affection reaction rate (46%).

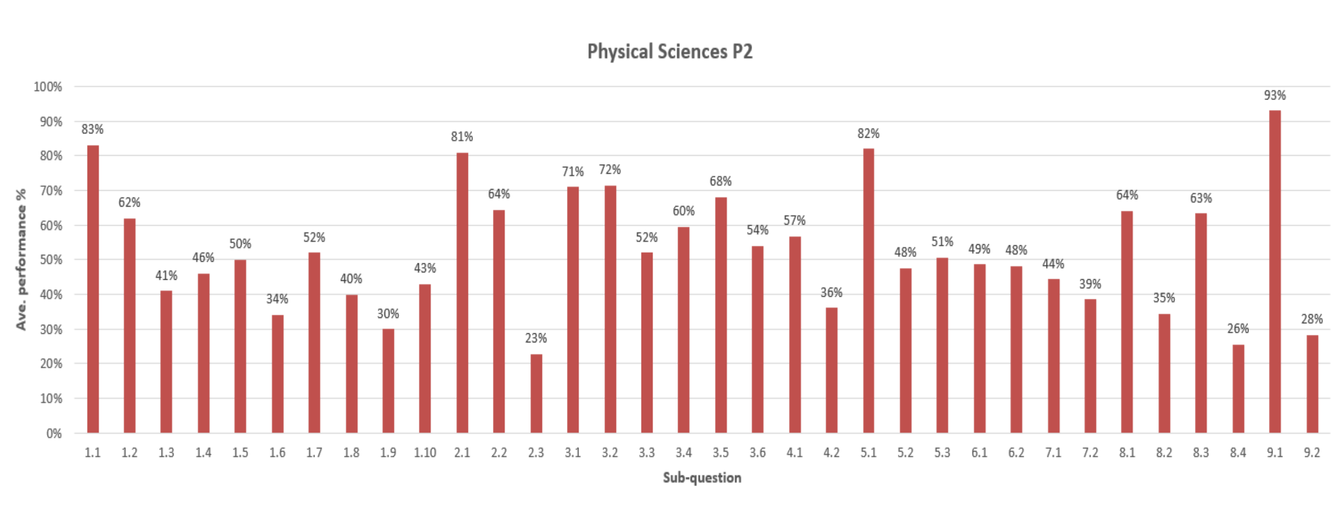
6.2.3 Calculating mass of NH_4HS at equilibrium (46%).

4.2.3 Structural formula (47%).

5.2.4 Interpretation of reaction rate graph (47%).

7.1.4 Hydrolysis: Acidity or basicity of the product (47%).

The graph below shows the average percentage per sub-question in the 2025 NSC examination, based on information from the RASCH Analysis.

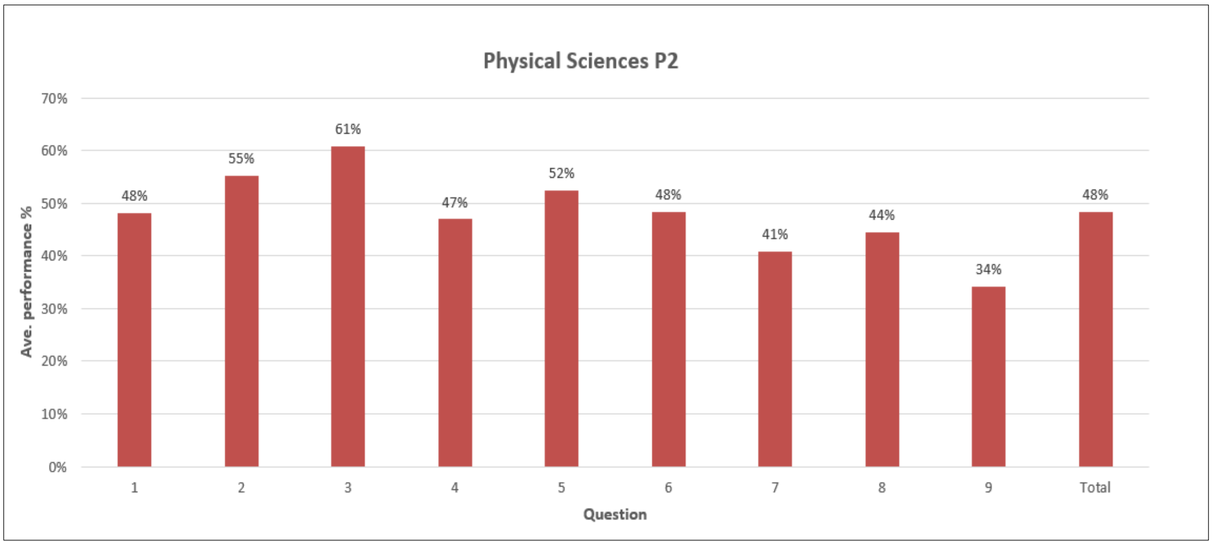


Sub-Question	Topic	Sub-Question	Topic
1.1	Nomenclature	**5.1.**	Define reaction rate
1.2	Organic reaction	**5.2.1**	At which time 10s and 30s is the reaction rate higher
1.3	Nomenclature	**5.2.2**	Calculate the average rate at which CO_2 is formed in the first 10s
1.4	Rate of the reaction	**5.2.3**	Which reactant is in excess?
1.5	Chemical Equilibrium	**5.2.4**	How will the smaller sealed container affect the magnitude of the gradient of the graph? Explain.
1.6	Energy and change	**5.3.1**	Was there a net release or net absorption of energy during the reverse reaction
1.7	Acids and Bases	**5.3.2**	Define the term activated complex
1.8	Acids and Bases	**5.3.3**	A catalyst is added to the reaction. Explain in terms of collision theory why reaction rate increase
1.9	Galvanic cell	**5.3.4**	When more SO_2 is added ,how it will affect the heat of reaction
1.10	Electrolysis	**5.3.5**	Redraw the graph, on the same axes draw the curve that will be obtained when more SO_2 is added
2.1.1	Write down letter that represent an alcohol	**6.1.1**	State Le Chatelier's principle
2.1.2	Write down letters that represent compounds that are functional isomers	**6.1.2**	What effect does the addition conc. HCl on the mass of the $Ca(OH)_2$

2.1.3	Write down letters that represent compounds that belong to the same homologous series	**6.1.3**	Explain the answer to Q6.1.2 using Le Chatelier's principle
2.2.1	Write down the IUPAC of compound A	**6.2.1**	Is the decomposition of NH_4HS an EXOTHEMIC or ENDOTHERMIC
2.2.2	Write down the IUPAC of compound B	**6.2.2**	Explain the answer to Q6.2.1 using Le Chatelier's principle
2.2.3	Write down the IUPAC of compound G	**6.2.3**	Calculate the mass of NH4HS that will be present at equilibrium
2.2.4	Write down the structural formula of two straight-chain positional isomers of D	**7.1.1**	Which one is the stronger acid: $H_2PO_4^-$ or $H_2PO_4^{2-}$
2.3.1	Write down the name of the type of reaction	**7.1.2**	Write down the FORMULA for the conjugate base of H_2PO4^{2-}
2.3.2	Calculate the total volume of the gases present in the containers	**7.1.3**	Identify a substance behaving as an ampholytes in the reactions above
3.1	Define the term homologous series	**7.1.4**	Will the solution be acidic or basic when Na_2HPO4 dissolve in water
3.2	Identify the TWO homologous series to which the compounds	**7.1.5**	Write a balanced equation to explain the answer to Q7.1.4
3.3.1	Write down the structural formula of compound A	**7.2.1**	Calculate the final concentration of the hydroxide ions in the flask
3.3.2	Write down the IUPAC name for a possible compound B	**7.2.2**	Calculate the number of moles of $Ba(OH)_2$ used to prepare the 100cm3 solution
3.4.1	Write down the strongest type of IMF in Compound A.	**8.1**	Define the term electrolyte
3.4.2	Write down the strongest type of IMF in Compound B	**8.2**	Which ions will increase Al^{3+} or Zn^{2+} will increase. Give a reason for the answer
3.5	Which compound has A or B, has a higher boiling point? Give reasons for the answer	**8.3**	Write down the cell notation for this cell
3.6	How will the BP of A be affected when measured under lower atmospheric pressure	**8.4**	Calculate the mass of $Al_2(SO_4)_3$ needed to prepare the 250cm^3 solution
4.1.1	Write down the IUPAC name for a possible compound W	**9.1**	Is this an electrolytic cell or a galvanic cell?
4.1.2	Write down the name or formula of R	**9.2.1**	How will the concentration of Zinc ions be affected during the refining of the copper

4.1.3	Write down the two names for the type of reaction in reaction 1	**9.2.2**	Will the amount of copper ions increase or decrease? Explain the answer
4.1.4	Write down the name or formula of S	**9.2.3**	Calculate the change in mass of electrode R after T hours
4.1.5	Write down the structural formula of compound T	**8.1**	Define the term electrolyte
4.1.6	State reaction condition for the conversion of compound W to T	**8.2**	Which ions will increase Al^{3+} or Zn^{2+} will increase? Give a reason for the answer
4.2.1	Define cracking	**8.3**	Write down the cell notation for this cell
4.2.2	State besides temperature that will be observed when the mixture is bubbled in bromine gas	**8.4**	Calculate the mass of $Al_2(SO_4)_3$ needed to prepare the 250 cm^3 solution
4.2.3	Write the structural formula of X		
4.2.4	Which compound X or C_4H_{10} reacts faster with Br_2		

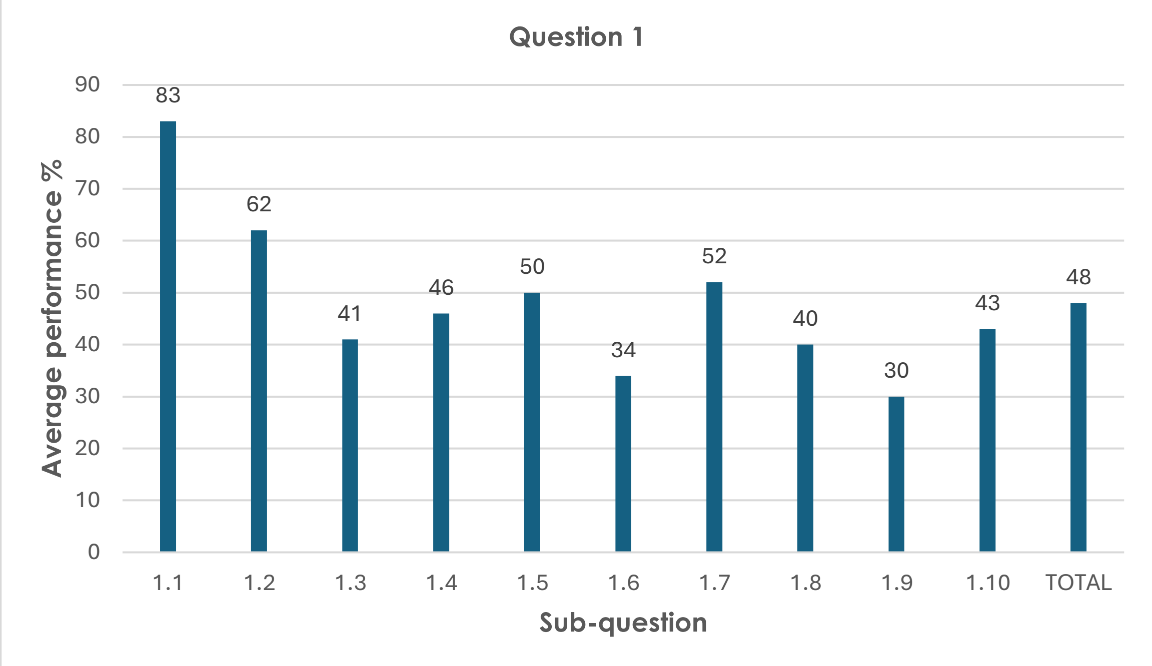
The graph below shows the average performance per question in the 2025 NSC examination, based on the information from the RASCH Analysis.



Question	Topic	Ave. performance %
1	Multi-choice questions	48%
2	Organic nomenclature, structures and combustion and calculating VT(gas)	55%
3	Physical Properties (Vapour pressure).	61%
4	Organic reactions	47%
5	Rate of reaction	52%
6	Chemical Equilibrium	48%
7	Acids and Bases	41%
8	Galvanic cells	44%
9	Electrolytic cells	34%
Total		**48%**

SECTION 2: Comment on candidates' performance in individual questions

QUESTION 1:



(a) **General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?**

- Candidates recorded a score of 48%, lower than the 53% scored in 2024.
- Best performing question was 1.1, scoring 83%, followed by 1.2 at 62%.
- Sub-questions poorly answered were 1.9 (30%), 1.6 (34%), 1.8 (40%), 1.3 (41%) and 1.10 (43%).

(b) **Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**

Q1.9

- Candidates were unable to identify the Pt electrode at the cathode in the $Fe^{3+}{}_{(aq)}/Fe^{2+}{}_{(aq)}$ half-cell.

Q1.6

- Candidates failed to see the term "endothermic", hence ΔH is positive.

Q.1.8

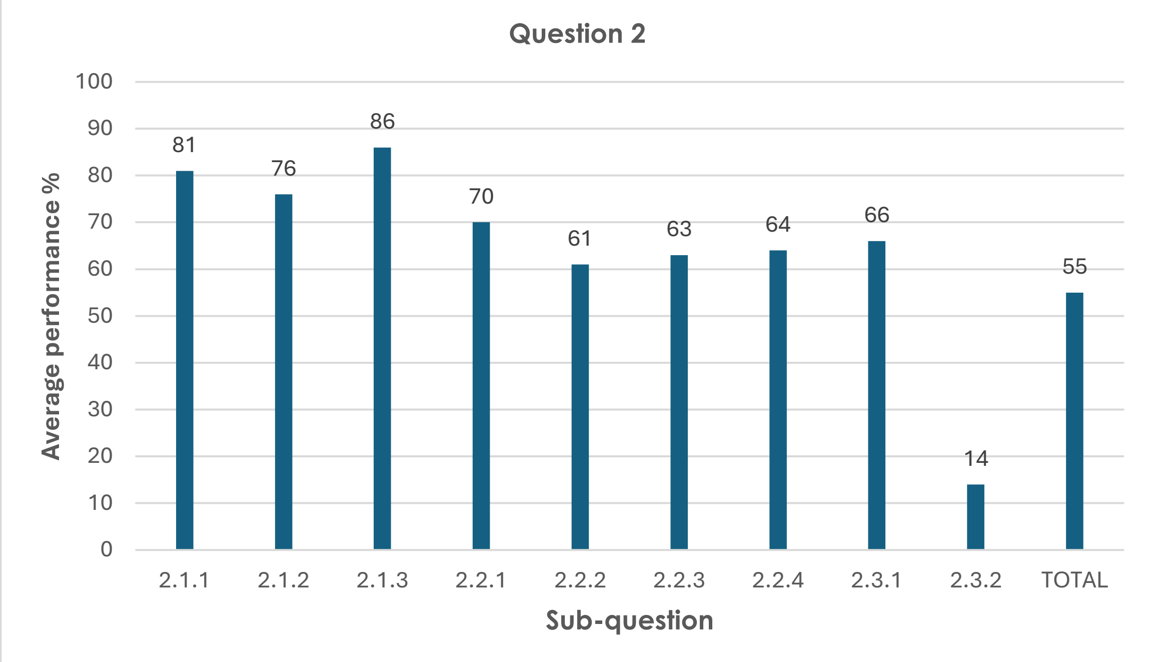
• Candidates had to understand the concept pH, linking lower pH to stronger acid and higher pH to stronger base. Candidates could not arrange the substances in order of increasing pH (acids below 7, bases above 7).
Q1.3 • Candidates did not know the definition of structural isomers.
Q1.10 • Most candidates could not interpret this electrolytic cell. They could not differentiate between the anode and the cathode as well as the reaction occurring at the cathode.

(c) **Provide suggestions for improvement in relation to Teaching and Learning.**
Q1.9 • Educators must teach learners that of the half-cell contains two aqueous solutions, then an inert (solid) electrode is needed for electron transfer.
Q1.6 • Educators must emphasise the difference between endo- and exothermic reactions using energy profile graphs.
Q1.8 • Educators must link pH to strong / weak acids & strong / weak bases. Learners become confused with the pH scale.
Q1.3 • Educators must apply English across the Curriculum. This is an application of a basic definition, but learners do not understand the definition. They memorise definitions through rote learning instead of UNDERSTANDING the concepts.
Q1.10 • Educators should do different examples of electrolysis, electroplating, refining of metals to expose learners to as many questions as possible. Candidates displayed a poor understanding of oxidation and reduction processes in the cell.

(d) **Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**

- Educators must guide and learners must practice the skill of eliminating incorrect answers.
- Assessing multiple choice questions on a regular basis in tests and in all topics.
- Educators must teach all the content that learners are supposed to learn according to the CAPS document, Examination Guidelines and ATP.
- Using past papers as a resource for revision to expose learners to different types of questions.
- Subject Advisors / Lead teachers / Educators should compile a booklet of multiple-choice questions arranged according to topics for schools. These questions can be used for weekly assessments. In cluster meetings and subject clinics, the different strategies to answer multiple-choice questions should be discussed so that educators will be able to help learners tackle multiple-choice questions. Subject advisors should monitor whether teachers are preparing learners to answer multiple-choice questions in class when they visit the school to monitor curriculum coverage.
- Learners must be taught not to leave multiple choice questions unanswered as there is no negative mark for an incorrect answer. They should rather take a guess if they do not know the answer.
- This section accounts for 13,3% of the total marks in the question paper and it is important for learners to practice the skill of answering multiple choice questions. These questions can be used as a quick test to see if learners know their theory without taking a lot of time to mark. Teachers should use them as continuous assessment or as spot tests once a topic is completed to test the learners' level of understanding. Learners must be guided to eliminate the wrong answers through regular practice and assessment. They should not just be given the answer but should be provided with the reasoning behind the answers.
- Candidates' confidence in answering the rest of the paper depends on how they perform in the multiple-choice questions, which are the first question. More practice is needed in preparing the learners for multiple-choice questions of higher cognitive levels. After each concept, learners should be exposed to different multiple-choice questions from the topic, and they should also be included in the informal tests. Learners must be taught the different strategies to answer the multiple-choice questions such as comparison, elimination, etc., which could be applied to most of the multiple-choice questions.

QUESTION 2



(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Q2

- Was not answered well.
- The average score for question 2 was 55%, compared to the 70% of 2024.

- The sub-question with the lowest score was 2.3.2 (14%) – volume calculation.
- Questions 2.1.3 and 2.1.1 scored the highest with 86% and 81% respectively.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q 2.1.2

- Many candidates could not identify functional isomers.

Q 2.2.1

- Many candidates wrote "but-one", "but-2-one."
- Many candidates wrote 'methly."
- Many candidates omitted the hyphens.
- Incorrect numbering.

Q 2.2.2

- Many candidates omitted the "di", they only wrote "chloro" or "methyl."
- Many candidates are putting a hyphen between the names, e.g. "dimethyl-heptane."
- Candidates were unable to identify the longest chain, e.g. "octane."

• Position of the side chain (substituent) are not numbered correctly.
Q 2.2.3 • Candidates failed to write the substituents in alphabetical order.
Q 2.2.4 • Candidates were unable to write the position of the functional group. Instead of the first carbon, it was placed on the second carbon atom. • They drew the chain isomer instead of a positional isomer. • Incorrect number of bonds around C-atom. • Candidates wrote – HO, instead of – OH. • Drawing mirror images of the same structure.
Q2.3.2 • Candidates did not identify the limiting reagent in this calculation and therefore they could not follow through with the calculation. • Incorrect conversion of cm^3 to dm^3. • Most candidates used the molar volume formula. This formula can only be used for gases at STP. • Candidates were not subtracting the excess oxygen left in the container.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Q2.1.2 • Educators must use both structural – and condensed structural formula when exposing learners to isomerism.
Q2.2.1 – Q2.2.3 • Follow the IUPAC rules of nomenclature. • Practice identifying the longest carbon chain, especially when it is not a straight chain. • IUPAC rules on nomenclature should be taught and practiced regularly when teaching IUPAC naming. • Examination Guidelines 2021, Chief Marker's Report and the DBE Diagnostic report should be used WITH the CAPS document when preparing and planning for a lesson (so that educators can see the depth/extent of a specific topic). • Develop exercises that address the IUPAC naming. • Teach learners the structural formulae of the functional groups of the different homologous series. • For IUPAC naming, it is important to emphasise the following sequence: 1. Identify the longest carbon chain which gives the correct parent name. 2. Start numbering from the side giving the functional group the smallest number.

3. The functional group of haloalkanes do not get preference over the alkyl groups. Therefore, numbering should not necessarily start from the side closest to the halogen. Instead, numbering should start from the side giving substituents, halogen and alkyl, the lowest total number.

- Substituents must be written in alphabetical order in IUPAC names, regardless of their position in the longest chain. Numbers of substituents indicate the position of the substituents in the longest chain.

Q2.2.4

- Educators must train learners on how to change the position of the functional group or substituent in positional isomers.
- Candidates must be taught the difference between a chain isomer and a positional isomer.

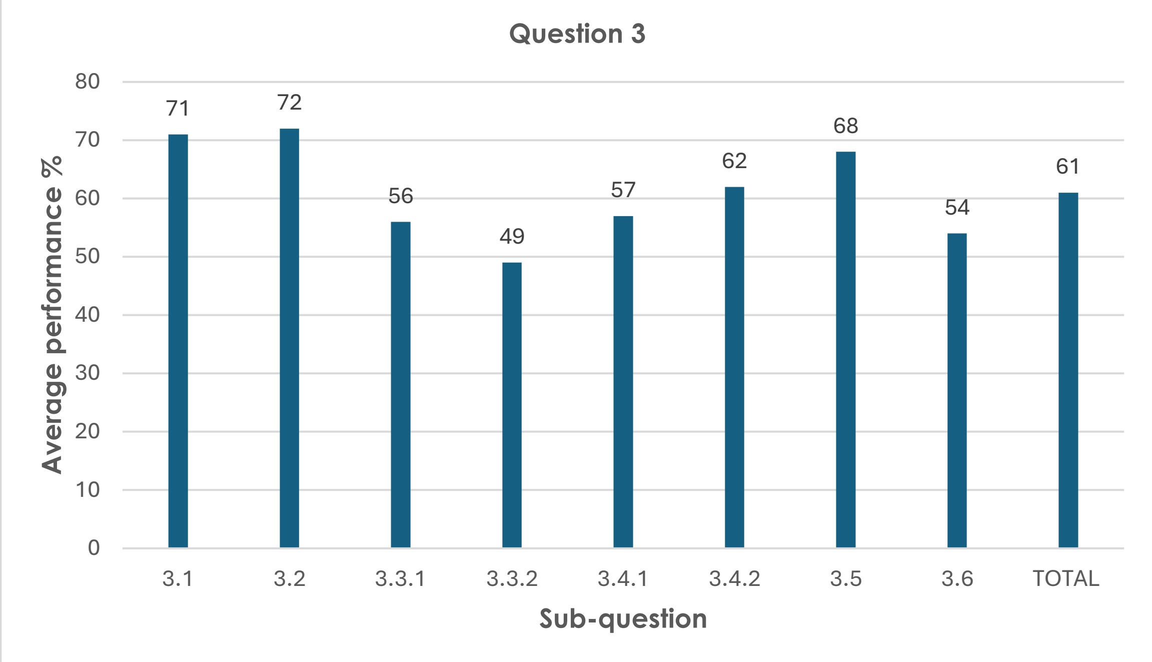
Q2.3.2

- Educator must teach volume – volume ratio's [See grade 10 CAPS / Examination Guidelines / ATP].
- Learners must be taught that the molar volume formula may only used for gases at STP.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

- When drawing structural formulae, learners should be encouraged to count the number of bonds drawn around atoms to eliminate unnecessary errors. They need to be reminded that a carbon atom cannot have less than or more than 4 bonds around it.
- Frequent informal tests should be used to ensure that learners write definitions correctly. Often, learners write different interpretations of a definition, and they usually end up with incorrect or partially correct statements.
- Emphasis should be placed on the difference between molecular formulae, structural formulae and condensed structural formulae.
- Educators should apply different assessment methods, e.g. learners should be able to write the structural formula and condensed formula from the IUPAC name and vice versa.
- Learners forget this topic easily as it is taught in the first term. Educators should revise organic chemistry by giving worksheets regularly and testing different concepts from the topic throughout the year to overcome this problem.

QUESTION 3



(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Q3

- Candidates recorded a score of 61%.
- Candidates scored the highest in 3.2 (72%) and 3.1 (71%)
- The lowest scoring sub-questions were 3.3.2 (49%) and 3.6 (54%)

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q3.3.1

- Candidates could not identify the functional isomers using the molecular formulae given.
- Some candidates gave the structural formulae of aldehydes and ketones.
- Many candidates drew the functional group only.
- Candidates gave the condensed formula instead of structural formula.
- Many candidates added an extra H-atom onto the functional group (as well as an extra bond from the carbon atom to the hydrogen atom).

Q3.4

- Candidates wrote hydrogen "forces" instead of hydrogen bonds.
- Many candidates listed all the forces present in carboxylic acids and esters, not identifying the strongest intermolecular force.
- Writing only "dipole force" instead of dipole – dipole force.

Q3.5

- Candidates did not refer to the strength of the intermolecular force.
- Many candidates refer to "energy", instead of referring to the strength of the intermolecular forces.

Q3.6

- Many candidates cannot relate the atmospheric pressure with boiling point.
- Many candidates cannot relate vapour pressure with boiling point.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

- Teachers should expose learners to the use of graphs as well as tables.
- When writing explanations related to physical properties of compounds, learners should be taught to follow the following steps:

  Comparing compounds from the same homologous series:

  1. Compare the surface area of the compounds.
  2. Compare the strength of the intermolecular forces.
  3. Compare the energy needed to overcome the intermolecular force.

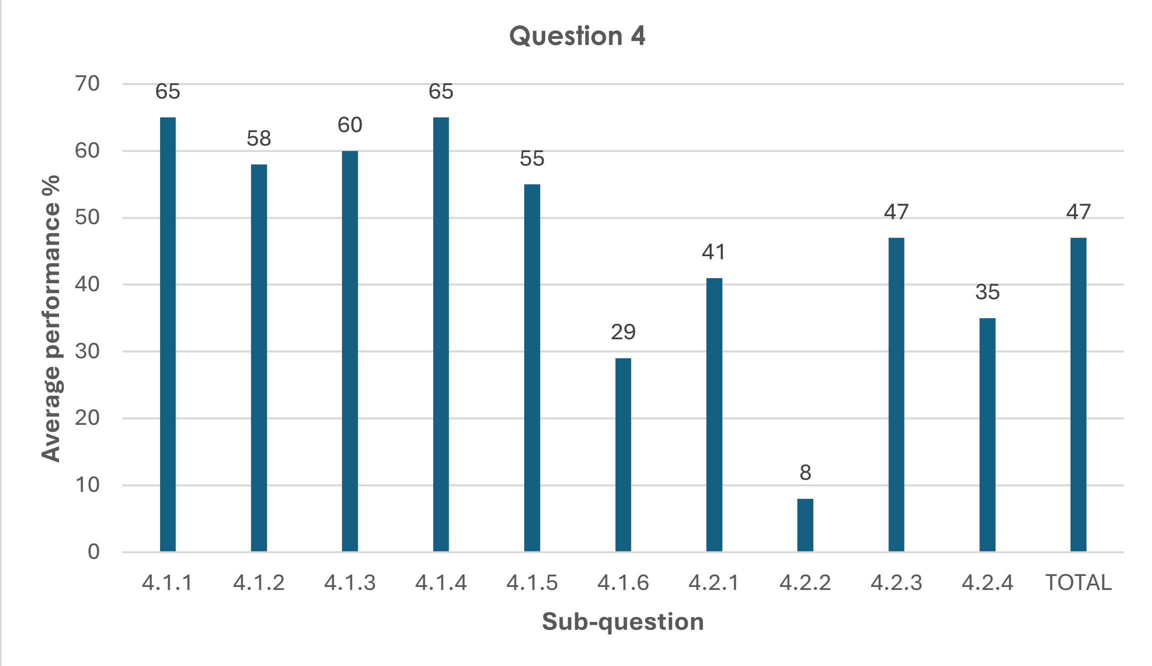
  Comparing compounds from different homologous series:

  1. State the intermolecular force in each compound.
  2. Compare the strength of the intermolecular forces.
  3. Compare the energy needed to overcome the intermolecular forces.

- Learners who are struggling to write the above in full sentences should use bullet points or even use a table to compare the physical properties of different compounds.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

- When teaching this topic of physical properties, teachers must make sure that they revise Grade 11 intermolecular forces. Teacher should make sure that learners are able to identify types of intermolecular forces from different compounds (i.e. London forces, dipole-dipole forces, hydrogen bonds). Teachers must ensure that learners are able to compare the strength of intermolecular forces.
- Use of Examination Guidelines as a source of correct definitions for concepts cannot be over-emphasised. Often, learners write different interpretations of a definition, and they usually end up with incorrect or partially correct statements.
- The PED must ensure that schools have enough resources for the experiments and that educators are properly trained. The PED should also distribute selected videos to schools on the different experiments to illustrate the physical properties of organic compounds.

QUESTION 4

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
• Candidates recorded a score of 47%. • Questions 4.1.1 and 4.1.4 scored the highest at 65% each. • Questions 4.2.2 and 4.1.6 scored the lowest with 8% and 29% respectively.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
Q4.1.1 • Many candidates omitted the hyphen or putting a hyphen between the names (e.g. "bromo-butane"). • Incorrect numbering.
Q4.1.2 • Many candidates wrote "H_2O" or "NaOH".
Q4.1.3 • Many candidates wrote "halogenation" or "substitution".
Q4.1.4 • Many candidates wrote "NaOH".
Q4.1.5 • Many candidates drew the functional group on the first carbon atom.

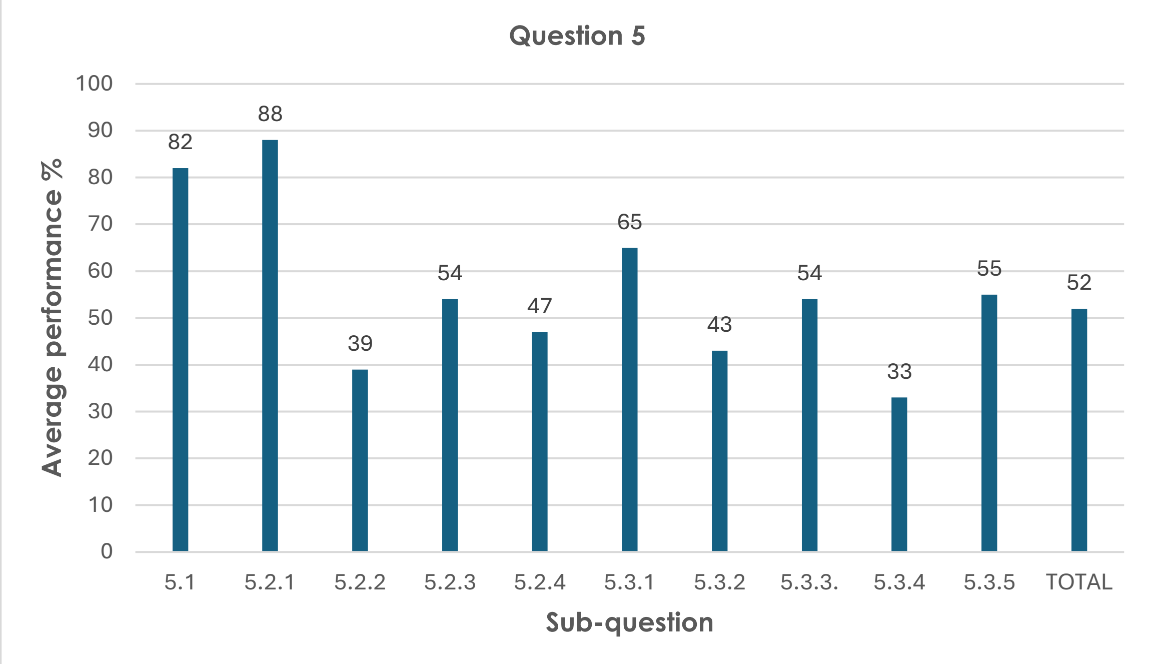
• Candidates also added more than 4 carbon atoms, because they were unable to balance the chemical reaction.
Q4.1.6 • Many candidates did not write "concentrated", they only wrote "strong base", which indicates they don't know the reaction conditions. • Many candidates wrote "[NaOH]", using square brackets to indicate concentration which is wrong. • Many candidates wrote "H_2SO_4"
Q4.2.1 • Many candidates omitted key words, e.g. "longer chain hydrocarbon" OR "molecules" • Many candidates used wrong words, e.g., "larger" or "higher" or "more complex" instead of "longer", "compound" or "substances" instead of "molecules", "smaller" or "simpler" instead or "shorter".
Q.4.2.2 • Many candidates wrote "colour change" or "clear". • Some candidates responded in terms of intermolecular forces.
Q4.2.3 • Many candidates drew 6 carbon atoms, because they were unable to balance the cracking reaction.
Q4.2.4 • Many candidates did not attempt this question. • Many candidates wrote "C_4H_{10}" and gave the statement from the question paper as their reason

(c) Provide suggestions for improvement in relation to Teaching and Learning.
• It was noted that candidates forgot most of the concepts in organic chemistry. The different reactions and reaction conditions are difficult to remember if not revised regularly. Educators should make a summary of reactions and make this available to learners. • Topic should be reinforced with questions from various national and provincial past papers. It is recommended that organic chemistry be considered as a topic for practice for the whole year. Motivate the learners by showing the percentage of marks that could be obtained from this topic and emphasising the fact that these can be easily scored through continuous practice. There should be homework or informal tasks from these topics throughout the year.

Q4.1.1 • IUPAC naming, it is important to emphasise the following sequence: 1. Identify the longest carbon chain which gives the correct parent name. 2. Start numbering from the side giving the functional group the smallest number. 3. The functional group of haloalkanes do not get preference over the alkyl groups. Therefore, numbering should not necessarily start from the side closest to the halogen. Instead, numbering should start from the side giving substituents, halogen and alkyl, the lowest total number.
Q4.1.2 • Teach the learners both the organic and inorganic reactants and products.
Q.4.1.3 – Q4.1.6 • Educators should teach learners all the different types of organic reactions with reaction conditions.
Q4.2.1 • Only use Examination Guidelines for definitions.
Q4.2.2 & Q4.2.4 • The bromine test should be demonstrated in class either doing the practical or showing a video of the practical being done.
Q.4.2.3 • Educators should teach the learners the number of carbon and hydrogen atoms in the reactants and the products remain the same. • Teach learners how to balance the cracking reaction.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
• Learners need a thorough knowledge of the different prescribed Organic reactions and their conditions to analyse flow diagrams. They must be prepared to analyse given data and devise steps to prepare a given compound using the reactants supplied; being able to go from one reaction to the next. They should also be able to work backwards (work out the reactant) when given a product. • Subject advisors should help educators in the development of the summary of organic reactions. They should also make learning materials, such as worksheets that could be used throughout the year to revise organic chemistry. Various methods/tips to consolidate the reactions should be discussed in the subject clinics and at cluster meetings. Subject advisors should ensure that organic chemistry is revised throughout the year.

- Reaction conditions and inorganic reactants must also be emphasised. These are marks that learners can easily get, if taught and assessed well.

QUESTION 5

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
• Candidates recorded a score of 52%.
• Questions 5.3.4 and 5.2.2 scored the lowest at 33% and 39% respectively. • Questions 5.2.1 scored the highest levels at 88% and 82% respectively.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
Q5.1 • Some candidates used "rate" and "per unit time" in the same sentence when defining reaction rate. • A few candidates omit key words, e.g. "change" or "per unit time".
Q5.2.1 • A few candidates got this question wrong by writing 30s.
Q5.2.2 • Most candidates found it difficult to analyse and interpret the graph to calculate the change. • Candidates swopped the coordinates when calculating the change. • Many candidates did not use the mole ratio between O_2 and CO_2. • Many candidates only calculated average rate for the O_2. • Most of the candidates did not use the negative gradient in the reaction rate formula.

Q5.2.3 • Many candidates failed to interpret the graph correctly to identify which reactant was in excess.
Q5.2.4 • Many candidates wrote "increases", but the reason showed that they did not understand the question. Many got the reason wrong. • Many candidates do not understand the relationship between volume and pressure, as well as the relationship between pressure and concentration of gases. • Many candidates do not understand the relationship between reaction rate and the gradient of the graph.
Q5.3.1 • Many candidates wrote "net release" because they did not read the question correctly. • Candidates gave an answer for the forward reaction as seen in the question paper.
Q5.3.2 • Many candidates gave the definition of "activation energy". • Many candidates omitted one or more key words, e.g. "state". • Many candidates created their own definition by using the potential energy graph as reference, e.g. "maximum energy or height between the reactants and products".
Q.5.3.3 • Most candidates omitted the word "more", they only wrote "particles have sufficient energy" or "effective collisions per unit time". • Many candidates also omitted other key words, e.g. "effective", "per unit time", "kinetic energy".
Q5.3.4 • Most candidates were only guessing the answer.
Q5.3.5 • Most candidates drew the Maxwell Boltzmann distribution curve for temperature.

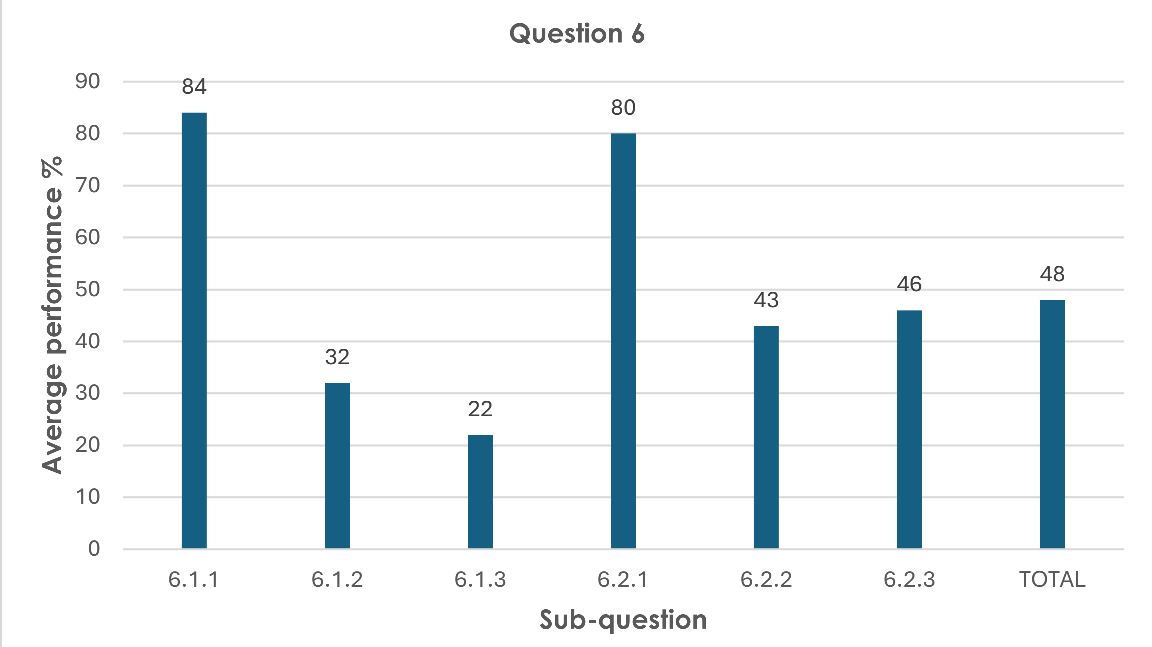
(c) Provide suggestions for improvement in relation to Teaching and Learning.
Q5.1 • Only use Examination Guidelines for definitions.

Q5.2.2 • Educators should expose learners to graph type questions; how to analyse and interpret graphs. Educators should do the same with table type questions. • Educators should teach learners how to calculate the positive and negative gradient using the correct coordinates. Show learners which coordinates go together.
Q5.2.3 & Q5.2.4 • Educators should teach learners the different types of reaction rate graphs, focusing on reaction rate graphs of a limiting reactant, the graph of reactant in excess and the graph for the forming product.
Q5.3.1 & Q5.3.2 • Only use Examination Guidelines for definitions.
Q5.3.3 • Educators should teach Collision Theory by using all the factors that influence rate of reaction.
Q5.3.4 & Q5.3.5 • Educators should teach learners how to draw the Maxwell Boltzmann distribution curve for temperature, concentration and catalyst. • Also teach them how to interpret the Maxwell Boltzmann distribution curve for temperature, concentration and catalyst.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
• Educators should teach and assess learners on all the different types of graphs on a regular basis and how to interpret, analyse and answer questions based on graphs. • Ensure that learners know the different factors affecting reaction rates and are this should be explained in terms of the Collision Theory. Use previous marking guidelines to assist learners on how to explain each factor in terms of the Collision Theory. • Subject Advisors need to support educators with Stoichiometry and worksheets should be designed involving calculations. Learners have a poor understanding of Stoichiometry and are very uncertain when selecting formulae for a specific calculation. • This question always consists of experiments and graphs. This topic must be taught with some of the informal experiments prescribed in the CAPS to emphasise the

different factors affecting the rate of reactions. Educators should explain how the different factors affect the shape of different graphs. (Maxwell-Boltzmann distribution & rate vs time graphs) during lessons. Educators must use questions based on graphs from previous papers regularly, as it is evident that the learners have a serious lack of conceptualisation in the drawing and interpretation of graphs.

- PEDs should ensure that the schools have the necessary equipment to do the experiments. DBE and PED should develop worksheets for such experiments, considering the teaching time allocated for these topics in CAPS.

QUESTION 6

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
• Candidates recorded a score of 48%.
• Question 6.1.1 scored the highest at 84%, with question 6.2.1 scoring 80%. • Questions 6.1.3 and 6.1.2 showed the lowest performance with 22% and 32% respectively.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
Q6.1.1 • This question was well answered with only a few candidates that omitted a few key words, e.g. "oppose" or "favouring". • A few candidates wrote "side" instead of "reaction".
Q6.1.2 • It was difficult for candidates to integrate the acid and base reaction with equilibrium.
Q6.1.3 • Many candidates did not know that the HCl/H^+ will react with the OH^-. • Many candidates used the Collision Theory to explain their answer.

Q6.2.2

- Many candidates identified the reaction correctly but could not explain using Le Chatelier's principle. Many gave the definition of Le Chatelier's principle instead of applying the principle.
- Many candidates could not see that the K_c value was increasing because they do not understand scientific notations with negative exponents.
- Many candidates don't know the relationship between the K_c value and the concentration of the products/reactants.

Q6.2.3

- Many candidates gave the incorrect K_c expression. They included the solid (NH_4HS.).
- Many candidates calculated wrong molar mass for NH_4HS.
- Many candidates only used the ratio for the products.
- Many candidates could not solve x.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

Q6.1

- Only use Examination Guidelines for definitions.

Q6.1.2 & Q6.1.3

- Educators should try to integrate topics.

Q6.2.1 & Q6.2.2

- Educators should teach learners to **apply** Le Chatelier's principle in specific examples, meaning how to explain by **using** Le Chatelier's principle.

Q6.2.3

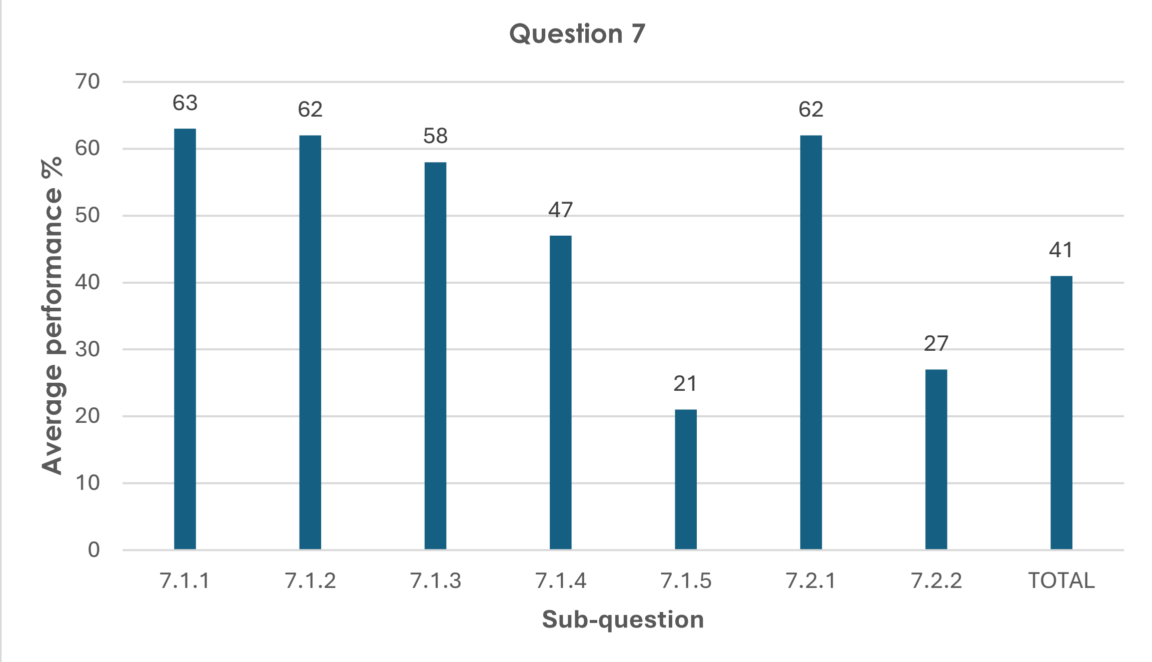
- Educators should train the learners on how to write the correct K_C expression before substituting values. Let learners only write K_c expressions of different reactions with reactants and products in different phases.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

- When using a table to solve Kc calculations, learners should be taught to use correct labels [n(initial), n(change), n(equilibrium), c(equilibrium)] in the table and write the correct values next to each label. Use previous marking guidelines to show learners the labelling in such tables. Learners need to be reminded that equilibrium concentrations and NOT moles are used in the Kc calculation.
- Teachers should avoid using $K_c = \frac{[products]}{[reactants]}$ in class. Instead, use chemical equations to teach the writing of Kc expressions.

- Educators and learners need to be made aware of the difference between **STATING** Le Chatelier's principle and **APPLYING** Le Chatelier's principle.
- Due to the high level of cognition involved, this is one of the most difficult topics for the learners. This topic should be taught with the application of the Le Chatelier principle and experiments to show the effect of various factors on the equilibrium. Educators are not using the experiments and cite a lack of resources. Another factor is that these experiments will not yield the desired outcome if the teacher is not well-experienced. This topic cannot be taught using the chalk-and-talk method. Simulations or software are essential for the teaching of the concept. PEDs should train the subject advisors and educators on experiments and the use of simulations.

QUESTION 7



(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

- Candidates recorded at score of 41%.

- Question 7.1.1 scored the highest at 63%, followed by questions 7.1.2 and 7.2.1 at 62% each.
- Questions 7.1.5 and 7.2.2 scored the lowest at 21% and 27% respectively.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q7.1.1

- Many candidates do not understand scientific notations with negative exponents.
- Many candidates gave the definition of a strong acid instead of using the given information.
- Many candidates did not know the relationship between the K_a value and the strength of acids.

Q7.1.2

- Many candidates omitted the charge.

Q7.1.3

- Many candidates wrote "H_2O".

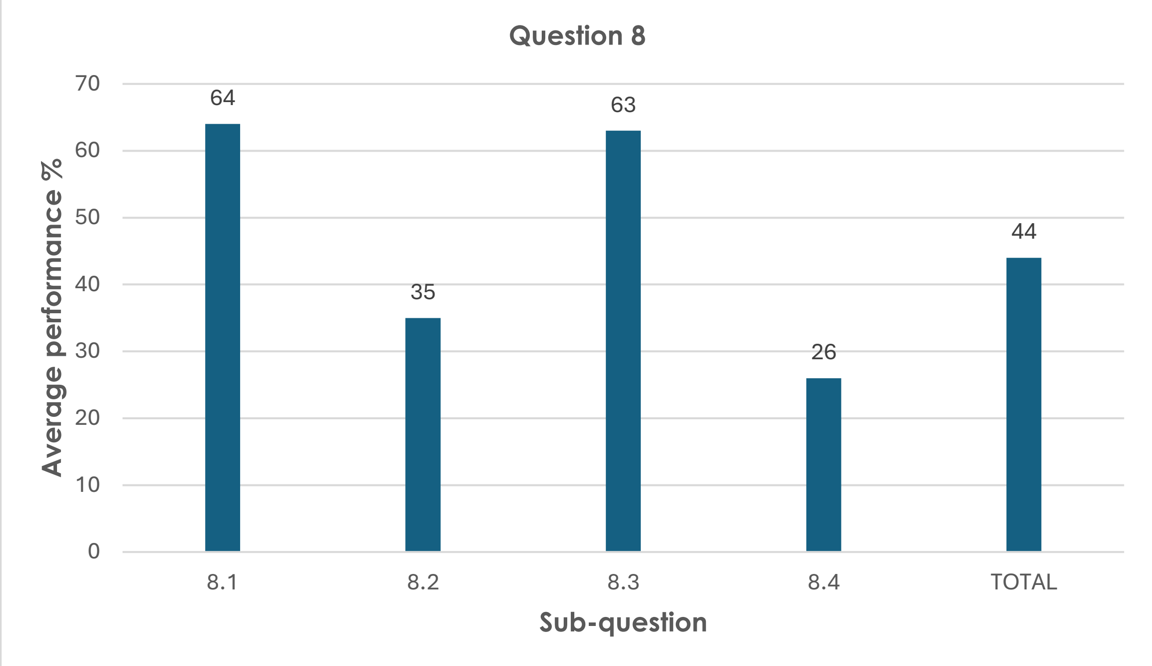
Q7.1.4 • This was an unfamiliar salt and many candidates could not determine if the solution formed would be acidic or basic.
Q7.1.5 • This was an unfamiliar salt to candidates, hence they did not know if OH^- or H_3O^+ would form. Many candidates copied the equation given in the question paper.
Q7.2.1 • Many candidates wrote incorrect formulae, e.g. "pH = -log[OH^-]" • Many candidates omitted the charge, e.g. "pH = -log [H_3O]" • Some candidates used the titration formula.
Q7.2.2 • Many candidates were using incorrect formulae because they did not know what to do or they did not understand the question.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Educators need to connect the concept of a strong acid or base to the Ka and Kb values. It is recommended that educators do the titration experiment in Term 3 as the formal experiment. This is to help improve learners' understanding of titration and neutralisation. If they do this experiment, they will always see that they must convert the cm^3 to dm^3 when they deal with the formula n = cV. Educators also need to understand that there will always be a higher-order question on this topic. Complex stoichiometric calculations start in Grade 11. It is recommended that more challenging stoichiometric questions involving percentage purity, percentage yield, and water of crystallisation should be dealt with in Grade 11 and revised in Grade 12.
Q7.1.1 • Teach learners the relationship between the K_a value and acid strength. • When using scientific notations, break it down in decimal places.
Q7.1.2 • Learners should copy correctly from the question paper.
Q7.1.3 • Educators should teach learners to identify ampholytes by using ionic equations. • Educators should emphasize that "H_2O" is not the only ampholyte. Use different examples to explain an ampholyte and to show that water is not the only ampholyte.

Q7.1.4 & Q7.1.5 • Educators should expose learners to different type of salts that can undergo hydrolysis.
Q7.2.1 & Q7.2.2 • Educators should give each learner a formula sheet when teaching acid – base calculations and let them write the formula from the formula sheet every time they do a calculation. • Expose the learners to calculating the oxonium ion concentration, when given the pH value. • Educators should teach learners when to use the titration formula. • Do exercises that will afford learners the opportunity to practice stoichiometric calculations. • Educators should emphasise the importance of units. There is a general rule what states, no unit = no mark for the final answer.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
• Ensure that Stoichiometric calculations are properly taught in Grades 10 and 11. • Rounding off should only be done at the final answer of a calculation. Learners should be taught NOT to round off in each step as it leads to an incorrect answer. • This is a topic that educators also struggle with a lot because of the stoichiometric calculations involved in it. Subject advisors should include this topic in their cluster meetings and subject clinics for training. They must develop worksheets involving high cognitive-level questions. They must also make sure that all the learners do the formal experiment on titration to create interest and understanding of this topic. It is also recommended that educators be trained in titration experiments. The PED must make sure that all the schools have the basic equipment and chemicals for performing the titration experiments.

QUESTION 8



(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

- Candidates recorded a score of 44%.

- Question 8.1 scored the highest at 64%, followed by 8.3 at 63%.
- Questions 8.4 and 8.2 showed the lowest performance at 26% and 35% respectively.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q8.1

- Many candidates defined “electrolysis” or “electrolytic cells”
- Many candidates were using incorrect terms, e.g. “substance” instead of “solution”.

Q8.2

- Candidates gave the incorrect reason.
- Many candidates wrote “it” oxidised referring to “Al^{3+}”.

Q8.3

- Many candidates included the electrons in the cell notation.
- They also include the balancing coefficient in the cell notation

Q8.4

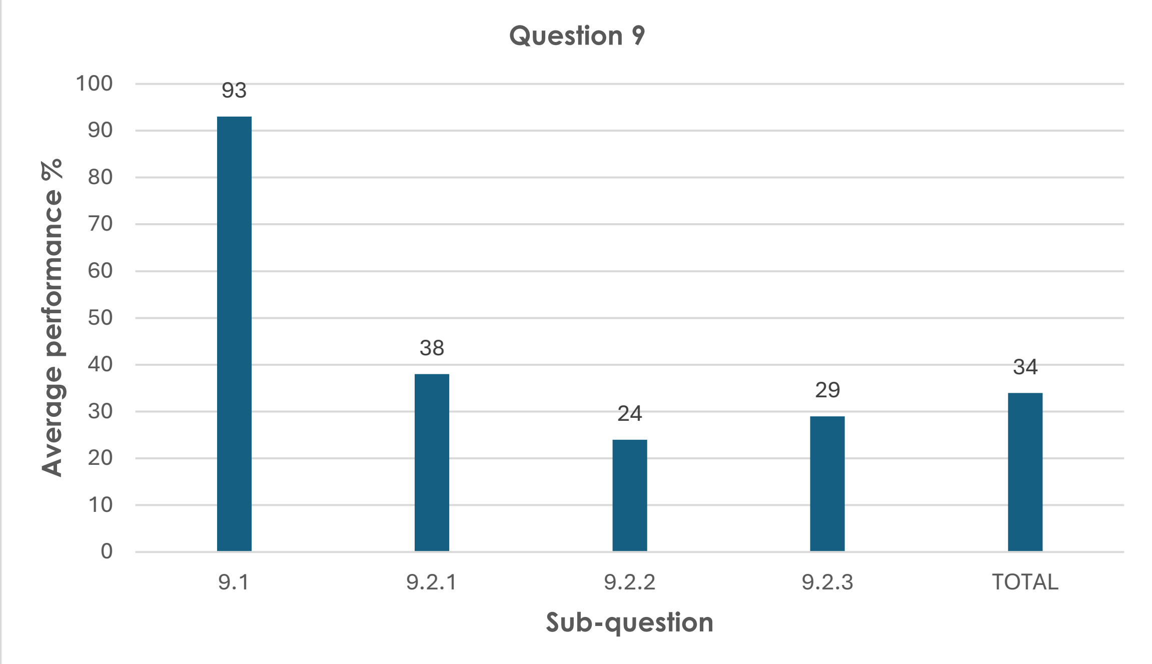
- Most candidates did not know the concentration of an electrolyte under standard condition.
- Most candidates did not used the molar ratio because they did not know they had to decompose the salt into the ions.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Q 8.1 • Only use Examination Guidelines for definitions.
Q 8.2 • Teachers must use the Table of Standard Reduction Potentials when teaching Electrochemistry.
Q 8.3 • Refer to Examination Guidelines, page 23. The cell notation excludes the electrons and coefficients of reactants. • Educators must teach the easy way of writing the cell notation as shown below. For active cell: reducing agent | oxidised species | | oxidising agent | reduced species For an inert electrode: Pt | reducing agent | oxidised species | | oxidising agent | reduced species | Pt
Q 8.4 • Teachers must assist learners in writing decomposition reactions under standard condition; the concentration of the electrolyte is 1 $mol.dm^{-3}$. • Teachers should stress the fact that the standard condition of the electrolyte (concentration) applies to the ion and not to the salt.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
• Educators must use the Table of Standard Reduction Potentials when teaching redox reactions. • They must show learners where to find the oxidising- and reducing agents on the table (Left-hand side of the table is the oxidising agents and right-hand side is the reducing agents). • Educators should start teaching the table in Grade 11, when teaching the redox chapter. • Educators must make the data/formula sheet available to all learners before they start with a specific topic.

- Learners must be taught that the number of electrons on the left-hand side of the arrow and those on the right-hand side of the arrow must cancel.
- Educators should conduct more informal experiments.
- When teaching redox reactions, teachers should start with direct electron transfer and from there go over to galvanic cells which are the indirect transfer of electrons.
- When the strengths of oxidising agents are compared, ions must be compared with ions and not atoms. Similarly, when the strengths of reducing agents are compared, learners should compare the atoms with atoms and not with ions.
- Educators need to spend time teaching learners how to use the table of reduction potentials correctly. This section is taught at the busiest of times (third term). Teachers must find time to avoid rushing when teaching Electrochemistry.
- Concepts such as reducing agent, oxidation, oxidizing agent and reduction should be taught with understanding. It starts in Grade 11.

QUESTION 9



(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

- Candidates recorded a score of 34%, the lowest of all the questions in this question paper.

- Question 9.1 scored the highest at 93%.
- All the other questions scored very low, with Q9.2.2 (24%), Q9.2.3 (29%) and Q9.2.1 (38%).

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q9.2.2

- Many candidates were guessing the answer without explaining.
- The candidates that tried to explain, did not know how to use the Table of Standard Reduction Potentials when explaining in terms of the relative strengths of oxidising agents.

Q.9.2.3

- Most candidates did not attempt this question.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Q9.2.1 – Q9.2.3 • When the strengths of oxidising agents are compared, ions must be compared with ions and not atoms. • Educators must show learners where to find the oxidising- and reducing agents on the table (Left-hand side of the table is the oxidising agents and right-hand side is the reducing agents). • When teaching the purification of copper, educators must include the ore with all metals that are going to be oxidised, forming sludge.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
• Use definitions that are from the Examination guidelines. • Educators should do different examples of electrolysis, electroplating and refining of metals to expose learners to as many questions as possible. • When copying either the oxidation or reduction half-reaction from the Table of Standard Reduction Potentials, single arrows should be used to represent either the oxidation or reduction half-reaction. • Teachers should provide learners with a summary of the types of prescribed electrolytic cells and thoroughly explain the functioning of each. This will enable learners to answer different questions on electrolytic cells with understanding rather than guessing. • Subject advisors should make sure that educators use the prescribed duration to teach this topic. Educators should be trained in constructing different electrochemical cells using the available chemicals and apparatus in the school. As this is a very abstract concept, the use of simulations or software is recommended. The training of educators in using the software is very critical.