Province of the
EASTERN CAPE
EDUCATION

SUBJECT	**Technical Sciences**	
PAPER	**2**	
DURATION OF PAPER:	**1 ½ hours**	
PROVINCE	**Eastern Cape**	
DATES OF MARKING	**8- 23 Dec 2022**	

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

The Technical Sciences Paper 2 average percentage of 24,7% was achieved on the seven (7) point scale for a total **number of 2948** learners, who were registered for 2022 grade 12. The graph (figure1) below represents the seven (7) point scale of level distribution for the performance at 24,7% in the 2022 matric results. Generally, the level distribution implies that the paper was poorly performed owing to a few different factors surrounding the years 2020 to 2022 which were 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. The class of 2022 was at grade 10 during Covid-19 era which implies that the said cohort was not properly taught in grade 10 and 11. The 24,7% performance indicates that the 2022 grade 12 candidates have the content gap in the lower grades content (grade 10 and 11) which is supposed to be a base in grade 12 teaching and learning.The time that was stipulated for grade 12 content was used to juggle between lower grades content (10 & 11) and grade 12.

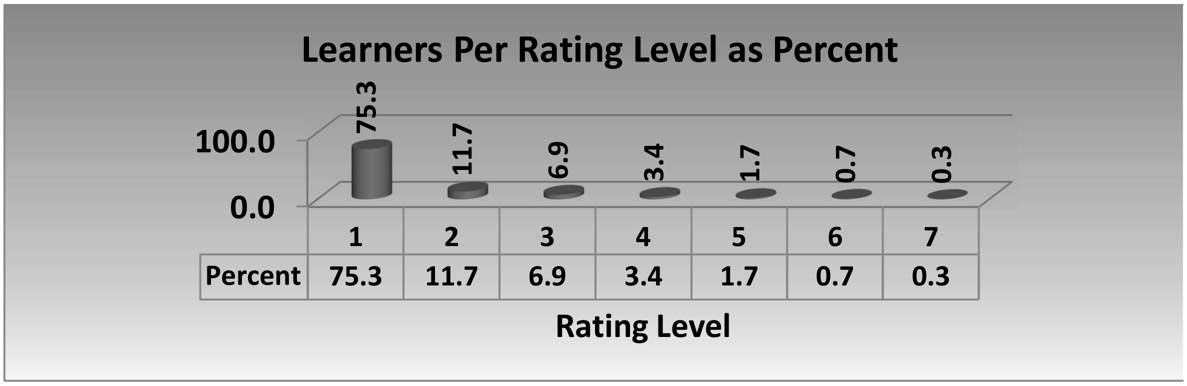


Figure 1- seven-point scale

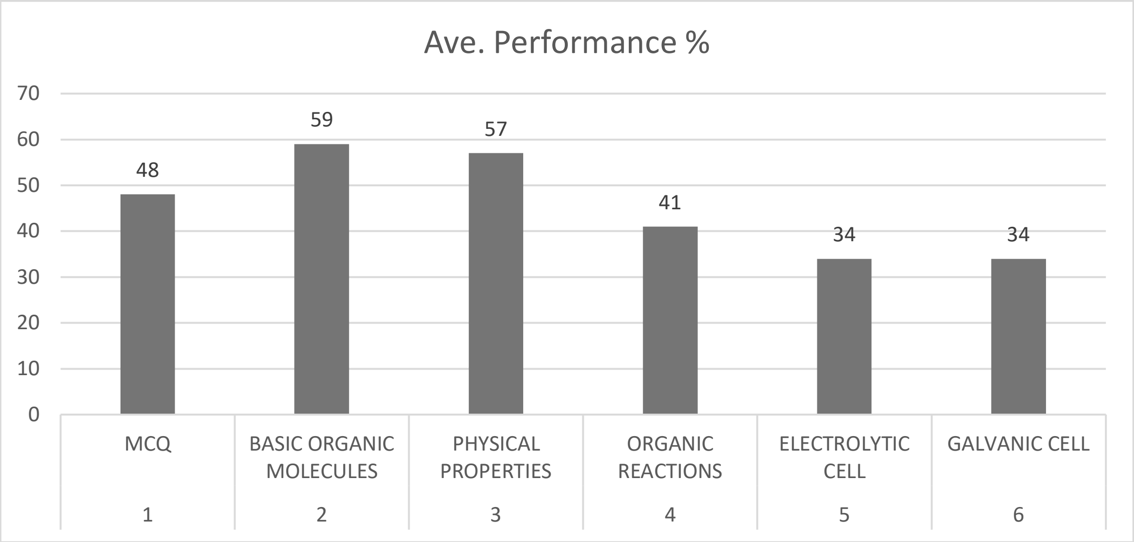
The results displayed by seven-point scale support the results of 100 sampled scripts tabled in the Rasch report.
The graph below shows the learner performance as per Rasch report which ranged between 34 % and 57% with electrolytic cell and galvanic cell being the least

performed topics at 34%.

TABLE 1: OVERALL LEARNER PERFORMANCE FROM QUESTION 1-6

Question	Topic	Ave. performance %
1	ALL TOPICS IN THE TECH SCIENCE CONTENT	48%
2	BASIC ORGANIC MOLECULES	59%
3	PHYSICAL PROPERTIES OF ORGANIC COMPOUNDS	57%
4	ORGANIC REACTIONS	41%
5	ELECTROLYTIC CELL	34%
6	GALVANIC CELL	34%
Total		**45%**

FIGURE 2: QUESTION SUMMARY



The information provided by both Seven-Point Scale and the Rasch Report evidently confirm poor performance of Technical Sciences Paper 2.

The table below shows the three-year performance trend on level distribution. Bulk of learners has performed at level with a decline rate of 13 % compared to 2020 and 6,5% decline rate compared to 2021.

There are pockets of excellence in level 6 performance where there is an improvement of 0,4% in comparison with 2021 results. Additionally, the percentage of level 7's has improved to 0,3% from 0,1% in 2021.

Table 2- levels of performance for 2020-2022

Levels of performance	2020	2022	2022
1	62,3	68,5	75,3
2	18,3	15,9	11,7
3	10,5	9	6,9
4	5,0	3,7	3,4
5	2,3	2,4	1,7
6	1,1	0,3	0,7
7	0,6	0,1	0,3

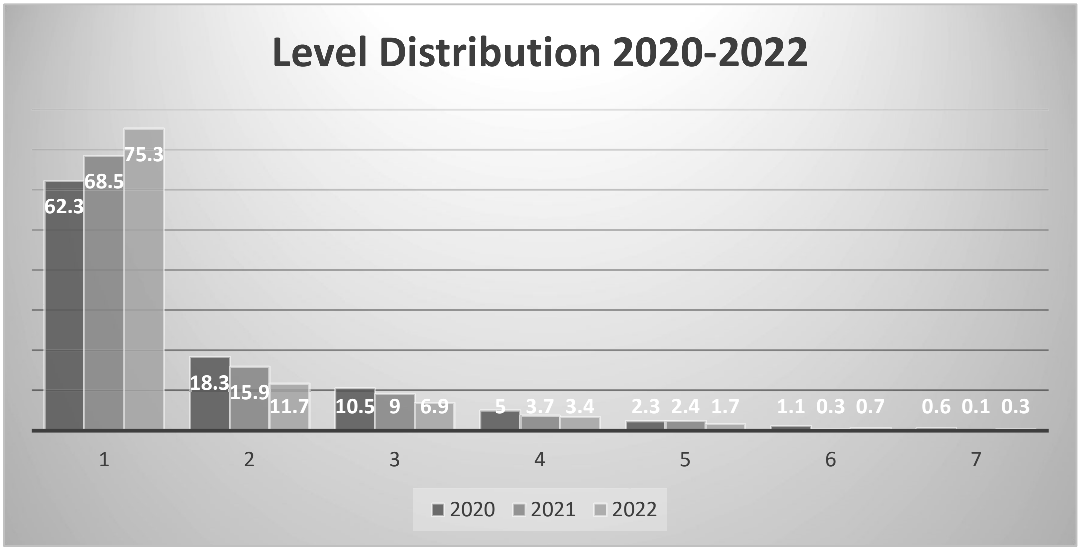


Figure 3

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 diminishing especially in levels 2 to 5. The prediction is that for the next two years, the texture of results will be drastically lessening because of 2020 academic year that was severely affected by covid-19 pandemic. The graph and the table 3 (figure 4 &table 3) for the 2020-2022 overall performance which displays the decline in 2022 results. Furthermore table 3 also displays a deterioration in the quality of results.

2020	2022	2022
37,7	31,5	24,7

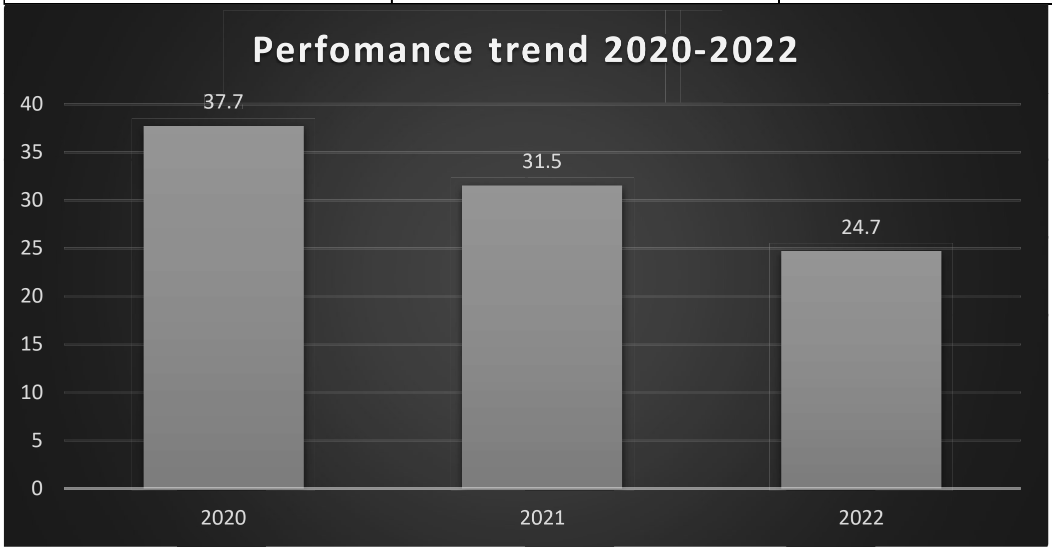


Figure 4

Table 3- quality levels (5-7)

Levels	2020 (number of learners)	2022 (number of learners)	2022
L5	45	66	51
L6	21	9	22
L7	12	4	9

Figure 5 exhibits a great improvement in the number of learners who passed at level 6 (22 %) which is a 13% improvement and level 7 (9%) with a 5% increase. However, the number of learners passing at level 5 is decreasing significantly at a 15% decline rate.

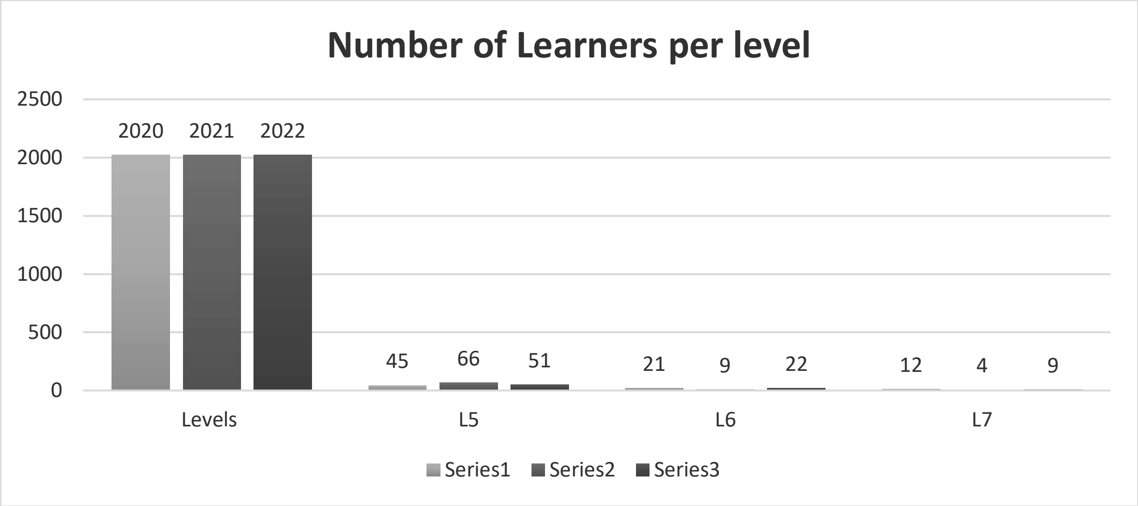


Figure 5

Table 4 below a decline rate over a period of three years which implies that the results are not improving but dropping at a rate of 6,5%.

Table 4- difference in overall performance (2020-2022)

Year	Overall Performance	Difference in % over 3 years (2018-2020)	Difference in % over 2 years (2019,2020-2022)
2020	**37,7%**	**10,6%**	**-6,9%**
2021	**31,5%**	**0,7%**	**-6,5%**
2022	**24,7**	**13%**	**-6,8**

SECTION 2: Comment on candidates' performance in individual questions

(It is expected that a comment will be provided for each question).

The learner performance is reputable on the relative performance of the 100 trialled scripts, tabled and graphed below (see table 1, figure 1 and figure 2). An overall performance of 45**%.** Based on the presented data from sampled 100 scripts, questions 5 and 6 (**Electrolytic Cell 34% & Galvanic cell 34%)** remain the most poorly performed questions, followed by question 4 **(Organic Reactions - 41%).**

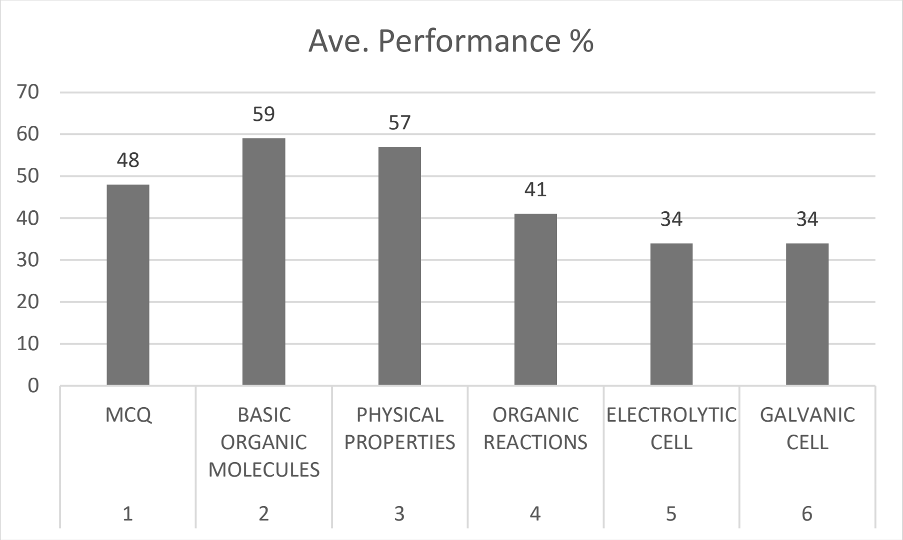


Figure 6

The better performed questions were question 2 (Basic Organic Compounds) and question 3(Physical Properties) organic compounds**;** with an average performance that ranges between 57% and 59 % which is not an outstanding performance at all.
The summary of sub-question results is tabled in table 2 and represented graphically in figure.

Table 5

Sub-question	Topic	Ave. performance %
1.1	BASIC ORGANIC COMPOUNDS	83
1.2	BASIC ORGANIC COMPOUNDS	57
1.3	MATTER AND MATERIAL	35
1.4	ELECTROLYTIC CELL	26
1.5	GALVANIC CELL	41
2.1	BASIC ORGANIC COMPOUNDS	61
2.2	BASIC ORGANIC COMPOUNDS	65
2.3	BASIC ORGANIC COMPOUNDS	90

2.4	BASIC ORGANIC COMPOUNDS	34
3.1	PHYSICAL PROPERTIES OF ORGANIC COMPOUNDS	74
3.2	PHYSICAL PROPERTIES OF ORGANIC COMPOUNDS	82
3.3	PHYSICAL PROPERTIES OF ORGANIC COMPOUNDS	61
3.4	PHYSICAL PROPERTIES OF ORGANIC COMPOUNDS	33
3.5	PHYSICAL PROPERTIES OF ORGANIC COMPOUNDS	77
4.1	ORGANIC REACTIONS	72
4.2	ORGANIC REACTIONS	29
4.3	ORGANIC REACTIONS	20
4.4	ORGANIC REACTIONS	30
4.5	MATTER AND MATERIAL	67
5.1	ELECTROLYTIC CELL	18
5.2	ELECTROLYTIC CELL	47
5.3	ELECTROLYTIC CELL	63
5.4	ELECTROLYTIC CELL	67
5.5	ELECTROLYTIC CELL	28
5.6	ELECTROLYTIC CELL	29
5.7	ELECTROLYTIC CELL	15
6.1	GALVANIC CELL	11
6.2	GALVANIC CELL	34
6.3	GALVANIC CELL	17
6.4	GALVANIC CELL	19
6.5	GALVANIC CELL	51

Figure 7 below shows the performance summary on each sub-question

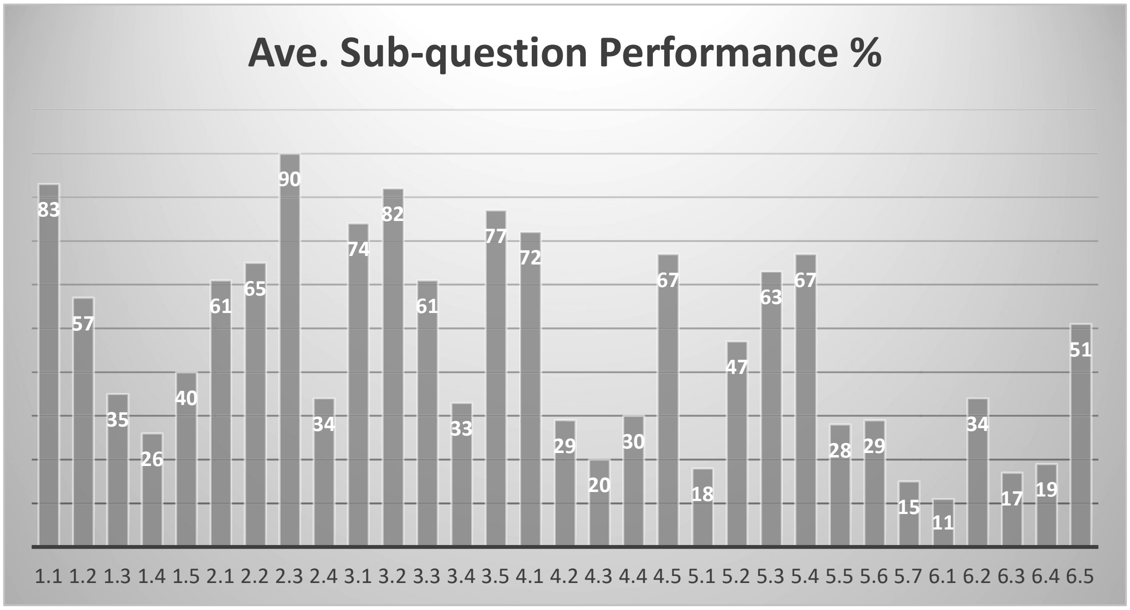


Figure 7

QUESTION 1

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

The average performance for question 1 is 48 %, this is a critical underperformance.

The table and the graph below depict the performance in question 1.

Table 6

Sub-question	Topic	Ave. performance %
1.1	Hydrocarbon	83
1.2	Secondary alcohol	57
1.3	Pure Semiconductors	35
1.4	Electroplating	26
1.5	Galvanic Cell	40

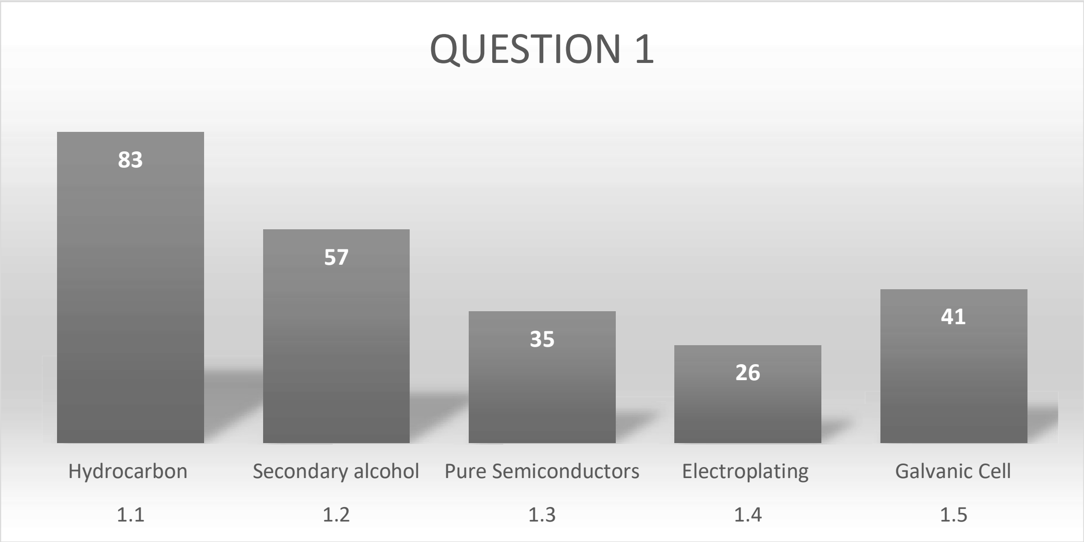


Figure 8

Question 1 was poorly answered especially 1.4 (Electroplating), 1.3 (Pure Semiconductors) &1.5 (Galvanic Cell) and as portrayed by the graph are the questions that made the whole question to attain an average of 48 %.

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).

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

Question 1.4 specifically was poorly performed at 26% owing to lack of misunderstanding of electroplating.

1.3 was poorly answered at 35% because learners could not understand the eamples of pure semiconductors.

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

Learners should be trained in electroplating and semiconductors.

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

1.5 also indicated that learners do not have deep understanding of the **galvanic cell**

QUESTION 2

Table 7: Question 2 summary of average performance

Sub-question	Topic	Ave. performance %
2.1	Homologous series	60,5
2.2.1	Haloalkane	88
2.2.2	Functional isomer	34,5
2.2.3	Ketone	85
2.2.4	Unsaturated hydrocarbon	84
2.3	IUPAC name	90
2.4.1	Structural formula of compound C	51,5
2.4.2	Functional Group of compound F	17

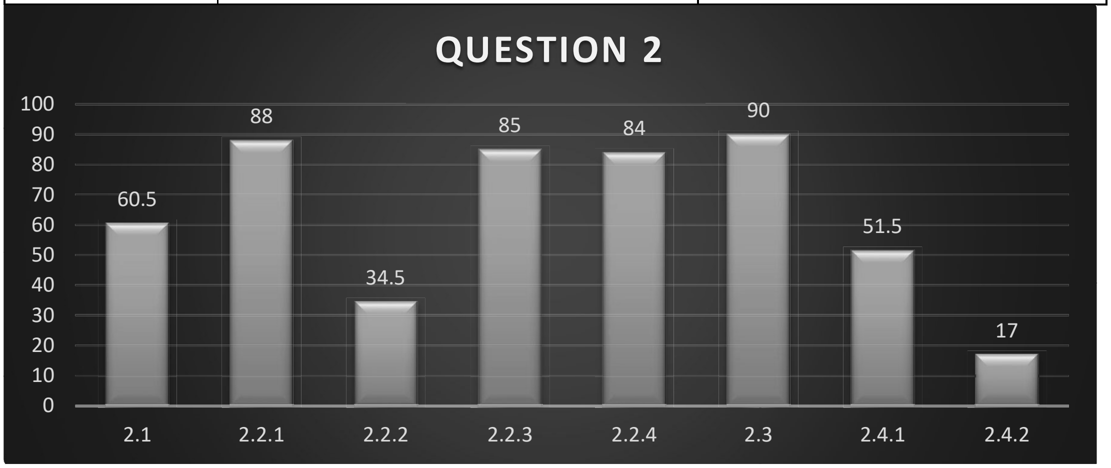


Figure 9

QUESTION 2 was performed at an average of 59% compared to 19 % in 2021. 2.4.2 (functional Isomers of compound F) was conspicuously poorly performed at 17%. In 2.2.2 candidates were unable to identify isomers that were in question. Question 2.1 was unexpectedly underperformed as the definition of the ‘homologous series” 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**.

For candidates to obtain marks in 2.1 & 2.2.2 they depended solely on understanding the condensed structural formulae which are not part of CAPS content.

In Q.2.4.2 It is evident that the candidates do not understand types of Isomers.

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

The topic needs thorough revision and practice, more time should be given to Basic Organic molecules Key words need to be highlighted in definitions and candidates be provided with examination guidelines.

(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 task should be done in all topics, not only the prescribed PATs should be given a priority. Sufficient time for revision must be catered for.

QUESTION 3

Table 8: Question 3 summary of average performance

Sub-question	Topic	Ave. performance %
3.1	Boiling point	74
3.2	Identifying compound with weakest Intermolecular forces	82
3.3.1	Identifying Propan-1-ol	61
3.3.2	Identifying Propanal	59
3.3.3	Identifying Propanal	62
3.4	Comparing vapour pressure of Propanoic Acid and propan-1-ol	33,25
3.5	Compound with a highest melting point	77

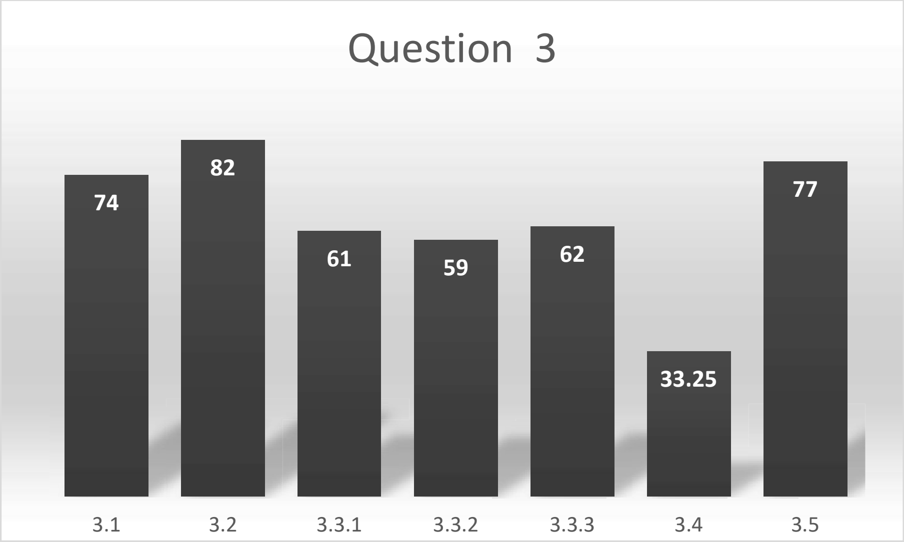


Figure 10

Question 3 was performed at 57 % on average and has improved by 37,5 % compared to 2021 where it was 19,7%.

3.4 was poorly answered at 33,25%, this question needed the candidates to explain the difference in vapour pressure of propanoic acid and propan-1-ol. The performance in this question ranged between 33,25%-82%.

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

in 3.4 candidates failed to explain the trends in vapour pressure of propanoic acid and propan-1-ol. The key reason that candidates could not score marks in this question is due to candidates' inability to mention both compounds, types, and strength of IMF as well as energy needed to overcome intermolecular forces.

. Moreover, candidates were unable to relate Intermolecular forces with physical properties of organic molecules.

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

When explaining the trends in physical properties the following aspects should be taken into consideration:

Mention the: organic molecules/ compounds in question (A and B, A and C)
The chain length ((branched/spherical/longer chain)/surface area)
The type of intermolecular forces
Strength of intermolecular forces.
Strength of intermolecular forces (weaker/ stronger)
Energy required to OVERCOME intermolecular forces (more/less)

Learners should also be trained on arranging compounds according to decrease/increase in vapour pressure, boiling points, melting points and viscosity.

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

Page 21 of 2021 Examination Guidelines and pages 46-47 of Technical Sciences CAPS document should be consulted when teaching Physical properties of organic compounds.

Questions that need **explanations** should be included in **informal tasks.**

Candidates 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, candidates 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 candidates with expected assessment tasks. The manual will not replace the existing LTSM but will expose candidates to various assessment tasks.

Question 4

Table 9: Question 4 summary of average performance

Sub-question	Topic	Ave. performance %
4.1.1	Type of reaction (1)	74
4.1.2	Type of reaction (3)	69
4.2	Chemical equation for reaction 1	29
4.3.1	Type of reaction	23
4.3.2	Name or formula for compound X	18
4.4.1	Type of reaction	39
4.4.2	Two reaction conditions	19,5
4.4.3	Name of compound Y	35
4.5.1	Type of material	58
4.5.2	Definition of term Doping	70
4.5.3	Type of a bias	68

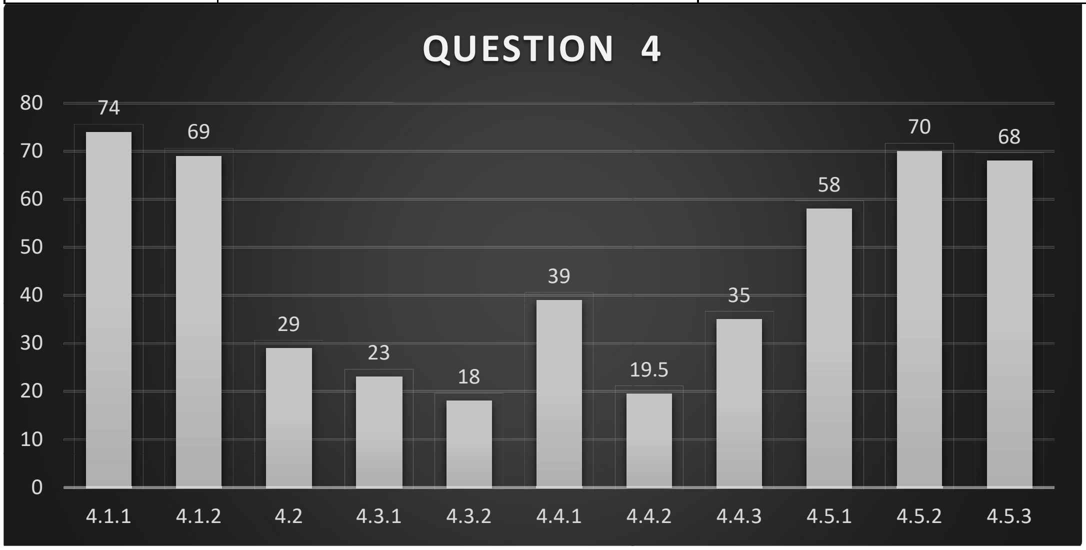


Figure 10

This question was answered at an attainment of 41 % in 2022 and upgraded with a rate 21,9% compared to 2021 where it was performed at 19,1%. Questions 4.3.1 (Combustion), 4.3.2. could not provide the (Name or formula of compound formed) and 4.4.2 (reaction conditions) were noticeably underperformed which pulled the performance in question 4 down. Organic reactions generally are still a challenge to candidates, they cannot interpret the given flow diagrams

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

In Questions 4.3.1 Candidates could not identify the **Combustion** reaction,
In Question 4.3.2. could not provide the **Name or Formula** of compound formed) and
In Question 4.4.2 could not provide reaction conditions for compound Y

(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 candidates how to answer these questions. Expose candidates to various organic reactions, writing them using structural formulae and molecular formulae.

Emphasis should be placed on studying the reaction conditions for the different reactions. Candidates 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.

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

QUESTION 5

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

Question 5 has improved to 34% in comparison with 2021where it was performed at 21,3 %, and the improvement rate is 12,7%. The sub-questions that dropped the performance in question 5 were: 5.5.1 (observation at electrode P), 5.5.2 (observation at electrode Q), 5.6 (balanced chemical reaction) and 5.7 (reason for using molten $CuCl_2$).

Table 10: Question 5 summary of average performance

Sub-question	Topic	Ave. performance %
5.1	Magnitude of the copper charge in $CuCl_2$	18
5.2	Definition of electrolysis	47
5.3	Endothermic reaction	63
5.4	Identification of cathode	67
5.5.1	Observation on electrode P	23
5.5.2	Observation on electrode Q	32
5.6	Balanced chemical reaction	28,7
5.7	Reason for using molten $CuCl_2$	15

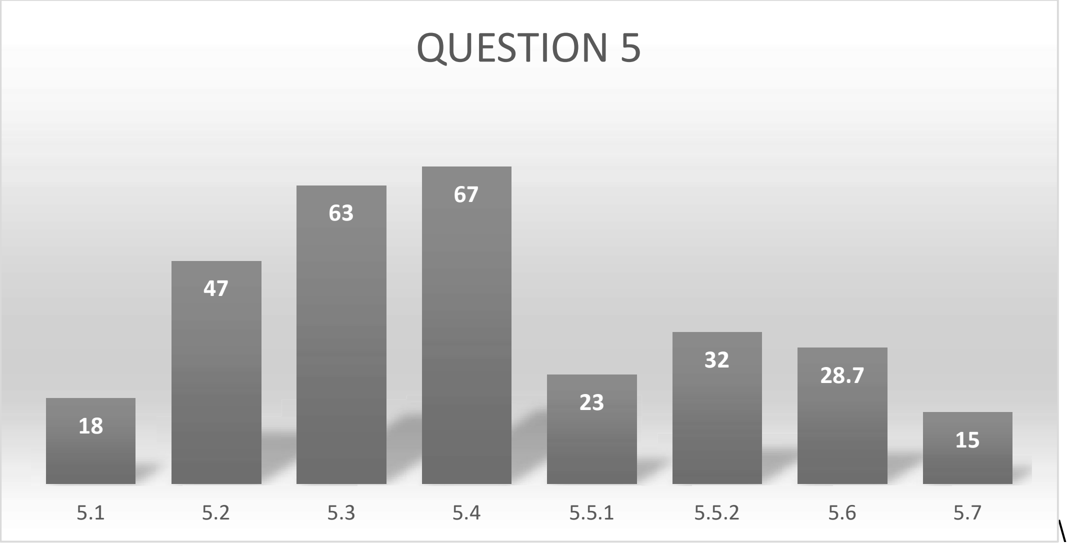


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Figure 11

Question 5 was performed between 0% and 42% which means the question is underperformed.

(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 provided the cell potential instead of the magnitude of the charge of copper in $CuCl_2$.

In Questions 5.5.1 and 5.5.2 candidates could not write down observations at electrode P and Q respectively.

In Question 5.6 Candidates struggled to provide balanced chemical reaction for electrolysis of copper chloride.

In Question 5.7 could not justify why the molten $CuCl_2$ should be used instead of itssolid State.

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

Teachers should stress the importance of studying definitions especially from exam guidelines and CAPS and assess them frequently. In this chapter there are certain definitions that are always examined, and teachers should point them out to the candidates.

Teachers should clearly explain the difference between the electrolytic cell and the galvanic cell and the processes occurring in these cells.

Teachers should do the **electrolysis of copper(II)chloride experiment** with the candidates for them to **observe the Cl_2 gas bubbles** formed at the anode and **the reddish-brown** deposit formed on the cathode. **Names and symbols** of ions should be clearly taught and practised by candidates.

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

Candidates should be taught to **draw** and **label** the components of an electrolytic cell

(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 practiced on writing of half and net reactions.

Emphasis on use of the voltmeter, cell /battery/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 (page 55 of Technical Sciences CAPS document and page 23 of examination guidelines).

Question 6

The overall performance of the question is 34% with is 5,5 % decline compared to 2022 where the percentage was 39,5%. This question was one of the most underperformed questions in the entire question.

6.1. (Meaning of single vertical lines) was performed at 11 % and was the worst performance in the entire question however, it is not a very good performance for this section.

6.3 (Name or formula of the oxidising agent) was noticeably underperformed at 17%.

6.4.1and 6.4.2 (Polarity of anode and cathode) was glaringly underperformed at 19%

6.2 (Two standard conditions for the cell) was performed at 33,5%

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

Table 11: Question 6 summary of average performance

Sub-question	Topic	Ave. performance %
6.1	Meaning of vertical lines in cell notation.	11
6.2	Standard conditions	33,5
6.3	Name or Formula of Oxidising agent	17
6.4.1	Polarity of anode	19
6.4.2	Polarity of cathode	19
6.5	Identification of metal Y	51,4

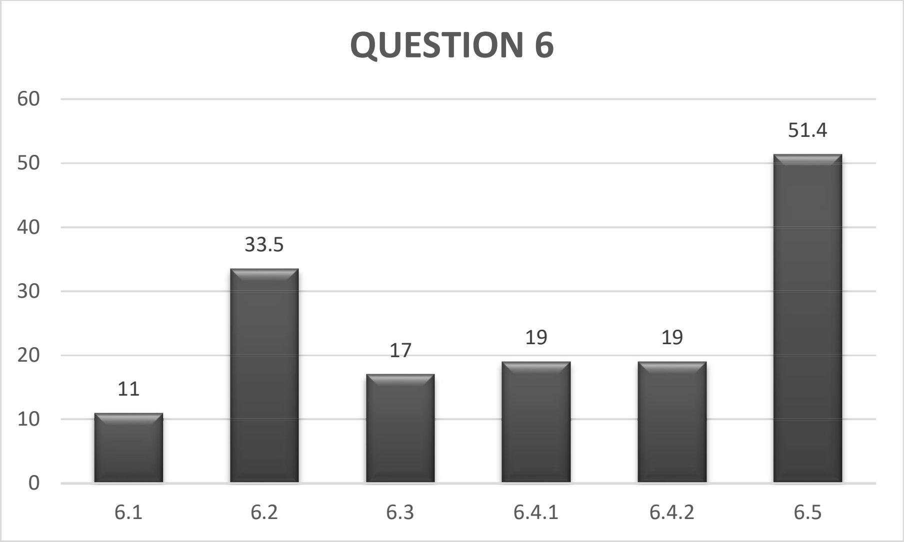


Figure 12

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

6.1. Candidates failed to state the meaning of single vertical lines in a cell notation.
6.3. Candidates failed to provide the name or formula of the oxidising agent.
6.4.1and 6.4.2 Candidates were unable to state the Polarity of anode and cathode
6.2 Candidates could not state the Two standard conditions for the cell

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

- Teachers should emphasize 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. Learners must be taught correct use of formulae for emf and how to substitute in an equation.
- Learners should also be exposed to marking criteria so that they picture how marks are allocated in calculations.
- 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.

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

Learners in this section should be exposed to the following in this chapter:

- ✓ Drawing of galvanic cell
- ✓ Labelling galvanic cell
- ✓ Proper use of table of reduction potentials
- ✓ Identification of anode and cathode

- ✓ Names and formulae of ions, electrolytes
- ✓ Correct writing of formulae for emf as they are in the formula book
- ✓ Energy conversions in a galvanic cell
- ✓ Standard conditions for setting up an electrochemical cell

The succeeding aspects mentioned will assist learners to understand the scientific phenomena:

- ➢ Scientific language in teaching and learning
- ➢ Scientific diagrams in examples and assessment,
- ➢ Practical work other than prescribed PAT, videos,
- ➢ and simulations on galvanic cells
- ➢ Copies of examination guidelines available to learners,
- ➢ Policy documents
- ➢ Question banks generated from previous question papers for assessment readiness.

2. RECOMMENDATION

Learners wrote with 4% content which was outside the scope of Technical Science CAPS, exam guidelines & three -year recovery plan. The condensed structural formulae in Question 2.2.1 & 2.4.1 were part of the questions and there was no official document like errata which was in place to rectify the error. The 4% (3 marks) disadvantaged most of the learners as their responses depicted that they were trying to figure out what the compounds at their disposal looked like.

Compounds A & C in the table in Question 2 made 2.2.1 and 2.4.1 to be invalid questions. On top of these invalid questions, it should also be considered that there was insufficient teaching and revision time due to time losses and delayed school reopening which led to the decline in performance. Taking into consideration the above-mentioned challenges, learner marks need to be adjusted by 10 %.

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

TECHNICAL SCIENCES P2

NOVEMBER 2022

MARKS: 75

TIME: 1½ hours

This question paper consists of 9 pages and 4 data sheets.

* T S C E 2 *

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 SIX 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 1.5) in the ANSWER BOOK, e.g. 1.6 D.

1.1 Which ONE of the compounds below represents a saturated hydrocarbon?

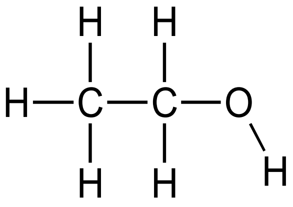
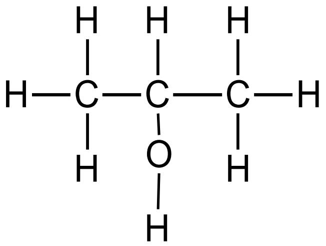
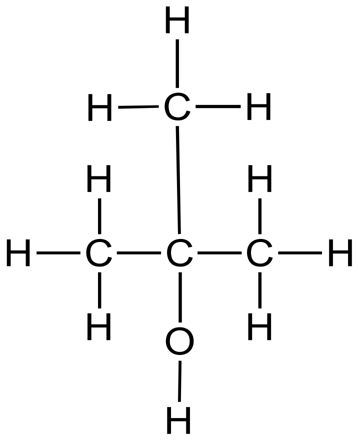
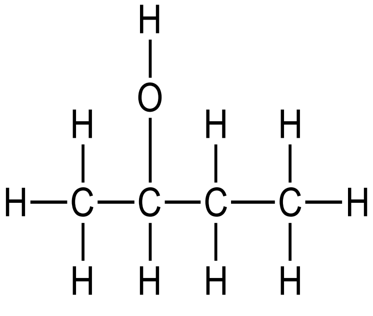
A C_3H_6

B C_4H_8

C C_5H_{12}

D C_6H_{10} (2)

1.2 Consider the structural formulae of the alcohols below.

(i)		(ii)	
(iii)		(iv)	

Which ONE of the following combinations represents a secondary alcohol?

A (ii), (iii) and (iv)

B (i) and (iv)

C (ii) and (iv)

D (i) only (2)

1.3 … are examples of PURE SEMICONDUCTORS.

A Diamonds, silicon and germanium

B Germanium, copper and lead

C Silicon, germanium and lead

D Diamonds, silicon and krypton (2)

1.4 Electroplating is a common application of electrolysis. Which ONE of the following is NOT used for electroplating metals?

A To enhance the appearance

B To make it stronger

C To increase the value

D To prevent rusting (2)

1.5 The net cell reaction taking place in a fuel cell is

$$2H_2(g) + O_2(g) \longrightarrow 2H_2O(\ell) + \text{energy}$$

This is a/an …

A electrolytic cell and the reaction is endothermic.

B electrolytic cell and the reaction is exothermic.

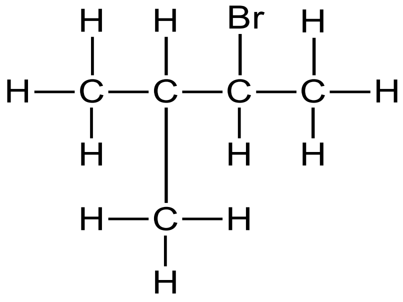
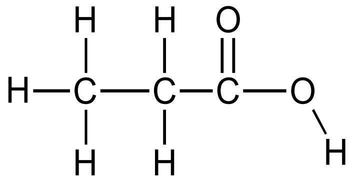
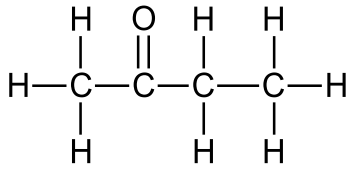
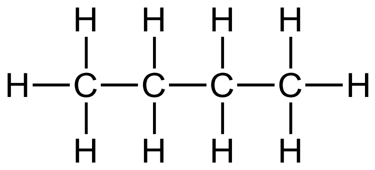
C galvanic cell and the reaction is endothermic.

D galvanic cell and the reaction is exothermic. (2)

[10]

QUESTION 2 (Start on a new page.)

The table below represents organic molecules with different functional groups.

A		**B**	
C	Methyl ethanoate	**D**	
E		**F**	Prop-1-ene

2.1 Define the term *homologous series.* (2)

2.2 Write down the letter (A–F) that represents the following:

2.2.1 Haloalkane (1)

2.2.2 Functional isomers (2)

2.2.3 Ketone (1)

2.2.4 Unsaturated hydrocarbon (1)

2.3 Write down the IUPAC name of compound **E.** (2)

2.4 Draw the structural formula of the following:

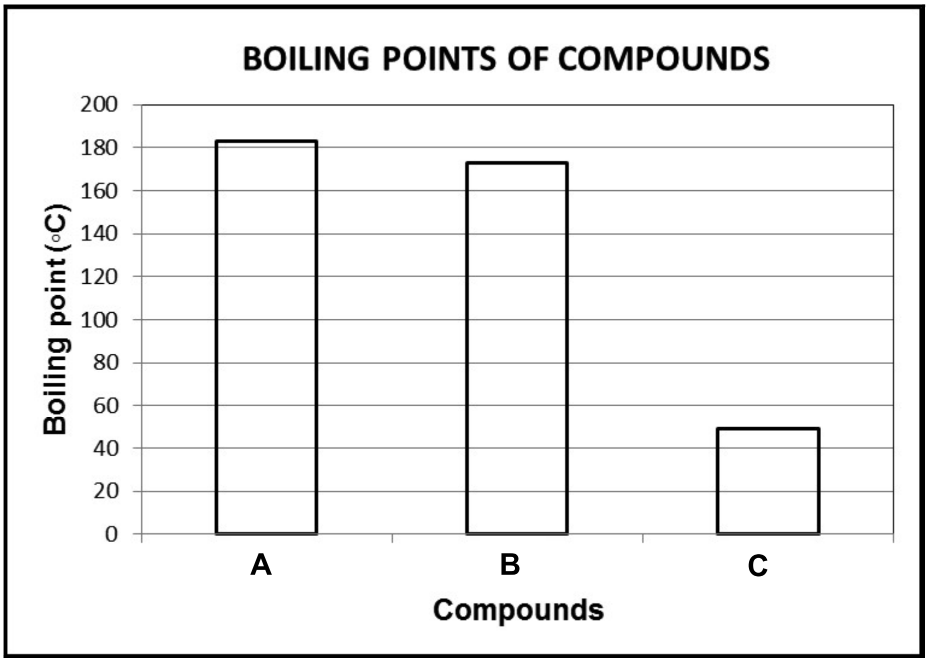
2.4.1 Compound **C** (2)

2.4.2 Functional group of compound **F** (2)

[13]

QUESTION 3 (Start on a new page.)

The graph below shows the boiling points of three different compounds represented by the letters **A**, **B** and **C**. These compounds are from different homologous series.



3.1 Define the term *boiling point*. (2)

3.2 Which ONE of the compounds above contains the weakest type of intermolecular force? (1)

In no specific order, the above compounds are identified as propan-1-ol, propanal and propanoic acid.

3.3 Write down the NAMES of the compounds above represented by the following letters:

3.3.1 **A** (1)

3.3.2 **B** (1)

3.3.3 **C** (1)

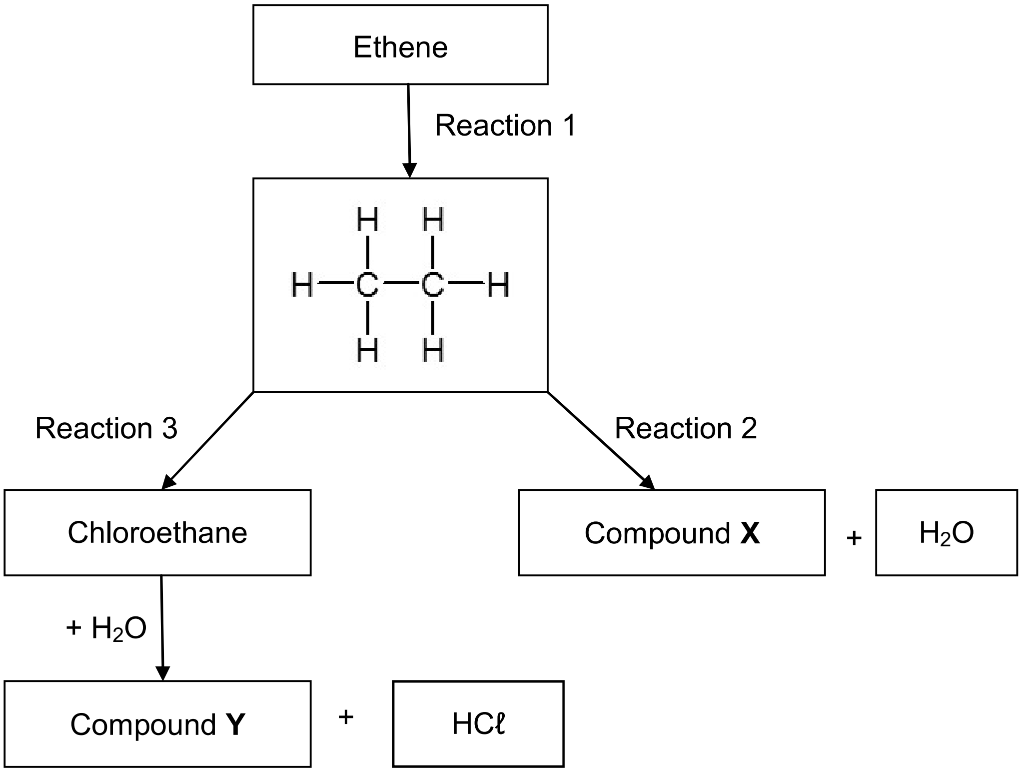
3.4 Explain the difference in the vapour pressure of propanoic acid and propan-1-ol. Refer to the TYPE OF INTERMOLECULAR FORCES, STRENGTH OF THE INTERMOLECULAR FORCES and the ENERGY NEEDED. (4)

3.5 Which compound has the highest melting point? Write down only **A**, **B** or **C**. (1)

[11]

QUESTION 4 (Start on a new page.)

Consider the flow diagram below that shows different organic reactions.



4.1 Write down the TYPE of reaction represented by the following:

4.1.1 Reaction **1** (1)

4.1.2 Reaction **3** (1)

4.2 Using molecular formulae, write down a balanced chemical equation for reaction 1. (3)

4.3 Excess oxygen is the other reactant in reaction 2.

4.3.1 Identify the type of reaction. (1)

4.3.2 Write down the NAME or FORMULA of compound **X**. (2)

4.4 Chloroethane reacts with water to form compound **Y**.

Write down the following for this reaction:

4.4.1 The type of reaction (1)

4.4.2 TWO reaction conditions (2)

4.4.3 The NAME of compound **Y** (2)

4.5 Materials consisting of certain elements in group IV have electrical conductivity between conductors and insulators.

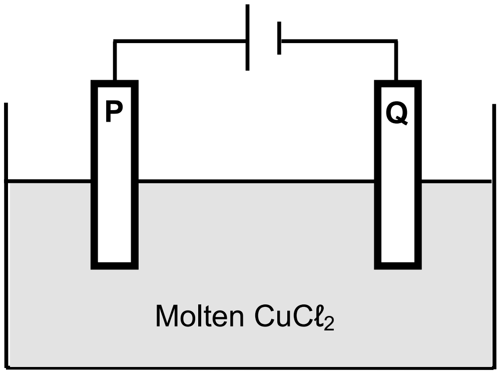
4.5.1 Write down the NAME of the materials referred to in the above statement. (1)

4.5.2 Define the term *doping.* (2)

4.5.3 A diode is constructed by connecting the positive terminal of the battery to a p-type material and the negative terminal to an n-type material. What type of a diode is this? Write down only FORWARD BIAS or REVERSE BIAS. (1)
[17]

QUESTION 5 (Start on a new page.)

The diagram below represents the electrochemical cell used in the electrolysis of molten $CuC\ell_2$. **P** and **Q** are carbon electrodes.



5.1 Write down the magnitude of the copper charge in $CuC\ell_2$. (1)

5.2 Define the term *electrolysis.* (2)

5.3 Is the reaction ENDOTHERMIC or EXOTHERMIC? (1)

5.4 Which electrode is the cathode? Write down only **P** or **Q**. (1)

5.5 Write down the observations made at the following electrodes:

5.5.1 **P** (1)

5.5.2 **Q** (1)

5.6 Write down a balanced chemical equation for the net cell reaction of the above cell. (3)

5.7 Give a reason why $CuC\ell_2$ is used in its molten form instead of its solid state. (2)
[12]

QUESTION 6 (Start on a new page.)

The cell notation of a standard galvanic (voltaic) cell containing an unknown metal **Y** is shown below.

$$\mathbf{Y}\,(s)\,|\,\mathbf{Y}^{2+}\,(aq)\,||\,Cu^{2+}\,(aq)\,|\,Cu(s)$$

6.1 What do the single vertical lines (|) in the cell notation represent? (1)

6.2 State TWO standard conditions for the cell. (2)

6.3 Write down the NAME or FORMULA of the oxidising agent. (2)

6.4 Identify the polarity of the:

- 6.4.1 Anode (1)
- 6.4.2 Cathode (1)

6.5 The initial reading on a voltmeter connected across the electrodes is 1,10 V. Use a calculation to identify metal **Y.** (5)
[12]

TOTAL: 75

DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 2
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VRAESTEL 2

TABLE 1/*TABEL 1*: PHYSICAL CONSTANTS/*FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	$p^{\ominus}$	$1,01 \times 10^5$ Pa
Standard temperature *Standaardtemperatuur*	$T^{\ominus}$	273 K/0 °C

TABLE 2/*TABEL 2*: FORMULAE/*FORMULES*

Emf/*Emk*	$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/*TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*

KEY/*SLEUTEL*

Atomic number/*Atoomgetal* → 29

Electronegativity/*Elektronegatiwiteit* → 1,9

Symbol/*Simbool* → Cu

Approximate relative atomic mass/*Benaderde relatiewe atoommassa* → 63,5

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)
1 2,1 H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24											13 1,5 Aℓ 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	17 3,0 Cℓ 35,5	18 Ar 40
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1,6 V 51	24 1,6 Cr 52	25 1,5 Mn 55	26 1,8 Fe 56	27 1,8 Co 59	28 1,8 Ni 59	29 1,9 Cu 63,5	30 1,6 Zn 65	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1,9 Tc	44 2,2 Ru 101	45 2,2 Rh 103	46 2,2 Pd 106	47 1,9 Ag 108	48 1,7 Cd 112	49 1,7 In 115	50 1,8 Sn 119	51 1,9 Sb 122	52 2,1 Te 128	53 2,5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 1,8 Tℓ 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 Rn
87 0,7 Fr	88 0,9 Ra 226	89 Ac															

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 4A: STANDARD REDUCTION POTENTIALS

Increasing oxidising ability ↑

Increasing reducing ability ↓

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

TABLE 4B: STANDARD REDUCTION POTENTIALS

Increasing oxidising ability ↓

Increasing reducing ability ↑

Half-reactions			E^θ (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

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

TECHNICAL SCIENCES P2/ *TEGNIESE WETENSKAPPE V2*

NOVEMBER 2022

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 75

These marking guidelines consist of 7 pages.
Hierdie nasienriglyne bestaan uit 7 bladsye.

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PRIVATE BAG X895, PRETORIA 0001
2022 -11- 25
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

DBE: IM
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DBE: IM
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Umalusi: EM
25/11/2022

Umalusi:EM
25/11/2022

QUESTION/*VRAAG* 1

1.1 C ✓✓ (2)

1.2 C ✓✓ (2)

1.3 A ✓✓ (2)

1.4 B ✓✓ (2)

1.5 D ✓✓ (2)
[10]

QUESTION/*VRAAG* 2

2.1 A series of organic compounds that are described by the same general formula ✓ and where each member differs from the next by a CH_2 group. ✓

'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word en waar elke lid van die volgende verskil deur 'n CH_2-groep. (2)

2.2.1 A ✓ (1)

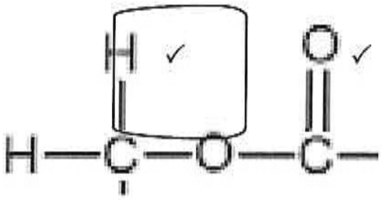
2.2.2 B and/*en* C ✓✓ (**NOTE/*LET WEL*:** 2 or/*of* 0. Both letters should be indicated/*Beide letters moet aangedui word*) (2)

2.2.3 D ✓ (1)

2.2.4 F ✓ (1)

2.3 Butane/*Butaan* ✓✓ (**NOTE/*LET WEL*:** 2 or/*of* 0) (2)

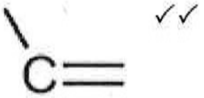
2.4.1



Marking criteria/*Nasienkriteria*:
- Correct functional group
- Whole structure correct
- If a bond or hydrogen is missing ½
- *Korrekte funksionele groep*
- *Volledige struktuur korrek*
- *Indien binding of waterstof uitgelaat is, ½*

(2)

2.4.2



(2)
[13]

QUESTION/*VRAAG* 3

3.1 The temperature at which the vapour pressure is equal to the atmospheric pressure. ✓✓

Die temperatuur waar die dampdruk aan die atmosferiese druk gelyk is. ✓✓ (2)

3.2 C ✓ (1)

3.3.1 Propanoic acid/*Propanoësuur* ✓

3.3.2 Propan-1-ol/*Propaan-1-ol* ✓

3.3.3 Propanal/*Propanaal* ✓ (3)

3.4

- Both propanoic acid and propan-1-ol/compounds **A** and **B** contain hydrogen bonds *(in addition to London and dipole-dipole forces).* ✓
- Propanoic acid/Compound **A** has (two sites) to form stronger intermolecular forces/hydrogen bonds than propan-1-ol (compound **B**) which has (only one site). ✓
- More energy is needed to overcome (stronger) hydrogen bonds/ intermolecular forces in propanoic acid/compound **A** than the (weaker) hydrogen bonds/intermolecular forces in propan-1-ol (compound **B**). ✓
- Thus, propanoic acid/compound **A** has a lower vapour pressure than propan-1-ol (compound **B**). ✓

- *Beide propanoësuur en propaan-1-ol/verbindings **A** en **B** bevat waterstofbindings (bykomend tot London- en dipool-dipool-kragte).*
- *Propanoësuur/Verbinding **A** het (twee gebiede om) sterker intermolukulêre kragte/waterstofbindings (te vorm) as propaan-1-ol (verbinding **B**) (wat net een gebied het).*
- *Meer energie word benodig om (sterker) waterstofbindings/intermolekulêre kragte in propanoësuur/verbinding **A** te oorkom as die (swakker) waterstofbindings/intermolekulêre kragte in propaan-1-ol (verbinding **B**).*
- *Dus, propanoësuur/verbinding **A** het 'n laer dampdruk as propaan-1-ol (verbinding **B**).*

OR/*OF*

- Both propanoic acid and propan-1-ol/compounds **A** and **B** contain hydrogen bonds *(in addition to London and dipole-dipole forces).*
- Propan-1-ol/Compound **B** has (only one site) to form weaker intermolecular forces/hydrogen bonds than propanoic acid (compound **A**) which has (two sites).
- Less energy is needed to overcome (weaker) hydrogen bonds/intermolecular forces in propan-1-ol/compound **B** than the (stronger) hydrogen bonds/intermolecular forces in propanoic acid (compound **A**).
- Thus, propan-1-ol/compound **B** has a higher vapour pressure than propanoic acid (compound **A**).

- *Beide propanoësuur en propaan-1-ol/verbindings **A** en **B** bevat waterstofbindings (bykomend tot London- en dipool-dipool-kragte).*
- *Propaan-1-ol/Verbinding **B** het (slegs een gebied) om swakker intermolukulêre kragte/waterstofbindings te vorm as propanoësuur (verbinding **A**), wat (twee gebiede het).*
- *Minder energie word benodig om (swakker) waterstofbindings/ intermolekulêre kragte in propaan-1-ol/verbinding **B** te oorkom as die (sterker) waterstofbindings/intermolekulêre kragte in propanoësuur (verbinding **A**).*
- *Dus, propaan-1-ol/verbinding **B** het 'n hoër dampdruk as propanoësuur (verbinding **A**).*

(4)

3.5 A ✓ (1)

[11]

QUESTION/*VRAAG* 4

4.1.1 Addition/*Addisie* / Hydrogenation/*Hidrogenering* ✓ (1)

4.1.2 Substitution/*Substitusie (Vervanging)* / Halogenation/*Halogenering* / Chlorination/*Chlorogenering* (1)

4.2 $C_2H_4 \overset{\checkmark}{+} H_2 \rightarrow \overset{\checkmark}{C_2H_6}$ (balancing/*balansering* ✓)

> **Marking criteria/*Nasienkriteria*:**
> - One mark for reactants / *Een punt vir reaktanse*
> - One mark for product/ *Een punt vir produk*
> - One mark for balancing/ *Een punt vir balansering*
>
> **Note/*Let wel*:** One mark for balancing when structural or condensed structural formulae used / *Een punt vir balansering indien struktuurformule of gekondenseerde struktuurformule gebruik word.*

(3)

4.3.1 Combustion/*Verbranding* ✓ / Oxidation/*Oksidasie* (1)

4.3.2 Carbon dioxide/*Koolstofdioksied* ✓✓ / CO_2
Accept/*Aanvaar*: Carbon(IV)oxide / *Koolstof(IV)oksied* (2)

4.4.1 Substitution/*Substitusie (Vervanging)* ✓ / Hydrolysis/*Hidrolise* (1)

4.4.2 Mild heat/*Matige hitte* ✓
Diluted strong base/*Verdunde sterk basis* ✓ **OR/*OF*** Excess water/ *Oormatige water*
Accept/*Aanvaar*: Diluted/*Verdunde* NaOH / KOH (2)

4.4.3 Ethanol/*Etanol* ✓✓ (2)

4.5.1 Semiconductors/*Halfgeleiers* ✓ / Metalloids/*Metalloïde* / Semimetals/*Halfmetale* (1)

4.5.2 The process of <u>adding impurities to intrinsic semiconductors</u>. ✓✓
Die proses om <u>onsuiwerhede by intrinsieke halfgeleiers te voeg</u>. (2)

4.5.3 Forward bias/*Meevoorspanning* ✓ (1)
[17]

MD BP.

QUESTION/*VRAAG* 5

5.1 +2 ✓ (1)

5.2 The decomposition of a substance ✓ when electric current is passing through it. ✓
Die ontbinding van 'n stof ✓ wanneer elektriese stroom daardeur beweeg. ✓
OR/*OF*
The chemical process in which electrical energy is converted to chemical energy.
Die chemiese proses waar elektriese energie na chemiese energie omgeskakel word.
OR/*OF*
The use of electrical energy to produce a chemical change.
Die gebruik van elektriese energie om chemiese verandering teweeg te bring. (2)

5.3 Endothermic/*Endotermies* ✓ (1)

5.4 Q ✓ (1)

5.5.1 Bubbles form/*Borrels vorm* ✓ / Effervescence/*Opbruising* (1)

5.5.2 Mass increases/*Massa neem toe* ✓ / Reddish brown deposit (copper) forms / *Rooibruin neerslag (koper) vorm* ✓ (1)

5.6 $Cu^{2+}(aq) + 2C\ell^{-}(g)$ ✓ $\rightarrow Cu(s) + C\ell_2(g)$ ✓ (balancing/*balansering* ✓)

OR/*OF*

$CuC\ell_2(aq) \rightarrow Cu(s) + C\ell_2(g)$ (balancing/*balansering*)

Marking criteria/*Nasienkriteria*:

- One mark for reactants / *Een punt vir reaktanse*
- One mark for product/ *Een punt vir produk*
- One mark for balancing/ *Een punt vir balansering*

Note/*Let wel*: Do NOT penalise when phases are omitted, but penalise when incorrect phases are indicated. / *MOENIE penaliseer indien fases uitgelos word nie, maar penaliseer indien verkeerde fases aangedui word.*

(3)

5.7 In molten $CuC\ell_2$, ions are able to move freely. ✓✓
In gesmelte $CuC\ell_2$ is ione instaat om vrylik te beweeg. ✓✓

Accept/*Aanvaar*: Molten $CuC\ell_2$ will conduct electricity (while a solid will not).
Gesmelte $CuC\ell_2$ sal elektrisiteit gelei (terwyl 'n vaste stof dit nie sal doen nie). (2)
[12]

MD B.P.

QUESTION/*VRAAG* 6

6.1 Phase boundary/*Fasegrens* ✓ / Interphase/*Tussenfase*
Accept/*Aanvaar*: phase separator/*faseskeier* (1)

6.2 Concentration/*Konsentrasie*: $\underline{1\ \text{mol·dm}^{-3}}$ ✓
Temperature/*Temperatuur*: $\underline{25\ ^\circ\text{C}}$ ✓ / $\underline{298}$ K (2)

6.3 Copper (II) ions/*Koper(II)ione* ✓✓ / Cu^{2+} (2)

6.4.1 Negative/*Negatief* ✓ (1)

6.4.2 Positive/*Positief* ✓ (1)

6.5 $E^\theta_{\text{cell}/sel} = E^\theta_{\text{cathode}/katode} - E^\theta_{\text{anode}/anode}$ ✓

$\underline{1{,}10}$ ✓ = $\underline{0{,}34}$ ✓ - $E^\theta_{(Y)}$

$E^\theta_{(Y)} = -\ 0{,}76\ V$ ✓

Y is Zinc (Zn)/*Y is Sink* ✓

Marking criteria/*Nasienkriteria*:

- Accept any other correct formula from the data sheet.
- Penalise with one mark for using unconventional or incomplete formula.

- *Aanvaar enige ander korrekte formule vanaf die gegewensblad.*
- *Penaliseer met een punt vir gebruik van onkonvensionele of onvolledige formule.*

OR/*OF*

$$\boxed{\begin{array}{l} Y \rightarrow Y^{2+} + 2e^- \\ Cu^{2+} + 2e^- \rightarrow Cu \end{array}} ✓$$

$E^\theta_{(Y)} = -\ 0{,}76\ V$ ✓

$E^\theta_{\text{cathode}/katode} = 0{,}34\ (V)$ ✓

$E^\theta_{\text{cell}/sel} = 1{,}10\ (V)$ ✓

Y is Zinc (Zn) / *Y is sink (Zn)* ✓ (5)

[12]

TOTAL/*TOTAAL*: 75

MD BP