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EASTERN CAPE
EDUCATION

**EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE**

Home of Examinations and Assessment, Zone 6, Zwelitsha, 5600

**REPUBLIC OF SOUTH AFRICA, Website:** www.ecdoe.gov.za

# 2020 NSC CHIEF MARKER'S REPORT

| | |
|---|---|
| **SUBJECT:** | **TECHNICAL SCIENCES** |
| **PAPER:** | **2** |
| **DURATION OF PAPER:** | **3 hours** |

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

The Technical Sciences Paper 2 average percentage on the seven (7) point scale for a **number of 1992** learners, who were registered for 2020 grade 12 is 37,7 %. The graph (figure1) below represents the seven (7) point scale of level distribution for the performance at 37,7% in the 2020 matric results. Generally, the level distribution implies that the paper was poorly performed owing to a few reasons surrounding the year 2020 which was severely affected by the Covid-19 pandemic. The challenges brought by the pandemic restricted the changes in the Annual Teaching Plan (ATP) which resulted in some topics given more attention to others. For example, the **electrochemistry topic** was shifted to term 4 and there was no proper teaching and revision for term 2 topics (**organic molecules**) that fell in the level 5 lockdown period.
The changes in the ATP might have an impact on learner performance due to teaching time deficiencies.

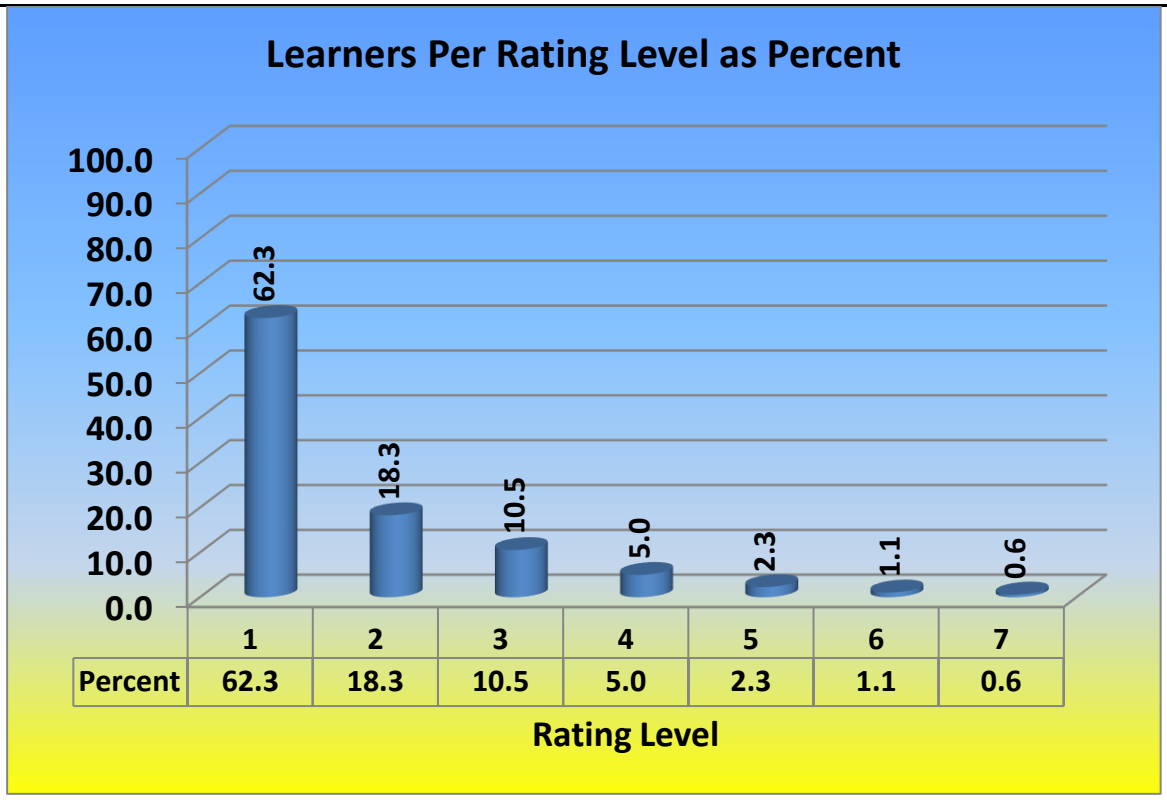



**Figure 1: 2020 seven-point scale**

In contrast to the 7-point scale, reflecting on the data offered by Rasch Report (sample of 100 scripts), question 3 (Physical properties of organic molecules -33%) was the most poorly performed question followed by question 6 (Galvanic cell- 38%). The most performed question was question 2 which summarises basic organic molecules; with an average performance of 64% which is not an outstanding performance. Questions 1 (Multiple Choice Questions) and question 8 (Lenses) performed at 62% and 60% respectively. Question 7 (Reflection and Refraction of light), question 9 (Electromagnetic waves), performed at a range of 54-57%. Questions 4 (Organic reactions) and 5 (Electrolytic cell) were performed in the range of 45% and 40% respectively. The information provided by both Seven-Point Scale and the Rasch Report clearly designated that the performance for Technical Sciences Paper 2 was justly poor.

**TABLE 1: OVERALL LEARNER PERFORMANCE FROM QUESTION 1-9.**

| Question | Topic | Ave. performance % |
|---|---|---|
| 1 | ALL TOPICS IN THE TECH SCIENCE CONTENT | 62% |
| 2 | BASIC ORGANIC MOLECULES | 64% |
| 3 | PHYSICAL PROPERTIES OF ORGANIC COMPOUNDS | 33% |
| 4 | ORGANIC REACTIONS | 45% |
| 5 | ELECTROLYTIC CELL | 40% |
| 6 | GALVANIC CELL | 38% |
| 7 | LIGHT- REFFLECTION AND REFRACTION | 57% |
| 8 | LIGHT- DISPERSION AND LENSES | 60% |
| 9 | ELECTROMAGNETIC RADIATION | 54% |
| **Total** | | **51%** |

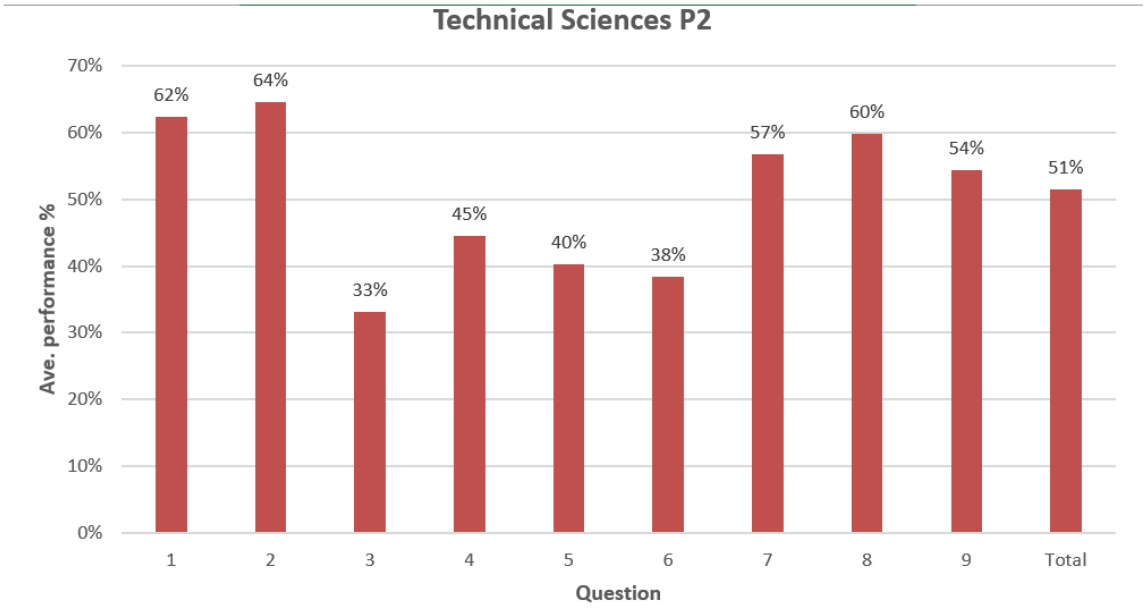



**Figure 2: Overall learner performance from question 1- 9 and Total performance.**

The overall percentage for 2020 results as portrayed by the graph is 37,7% with a bulk of learners performing at level 1 (62,3%) and 2 (18,3%). The graph therefore is skewed to the left with a very low percentage of learners performing at level 7. However, the table below displays the performance trend for level disribution from 2018- 2020 and confirms a slight improvement in 2020 results, with a slight decline in the number of level 1's and 2's and partial improvement from levels 3-7.

**TABLE 2: LEVEL DISTRIBUTION TRENDS (2018-2020)**

| **Levels of performance** | **2018%** | **2019%** | **2020%** |
|---|---|---|---|
| 1 | 72,5 | 69,2 | 62,3 |
| 2 | 13,1 | 16,8 | 18,3 |
| 3 | 7,4 | 7,7 | 10,5 |
| 4 | 3,9 | 3,9 | 5,0 |
| 5 | 2,2 | 1,4 | 2,3 |
| 6 | 0,5 | 0,7 | 1,1 |
| 7 | 0,1 | 0,2 | 0,6 |

The graphed results for the 2018- 2020 indicate a change of 3,1% in the performance at level 3, a change of 1,1 % in the performance at level 4, 0,1% in the performance at level 5, 0,6% in the

performance at level 6 and 0,5% in the performance at level 7. The 0,6% and 0,5% **improvement** at level 6&7 respectively in the 2020 results shows that the **quality** of results is slowly refining such that it can deduced that the 2021 quality of results are **projected** to be better than the 2020 results.

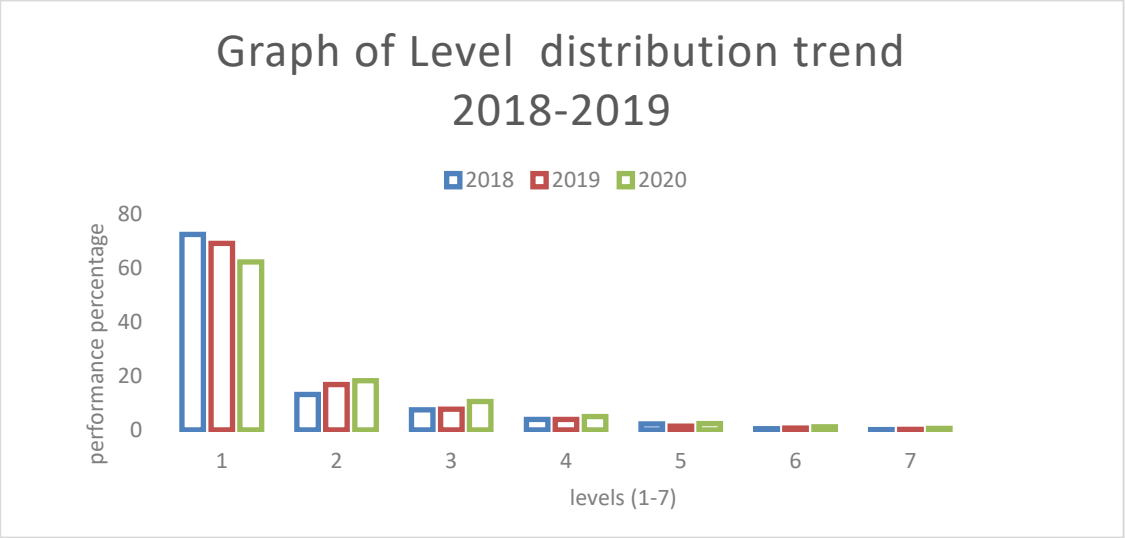



**Figure3: 2018-2020 level distribution trend.**

**QUALITY OF RESULTS**

The table and the graph below display the performance trend for number of learners in each level (5-7) for the past three years. The performance seems to be improving with a prognosis that for the next three years, the texture of results will be of great quality.

**TABLE 3: QUALITY OF RESULTS FROM LEVEL 5 -7 (2018-2020)**

| Levels | 2018 (number of learners) | 2019 (number of learners) | 2020 (number of learners) |
|---|---|---|---|
| L5 | 32 | 23 | 45 |
| L6 | 7 | 12 | 21 |
| L7 | 2 | 4 | 12 |

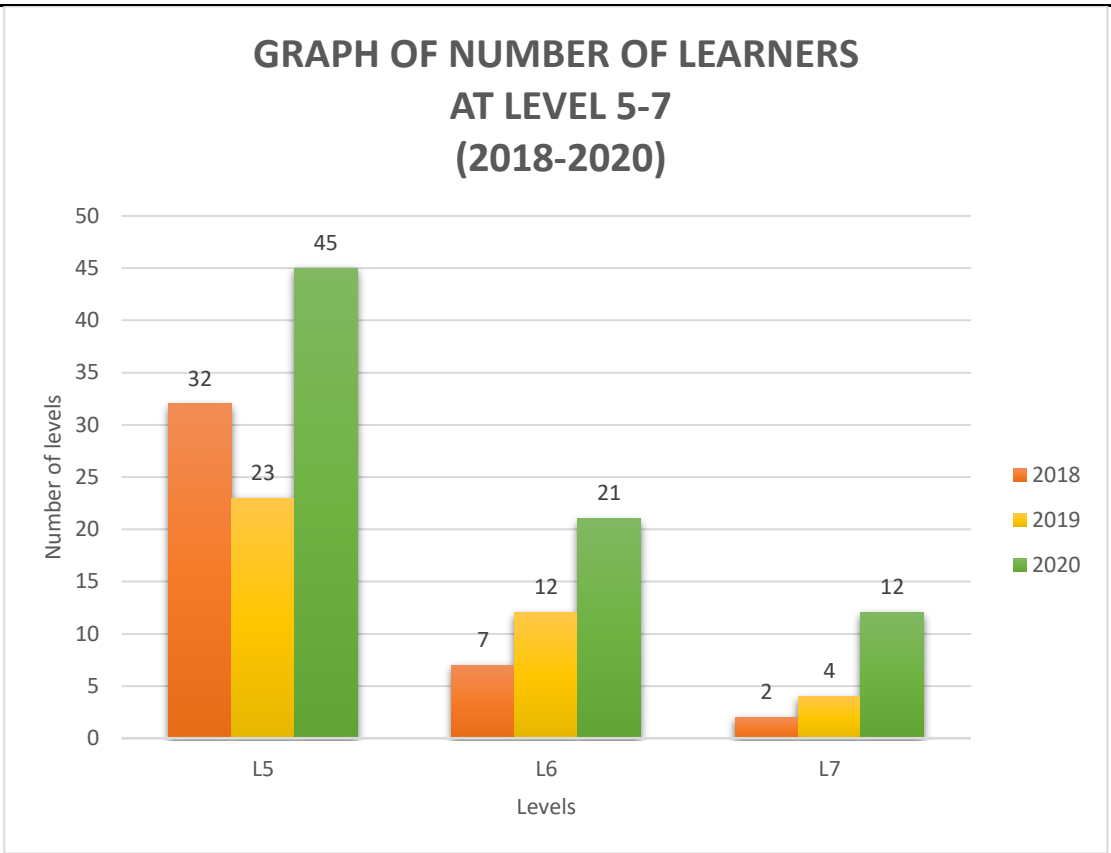



**Figure 4: number of learners performing at level 5-7 (2018-2020)**

## THE PERFORMANCE TREND OVER THREE YEARS

The results have improved by 10,6% over the period of 3 years as displayed by the overall percentage.

**Table 4: PERFORMANCE TREND (2018-2020)**

| **Year** | **Overall Performance** | **Difference in % over 3 years (2018-2020)** | **Difference in % over 2 years (2019-2020)** |
|---|---|---|---|
| 2018 | 27,1% | | |
| 2019 | 30,8% | | |
| **2020** | **37,7%** | **10,6%** | **6,9%** |

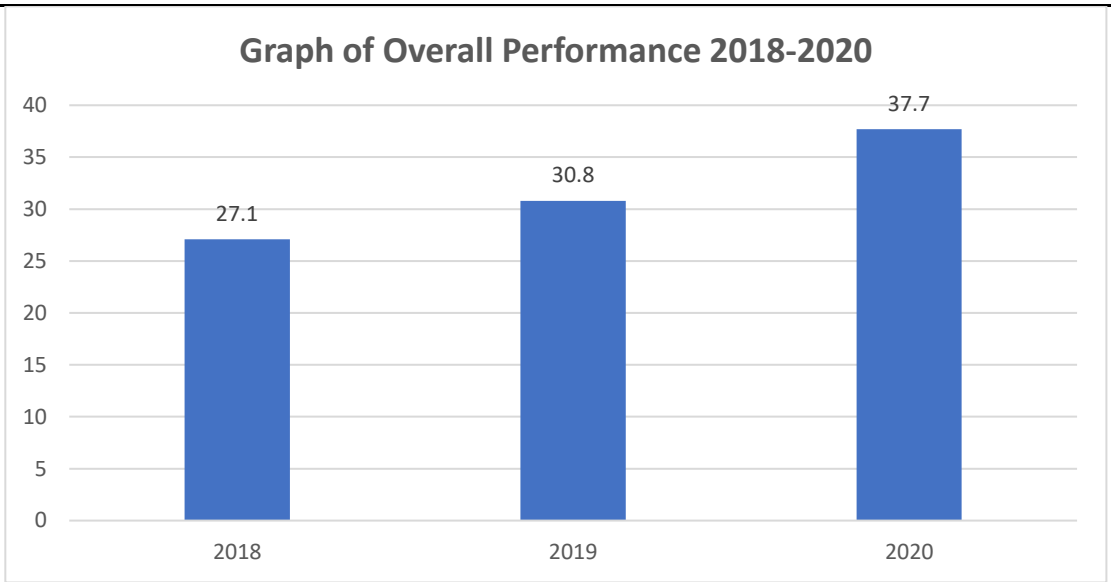



**Figure 5: Performance trend (2018-2020)**

The table and the graph above demonstrate an improvement of 6,9% between 2019 and 2020. The improvement of 6,9% is a great improvement but it means a lot of effort to be employed to improve the quality of results especially in the teaching and learning of the **content part** of the subject.

**SECTION 2: Comment on candidates' performance in individual questions**

**(It is expected that a comment will be provided for each question on a separate sheet).**

**QUESTION 1 MCQ – 62%**

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

**TABLE 5: QUESTION1 AVERAGE PERFORMANCE FOR EACH SUB-QUESTION**

| Sub-question | Topic | Ave. performance % |
|---|---|---|
| 1.1 | BASIC ORGANIC MOLECULES | 78% |
| 1.2 | BASIC ORGANIC MOLECULES | 86% |
| 1.3 | INTERMOLECULAR FORCES | 77% |
| 1.4 | ORGANIC REACTIONS | 65% |
| 1.5 | ELECTROLYTIC CELL | 38% |
| 1.6 | GALVANIC CELL | 77% |
| 1.7 | REFLECTION | 59% |
| 1.8 | REFRACTION | 64% |
| 1.9 | DISPERSION OF LIGHT | 32% |
| 1.10 | LENSES | 47% |

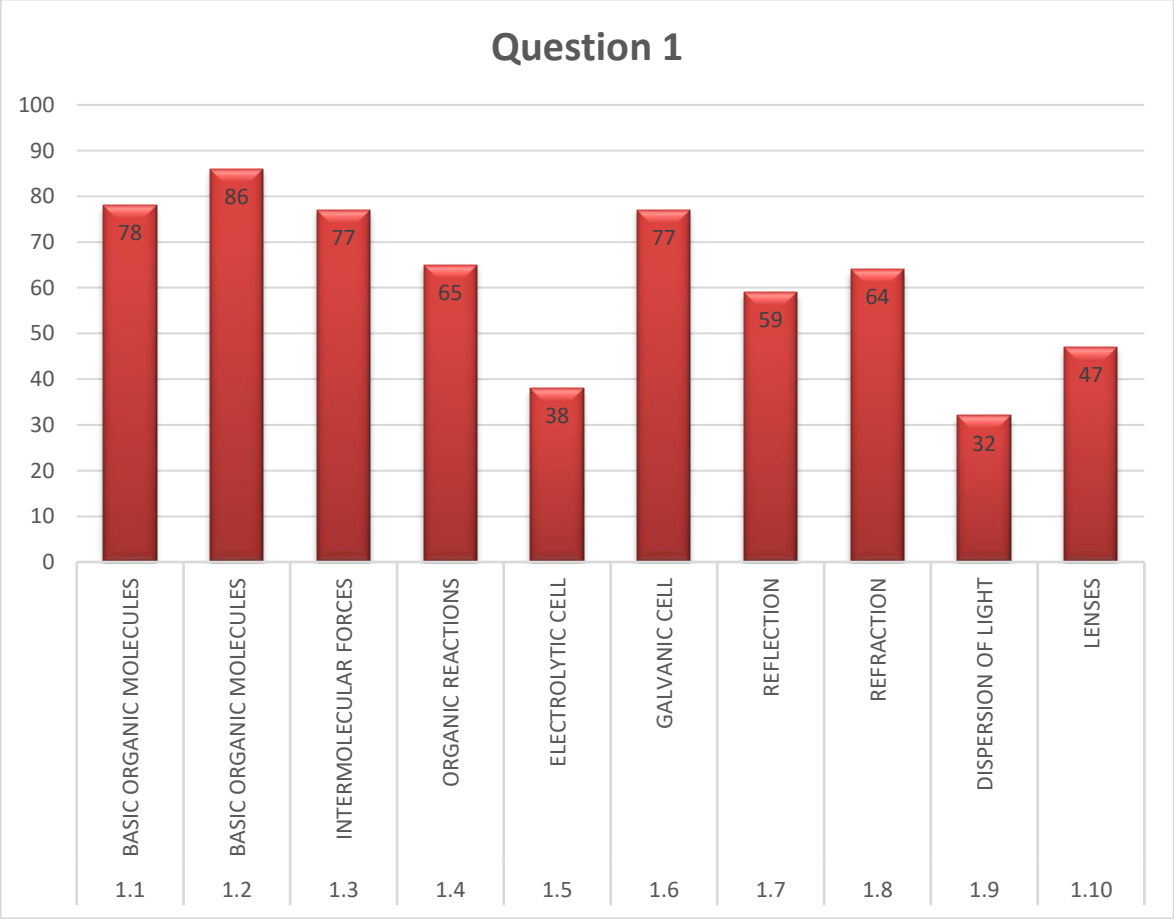



**Figure 6: Question 1 sub-questions**

**Question 1** was well answered especially 1.1 &1.2 (basic organic molecules), 1.3 (intermolecular forces and 1.6 (Galvanic cell).
1.10 (lenses), 1.8 (Refraction, 1.7(Refraction) ,1.4 (organic reactions were performed at a range of 47% and 65%.
Questions 1.5 (electrolytic cells) and 1.9 (Dispersion of light) as portrayed by the graph which are the questions that made the whole question to attain an average of 62%. The question 1 percentage in comparison with the 2019 one is a bit lower by 1% where the average percentage was 63%. As much as most learners performed at level 1 according to the 7-point scale but question 1 was not the sole reason for underperformance in this paper.

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

Question 1.5 specifically was poorly performed owing to language barriers. The term **MIGRATE** was new to learners as they are used to **"MOVE TOWARDS''**
Question 1.8 was poorly answered because learners could not analyse the diagram properly. Learners only know that the light moves away from the normal but now the diagram exposed many options to them**.**
In question 1.9 learners could not **visualise the visible spectrum** and failed to determine the **degree of refraction** from the visible spectrum.

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

Language used in the paper should be simple and cater for learners from various backgrounds. Diagram should have at least been provided for learners to understand the abstract concept "ANGLE OF REFRACTION''.

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

Question 1.9 also indicated that learners do not have deep understanding of refraction of colours of spectrum.

In Question 1.3 learners struggle to differentiate between which intermolecular forces are strong forces and which intermolecular forces are weak forces. This inability to differentiate the strength of IMF make the learners to fail to link the IMF with Homologous Series.

In Question 1.4 learners struggled with organic reactions especially interpreting flow diagrams and reaction conditions.

**QUESTION 2: BASIC ORGANIC MOLECULES -64%**

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

**TABLE 6: QUESTION 2 SUB-QUESTIONS**

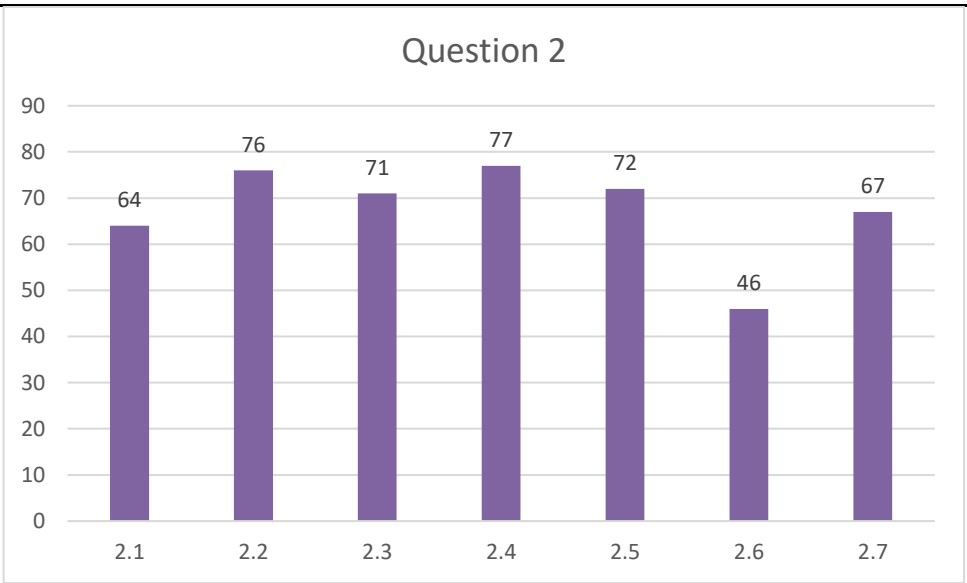



**Figure 7: Graph of question2 sub-questions**

QUESTION 2 was moderately performed at an average of 64 %.

There were pockets of excellence in this question as the level of performance was better in question 2.2 (identification of homologous series); question 2.4 (drawing structural hydrocarbon); question 2.5 (Structural formulae for Isomers).

Question 2.6 was conspicuously poorly performed at 46%. Learners were unable to identify isomers that were in the question. Question 2.1 was unexpectedly underperformed as the definition of the 'functional group' appears in the exam guidelines and CAPS document. Summarily the question was not performed as expected because it is the base for all other sections in Organic molecules.

| (**b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions**. |
|---|
| Question 2.6.1 the learner performance was based on the response learners gave in Question 2.5.1. Negative marking from 2.5.1 affected the performance in question 2.6.1.<br><br>In Question 2.1 it was evident that the learners did not study the definitions from proper documents.<br><br>In Question 2.3 learners struggled to name the organic compounds. They either got the prefix wrong or they did not know what the endings for the different homologous series are.<br><br>In question 2.7.2 most learners omitted the phrase 'between carbon atoms'; they knew that an unsaturated hydrocarbon has a double bond but could not finish the phrase.<br><br>Other learners could not identify the type of hydrocarbon in question 2.7.1 which made them to lose marks in question 2.7.2 because negative marking was applied.<br><br>The marking guide gave alternative options as per memo discussion at national level, but learner responses showed other alternatives that were not accommodated in the approved marking guide. The negative marking from question 2.5.1 to question 2.6.1 and from questions 2.7.1 and 2.7.2 were the reasons for most learners to perform at level 1 in the overall performance. |
| |
| **(c) Provide suggestions for improvement in relation to Teaching and Learning.** |
| The topic needs thorough **revision and practice** and more time should be given to Basic Organic molecules. A clear difference between **the prefixes and suffixes** should be made when learners are taught different homologous series. Nomenclature should be done thoroughly. Place emphasis on **"between carbon atoms"** when explaining unsaturated hydrocarbons. |
| |
| **(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.** |
| Use of relevant documents like **Policy documents and exam guidelines** need to be prioritised. **Practical assessment tasks** should be done in all topics, not only the prescribed PATs should be given a priority. **Ample time for revision** must be catered for. |

**QUESTION 3: PHYSICAL PROPERTIES OF ORGANIC MOLECULES -33%**

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

**TABLE 7: QUESTION3 SUB-QUESTIONS**

| Sub-question | Topic | Ave. performance % |
|---|---|---|
| 3.1 | DEFINITION OF VAPOUR PRESSURE | 40% |
| 3.2 | TRENDS OF VAPOUR PRESSURE IN ALCOHOLS | 25% |
| 3.3 | GRAPH ON BOILING POINTS | 37% |

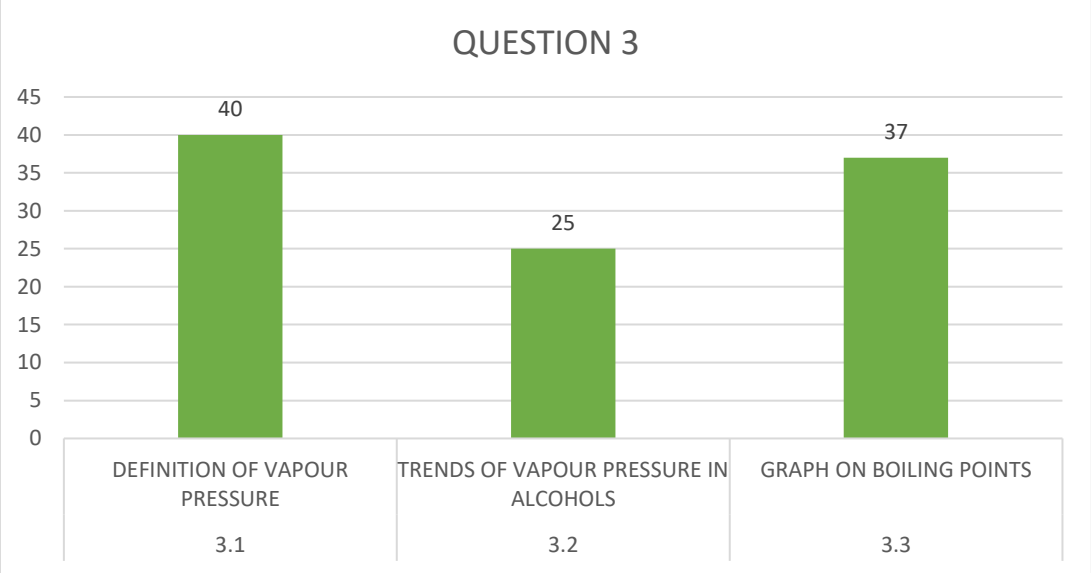



**Figure 8: Graph of question 3 sub-questions**

Question 3 was performed at 33% on average and has dropped by 11% compared to 2019 where it was 44%.

Question 3.2 was the most poorly performed question at 25%.

Question 3.3 was poorly answered at 37%; the question needed the learners to interpret the graph to give an explanation for the difference in boiling points. The performance in this question ranged between 25%-37%. This question was the reason for underperformance in the entire question paper as portrayed by the seven-point scale.

| (**b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions**. |
|---|
| Question 3.1 Learner responses on the definition of vapour pressure **did not align** with neither the CAPS document nor the Exam guidelines.<br>Questions 3.2.1 and 3.2.2 Learners failed to describe and explain the trends in vapour pressure of the 3 alcohols that were provided. The main reason that learners could not score marks in this question was due to learners' inability to **mention the alcohols and strength of IMF in their explanations.**<br>Question 3.3 Learners had poor understanding of different **strength of intermolecular forces** from **different homologous series**. Furthermore, learners were unable to **link** Intermolecular forces with Physical Properties of organic molecules. |
| |
| **(c) Provide suggestions for improvement in relation to Teaching and Learning.** |
| Definitions should be given as they appear in the examination guidelines. It should be compulsory that all learners are provided with copies of examination guidelines at the beginning of the year. |
| When explaining the trends in physical properties the following aspects should be taken into consideration**:** |
| Mention the: organic molecules in question (1-propanol, 1-butanol and 1-pentanol)<br>The intermolecular forces; aldehydes- London forces and dipole-dipole IMF.<br>Alkanes- London Forces only. |
| Chain length (branched/spherical/longer chain)/surface area |
| Strength of intermolecular forces (weaker/ stronger) |
| Energy required to OVERCOME intermolecular forces (more/less) |
| The boiling point: higher boiling point- aldehydes<br>Lower boiling point- alkanes |

| (**d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.** |
|---|
| Questions that need **explanations** should be included in **informal tasks.** |
| Learner should be trained on writing the phrase "**TO OVERCOME INTERMOLECULAR FORCES**" not to break the bonds when explaining the trends of physical properties. |
| When comparing two compounds, learners should be taught to **mention all the** compounds and not be too general but be **specific to the given compounds and intermolecular forces**. |
| **A resource manual for different types of questions** should be developed to assist learners with expected assessment tasks. The manual will not replace the existing LTSM but will expose learners to various assessment tasks. |

**QUESTION 4: ORGANIC REACTIONS- 45%**

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

**TABLE 8: QUESTION 4 SUB-QUESTIONS**

| Sub-question | Topic | Ave. performance % |
|---|---|---|
| 4.1 | TYPE OF REACTION | 65% |
| 4.2 | NAME/FORMULA OF REACTANT AND CATALYST | 23% |
| 4.3 | BALANCED CHEMICAL EQUATION OF HYDROHALOGENATION | 57% |
| 4.4 | REACTION CONDITIONS OF HALOGENATION | 22% |
| 4.5 | COMBUSTION REACTION | 40% |
| 4.6 | MONOMER OF POLYETHENE | 50% |

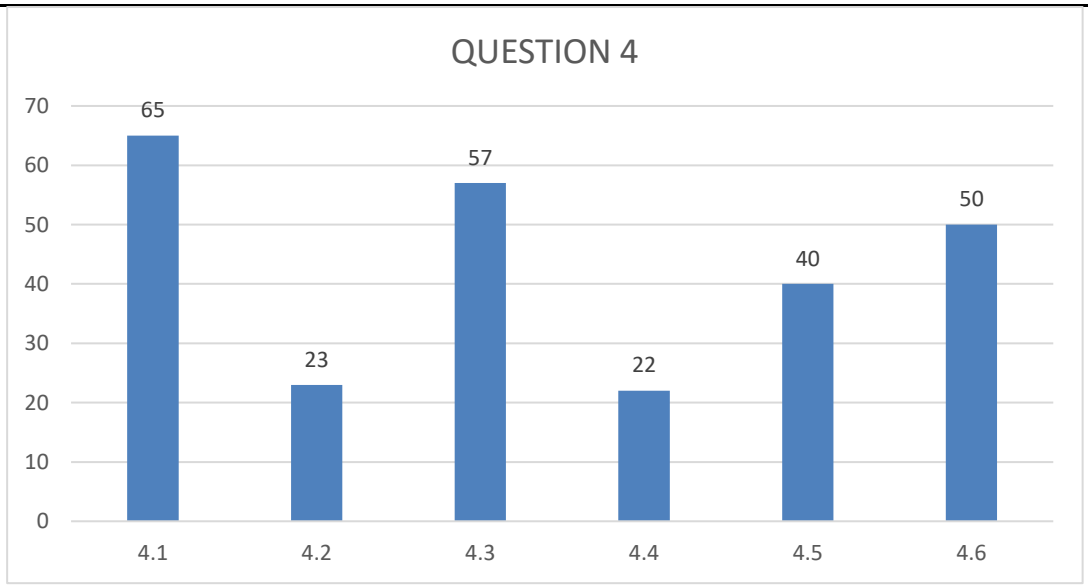



**Figure 9: Graph of question 4 sub-questions**

This question was answered at an achievement of 44% in 2019 and improved to 45% in 2020, even though it was not a decent performance but there was 1% positive difference. Questions 4.2 **(Nomenclature**) and 4.4. (**Reaction conditions**) were noticeably underperformed which dragged the performance in question 4 and led most learners to perform at level 1 as revealed by the seven-point scale. **Organic reactions** generally are still a **challenge** to learners as they cannot interpret the flow diagram.

Questions 4.1(Reaction types), 4.3 (structural formulae) and 4.6 (Name of a Monomer) were performed between 50 and 65% which is a better performance compared to other subquestions in the question.

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

Question 4.2 learners struggled to identify **reaction conditions** and had not studied the reaction conditions of the different reactions

In Question 4.3 some learners used molecular formula instead **of structural formulae** to write the balanced chemical reaction.

In Question 4.4 learners failed to identify the reaction conditions. Some learners just wrote heat instead of **mild heat** (Candidates underperformed in question 4.4 due to omission of **"mild"** before heat). A lot of the learners wrote that excess water is needed instead of saying **NO water** must be present.

In Question 4.5 learners struggled to balance the equation.

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

**Interpretation of flow diagrams and understanding of reaction conditions should be the integral part in the teaching of organic reactions and should be assessed in all assessment tasks, both formal and informal**. Teachers should use a variety **of flow diagram type questions** to train the learners how to answer these questions. Additionally, teachers should help learners to understand the flow diagram first before starting to answer the questions.

Prominence should be placed on studying the reaction conditions for the different reactions. Learners must also be taught to write all words needed in the reaction condition such as **concentrated/dilute acid** instead of just saying acid and mild heat instead of writing just heat.

Teachers should use both informal and formal assignments to assess the flow diagrams in this question.

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

Teachers should teach learners how to **balance chemical equations**. Emphasis should be placed **on the difference between molecular and structural formulae** by giving the learners activities where they need to write balanced chemical equations by using both molecular formulae and structural formulae.

**QUESTION 5: ELECTROLYTIC CELL-40%**

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

Question 5 has declined in comparison with 2019 where it was performed at 50%, the section declined to 40% which is 10% diminish. The subquestions that dropped the performance in question 5 were: 5.2 (justification for a non-spontaneous reaction- 12%), Questions 5.4 (formula of the electrolyte-16%) and 5.1(definition of the electrolyte- 40%).

**TABLE 9: QUESTION 5 SUB-QUESTIONS**

| Sub-question | Topic | Ave. performance % |
|---|---|---|
| 5.1 | DEFINITION OF ELECTROLYSIS | 45% |
| 5.2 | IDENTIFICATION OF NON-SPONTANEOUS REACTION | 61% |
| 5.3 | JUSTIFICATION FOR CONSIDERING THE REACTION AS NON-SPONTANEOUS | 12% |
| 5.4 | NAME OF THE ELECTROLYTE USED | 16% |
| 5.5 | OBSERVATIONS ON THE ANODE AND CATHODE OF AN ELECTROLYTIC CELL | 59% |
| 5.6 | DEFINITION OF THE REDUCING AGENT | 75% |
| 5.7 | OXIDATION AND REDUCTION HALF REACTIONS. NET REACTION | 26% |

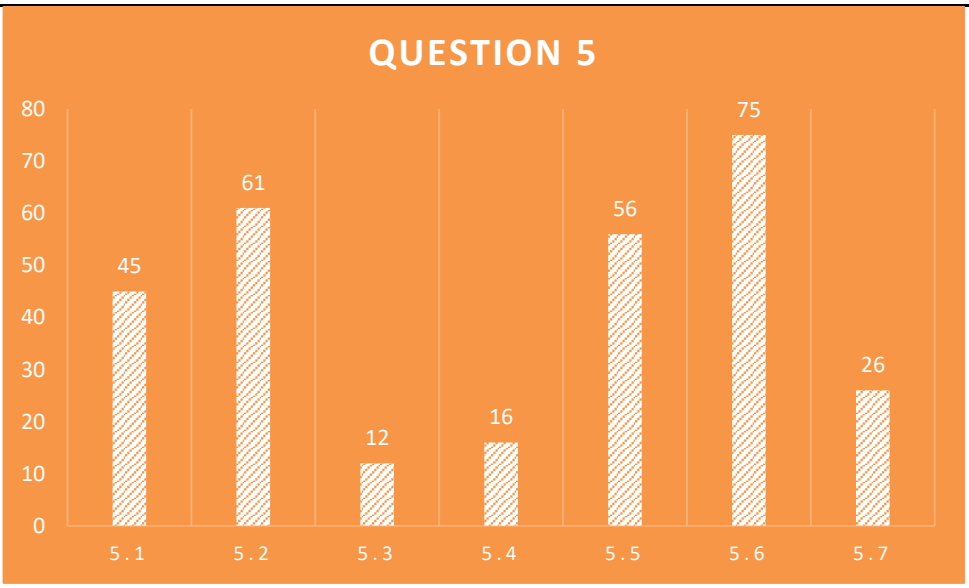



**Figure 10: Graph of question 5 sub-questions**

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

In Question 5.1 Candidates struggled to define the term electrolysis. Most learners confused the energy conversion in this definition. They wrote chemical energy is converted to electrical energy instead of writing electrical energy is converted to chemical energy.

Question 5.3 Learners struggled to explain why the process of electrolysis is non-spontaneous. Most learners wrote that 'it is a reaction that requires energy' instead of writing 'it is a reaction that requires ELECTRICAL energy'.

Question 5.4 Learners struggled to write the formula for copper(ii) chloride and most learners just rewrote the name instead of writing the formula, or the learners wrote the formula incorrectly for example they wrote **CuCl instead of $CuCl_2$.**

Question 5.6 Learners struggled to define the term reducing agent though It is a basic definition, but learners did not use the proper key words for the definition. Most **learners wrote it is the substance that undergoes REDUCTION instead of writing it is the substance that undergoes OXIDATION.**

Question 5.7 Learners struggled to write the half reactions, they **confused the oxidation and reduction half reactions** with each other, or they wrote the half reaction in the wrong direction.

Learners also **omitted the charges** on the ions or **used double arrows** instead of one arrow. This another question that dragged the learner performance in accordance with the seven-point scale.

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

Teachers should emphasise the importance of studying definitions. In this chapter there are certain definitions that are always examined, and teachers should point them out to the learners. Definitions should be assessed frequently in informal assessments.

Teachers should clearly explain **the difference between the electrolytic cell and the galvanic cell.**

Teachers should do the **electrolysis of copper (II)chloride** experiment with the learners for them to observe the $Cl_2$ gas bubbles formed at the anode and the red brown deposit formed on the cathode.

The **table of standard reduction potentials** should be clearly explained to the learners and teachers should train the learners on how to use the table. Informal and formal assessments should be done to train the learners on how to answer this question.

| **(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.** |
|---|
| The table of reduction potentials should be thoroughly practised on writing of half and net reactions. |
| Emphasis on using voltmeter, power source / globe in an electrolytic cell should be made. |
| Clear differences between an electrolytic cell and galvanic cell should be tabulated. |
| Proper use of policy documents should be maintained. |

**QUESTION 6: GALVANIC CELL-38%**

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

The overall performance of the question is 38% which is a 10 % decline compared to 2019. This was one of the most poorly performed questions in the entire question paper.

Question 6.1 (questions on the galvanic cell by interpreting the cell notation) was performed at 48% which is not a very good performance for this section. Question 6.2 (application of Reduction potential) was conspicuously underperformed at 27%.

The underperformance in these questions severely affected the overall performance of learners in Tech Sciences P2.

**TABLE 10: QUESTION 6 SUB-QUESTIONS**

| Sub-question | Topic | Ave. performance % |
|---|---|---|
| 6.1 | GALVANIC CELL DEFINITION, LABELLED DIAGRAM, STANDARD CONDITITIONS, MOVEMENT OF ANIONS | 48% |
| 6.2 | CELL POTENTIAL CALCULATIONS | 27% |

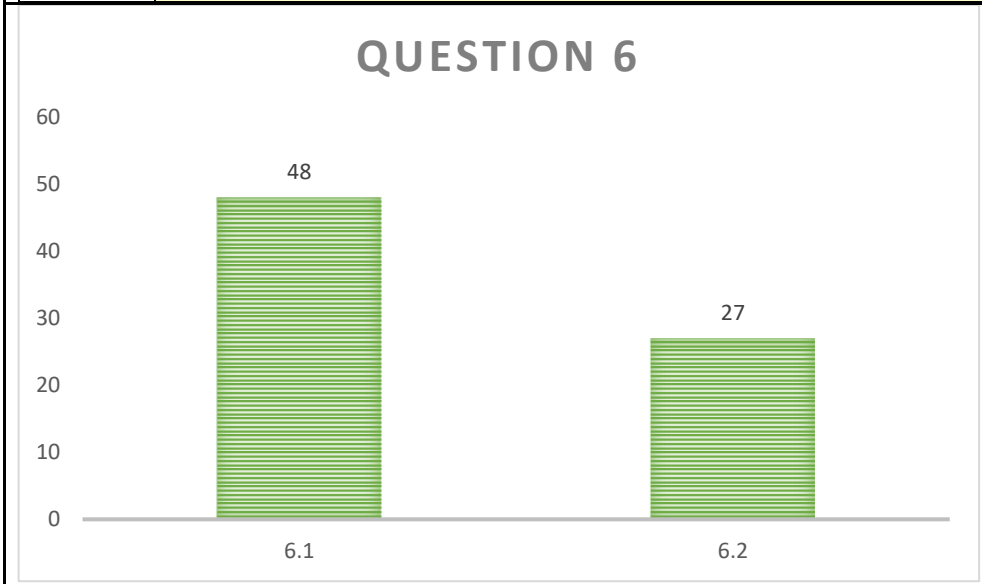



**FIGURE 11: GRAPH OF QUESTION 6 SUB-QUESTIONS**

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

In Question 6.1.2 learners struggled **to draw** a labelled **diagram for the Zn-Cu half-cell**. Most learners drew the cell in one beaker instead of drawing two separate beakers. This proved the **learners' confusion between the diagrams of electrolytic and galvanic cell**. Most learners left out the direction of flow of electrons in the external circuit, or they wrote the Cu is the anode and the Zn is the cathode instead of the other way around. They also did not label the electrolytes present.

Question 6.1.5 was very poorly answered. The learners did not seem to understand the question. Learners could not make the conclusion that the anions migrate to the anode to ensure electrical neutrality in the cell. Most learners just wrote that the anions move to the anode.

Question 6.2.1 was very poorly answered. The learners managed to write down the equation and some managed to substitute the correct values, but the learners struggled to solve for the unknown electrode from the equations. Most learners who managed to do the correct calculation left out to conclude that the unknown anode is Aluminium.

Question 6.2.2 learners struggled to write half reactions.

Question 6.2.3 most learners said that the Zn electrode will experience a decrease in mass instead of using the new anode calculated in Question 6.2.1

Question 6.2.4 Learners did not use the new electrode calculated in Question 6.2.1 to explain the decrease in mass observed at the anode. Question 6 is one of main reasons for underperformance in the whole question paper hence most learners performed at level 1 in the overall performance.

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

Teachers should emphasise the differences between the electrolytic and galvanic cell and show the learners what the two cells look like as well as pointing out by means of the diagrams what the differences are.

More time should be spent on explaining to the learners how to use the table of standard reduction potentials, identifying the anode, oxidation half reactions, cathode, reduction half reactions and writing of net reactions with their cell notations.

Informal and formal assessments should be done to **train learners on how to answer questions on various sets of Galvanic cells.**

Teachers should take time to develop learners' problem-solving skills which will help learners in solving calculations in this section.

Learners should be exposed to **hands-on activities through practical work** and experiments on various pairs of galvanic cells.

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

Use of scientific language; scientific diagrams, practical work, videos, and simulations on galvanic cells is during teaching and learning should be emphasised. The aspects mentioned above will assist learners to understand the scientific phenomena and allow space for learners to think broadly and reason scientifically.

Learners should be provided with copies of examination guidelines, policy documents and question banks generated from previous question papers for assessment readiness.

**QUESTION 7: REFLECTION AND REFRACTION OF LIGHT (57%)**

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

The learner performance for 2020 in the topic of light has improved from 21% to 57% which is 31% upward improvement. 7.1 (Reflection of light) and 7.2 (Magnitude of angle 2) were performed in the range of 72-74% and were the best performed sub-questions in question7. Question 7. 5 (Total internal reflection and refraction) was the most underperformed question.

**TABLE11: QUESTION 7 SUB-QUESTIONS**

| Sub-question | Topic | Ave. performance % |
|---|---|---|
| 7.1 | DEFINITION OF REFLECTION, LABELLING THE DIAGRAM OF REFLECTION | 74% |
| 7.2 | MAGNITUDE OF ANGLE 2 | 72% |
| 7.3 | SPEED OF LIGHT FROM AIR TO WATER | 53% |
| 7.4 | OPTICAL DENSITY, DIRECTION OF LIGHT WHEN ENTERING A NEW MEDIUM, REFRACTION | 60% |
| 7.5 | CRITICAL ANGLE DEFINITION, OBSERVATION WHEN LIGHT MOVES FROM WATER TO AIR, DESCRIPTION OF TOTAL INTERNAL REFLECTION, THE MAGNITUDE OF INCIDENT ANGLE VS CRITICAL ANGLE | 37% |

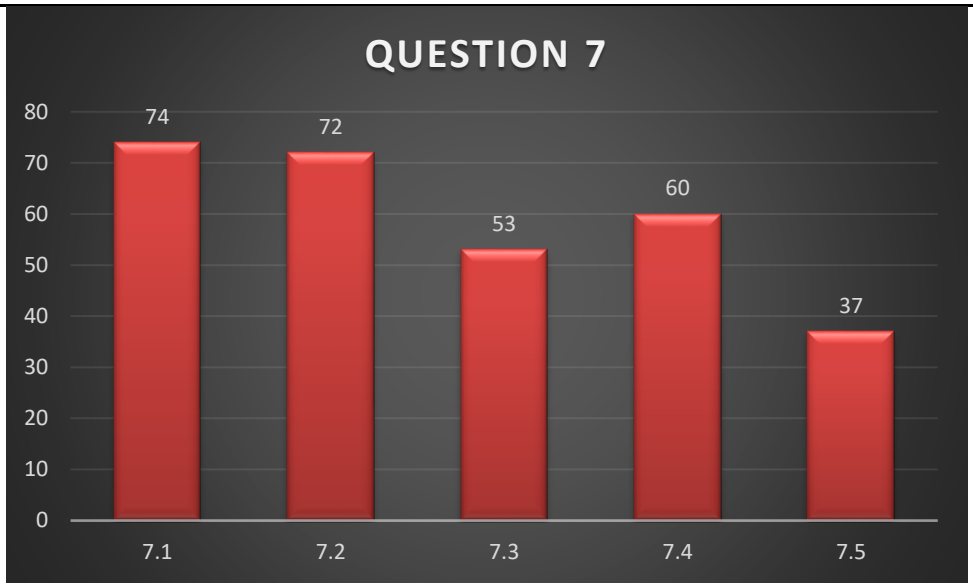



**Figure 12: Graph of question 7 sub-questions**

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

Question 7.1.1 Definition for reflection poorly answered the question was wrongly posed instead of "define reflection the question said, "**what is reflection?**". To most learners **"What is reflection?"** meant description of reflection not definition of reflection which led to underperformance by most learners.

Question 7.3 Some of the learners had a misconception that the speed will not change when the light ray enters the water perpendicular. Just because the light ray will not bend if it hits the surface perpendicular does not mean the speed will not change.

Question7.4.2 Learners could not differentiate **when the ray will be bent towards the normal** or **away from the normal.**

Question 7.4.3 Learners confused refraction with reflection. They do not seem to know the difference between the two.

Question 7.5.1 Definition of critical angle was poorly answered. Learners left out **key words** like **'in the denser medium'**. The learners also wrote incident ray instead of incident angle. The learners wrote reflected ray instead of refracted ray.

Question 7.5.2 Learners were confused whether the ray was bent towards the normal or away from the normal when travelling from water to air.

Question 7.5.3 Definition for total internal reflection poorly answered. Learners do not know that for total internal reflection to take place the angle of incidence must be GREATER than the critical angle. This question did not drag the learner performance instead it boosted performance of most learners yielding the few level 7's obtained in the total learner performance.

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

The difference **between reflection and refraction** should be emphasised to learners.

The concept of reflection and refraction can easily be explained and demonstrated by means of **experiments, videos, and simulations**.

Definitions should be emphasised, and learners should be encouraged to study the definitions from the CAPS document and Exam guidelines. Informal assessments should be done to train the learners in answering the definitions.

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

Learners were not able to answer questions that needed explanations and justifications like in questions 7.5.2 and 7.5.3.

Practical sessions and thorough lesson preparation by teachers can help learners pass this section.

Continuous professional teacher development workshops on this section should be conducted.

**QUESTION 8: DISPERSION AND LENSES- 60%**

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

This question improved from 25% in 2019 to 60% in the 2020 sample.

Question 8.2 (colours of the visible light) was the most performed question at 95%. Question 8.4 (path of light through a lens) was the most underperformed question at 31%. Question 8.3 (properties of an image formed in a plane mirror) was performed at 55% which is a better percentage compared to 2019 where it was performed at 27%. Definition of dispersion (Question 8.1) was performed at 69% and that was a worryingly low performance because the concept is known to be a familiar one. This contributed to the better overall performance of learners as it was positively performed by most learners.

**TABLE 12: QUESTION 8 SUB-QUESTIONS**

| Sub-question | Topic | Ave. performance % |
|---|---|---|
| 8.1 | DEFINITION OF DISOERSION | 69% |
| 8.2 | FOUR COLOURS OF VISIBLE LIGHT | 95% |
| 8.3 | PROPERTIES OF IMAGE FORMED | 55% |
| 8.4 | COMPLETION OF PATH OF LIGHT THROUGH LENSES | 31% |

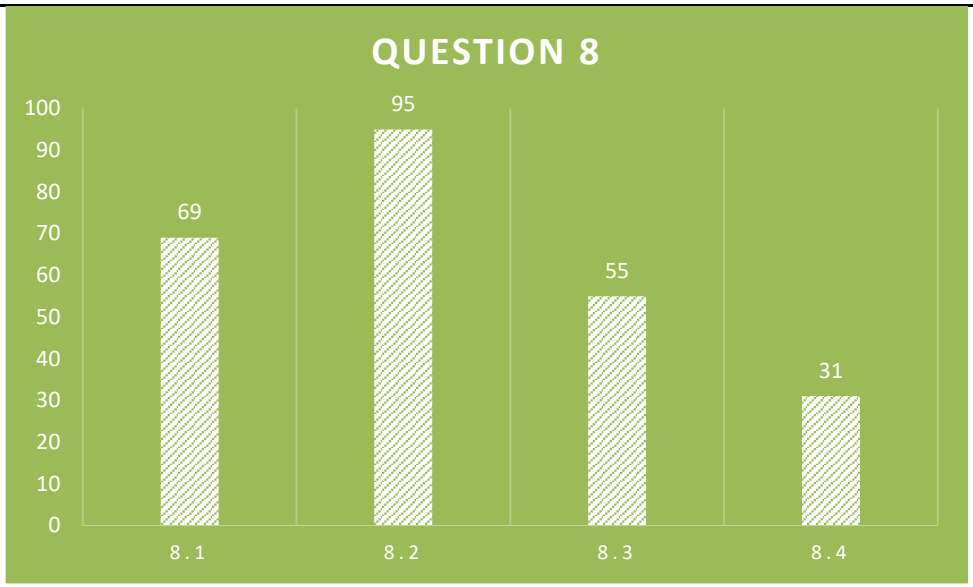



**Figure 13: Graph of question 8 sub-questions**

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

In Question 8.1 the highest number of learners defined the term dispersion correctly although some learners omitted key words like '**white'.** Some learners wrote **white colour** break up instead of writing **white light**.

In Question 8.3 the bulk of learners succeeded to mention at least **two** properties of an image formed in a plane mirror.

In Question 8.4.1 to Question 8.4.3 numerous learners managed to draw some of the ray diagrams correctly. Some learners did not indicate the direction in which the ray is moving.

In Question 8.4.3 most learners were not aware that the light ray should diverge because a concave lens (different type of a lens) is used.

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

The proper use of relevant key words when writing definitions should be highlighted to learners.

The difference between how rays will move through a concave lens and a convex lens should be emphasised and learners be exposed to several activities on those rays.

Informal and formal assessment should be done to train learners on how to draw ray diagrams and worksheets or ray diagrams be developed for learner enrichment.

Teachers should teach learners the properties of an image formed in a plane mirror and should also emphasise the difference between real image and virtual image.

| (**d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.** |
|---|
| Content gap workshops need to be conducted to emphasise the recommendations to the misconceptions that were picked up during the marking session. |

**QUESTION 9: Electromagnetic Radiation- 54%**

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

The performance in this question has dropped from 64% (2019) to 54% (2020). The overall performance in this question had a decline of 10% in comparison to 2019 sample. Question 9.2 was the worst performed question where learners could not provide the **property of radio waves that makes them suitable to transmit a signal over a long distance**. Question 9.6 (calculation of the energy of a photon) was the best performed question and it has improved from 64% (2019) to 80% (2020).

**TABLE 13: QUESTION 9 SUB-QUESTIONS**

| Sub-question | Topic | Ave. performance % |
|---|---|---|
| 9.1 | DEFINITION OF ELECTROMAGNETIC WAVES | 44% |
| 9.2 | PROPERTY OF RADIO WAVES OVER LONG DISTANCES | 5% |
| 9.3 | DEFINITION OF A PHOTON | 62% |
| 9.4 | APPLICATION OF ELECTROMAGNETIC WAVES | 35% |
| 9.5 | RELATIONSHIP BETWEEN FREQUENCY OF LIGHT AND ITS WAVELENGTH | 52% |
| 9.6 | CALTULATING THE ENERGY OF A PHOTON | 80% |

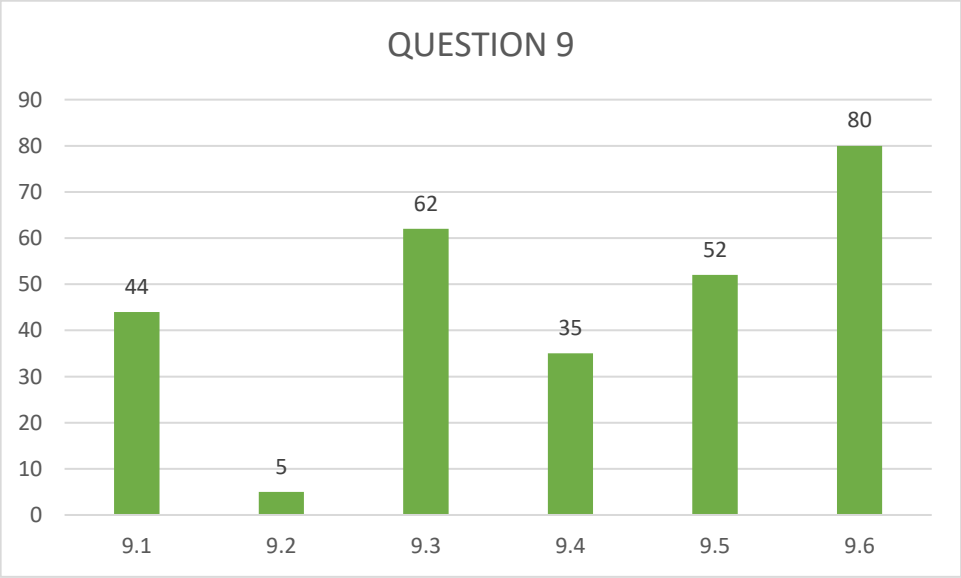



**Figure 14: Question 9 sub-questions**

| **(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.** |
|---|
| Question 9.1 Learners left out key words (**changing magnetic field, mutually perpendicular to each other, perpendicular to the direction of propagation of the wave)** when defining an electromagnetic wave.<br>Question 9.2 Learners could not give **longer wavelength** as the property of radio waves that make them to transmit signal over long distances.<br>Question 9.6 Bulk of learners managed to use the correct formula and substitution, but they struggled to use scientific calculations on their calculator. The learners who were able to calculate the correct answer, made mistakes in rounding off the value of $4,8990X10^{-15}J$. The learners who were able to calculate the correct answer omitted the SI units in the final answer. |
| |
| **(c) Provide suggestions for improvement in relation to Teaching and Learning.** |
| **Key words in definitions** should be emphasised to the learners and be extracted from Technical Sciences Examination Guidelines.<br>**Properties of electromagnetic waves** should be stressed, and more activities should be given to learners.<br>**Correct Use of calculator should form part of Technical Sciences daily lesson** in the teaching and learning routine.<br>Learners should be shown how to use scientific notation on a calculator.<br>Learners should be taught to **round off** in 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.** |
|---|
| Prompt use of revised ATP, policy documents and exam guidelines should be emphasized.<br>Definitions should be defined as they appear on exam guidelines.<br>Basic organic chemistry must be thoroughly taught as it lays a foundation for Physical properties of organic molecules and organic reactions.<br>Trends in physical properties of organic molecules should be emphasised during the teaching and learning process. Stern revision needs to be done in this section because learners could not substantiate their choices pertaining trends.<br>Reaction conditions should be highlighted and tabulated for each relevant organic reaction.<br>Table of reduction potentials be taught and le learners be trained on how to use it to identify oxidation and reduction half reactions.<br>Reflection and refraction of light was confused by learners therefore these topics need to be clearly taught and differences between them be thoroughly clarified to limit confusions.<br>Applications of all electromagnetic waves should be thoroughly revised.<br>The syllabus should be completed on time to provide sufficient time for revision. |

## CONCLUSION

### ASPECTS TO CONSIDER FOR IMPROVEMENT

Great emphasis should be put on **basic organic molecules** as they are the **building blocks** for Physical Properties of organic molecules and organic reactions. The experiment for **the electrolysis of copper (II) chloride** should be taught in grade 11 and thoroughly revised in grade 12. A clear distinction on how to **draw the diagrams of Electrolytic cell and Galvanic cell** should be made as these diagrams clear draw the differences between these two types of electrochemical cell. The **differences between reflection a refraction of light** should be clearly tabulated for learners for them to understand these concepts. **Definitions and energy conversions** should be extracted from examination guidelines and policy document for them to be valid. The **key words** for all definitions should be emphasised for learners to score more marks.

basic education

Department:
Basic Education
**REPUBLIC OF SOUTH AFRICA**

# SENIOR CERTIFICATE/ NATIONAL SENIOR CERTIFICATE

## GRADE 12

## TECHNICAL SCIENCES P2

## NOVEMBER 2020

**MARKS: 150**

**TIME: 3 hours**

**This question paper consists of 15 pages and 4 data sheets.**

*TSCE2*

## INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of NINE questions. Answer ALL the questions in the ANSWER BOOK.

3. Start EACH question on a NEW page in the ANSWER BOOK.

4. Number the answers correctly according to the numbering system used in this question paper.

5. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.

6. You may use a non-programmable calculator.

7. You are advised to use the attached DATA SHEETS.

8. Round off your FINAL numerical answers to a minimum of TWO decimal places.

9. Give brief motivations, discussions etc. where required.

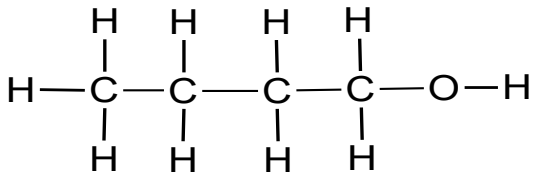
10. Write neatly and legibly.

## QUESTION 1: MULTIPLE-CHOICE QUESTIONS

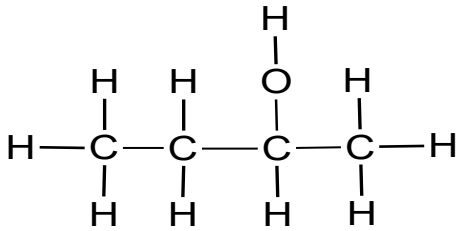
Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 Which ONE of the structural formulae below represents a secondary alcohol?

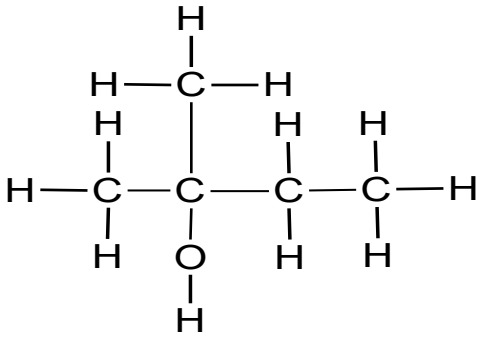
A



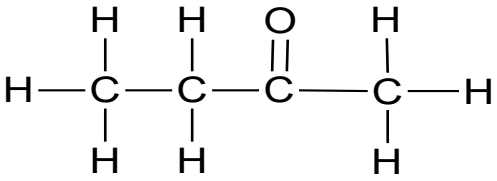
B



C



D



(2)

1.2 To which homologous series does dichloromethane belong?

A Alkanes

B Alcohols

C Haloalkanes

D Carboxylic acids (2)

1.3 In which ONE of the options below are the intermolecular forces arranged from the weakest to the strongest?

A Hydrogen bonds, dipole-dipole forces, London forces

B Hydrogen bonds, London forces, dipole-dipole forces

C Dipole-dipole forces, London forces, hydrogen bonds

D London forces, dipole-dipole forces, hydrogen bonds (2)

1.4 Alkenes react with hydrogen to form …

A alkanes.

B alcohols.

C aldehydes.

D alkynes. (2)

1.5 In an electrolytic cell the cations will migrate to the …

A cathode and undergo reduction.

B anode and undergo oxidation.

C cathode and undergo oxidation.

D anode and undergo reduction. (2)

1.6 In the cell notation of a galvanic cell, the double vertical lines (//) represent a/the …

A phase separator.

B solid electrode.

C gas electrode.

D salt bridge. (2)

1.7 Consider the statements below when an incident light ray is reflected from a flat surface.

(i) The angle of incidence is equal to the angle of reflection.
(ii) The angle measured between the surface and the incident ray is the incidence angle.
(iii) The incidence angle is the angle formed between the incident ray and the normal.

Which statement(s) is/are TRUE?

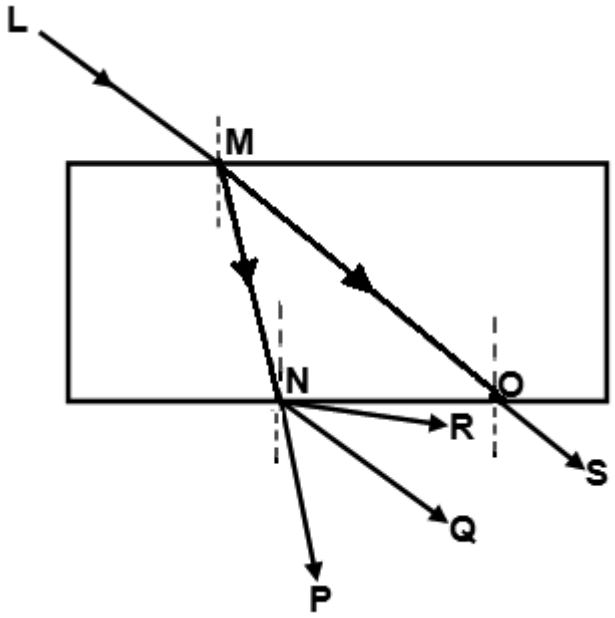
A (i) and (ii)

B (i) and (iii)

C (ii) only

D (i) only (2)

1.8 The diagram below shows light ray **LM** incident on a rectangular glass prism.




Which ONE of the following represents the CORRECT emergent ray?

A OS

B NR

C NQ

D NP (2)

1.9 During the dispersion of white light, which colour in the visible spectrum has the smallest angle of refraction?

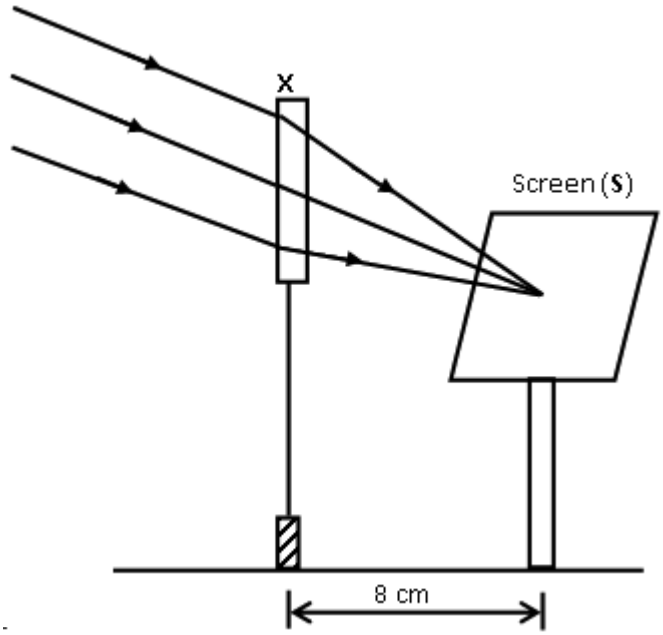
A Green

B Violet

C Red

D Orange (2)

1.10 A learner used a lens (**X**) to focus the image of a well-illuminated faraway building on a screen (**S**), as shown in the diagram below.




This lens is …

A concave of focal length 4 cm.

B convex of focal length 4 cm.

C concave of focal length 8 cm.

D convex of focal length 8 cm. (2)

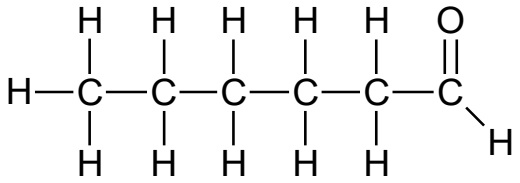
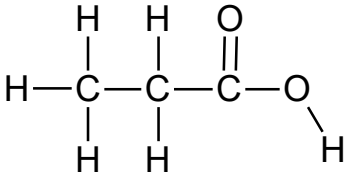
**[20]**

**QUESTION 2 (Start on a new page.)**

Organic molecules can be classified into different homologous series that are identified by their functional groups.

2.1 Define the term *functional group*. (2)

2.2 Consider the organic molecules in the table below and answer the questions that follow.

| | |
|---|---|
| **A** But-2-ene | **B**  |
| **C**  | **D** Pentan-2-one |

Write down the NAME of the homologous series of compounds represented by:

2.2.1 **A** (1)

2.2.2 **B** (1)

2.2.3 **C** (1)

2.3 Write down the IUPAC name of the organic compounds represented by:

2.3.1 **B** (2)

2.3.2 **C** (2)

2.4 Draw the structural formulae of the organic compounds represented by:

2.4.1 **A** (2)

2.4.2 **D** (2)

2.5 Draw the structural formulae of the ISOMER of the organic compounds represented by:

2.5.1 **A** (2)

2.5.2 **C** (2)

2.6 Identify the TYPE of isomer in:

2.6.1 QUESTION 2.5.1 (1)

2.6.2 QUESTION 2.5.2 (1)

2.7 Consider compound **A**.

2.7.1 Is compound **A** saturated or unsaturated? (1)

2.7.2 Explain the answer to QUESTION 2.7.1. (1)
**[21]**

**QUESTION 3 (Start on a new page.)**

The table below shows organic molecules with different molar masses and vapour pressures.

| **COMPOUND** | **MOLAR MASS ($g \cdot mol^{-1}$)** | **VAPOUR PRESSURE ($x\ 10^2$ Pa)** |
|---|---|---|
| 1-propanol | 60 | 21,0 |
| 1-butanol | 74 | 6,2 |
| 1-pentanol | 88 | 2,2 |

3.1 Define the term *vapour pressure*. (2)

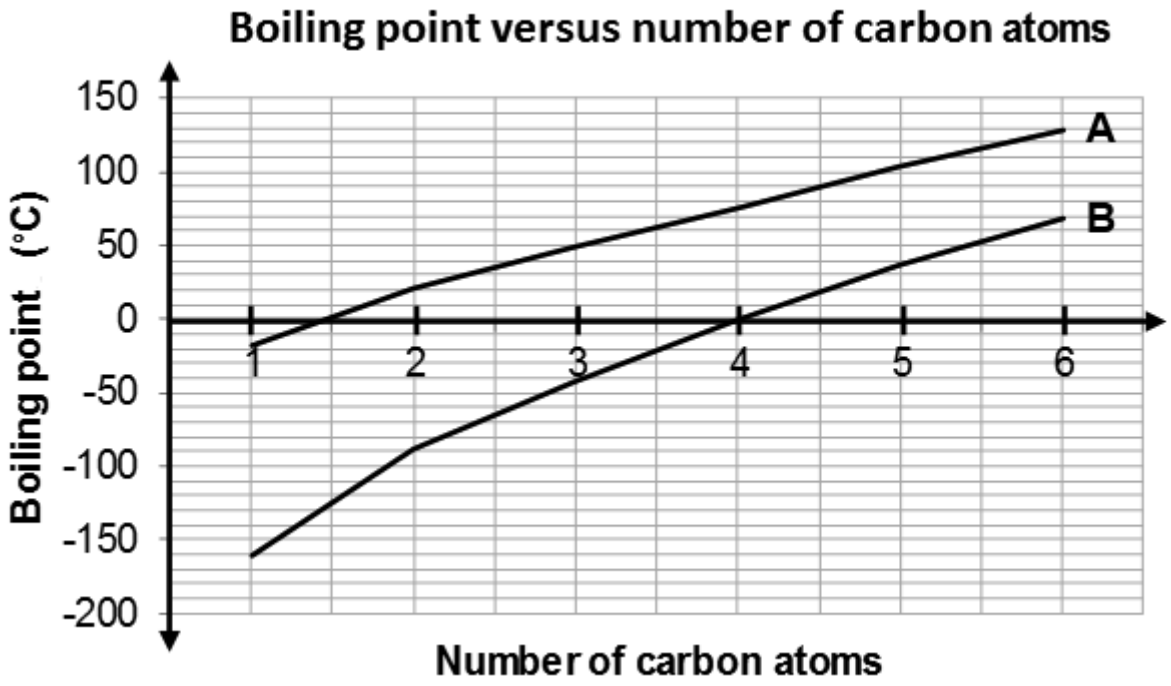
3.2 Use the table above to answer questions that follow.

3.2.1 Describe the trend in the vapour pressure of the compounds above. (1)

3.2.2 Explain the answer to QUESTION 3.2.1.

Refer to CHAIN LENGTH/MOLAR MASS, STRENGTH OF INTERMOLECULAR FORCES and ENERGY. (3)

3.3 Consider the graph below that indicates the boiling points of alkanes and aldehydes.

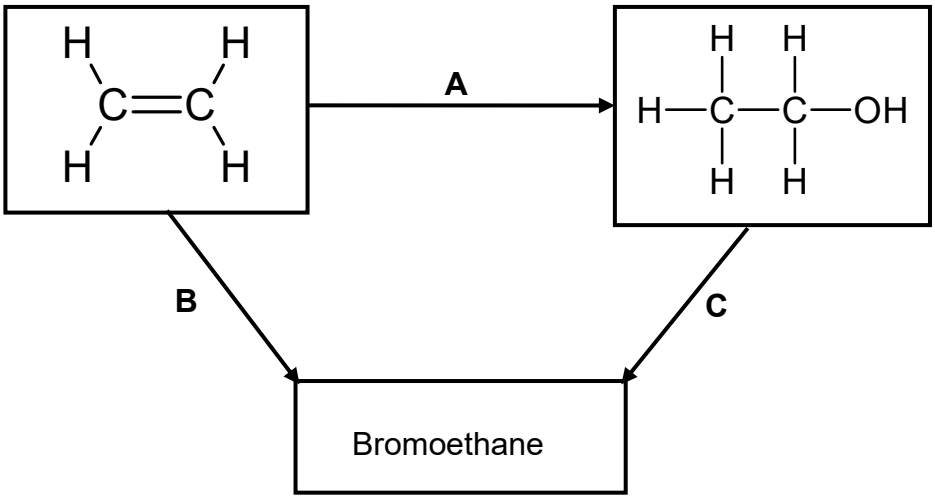



3.3.1 Identify the homologous series represented by graphs **A** and **B** respectively. (2)

3.3.2 Explain the difference in the boiling points of the two homologous series represented by graphs **A** and **B**. Refer to the TYPE and STRENGTH of the intermolecular forces. (3)
**[11]**

**QUESTION 4 (Start on a new page.)**

Use the flow diagram below to answer the questions that follow.




4.1 Write down the NAME or TYPE of reaction represented by the following letters:

4.1.1 **A** (1)

4.1.2 **B** (1)

4.1.3 **C** (1)

4.2 Apart from the alkene, another reactant and a catalyst are needed in reaction **A**. Write down the NAME or FORMULA of the:

4.2.1 Other reactant (1)

4.2.2 Catalyst (1)

4.3 Use STRUCTURAL FORMULAE to write down a balanced chemical equation for reaction **B**. (3)

4.4 Write TWO reaction conditions for reaction **C**. (2)

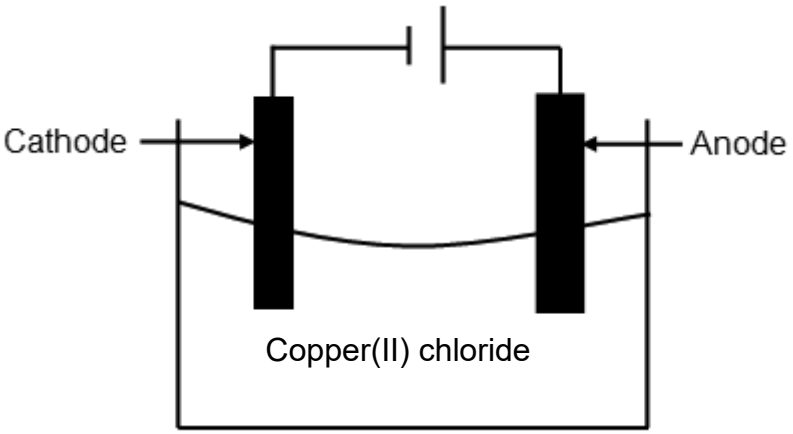
4.5 Use molecular formulae to write down a balanced equation for the reaction of the alkene in the flow diagram in excess oxygen. (3)

4.6 Write down the NAME of the organic compound in the flow diagram that can be used as a monomer of polythene. (1)

**[14]**

**QUESTION 5 (Start on a new page.)**

The diagram below represents the electrolysis of copper(II) chloride.




5.1 Define the term *electrolysis*. (2)

5.2 Is the electrolysis of copper(II) chloride a spontaneous or a non-spontaneous reaction? (1)

5.3 Explain the answer to QUESTION 5.2. (1)

5.4 Write down the FORMULA of an electrolyte used in the cell above. (1)

5.5 At which electrode will the following observations be made? Write down only ANODE or CATHODE.

5.5.1 Gas bubbles are formed. (1)

5.5.2 A brownish deposit is formed. (1)

5.6 Define the term *reducing agent*. (2)

5.7 For the cell above, write down the:

5.7.1 Oxidation half-reaction (2)

5.7.2 Reduction half-reaction (2)

5.7.3 Net reaction (2)
**[15]**

**QUESTION 6 (Start on a new page.)**

6.1 The cell notation $Zn(s)|Zn^{2+}(aq)\|Cu^{2+}(aq)|Cu(s)$ represents a galvanic cell operating under standard conditions.

6.1.1 Define the term *galvanic cell*. (2)

6.1.2 Draw a labelled diagram to represent the Zn-Cu cell. Show the direction of electron flow in the external circuit. (5)

6.1.3 Write down TWO standard conditions under which the Zn-Cu cell operates. (2)

6.1.4 To which half-cell do the anions in the salt bridge migrate? (1)

6.1.5 Explain the answer to QUESTION 6.1.4. (2)

6.2 The anode in the Zn-Cu cell is replaced by an unknown electrode, **X**. The voltmeter gives a reading of 2,00 V.

6.2.1 Identify electrode **X** by means of a calculation. (5)

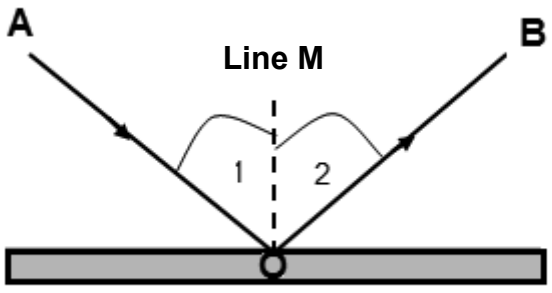
6.2.2 Write down the half-reaction taking place at the anode. (2)

6.2.3 Which electrode will experience a decrease in mass? (1)

6.2.4 Explain the answer to QUESTION 6.2.3. (2)
**[22]**

**QUESTION 7 (Start on a new page.)**

7.1 The diagram below shows the reflection of a light ray that strikes a flat mirror with a 30° angle of incidence.




7.1.1 What is *reflection*? (2)

Use the diagram to write down the NAMES of:

7.1.2 Ray **AO** (1)

7.1.3 Ray **OB** (1)

7.1.4 Line **M** (1)

7.1.5 Angle 1 (1)

7.1.6 Angle 2 (1)

7.2 What is the magnitude of angle 2? (1)

7.3 How will the speed of light be affected when a light ray travels from air into water, perpendicular to the surface? (1)

7.4 A light ray enters the water from air at an angle.

7.4.1 Which medium, air or water, has the higher optical density? (1)

7.4.2 What will happen to the DIRECTION of the light ray as it enters the water? (1)

7.4.3 Write down the NAME of the phenomenon in QUESTION 7.4.2. (1)

7.5 A ray of light moves from water towards air and strikes the interfase (boundary) at an angle of incidence smaller than the critical angle.

7.5.1 Define the term *critical angle*. (2)

7.5.2 What observation will be made? (2)

The incident angle in QUESTION 7.5 is changed such that the ray undergoes total internal reflection.

7.5.3 Describe the phenomenon *total internal reflection*. (2)

7.5.4 Is the incident angle GREATER THAN or SMALLER THAN the critical angle? (1)

**[19]**

**QUESTION 8 (Start on a new page.)**

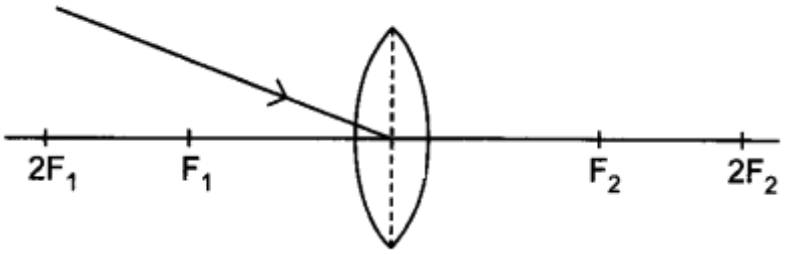
8.1 Define the term *dispersion.* (2)

8.2 Name any FOUR colours in visible light. (4)

8.3 State THREE properties of the image formed in a plane mirror. (3)

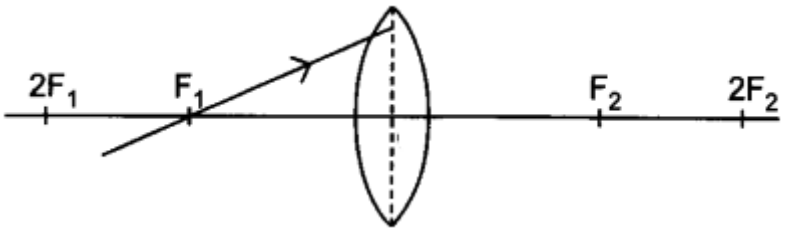
8.4 Redraw the diagrams below in the ANSWER BOOK and complete EACH to show the path of the ray after passing through the lens.

8.4.1



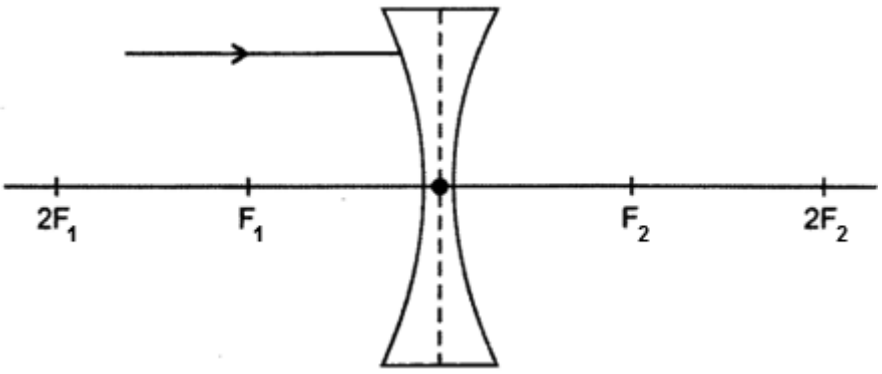

(1)

8.4.2




(2)

8.4.3




(2)
**[14]**

**QUESTION 9 Start on a new page.)**

9.1 Define an *electromagnetic wave*. (2)

9.2 Which property of radio waves makes it suitable to transmit a signal over long distances? (1)

9.3 What is a *photon*? (1)

9.4 Write down the NAME of the electromagnetic wave that is used:

9.4.1 To detect counterfeit notes (1)

9.4.2 To open and close automatic doors (1)

9.4.3 In navigation systems (1)

9.5 What is the relationship between the frequency of light and its wavelength? (2)

9.6 Calculate the energy of light with a wavelength of $4,06 \times 10^{-11}$ m. (5)
**[14]**

**TOTAL: 150**

# DATA FOR TECHNICAL SCIENCES GRADE 12
# PAPER 2

## *GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12*
## *VRAESTEL 2*

## TABLE 1: PHYSICAL CONSTANTS

| NAME | SYMBOL | VALUE |
|---|---|---|
| Standard pressure | $p^{\theta}$ | $1{,}01 \times 10^{5}$ Pa |
| Standard temperature | $T^{\theta}$ | 0 $^{o}$C/273 K |
| Speed of light in a vacuum | c | $3{,}0 \times 10^{8}$ m·s$^{-1}$ |
| Planck's constant | h | $6{,}63 \times 10^{-34}$ J·s |

## TABLE 2: WAVES, SOUND AND LIGHT

| | |
|---|---|
| $v = f\lambda$ | $T = \frac{1}{f}$ |
| $E = hf$ or $E = h\frac{c}{\lambda}$ | |

## TABLE 3: FORMULAE

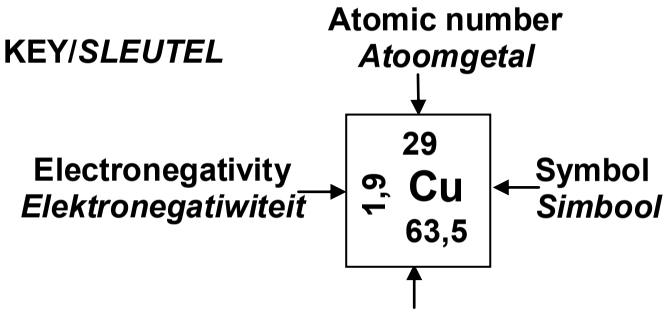
$$E_{cell}^{\theta} = E_{cathode}^{\theta} - E_{anode}^{\theta}$$

$$E_{cell}^{\theta} = E_{reduction}^{\theta} - E_{oxidation}^{\theta}$$

$$E_{cell}^{\theta} = E_{oxidisingagent}^{\theta} - E_{reducingagent}^{\theta}$$

SC/NSC

# TABLE 4: THE PERIODIC TABLE OF ELEMENTS
## *TABEL 4: DIE PERIODIEKE TABEL VAN ELEMENTE*




| 1 (I) | 2 (II) | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 (III) | 14 (IV) | 15 (V) | 16 (VI) | 17 (VII) | 18 (VIII) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2,1 H 1 | | | | | | | | | | | | | | | | | 2 He 4 |
| 1,0 Li 7 | 1,5 Be 9 | | | | | | | | | | | 2,0 B 11 | 2,5 C 12 | 3,0 N 14 | 3,5 O 16 | 4,0 F 19 | 10 Ne 20 |
| 0,9 Na 23 | 1,2 Mg 24 | | | | | | | | | | | 1,5 Aℓ 27 | 1,8 Si 28 | 2,1 P 31 | 2,5 S 32 | 3,0 Cℓ 35,5 | 18 Ar 40 |
| 0,8 K 39 | 1,0 Ca 40 | 1,3 Sc 45 | 1,5 Ti 48 | 1,6 V 51 | 1,6 Cr 52 | 1,5 Mn 55 | 1,8 Fe 56 | 1,8 Co 59 | 1,8 Ni 59 | 1,9 Cu 63,5 | 1,6 Zn 65 | 1,6 Ga 70 | 1,8 Ge 73 | 2,0 As 75 | 2,4 Se 79 | 2,8 Br 80 | 36 Kr 84 |
| 0,8 Rb 86 | 1,0 Sr 88 | 1,2 Y 89 | 1,4 Zr 91 | Nb 92 | 1,8 Mo 96 | 1,9 Tc | 2,2 Ru 101 | 2,2 Rh 103 | 2,2 Pd 106 | 1,9 Ag 108 | 1,7 Cd 112 | 1,7 In 115 | 1,8 Sn 119 | 1,9 Sb 122 | 2,1 Te 128 | 2,5 I 127 | 54 Xe 131 |
| 0,7 Cs 133 | 0,9 Ba 137 | La 139 | 1,6 Hf 179 | Ta 181 | W 184 | Re 186 | Os 190 | Ir 192 | Pt 195 | Au 197 | Hg 201 | 1,8 Tℓ 204 | 1,8 Pb 207 | 1,9 Bi 209 | 2,0 Po | 2,5 At | 86 Rn |
| 0,7 Fr 87 | 0,9 Ra 226 | Ac 89 | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58 Ce 140 | 59 Pr 141 | 60 Nd 144 | 61 Pm | 62 Sm 150 | 63 Eu 152 | 64 Gd 157 | 65 Tb 159 | 66 Dy 163 | 67 Ho 165 | 68 Er 167 | 69 Tm 169 | 70 Yb 173 | 71 Lu 175 |
| 90 Th 232 | 91 Pa | 92 U 238 | 93 Np | 94 Pu | 95 Am | 96 Cm | 97 Bk | 98 Cf | 99 Es | 100 Fm | 101 Md | 102 No | 103 Lr |

# TABLE 5A: STANDARD REDUCTION POTENTIALS

Increasing oxidising ability ↑

| Half-reactions | | | $E^{\theta}$ (V) |
|---|---|---|---|
| $F_2(g) + 2e^-$ | ⇌ | $2F^-$ | + 2,87 |
| $Co^{3+} + e^-$ | ⇌ | $Co^{2+}$ | + 1,81 |
| $H_2O_2 + 2H^+ + 2e^-$ | ⇌ | $2H_2O$ | +1,77 |
| $MnO_4^- + 8H^+ + 5e^-$ | ⇌ | $Mn^{2+} + 4H_2O$ | + 1,51 |
| $C\ell_2(g) + 2e^-$ | ⇌ | $2C\ell^-$ | + 1,36 |
| $Cr_2O_7^{2-} + 14H^+ + 6e^-$ | ⇌ | $2Cr^{3+} + 7H_2O$ | + 1,33 |
| $O_2(g) + 4H^+ + 4e^-$ | ⇌ | $2H_2O$ | + 1,23 |
| $MnO_2 + 4H^+ + 2e^-$ | ⇌ | $Mn^{2+} + 2H_2O$ | + 1,23 |
| $Pt^{2+} + 2e^-$ | ⇌ | Pt | + 1,20 |
| $Br_2(\ell) + 2e^-$ | ⇌ | $2Br^-$ | + 1,07 |
| $NO_3^- + 4H^+ + 3e^-$ | ⇌ | $NO(g) + 2H_2O$ | + 0,96 |
| $Hg^{2+} + 2e^-$ | ⇌ | $Hg(\ell)$ | + 0,85 |
| $Ag^+ + e^-$ | ⇌ | Ag | + 0,80 |
| $NO_3^- + 2H^+ + e^-$ | ⇌ | $NO_2(g) + H_2O$ | + 0,80 |
| $Fe^{3+} + e^-$ | ⇌ | $Fe^{2+}$ | + 0,77 |
| $O_2(g) + 2H^+ + 2e^-$ | ⇌ | $H_2O_2$ | + 0,68 |
| $I_2 + 2e^-$ | ⇌ | $2I^-$ | + 0,54 |
| $Cu^+ + e^-$ | ⇌ | Cu | + 0,52 |
| $SO_2 + 4H^+ + 4e^-$ | ⇌ | $S + 2H_2O$ | + 0,45 |
| $2H_2O + O_2 + 4e^-$ | ⇌ | $4OH^-$ | + 0,40 |
| $Cu^{2+} + 2e^-$ | ⇌ | Cu | + 0,34 |
| $SO_4^{2-} + 4H^+ + 2e^-$ | ⇌ | $SO_2(g) + 2H_2O$ | + 0,17 |
| $Cu^{2+} + e^-$ | ⇌ | $Cu^+$ | + 0,16 |
| $Sn^{4+} + 2e^-$ | ⇌ | $Sn^{2+}$ | + 0,15 |
| $S + 2H^+ + 2e^-$ | ⇌ | $H_2S(g)$ | + 0,14 |
| **$2H^+ + 2e^-$** | **⇌** | **$H_2(g)$** | **0,00** |
| $Fe^{3+} + 3e^-$ | ⇌ | Fe | – 0,06 |
| $Pb^{2+} + 2e^-$ | ⇌ | Pb | – 0,13 |
| $Sn^{2+} + 2e^-$ | ⇌ | Sn | – 0,14 |
| $Ni^{2+} + 2e^-$ | ⇌ | Ni | – 0,27 |
| $Co^{2+} + 2e^-$ | ⇌ | Co | – 0,28 |
| $Cd^{2+} + 2e^-$ | ⇌ | Cd | – 0,40 |
| $Cr^{3+} + e^-$ | ⇌ | $Cr^{2+}$ | – 0,41 |
| $Fe^{2+} + 2e^-$ | ⇌ | Fe | – 0,44 |
| $Cr^{3+} + 3e^-$ | ⇌ | Cr | – 0,74 |
| $Zn^{2+} + 2e^-$ | ⇌ | Zn | – 0,76 |
| $2H_2O + 2e^-$ | ⇌ | $H_2(g) + 2OH^-$ | – 0,83 |
| $Cr^{2+} + 2e^-$ | ⇌ | Cr | – 0,91 |
| $Mn^{2+} + 2e^-$ | ⇌ | Mn | – 1,18 |
| $A\ell^{3+} + 3e^-$ | ⇌ | $A\ell$ | – 1,66 |
| $Mg^{2+} + 2e^-$ | ⇌ | Mg | – 2,36 |
| $Na^+ + e^-$ | ⇌ | Na | – 2,71 |
| $Ca^{2+} + 2e^-$ | ⇌ | Ca | – 2,87 |
| $Sr^{2+} + 2e^-$ | ⇌ | Sr | – 2,89 |
| $Ba^{2+} + 2e^-$ | ⇌ | Ba | – 2,90 |
| $Cs^+ + e^-$ | ⇌ | Cs | - 2,92 |
| $K^+ + e^-$ | ⇌ | K | – 2,93 |
| $Li^+ + e^-$ | ⇌ | Li | – 3,05 |

Increasing reducing ability ↓

## TABLE 5B: STANDARD REDUCTION POTENTIALS

Increasing oxidising ability ↓

| Half-reactions | | | $E^{\theta}$ (V) |
|---|---|---|---|
| $Li^+ + e^-$ | ⇌ | $Li$ | − 3,05 |
| $K^+ + e^-$ | ⇌ | $K$ | − 2,93 |
| $Cs^+ + e^-$ | ⇌ | $Cs$ | − 2,92 |
| $Ba^{2+} + 2e^-$ | ⇌ | $Ba$ | − 2,90 |
| $Sr^{2+} + 2e^-$ | ⇌ | $Sr$ | − 2,89 |
| $Ca^{2+} + 2e^-$ | ⇌ | $Ca$ | − 2,87 |
| $Na^+ + e^-$ | ⇌ | $Na$ | − 2,71 |
| $Mg^{2+} + 2e^-$ | ⇌ | $Mg$ | − 2,36 |
| $A\ell^{3+} + 3e^-$ | ⇌ | $A\ell$ | − 1,66 |
| $Mn^{2+} + 2e^-$ | ⇌ | $Mn$ | − 1,18 |
| $Cr^{2+} + 2e^-$ | ⇌ | $Cr$ | − 0,91 |
| $2H_2O + 2e^-$ | ⇌ | $H_2(g) + 2OH^-$ | − 0,83 |
| $Zn^{2+} + 2e^-$ | ⇌ | $Zn$ | − 0,76 |
| $Cr^{3+} + 3e^-$ | ⇌ | $Cr$ | − 0,74 |
| $Fe^{2+} + 2e^-$ | ⇌ | $Fe$ | − 0,44 |
| $Cr^{3+} + e^-$ | ⇌ | $Cr^{2+}$ | − 0,41 |
| $Cd^{2+} + 2e^-$ | ⇌ | $Cd$ | − 0,40 |
| $Co^{2+} + 2e^-$ | ⇌ | $Co$ | − 0,28 |
| $Ni^{2+} + 2e^-$ | ⇌ | $Ni$ | − 0,27 |
| $Sn^{2+} + 2e^-$ | ⇌ | $Sn$ | − 0,14 |
| $Pb^{2+} + 2e^-$ | ⇌ | $Pb$ | − 0,13 |
| $Fe^{3+} + 3e^-$ | ⇌ | $Fe$ | − 0,06 |
| **$2H^+ + 2e^-$** | **⇌** | **$H_2(g)$** | **0,00** |
| $S + 2H^+ + 2e^-$ | ⇌ | $H_2S(g)$ | + 0,14 |
| $Sn^{4+} + 2e^-$ | ⇌ | $Sn^{2+}$ | + 0,15 |
| $Cu^{2+} + e^-$ | ⇌ | $Cu^+$ | + 0,16 |
| $SO_4^{2-} + 4H^+ + 2e^-$ | ⇌ | $SO_2(g) + 2H_2O$ | + 0,17 |
| $Cu^{2+} + 2e^-$ | ⇌ | $Cu$ | + 0,34 |
| $2H_2O + O_2 + 4e^-$ | ⇌ | $4OH^-$ | + 0,40 |
| $SO_2 + 4H^+ + 4e^-$ | ⇌ | $S + 2H_2O$ | + 0,45 |
| $Cu^+ + e^-$ | ⇌ | $Cu$ | + 0,52 |
| $I_2 + 2e^-$ | ⇌ | $2I^-$ | + 0,54 |
| $O_2(g) + 2H^+ + 2e^-$ | ⇌ | $H_2O_2$ | + 0,68 |
| $Fe^{3+} + e^-$ | ⇌ | $Fe^{2+}$ | + 0,77 |
| $NO_3^- + 2H^+ + e^-$ | ⇌ | $NO_2(g) + H_2O$ | + 0,80 |
| $Ag^+ + e^-$ | ⇌ | $Ag$ | + 0,80 |
| $Hg^{2+} + 2e^-$ | ⇌ | $Hg(\ell)$ | + 0,85 |
| $NO_3^- + 4H^+ + 3e^-$ | ⇌ | $NO(g) + 2H_2O$ | + 0,96 |
| $Br_2(\ell) + 2e^-$ | ⇌ | $2Br^-$ | + 1,07 |
| $Pt^{2+} + 2e^-$ | ⇌ | $Pt$ | + 1,20 |
| $MnO_2 + 4H^+ + 2e^-$ | ⇌ | $Mn^{2+} + 2H_2O$ | + 1,23 |
| $O_2(g) + 4H^+ + 4e^-$ | ⇌ | $2H_2O$ | + 1,23 |
| $Cr_2O_7^{2-} + 14H^+ + 6e^-$ | ⇌ | $2Cr^{3+} + 7H_2O$ | + 1,33 |
| $C\ell_2(g) + 2e^-$ | ⇌ | $2C\ell^-$ | + 1,36 |
| $MnO_4^- + 8H^+ + 5e^-$ | ⇌ | $Mn^{2+} + 4H_2O$ | + 1,51 |
| $H_2O_2 + 2H^+ + 2e^-$ | ⇌ | $2H_2O$ | +1,77 |
| $Co^{3+} + e^-$ | ⇌ | $Co^{2+}$ | + 1,81 |
| $F_2(g) + 2e^-$ | ⇌ | $2F^-$ | + 2,87 |

↑ Increasing reducing ability

# basic education

Department:
Basic Education
**REPUBLIC OF SOUTH AFRICA**

## SENIOR CERTIFICATE/*SENIOR SERTIFIKAAT*
## NATIONAL SENIOR CERTIFICATE/
## *NASIONALE SENIOR SERTIFIKAAT*

## GRADE/*GRAAD* 12

## TECHNICAL SCIENCES P2/
## *TEGNIESE WETENSKAPPE V2*

## NOVEMBER 2020

## MARKING GUIDELINES/*NASIENRIGLYNE*

**MARKS/*PUNTE*: 150**

Approved: DBE IM 03/12/2020
APPROVED DBE IM 03/12/2020

**These marking guidelines consist of 17 pages**
***Hierdie nasienriglyne bestaan uit 17 bladsye .***

Approved: Umalusi 03/12/2020
approved: KLyttonel
examiner 8/12/2020

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2020 -12- 03
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

## QUESTION/*VRAAG* 1

| | | |
|---|---|---|
| 1.1 | B ✓✓ | (2) |
| 1.2 | C ✓✓ | (2) |
| 1.3 | D ✓✓ | (2) |
| 1.4 | A ✓✓ | (2) |
| 1.5 | A ✓✓ | (2) |
| 1.6 | D ✓✓ | (2) |
| 1.7 | B ✓✓ | (2) |
| 1.8 | C ✓✓ | (2) |
| 1.9 | C ✓✓ | (2) |
| 1.10 | D ✓✓ | (2) |

**[20]**

## QUESTION/*VRAAG* 2

2.1 An atom or a group of atoms (bond) that determine the chemistry of a molecule. ✓✓
**OR**
An atom or a group of atoms (bond) that determine(s) the physical and chemical properties of a group of organic compounds.

*'n Atoom of groep atome (binding) wat die chemie van 'n molekule bepaal.*
***OF***
*'n Atoom of groep atome (binding) wat die fisiese en chemiese eienskappe van 'n groep organiese verbindings bepaal.* (2)

2.2.1 Alkenes ✓/*Alkene* (1)

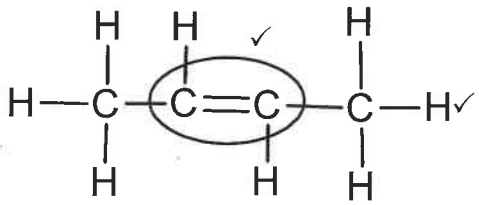
2.2.2 Aldehydes ✓/*Aldehiede* (1)

2.2.3 Carboxylic acids ✓/*Karboksielsure* (1)

2.3.1 Hexanal✓/*Heksanal* (2)

2.3.2 Propanoic acid✓/*Propanoësuur* (2)

2.4.1



**Marking criteria/*Nasienriglyne*:**
- Double bond ✓
- Whole structure correct. ✓

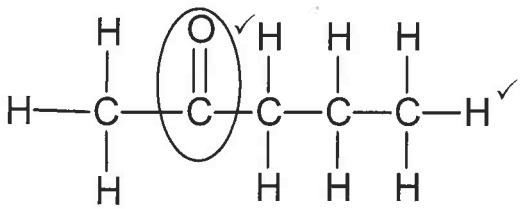
**Note**: Any hydrogen atom or bond missing or added Max: 1/2

- *Dubbelbinding*
- *Hele struktuur korrek.*

***Let wel**: Enige waterstofatoom of binding uitgelaat of bygevoeg Maks: 1/2*

(2)

2.4.2



**Marking criteria/ *Nasienriglyne*:**
- Functional group ✓
- Whole structure correct. ✓

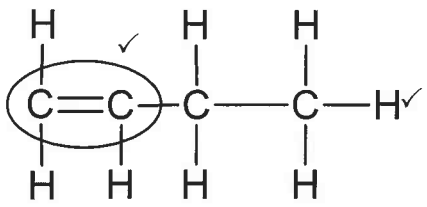
**Note:** Any hydrogen atom or bond missing or added Max 1/2

- *Funksionele groep.*
- *Hele struktuur korrek.*

***Let wel:** Enige waterstofatoom of binding uitgelaat of bygevoeg Maks: 1/2*

(2)

2.5.1

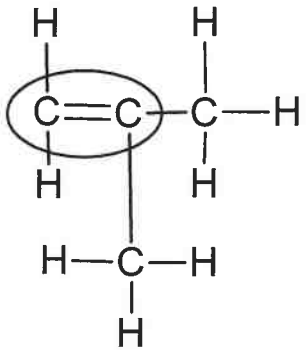


**Marking criteria/*Nasienriglyne*:**
- Double bond ✓
- Whole structure correct. ✓

**Note:** Any hydrogen atom or bond missing or too many bonds Max ½
If compound A is drawn 0/2

(2)

**OR/OF**

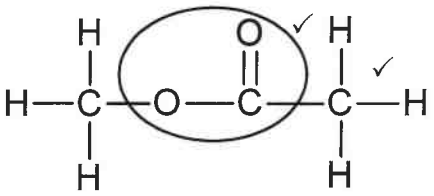


- *Dubbelbinding.*
- *Hele struktuur korrek.*

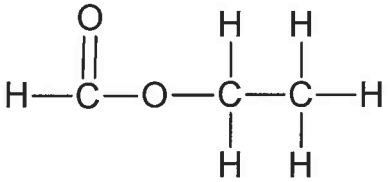
***Let wel:*** *Enige waterstofatoom of binding uitgelaat of teveel binding*
*Maks: ½*
*Indien verbinding A geteken 0/2*



2.5.2



**OR/OF**



**Marking criteria/ *Nasienriglyne*:**
- Correct functional group ✓
- Whole structure correct. ✓

**Note:** Any hydrogen atom or bond missing or added Max ½
- *Korrekte funksionele groep.*
- *Hele struktuur korrek.*

***Let wel:*** *Enige waterstofatoom of binding uitgelaat of bygevoeg Maks: ½*

(2)

2.6.1 **Negative marking from 2.5.1/*Negatiewe nasien van 2.5.1.***

Positional ✓ *(*if but-1-ene is given in 2.5.1).
*Posisioneel (indien but – 1-een gegee is in 2.5.1)*
***OR/OF***
*Chain/positional isomer (if 2-methyl prop-1-ene is given in 2.5.1)*
*Ketting/posisionele isomeer (indien 2-metielprop-1-een gegee is)* (1)

2.6.2 Functional ✓/*Funksioneel* (1)

2.7.1 Unsaturated ✓/*Onversadig* (1)

2.7.2 **Negative marking from 2.7.1/*Negatiewe nasien van 2.7.1.***

It contains carbon - carbon double/multiple bond ✓
*Bevat koolstof-koolstof dubbelbindinge/meervoudige bindinge* (1)

**[21]**

## QUESTION/*VRAAG* 3

3.1 The pressure exerted by a gas in equilibrium with a (solid or) liquid ✓ in a closed container/closed system (at a given temperature). ✓

*Die druk wat deur 'n gas in ewewig met 'n (vaste stof) of vloeistof in 'n geslote houer/geslote stelsel (by 'n bepaalde temperatuur), uitgeoefen word.* (2)

3.2.1 Vapour pressure decreases with an increase in molar mass/molecular mass/number of C-atoms/chain length.✓
**OR**
Vapour pressure increases with a decrease in molar mass/molecular mass/number of C-atoms/chain length.

**OR**

Vapour pressure decreases from 1-propanol to 1-pentanol.
**OR**
Vapour pressure increases from 1-pentanol to 1-propanol.

*Dampdruk verlaag met 'n toename in mol massa/molekulêre massa/aantal C-atome/kettinglengte.*
***OF***
*Dampdruk verhoog met 'n afname in mol massa/molekulêre massa/aantal C-atome/kettinglengte.*

***OF***

*Dampdruk verlaag* van 1-propanol na 1-pentanol.
**OF**
*Dampdruk verhoog* van 1-pentanol na 1-propanol (1)

3.2.2
- Chain length/molar mass increases from 1-propanol to 1-pentanol. ✓
- The strength of intermolecular forces increases from 1-propanol to 1-pentanol/with increase in chain length/molar mass✓
- More energy is needed to overcome strong intermolecular forces from 1-pentanol to 1-propanol. ✓

**OR**

- Chain length/molar mass decreases from 1-pentanol to 1-propanol.
- The strength of intermolecular forces decreases from 1-pentanol to 1-propanol/with decrease in chain length/molar mass area.
- Less energy is needed to overcome weak intermolecular forces from 1-propanol to 1-pentanol.

- *Kettinglengte/molekulêre massa verhoog van 1-propanol na 1-pentanol.*
- *Die sterkte van die intermolekulêre kragte verhoog van 1-propanol na 1-pentanol/met toename in kettinglengte/molekulêre massa*
- *Meer energie is nodig om die sterk intermolekulêre kragte in 1-pentanol te oorkom as in 1-propanol.*

***OF***

- *Kettinglengte/mol massa verlaag van 1-pentanol na1-propanol.*
- *Die sterkte van die intermolekulêre kragte verlaag van 1-pentanol na 1-propanol/ met afname in kettinglengte/molekulêre massa.*
- *Minder energie is nodig om die swak intermolekulêre kragte in 1-propanol te oorkom as in 1-pentanol.* (3)

3.3.1 **A** : Aldehydes ✓/**A***: Aldehiede*
**B** : Alkanes ✓/***B****: Alkane* (2)

3.3.2

- **A**/Aldehydes have (London forces) and dipole-dipole forces. **B**/Alkanes contain London forces only. ✓

- Dipole-dipole forces/forces in **A/**aldehydes are stronger than London forces/forces in **B/** alkanes. ✓

**OR**

- London forces/Forces in **B/**alkanes are weaker than dipole-dipole forces /forces in **A/**aldehydes.

**OR**

- The intermolecular forces in **A** are stronger than the intermolecular forces in **B**.

**OF**

- The intermolecular forces in **B** are weaker than the intermolecular forces in **A**.

- Aldehydes need more energy to overcome the intermolecular forces and therefore have higher boiling points. ✓

**OR**

- Aldehydes have higher boiling points than alkanes.

**OR**

- Alkanes have lower boiling points than aldehydes.

**Marking criteria/*Nasienriglyne*:**

- **A/B** or forces is only accepted if 3.3.1 is correctly identified.
- ***A/B*** *of kragte word slegs aanvaar indien 3.3.1 korrek is.*



- ***A****/Aldehiede het (London-kragte) en dipool-dipool-kragte.* ***B****/Alkane het slegs London-kragte.*

- *Dipool-dipool-kragte/Kragte in* ***A****/aldehiede is sterker as London-kragte/Kragte in* ***B****.*

***OF***

- *London-kragte/Kragte in* ***B****/alkane is swakker as dipool-dipool-kragte/Kragte in* ***A****.*

***OF***

- *Die intermolekulêre kragte in* ***A*** *is sterker as die intermolekulêre kragte in* ***B****.*

***OF***

- *Die intermolekulêre kragte in* ***B*** *is sterker as die intermolekulêre kragte in* ***A****.*

- *Aldehiede benodig meer energie om die intermolekulere kragte te oorkom en het dus hoër kookpunte.*

***OF***

- *Aldehiede het hoër kookpunte as alkane.*

***OF***

- *Alkane het laer kookpunte as aldehiede.*

(3)
**[11]**

## QUESTION/*VRAAG* 4



4.1.1 Addition/hydration ✓
*Addisie/hidrasie* (1)

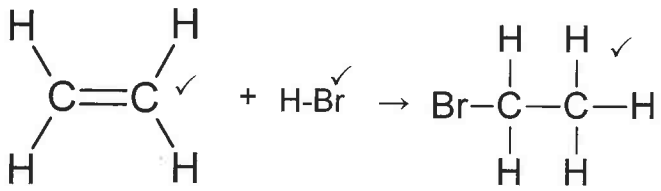
4.1.2 Addition/hydrohalogenation/hydrobromination ✓
*Addisie/hidrohalogenering/hidrobrominering* (1)

4.1.3 Substitution/Halogenation ✓
*Substitusie/Halogenasie* (1)

4.2.1 Water/$H_2O$ ✓ (1)

4.2.2 (Dilute) sulphuric acid/$H_2SO_4$ **OR** (Dilute) phosphoric acid/$H_3PO_4$ ✓
*(Verdunde) swaelsuur/$H_2SO_4$* ***OF*** *(Verdunde) fosforsuur/$H_3PO_4$* (1)

4.3



(3)

**Note:** Do not penalise HBr
***Let wel:*** *Moenie* HBr *penaliseer nie.*
No arrow max 2/3
*Geen pyl* *maks 2/3*

4.4 Moderate/warm temperature ✓/Mild heat. (***Accept****: UV light).*
No water✓ (**Accept:** concentrated $H_2SO_4$ + NaBr/HBr).
*Warm/Matige temperatuur/Matige warmte/hitte* (**Aanvaar**: UV lig).
*Geen water* (***Aanvaar****: gekonsentreerde* $H_2SO_4$ + NaBr/HBr). (2)

4.5 $C_2H_4 + 3O_2$ ✓ $\rightarrow 2CO_2 + 2H_2O$ (+ energy)✓ (balancing/*balansering*) ✓

**Marking criteria/*Nasienriglyne*:**
- Reactants/*reagense* ✓
- Products/*produkte* ✓
- Balancing/*balansering* ✓

**Note:** Do not penalise if energy is omitted.
***Let wel:*** *Moenie penaliseer indien energie uitgelaat is*

(3)

4.6 Ethene✓/*Eteen* (1)

**Note:** Penalise if molecular formula is written
***Let wel:*** *Penaliseer indien molekulêre formule geskryf is*

**[14]**

## QUESTION/*VRAAG 5*

5.1 (A process) in which electrical energy is converted into chemical energy ✓✓
**OR**
The decomposition of a (ionic) substance when an electric current is passed through it.

*('n Proses) waar elektriese energie omgeskakel word in chemiese energie.*
***OF***
*Die ontbinding van 'n (ioniese) stof/verbinding wanneer elektriese stroom daardeur gestuur word.* (2)

5.2 Non spontaneous ✓/*Nie-spontane* (1)

5.3 **Apply negative marking from 5.2./*Negatiewe nasien van 5.2.*** (1)

It requires electrical energy ✓
**OR**
It is an endothermic reaction

*Dit vereis elektriese energie*
***OF***
*Dit is 'n endotermiese reaksie.*


5.4 $CuC\ell_2$ ✓ (1)

| |
|---|
| **Note:** Penalise if name is written.<br>***Let wel:*** *Penaliseer indien naam geskryf is.* |

5.5.1 Anode ✓ (1)

5.5.2 Cathode ✓/*Katode* (1)

5.6 Reducing agent – a substance that is oxidised/loses electrons. ✓✓
**OR**
Reducing agent – A substance that undergoes oxidation.

*Reduseermiddel – 'n Stof wat geoksideer word/verlies van elektrone.*
***OF***
*Reduseermiddel – 'n Stof wat oksidasie ondergaan.* (2)

5.7.1 $2C\ell^- \rightarrow C\ell_2 + 2e^-$ ✓✓ (2)

| **Note**:<br>Penalise once if charge if left out on chloride ion<br>*Penaliseer eenmalig indien lading op chloorioon uitgelaat is* |
|---|

| **Marking criteria:/*Nasienriglyne:*** | |
|---|---|
| $2C\ell^- \rightarrow C\ell_2 + 2e^-$ | 2/2 |
| $2C\ell^- \rightleftharpoons C\ell_2 + 2e^-$ | 1/2 |
| $2C\ell^- \leftarrow C\ell_2 + 2e^-$ | 0/2 |
| $C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$ | 0/2 |

5.7.2 $Cu^{2+} + 2e^- \rightarrow Cu$ ✓✓ (2)

| **Note**: | **Marking criteria:/*Nasienriglyne:*** | |
|---|---|---|
| Penalise once if charge if left out on copper ion | $Cu^{2+} + 2e^- \rightarrow Cu$ | 2/2 |
| *Penaliseer eenmalig indien lading op koperioon uitgelaat is* | $Cu^{2+} + 2e^- \rightleftharpoons Cu$ | 1/2 |
| | $Cu \rightleftharpoons Cu^{2+} + 2e^-$ | 0/2 |
| | $Cu^{2+} + 2e \leftarrow Cu$ | 0/2 |

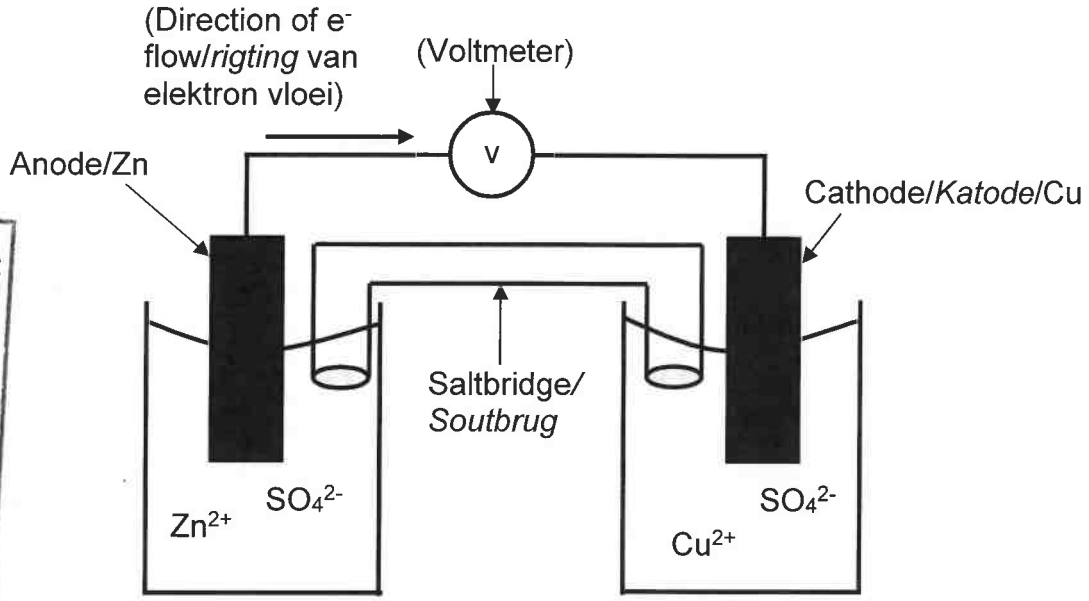
5.7.3 $Cu^{2+} + 2C\ell^-$ ✓→ $C\ell_2 + Cu$ ✓ (2)
***Accept/Aanvaar***: $CuC\ell_2(aq) \rightarrow C\ell_2 + Cu$

**[15]**

## QUESTION/*VRAAG* 6

6.1.1 An (electrochemical cell) that converts chemical energy to electrical energy.✓✓
*'n (Elektrochemiese sel) waar chemiese energie na elektriese energie omgeskakel word.* (2)

6.1.2






| CRITERIA FOR MARKING/*NASIENRIGLYNE* | |
|---|---|
| Anode in correct half cell, labelled (Zn electrode in $Zn^{2+}$ /zinc sulphate or zinc nitrate solution)<br>*Anode in korrekte halfsel, benoem (Zn elektrode in $Zn^{2+}$ /sinksulfaat of sinknitraatoplossing)* | ✓ |
| Cathode in correct half cell, labelled (Cu electrode in $Cu^{2+}$ /copper sulphate or copper nitrate solution)<br>*Katode in korrekte halfsel, benoem (Cu elektrode in $Cu^{2+}$ /kopersulfaat of kopernitraatoplossing)* | ✓ |
| Voltmeter included and labelled/*Voltmeter ingesluit en benoem*<br>***Accept**: galvanometer/multimeter/lightbulb/gloeilamp* | ✓ |
| Salt bridge included and labeled | ✓ |
| Correct direction of the flow electrons in the external circuit<br>*Korrekte rigting van elektron vloei in eksterne stroombaan.*<br>***Note**: if not labelled, do not penalise/indien geen byskrif gegee nie, moenie penaliseer nie* | ✓ |

(5)

**Note**: Credit the saltbridge and voltmeter only if separate containers.
*Krediteer soutbrug en voltmeter slegs indien verskillende houers.*

6.1.3 Temperature/*Temperatuur*: 25°C/298 K ✓
*Concentration of electrolytes / Konsentrasie van elektroliete*: 1 mol·dm$^{-3}$ ✓ (2)

6.1.4 Towards the zinc (half cell)/anode. ✓/*Na sink(halfsel)/anode*
**Accept/*Aanvaar***: *Zn/$Zn^{2+}$(aq)* (1)

6.1.5 To maintain electrical neutrality, ✓ because the Zinc half-cell becomes more positive as zinc is oxidised to form zinc ions/$Zn^{2+}$.✓.
*Handhaaf elektriese neutraliteit, omdat die sinkhalfsel meer positief word soos wat die sink na sinkione/$Zn^{2+}$ geoksideer word.* (2)

6.2.1

| **OPTION/*OPSIE* 1** | **OPTION/*OPSIE* 2** |
|---|---|
| $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓<br>2,00✓= 0,34 - $E^{\theta}x$ ✓<br>$E^{\theta}x$ = - 1,66 V ✓<br>Electrode **X** is aluminium/Aℓ ✓<br>*Elektrode **X** is aluminium/Aℓ* | **X** → $X^{n+}$ + ne⁻ (**y**) ✓<br>$Cu^{2+}$ + 2e⁻ → Cu -(0,34) ✓<br>**X** + $Cu^{2+}$ → $X^{n+}$ + Cu ✓ 2,00V ✓<br>$E^{\theta}x$ = - 1,66 V ✓<br>Electrode **X** is aluminium/Aℓ ✓<br>*Elektrode **X** is aluminium/Aℓ* |

(5)

**Note**:
**Positive marking of answer obtained in 6.2.1 for 6.2.2, 6.2.3. and 6.2.4.**
***Positiewe nasien van antwoord in 6.2.1 in 6.2.2, 6.2.3 en 6.2.4***

6.2.2 Aℓ → $Aℓ^{3+}$ + 3e⁻ ✓✓ (2)

| **Marking criteria:/*Nasienriglyne:*** | |
|---|---|
| Aℓ → $Aℓ^{3+}$ + 3e⁻ | 2/2 |
| Aℓ ⇌ $Aℓ^{3+}$ + 3e⁻ | 1/2 |
| $Aℓ^{3+}$ + 3e⁻ ⇌ Aℓ | 0/2 |
| Aℓ ← $Aℓ^{3+}$ + 3e⁻ | 0/2 |

6.2.3 X/Aluminium/ Aℓ/ anode/negative electrode ✓ / *negatiewe elektrode* (1)

6.2.4 X/Aluminium/Aℓ will be oxidised. ✓✓
**OR**
X/Aluminium/Aℓ will lose electrons.

*X/Aluminium/Aℓ word geoksideer.*
***OF***
*X/Aluminium/Aℓ verloor elektrone.* (2)
**[22]**

## QUESTION/*VRAAG* 7

7.1.1 The change in direction ✓ of a wave upon striking the interface ✓ between two materials.
**OR**
The change in direction of a wave front at the interface (boundary) between two media, bouncing back into the original medium.

*Die verandering in bewegingsrigting van 'n golf wanneer dit die grens tussen die twee media tref.*
***OF***
*Die verandering in bewegingsrigting van 'n golffront by die grens tussen twee media, en dit terugweerkaats word in die oorspronklike medium.* (2)

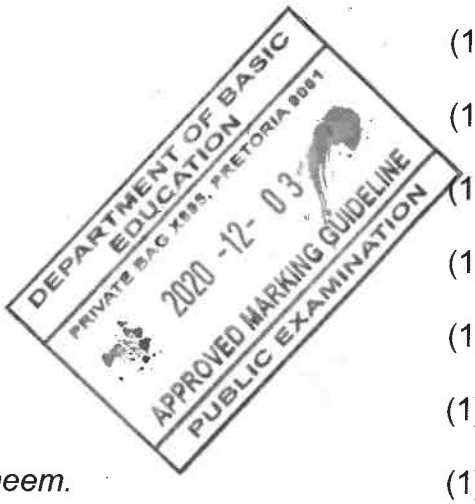
7.1.2 Incident (ray) ✓/*Invallende (straal)* (1)

7.1.3 Reflected (ray) ✓/*Weerkaatste (straal)* (1)

7.1.4 Normal ✓/*Normaal* (1)

7.1.5 (Angle) of incidence ✓/*invals(hoek)* (1)

7.1.6 (Angle) of reflection ✓/*weerkaatsings(hoek)* (1)




7.2 30° ✓ (1)

7.3 The speed will decrease. ✓/*Die spoed sal afneem.* (1)

7.4.1 Water ✓ (1)

7.4.2 It will bent towards the normal/It will be refracted towards the normal ✓
*Dit sal na die normaal gebuig word./Dit sal na die normaal gebreek word.*
**Accept/*Aanvaar*:** change direction/*verander rigting* (1)

7.4.3 Refraction ✓/*Refraksie* (1)

7.5.1 (Critical angle) is the angle of incidence in the denser medium ✓ such that the refracted ray just passes through the surface of separation of the two media. ✓
**OR**
An angle of incidence in the denser medium whose angle of refraction is 90° (a right angle).

*Die (grenshoek) is die invalshoek in die digter medium sodanig dat die gebreekte straal al langs die skeidingsoppervlak van die twee media beweeg.*
***OF***
*Die invalshoek in die digter medium waar die refraksiehoek 90° (regtehoek) is.* (2)

7.5.2 Light ray will travel from water and pass into the air. ✓ It will be refracted away/move away from the normal✓/*Ligstraal sal vanaf water na die lug beweeg. Dit sal weg van die normaal breek.* (2)

7.5.3 When the angle of incidence is greater than the critical angle ✓ the ray of light reflects (back) into the original medium ✓

*Wanneer die invalshoek groter is as die grenshoek, sal die ligstraal (terug) weerkaats word in die oorspronklike medium.* (2)

7.5.4 Greater than ✓/*Groter as* (1)
**[19]**

**QUESTION/*VRAAG* 8**

8.1 (The phenomenon) whereby white light breaks up (spreads out) ✓ into its component colours. ✓

*(Die verskynsel) wanneer witlig in sy saamgestelde kleure opbreek.* (2)

8.2 The different colours of visible light include:/*Die verskillende kleure van sigbare lig is:*

- Red ✓ *Rooi*
- Orange ✓ *Oranje*
- Yellow ✓ *Geel*
- Green ✓ *Groen*
- Blue *Blou*
- Indigo *Indigo*
- Violet *Violet*

(Any FOUR)/(*Enige VIER*) (4)

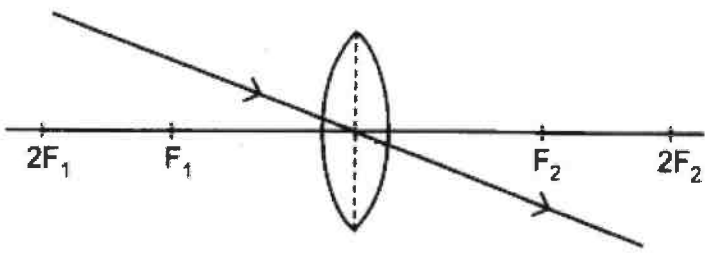

8.3. 
- It is always virtual. ✓
- Erect/upright. ✓
- Its size is equal to that of the object. ✓
- It is formed at the same distance behind the mirror as the object is in front of the mirror.
- It is laterally inverted.

(Any THREE)

- *Dit is 'n skynbeeld.*
- *Regop.*
- *Dieselfde grootte as die voorwerp.*
- *Dit is dieselfde afstand agter die spieël as die voorwerp voor die spieël is.*
- *Dit is sywaarts omgekeerd.*

*(Enige DRIE)* (3)

8.4.1

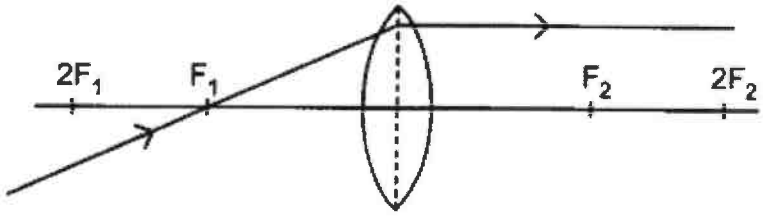



**Note**:
Penalise once if arrow is missing in answer 8.4.1, 8.4.2 and/or 8.4.3.
*Penaliseer slegs eenmalig indien pyl uitgelaat is in 8.4.1, 8.4.2 en/of 8.4.3*

**Marking criteria/*Nasienriglyne*:**
- Ray through the optical centre of the lens continues straight through the lens without deviation. ✓
- *Straal beweeg regdeur die optiese middelpunt van die lens sonder afwyking*

(1)

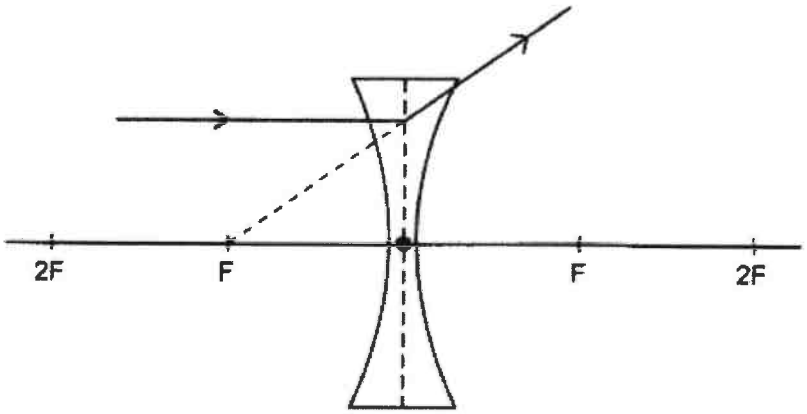
8.4.2




**Marking criteria/*Nasienriglyne*:**
- Ray parallel to the principal axis on the opposite side of the lens without any refraction ✓
- Correct direction of ray ✓
- *Straal beweeg parallel aan die hoofas, aan die teenoorgestelde kant van die lens sonder enige breeking.*
- *Korrekte rigting van die straal*

(2)

8.4.3




**Marking criteria/*Nasienriglyne*:**
- Ray refracted and diverges on the opposite side of the lens ✓
- Correct direction of ray ✓

**Note:** Don't penalise if dotted extrapolated line is omitted or is incorrectly drawn, but angle of refracted ray must be correct

- *Straal gebreek, divergeer aan die teenoorgestelde kant van die lens*
- *Korrekte rigting van die straal*

***Let wel:*** *Moenie penaliseer indien gestippelde ge-ekstrapoleerde straal uitgelaat is of verkeerd geteken is nie, maar hoek van die gerefrakteerde straal moet korrek wees*

(2)
**[14]**

## QUESTION/*VRAAG* 9

9.1 (Electromagnetic wave) is the changing of the magnetic and electric fields mutually perpendicular to each other ✓ and to the direction of propagation of the wave. ✓

*(Elektromagnetiese golf) is die verandering in die magneet- en elektriese velde wat onderling loodreg op mekaar is en op die voortplantingsrigting van die golf.* (2)

9.2 They have longer wavelengths ✓/*Hulle het langer golflengtes* (1)

9.3 Quantum (packets) of energy✓/*Kwantumenergie (pakkies)* (1)

9.4.1 Ultraviolet ✓ (1)

9.4.2 Infrared ✓/*Infrarooi* (1)
**Accept/Aanvaar**: radio waves/*radiogolwe*

9.4.3 Radio waves ✓/*Radiogolwe* (1)
**Accept/*Aanvaar***: micro waves/*mikrogolwe*

9.5 Wavelength and frequency are inversely proportional. ✓✓
**OR**
When wavelength becomes longer, frequency decreases.
**OR**
When wavelength becomes shorter, frequency increases

*Golflengte en frekwensie is omgekeerd eweredig.*
***OF***
*Wanneer golflengte langer word, word frekwensie korter.*
***OF***
*Wanneer golflengte korter word, word frekwensie langer.* (2)



9.6

| OPTION/*OPSIE* 1 | OPTION/*OPSIE* 2 |
|---|---|
| $c = f\lambda$<br>$3,0 \times 10^8$ ✓ $= f\ (4,06 \times 10^{-11})$ ✓<br>$f = 7,39 \times 10^{18}$ Hz<br>$E = hf$ ✓<br>$= (6,63 \times 10^{-34})(7,39 \times 10^{18})$<br>$= 4,90 \times 10^{-15}$ J ✓<br>**Accept/*Aanvaar*** : $4,8990 \times 10^{-15}$ J | $E = h\frac{c}{\lambda}$ ✓<br>$E = \frac{(6,63 \times 10^{-34})(3,0 \times 10^{8})}{4,06 \times 10^{-11}}$ ✓<br>$E = 4,90 \times 10^{-15}$ J ✓ |

(5)
**[14]**

**TOTAL/*TOTAAL*: 150**