



Province of the
EASTERN CAPE
EDUCATION

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NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2025

PHYSICAL SCIENCES P2: (CHEMISTRY)

MARKS: 150

TIME: 3 hours



This question paper consists of 20 pages, including 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and surname in the appropriate space 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 sub questions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your FINAL numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, etc. where required.
11. You are advised to use the attached DATA SHEETS.
12. 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, for example 1.11 D.

1.1 Which ONE of the following homologous series can be described by the general formula $C_nH_{2n}O$?

A Alcohols

B Aldehydes

C Esters

D Carboxylic acids

(2)

1.2 The empirical formula of methyl propanoate is ...

A $C_4H_8O_2$

B C_4H_8O

C C_2H_4O

D CH_2O

(2)

1.3 Consider the following compounds from the SAME HOMOLOGOUS SERIES with different boiling points.

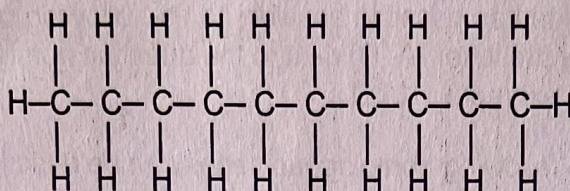
Compounds	Boiling point ($^{\circ}C$)
C_4H_8O	63
C_4H_8O	75

Which ONE of the following combinations is CORRECT regarding the homologous series to which compounds belong and type of isomers they form?

	Homologous series	Type of isomers
A	Ketones	Positional isomers
B	Ketones	Chain isomers
C	Aldehydes	Positional isomers
D	Aldehydes	Chain isomers

(2)

- 1.4 The organic molecule shown below undergoes thermal cracking.



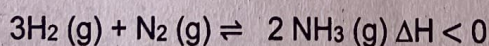
Which ONE of the following are possible products from the reaction?

- A Hexane and butane
- B Octane, ethane and hydrogen gas
- C Pentane, propene and ethene
- D Propane, butane and ethene (2)

- 1.5 Which ONE of the following is TRUE regarding an EXOTHERMIC REACTION?

- A No energy is absorbed or released.
- B The amount of energy released is greater than the amount of energy absorbed.
- C The amount of energy absorbed is greater than the amount of energy released.
- D The amount of energy absorbed is equal to the amount of energy released. (2)

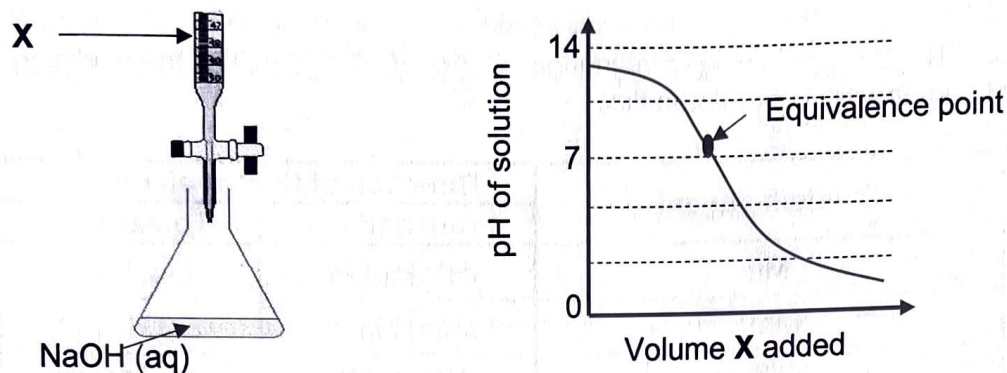
- 1.6 Consider the reaction below that reaches chemical equilibrium in a closed container.



Which ONE of the following changes will increase the yield of NH_3 ?

- A Addition of a catalyst
- B Increase temperature
- C Decrease in the volume of the container
- D Decrease in the concentration of N_2 (2)

1.7 The diagrams shows a titration set-up and titration curve obtained.



Consider the statements regarding substance X.

- I The K_a value for substance X is greater than 1.
- II The amount of X is equal the amount of NaOH at the equivalence point.
- III Substance X ionises in water to produce low concentration of H_3O^+

Which of the above statement(s) is/are TRUE?

A I and II only

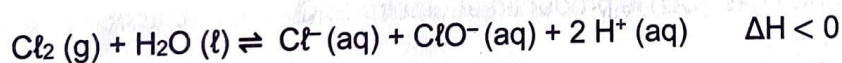
B II only

C II and III only

D I and III only

(2)

1.8 The reaction represented by the balanced equation below reaches equilibrium in a closed container.



Which ONE of the following changes will favour the reverse reaction?

A Addition of hydrogen (H_2)

B Addition of potassium hydroxide (KOH)

C Decrease the pH of the equilibrium mixture

D Cool the equilibrium mixture

(2)

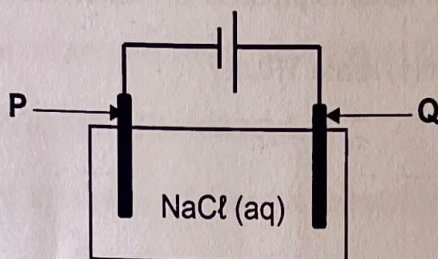
- 1.9 The standard hydrogen half-cell ($\text{H}^+ | \text{H}_2 | \text{Pt}$) is connected to $\text{Mn} | \text{Mn}^{2+}$ half-cell to form a galvanic cell.

Which ONE of the following combinations CORRECTLY identifies the oxidising agent and direction of electron flow?

	Oxidising agent	Direction of flow of electrons	
		From half-cell	To half-cell
A	Mn	$\text{H}^+ \text{H}_2 \text{Pt}$	$\text{Mn} \text{Mn}^{2+}$
B	Mn^{2+}	$\text{Mn} \text{Mn}^{2+}$	$\text{H}^+ \text{H}_2 \text{Pt}$
C	H^+	$\text{H}^+ \text{H}_2 \text{Pt}$	$\text{Mn} \text{Mn}^{2+}$
D	H^+	$\text{Mn} \text{Mn}^{2+}$	$\text{H}^+ \text{H}_2 \text{Pt}$

(2)

- 1.10 The electrolytic cell below is used for the electrolysis of concentrated sodium chloride (NaCl).



Consider the statements regarding the electrolysis of concentrated sodium chloride (NaCl).

- I The pH of the electrolyte increases over time.
- II H_2O is oxidised at electrode P.
- III Chlorine gas (Cl_2) is produced at electrode Q.

Which of the above statement(s) is/are TRUE?

- A I and II only
- B III only
- C II and III only
- D I and III only

(2)
[20]

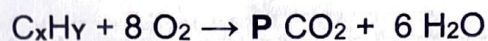
QUESTION 2 (Start on a NEW page.)

The table below shows organic molecules (A–F) from different homologous series.

A $ \begin{array}{ccccccc} & & & \text{CH}_3 & & & \\ & & & & & & \\ \text{CH}_2 & - & \text{CH} & - & \text{CH}_2 & - & \text{CH} \\ & & & & & & \\ \text{CH}_3 & & \text{Cl} & & & & \text{CH}_3 \end{array} $	B 3,4-dimethylpentan-2-ol
C $\text{CH}_3\text{CH}(\text{CH}_3)\text{CCCH}_3$	D $ \begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & \text{O} \\ & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{C} - \text{H} \\ & & & & & & \\ & \text{H} & & & & \text{H} & \\ & & & & & & \\ & & & \text{H} - \text{C} - \text{H} & & & \\ & & & & & & \\ & & & \text{H} & & & \end{array} $
E 3-methylbutanone	F C_xH_y

- 2.1 Define *homologous series*. (2)
- 2.2 Write down the LETTER that represents EACH of the following:
- 2.2.1 Unsaturated hydrocarbon (1)
- 2.2.2 A compound with a carbonyl group bonded to two saturated carbon atoms (1)
- 2.2.3 Compounds that are functional isomers (2)
- 2.3 Write down the IUPAC name of:
- 2.3.1 Compound A (3)
- 2.3.2 Compound C (2)
- 2.4 Draw the STRUCTURAL FORMULA of compound B. (2)
- 2.5 Compound D has a positional isomer.
- 2.5.1 Define the term *positional isomer*. (2)
- 2.5.2 Draw the positional isomer of compound D. (2)

- 2.6 Compound **F** (C_xH_y) is an alkane that undergoes complete combustion with excess oxygen as shown below.



- 2.6.1 Determine the value **P**.

(2)

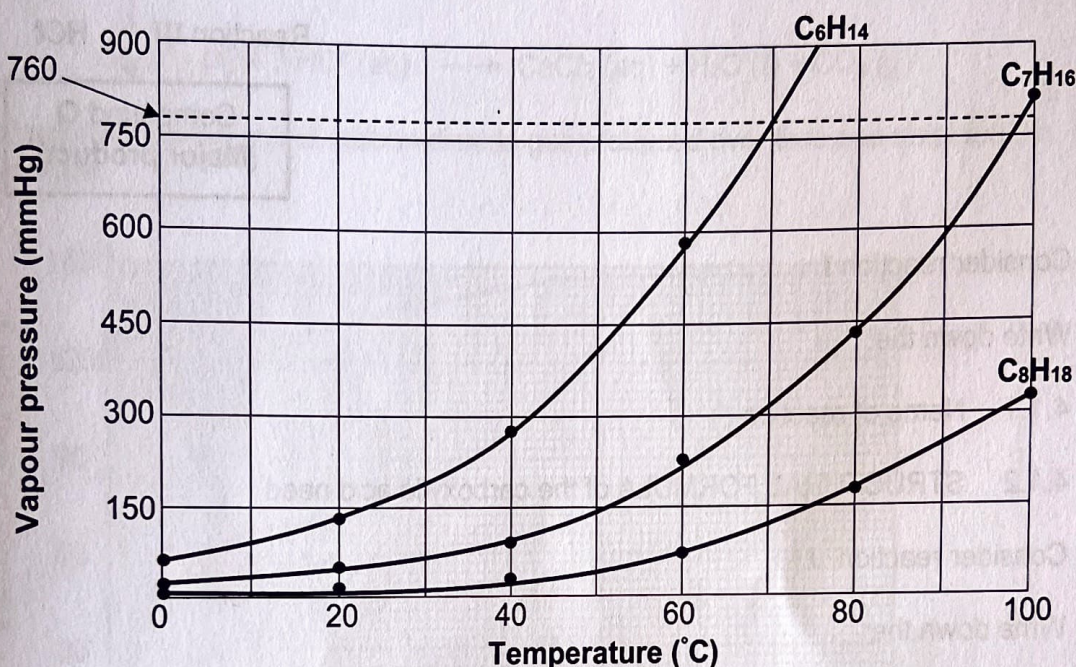
- 2.6.2 Write down the CONDENSED STRUCTURAL FORMULA of compound **F**.

(2)

[21]

QUESTION 3 (Start on a NEW page.)

The vapour pressure against temperature curves are drawn for THREE STRAIGHT CHAIN ALKANES. The vapour pressure are measured in mmHg. The atmospheric pressure is 760 mmHg.

GRAPH OF VAPOUR PRESSURE VERSUS TEMPERATURE

- 3.1 Define *vapour pressure*. (2)
- 3.2 At what phase are the alkanes at room temperature?
Write down only GAS, LIQUID or SOLID.
Give a reason for the answer. (2)
- 3.3 How will the boiling points change if the atmospheric pressure decreases?
Choose from INCREASES, DECREASES or REMAIN THE SAME. (1)
- 3.4 What can be concluded from the curve regarding the relationship between intermolecular forces and vapour pressure? (2)
- 3.5 The table below shows the boiling point of propan-1-ol and propanoic acid.

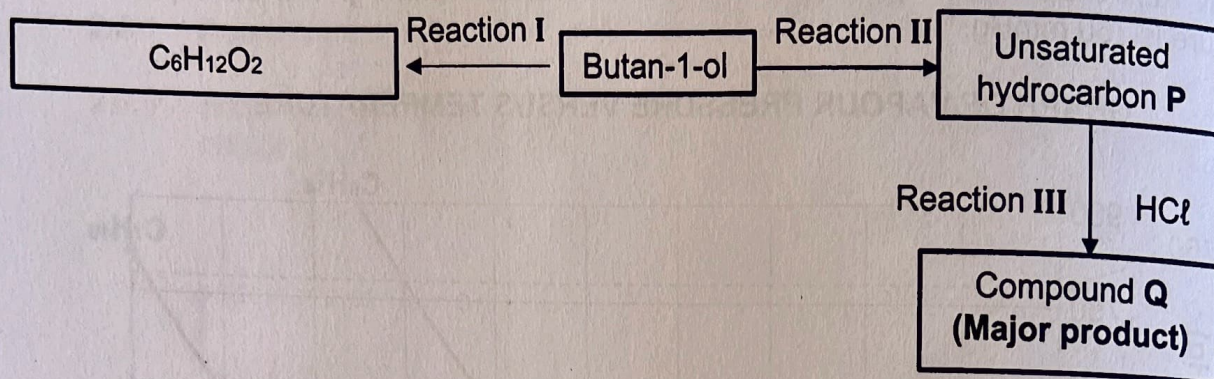
	COMPOUND	BOILING POINT (°C)
A	Propan-1-ol	97
B	Propanoic acid	141

- 3.5.1 Define the term *boiling point*. (2)
- 3.5.2 Fully explain the difference in the boiling points. (4)

[13]

QUESTION 4 (Start on a NEW page.)

Consider the flow diagram below:



4.1 Consider reaction I.

Write down the:

4.1.1 Name of reaction

(1)

4.1.2 STRUCTURAL FORMULA of the carboxylic acid need

(2)

4.2 Consider reaction II.

Write down the:

4.2.1 NAME or FORMULA of the inorganic reagent needed

(1)

4.2.2 IUPAC name of unsaturated hydrocarbon P

(2)

4.3 Consider reaction III.

4.3.1 Write down the name of the type of addition reaction.

(1)

4.3.2 Is compound Q a PRIMARY, SECONDARY or TERTIARY HALOALKANE? Give a reason for the answer.

(2)

4.4 Compound Q is mixed with concentrated sodium hydroxide (NaOH) and strongly heated.

Write down the:

4.4.1 Type of reaction that occurred

(1)

4.4.2 Balanced equation by using STRUCTURAL FORMULAE for the organic compounds and write the structural formula for the major product only in

(6)

[16]

QUESTION 5 (Start on a NEW page.)

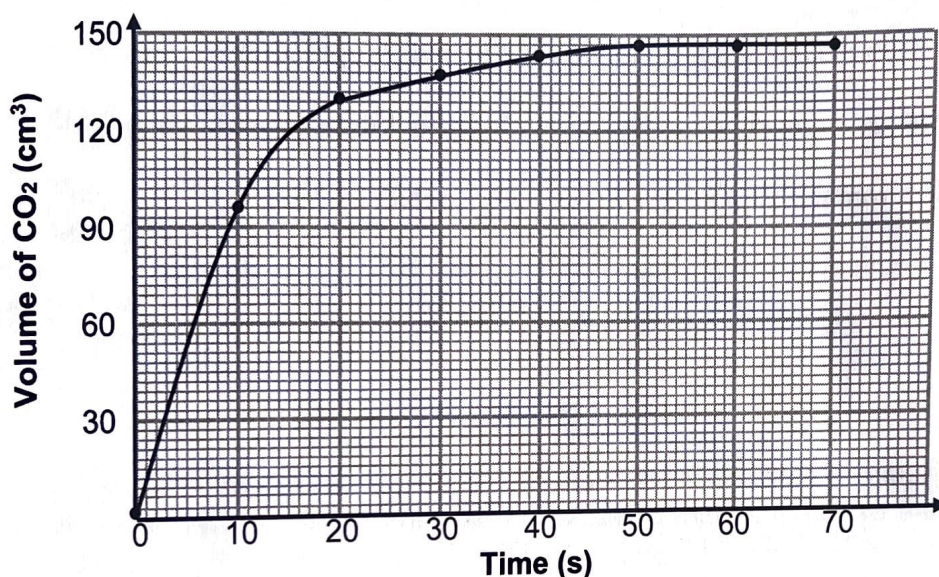
5.1 Define the term *reaction rate*.

(2)

A group of learners want to determine the percentage purity of a sample that contains calcium carbonate (CaCO_3). They react 2,5 g sample of impure calcium carbonate (CaCO_3) with EXCESS dilute hydrochloric acid (HCl) according to the balanced equation.



They measure the volume of carbon dioxide gas produced over time and obtained the graph below.



5.2 How will the learners know that the reaction has reached completion?

(1)

5.3 Calculate the:

5.3.1 Average rate at which CO_2 is produced in $\text{cm}^3 \cdot \text{s}^{-1}$

(3)

5.3.2 Percentage purity of CaCO_3 if the molar volume of CO_2 is $24\,000 \text{ cm}^3 \cdot \text{mol}^{-1}$ at 25°C

(5)

5.4 The experiment is repeated by using powdered sample of calcium carbonate instead of chunked sample of calcium carbonate.

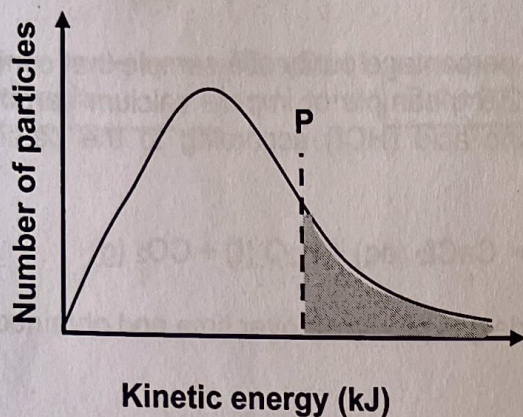
5.4.1 Will the reaction rate INCREASE, DECREASE or REMAIN THE SAME?

(1)

5.4.2 Explain the answer to QUESTION 5.4.1 by referring to the collision theory.

(3)

- 5.5 The graph below represents the Maxwell-Boltzmann distribution curve for CO_2 (g) at 25°C .



- 5.5.1 What does the shaded area to the right of line **P** represents? (1)

- 5.5.2 How will an increase in temperature affect the shaded area?

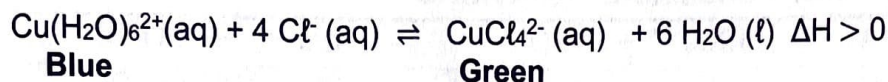
Choose from INCREASES, DECREASES or NO EFFECT.

Give a reason for the answer.

(2)
[18]

QUESTION 6 (Start on a NEW page.)

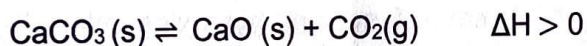
When copper(II)chloride is dissolved in water the following chemical equilibrium equation is obtained. This can be used to demonstrate Le Chatelier's principle.



- 6.1 State *Le Chatelier's principle*. (2)
- 6.2 State whether the solution will become **BLUE** or **GREEN** when the following changes are made.

The colour of the equilibrium mixture is **BLUE**.

- 6.2.1 The mixture is cooled. (1)
- 6.2.2 Addition of saturated sodium chloride solution. (1)
- 6.3 Fully explain the answer to QUESTION 6.2.2 by referring to Le Chatelier's principle. (3)
- 6.4 Calcium carbonate is allowed to decompose at 1 000 °C in a sealed container according to the balanced chemical equation below.



Initially 0,24 mol of calcium carbonate is placed in a 2 dm³ container and heated. An equilibrium is established at 1 000 °C. At this temperature the equilibrium constant is 0,0385.

- 6.4.1 Will the K_c value INCREASE, DECREASE or REMAIN THE SAME if the temperature at which calcium carbonate decomposes is INCREASED? (3)
- Fully explain the answer.
- 6.4.2 Calculate the mass of unreacted calcium carbonate that will remain in the container when the system reaches equilibrium at 1 000 °C. (7)

[17]

QUESTION 7 (Start on a NEW page.)

7.1 Consider the reactions below and answer questions that follow.

REACTION	CHEMICAL EQUATIONS
A	$\text{HSO}_4^- + \text{H}_2\text{O} \rightarrow \text{SO}_4^{2-} + \text{H}_3\text{O}^+$
B	$\text{KOH} + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COOK} + \text{H}_2\text{O}$

7.1.1 Define a base in term of the *Arrhenius theory*. (2)

From the reactions above:

7.1.2 Which ONE of the reactions (**A** or **B**) represents the Arrhenius model? (1)

7.1.3 Write down a conjugate base of HSO_4^- . (1)

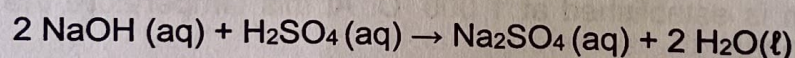
7.2 Consider reaction **B**.

7.2.1 Give a reason why CH_3COOH can be regarded as a weak acid. (2)

7.2.2 Will CH_3COOK be ACIDIC, NEUTRAL or ALKALINE solution in water? (1)

7.2.3 Explain the answer in QUESTION 7.2.2 by using the relevant equation. (3)

7.3 During a titration, $12,5 \text{ cm}^3$ of sodium hydroxide (NaOH) solution with a concentration of $0,2 \text{ mol} \cdot \text{dm}^{-3}$ neutralises 25 cm^3 of sulphuric acid (H_2SO_4) solution, according to the following balanced chemical equation:



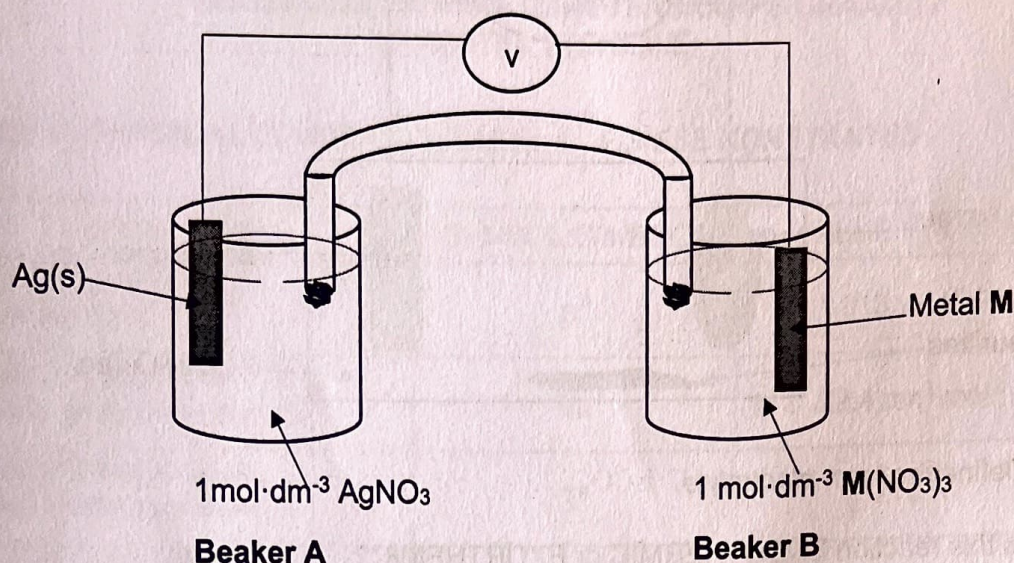
7.3.1 Write down the name of a suitable indicator for this neutralisation reaction. (1)

7.3.2 Calculate the pH of the H_2SO_4 solution. (7)

[18]

QUESTION 8 (Start on a NEW page.)

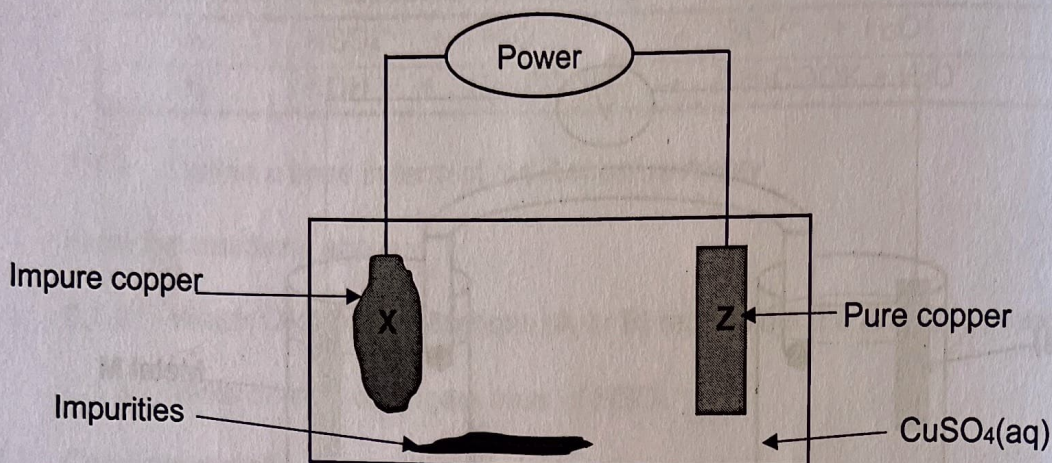
- 8.1 A galvanic cell is set up under standard conditions using unknown metal **M** and silver as an electrode. The standard electrode potential for the unknown metal **M** is less than 0 V.



- 8.1.1 Write down the energy conversion in this cell. (2)
- 8.1.2 Which electrode is the anode in the cell (Ag or Metal **M**)? (3)
- Explain the answer.
- 8.2 The initial potential difference for this cell is 1,54 V. (5)
- 8.2.1 Identify metal **M** by calculation. (3)
- 8.2.2 Write down the cell notation for the cell.
- 8.3 How will the initial reading on the voltmeter change when the following changes are made to the cell above? Write down only INCREASES, DECREASES or REMAINS THE SAME
- 8.3.1 Surface area of the Ag electrode is increased. (1)
- 8.3.2 The concentration of AgNO₃ solution is increased to 2 mol·dm⁻³. (1)
- [15]

QUESTION 9 (Start on a NEW page.)

The electrolytic cell, represented in the diagram below, is set up to purify copper which contains zinc and silver impurities.



- 9.1 Define the term *electrolyte*. (2)
- 9.2 Is this reaction ENDOTHERMIC or EXOTHERMIC? (1)
- 9.3 Which of the electrodes (X or Z) is connected to the positive terminal of the battery? (1)
- 9.4 Write down the half reaction that takes place at electrode Z. (2)
- 9.5 During the electrolysis it is observed that zinc is also oxidised but not silver. Give a reason for this observation by referring to the relative strengths of the reducing agents. (1)
- 9.6 An unknown solution (MCl_2) was electrolysed using copper electrodes. After some time $1,806 \times 10^{22}$ electrons were gained at the cathode while the cathode gained 0,6 g. Determine, by calculations, the formula of an unknown solution. (5)

[12]**TOTAL: 150**

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DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume teen STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^θ	273 K
Charge on electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro se konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$ or/of $n = \frac{N}{N_A}$ or/of $n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$ $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$ $K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14}$ at /by 298K
$E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}} / E^\theta_{\text{sel}} = E^\theta_{\text{katode}} - E^\theta_{\text{anode}}$ $E^\theta_{\text{cell}} = E^\theta_{\text{reduction}} - E^\theta_{\text{oxidation}} / E^\theta_{\text{sel}} = E^\theta_{\text{reduksie}} - E^\theta_{\text{oksidasie}}$ $E^\theta_{\text{cell}} = E^\theta_{\text{oxidising agent}} - E^\theta_{\text{reducing agent}} / E^\theta_{\text{sel}} = E^\theta_{\text{oksideermiddel}} - E^\theta_{\text{reduseermiddel}}$		
$q = I\Delta t$ $n = \frac{Q}{e}$ or/of $n = \frac{Q}{q_e}$		

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

		(I)		(II)																																			
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TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD REDUKSIEPOTENSIALE

Half-reactions/Halfreaksies		E^{θ} (V)
$\text{Li}^{+} + \text{e}^{-}$	$\rightleftharpoons$ Li	-3,05
$\text{K}^{+} + \text{e}^{-}$	$\rightleftharpoons$ K	-2,93
$\text{Cs}^{+} + \text{e}^{-}$	$\rightleftharpoons$ Cs	-2,92
$\text{Ba}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Ba	-2,90
$\text{Sr}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Sr	-2,89
$\text{Ca}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Ca	-2,87
$\text{Na}^{+} + \text{e}^{-}$	$\rightleftharpoons$ Na	-2,71
$\text{Mg}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Mg	-2,36
$\text{Al}^{3+} + 3\text{e}^{-}$	$\rightleftharpoons$ Al	-1,66
$\text{Mn}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Mn	-1,18
$\text{Cr}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Cr	-0,91
$2\text{H}_2\text{O} + 2\text{e}^{-}$	$\rightleftharpoons$ $\text{H}_2(\text{g}) + 2\text{OH}^{-}$	-0,83
$\text{Zn}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Zn	-0,76
$\text{Cr}^{3+} + 3\text{e}^{-}$	$\rightleftharpoons$ Cr	-0,74
$\text{Fe}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Fe	-0,44
$\text{Cr}^{3+} + \text{e}^{-}$	$\rightleftharpoons$ Cr^{2+}	-0,41
$\text{Cd}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Cd	-0,40
$\text{Co}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Co	-0,28
$\text{Ni}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Ni	-0,27
$\text{Sn}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Sn	-0,14
$\text{Pb}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Pb	-0,13
$\text{Fe}^{3+} + 3\text{e}^{-}$	$\rightleftharpoons$ Fe	-0,06
$2\text{H}^{+} + 2\text{e}^{-}$	$\rightleftharpoons$ $\text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^{+} + 2\text{e}^{-}$	$\rightleftharpoons$ $\text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2\text{e}^{-}$	$\rightleftharpoons$ Sn^{2+}	+0,15
$\text{Cu}^{2+} + \text{e}^{-}$	$\rightleftharpoons$ Cu^{+}	+0,16
$\text{SO}_4^{2-} + 4\text{H}^{+} + 2\text{e}^{-}$	$\rightleftharpoons$ $\text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Cu	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^{-}$	$\rightleftharpoons$ 4OH^{-}	+0,40
$\text{SO}_2 + 4\text{H}^{+} + 4\text{e}^{-}$	$\rightleftharpoons$ $\text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^{+} + \text{e}^{-}$	$\rightleftharpoons$ Cu	+0,52
$\text{I}_2 + 2\text{e}^{-}$	$\rightleftharpoons$ 2I^{-}	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^{+} + 2\text{e}^{-}$	$\rightleftharpoons$ H_2O_2	+0,68
$\text{Fe}^{3+} + \text{e}^{-}$	$\rightleftharpoons$ Fe^{2+}	+0,77
$\text{NO}_3^{-} + 2\text{H}^{+} + \text{e}^{-}$	$\rightleftharpoons$ $\text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^{+} + \text{e}^{-}$	$\rightleftharpoons$ Ag	+0,80
$\text{Hg}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ $\text{Hg}(\text{l})$	+0,85
$\text{NO}_3^{-} + 4\text{H}^{+} + 3\text{e}^{-}$	$\rightleftharpoons$ $\text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\text{l}) + 2\text{e}^{-}$	$\rightleftharpoons$ 2Br^{-}	+1,07
$\text{Pt}^{2+} + 2\text{e}^{-}$	$\rightleftharpoons$ Pt	+1,20
$\text{MnO}_2 + 4\text{H}^{+} + 2\text{e}^{-}$	$\rightleftharpoons$ $\text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^{+} + 4\text{e}^{-}$	$\rightleftharpoons$ $2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^{+} + 6\text{e}^{-}$	$\rightleftharpoons$ $2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^{-}$	$\rightleftharpoons$ 2Cl^{-}	+1,36
$\text{MnO}_4^{-} + 8\text{H}^{+} + 5\text{e}^{-}$	$\rightleftharpoons$ $\text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^{+} + 2\text{e}^{-}$	$\rightleftharpoons$ $2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + \text{e}^{-}$	$\rightleftharpoons$ Co^{2+}	+1,81
$\text{F}_2(\text{g}) + 2\text{e}^{-}$	$\rightleftharpoons$ 2F^{-}	+2,87

Increasing oxidising ability/Toenemende oksiderende vermoë

Increasing reducing ability/Toenemende reducerende vermoë



**NATIONAL
SENIOR CERTIFICATE/
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

SEPTEMBER 2025

**PHYSICAL SCIENCES P2: CHEMISTRY/
FISIESE WETENSKAPPE V2: CHEMIE
MARKING GUIDELINE / NASIENRIGLYN**

MARKS/PUNTE: 150

This marking guideline consists of 17 pages./
Hierdie nasienriglyn bestaan uit 17 bladsye.

QUESTION/VRAAG 1

1.1	B ✓✓	(2)
1.2	C ✓✓	(2)
1.3	D ✓✓	(2)
1.4	C ✓✓	(2)
1.5	B ✓✓	(2)
1.6	C ✓✓	(2)
1.7	A ✓✓	(2)
1.8	C ✓✓	(2)
1.9	D ✓✓	(2)
1.10	D ✓✓	(2)
		[20]

QUESTION/VRAAG 2

- 2.1 A series of organic compounds that can be described by the same general formula. ✓✓
'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word.

OR / OF

A series of organic compounds in which one member differs from the next with a CH_2 group. ✓✓
'n Reeks organiese verbindings waarin een lid van die volgende met 'n CH_2 -groep verskil.

(2)

- 2.2 2.2.1 C ✓ (1)

- 2.2.2 E ✓ (1)

- 2.2.3 D and/en E ✓✓ (2)

- 2.3 2.3.1 4-chloro-2-methylhexane ✓✓✓
 4-chloro-2-metielheksaan

Marking criteria/Nasienkriteria:

- hexane / *heksaan* ✓
- chloro and methyl / *en metiel* ✓
- Whole name correct / *Hele naam korrek* ✓

(3)

- 2.3.2 4-methylpent-2-yne ✓✓
 4-metielpent-2-yn

OR / OF

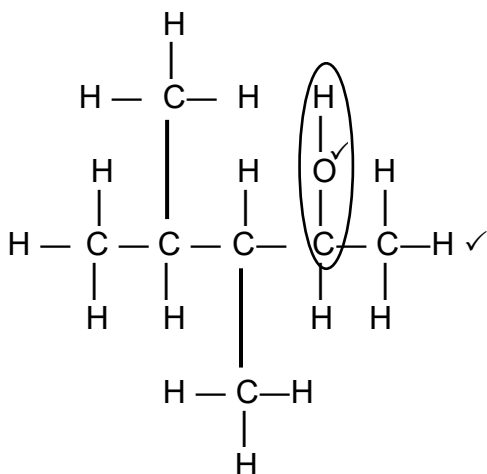
- 4-methyl-2-pentyne ✓✓
 4-metiel-2-pentyn

Marking criteria/Nasienkriteria:

- Pentyne / *Pentyn* ✓
- Whole name correct / *Hele naam korrek* ✓

(2)

2.4

**Marking criteria/Nasienkriteria:**

- Correct functional group. ✓
- Whole structure correct ✓
- *Korrek funksionele groep*
- *Hele struktuur korrek*

(2)

2.5 2.5.1

Marking criteria/ Nasienkriteria

If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.

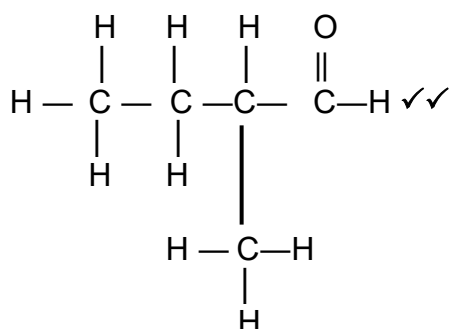
*Indien enige van onderstreepte die sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase.*

Compounds with the same molecular formula but different positions of the side chain, substituents or functional group on the parent chain. ✓✓

Verbindings met dieselfde molekulêre formule, maar verskillende posisies van die syketting, substituenten of funksionele groepe op die stamketting.

(2)

2.5.2

**Marking criteria/Nasienkriteria:**

- Position of the methyl group moved to carbon 2 ✓
- Whole structure correct ✓
- *Posisie van metiel groep verskuif na koolstof 2*
- *Hele struktuur korrek*

NOTE: If position of functional group is changed then 0/2

LET WEL: As die posisie van die funksionele groep verander dan 0/2

(2)

2.6 2.6.1

Using oxygen/gebruik suurstof

$$P(2) + 6(1) = 8(2) \checkmark$$

$$P = 5 \checkmark$$

Using hydrogen/gebruik waterstof

$$6 \times 2 = 12 \quad C_xH_{12} \checkmark \therefore C_5H_{12}$$

$$P = 5 \checkmark$$

(2)

2.6.2 $CH_3CH_2CH_2CH_2CH_3$ ✓✓

(2)

[21]

QUESTION/VRAAG 3

Marking criteria/ Nasienkriteria

If any of the underlined key words/phrases in the **correct context** are omitted:
- 1 mark per word/phrase.

*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase.*

- 3.1 The pressure exerted by a vapour at equilibrium with its liquid in a closed system. ✓✓

Die druk wat deur damp uitgeoefen word by ewewig met sy vloeistof in 'n geslote sisteem.

(2)

- 3.2 LIQUID ✓

The boiling points of the substances are above room temperature. ✓

OR

The vapour pressure of the substances at 25 °C are below the atmospheric pressure. ✓

VLOEISTOF

Die kookpunt van die stowwe is hoër as kamertemperatuur.

OF

Die dampdruk van die stowwe by 25 °C is laer as die atmosferiese druk.

(2)

- 3.3 DECREASES / LAER AS. ✓

(1)

- 3.4 The longer the chainlength / stronger the intermolecular forces the lower the vapour pressure. ✓✓

Hoe langer die kettinglengte / sterker die intermolekulêre kragte hoe laer die dampdruk.

(2)

- 3.5 3.5.1 **Marking criteria/ Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.

*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase.*

The temperature at which the vapour pressure of a substance equals the atmospheric pressure. ✓✓

Die temperatuur waarteen die dampdruk van 'n stof gelyk is aan die atmosferiese druk.

(2)

3.5.2

Marking criteria

- Identify the number of sites of hydrogen bonds in propan-1-ol
- Identify the number of sites of hydrogen bonds in propanoic acid
- Compare the strength of the hydrogen bonds / intermolecular forces
- Relate the strength of intermolecular to energy involved.

Nasienkriteria

- *Identifiseer die aantal waterstofbindings in propan-1-ol*
- *Identifiseer die aantal waterstofbindings in propaansuur*
- *Vergelyk die sterkte van die waterstofbindings / intermolekulêrekragte*
- *Vergelyk die energie van die intermolekulêrekragte*

- One site of hydrogen bonds in propan-1-ol/A ✓
- Two sites of hydrogen bonds in propanoic acid/B ✓
- Hydrogen bonds / intermolecular forces in propanoic acid/B are stronger than that of propan-1-ol/A ✓
- More energy is needed to overcome the intermolecular forces is propanoic acid/B ✓

OR

- One site of hydrogen bonds in propan-1-ol/A ✓
- Two sites of hydrogen bonds in propanoic acid/B ✓
- Hydrogen bonds/ intermolecular forces in propan-1-ol/A is weaker than that of propanoic acid/B ✓
- Less energy is needed to overcome the intermolecular forces is propan-1-ol/A ✓

- *Een plek vir waterstofbindings in propan-1-ol/A*
- *Twee plekke vir waterstofbindings in propaansuur/B*
- *Waterstofbinding/ intermolekulêrekragte in propaansuur/B is sterker as dié van propan-1-ol/A*
- *Meer energie word benodig om die intermolekulêrekragte in propaansuur/B te oorkom*

OF

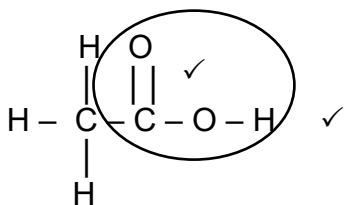
- *Een plek vir waterstofbindings in propan-1-ol/A*
- *Twee plekke vir waterstofbindings in propaansuur/B*
- *Waterstofbinding / intermolekulêrekragte in propan-1-ol/A is swakker as dié van propaansuur/B*
- *Minder energie word benodig om die intermolekulêrekragte in propan-1-ol/A te oorkom*

(4)
[13]

QUESTION/VRAAG 4

4.1 4.1.1 Esterification/Condensation/*Esterifikasie/Versteuring* ✓ (1)

4.1.2



Marking criteria/Nasienkriteria

- Correct functional group ✓
Funksionele groep korrek
- Whole structure correct ✓
Hele struktuur korrek

(2)

4.2 4.2.1 H_2SO_4 / Sulphuric acid / *Swawelsuur* ✓ (1)

4.2.2 But-1-ene/ 1-Butene/ *But-1-een /1-Buteen* ✓✓ (2)

4.3 4.3.1 Hydrohalogenation/*Hidrohalogenering* ✓ (1)

4.3.2 Secondary Halolalkane ✓

The halogen/Cl is bonded to a secondary carbon. /The halogen/Cl is bonded to a carbon that is bonded to two other carbon atoms. /The halogen/Cl is bonded to a carbon that contains one hydrogen atom. ✓

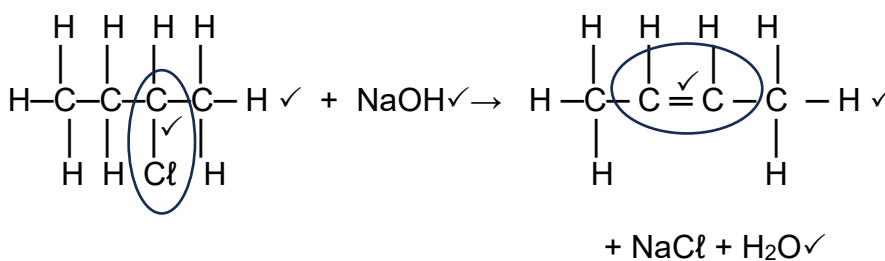
Sekondêre haloalkaan

Die halogeen/Cl is aan 'n sekondêre koolstof verbind. /Die halogeen/ Cl is verbind aan 'n koolstof wat verbind is aan twee ander koolstofatome. / Die halogeen/ Cl is verbind aan 'n koolstof wat een waterstof atoom bevat.

(2)

4.4 4.4.1 Elimination/dehydrohalogenation/
Eliminasie/dehidrohalogenering ✓ (1)

4.4.2



**Marking criteria for organic compounds/
*Nasienkriteria vir organiese verbindings***

- Correct functional group ✓
Funksionele groep korrek
- Whole structure correct ✓
Hele struktuur korrek

Inorganic reagent / Anorganiese reagentse

- NaOH , ✓ NaBr and H_2O ✓

(6)
[16]

QUESTION/VRAAG 5

5.1 **Marking criteria/ Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** are omitted:
- 1 mark per word/phrase.

*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase.*

ANY ONE

Change in concentration ✓ of reactant or product per (unit) time. ✓

Change in amount/ number of moles/ volume/ mass of products or reactants per (unit) time. ✓✓

Change in amount/ number of moles/ volume/ mass of products formed or reactants used reactants per (unit) time. ✓✓

ENIGE EEN

Verandering in konsentrasie van reaktanse of produkte per (eenheid) tyd.

Verandering in hoeveelheid/ getal mol/ volume /massa van produkte of reaktanse per (eenheid) tyd.

Verandering in hoeveelheid/ getal mol/ volume/ massa van produkte gevorm/ reaktanse gebruik per (eenheid) tyd.

OR/OF

The rate of change in concentration/amount of moles/number of moles/volume /mass. ✓✓ **(2 or 0)**

*Die tempo van verandering in konsentrasie/hoeveelheid mol/getal mo/volume/ massa. **(2 of 0)*** (2)

- 5.2 Volume of carbon dioxide (CO₂) gas produced remains constant/No CO₂ gas bubbles produced ✓
Volume koolstof dioksied (CO₂) wat geproduseer word bly konstant/Geen CO₂ gasborrels word geproduseer. (1)

5.3 5.3.1 Reaction rate = $\frac{\Delta V}{\Delta t}$
Reaksietempo

$$= \frac{147 - 0}{50} \checkmark$$

$$= 2,94 \text{ (cm} \cdot \text{s}^{-1}) \checkmark$$

(3)

5.3.2 **Marking criteria/ Nasienkriteria**

- (a) Substitution into/ *Vervanging in* $n = V / V_m$
- (b) Use of mole ratio/ *Gebruik van mol verhouding* CaCO₃ : CO₂
- (c) Substitution into/ *Vervanging in* $m = nM$
- (d) Substitution into *percentage purity equation/ Vervanging in persentasie suiwerheid vergelyking*
- (e) Final answer/ *Finale Antwoord*

$$n = \frac{V}{V_m}$$

$$= \frac{147}{24\,000} \quad (a) \checkmark$$

$$n = 6,125 \times 10^{-3} \text{ mol}$$

$$n(\text{CaCO}_3) = n(\text{CO}_2) = 6,125 \times 10^{-3} \text{ mol} \quad (b) \checkmark$$

$$m = nM$$

$$m(\text{CaCO}_3) = (6,125 \times 10^{-3})(100) \quad (c) \checkmark$$

$$m(\text{CaCO}_3) = 0,6125 \text{ g}$$

$$\% \text{ purity/ suiwerheid} = \frac{0,6125}{2,5} \times 100 \quad (d) \checkmark$$

$$\% \text{ purity/ suiwerheid} = 24,5 \% \quad (e) \checkmark$$

(5)

5.4 5.4.1 INCREASES / TOENEEM $\checkmark$

(1)

- 5.4.2
- Powdered CaCO_3 will increase the surface area/contact area/ increases the state of division of CaCO_3 . $\checkmark$
 - More particles will collide with the correct orientation. $\checkmark$
 - More effective collisions per unit time / Frequency of the effective collisions increase $\checkmark$
 - Gepoeierde CaCO_3 sal die oppervlakte/kontakarea vergroot/vergroot die toestand van verdeling van CaCO_3 .
 - Meer deeltjies sal met die korrekte oriëntasie bots
 - Meer effektiewe botsings per eenheidstyd/ Frekwensie van die effektiewe botsings neem toe

(3)

- 5.5 5.5.1 Particles with sufficient kinetic energy for effective collisions. $\checkmark$
Deeltjies met genoeg kinetiese energie vir effektiewe botsings.

(1)

5.5.2 INCREASE/ TOENEEM $\checkmark$

An increase in temperature increases the average kinetic energy of the particles. $\checkmark$

'n Toename in temperatuur verhoog die gemiddelde kinetiese energie van die deeltjies.

(2)

[18]

QUESTION/VRAAG 6

6.1 **Marking criteria/ Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** are omitted:
- 1 mark per word/phrase.

*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per word/frase.*

When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose/cancel the disturbance. ✓✓

Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n nuwe ewewig herstel deur die reaksie wat die versteuring sal teenwerk/kanselleer, te bevoordeel.

(2)

6.2 6.2.1 Blue/Blou ✓

(1)

6.2.2 Green/Groen ✓

(1)

- 6.3
- The addition of saturated sodium chloride solution increases the concentration of the chloride ions (Cl^-). ✓
 - According to Le Chatelier's principle the system will respond by consuming the $\text{Cu}(\text{H}_2\text{O})_6^{2+}$ and Cl^- . ✓
 - The forward reaction will be favoured / the equilibrium position shifts towards right ✓
 - *Die byvoeging van versadigde natriumchloriedoplossing verhoog die konsentrasie van die chloriedione (Cl^-).*
 - *Volgens Le Chatelier se beginsel sal die sisteem reageer deur die $\text{Cu}(\text{H}_2\text{O})_6^{2+}$ en Cl^- op te gebruik*
 - *Die voortwaartse reaksie word bevoordeel/Die ewewigsposisie verskuif na regs*

(3)

6.4 6.4.1 INCREASES / TOENEEM ✓

- According to Le Chatelier's principle an increase in temperature favours the endothermic reaction. ✓
- The forward reaction is favoured / the equilibrium position shifts towards right. ✓
- More CO_2 is produced.
- *Volgens Le Chatelier se beginsel 'n toename in temperatuur bevoordeel die endotermiese reaksie.*
- *Die voortwaartse reaksie word bevoordeel/ die ewewigsposisie verskuif regs.*
- *Meer CO_2 word geproduseer.*

(3)

6.4.2 **OPTION 1 / OPSIE 1****Marking criteria:**

- (a) Correct K_c expression ✓
- (b) Substitution into correct K_c expression ✓
- (c) Calculation of moles of CO_2 by substitution into $n = cV$ ✓
- (d) The use of molar ratio to calculate reacted moles of CaCO_3 ✓
- (e) Calculating the mol of CaCO_3 that is unreacted ✓
- (f) Substituting molar mass and unreacted moles of CaCO_3 in $m = nM$ ✓
- (g) Final answer ✓

Nasienkriteria:

- (a) Korrekte K_c -uitdrukking
- (b) Vervanging in korrekte K_c -uitdrukking
- (c) Bereken die mol van CO_2 deur in $n = cV$ te vervang
- (d) Die gebruik van mol verhouding om die aantal mol te bereken van CaCO_3 wat reageer het
- (e) Bereken die aantal onreageerde mol van CaCO_3
- (f) Vervanging van molêre massa en onreageerde mole van CaCO_3 in $m = nM$
- (g) Finale antwoord ✓

$$K_c = [\text{CO}_2] \text{ (a) } \checkmark$$

$$[\text{CO}_2] = 0,0385 \text{ mol} \cdot \text{dm}^{-3} \text{ (b) } \checkmark$$

$$\begin{aligned} n(\text{CO}_2) &= cV \\ &= 0,0385 \times 2 \text{ (c) } \checkmark \\ &= 0,077 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{CO}_2) &= n(\text{CaCO}_3) \\ n(\text{CaCO}_3) &= 0,077 \text{ mol CaCO}_3 \text{ reacted/reageer (d) } \checkmark \end{aligned}$$

$$\begin{aligned} n(\text{unreacted / onreageerde CaCO}_3) &= n(\text{Initial}) - n(\text{reacted/reageer}) \\ &= 0,24 - 0,077 \checkmark \text{ (e)} \\ &= 0,163 \text{ mol} \end{aligned}$$

$$\begin{aligned} m(\text{unreacted/onreageerde}) &= nM \\ &= 0,163 \times 100 \checkmark \text{ (f)} \\ &= 16,3 \text{ g } \checkmark \text{ (g)} \end{aligned}$$

OPTION 2 / OPSIE 2**Marking criteria:**

- (a) Correct mol ratio
- (b) Divide the equilibrium mol of CO_2 by 2
- (c) Correct K_c expression ✓
- (d) Substitution into correct K_c expression ✓
- (e) Calculating the mol of CaCO_3 that is unreacted ✓
- (f) Substituting molar mass and unreacted moles of CaCO_3 in $m = nM$ ✓
- (g) Final answer ✓

Nasienkriteria:

- (a) Korrekte mol verhouding
- (b) Deel ewewigs mol van CO_2 deur 2
- (c) Korrekte K_c -uitdrukking
- (d) Vervanging in korrekte K_c -uitdrukking
- (e) Bereken die aantal onreageerde mol van CaCO_3
- (f) Vervanging van molêre massa en onreageerde mole van CaCO_3 in $m = nM$
- (g) Finale antwoord ✓

	CaCO_3 (s)	CaO (s)	CO_2 (g)
Initial mol <i>Aanvangsmol</i>	0,24		
Change in mol <i>Verandering in mol</i>	- x		$+x$ ✓ (a)
Equilibrium mol <i>Ewewigsmol</i>	$0,24 - x$		x
Concentration			$\frac{x}{2}$ ✓ (b)

$$K_c = [\text{CO}] \quad \checkmark \quad (\text{c})$$

$$0,038 = \frac{x}{2} \quad \checkmark \quad (\text{d})$$

$$x = 0,077$$

$$n_e = 0,24 - 0,077 \quad \checkmark \quad (\text{e})$$

$$n_e = 0,163 \text{ mol}$$

$$m(\text{CaCO}_3) = nM$$

$$m(\text{CaCO}_3) = (0,163)(100) \quad \checkmark \quad (\text{f})$$

$$(\text{CaCO}_3) = 16,3 \text{ g} \quad \checkmark \quad (\text{g})$$

(7)
[17]

QUESTION/VRAAG 7

- 7.1 7.1.1 Bases produce hydroxide ions (OH^-) in aqueous solution. ✓✓ (2 or 0)
 Basisse produseer hidroksiedione (OH^-) in waterige oplossing. (2 of 0) (2)
- 7.1.2 A ✓ (1)
- 7.1.3 SO_4^{2-} ✓ (1)
- 7.2 7.2.1 It ionises incompletely in water ✓ to form low concentration of H_3O^+ ions. ✓
Dit ioniseer onvolledig in water om lae konsentrasie H_3O^+ -ione te vorm. (2)
- 7.2.2 Alkaline salt/Alkaliese sout ✓ (1)
- 7.2.3 $\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COOH} + \text{OH}^-$ ✓✓
 (reactants / reaktanse and / en products / produkte)
 Excess OH^- is produced/Produseer oormaat OH^- . ✓ (3)
- 7.3 7.3.1 Bromothymol blue/Broomtimol blou ✓ (1)
- 7.3.2 **Marking criteria**
 (a) Substitution in c_aV_a
 (b) Substitution in c_bV_b
 (c) Substitution in n_a/ n_b
 (d) Use of mole ratio $\text{H}_2\text{SO}_4 : \text{H}_3\text{O}^+$
 (e) Formula $\text{pH} = -\log [\text{H}_3\text{O}^+]$
 (f) Substitution in $\text{pH} = -\log [\text{H}_3\text{O}^+]$
 (g) Final answer
- Nasienkriteria**
 (a) Vervanging in c_aV_a
 (b) Vervanging in c_bV_b
 (c) Vervanging in n_a/ n_b
 (d) Gebruik van mol verhouding $\text{H}_2\text{SO}_4 : \text{H}_3\text{O}^+$
 (e) Formule $\text{pH} = -\log [\text{H}_3\text{O}^+]$
 (f) Vervanging in $\text{pH} = -\log [\text{H}_3\text{O}^+]$
 (g) Finale antwoord

OPTION 1 / OPSIE 1

$$\frac{C_a V_a}{C_b V_b} = \frac{n_a}{n_b}$$

$$\frac{C_a \times 25 \text{ (a) } \checkmark}{0,2 \times 12,5 \text{ (b) } \checkmark} = \frac{1}{2} \text{ (c) } \checkmark$$

$$c_a = 0,05 \text{ mol} \cdot \text{dm}^{-3}$$

OPTION 2 / OPSIE 2

$$n(\text{NaOH}) = cV$$

$$n(\text{NaOH}) = (0,2)(12,5 \times 10^{-3}) \text{ (a) } \checkmark$$

$$n(\text{NaOH}) = 2,5 \times 10^{-3} \text{ mol}$$

$$n(\text{H}_2\text{SO}_4) = 2 \times n(\text{NaOH})$$

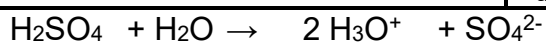
$$n(\text{H}_2\text{SO}_4) = \frac{1}{2} \times (2,5 \times 10^{-3}) \text{ (b) } \checkmark$$

$$n(\text{H}_2\text{SO}_4) = 1,25 \times 10^{-3} \text{ mol}$$

$$c = n/V$$

$$c = 1,25 \times 10^{-3} / 25 \times 10^{-3} \text{ (c) } \checkmark$$

$$c_a = 0,05 \text{ mol} \cdot \text{dm}^{-3}$$



$$c(\text{H}_3\text{O}^+) = 2 c(\text{H}_2\text{SO}_4)$$

$$c(\text{H}_3\text{O}^+) = 2(0,05) \text{ (d) } \checkmark$$

$$[\text{H}_3\text{O}^+] = 0,1 \text{ mol} \cdot \text{dm}^{-3}$$

$$\text{pH} = -\log [\text{H}_3\text{O}^+] \text{ (e) } \checkmark$$

$$= -\log 0,1 \text{ (f) } \checkmark$$

$$= 1 \text{ (g) } \checkmark$$

(7)
[18]

QUESTION 8/VRAAG 8

8.1 8.1.1 Chemical energy to electrical energy. ✓✓
Chemiese energie na elektriese energie. (2)

8.1.2 Metal **M** ✓
 The substance with the lower standard electrode potential is more easily oxidized. / Metal **M** is a stronger reducing agent than silver. ✓
 Metal M will be oxidised ✓
Metaal M
 Die stof met die laer standaard elektrodepotensiaal word makliker geoksideer / Metaal **M** is 'n sterker reduseermiddel as silwer.
 Metaal M sal geoksideer word (3)

8.2 8.2.1 $E^{\theta}_{\text{cell}} = E^{\theta}_{\text{cathode/reduction/oxidising agent}} - E^{\theta}_{\text{anode/oxidation/reducing agent}}$ ✓
 $E^{\theta}_{\text{sel}} = E^{\theta}_{\text{katode/reduksie/oksidaseermiddel}} - E^{\theta}_{\text{anode/oksidasie/reduseermiddel}}$

$$1,54 \checkmark = (0,8) - E^{\theta}_{\text{anode/oxidation/reducing agent}} / E^{\theta}_{\text{anode/oksidasie/reduseermiddel}} \checkmark$$

$$E^{\theta}_{\text{anode/oxidation/reducing agent}} / E^{\theta}_{\text{anode/oksidasie/reduseermiddel}} = 0,74 \text{ V } \checkmark$$

Metal is chromium (Cr) ✓

Metaal is chroom (Cr)

Marking criteria/Nasienkriteria

- Any other formula using unconventional abbreviation, e.g. /
 $E^{\theta}_{\text{cell}} = E^{\theta}_{\text{OA}} - E^{\theta}_{\text{RA}}$ followed by the correct substitution Max $\frac{3}{4}$
 Enige ander formule wat onkonvensionele afkorting gebruik bv. $E^{\theta}_{\text{sel}} = E^{\theta}_{\text{OM}} - E^{\theta}_{\text{RM}}$
 gevolg deur korrekte vervanging Maks $\frac{3}{4}$

(5)

8.2.2 $\text{Cr} | \text{Cr}^{3+} \checkmark || \checkmark \text{Ag}^+ | \text{Ag} \checkmark$ (3)

8.3 8.3.1 REMAINS THE SAME/BLY DIESELFDE ✓ (1)

8.3.2 INCREASES/TOENEEM ✓ (1)

[15]

QUESTION/VRAAG 9

- 9.1 A substance of which aqueous solutions contains ions ✓✓ (2 or 0)
'n Stof waarvan die oplossing in water ione bevat (2 of 0)

OR / OF

A substance that dissolves in water to give a solution that conducts electricity. (2 or 0) ✓✓
'n Stof wat in water oplos om 'n oplossing te vorm wat elektrisiteit gelei.
(2 of 0)

(2)

- 9.2 ENDOTHERMIC/ENDOTERMIES ✓

(1)

- 9.3 X ✓

(1)

- 9.4 $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$ ✓✓
 Ignore phases/ Ignoreer fase

(2)

Marking criteria / Nasienkriteria

- $\text{Cu}(\text{s}) \leftarrow \text{Cu}^{2+}(\text{aq}) + 2\text{e}^-$ 2/2
- $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Cu}(\text{s})$ 1/2
- $\text{Cu}(\text{s}) \rightleftharpoons \text{Cu}^{2+}(\text{aq}) + 2\text{e}^-$ 0/2
- $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \leftarrow \text{Cu}(\text{s})$ 0/2

Ignore if the charge omitted on electron/
Ignoreer indien lading weggelaat op elektron

- 9.5 Silver (Ag) is a weaker reducing agent than copper (Cu) and Zinc (Zn). ✓
 Silver (Ag) will not be oxidized.
Silwer (Ag) is 'n swakker reduseermiddel as koper (Cu) en sink (Zn).
Silwer (Ag) word nie geoksideer nie.

(1)

- 9.6 **Marking criteria / Nasienkriteria**

- (a) Substitution in/ Vervang in $n = N/N_A$
- (b) Use of mole ratio/ Gerbuik van mol verhouding $M : e^-$
- (c) Formula/ Formule $n = m/M$
- (d) Substitution into/ Vervang in $n = m/M$
- (e) Formula/ Formule CaCl_2

$$n = \frac{N}{N_A}$$

$$n = \frac{1,806 \times 10^{22}}{6,02 \times 10^{23}} \quad (\text{a}) \checkmark$$

$$n = 0,03 \text{ mol}$$

$$n(M) = 0,03 \times \frac{1}{2} \text{ (b) } \checkmark$$

$$n(M) = 0,015 \text{ mol}$$

$$M = \frac{m}{n} \text{ (c) } \checkmark$$

$$M = \frac{0,6}{0,015} \text{ (d) } \checkmark$$

$$M = 40 \text{ g} \cdot \text{mol}^{-1}$$

$$M = \text{CaCl}_2 \text{ (e) } \checkmark$$

(5)
[12]

TOTAL/TOTAAL: 150

PREPARATORY EXAMINATION

2025

10842

PHYSICAL SCIENCES: CHEMISTRY
(PAPER 2)

PHYSICAL SCIENCES: Paper 2



10842E

TIME: 3 hours

MARKS: 150

15 pages + 4 data sheets

X05



P.T.O.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space 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.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between subquestions, for example, between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. Round-off your final numerical answers to a minimum of TWO decimal places.
9. Show ALL formulae and substitutions in ALL calculations.
10. You are advised to use the attached DATA SHEETS.
11. Give brief motivations, discussions, etc. where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

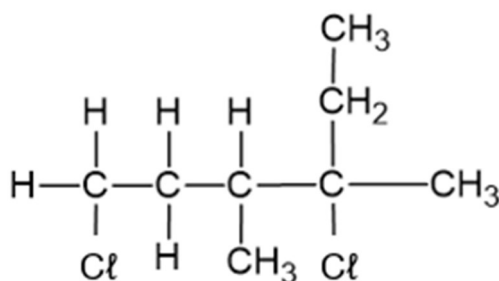
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A — D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 Which of the following compounds has a formyl group as its functional group?

- A Propan-1-ol
- B Propanoic acid
- C Prop-1-ene
- D Propanal

(2)

1.2 The correct IUPAC name for the structure shown below is:



- A 1,4-dichloro-4-ethyl-3-methylpentane
- B 2,4-dichloro-2-ethyl-3-methylpentane
- C 3,6-dichloro-3,4-dimethylhexane
- D 1,4-dichloro-3,4-dimethylhexane

(2)

1.3 Consider the following reaction:

Step 1: $\text{CH}_3\text{CHCHCH}_3 + \text{HBr} \rightarrow \text{compound P}$

Step 2: $\text{Compound P} + \text{NaOH(aq)} \rightarrow \text{compound X} + \text{NaBr}$

The IUPAC name for compound X is:

- A Butan-2-ol
- B But-2-ene
- C 2-bromobut-2-ene
- D 2-bromobutane

(2)

P.T.O.

1.4 Consider the organic compound propanal.

Which of the following is CORRECT for the homologous series and intermolecular forces between the molecules of the compound?

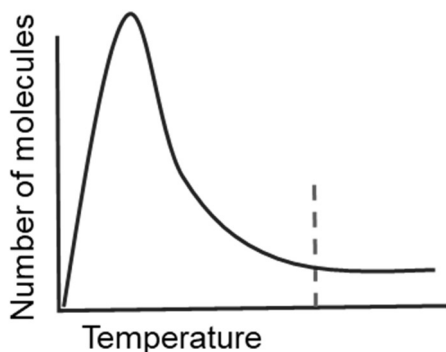
	HOMOLOGOUS SERIES	INTERMOLECULAR FORCES
A	Aldehyde	Hydrogen bonds
B	Ketone	Dipole-dipole forces
C	Aldehyde	Dipole-dipole forces
D	Alcohol	Hydrogen bonds

(2)

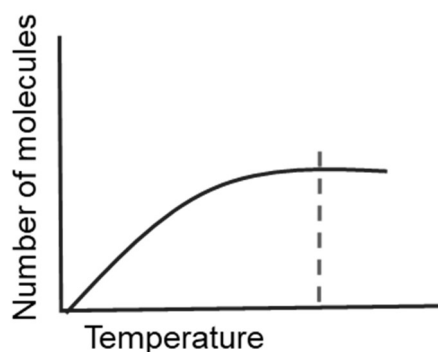
1.5 The graphs below illustrate the distribution of the same amount of four different O₂ gas samples. Each sample is at a different temperature.

Which gas is at the highest temperature?

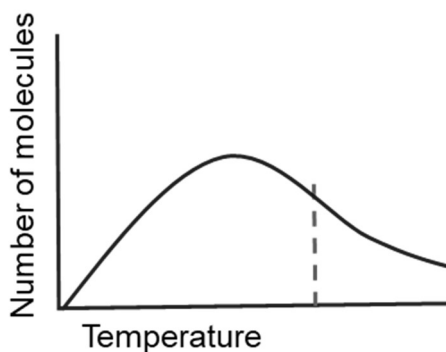
A



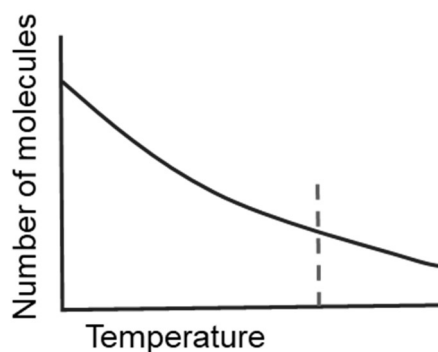
B



C



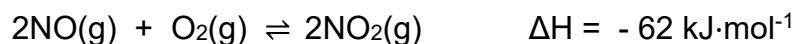
D



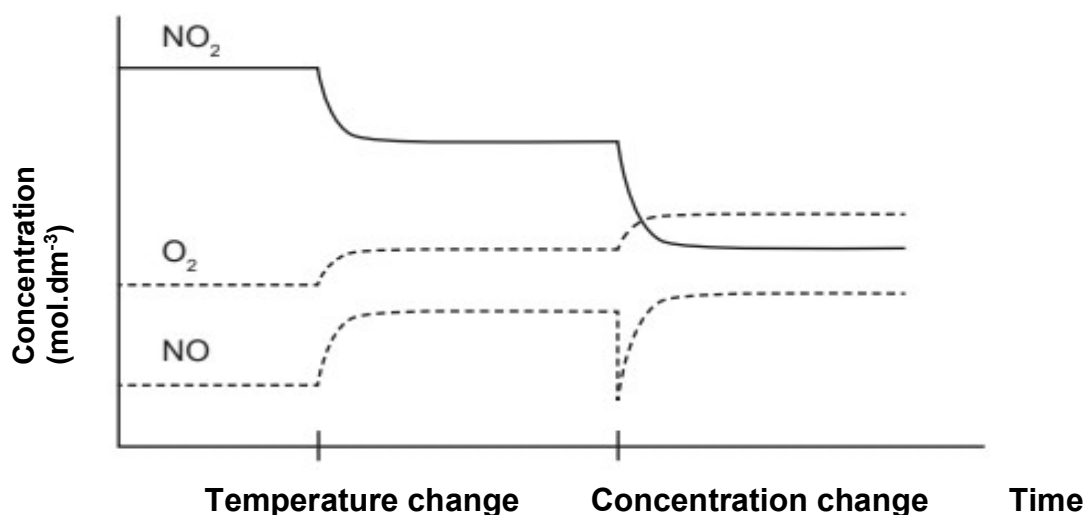
(2)

P.T.O.

1.6 Consider the chemical reaction shown below:



A change was applied to the equilibrium of the gas mixture. The mixture returned to equilibrium and a second change was applied. The following graph shows the effects of the two changes.



Identify the applied changes that best account for the shape of the graph.

	TEMPERATURE CHANGE	CONCENTRATION CHANGE
A	decreased	O ₂ increased
B	decreased	NO decreased
C	increased	O ₂ increased
D	increased	NO decreased

(2)

1.7 Which of the following statements about water is TRUE?

- (i) It is a weak electrolyte that undergoes auto-ionisation.
- (ii) The equilibrium constant for the ionisation of water at room temperature is 1×10^{-14} .
- (iii) It ionises completely at room temperature, hence $[\text{H}_3\text{O}^+] = [\text{OH}^-]$.
- (iv) The ionisation of water produces twice as many hydronium ions as compared to hydroxide ions.

- A i and ii only
- B ii and iii only
- C iii and iv only
- D i, ii, iii and iv

(2)

P.T.O.

- 1.8 A laboratory assistant prepares solutions of nitrous acid and hydrogen cyanide acid, both at the same concentration.

The K_a values of these acidic solutions are:

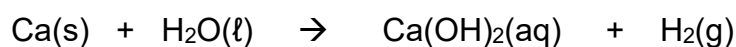
- nitrous acid (HNO_2) = $4,6 \times 10^{-4}$
- hydrogen cyanide acid (HCN) = $6,17 \times 10^{-10}$

Which of these two acids is the stronger acid, and which has the higher pH?

	STRONGER ACID	HIGHER pH
A	HNO_2	HNO_2
B	HNO_2	HCN
C	HCN	HCN
D	HCN	HNO_2

(2)

- 1.9 Calcium metal reacts quickly with hot water to produce calcium hydroxide and hydrogen:

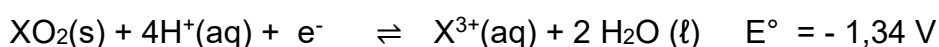
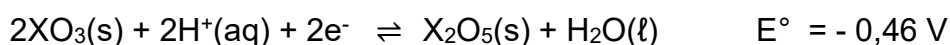


Identify the oxidising and reducing agents in this reaction:

	OXIDISING AGENT	REDUCING AGENT
A	H_2O	H_2
B	Ca	H_2O
C	H_2O	Ca
D	Ca(OH)_2	Ca

(2)

- 1.10 The following half-reactions show some predicted standard reduction potentials for the oxides of a hypothetical element X.



The strongest reducing agent is:

- A XO_3
- B X_2O_5
- C XO_2
- D X^{3+}

(2)
[20]

P.T.O.

QUESTION 2 (Start on a new page.)

The letters **A** to **F** in the table below represent six organic compounds.

A	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\text{CH}_2-\text{C}-\text{CH}_3 \end{array}$	B	$\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
C	$\begin{array}{ccccccc} & \text{Br} & & \text{Cl} & & \text{CH}_3 & \\ & & & & & & \\ \text{H}_2\text{C} & -\text{CH}_2- & \text{CH} & - & \text{CH} & & \\ & & & & & & \\ & & & & \text{CH}_3 & & \end{array}$	D	CH_3COOH
E	Ethyne	F	$\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{OH} & & \text{H} \\ & & & & & & & \\ \text{H} & -\text{C} & - & \text{C} & - & \text{C} & - & \text{C} & -\text{H} \\ & & & & & & & \\ & \text{H} & & \text{H} & & \text{H} & & \text{H} \end{array}$

- 2.1 Name the homologous series to which each of the following compounds belong:
- 2.1.1 **A** (1)
- 2.1.2 **C** (1)
- 2.2 Write down the IUPAC name of compound **C**. (3)
- 2.3 Write down the letter for the compound that has a carbonyl group. (1)
- 2.4 Write down the structural formula for the:
- 2.4.1 Functional isomer of compound **A** (2)
- 2.4.2 Ester with the same molecular formula as compound **D** (2)
- 2.4.3 Tertiary alcohol of compound **F** (2)
- 2.5 Explain why compound **A** is not an unsaturated hydrocarbon. (2)
- 2.6 Which letter in the table above represents:
- 2.6.1 An unsaturated hydrocarbon (1)
- 2.6.2 The compound with the general formula $\text{C}_n\text{H}_{2n}\text{O}$ (1)
- 2.7 Using molecular formulae, write down a balanced chemical equation for the combustion of compound **B** in excess oxygen. (3)

P.T.O.

- 2.8 A compound is analysed and found to have an empirical formula of CH_2O . The molar mass of the compound is found to be $150 \text{ g}\cdot\text{mol}^{-1}$.

What is the molecular formula of the compound?

(2)
[21]

QUESTION 3 (Start on a new page.)

During an investigation, a table of data was collected for four organic compounds **A**, **B**, **C** and **D**. The compounds have different functional groups.

	COMPOUND	MOLAR MASS	BOILING POINT ($^{\circ}\text{C}$)
A	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	72	36,1
B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$	72	74,8
C	$\text{CH}_3\text{COCH}_2\text{CH}_3$	72	79,64
D	$\text{CH}_3\text{CH}_2\text{COOH}$	74	163,5

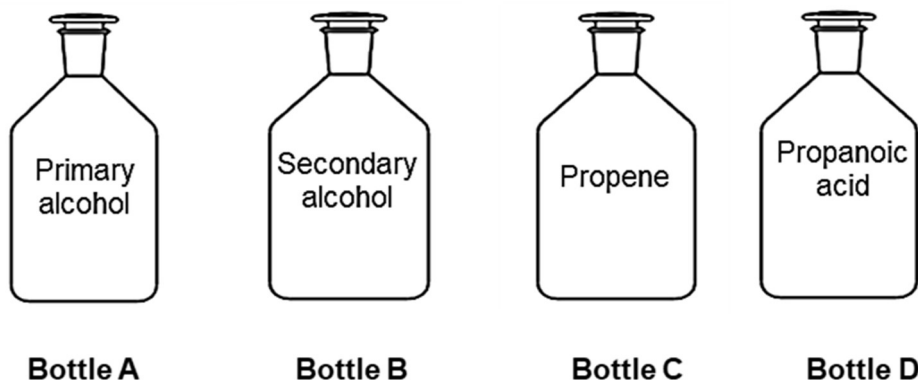
- 3.1 Define the term *boiling point*. (2)
- 3.2 In the investigation above, name the independent variable. (1)
- 3.3 Explain the trend in the boiling points among **A**, **B**, and **C** as shown in the table above. (4)
- 3.4 Which compound, **C** or **D**, would have the lowest vapour pressure?
Give a reason for the answer. (2)
- 3.5 Write down the following:
- 3.5.1 The phase of compound **A** at room temperature (1)
- 3.5.2 The structural formula of the functional group of **B** (1)
- 3.5.3 The IUPAC name of compound **C** (1)

[12]

P.T.O.

QUESTION 4 (Start on a new page.)

Four bottles containing organic compounds are found in the laboratory. The chemicals are used in various reactions.



- 4.1 Identify the type of reaction that occurs when each of the following reactants are used:
- 4.1.1 Bottle **A** and bottle **D** (1)
 - 4.1.2 Bromine water and bottle **C** (1)
 - 4.1.3 Bottle **B** and concentrated sulphuric acid (1)
- 4.2 Give the structural formula of the alcohol in bottle **B** if the alcohol has a prefix of hex. (2)
- 4.3 Use structural formulae to represent the chemical equation for the formation of the ester called butyl propanoate while using the primary alcohol in bottle **A**.
 Include the IUPAC names for the reactants. (6)
- 4.4 Concentrated sulphuric acid is added to the reaction in QUESTION 4.3.
 What is the function of the acid? (1)
- 4.5 Give the name of the functional group for bottle **B**. (1)
- 4.6 Bottle **C** is used to produce an alcohol.
- 4.6.1 Name the reaction conditions required. (1)
 - 4.6.2 Give the structural formula of the major product that forms. (2)
 - 4.6.3 Name the type of addition reaction that occurs. (1)

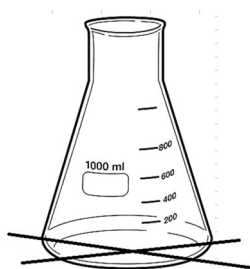
- 4.6.4 Two products are formed during this reaction. The products can be separated through distillation.

Which property of the compounds allows this separation?

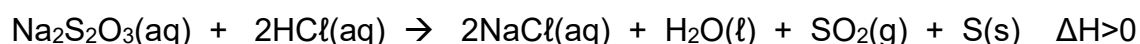
(1)
[18]

QUESTION 5 (Start on a new page.)

- 5.1 Define the term *heat of reaction*. (2)
- 5.2 The reaction between sodium thiosulfate and hydrochloric acid is investigated. A conical flask is placed over a cross on a piece of paper. The time is measured from the moment the acid is added to the sodium thiosulfate until the cross disappears.



The equation of the reaction is given:



The reaction is carried out with solutions of different concentrations of sodium thiosulfate.

The table below shows the data collected.

CONCENTRATION OF $\text{Na}_2\text{S}_2\text{O}_3$ ($\text{mol}\cdot\text{dm}^{-3}$)	TIME TAKEN UNTIL THE CROSS COULD NOT BE SEEN (IN SECONDS)			
	TRIAL 1	TRIAL 2	TRIAL 3	AVERAGE
0,040	71	67	69	69
0,060	42	45	45	44
0,080	31	41	33	X

- 5.2.1 Identify the independent variable. (1)
- 5.2.2 Calculate the average rate of reaction, in $\text{mol}\cdot\text{dm}^{-3}\cdot\text{s}^{-1}$, for the highest concentration used. (3)
- 5.2.3 Give the reason for the disappearance of the cross. (1)
- 5.2.4 Use the collision theory and explain the trend observed in this experiment. (3)

P.T.O.

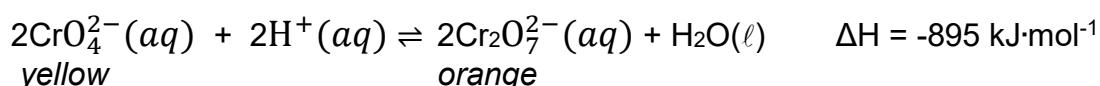
5.3 The activation energy for this reaction is 27,3 kJ.

5.3.1 Define the term *activation energy*. (2)

5.3.2 Draw a fully-labelled sketch graph of the potential energy graph for this reaction. (2)
[14]

QUESTION 6 (Start on a new page.)

6.1 Consider the following chemical equilibrium:



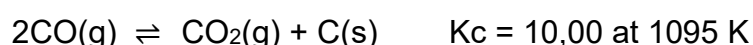
6.1.1 What is meant by the term *chemical equilibrium*? (2)

6.1.2 Using Le Chatelier's principle, explain how an increase in temperature will change the colour of the solution. (3)

6.1.3 A concentrated solution of hydrochloric acid is added to the equilibrium mixture. What is the effect on the concentration of the dichromate ions ($\text{Cr}_2\text{O}_7^{2-}$), and hence on the colour of the solution?

Write only INCREASE, DECREASE or REMAIN THE SAME. Explain the answer. (3)

6.2 Consider the following chemical reaction:



A 1,0 dm³ sealed vessel at a temperature of 1 095 K contains CO and CO₂ gas. An excess of solid carbon is formed. The concentration of CO is 1,10 x 10⁻² mol·dm⁻³, and the concentration of CO₂ is 1,21 x 10⁻³ mol·dm⁻³.

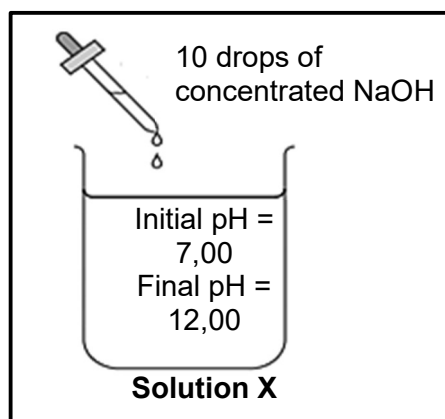
6.2.1 Is the system at equilibrium? Support the answer with a calculation. (3)

6.2.2 Carbon dioxide gas is added to the system and the mixture reaches a new equilibrium. The equilibrium concentrations of CO(g) and CO₂(g) are now equal. The temperature remains constant at 1 095 K.

Calculate the amount (in mol) of carbon dioxide that was added to the system. (7)
[18]

QUESTION 7 (Start on a new page.)

- 7.1 The pH of a solution **X** is measured before and after adding 10 drops of concentrated sodium hydroxide solution (NaOH) to it.



7.1.1 What is meant by a “concentrated NaOH solution”? (1)

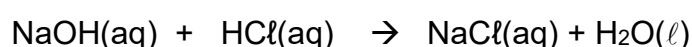
7.1.2 What happens to the concentration of the hydronium ions in solution **X**?

Write only INCREASES, DECREASES or REMAINS THE SAME.

Explain the answer in terms of the ionisation constant of water (K_w). (3)

7.1.3 Calculate the concentration of the OH^- ions in the final solution. (4)

- 7.2 A learner titrates a sodium hydroxide solution with a standard hydrochloric acid solution with a concentration of $0,0958 \text{ mol}\cdot\text{dm}^{-3}$.



The learner uses a pipette to transfer 20 cm^3 of the sodium hydroxide solution into a conical flask and adds 2 drops of indicator. The solution is then titrated with the hydrochloric acid until the endpoint is reached. The titration is repeated three times. A table of the learner's results is as follows:

TITRATION NUMBER	VOLUME OF HCl ADDED (cm^3)
1	20,05
2	20,15
3	20,10

7.2.1 Calculate the average volume of hydrochloric acid added. (1)

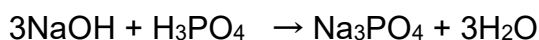
7.2.2 Prove, with a calculation, that the initial concentration of the sodium hydroxide solution was 0,0963 mol·dm⁻³. (4)

The standard sodium hydroxide solution is used to determine the percentage by mass of phosphoric acid (H₃PO₄) in a commercial brand of a rust remover.

A 10 g sample of the rust remover is weighed off and transferred to a volumetric flask. Thereafter, the flask is filled with distilled water up to 250 cm³.

10 cm³ of this diluted solution of the rust remover is titrated with 24,45 cm³ of the sodium hydroxide solution.

The balanced chemical reaction is as follows:



7.2.3 Calculate the percentage by mass of phosphoric acid in the original undiluted rust remover. (7)
[20]

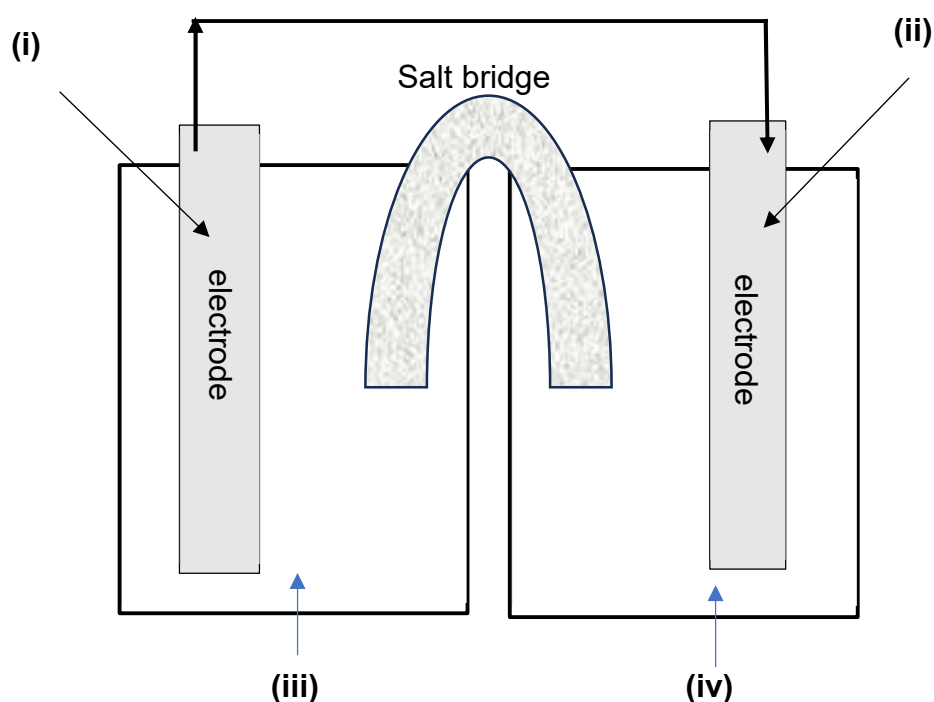
P.T.O.

QUESTION 8 (Start on a new page.)

A learner was asked to build a functioning galvanic cell. The following are provided:

- A magnesium rod
- A copper rod
- A $1 \text{ mol}\cdot\text{dm}^{-3}$ sodium carbonate solution
- A $1 \text{ mol}\cdot\text{dm}^{-3}$ magnesium sulfate solution
- A $1 \text{ mol}\cdot\text{dm}^{-3}$ copper(II)sulfate solution

A partially labelled galvanic cell built by the learner is shown below.



- 8.1 If the electrons move from the left electrode to the right electrode, label the parts **(i)** to **(iv)** using the information provided above. (4)
- 8.2 Write down the equation for the half-reaction taking place at the cathode. (2)
- 8.3 Calculate the initial emf of this cell under standard conditions. (4)
- 8.4 State ONE function of the salt bridge. (1)

P.T.O.

8.5 How will the following changes affect the initial emf of the cell?

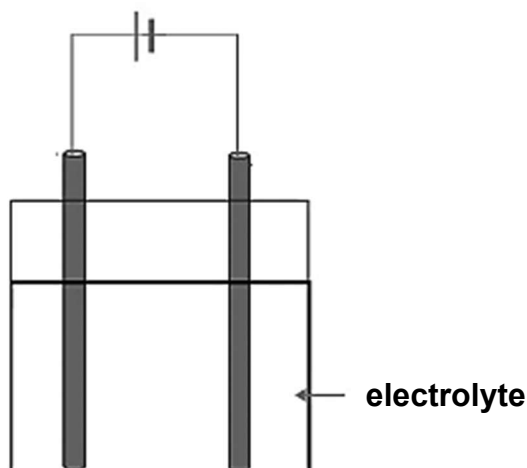
Write only INCREASE, DECREASE or REMAIN THE SAME.

8.5.1 The concentration of the Mg^{2+} ions is increased. (2)

8.5.2 The area of the copper rod is increased. (1)
[14]

QUESTION 9 (Start on a new page.)

Impure copper is refined using an electrolytic process, as shown in the diagram below.



9.1 Define the term *electrolyte*. (2)

9.2 Name a suitable solution that can be used as an electrolyte in this process. (1)

9.3 Write down the equation for the half-reaction taking place at the anode. (2)

9.4 A precious metal, such as silver, which is usually part of the impure anode, sinks to the bottom of the cell. Explain this observation referring to the relative strength of the reducing agents. (3)

9.5 After 10 minutes, 1,6 g of pure copper is deposited on the electrode. Calculate the number of electrons that flowed through the circuit while this mass of copper was deposited. (5)
[13]

TOTAL: 150

END

DATA FOR PHYSICAL SCIENCES GRADE 12
 PAPER 2 (CHEMISTRY)

 GEGEWENS VIR FISIESTE WETENSKAPPE GRAAD 12
 VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^θ	273 K
Charge on electron <i>Lading op elektron</i>	q_e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro-konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at/by } 298 \text{ K}$	
$E_{\text{cell}}^\theta = E_{\text{cathode}}^\theta - E_{\text{anode}}^\theta$ / $E_{\text{sel}}^\theta = E_{\text{katode}}^\theta - E_{\text{anode}}^\theta$ $E_{\text{cell}}^\theta = E_{\text{reduction}}^\theta - E_{\text{oxidation}}^\theta$ / $E_{\text{sel}}^\theta = E_{\text{reduksie}}^\theta - E_{\text{oksidasie}}^\theta$ $E_{\text{cell}}^\theta = E_{\text{oxidising agent}}^\theta - E_{\text{reducing agent}}^\theta$ / $E_{\text{sel}}^\theta = E_{\text{oksideermiddel}}^\theta - E_{\text{reduseermiddel}}^\theta$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TABEL 3: 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)																												
KEY/SLEUTEL Atomic number/ Atoomgetal Electro negativity/ Elektronegatiwiteit Symbol/ Simbool Approximate relative atomic mass/ Benaderde relatiewe atoommassa 29 1,9 Cu 63,5																																													
2,1 1 H 1	1,0 3 Li 7		1,5 4 Be 9												2,0 5 B 11	2,5 6 C 12	3,0 7 N 14	3,5 8 O 16	4,0 9 F 19	10 Ne 20																									
0,9 11 Na 23	1,2 12 Mg 24												1,5 13 Al 27	1,8 14 Si 28	2,1 15 P 31	2,5 16 S 32	3,0 17 Cl 35,5	18 Ar 40																											
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1,5 22 Ti 48	1,6 23 V 51	1,6 24 Cr 52	1,5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1,6 31 Ga 70	1,8 32 Ge 73	2,0 33 As 75	2,4 34 Se 79	2,8 35 Br 80	36 Kr 84																												
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1,4 40 Zr 91	1,6 41 Nb 92	1,8 42 Mo 96	1,9 43 Tc	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1,7 49 In 115	1,8 50 Sn 119	1,9 51 Sb 122	2,1 52 Te 128	2,5 53 I 127	54 Xe 131																												
0,7 55 Cs 133	0,9 56 Ba 137	1,6 57 La 139	1,6 72 Hf 179	1,6 73 Ta 181	1,6 74 W 184	1,6 75 Re 186	1,6 76 Os 190	1,6 77 Ir 192	1,6 78 Pt 195	1,6 79 Au 197	1,6 80 Hg 201	1,8 81 Tl 204	1,8 82 Pb 207	1,9 83 Bi 209	2,0 84 Po	2,5 85 At	86 Rn																												
0,7 87 Fr	0,9 88 Ra 226	89 Ac																																											
<table><tr><td>58 Ce 140</td><td>59 Pr 141</td><td>60 Nd 144</td><td>61 Pm</td><td>62 Sm 150</td><td>63 Eu 152</td><td>64 Gd 157</td><td>65 Tb 159</td><td>66 Dy 163</td><td>67 Ho 165</td><td>68 Er 167</td><td>69 Tm 169</td><td>70 Yb 173</td><td>71 Lu 175</td></tr><tr><td>90 Th 232</td><td>91 Pa</td><td>92 U 238</td><td>93 Np</td><td>94 Pu</td><td>95 Am</td><td>96 Cm</td><td>97 Bk</td><td>98 Cf</td><td>99 Es</td><td>100 Fm</td><td>101 Md</td><td>102 No</td><td>103 Lr</td></tr></table>																		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
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
 TABEL 4A: STANDAARDREDUKSIEPOTENSIALE

Half-reactions/Halfreaksies	E ⁰ (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
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 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
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 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
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	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
$Al^{3+} + 3e^- \rightleftharpoons Al$	- 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

Increasing oxidising ability/Toenemende oksiderende vermoë

Increasing reducing ability/Toenemende reduserende vermoë

TABLE 4B: STANDARD REDUCTION POTENTIALS
 TABEL 4B: STANDAARDREDUKSIEPOTENSIALE

Increasing oxidising ability/Toenemende oksiderende vermoë

Half-reactions/Halfreaksies	$E^{\ominus}$ (V)
$\text{Li}^+ + \text{e}^- \rightleftharpoons \text{Li}$	-3,05
$\text{K}^+ + \text{e}^- \rightleftharpoons \text{K}$	-2,93
$\text{Cs}^+ + \text{e}^- \rightleftharpoons \text{Cs}$	-2,92
$\text{Ba}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ba}$	-2,90
$\text{Sr}^{2+} + 2\text{e}^- \rightleftharpoons \text{Sr}$	-2,89
$\text{Ca}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ca}$	-2,87
$\text{Na}^+ + \text{e}^- \rightleftharpoons \text{Na}$	-2,71
$\text{Mg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mg}$	-2,36
$\text{Al}^{3+} + 3\text{e}^- \rightleftharpoons \text{Al}$	-1,66
$\text{Mn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mn}$	-1,18
$\text{Cr}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cr}$	-0,91
$2\text{H}_2\text{O} + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^-$	-0,83
$\text{Zn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Zn}$	-0,76
$\text{Cr}^{3+} + 3\text{e}^- \rightleftharpoons \text{Cr}$	-0,74
$\text{Fe}^{2+} + 2\text{e}^- \rightleftharpoons \text{Fe}$	-0,44
$\text{Cr}^{3+} + \text{e}^- \rightleftharpoons \text{Cr}^{2+}$	-0,41
$\text{Cd}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cd}$	-0,40
$\text{Co}^{2+} + 2\text{e}^- \rightleftharpoons \text{Co}$	-0,28
$\text{Ni}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ni}$	-0,27
$\text{Sn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Sn}$	-0,14
$\text{Pb}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pb}$	-0,13
$\text{Fe}^{3+} + 3\text{e}^- \rightleftharpoons \text{Fe}$	-0,06
$2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2\text{e}^- \rightleftharpoons \text{Sn}^{2+}$	+0,15
$\text{Cu}^{2+} + \text{e}^- \rightleftharpoons \text{Cu}^+$	+0,16
$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightleftharpoons 4\text{OH}^-$	+0,40
$\text{SO}_2 + 4\text{H}^+ + 4\text{e}^- \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^+ + \text{e}^- \rightleftharpoons \text{Cu}$	+0,52
$\text{I}_2 + 2\text{e}^- \rightleftharpoons 2\text{I}^-$	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2\text{O}_2$	+0,68
$\text{Fe}^{3+} + \text{e}^- \rightleftharpoons \text{Fe}^{2+}$	+0,77
$\text{NO}_3^- + 2\text{H}^+ + \text{e}^- \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^+ + \text{e}^- \rightleftharpoons \text{Ag}$	+0,80
$\text{Hg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Hg}(\ell)$	+0,85
$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^- \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\ell) + 2\text{e}^- \rightleftharpoons 2\text{Br}^-$	+1,07
$\text{Pt}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pt}$	+1,20
$\text{MnO}_2 + 4\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^+ + 4\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$	+1,36
$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + \text{e}^- \rightleftharpoons \text{Co}^{2+}$	+1,81
$\text{F}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{F}^-$	+2,87

Increasing reducing ability/Toenemende reduserende vermoë



GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

VOORBEREIDENDE EKSAMEN

2025

10842

FISIESE WETENSKAPPE: CHEMIE
(VRAESTEL 2)

FISIESE WETENSKAPPE: Vraestel 2



10842A

TYD: 3 uur

PUNTE: 150

15 bladsye + 4 gegewensblaaie

X05



b.o.

INSTRUKSIES EN INLIGTING

1. Skryf jou naam in die toepaslike spasie op die ANTWOORDBOEK.
2. Hierdie vraestel bestaan uit NEGE vrae. Beantwoord AL die vrae in die ANTWOORDBOEK.
3. Begin ELKE vraag op 'n NUWE bladsy.
4. Nommer die antwoorde korrek volgens die nommeringstelsel wat in hierdie vraestel gebruik is.
5. Laat EEN reël oop tussen subvrae, byvoorbeeld tussen VRAAG 2.1 en VRAAG 2.2.
6. Jy mag 'n nie-programmeerbare sakrekenaar gebruik.
7. Jy mag toepaslike wiskundige apparaat gebruik.
8. Wys ALLE formules en vervangings in ALLE berekeninge.
9. Rond jou finale numeriese antwoorde af tot 'n minimum van TWEE desimale plekke.
10. Jy word aangeraai om die aangehegte GEGEWENSBLAAIE te gebruik.
11. Gee kort (bondige) motiverings, besprekings ens. waar nodig.
12. Skryf netjies en leesbaar.

VRAAG 1: MEERVOUDIGEKEUSE-VRAE

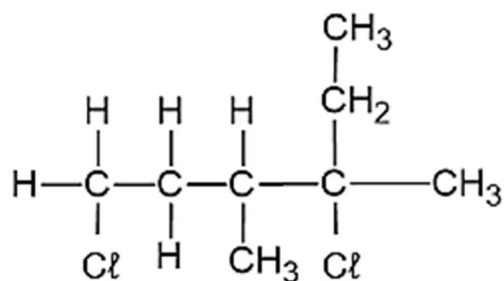
Vier opsies word gegee as moontlike antwoorde vir die volgende vrae. Elke vraag het slegs EEN korrekte antwoord. Kies die antwoord en skryf slegs die letter (A — D) langs die vraagnommers (1.1 tot 1.10) in die ANTWOORDBOEK, bv. 1.11 E.

1.1 Watter van die volgende verbindings het 'n formielgroep as sy funksionele groep?

- A Propan-1-ol
- B Propanoësuur
- C Prop-1-een
- D Propanaal

(2)

1.2 Die korrekte IUPAC-naam vir die struktuur hieronder getoon, is:



- A 1,4-dichloro-4-eties-3-metielpentaan
- B 2,4-dichloro-2-eties-3-metielpentaan
- C 3,6-dichloro-3,4-dimetielheksaan
- D 1,4-dichloro-3,4-dimetielheksaan

(2)

1.3 Oorweeg die volgende reaksie:

Stap 1: $\text{CH}_3\text{CHCHCH}_3 + \text{HBr} \rightarrow$ verbinding **P**

Stap 2: verbinding **P** + $\text{NaOH(aq)} \rightarrow$ verbinding **X** + NaBr

Die IUPAC-naam vir verbinding **X** is:

- A Butan-2-ol
- B But-2-een
- C 2-bromobut-2-een
- D 2-bromobutaan

(2)

1.4 Oorweeg die organiese verbinding propaanal.

Watter van die volgende is KORREK vir die homoloë reeks en intermolekulêre kragte tussen die molekule van die verbinding?

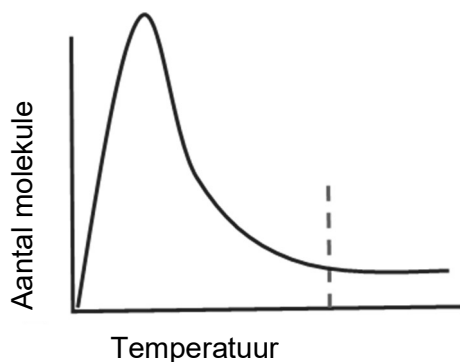
	HOMOLOË REEKS	INTERMOLEKULÊRE Kragte
A	Aldehyd	Waterstofbinding
B	Ketoon	Dipool-dipool kragte
C	Aldehyd	Dipool-dipool kragte
D	Alkohol	Waterstofbinding

(2)

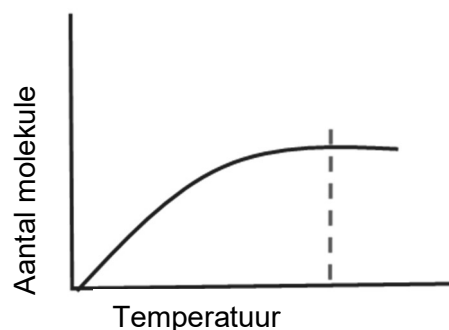
1.5 Die grafieke hieronder illustreer die verspreiding van dieselfde hoeveelheid van vier verskillende O₂-gasmonsters. Elke monster is by 'n ander temperatuur.

Watter gas is by die hoogste temperatuur?

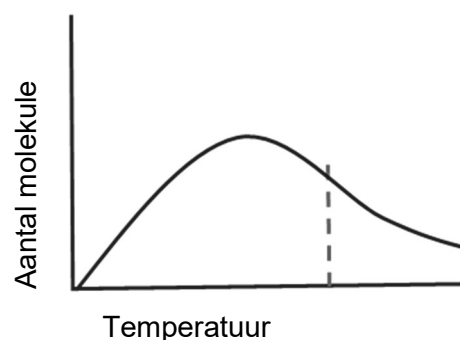
A



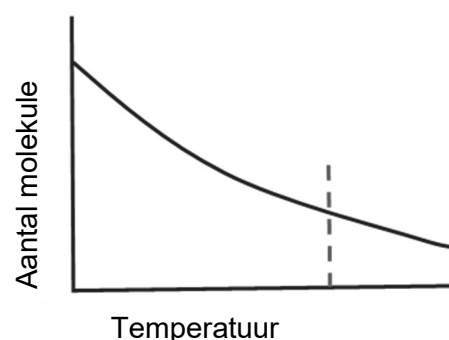
B



C

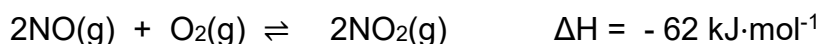


D

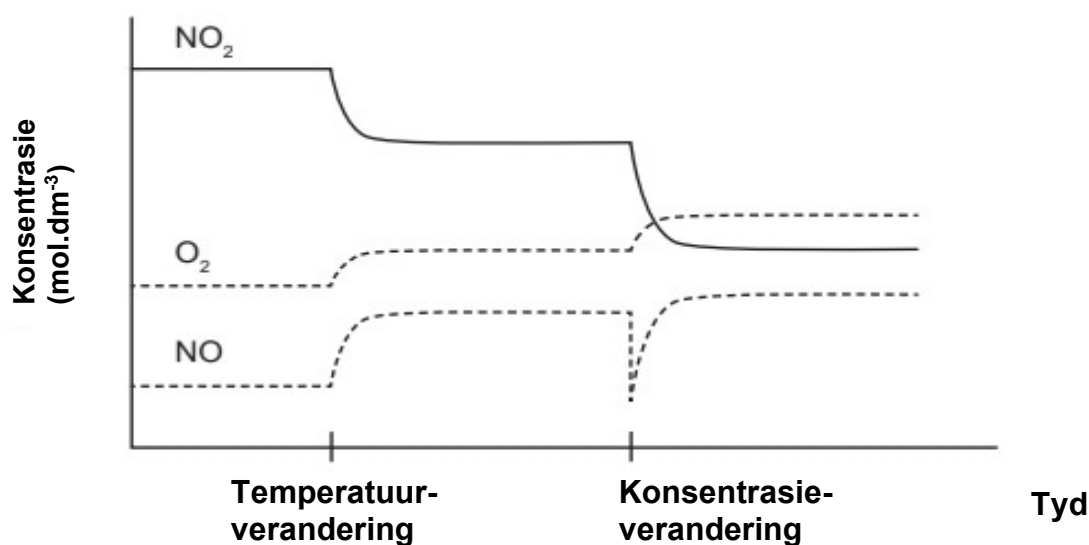


(2)

1.6 Oorweeg die chemiese reaksie wat hieronder getoon word:



'n Verandering is op die ewewig van die gasmengsel aangebring. Die mengsel het teruggekeer na ewewig en 'n tweede verandering is aangebring. Die volgende grafiek toon die uitwerking van die twee veranderinge.



Identifiseer die veranderinge wat gemaak is om die vorm van die grafiek te verduidelik.

	TEMPERATUURVERANDERING	KONSENTRASIEVERANDERING
A	verlaag	O_2 verhoog
B	verlaag	NO verlaag
C	verhoog	O_2 verhoog
D	verhoog	NO verlaag

(2)

1.7 Watter van die volgende stellings oor water is WAAR?

- (i) Dit is 'n swak elektroliet wat outo-ionisasie ondergaan.
- (ii) Die ewewigskonstante vir die ionisasie van water by kamertemperatuur is 1×10^{-14} .
- (iii) Dit ioniseer heeltemal by kamertemperatuur dus $[\text{H}_3\text{O}^+] = [\text{OH}^-]$.
- (iv) Die ionisasie van water produseer twee keer soveel hidroniumione as hidroksiedione.

- A Slegs i en ii
- B Slegs ii en iii
- C Slegs iii en iv
- D i, ii, iii en iv

(2)

b.o.

- 1.8 'n Laboratorium-assistent berei oplossings van waterstofnitriet en waterstofsianiedsuur voor wat dieselfde konsentrasie het.

Die K_a waardes van hierdie suuroplossings is:

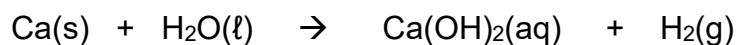
- waterstofnitriet (HNO_2) = $4,6 \times 10^{-4}$
- waterstofsianiedsuur (HCN) = $6,17 \times 10^{-10}$

Watter van hierdie twee sure is die sterker suur, en watter het die hoër pH?

	STERKER SUUR	HOËR pH
A	HNO_2	HNO_2
B	HNO_2	HCN
C	HCN	HCN
D	HCN	HNO_2

(2)

- 1.9 Kalsiummetaal reageer vinnig met warm water om kalsiumhidroksied en waterstof te produseer:

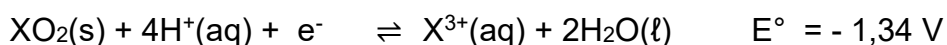
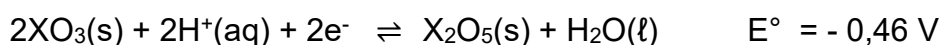


Identifiseer die oksideer- en reduseermiddels in hierdie reaksie:

	OKSIDEERMIDDEL	REDUSEERMIDDEL
A	H_2O	H_2
B	Ca	H_2O
C	H_2O	Ca
D	Ca(OH)_2	Ca

(2)

- 1.10 Die volgende halfreaksies toon 'n paar voorspelde standaardreduksiepotensiale vir die oksiede van 'n hipotetiese element X:



Die sterkste reduseermiddel is:

- A XO_3
- B X_2O_5
- C XO_2
- D X^{3+}

(2)
[20]

b.o.

VRAAG 2 (Begin op 'n nuwe bladsy.)

Die letters **A** tot **F** in die tabel hieronder verteenwoordig ses organiese verbindings.

A	$\text{H}_3\text{C}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$	B	$\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
C	$\begin{array}{ccccccc} & \text{Br} & & \text{Cl} & & \text{CH}_3 & \\ & & & & & & \\ \text{H}_2\text{C} & -\text{CH}_2- & \text{CH} & - & \text{CH} & & \\ & & & & & & \\ & & & & \text{CH}_3 & & \end{array}$	D	CH_3COOH
E	Etyn	F	$\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{OH} & & \text{H} \\ & & & & & & & \\ \text{H} & -\text{C} & - & \text{C} & - & \text{C} & - & \text{C} & -\text{H} \\ & & & & & & & \\ & \text{H} & & \text{H} & & \text{H} & & \text{H} \end{array}$

- 2.1 Noem die homoloë reeks waaraan elk van die volgende verbindings behoort:
 - 2.1.1 **A** (1)
 - 2.1.2 **C** (1)
- 2.2 Skryf die IUPAC-naam van verbinding **C** neer. (3)
- 2.3 Skryf die letter neer vir die verbinding wat 'n karbonielgroep het. (1)
- 2.4 Skryf die struktuurformule neer vir die:
 - 2.4.1 Funksionele isomeer van verbinding **A** (2)
 - 2.4.2 Ester met dieselfde molekulêre formule as verbinding **D** (2)
 - 2.4.3 Tersiêre alkohol van verbinding **F** (2)
- 2.5 Verduidelik waarom verbinding **A** nie 'n onversadigde koolwaterstof is nie. (2)
- 2.6 Watter letter in die tabel hierbo verteenwoordig:
 - 2.6.1 'n Onversadigde koolwaterstof (1)
 - 2.6.2 Die verbinding met die algemene formule $\text{C}_n\text{H}_{2n}\text{O}$ (1)
- 2.7 Gebruik molekulêre formules en skryf 'n gebalanseerde chemiese vergelyking vir die verbranding van verbinding **B** in 'n oormaat suurstof neer. (3)

b.o.

- 2.8 'n Verbinding word ontleed en dit word gevind dat die empiriese formule CH_2O is. Die molêre massa van die verbinding is $150 \text{ g}\cdot\text{mol}^{-1}$.

Wat is die molekulêre formule van die verbinding?

(2)
[21]

VRAAG 3 (Begin op 'n nuwe bladsy.)

Tydens 'n ondersoek is die tabel met data versamel vir vier organiese verbindings **A**, **B**, **C** en **D**. Die verbindings het verskillende funksionele groepe.

	VERBINDING	MOLÊRE MASSA	KOOKPUNT ($^{\circ}\text{C}$)
A	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	72	36,1
B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$	72	74,8
C	$\text{CH}_3\text{COCH}_2\text{CH}_3$	72	79,64
D	$\text{CH}_3\text{CH}_2\text{COOH}$	74	163,5

- 3.1 Definieer die term *kookpunt*. (2)
- 3.2 In die ondersoek hierbo, noem die onafhanklike veranderlike. (1)
- 3.3 Verduidelik die tendens van die kookpunte tussen **A**, **B** en **C** soos in die tabel hierbo gesien. (4)
- 3.4 Watter verbinding, **C** of **D**, sal die laagste dampdruk hê?
Gee 'n rede vir die antwoord. (2)
- 3.5 Skryf die volgende neer:
- 3.5.1 Die fase van verbinding **A** by kamertemperatuur (1)
- 3.5.2 Die struktuurformule van die funksionele groep van **B** (1)
- 3.5.3 Die IUPAC-naam van verbinding **C** (1)

[12]

b.o.

VRAAG 4 (Begin op 'n nuwe bladsy.)

Vier bottels met organiese verbindings word in die laboratorium gevind. Die chemikalieë word in verskeie reaksies gebruik.

**Bottel A****Bottel B****Bottel C****Bottel D**

- 4.1 Identifiseer die tipe reaksie wat plaasvind wanneer elk van die volgende reaktante gebruik word:
- 4.1.1 Bottel **A** and bottel **D** (1)
 - 4.1.2 Broomwater and bottel **C** (1)
 - 4.1.3 Bottel **B** en gekonsentreerde swawelsuur (1)
- 4.2 Gee die struktuurformule van die alkohol in bottel **B** as die alkohol 'n voorvoegsel van heks het. (2)
- 4.3 Gebruik struktuurformules om die chemiese vergelyking vir die vorming van die ester genoem butielpropanoaat voor te stel, terwyl die primêre alkohol in bottel **A** gebruik word.
- Sluit die IUPAC-name vir die reaktante in. (6)
- 4.4 Gekonsentreerde swawelsuur word by die reaksie in VRAAG 4.3 gevoeg.
- Wat is die funksie van die suur? (1)
- 4.5 Gee die naam van die funksionele groep vir bottel **B**. (1)
- 4.6 Bottel **C** word gebruik om 'n alkohol te produseer.
- 4.6.1 Noem die reaksietoestande wat vereis word. (1)
 - 4.6.2 Gee die struktuurformule van die hoofproduk wat vorm. (2)
 - 4.6.3 Noem die tipe addisiereaksie wat plaasvind. (1)

b.o.

- 4.6.4 Twee produkte word tydens hierdie reaksie gevorm. Die produkte kan deur distillasie geskei word.

Watter eienskap van die verbindings maak die skeiding moontlik?

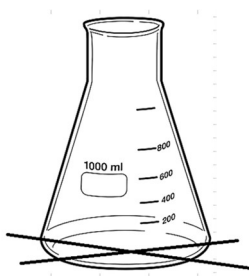
(1)
[18]

VRAAG 5 (Begin op 'n nuwe bladsy.)

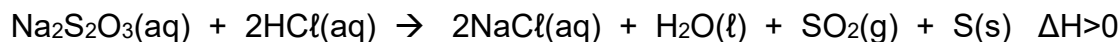
- 5.1 Definieer die term *reaksiewarmte*.

(2)

- 5.2 Die reaksie tussen natriumtiosulfaat en soutsuur word ondersoek. 'n Koniese fles word bo-op 'n kruis op 'n stuk papier geplaas. Die tyd word gemeet vanaf die oomblik dat die suur by die natriumtiosulfaat gevoeg word totdat die kruis verdwyn.



Die reaksievergelyking word gegee:



Die reaksie word uitgevoer met verskillende konsentrasies natriumtiosulfaat oplossings.

Die tabel hieronder toon die data wat ingesamel is.

KONSENTRASIE VAN $\text{Na}_2\text{S}_2\text{O}_3$ ($\text{mol}\cdot\text{dm}^{-3}$)	TYD GEMEET TOTDAT DIE KRUIS VERDWIN (IN SEKONDES)			
	LOPIE 1	LOPIE 2	LOPIE 3	GEMIDDELD
0,040	71	67	69	69
0,060	42	45	45	44
0,080	31	41	33	X

- 5.2.1 Identifiseer die onafhanklike veranderlike.

(1)

- 5.2.2 Bereken die gemiddelde reaksietempo, in $\text{mol}\cdot\text{dm}^{-3}\cdot\text{s}^{-1}$, vir die hoogste konsentrasie wat gebruik word.

(3)

- 5.2.3 Gee die rede vir die verdwyning van die kruis.

(1)

- 5.2.4 Gebruik die botsingsteorie en verduidelik die tendens wat in hierdie eksperiment waargeneem word.

(3)

b.o.

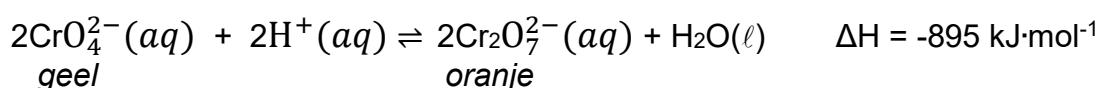
5.3 Die aktiveringsenergie vir hierdie reaksie is 27,3 kJ.

5.3.1 Definieer die term *aktiveringsenergie*. (2)

5.3.2 Teken 'n volledig benoemde sketsgrafiek van die potensiële energie diagram vir hierdie reaksie. (2)
[14]

VRAAG 6 (Begin op 'n nuwe bladsy.)

6.1 Beskou die volgende chemiese ewewig:



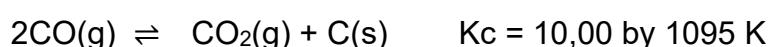
6.1.1 Wat word bedoel met die term *chemiese ewewig*? (2)

6.1.2 Gebruik Le Chatelier se beginsel en verduidelik hoe 'n toename in temperatuur die kleur van die oplossing sal verander. (3)

6.1.3 'n Gekonsentreerde oplossing van soutsuur word by die ewewigmengsel gevoeg. Wat is die effek op die konsentrasie van die dichromaatione ($\text{Cr}_2\text{O}_7^{2-}$), en gevolglik die kleur van die oplossing?

Skryf slegs VERHOOG, VERLAAG of BLY DIESELFDE. Verduidelik die antwoord. (3)

6.2 Oorweeg die volgende chemiese reaksie:



'n 1,0 dm³ geseëde houer by 'n temperatuur van 1 095 K bevat CO en CO₂ gas. 'n Oormaat soliede koolstof word gevorm. Die konsentrasie van CO is 1,10 x 10⁻² mol·dm⁻³, en die konsentrasie vir CO₂ is 1,21 x 10⁻³ mol·dm⁻³.

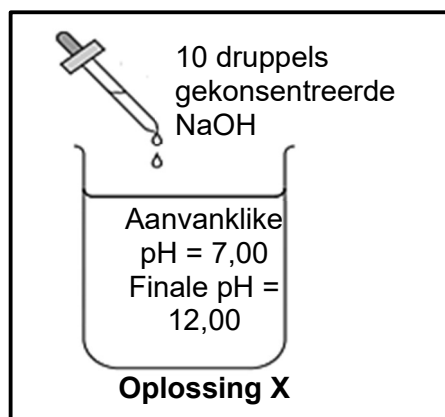
6.2.1 Is die sisteem in ewewig? Ondersteun die antwoord met 'n berekening. (3)

6.2.2 Koolstofdioksiedgas word by die sisteem gevoeg en die mengsel bereik 'n nuwe ewewig. Die ewewigskonsentrasies van CO(g) en CO₂(g) is nou dieselfde. Die temperatuur bly konstant op 1 095 K.

Bereken die hoeveelheid (in mol) koolstofdioksied wat by die sisteem gevoeg is. (7)
[18]

VRAAG 7 (Begin op 'n nuwe bladsy.)

- 7.1 Die pH van 'n oplossing **X** is gemeet voor en nadat 10 druppels gekonsentreerde natriumhidroksiedoplossing (NaOH) daarby gevoeg is.



- 7.1.1 Wat word bedoel met 'n "gekonsentreerde NaOH oplossing"? (1)

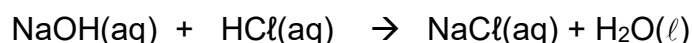
- 7.1.2 Wat gebeur met die konsentrasie van die hidroniumione in oplossing **X**?

Skryf slegs VERMEERDER, VERMINDER of BLY DIESELFDE.
Verduidelik die antwoord in terme van die ionisasie konstante van water (K_w).

(3)

- 7.1.3 Bereken die konsentrasie van die OH^- ione in die finale oplossing. (4)

- 7.2 'n Leerder titreer 'n natriumhidroksiedoplossing met 'n standaard soutsuuroplossing met 'n konsentrasie van $0,0958 \text{ mol} \cdot \text{dm}^{-3}$.



Die leerder gebruik 'n pipet om 20 cm^3 van die natriumhidroksiedoplossing in 'n koniese fles oor te dra en voeg 2 druppels indikator by. Die oplossing word dan met die soutsuur getitreer totdat die eindpunt bereik is. Die titrasie word drie keer herhaal. 'n Tabel van die leerder se resultate is as volg:

TITRASIE NOMMER	VOLUME HCl BYGEOVOEG (cm^3)
1	20,05
2	20,15
3	20,10

7.2.1 Bereken die gemiddelde volume soutsuur wat bygevoeg is. (1)

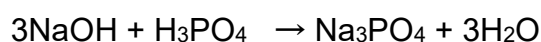
7.2.2 Bewys, met 'n berekening, dat die aanvanklike konsentrasie van die natriumhidroksiedoplossing $0,0963 \text{ mol}\cdot\text{dm}^{-3}$ was. (4)

Die standaard natriumhidroksiedoplossing word gebruik om die massapersentasie fosforsuur (H_3PO_4) in 'n kommersiële handelsmerk roesverwyderaar te bepaal.

'n 10 g-monster van die roesverwyderaar word afgeweg en oorgeplaas na 'n volumetriese fles. Daarna word die fles met gedistilleerde water tot 250 cm^3 gevul.

10 cm^3 van hierdie verdunde oplossing van die roesverwyderaar word getitreer met $24,45 \text{ cm}^3$ van die natriumhidroksiedoplossing.

Die gebalanseerde chemiese reaksie is soos volg:



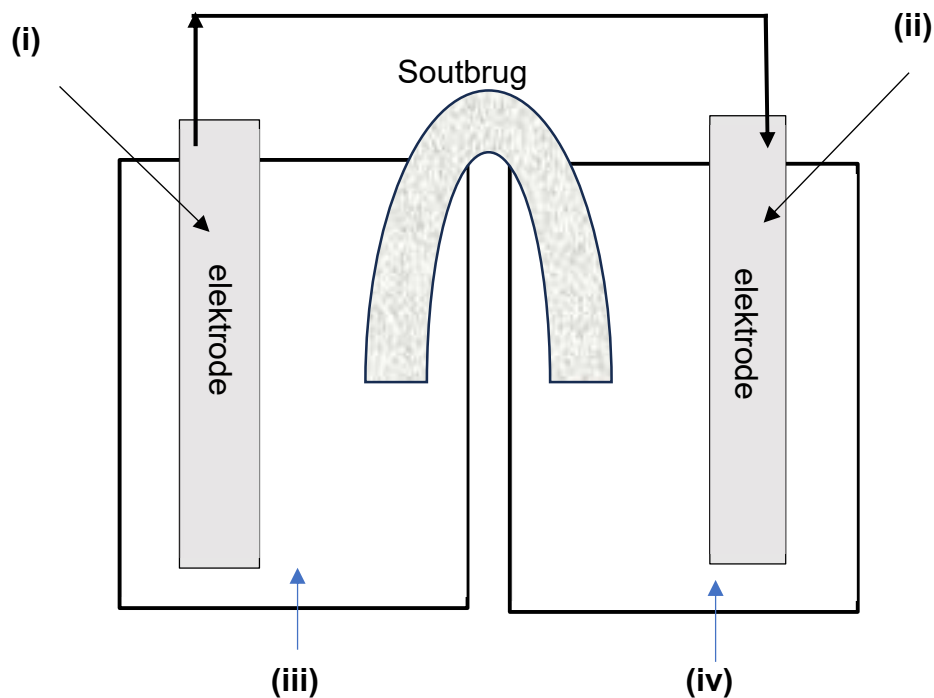
7.2.3 Bereken die persentasie per massa fosforsuur in die oorspronklike onverdunde roesverwyderaar. (7)
[20]

VRAAG 8 (Begin op 'n nuwe bladsy.)

'n Leerder is gevra om 'n funksionerende galvaniese sel te bou. Die volgende word voorsien:

- 'n Magnesiumstaaf
- 'n Koperstaaf
- 'n $1 \text{ mol} \cdot \text{dm}^{-3}$ natriumkarbonaatoplossing
- 'n $1 \text{ mol} \cdot \text{dm}^{-3}$ magnesiumsulfaatoplossing
- 'n $1 \text{ mol} \cdot \text{dm}^{-3}$ koper(II)sulfaatoplossing

'n Gedeeltelik benoemde galvaniese sel wat deur die leerder gebou is, word hieronder getoon.



- 8.1 As die elektrone van die linkerkantse elektrode na die regterkantse elektrode beweeg, benoem die dele (i) tot (iv) deur van die inligting hierbo gebruik te maak. (4)
- 8.2 Skryf die vergelyking neer vir die halfreaksie wat by die katode plaasvind. (2)
- 8.3 Bereken die aanvanklike emk van hierdie sel onder standaardtoestande. (4)
- 8.4 Noem EEN funksie van die soutbrug. (1)

b.o.

8.5 Hoe sal die volgende veranderinge die aanvanklike emk van die sel beïnvloed?

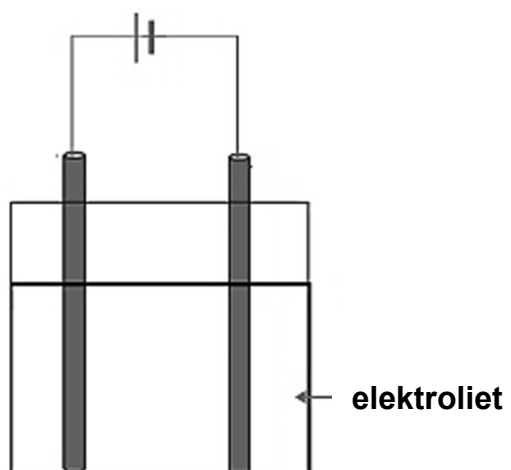
Skryf slegs VERHOOG, VERLAAG of BLY DIESELFDE.

8.5.1 Die konsentrasie van die Mg^{2+} ione word verhoog. (2)

8.5.2 Die oppervlak van die koperstaaf word vergroot. (1)
[14]

VRAAG 9 (Begin op 'n nuwe bladsy.)

Onsuiwer koper word verfyn deur 'n elektrolitiese proses, soos in die diagram hieronder getoon.



9.1 Definieer die term *elektroliet*. (2)

9.2 Noem 'n geskikte oplossing wat as 'n elektroliet in hierdie proses gebruik kan word. (1)

9.3 Skryf die vergelyking neer vir die halfreaksie wat by die anode plaasvind. (2)

9.4 'n Edelmetaal, soos silwer, wat gewoonlik deel van die onsuiwer anode is, sink na die onderkant van die sel. Verduidelik hierdie waarneming met verwysing na die relatiewe sterkte van die reduseermiddels. (3)

9.5 Na 10 minute is 1,6 g suiwer koper op die elektrode neergeslaan. Bereken die aantal elektrone wat deur die stroombaan gevloei het terwyl hierdie massa koper neergeslaan het. (5)
[13]

TOTAAL: 150

EINDE

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	p^{θ}	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^{θ}	273 K
Charge on electron <i>Lading op elektron</i>	q_e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro-konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14}$ at/by 298 K	
$E_{\text{cell}}^{\theta} = E_{\text{cathode}}^{\theta} - E_{\text{anode}}^{\theta} / E_{\text{sel}}^{\theta} = E_{\text{katode}}^{\theta} - E_{\text{anode}}^{\theta}$ $E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} / E_{\text{sel}}^{\theta} = E_{\text{reduksie}}^{\theta} - E_{\text{oksidasie}}^{\theta}$ $E_{\text{cell}}^{\theta} = E_{\text{oxidising agent}}^{\theta} - E_{\text{reducing agent}}^{\theta} / E_{\text{sel}}^{\theta} = E_{\text{oksideermiddel}}^{\theta} - E_{\text{reduseermiddel}}^{\theta}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TABEL 3: 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)	
KEY/SLEUTEL Atomic number/ Atoomgetal Electro negativity/ Elektronegatiwiteit Symbol/ Simbool Approximate relative atomic mass/ Benaderde relatiewe atoommassa 29 1,9 Cu 63.5																		
2,1 1 H 1	1,0 3 Li 7	1,5 4 Be 9											2,0 5 B 11	2,5 6 C 12	3,0 7 N 14	3,5 8 O 16	4,0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1,5 13 Al 27	1,8 14 Si 28	2,1 15 P 31	2,5 16 S 32	3,0 17 Cl 35,5	18 Ar 40	
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1,5 22 Ti 48	1,6 23 V 51	1,6 24 Cr 52	1,5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1,6 31 Ga 70	1,8 32 Ge 73	2,0 33 As 75	2,4 34 Se 79	2,8 35 Br 80	36 Kr 84	
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1,4 40 Zr 91	1,8 41 Nb 92	1,8 42 Mo 96	1,9 43 Tc 98	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1,7 49 In 115	1,8 50 Sn 119	1,9 51 Sb 122	2,1 52 Te 128	2,5 53 I 127	54 Xe 131	
0,7 55 Cs 133	0,9 56 Ba 137	1,6 57 La 139	1,6 72 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	1,8 81 Tl 204	1,8 82 Pb 207	1,9 83 Bi 209	2,0 84 Po 209	2,5 85 At 210	86 Rn 222	
0,7 87 Fr 223	0,9 88 Ra 226	89 Ac																
			58 Ce 140	59 Pr 141	60 Nd 144	61 Pm 147	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 231	92 U 238	93 Np 237	94 Pu 244	95 Am 243	96 Cm 247	97 Bk 247	98 Cf 251	99 Es 252	100 Fm 257	101 Md 288	102 No 289	103 Lr 262		

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARDREDUKSIEPOTENSIALE

Half-reactions/Halfreaksies	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
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 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
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 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
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	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
$Al^{3+} + 3e^- \rightleftharpoons Al$	- 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

Increasing oxidising ability/Toenemende oksiderende vermoë

Increasing reducing ability/Toenemende reducerende vermoë

TABLE 4B: STANDARD REDUCTION POTENTIALS
 TABEL 4B: STANDAARDREDUKSIEPOTENSIALE

Half-reactions/Halfreaksies	$E^{\ominus}$ (V)
$\text{Li}^+ + \text{e}^- \rightleftharpoons \text{Li}$	-3,05
$\text{K}^+ + \text{e}^- \rightleftharpoons \text{K}$	-2,93
$\text{Cs}^+ + \text{e}^- \rightleftharpoons \text{Cs}$	-2,92
$\text{Ba}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ba}$	-2,90
$\text{Sr}^{2+} + 2\text{e}^- \rightleftharpoons \text{Sr}$	-2,89
$\text{Ca}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ca}$	-2,87
$\text{Na}^+ + \text{e}^- \rightleftharpoons \text{Na}$	-2,71
$\text{Mg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mg}$	-2,36
$\text{Al}^{3+} + 3\text{e}^- \rightleftharpoons \text{Al}$	-1,66
$\text{Mn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mn}$	-1,18
$\text{Cr}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cr}$	-0,91
$2\text{H}_2\text{O} + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^-$	-0,83
$\text{Zn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Zn}$	-0,76
$\text{Cr}^{3+} + 3\text{e}^- \rightleftharpoons \text{Cr}$	-0,74
$\text{Fe}^{2+} + 2\text{e}^- \rightleftharpoons \text{Fe}$	-0,44
$\text{Cr}^{3+} + \text{e}^- \rightleftharpoons \text{Cr}^{2+}$	-0,41
$\text{Cd}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cd}$	-0,40
$\text{Co}^{2+} + 2\text{e}^- \rightleftharpoons \text{Co}$	-0,28
$\text{Ni}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ni}$	-0,27
$\text{Sn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Sn}$	-0,14
$\text{Pb}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pb}$	-0,13
$\text{Fe}^{3+} + 3\text{e}^- \rightleftharpoons \text{Fe}$	-0,06
$2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2\text{e}^- \rightleftharpoons \text{Sn}^{2+}$	+0,15
$\text{Cu}^{2+} + \text{e}^- \rightleftharpoons \text{Cu}^+$	+0,16
$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightleftharpoons 4\text{OH}^-$	+0,40
$\text{SO}_2 + 4\text{H}^+ + 4\text{e}^- \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^+ + \text{e}^- \rightleftharpoons \text{Cu}$	+0,52
$\text{I}_2 + 2\text{e}^- \rightleftharpoons 2\text{I}^-$	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2\text{O}_2$	+0,68
$\text{Fe}^{3+} + \text{e}^- \rightleftharpoons \text{Fe}^{2+}$	+0,77
$\text{NO}_3^- + 2\text{H}^+ + \text{e}^- \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^+ + \text{e}^- \rightleftharpoons \text{Ag}$	+0,80
$\text{Hg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Hg}(\ell)$	+0,85
$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^- \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\ell) + 2\text{e}^- \rightleftharpoons 2\text{Br}^-$	+1,07
$\text{Pt}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pt}$	+1,20
$\text{MnO}_2 + 4\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^+ + 4\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$	+1,36
$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + \text{e}^- \rightleftharpoons \text{Co}^{2+}$	+1,81
$\text{F}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{F}^-$	+2,87

Increasing oxidising ability/Toenemende oksiderende vermoë

Increasing reducing ability/Toenemende reducerende vermoë



PREPARATORY EXAMINATION

VOORBEREIDENDE EKSAMEN

2025

MARKING GUIDELINES

NASIENRIGLYNE

10842

PHYSICAL SCIENCES: CHEMISTRY
FISIESE WETENSKAPPE: CHEMIE

(PAPER/VRAESTEL 2)

11 pages/*bladsye*

QUESTION/VRAAG 1

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

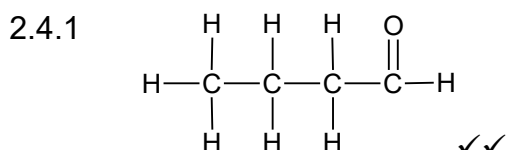
[20]**QUESTION/VRAAG 2**

- 2.1.1 Ketone/Ketoon ✓ (1)
- 2.1.2 Haloalkane ✓ or alkyl halide/*Haloalkane of alkielhalied* (1)
- 2.2 1-bromo-3-chloro-4-methylpentane/
1-bromo-3-chloro-4-metielpentaaan ✓✓✓ (3)

Marking criteria/Nasienriglyne:

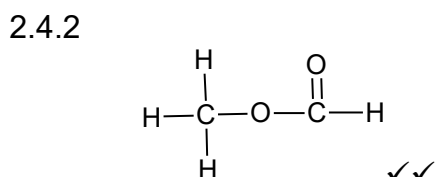
- Correct stem (pentane) ✓/*korrekte stamnaam (pentaan)*
- All substituents (chloro, bromo and methyl) were correctly identified. ✓/*alle substituenten (chloro, bromo en metiel) is korrek geïdentifiseer*
- IUPAC name is completely correct including numbering, sequence, hyphens and commas. ✓/*IUPAC naam is heeltemal korrek insluitend nommering, volgorde, koppelteken en kommas*

- 2.3 A ✓ (1)

**Marking criteria/Nasienriglyne:**

- Functional group **-COH** on the first carbon ✓/*Funksionele groep -COH op die eerste koolstof*
- Correct whole structure ✓/*Korrekte volledige struktuur*

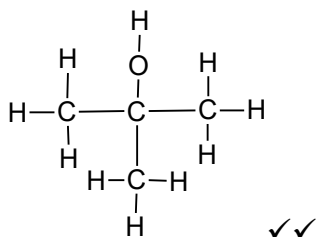
(2)

**Marking criteria/Nasienriglyne:**

- Functional group **-COOC-** ✓/*Funksionele groep -COOC-*
- Correct whole structure ✓/*Korrekte volledige struktuur*

(2)

2.4.3

**Marking criteria/Nasienriglyne:**

- Correct stem – 3 carbons ✓ / *Korrekte stam- 3 koolstowwe*
- Functional group **-OH** and a methyl on the second carbon ✓ the O must be bonded on the C / *Funksionele groep -OH en metielgroep op tweede koolstof, die O moet op die C gebind wees*

(2)

2.5

Unsaturated indicates a multiple bond between two C atoms. ✓
 This compound has an oxygen atom, hydrocarbons do not have an Oxygen.
 ✓

Onversadig dui aan om meervoudige bindings tussen C atome.

Hierdie verbinding het 'n suurstofatoom, koolwaterstowwe moet nie 'n suurstof hê nie.

(2)

2.6.1

E ✓

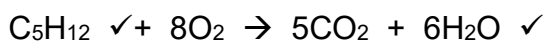
(1)

2.6.2

A ✓

(1)

2.7



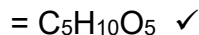
✓ balancing/balansering

(3)

2.8

Empirical formula/*Empiriese formule* = CH_2O Molar mass/*Molêre massa* = $150 \text{ g}\cdot\text{mol}^{-1}$ $M(\text{CH}_2\text{O}) = 30 \text{ g}\cdot\text{mol}^{-1}$ Molecular formula/*Molekulêre formule* = ?

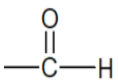
$$\frac{150}{30} \checkmark = 5$$

Molecular formula/*Molekulêre formule* = $5 \times \text{CH}_2\text{O}$ 

(2)

[21]

QUESTION/VRAAG 3

- 3.1 The temperature at which the vapour pressure of a substance equals atmospheric pressure. ✓✓/ (2 or 0)
Die temperatuur waarby die dampdruk van die stof gelyk is aan atmosferiese druk. (2)
- 3.2 Different homologous series ✓ OR organic compounds with different functional groups
Verskillende homoloë reekse OF organiese verbindings met verskillende funksionele groepe (1)
- 3.3
- Both B and C have dipole-dipole forces. ✓
 - A has London forces. ✓
 - The intermolecular forces in C are stronger than those in B and the weakest in A. ✓
 - Therefore, C will require more energy to overcome the forces between the molecules than in B or A. ✓
- *Beide B en C het dipool-dipoolkragte.*
 • *A het London kragte.*
 • *Die intermolekulêre kragte in C is sterker as dié in B en die swakste in A.*
 • *Daarom sal C meer energie benodig om die kragte tussen die molekules te oorkom as in B of A.* (4)
- 3.4 **Marking criteria/Nasienkriteria**
 Do not accept if the reason is given as inversely proportional.
Moet nie aanvaar indien die rede gegee word as omgekeerd eweredig nie.
- D ✓
 The highest boiling point (will have the lowest vapour pressure). ✓
OR
 D has the strongest intermolecular forces and will need the most energy to weaken the intermolecular forces.
OR
 D has the highest number of particles present in the vapour phase.
- Die hoogste kookpunt (sal die laagste dampdruk hê).*
OF
D het die sterkste intermolekulêre kragte en sal dus die meeste energie benodig om die intermolekulêre kragte te verswak.
OF
D het die hoogste getal deeltjies in die dampfase. (2)
- 3.5.1 Liquid/Vloeistof ✓ (1)
- 3.5.2  ✓ (1)
- 3.5.3 2-Butanone OR butan-2-one OR butanone ✓/ 2-butanoon OF butan-2-oon OF butanoon NO marks for but-2-one *GEEN punte vir but-2-oon* (1)

[12]

QUESTION/VRAAG 4

4.1.1 Esterification OR Condensation/Verestering/Esterifikasie/Kondensasie ✓ (1)

4.1.2 Addition/Addisie✓

Accept: bromination/halogenation

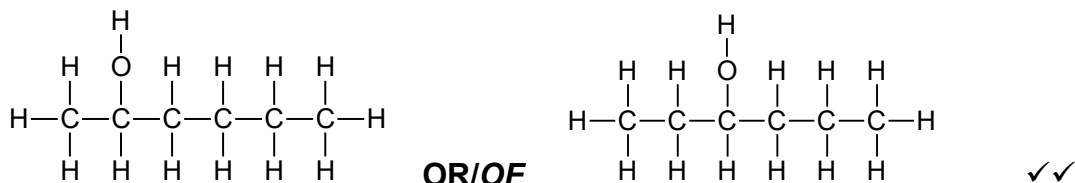
Aanvaar: brominering/halogenering (1)

4.1.3 Elimination/Eliminasie ✓

Accept: dehydration

Aanvaar: dehidrasie (1)

4.2

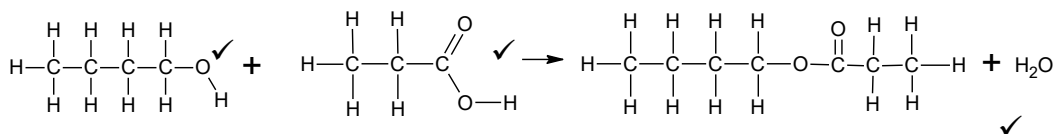


Marking criteria/Nasienriglyne:

- Correct stem – six carbons ✓ /Korrekte stam – ses koolstowwe
- Functional group -OH on the 2nd or 3rd carbon/funksionele groep-OH op die 2de of 3de koolstof ✓

(2)

4.3



butan-1-ol / 1-butanol ✓ propanoic acid ✓

butan-1-ol / 1-butanol propaansuur ✓

do not accept butanol/moenie butanol aanvaar nie

Marking criteria/Nasienriglyne:

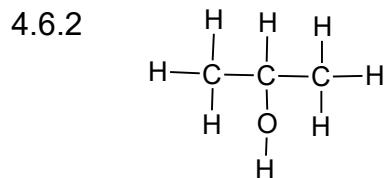
- Whole structure correct for butan-1-ol ✓ /Korrekte volledige struktuur vir butan-1-ol
- Correct name reactant 1/Korrekte naam reaktant 1
- Whole structure correct for propanoic acid ✓ /Korrekte volledige struktuur vir propaansuur
- Correct name reactant 2/Korrekte naam reaktant 2
- Whole structure correct for ester ✓ /Korrekte volledige struktuur vir ester
- Correct formula for water/Korrekte formule vir water

(6)

4.4 To act as a catalyst/Dit dien as 'n katalisator ✓ (1)

4.5 Hydroxyl (group) /Hidroksiel(groep) ✓ (1)

4.6.1 Water and a strong acid (suphuric acid/phosphoric acid) ✓
Water en 'n sterk suur (swawelsuur/fosforsuur) (1)



Marking criteria/Nasienriglyne:

- Functional group **-OH** on the 2nd carbon ✓/*Funksionele groep -OH op die 2de koolstof*
- Correct whole structure ✓/*Korrekte volledige struktuur*

(2)

4.6.3 Hydration/*Hidrasie* ✓ (1)

4.6.4 By using their different boiling points. ✓/*deur gebruik te maak van die verskillende kookpunte.* (1)

[18]

QUESTION/VRAAG 5

5.1 The energy absorbed or released in a chemical reaction. ✓✓ (2 or 0)
Die energie geabsorbeer of vrygestel in 'n chemiese reaksie. (2)

5.2.1 The concentration (of the sodium thiosulfate/ $\text{Na}_2\text{S}_2\text{O}_3$.) ✓/*Konsentrasie* (van die natriumtiosulfaat/ $\text{Na}_2\text{S}_2\text{O}_3$) (1)

5.2.2 Average rate of reaction/*Gemiddelde tempo van reaksie*

$$= \frac{0,080}{35}$$

$$= 0,0023 \text{ (mol} \cdot \text{dm}^{-3} \cdot \text{s}^{-1})$$
 (2,3x10⁻³) (3)

5.2.3 The sulphur/sulfur ✓ that forms is a solid and covers the visibility of the cross/ Precipitate is formed/murky solution
Die swawel wat vorm is 'n vaste stof en bedek die sigbaarheid van die kruis/ neerslag vorm/deinserige oplossing/ondeursigtige oplossing (1)

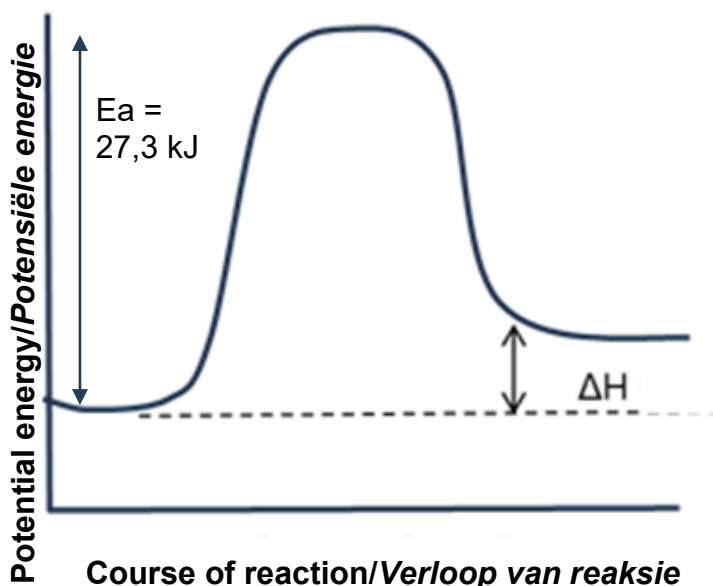
5.2.4

- As the concentration increases, the number of particles per unit volume increases ✓
- More effective collisions per unit time ✓
- The rate of reaction increase ✓
- Soos die konsentrasie toeneem, neem die aantal deeltjies per volume-eenheid toe
- Meer effektiewe botsings vind per tydseenheid plaas
- Die reaksietempo neem toe

(3)

- 5.3.1 The minimum energy needed for a reaction to take place. ✓✓ (2 OR 0)
Die minimum energie benodig vir 'n reaksie om plaas te vind. (2)

5.3.2



Marking criteria/Nasienkriteria:

- The shape is endothermic. ✓/Die vorm is endotermies
- Axes labelled correctly AND E_a (Activation energy) or ΔH indicated ✓if time on x-axis no marks /Asse korrek benoem EN E_a (aktiveringsenergie) ΔH aangedui / indien tyd op x-as geen punte

(2)
[14]

QUESTION/VRAAG 6

- 6.1.1 It is a dynamic equilibrium when the rate of the forward reaction is equal to the rate of the reverse reaction. ✓✓
Dit is 'n dinamiese ewewig wanneer die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie. (2)

- 6.1.2 According to Le Chatelier's principle:
- An increase in temperature favours the endothermic reaction ✓
 - The reverse reaction will be favoured ✓
 - The colour of the solution changes to yellow ✓

Volgens Le Chatelier se beginsel:

- 'n Toename in temperatuur bevoordeel die endotermiese reaksie
 - Die terugwaartse reaksie sal bevoordeel word
 - Die kleur van die oplossing word geel
- (3)

6.1.3 Increases ✓

- Adding concentrated HCl increases the concentration of the common ion H^+ , the system will react to decrease the concentration of the H^+ ions by favouring the forward reaction ✓
- More dichromate ions form, the colour of the solution changes to orange. ✓

Verhoog

- *Die byvoeging van gekonsentreerde HCl verhoog die konsentrasie van die gemeenskaplike H^+ ioon, die sisteem sal reageer om die konsentrasie van die H^+ ione te verlaag deur die voorwaartse reaksie te bevoordeel.*
- *Meer dichromaatione vorm, die kleur van die oplossing word oranje* (3)

6.2.1

$$K_c = \frac{[CO_2]}{[CO]^2} \quad \checkmark$$

$$K_c = \frac{(1,21 \times 10^{-3})}{(1,1 \times 10^{-2})^2} \quad \checkmark$$

$$K_c = 10$$

Since the $K_{c \text{ new}} = K_{c \text{ original}}$ therefore the system is in equilibrium. ✓ K_c value remains the same

Aangesien die $K_{c \text{ nuwe}} = K_{c \text{ oorspronklike}}$ is die sisteem in ewewig/ K_c waarde bly dieselfde (3)

6.2.2

Marking criteria

- (a) Substitution of concentration into K_c expression. ✓
- (b) n at equilibrium ✓
- (c) Calculating the change in mole of CO ✓
- (d) Using the mole ratio of $2CO:1CO_2$. ✓
- (e) Calculating the new initial n of CO_2 ✓
- (f) subtracting mol ✓
- (g) final answer ✓

Nasienkriteria:

- (a) *Vervanging van konsentrasie in K_c uitdrukking*
- (b) *n by ewewig*
- (c) *bereken die verandering in mol van CO*
- (d) *gebruik die mol verhouding van $2CO:1CO_2$.*
- (e) *bereken die nuwe aanvanklike n van CO_2*
- (f) *af trek van mol*
- (g) *finale Antwoord*

OPTION 1/OPSIE 1

$$K_c = \frac{[CO_2]}{[CO]^2}$$

$$10 = \frac{(x)}{(x)^2} \quad \checkmark \quad \text{(a)}$$

$$x = 0,1$$

$$\therefore [CO_2] = [CO] = 0,1 \text{ mol} \cdot \text{dm}^{-3}$$

(7)

	2CO	CO ₂
$n_{\text{initial}}/n_{\text{aanvanklik}}$	$1,1 \times 10^{-2}$	$1,445 \times 10^{-1} \checkmark$ (e)
$\Delta n_{\text{change}}/\Delta n_{\text{verandering}}$	$0,089 \checkmark$ (c)	$0,0445 \checkmark$ (ratio) (d)
$n_{\text{equilibrium}}/n_{\text{ewewig}}$	0,1	0,1 $\checkmark$ (b)
$C_{\text{equilibrium}}/C_{\text{ewewig}}$	x	x

$$\begin{aligned}
 n_{\text{added}}/\text{bygevoeg} &= n_{\text{new initial}}/\text{nuwe aanvanklik} - n_{\text{original mole at eq}}/\text{oorspronklike mol by ew.} \\
 &= 1,445 \times 10^{-1} - 1,21 \times 10^{-3} \checkmark \text{ (f)} \\
 &= 0,143 \text{ mol } \checkmark \text{ (g)}
 \end{aligned}$$

OPTION 2/OPSIE 2

	CO	CO ₂
Ratio	2	1
n_i	$1,1 \times 10^{-2}$	$1,21 \times 10^{-3} + x$
Δn	$1,1 \times 10^{-2} + 2y$	$1,21 \times 10^{-3} + x - y$
n_f	0,1	0,1
$c = n/V$	0,1	0,1

$$\begin{aligned}
 1,1 \times 10^{-2} + 2y &= 0,1 \\
 2y &= 0,089 \\
 y &= 0,0445 \text{ mol} \\
 1,21 \times 10^{-3} + x - y &= 0,1 \\
 1,21 \times 10^{-3} + x - 0,0445 &= 0,1 \\
 x &= 0,14329 \text{ mol added}
 \end{aligned}$$

[18]

QUESTION/VRAAG 7

- 7.1.1 A concentrated sodium hydroxide solution contains a large amount of base particles as compared to the water particles ✓
'n Gekonsentreerde natriumhidroksiedoplossing bevat 'n groot hoeveelheid basisdeeltjies in verhouding met die volume waterdeeltjies. (1)

- 7.1.2 Decreases. ✓
 Since hydroxide ions increase, ✓ the hydronium decreases because K_w is constant ✓
Neem af.
Omdat die hidroksiedione toeneem moet die hidronium ione verminder aangesien K_w konstant is (3)

- 7.1.3
- | | |
|---|--|
| <p>OPTION 1/OPSIE 1</p> <p>$\text{pH} = -\log[\text{H}_3\text{O}^+] \quad \checkmark \text{ or } [\text{H}_3\text{O}^+] = 10^{-\text{pH}}$</p> <p>$12 \checkmark = -\log[\text{H}_3\text{O}^+]$</p> <p>$[\text{H}_3\text{O}^+] = 1 \times 10^{-12}$</p> <p>$\therefore K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$
 $= 1 \times 10^{-14} \checkmark$</p> <p>$[\text{OH}^-] = \frac{1 \times 10^{-14}}{1 \times 10^{-12}}$</p> <p>$[\text{OH}^-] = 1 \times 10^{-2} \text{ mol. dm}^{-3} \checkmark$</p> | <p>OPTION 2/OPSIE 2</p> <p>$\text{pH} + \text{pOH} = 14$
 $12 + \text{pOH} = 14 \checkmark$
 $\text{pOH} = 2$</p> <p>$\text{pOH} = -\log[\text{OH}^-] \checkmark$
 $2 \checkmark = -\log[\text{OH}^-]$</p> <p>$[\text{OH}^-] = 1 \times 10^{-2} \text{ mol. dm}^{-3} \checkmark$</p> |
|---|--|
- (4)

- 7.2.1 Average/Gemiddeld = $\frac{20,05 + 20,15 + 20,10}{3}$
 $= 20,10 \text{ cm}^3 \checkmark (0,0201 \text{ dm}^3)$ (1)

- 7.2.2 **POSITIVE MARKING FROM 7.2.1/POSITIEWE NASIEN VANAF 7.2.1**

OPTION 1/OPSIE 1

$$\begin{aligned} n_{\text{HCl}} &= cV \\ &= 0,0958 (0,0201) \checkmark \\ &= 1,92558 \times 10^{-3} \text{ mol} \end{aligned}$$

since/aangesien $n_{\text{NaOH}} : n_{\text{HCl}}$
 $= 1 : 1 \checkmark$

$$\therefore n_{\text{NaOH}} = 1,92558 \times 10^{-3}$$

$$\begin{aligned} \therefore c_{\text{NaOH}} &= \frac{n}{V} \checkmark \\ &= \frac{1,92558 \times 10^{-3}}{0,02} \checkmark \\ &= 0,0963 \text{ mol. dm}^{-3} \end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned} \frac{c_1 V_1}{c_2 V_2} &= \frac{n_1}{n_2} \\ \frac{(0,0958)(20,1)}{c_2 (20)} &= \frac{1}{1} \\ c_2 &= 0,0963 \text{ mol. dm}^{-3} \end{aligned}$$

Marking criteria:

- (a) Calculating mol of HCl
 (b) Use ratio
 (c) Formula mark for $c_{\text{NaOH}} = \frac{n}{V}$
 (d) Substitution of correct values

(4)

Nasienkriteria:

- (a) Bereken mol HCl
 (b) Gebruiksverhouding
 (c) Formulepunt $c_{\text{NaOH}} = \frac{n}{V}$
 (d) Vervanging van korrekte waardes

7.2.3 $n_{\text{NaOH used/gebruik}} = cV$
 $= 0,0963 (0,02445) \checkmark$
 $= 2,354 \times 10^{-3} \text{ mol}$

Ratio $n_{\text{NaOH}} : n_{\text{H}_3\text{PO}_4}$
 $3 : 1 \checkmark$ $\rightarrow \therefore n_{\text{H}_3\text{PO}_4 \text{ used/gebruik}} = \frac{2,354 \times 10^{-3}}{3}$
 $= 7,848 \times 10^{-4} \text{ mol}$
 in 10 cm^3 of solution/oplossing $\checkmark$

$\therefore n_{\text{H}_3\text{PO}_4} \text{ in } 250 \text{ cm}^3 \text{ of solution/oplossing}$
 $= \frac{250}{10} (7,848 \times 10^{-4}) \checkmark$
 $= 0,01962 \text{ mol}$

$\therefore m = nM$
 $= 0,01962(98) \checkmark$
 $= 1,92276 \text{ g}$

$\therefore \% \text{ purity/suiwerheid} = \frac{1,92276}{10} \times 100 \% \checkmark$
 $= 19,23 \% \checkmark$

(Range/Reeks 19,11 – 19,30)

(7)
 [20]

QUESTION/VRAAG 8

- 8.1 (i) Mg/magnesium rod/magnesiumstaaf $\checkmark$
 (ii) Cu/copper rod/koperstaaf $\checkmark$
 (iii) MgSO_4 /magnesium sulphate solution/magnesiumsulfaatoplossing $\checkmark$
 (iv) CuSO_4 /copper(II)sulphate solution/koper(II)sulfaatoplossing $\checkmark$ (4)

- 8.2 $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu} \checkmark \checkmark$
 -1 mark if double arrow used/-1 indien dubbelpyle gebruik is (2)

- 8.3 $E^\circ_{\text{cell/sel}} = E^\circ_{\text{cathode/katode}} - E^\circ_{\text{anode/anode}} \checkmark$ (any one of the three as on data sheet)
 $= +0,34 \checkmark - (-2,36) \checkmark$
 $= 2,7 \text{ V} \checkmark$ (4)

- 8.4 The salt bridge completes the circuit $\checkmark$ **OR**
It maintains the electrical neutrality of the two solutions by providing a pathway for the ions to be exchanged. **OR** separates the two half cells
Die soutbrug voltooi die stroombaan **OF**
Dit handhaaf die elektriese neutraliteit van die twee oplossings deur 'n pad te verskaf vir die ione om uitgeruil te word. **OF** skei die twee halfselle (1)

- 8.5.1 DECREASE/VERLAAG $\checkmark \checkmark$ (2)

- 8.5.2 REMAINS THE SAME/BLY DIESELFDE $\checkmark$ (1)
 [14]

QUESTION/VRAAG 9

- 9.1 A substance whose aqueous solution contains ions OR a substance that dissolves in water to form a solution that conducts electricity. ✓✓

'n Stof waarvan die oplossing in water ione bevat OF 'n Stof wat in water oplos om 'n oplossing te vorm wat elektrisiteit gelei.

(2)

- 9.2 Copper(II)sulfate or copper(II)chloride solution or any other copper(II) solution /koper(II)sulfaat of koper(II)chloride of enige ander koper(II) oplossing ✓

(1)

- 9.3 $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$ ✓✓

-1 mark if double arrow used/-1 indien dubbelpyle gebruik is

(2)

- 9.4 Silver/Ag is a weaker reducing agent ✓ than copper, ✓ and silver will not be oxidised at the anode. ✓

OR

Copper is a stronger reducing agent than silver and silver will not be oxidised at the anode.

Silwer/Ag is 'n swakker reduseermiddel as koper, en daarom sal silwer sal nie by die anode geoksideer word nie.

OF

Koper is 'n sterker reduseermiddel as silwer en daarom sal silwer nie by die anode geoksideer word nie.

(3)

- 9.5

If Cu^{2+} is used/As Cu^{2+} gebruik word

$$\begin{aligned} n_{\text{Cu}} &= \frac{m}{M} \checkmark \\ &= \frac{1,6}{63,5} \checkmark \\ &= 0,02519 \text{ mol} \end{aligned}$$

Since 1 Cu atom gives off 2e^- /Aangesien 1 Cu-atoom 2e^- afgee

$$\begin{aligned} \therefore n_{\text{e}^-} &= 0,02519 (2) \checkmark \\ &= 0,05039 \text{ mol} \end{aligned}$$

$$\begin{aligned} n &= \frac{N}{N_A} \\ N &= (0,05039)(6,02 \times 10^{23}) \checkmark \\ &= 3,034 \times 10^{22} \text{ electrons/elektrone } \checkmark \end{aligned}$$

Marking criteria:

- ✓ formula for calculating n
- ✓ substitution of molar mass 63,5
- ✓ mole ratio used
- ✓ substitution of N_A in formula
- ✓ final answer

Nasienkriteria:

- ✓ formule vir die berekenin van n
- ✓ vervanging van molêre massa van 63,5
- ✓ mol verhouding gebruik
- ✓ vervanging van N_A in formule
- ✓ finale antwoord

(5)

[13]

TOTAL/TOTAAL:

150



LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

**PHYSICAL SCIENCES: CHEMISTRY (P2)
SEPTEMBER 2025**

MARKS: 150

TIME: 3 hours

This question paper consists of 17 pages, 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and surname (and centre number if applicable) in the appropriate spaces on the ANSWER BOOK/ANSWER SHEET.
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. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Leave ONE line between two sub questions, e.g. between QUESTION 2.1 and QUESTION 2.2.
7. Number the answers correctly according to the numbering system used in this question paper.
8. Data sheets are attached for your use.
9. Wherever motivations, discussions, et cetera are required, be brief.
10. Show ALL formulae and substitutions in ALL calculations.
11. Write neatly and legibly.

QUESTION1: MULTIPLE CHOICE QUESTIONS

Four possible options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the correct answer and write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK, e.g. 1.11 E

1.1 Which one of the following compounds is unsaturated hydrocarbon?

- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- B. $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- C. $\text{CH}_3\text{CH}_2\text{CHCHCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- D. $\text{CH}_3\text{C}(\text{CH}_3)_2\text{C}(\text{CH}_3)_2\text{CH}_3$

(2)

Which of the following is the functional group for ketones?

- 1.2
- A. Carbonyl group.
 - B. Carboxyl group.
 - C. Formyl group.
 - D. Hydroxyl group.

(2)

Which of the following pairs of organic compounds are chain isomers?

- 1.3
- A. Butane and methyl butane.
 - B. Hexane and 2,2 – dimethyl butane.
 - C. 2 – methyl pentane and 3 – methyl pentane.
 - D. Pentanoic acid and methylbutanoate.

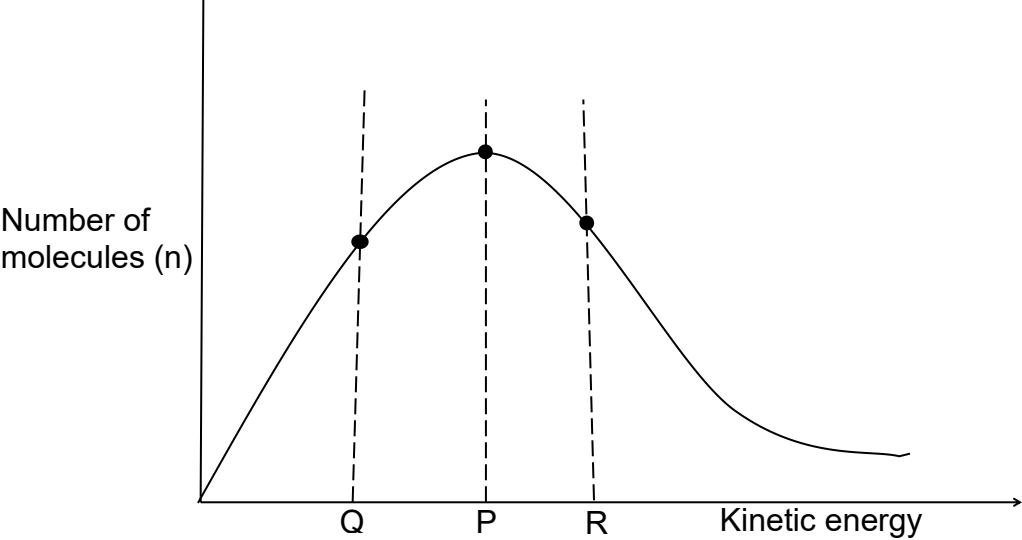
Which one of the following compounds is a product of the cracking of octane?

- 1.4
- A. CH_2CH_2 .
 - B. $\text{CH}_3\text{CH}_2\text{Cl}$
 - C. $\text{CH}_3\text{CH}_2\text{Br}$
 - D. CH_3CHO

(2)

1.5

The Boltzman distribution curve for a certain gas at constant temperature is shown below:



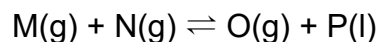
If the temperature of the gas is REDUCED by 20⁰C, the shape of the graph changes.

What happens to the values of n for the kinetic energies Q, P and R?

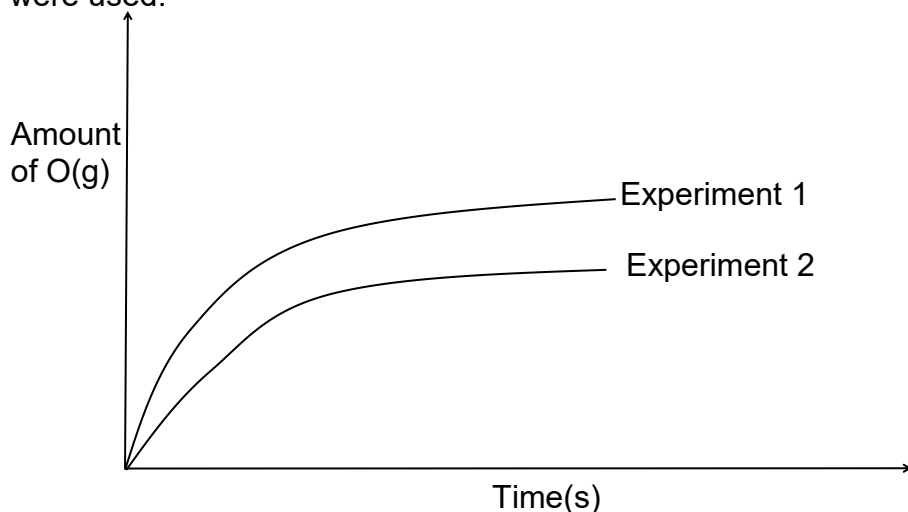
	Q	P	R
A	Higher.	Lower.	Higher.
B	Higher.	Lower.	Lower.
C	Lower.	Higher.	Lower.
D	Lower.	Lower.	Lower.

(2)

1.6 Consider the following hypothetical reversible reaction below:



Two experiments in which the production of O was measured were carried out. The results are shown in the graph below. The same initial amounts of M and N were used.



What change in the conditions can explain the results shown?

- A. A lower pressure was used in experiment 2.
- B. A catalyst was used in experiment 2.
- C. A higher temperature was used in experiment 2.
- D. A lower temperature was used in experiment 2.

(2)

1.7 Which of the following statements is/are true regarding the equivalence point of a reaction between ethanoic acid and sodium hydroxide?

(i) It is the point where the acid and the base have reacted so that neither is in excess.

(ii) $[\text{H}_3\text{O}^+] = [\text{OH}^-]$

(iii) $\text{pH} = 7$

- A. (i) only.
- B. (i) and (ii).
- C. (i), (ii) and (iii).
- D. (ii) and (iii).

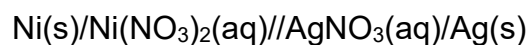
(2)

- 1.8 A beaker contains a dilute solution of hydrochloric acid. A second beaker contains a solution of sodium hydroxide. Water is added to EACH solution. What happens to the pH of each solution?

	Hydrochloric acid solution	Sodium hydroxide solution
A	Decreases.	Increases.
B	Increases.	Decreases.
C	Decreases.	Decreases.
D	Increases.	Increases.

(2)

- 1.9 Consider the galvanic cell represented by the cell notation below:

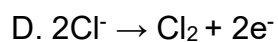
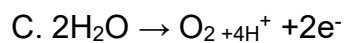
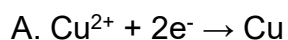


Which one of the following describes the movement of ions between the two half cells?

	Positive ions	Negative ions
A	From Ni to Ag.	From Ni to Ag.
B	From Ni to Ag.	From Ag to Ni.
C	From Ag to Ni.	From Ag to Ni.
D	From Ag to Ni.	From Ni to Ag.

(2)

- 1.10 Which ONE of the half reactions below will occur at the POSITIVE electrode during the electrolysis of $\text{CuCl}_2(\text{aq})$?



(2)

[20]

QUESTION 2

The table below represents organic compounds. Study the table and answer the questions that follow.

A	HCHO	B	CH ₃ -CHBr-CH ₂ -C(CH ₃) ₃
C	C(CH ₃) ₄	D	CH ₃ (CH ₂) ₂ CHCH ₂
E	C _x H _y	F	Methyl propanoate

- 2.1 Define the term chain isomer. (2)
- 2.2 Write down the:
- 2.2.1 Letter that represents a chain isomer of pentane. (1)
- 2.2.2 IUPAC name of compound **B**. (3)
- 2.2.3 IUPAC name of compound **D**. (2)
- 2.2.4 GENERAL FORMULA of the homologous series to which compound **D** belongs. (1)
- 2.3 Draw a STRUCTURAL FORMULA of compound **F**. (2)
- 2.4 Write down a balanced equation, using MOLECULAR FORMULAE, for the complete combustion of compound **C**. (3)
- 2.5 To which homologous series does **A** belongs? (1)
- 2.6 Compound **E** is an alkane with an extra 20% of C-atoms than compound **C**. Determine the values of X and Y. (4)

[19]

QUESTION 3

The melting and boiling points of the first four straight-chain alkanes are compared under the same conditions.

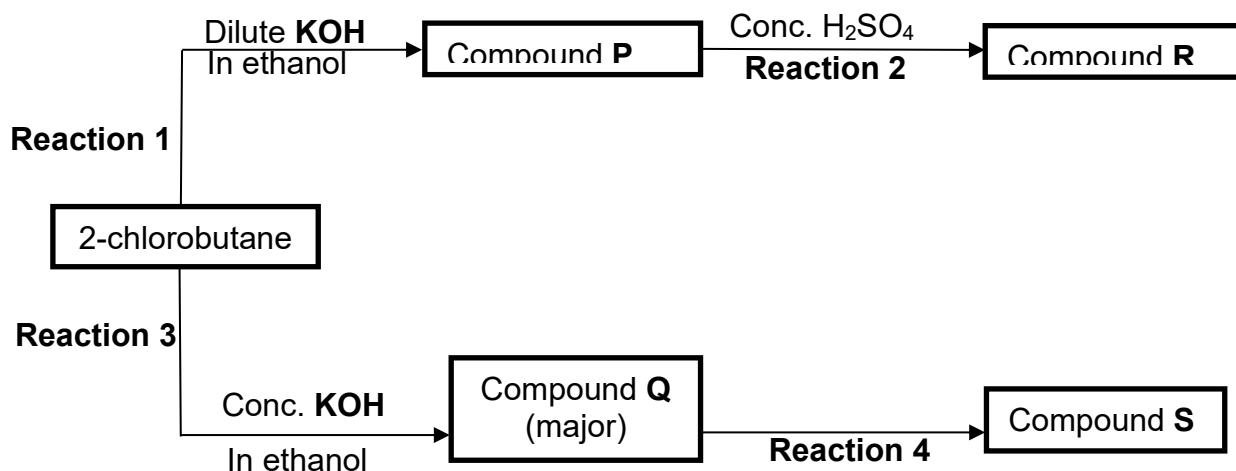
Number of C atoms	Name	Melting point	Boiling point
1	Methane	-183	-162
2	Ethane	-172	-89
3	Propane	-186	-42
4	Butane	-136	0

- 3.1 Define the term melting point. (2)
- 3.2 What CONCLUSION can be drawn from data in the table? (2)
- 3.3 How will the strength of intermolecular forces butane compare to its isomer? Write only STRONGER THAN, WEAKER THAN or EQUAL TO. (1)
- 3.4 Is this comparison fair or unfair? Give a reason to your answer. (2)
- 3.5 In which phase will propane be at room temperature? Write only GAS, LIQUID or SOLID. (1)
- 3.6 Explain the difference in boiling point between ethane and propane. (3)

[11]

QUESTION 4

The flow diagram below shows different organic reactions. Compounds P, Q, R and S are organic compounds.



4.1 **Reaction 1**, Write down:

4.1.1 The TYPE of reaction. (1)

4.1.2 IUPAC name of compound P. (2)

4.2 Consider **reaction 2**.

4.2.1 Write down the STRUCTURAL formula of compound R. (2)

4.2.2 Apart from concentrated sulphuric acid, what is the other condition for this reaction to take place? (1)

4.3 For **reaction 3**, write down:

4.3.1 A balanced equation using STRUCTURAL FORMULAE for this reaction. (5)

4.3.2 The IUPAC name of compound Q. (2)

4.4 **Reaction 4:** compound S is an alkane. Write down the:

4.4.1 TYPE of reaction. (1)

4.4.2 NAME or FORMULA of a catalyst needed for this reaction (1)

4.5 Compound S, can undergo cracking under certain conditions.

4.5.1 Define the term cracking. (2)

4.5.2 Except for high temperature and high pressure, what is the other condition required for compound S to undergo cracking? (1)

[18]

QUESTION 5

Roloids is a tablet which contains calcium carbonate as one of the active ingredients. A pharmacist wants to determine the rate of reaction between stomach acid and Roloids. He performs an experiment using calcium carbonate powder and concentrated hydrochloric acid of concentration $0,1\text{mol/dm}^3$. He then performs the same experiment using a lump of calcium carbonate of the same mass as the powder. The reaction takes place according to the following chemical equation:



- 5.1 Define the term rate of reaction. (2)
- 5.2 What type of reaction takes place between the Roloids tablet and hydrochloric acid? (1)
- 5.3 The pharmacist repeated the same experiment using the same mass of calcium carbonate lumps. Which factor affecting the rate of reaction is the pharmacist investigating? (1)
- 5.4 What is the dependent variable for the investigation? (1)
- 5.5 In the second experiment 53cm^3 of carbon dioxide was produced in one minute. Calculate the average rate of reaction in mol.s^{-1} . (5)

[10]**QUESTION 6**

- 6.1 The following reaction is one of the steps in the production of sulphuric acid:



- 6.1.1 Define the term chemical equilibrium. (2)
- 6.1.2 In an industry, they mix a certain moles x of sulphur dioxide with $0,5\text{ mol}$ of oxygen gas. The reaction proceeds until equilibrium is reached in a 2dm^3 container. Upon analysis of the equilibrium mixture it was discovered that a quarter ($\frac{1}{4}$) of the initial number of moles of oxygen remains. The K_c value for this reaction is 10. Calculate the initial number of moles of sulphur dioxide that was in the container. (8)

6.1.3 Calculate the mass of sulphur dioxide that was sealed in the container. (3)

6.2 Certain changes were made to the equilibrium conditions. What effect will they have on the yield of SO_3 ? Write only INCREASES, DECREASES or STAYS THE SAME.

6.2.1 Increase in temperature. (1)

6.2.2 Catalyst added. (1)

6.2.3 Pressure decreased. Use Le Chatelier's principle to explain your choice. (3)

[18]

QUESTION 7

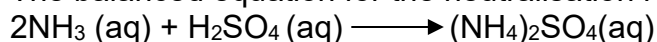
Ammonia is a weak base found in many household cleaning products.

7.1 Define the term weak base. (2)

In an attempt to determine the concentration of ammonia in a local carpet cleaner, Thabo added 20 cm^3 of the carpet cleaner to a 250 cm^3 volumetric flask and added water up to the 250 cm^3 mark. $31,2 \text{ cm}^3$ of this solution was neutralised by 25 cm^3 of sulphuric acid of concentration $0,02 \text{ mol} \cdot \text{dm}^{-3}$

7.2 Calculate the concentration of hydroxide ions, OH^- , in the acid. (4)

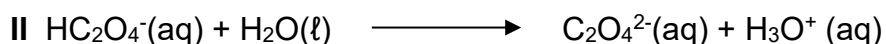
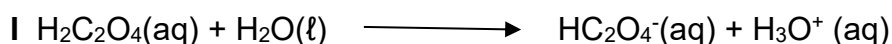
The balanced equation for the neutralisation reaction is;



7.3.1 Calculate the concentration of ammonia in the household cleaner. (7)

7.3.2 At the equivalence point the pH of the mixture is not 7. State whether the pH is ABOVE 7 or BELOW 7 and explain your answer using a relevant equation. (4)

7.4 A diprotic weak acid ionises in water in two steps as shown in the two equations shown below.



7.4.1 Define the term ampholyte. (2)

From the above reactions, write down the formulae of the:

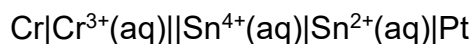
7.4.2 Ampholyte. (1)

7.4.3 Two acids in equation I. (2)

[22]

QUESTION 8

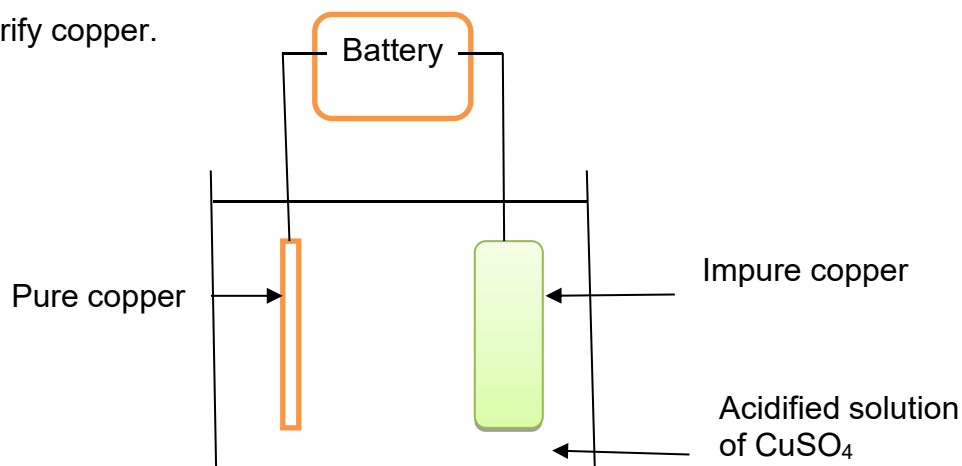
A galvanic cell is set up under standard conditions as represented by the cell notation below.



- 8.1 Define the term galvanic cell. (2)
- 8.2 Write down the standard conditions under which this cell operates. (2)
- 8.3 Write down the formula of the:
- 8.3.1 Cathode. (1)
- 8.3.2 Reducing agent. (1)
- 8.4 What is the total concentration of tin ions in the electrolyte of the Sn half-cell? (1)
- 8.5 Write down a balanced equation for the net cell reaction. (3)
- 8.6 Calculate the initial Emf of the cell. (4)
- 8.7 How does an increase in the initial concentration of Cr^{3+} ions affect the voltmeter reading? Write only INCREASES, DECREASES or REMAINS THE SAME (1)

[16]**QUESTION 9**

Copper metal of very high purity is required to manufacture electrical copper cables. The diagram below shows an electrochemical cell used to purify copper.



- 9.1 Define the term electrolysis. (2)

- 9.2 Write down a balanced equation for the anode half reaction. (2)
- 9.3 Which electrode is the positive electrode of the cell? Write only PURE COPPER or IMPURE COPPER. (1)
- 9.4 The impure copper contains zinc, silver, gold and nickel as impurities
- 9.4.1 Identify one impurity that may be oxidised. (1)
- 9.4.2 Explain your answer to 9.3.1 (2)
- 9.4.3 State what happens to the impurities that are not oxidised. (1)

A current was passed through the solution for a certain period of time. The electrodes were weighed before and after electrolysis. The results are shown in the table below.

	Mass of impure copper(g)	Mass of pure copper(g)
Before electrolysis	600	150
After electrolysis	390	320

- 9.5 Use the information in the table to calculate the percentage purity of the impure copper. (4)
- 9.6 What happens to the concentration of the electrolyte during the process? Explain your answer. (3)

[16]

TOTAL: 150

**NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT**

**DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)
GEGEWENS VIR FISIESTE WETENSKAPPE GRAAD 12**

VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS / TABEL 1: FISIESTE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^θ	273 K
Charge on electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro se konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE / TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$	$n = \frac{V}{V_M}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at/by } 298 \text{ K}$	
$E_{\text{cell}}^\theta = E_{\text{cathode}}^\theta - E_{\text{anode}}^\theta / E_{\text{sel}}^\theta = E_{\text{katode}}^\theta - E_{\text{anode}}^\theta$ Or/of $E_{\text{cell}}^\theta = E_{\text{reduction}}^\theta - E_{\text{oxidation}}^\theta / E_{\text{sel}}^\theta = E_{\text{reduksie}}^\theta - E_{\text{oksidasie}}^\theta$ Or/of $E_{\text{cell}}^\theta = E_{\text{oxidising agent}}^\theta - E_{\text{reducing agent}}^\theta / E_{\text{sel}}^\theta = E_{\text{oksideer middel}}^\theta - E_{\text{reduseer middel}}^\theta$	

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TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABEL 3: 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)
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	

KEY/SLEUTEL

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

29
Cu
63,5

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TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

Half-reactions/ <i>Halfreaksies</i>	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
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 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
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 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
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	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
$Al^{3+} + 3e^- \rightleftharpoons Al$	- 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

Increasing oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*

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TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD REDUKSIEPOTENSIALE

Half-reactions/ <i>Halfreaksies</i>	E^{θ} (V)
$\text{Li}^{+} + \text{e}^{-} \rightleftharpoons \text{Li}$	-3,05
$\text{K}^{+} + \text{e}^{-} \rightleftharpoons \text{K}$	-2,93
$\text{Cs}^{+} + \text{e}^{-} \rightleftharpoons \text{Cs}$	-2,92
$\text{Ba}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ba}$	-2,90
$\text{Sr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sr}$	-2,89
$\text{Ca}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ca}$	-2,87
$\text{Na}^{+} + \text{e}^{-} \rightleftharpoons \text{Na}$	-2,71
$\text{Mg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mg}$	-2,36
$\text{Al}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Al}$	-1,66
$\text{Mn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}$	-1,18
$\text{Cr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,91
$2\text{H}_2\text{O} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^{-}$	-0,83
$\text{Zn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Zn}$	-0,76
$\text{Cr}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,74
$\text{Fe}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,44
$\text{Cr}^{3+} + \text{e}^{-} \rightleftharpoons \text{Cr}^{2+}$	-0,41
$\text{Cd}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cd}$	-0,40
$\text{Co}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Co}$	-0,28
$\text{Ni}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ni}$	-0,27
$\text{Sn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}$	-0,14
$\text{Pb}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pb}$	-0,13
$\text{Fe}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,06
$2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}^{2+}$	+0,15
$\text{Cu}^{2+} + \text{e}^{-} \rightleftharpoons \text{Cu}^{+}$	+0,16
$\text{SO}_4^{2-} + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cu}$	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^{-} \rightleftharpoons 4\text{OH}^{-}$	+0,40
$\text{SO}_2 + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^{+} + \text{e}^{-} \rightleftharpoons \text{Cu}$	+0,52
$\text{I}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{I}^{-}$	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{O}_2$	+0,68
$\text{Fe}^{3+} + \text{e}^{-} \rightleftharpoons \text{Fe}^{2+}$	+0,77
$\text{NO}_3^{-} + 2\text{H}^{+} + \text{e}^{-} \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^{+} + \text{e}^{-} \rightleftharpoons \text{Ag}$	+0,80
$\text{Hg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Hg}(\ell)$	+0,85
$\text{NO}_3^{-} + 4\text{H}^{+} + 3\text{e}^{-} \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\ell) + 2\text{e}^{-} \rightleftharpoons 2\text{Br}^{-}$	+1,07
$\text{Pt}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pt}$	+1,20
$\text{MnO}_2 + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^{+} + 6\text{e}^{-} \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{Cl}^{-}$	+1,36
$\text{MnO}_4^{-} + 8\text{H}^{+} + 5\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + \text{e}^{-} \rightleftharpoons \text{Co}^{2+}$	+1,81
$\text{F}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{F}^{-}$	+2,87

Increasing oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*



LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES FINAL AMMENDED MARKING GUIDELINES PREPARATORY 2025

MARKS: 150

TIME: 3 Hours

This Marking Guidelines consist of 10 pages including the cover page

QUESTION 1

- 1.1 C✓✓ (2)
- 1.2 A✓✓ (2)
- 1.3 B✓✓ (2)
- 1.4 A✓✓ (2)
- 1.5 B✓✓ (2)
- 1.6 A✓✓ (2)
- 1.7 A✓✓ remove for Afrikaans due to translation error. (2)
- 1.8 B✓✓ (2)
- 1.9 B✓✓ (2)
- 1.10 D✓✓ (2)

[20]**QUESTION 2**

- 2.1 Chain isomers are compounds with the same molecular formula but different types of chains. ✓✓ (2)
- 2.2.1 C✓ (1)
- 2.2.2 4 – bromo – 2,2 – dimethylpentane✓✓✓
- Notes:**

 1. Bromo, dimethyl identified✓
 2. Pentane✓
 3. Whole structure correct✓
- (3)
- 2.2.3 Pent – 1 – ene✓✓
- Notes:**

 1. Correct functional group✓
 2. Whole structure correct✓
- (2)
- 2.2.4 C_nH_{2n} ✓ (1)
- 2.3
-
- Notes:**

 1. Correct functional group✓
 2. Whole structure correct✓
- (2)
- 2.4 $C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$ ✓ (✓balance) (3)
- 2.5 Aldehydes✓ (1)

2.6 $20\% \text{ C} - \text{atoms in comp. } C = \frac{20}{100} \times 5 \checkmark$
 $= 1 \checkmark$

Compound E has 6 C – atoms

$\therefore x = 6 \checkmark$ and $y = 14 \checkmark$ **OR** ($x = 6 \checkmark \checkmark$ and $y = 14 \checkmark \checkmark$) (4)

[19]

QUESTION 3

- 3.1 Melting point is the temperature at which the solid and the liquid phases of a substance are at equilibrium. $\checkmark \checkmark$ (2)
- 3.2 As the chain length/molar mass/number of carbon atoms increases, the boiling/melting point increases. $\checkmark \checkmark$ (2)
- 3.3 Stronger than. $\checkmark$ (1)
- 3.4 Fair. $\checkmark$ The compounds belong to the same homologous/intermolecular force/functional group/there is only one independent variable. $\checkmark$ (2)
- 3.5 Gas. $\checkmark$ (1)
- 3.6
- Propane has a longer chain length/larger/ surface area/ bigger molecular size/more carbon atoms than ethane. $\checkmark$
 - Both have London forces/dispersion/dipole-dipole which are stronger between propane molecules than in ethane. $\checkmark$ /the intermolecular forces of propane are stronger
 - More energy is needed to overcome the intermolecular force in propane than in ethane. $\checkmark$

OR

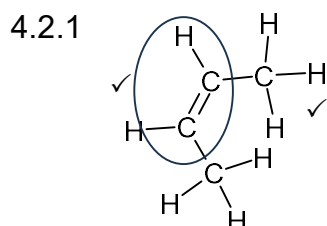
- Ethane has shorter chain length/smaller surface area/smaller molecular size/less carbon atoms than propane. $\checkmark$
- Both have London forces/dispersion/dipole-dipole which are weaker between ethane molecules than in propane. $\checkmark$
- Less energy is needed to overcome the intermolecular forces in ethane than in propane. $\checkmark$ (3)

[11]

QUESTION 4

4.1.1 Substitution/hydrolysis✓ (1)

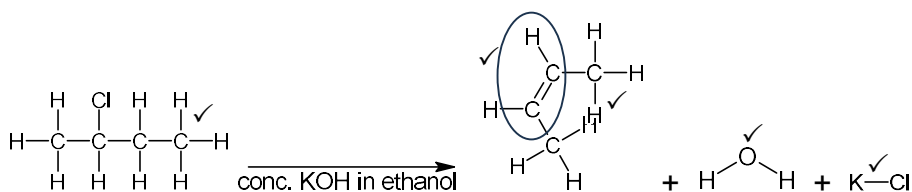
4.1.2 Butan – 2 – ol✓✓ Accept 2-butanol (1 mark for butanol, 1 mark for position) (2)

**Notes:**

1. Correct functional group✓
2. Whole structure correct✓

4.2.2 (Strong) Heat✓ (1)

4.3.1



(5)

4.3.2 **Positive marking form 4.3.1**

But-2-ene.✓✓ /Accept 2-Butene (1 mark for butene, 1 mark for position) (2)

4.4.1 Addition/hydrogenation.✓ (1)

4.4.2 Ni/Pt/Pd/Nickel/Platinum/Palladium.✓ (1)

4.5.1 Cracking is the chemical process in which longer chain hydrocarbon molecules are broken down to shorter more useful molecules.✓✓ (2)

4.5.2 Catalyst (Pt, Pd and Ni).✓ (1)

[18]

QUESTION 5

5.1 Rate of reaction is the change in concentration of reactants or products per unit time.✓✓ (2)

5.2 Neutralisation reaction.✓/Acid-base reaction (1)

5.3 State of division/surface area.✓ (1)

5.4 Rate of reaction.✓ (1)

$$\begin{aligned} 5.5 \quad n(\text{CO}_2) &= \frac{v}{V_m} \checkmark \\ &= \frac{53}{22\,400} \checkmark \\ &= 0,002366 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{HCl}) &= \frac{2(0,002366)}{22\,400} \checkmark \\ &= 0,004732 \text{ mol} \end{aligned}$$

$$\begin{aligned} \text{Rate} &= \frac{\Delta n}{\Delta t} \checkmark \\ &= \frac{0,004732}{60} \checkmark \\ &= 0,0000789 \text{ mol.s}^{-1} / (7,89 \times 10^{-5} \text{ mol.s}^{-1}) \checkmark \end{aligned}$$

(5)

[10]

QUESTION 6

6.1.1 Chemical equilibrium is a dynamic equilibrium when the rate of the forward reaction equals to the rate of the reverse reaction.✓✓ (2)

6.1.2

	SO ₂	O ₂	SO ₃	
Ratio	2	1	2	
Initial amount(mol)	x	0,5	0	
Change	-0,75	-0,375✓	0,75	✓Ratio
Equilibrium	x - 0,75	0,125✓	0,75	
Concentration	$\frac{x - 0,75}{2}$	0,0625	0,375	✓ ÷ 2

$$K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]} \checkmark$$

$$10 \checkmark = \frac{(0,375)^2}{\left(\frac{x-0,75}{2}\right)^2 (0,0625)} \checkmark$$

$$x = 1,70 \text{ mol} \checkmark \quad (8)$$

6.1.3 **Positive marking from 6.1.2**

$$n = \frac{m}{M} \checkmark$$

$$1,70 = \frac{m}{64} \checkmark$$

$$\therefore m = 108,8\text{g} \checkmark \quad (3)$$

6.2.1 Decreases.✓ (1)

6.2.2 Stays the same.✓ (1)

6.2.3 Decreases.✓ A decrease in pressure favours the reaction that produces more moles of gas/more volume.✓ The reverse reaction is favoured.✓ (3)

[18]

QUESTION 7

7.1 A weak base is a base that ionises/dissociates incompletely in water to form a low concentration of hydroxide ions.✓✓ (2)

7.2 **Option 1:**

$$[\text{H}_3\text{O}^+] = 2 \times 0,02\checkmark = 0,04 \text{ mol.dm}^{-3}$$

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-]\checkmark$$

$$1 \times 10^{-14} = 0,04 [\text{OH}^-]\checkmark [\text{OH}^-] = 2,5 \times 10^{-13} \text{ mol.dm}^{-3}\checkmark$$

Option 2:

$$\text{pH} = -\log[\text{H}_3\text{O}^+]\checkmark$$

$$= -\log(0,04) \checkmark$$

$$= 1,398$$

$$\text{pH} + \text{pOH} = 14$$

$$1,398 + \text{pOH} = 14\checkmark$$

$$\text{pOH} = 12,602$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$12,602 = -\log[\text{OH}^-]$$

$$[\text{OH}^-] = 2,50 \times 10^{-13} \text{ mol.dm}^{-3}\checkmark$$

(4)

$$7.3.1 \quad n(\text{H}_2\text{SO}_4) = cv \checkmark$$

$$= (0,02)(0,025) \checkmark$$

$$= 0,0005 \text{ mol}$$

$$n(\text{NH}_3) = 2(0,0005) \checkmark$$

$$= 0,001 \text{ mol}$$

$$[\text{NH}_3] \text{ in diluted solution} = \frac{c}{V}$$

$$= \frac{0,001}{0,0312} \checkmark$$

$$= 0,032051 \text{ mol}$$

$$n(\text{NH}_3) \text{ in } 250 \text{ cm}^3 = cv$$

$$= 0,032051 \times 0,25 \checkmark$$

$$= 0,0080128 \text{ mol}$$

$$n(\text{NH}_3) \text{ in } 250 \text{ cm}^3 = n(\text{NH}_3) \text{ in } 20 \text{ cm}^3 \text{ of undiluted solution}$$

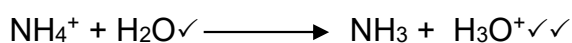
$$[\text{NH}_3] = \frac{n}{V}$$

$$= \frac{0,0080128}{0,02} \checkmark$$

$$= 0,4 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

(7)

$$7.3.2 \quad \text{Below } 7 \checkmark$$



(4)

$$7.4.1 \quad \text{An Ampholyte is a substance that can act as either an acid or a base} \checkmark \checkmark$$

(2)

$$7.4.2 \quad \text{HC}_2\text{O}_4^- \checkmark$$

(1)

$$7.4.3 \quad \text{H}_2\text{C}_2\text{O}_4 \checkmark \text{ and } \text{H}_3\text{O}^+ \checkmark$$

(2)

[22]

QUESTION 8

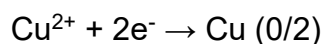
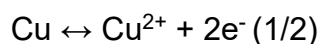
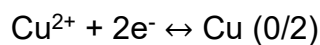
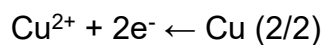
- 8.1 A galvanic cell is a cell in which chemical energy is converted to electrical energy.✓✓ (2)
- 8.2 Concentration of 1mol.dm^{-3} ✓
Temperature of $25^{\circ}\text{C}/298\text{K}$ ✓ (2)
- 8.3.1 Pt✓ (1)
- 8.3.2 Cr✓ (1)
- 8.4 2 mol.dm^{-3} ✓ (2)
- 8.5 $3\text{Sn}^{4+} + 2\text{Cr} \longrightarrow 3\text{Sn}^{2+} + 2\text{Cr}^{3+}$ ✓ (✓balancing) (3)
- 8.6 $E^{\theta}_{\text{cell}} = E^{\theta}_{\text{cathode}} - E^{\theta}_{\text{anode}}$ ✓
 $= +0,15\text{✓} - (-0,74)\text{✓}$
 $= +0,89\text{V}$ ✓ (4)
- 8.7 Decreases.✓ (1)

[16]

QUESTION 9

9.1 Electrolysis is the chemical process in which electrical energy is converted to chemical energy.✓✓ (2)

9.2 $\text{Cu} \longrightarrow \text{Cu}^{2+} + 2\text{e}^-$ ✓✓

Notes/Notas:Ignore phases/*ignoreer fases*

(2)

9.3 Impure copper.✓ (1)

9.4.1 Zinc/Nickel/Zn/Ni.✓ (1)

9.4.2 Zinc/Nickel is a stronger reducing agent✓ than copper.✓ (2)

9.4.3 They will fall to the bottom.✓ (1)

9.5 ***mass of copper + impurities = 600 – 390✓***
= 210g

mass of pure copper = 320 – 150✓
= 170g

% purity = $\frac{170}{210} \times 100$ ✓
= 80,95%✓ (4)

9.6 It remains constant.✓ The rate of oxidation of copper is equal to the rate of reduction of copper ions.✓✓ (3)

[16]**TOTAL: 150**



education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

SEPTEMBER 2025

MARKS: 150

TIME: 3 hours

This question paper consists of 14 pages and 4 data sheets.

INSTRUCTIONS AND INFORMATION

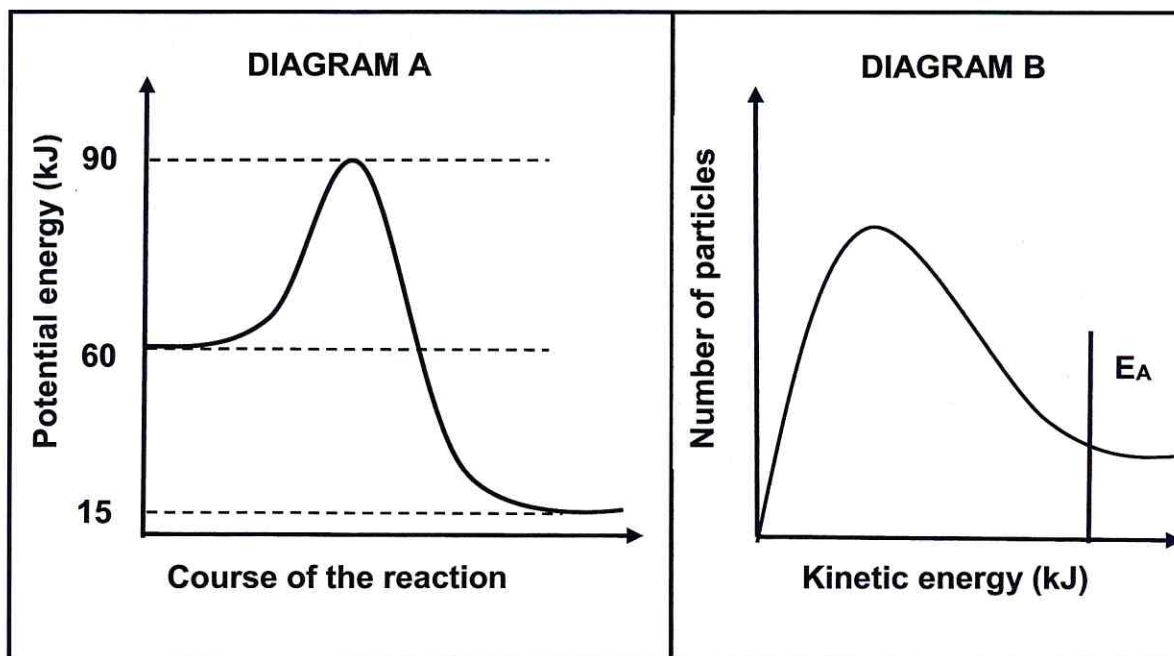
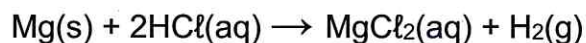
1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of NINE questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between the two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your FINAL numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, etc. where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. 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 E.

- 1.1 Which ONE of the following represents the GENERAL FORMULA for the alcohol?
- A C_nH_{2n}
- B C_nH_{2n+2}
- C $C_nH_{2n}O$
- D $C_nH_{2n+2}O$ (2)
- 1.2 Which ONE of the following organic compounds has the STRONGEST intermolecular forces?
- A CH_4
- B CH_3CH_2OH
- C CH_3COOCH_3
- D $CH_3CH_2CH_2CH_3$ (2)
- 1.3 Which ONE of the following represents the reaction of ethane with chlorine gas?
- A Addition reaction
- B Hydration reaction
- C Hydrolysis reaction
- D Substitution reaction (2)

- 1.4 Consider the following energy diagrams (not drawn to scale) for the reaction between magnesium and hydrochloric acid to investigate the factors affecting the rate of reaction.

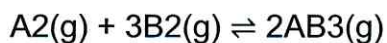


The numerical value represented by the line E_A on the diagram **B** is ...

- A 30 kJ
- B 45 kJ
- C 60 kJ
- D 90 kJ

(2)

- 1.5 Consider the following hypothetical reaction in a closed container.

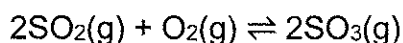


Which ONE of the following combinations is CORRECT, when the concentration of the reactants increase?

	RATE OF REACTION	EQUILIBRIUM CONSTANT (K_c)
A	Increases	increases
B	Increases	Remain constant
C	Decreases	Decreases
D	Decreases	Increases

(2)

- 1.6 Consider the following chemical reaction at equilibrium in a closed container:



The pressure is increased by decreasing the volume of the container while keeping the temperature constant.

Which ONE of the following statements CORRECTLY describes the disturbance above?

- A The forward reaction is favoured to decrease the pressure
- B The forward reaction is favoured to increase the pressure
- C The reverse reaction is favoured to increase the pressure
- D The reverse reaction is favoured to decrease the pressure (2)

- 1.7 The aqueous solution of sodium carbonate, $\text{Na}_2\text{CO}_3(\text{aq})$, turns red litmus blue.

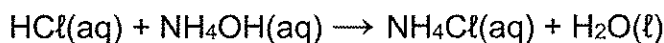
Consider the following statements:

- (i) The $[\text{H}^+]$ increases.
- (ii) The $[\text{OH}^-]$ increases.
- (iii) CO_3^{2-} reacts with water.

Which of the above statement(s) is/are TRUE?

- A (i) only
- B (i) and (ii) only
- C (i) and (iii) only
- D (ii) and (iii) only (2)

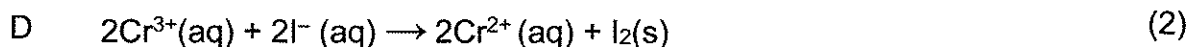
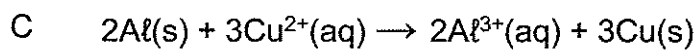
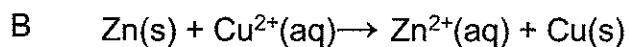
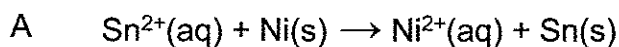
- 1.8 10 cm^3 of hydrochloric acid of concentration $0,01 \text{ mol} \cdot \text{dm}^{-3}$ is added to 10 cm^3 ammonium hydroxide of equal concentration according to the following equation:



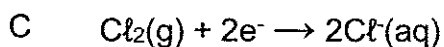
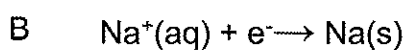
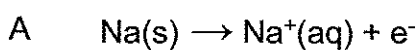
The pH of the final solution will ...

- A not change.
- B be equal to 7.
- C be lower than 7.
- D be greater than 7. (2)

1.9 Which ONE of the following reactions, when used in a voltaic cell, will give an emf of 2,00 V?



1.10 Which ONE of the half reactions below will be the reaction at the CATHODE during the electrolysis of CONCENTRATED SOLUTION of sodium chloride, $\text{NaCl}(\text{aq})$?



QUESTION 2 (Start on a new page.)

The letters **A** to **G** in the table below represent seven organic compounds.

A	$\text{CH}_3\text{CH}_2\text{COOCH}_3$	B	$\text{C}_3\text{H}_8\text{O}$
C	$ \begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & & \text{O} \\ & & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{H} \\ & & & & & & & \\ & \text{H} & & \text{H} & & \text{H} & & \end{array} $	D	3,3-difluorohexane
E	$ \begin{array}{ccccccc} & \text{CH}_3 & & \text{H} & & \text{CH}_3 & & \text{H} & & \text{H} \\ & & & & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{H} \\ & & & & & & & & & \\ & \text{Cl} & & \text{Cl} & & \text{H} & & \text{CH}_3 & & \text{CH}_3 \end{array} $	F	$\text{CH}_3(\text{CH})_2\text{CH}_2\text{CH}_3$
G	3-methylbutan-2-one		

- 2.1 Define the term *functional group*. (2)
- 2.2 Write down the STRUCTURAL FORMULA of the FUNCTIONAL GROUP to which compound **A** belongs. (1)
- 2.3 Write down the:
- 2.3.1 Letter that represents an UNSATURATED hydrocarbon (1)
- 2.3.2 IUPAC name of compound **C** (2)
- 2.3.3 IUPAC name of compound **E** (3)
- 2.3.4 STRUCTURAL FORMULA of compound **G** (2)
- 2.3.5 STRUCTURAL FORMULA of compound **D** (2)
- 2.4 **B** has two STRUCTURAL ISOMERS.
- 2.4.1 Define the term *structural isomers*. (2)
- 2.4.2 Write down the IUPAC names of these compounds. (2)
- 2.5 Write down the NAMES of any two HOMOLOGOUS SERIES that can be FUNCTIONAL ISOMERS. (2)

[19]

QUESTION 3 (Start on a new page.)

The boiling point of four straight chain organic compounds are shown in the table below.

	COMPOUND	MOLECULAR MASS (g·mol ⁻¹)	BOILING POINT (°C)
A	CH ₃ COOH	60	118
B	CH ₃ CH ₂ COOH	74	141
C	CH ₃ CH ₂ CH ₂ COOH	88	163
D	CH ₃ CH ₂ CH ₂ CH ₂ COOH	102	185

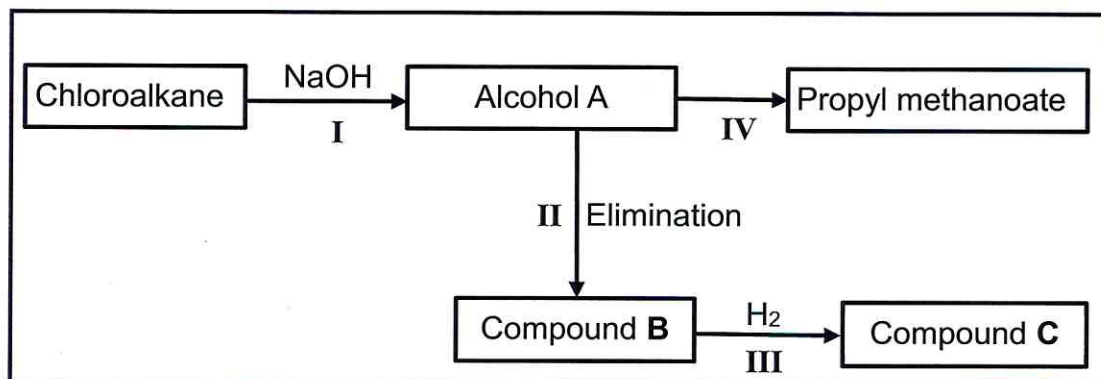
- 3.1 Define the term *boiling point*. (2)
- 3.2 Write down the:
- 3.2.1 Name of the HOMOLOGOUS SERIES to which the compounds belong (1)
- 3.2.2 Type of Van der Waals forces responsible for the higher boiling point of the organic compounds (1)
- 3.3 What is the trend of the boiling points of the compounds?
Fully explain the difference in the boiling points of the compounds. (4)
- 3.4 Which ONE of the compounds, **A**, **B** or **C**, has the lowest vapour pressure?
Explain the answer. (2)
- 3.5 Write down the IUPAC name of compound **D**. (2)
- 3.6 The boiling point of compound **D** is compared with an ESTER with the same number of carbon atoms.
Fully explain the difference in the boiling points of these compounds. (4)
- [16]**

QUESTION 4 (Start on a new page.)

The flow diagram below shows how a chloroalkane can be used to prepare other organic compounds.

A, B and C represent organic compounds.

I, II, III and IV represent four organic reactions.



Consider the reaction **I**.

4.1 Write down the:

4.1.1 TYPE of reaction (1)

4.1.2 IUPAC name of the chloroalkane (2)

4.2 Is alcohol **A** primary, secondary or tertiary?

Explain the answer. (3)

Reaction **II** is an elimination reaction.

4.3 Write down the:

4.3.1 TYPE of elimination reaction (1)

4.3.2 Balanced equation using CONDENSED STRUCTURAL FORMULAE for the reaction (3)

4.4 Write down the IUPAC name of Compound **C** formed in reaction **III**. (2)

Consider reaction **IV**.

4.5 Write down the:

4.5.1 NAME or FORMULA of the catalyst used (1)

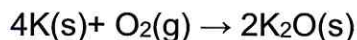
4.5.2 Balanced equation using STRUCTURAL FORMULAE (4)

[17]

QUESTION 5 (Start on a new page.)

Two experiments, I and II, are conducted to investigate one of the factors that affects the rate of reaction using the reaction between potassium, K(s) and EXCESS oxygen O₂(g) at a certain temperature.

The balanced equation for the reaction is:



The reaction conditions used for each experiment are as follows:

EXPERIMENT I

6,92 g of potassium granules react with 4,28g oxygen at 30 °C.

EXPERIMENT II

6,92 g of potassium powder react with 4,28g oxygen at 30 °C.

5.1 Define the term *reaction rate*. (2)

5.2 Write down the independent variable for the reaction. (1)

5.3 In which experiment is the reaction rate higher?

Write only Experiment I or Experiment II. (1)

5.4 Use the COLLISION THEORY to explain the answer in QUESTION 5.3. (3)

7,36 g of potassium oxide is produced when the reaction reaches its completion in EXPERIMENT II in 5,2 s.

5.5 Calculate the:

5.5.1 Average rate of production of potassium oxide in g·s⁻¹ (3)

5.5.2 Percentage purity of potassium (6)

5.6 Is ΔH for the experiments POSITIVE or NEGATIVE?

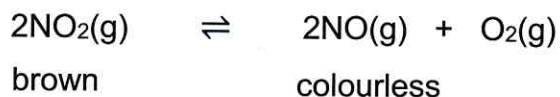
Explain the answer. (2)

[18]

QUESTION 6 (Start on a new page.)

The nitrogen dioxide, $\text{NO}_2(\text{g})$ decomposes to form Nitric oxide, $\text{NO}(\text{g})$ and oxygen, $\text{O}_2(\text{g})$ at $330\text{ }^\circ\text{C}$ in a 2 dm^3 container.

The reaction reaches equilibrium according to the balanced equation:



6.1 Define the term *chemical equilibrium*. (2)

When the container is cooled down, the reaction mixture turns brown.

6.2 Is the forward reaction EXOTHERMIC or ENDOTHERMIC? (2)

6.3 Use Le Chatelier's principle to explain the answer to QUESTION 6.2. (3)

Initially x moles of $\text{NO}_2(\text{g})$ is introduced into the container. At equilibrium the concentration of $\text{NO}_2(\text{g})$ is found to be $0,3\text{ mol}\cdot\text{dm}^{-3}$. The equilibrium constant, K_c , for the reaction at $330\text{ }^\circ\text{C}$ is $0,48$.

6.4 Calculate the initial number of moles of $\text{NO}_2(\text{g})$. (8)
[15]

QUESTION 7 (Start on a new page.)

- 7.1 A learner prepares a standard solution by dissolving 4 g of sodium hydroxide, NaOH in 500 cm³ of water.

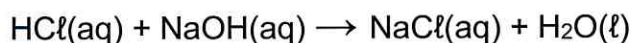
7.1.1 Define the term *standard solution*. (2)

7.1.2 Calculate the concentration of the sodium hydroxide solution. (4)

The learner uses the above standard solution to find the concentration of hydrochloric acid.

In one of the titrations exactly 30 cm³ of sodium hydroxide, NaOH neutralises 35 cm³ of hydrochloric acid, HCl.

The balanced equation for the reaction is:



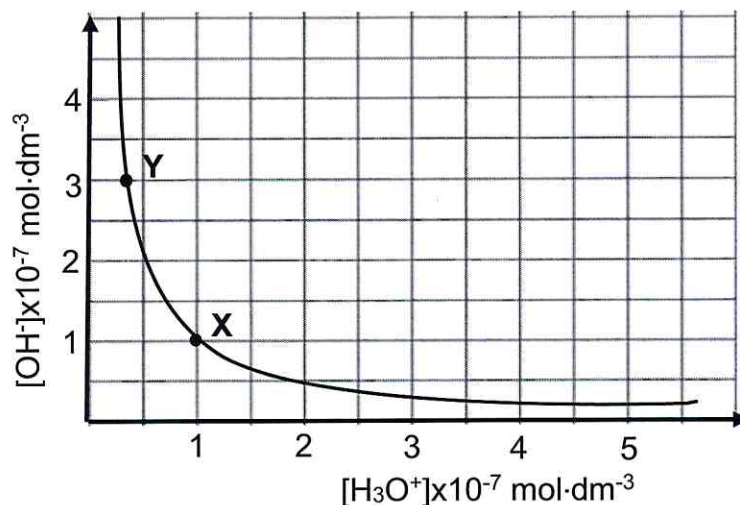
7.1.3 Calculate the concentration of HCl. (4)

7.1.4 Will the salt formed in the above reaction undergo HYDROLYSIS?

Write YES or NO.

Give a reason for the answer. (2)

- 7.2 The graph below shows pairs of H₃O⁺(aq) and OH⁻(aq) ion concentrations that can exist together at equilibrium in water at 25 °C.



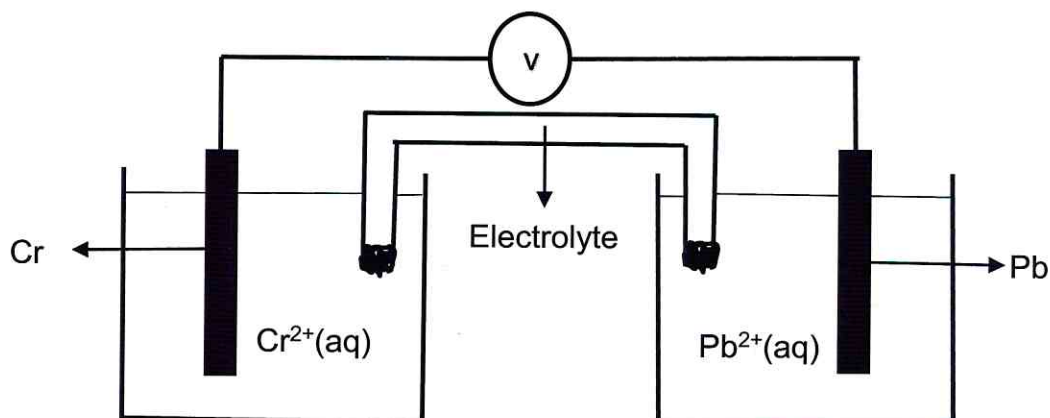
7.2.1 Is the compound at point X, ACIDIC, BASIC or NEUTRAL?

Give a reason for the answer. (2)

7.2.2 Calculate the pH of the compound at point Y. (5)
[19]

QUESTION 8 (Start on a new page.)

The electrochemical cell is set up under standard conditions using two half cells. The simplified diagram of the cell is shown below.

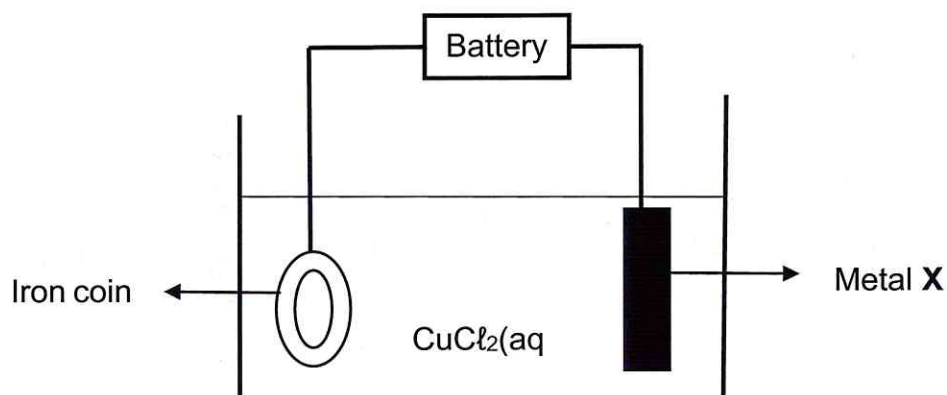


- 8.1 State the standard conditions under which the cell functions. (2)
- 8.2 Write down the NAME or FORMULA for the electrolyte used in the salt bridge. (1)
- 8.3 Define the term *cathode*. (2)
- 8.4 Write down the half reaction that takes place at the CATHODE. (2)
- 8.5 Calculate the initial emf of the cell. (4)
- 8.6 Write down the cell notation of the above cell. (3)
- 8.7 How will the concentration of Cr^{2+} be affected as the cell goes flat. Choose from INCREASE, DECREASE or REMAIN THE SAME. Give a reason for the answer. (2)

[16]

QUESTION 9 (Start on a new page.)

The simplified diagram below represents the cell used for electroplating the iron coin with metal X.



9.1 Define the term *electrolytic cell*. (2)

9.2 Write down the NAME or FORMULA of metal X. (1)

9.3 Which electrode is POSITIVE?

Write only X or coin. (2)

Give a reason for the answer. (2)

9.4 Write down the half reaction that takes place at the iron coin. (2)

The two electrodes in the above electrolytic cell are replaced with carbon electrodes.

9.5 Write down the balanced equation for the reaction that takes place in the new cell. (3)
[10]

TOTAL: 150

**DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^θ	273 K
Charge on electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro-konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a v_a}{c_b v_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at/by } 298 \text{ K}$	
$E_{\text{cell}}^\theta = E_{\text{cathode}}^\theta - E_{\text{anode}}^\theta / E_{\text{sel}}^\theta = E_{\text{katode}}^\theta - E_{\text{anode}}^\theta$ or/of $E_{\text{cell}}^\theta = E_{\text{reduction}}^\theta - E_{\text{oxidation}}^\theta / E_{\text{sel}}^\theta = E_{\text{reduksie}}^\theta - E_{\text{oksidasie}}^\theta$ or/of $E_{\text{cell}}^\theta = E_{\text{oxidising agent}}^\theta - E_{\text{reducing agent}}^\theta / E_{\text{sel}}^\theta = E_{\text{oksideermiddel}}^\theta - E_{\text{reduseermiddel}}^\theta$	

6 18 (II)	17 (VII)	18 (VIII)
8 O	9 F	10 Ne
16 S	17 Cl	18 Ar
32 Se	35,5 Br	40 Kr
34 Te	53 I	54 Xe
79 Po	85 At	86 Rn
9 m	70 Yb	71 Lu
11 d	102 No	103 Lr

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE

Increasing strength of oxidising agents/Toenemende sterkte van oksideermiddels

Half-reactions/Halfreaksies	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
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 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
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 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
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	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
$Al^{3+} + 3e^- \rightleftharpoons Al$	- 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

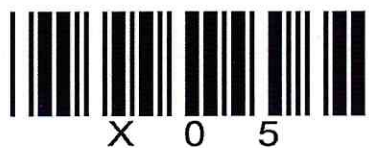
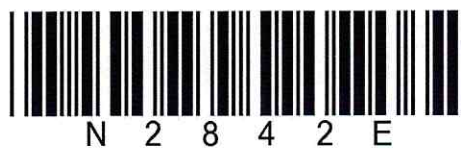
Increasing strength of reducing agents/Toenemende sterkte van reduseermiddels

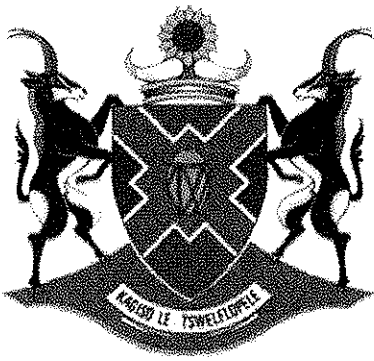
TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE

Increasing strength of oxidising agents/Toenemende sterkte van oksideermiddels

Half-reactions/Halfreaksies	E^{θ} (V)
$\text{Li}^{+} + \text{e}^{-} \rightleftharpoons \text{Li}$	-3,05
$\text{K}^{+} + \text{e}^{-} \rightleftharpoons \text{K}$	-2,93
$\text{Cs}^{+} + \text{e}^{-} \rightleftharpoons \text{Cs}$	-2,92
$\text{Ba}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ba}$	-2,90
$\text{Sr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sr}$	-2,89
$\text{Ca}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ca}$	-2,87
$\text{Na}^{+} + \text{e}^{-} \rightleftharpoons \text{Na}$	-2,71
$\text{Mg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mg}$	-2,36
$\text{Al}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Al}$	-1,66
$\text{Mn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}$	-1,18
$\text{Cr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,91
$2\text{H}_2\text{O} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^{-}$	-0,83
$\text{Zn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Zn}$	-0,76
$\text{Cr}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,74
$\text{Fe}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,44
$\text{Cr}^{3+} + \text{e}^{-} \rightleftharpoons \text{Cr}^{2+}$	-0,41
$\text{Cd}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cd}$	-0,40
$\text{Co}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Co}$	-0,28
$\text{Ni}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ni}$	-0,27
$\text{Sn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}$	-0,14
$\text{Pb}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pb}$	-0,13
$\text{Fe}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,06
$2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}^{2+}$	+0,15
$\text{Cu}^{2+} + \text{e}^{-} \rightleftharpoons \text{Cu}^{+}$	+0,16
$\text{SO}_4^{2-} + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cu}$	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^{-} \rightleftharpoons 4\text{OH}^{-}$	+0,40
$\text{SO}_2 + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^{+} + \text{e}^{-} \rightleftharpoons \text{Cu}$	+0,52
$\text{I}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{I}^{-}$	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{O}_2$	+0,68
$\text{Fe}^{3+} + \text{e}^{-} \rightleftharpoons \text{Fe}^{2+}$	+0,77
$\text{NO}_3^{-} + 2\text{H}^{+} + \text{e}^{-} \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^{+} + \text{e}^{-} \rightleftharpoons \text{Ag}$	+0,80
$\text{Hg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Hg}(\ell)$	+0,85
$\text{NO}_3^{-} + 4\text{H}^{+} + 3\text{e}^{-} \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\ell) + 2\text{e}^{-} \rightleftharpoons 2\text{Br}^{-}$	+1,07
$\text{Pt}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pt}$	+1,20
$\text{MnO}_2 + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^{+} + 6\text{e}^{-} \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{Cl}^{-}$	+1,36
$\text{MnO}_4^{-} + 8\text{H}^{+} + 5\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + \text{e}^{-} \rightleftharpoons \text{Co}^{2+}$	+1,81
$\text{F}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{F}^{-}$	+2,87

Increasing strength of reducing agents/Toenemende sterkte van reduseermiddels





education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

NASIONALE SENIOR SERTIFIKAAT

GRAAD 12

FISIESE WETENSKAPPE: CHEMIE (V2)

SEPTEMBER 2025

PUNTE: 150

TYD: 3 uur

Hierdie vraestel bestaan uit 14 bladsye en 4 gegewensblaaie.

INSTRUKSIES EN INLIGTING

1. Skryf jou naam in die toepaslike ruimte op die ANTWOORDEBOEK neer.
2. Hierdie vraestel bestaan uit NEGE vrae. Beantwoord AL die vrae in die ANTWOORDEBOEK.
3. Begin ELKE vraag op 'n NUWE bladsy in die ANTWOORDEBOEK.
4. Nommer die antwoorde korrek volgens die nommeringstelsel wat in hierdie vraestel gebruik is.
5. Laat EEN reël tussen subvrae oop, bv tussen VRAAG 2.1 en VRAAG 2.2.
6. Jy mag 'n nieprogrammeerbare sakrekenaar gebruik.
7. Jy mag wiskundige instrumente gebruik.
8. Toon ALLE formules en substitusies in ALLE berekeninge.
9. Rond jou FINALE numeriese antwoorde tot 'n minimum van TWEE desimale plekke af.
10. Gee kort (bondige) motiverings, besprekings, ens. waar nodig.
11. Jy word aangeraai om die aangehegte GEGEWENSBLAAIE te gebruik.
12. Skryf netjies en leesbaar.

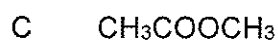
VRAAG 1: MEERVOUDIGEKEUSE-VRAE

Verskeie opsies word as moontlike antwoorde op die volgende vrae gegee. Elke vraag het slegs EEN korrekte antwoord. Kies die antwoord en skryf slegs die letter (A–D) langs die vraagnommers (1.1 tot 1.10) in die ANTWOORDEBOEK neer, bv. 1.11 E.

1.1 Watter EEN van die volgende is 'n KORREKTE ALGEMENE FORMULE vir die alkohol?



1.2 Watter EEN van die volgende organiese verbindings het die STERKSTE intermolekulêre kragte?



1.3 Watter EEN van die volgende verteenwoordig die reaksie van etaan met chloorgas?

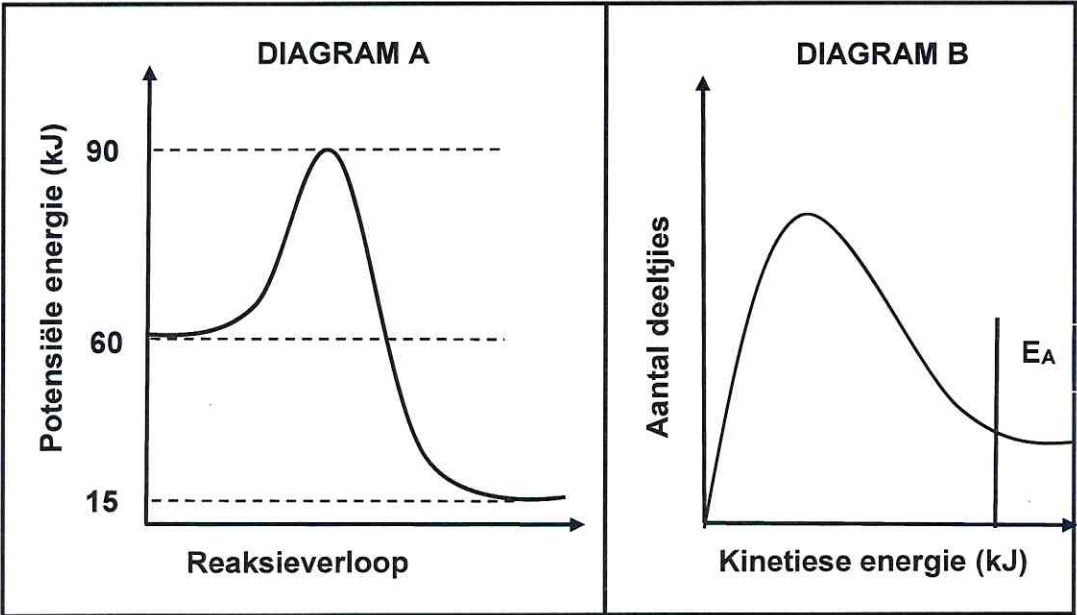
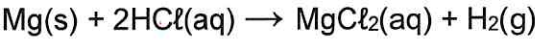
A Addisie reaksie

B Hidrasie reaksie

C Hidrolise reaksie

D Substitusie reaksie (2)

1.4 Bestudeer die volgende energie diagramme (nie volgens skaal geteken nie) vir die reaksie tussen magnesium en soutsuur om die faktore wat die reaksietempo beïnvloed te ondersoek.



Die numeriese waarde verteenwoordig deur die lyn E_A in diagram B is ...

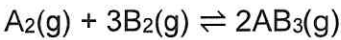
- A30 kJ

B45 kJ

C60 kJ

D90 kJ
- (2)

1.5 Bestudeer die volgende hipotetiese reaksie in 'n geslote houer.

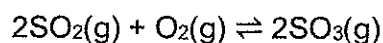


Watter EEN van die volgende kombinasies is KORREK, wanneer die konsentrasie van die reaktante verhoog word?

	REAKSIETEMPO	EWEWIGSKONSTANTE (K_c)
A	Neem toe	Neem toe
B	Neem toe	Bly konstant
C	Neem af	Neem af
D	Neem af	Neem toe

(2)

- 1.6 Beskou die volgende chemiese reaksie by ewewig in 'n geslote houer:



Die druk word verhoog deur die volume van die houer te verklein terwyl die temperatuur konstant gehou word.

Watter EEN van die volgende stellings beskryf die versteuring hierbo KORREK?

- A Die voorwaartse reaksie word bevoordeel om die druk te verlaag
- B Die voorwaartse reaksie word bevoordeel om die druk te verhoog
- C Die terugwaartse reaksie word bevoordeel om die druk te verhoog
- D Die terugwaartse reaksie word bevoordeel om die druk te verlaag (2)

- 1.7 Die waterige oplossing van natriumkarbonaat, $\text{Na}_2\text{CO}_3(\text{aq})$, verkleur rooi lakmoes blou.

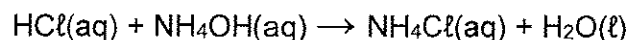
Beskou die volgende stellings:

- (i) Die $[\text{H}^+]$ neem toe.
- (ii) Die $[\text{OH}^-]$ neem toe.
- (iii) CO_3^{2-} reageer met water.

Watter van die stelling(s) hierbo is WAAR?

- A Slegs (i)
- B Slegs (i) en (ii)
- C Slegs (i) en (iii)
- D Slegs (ii) en (iii) (2)

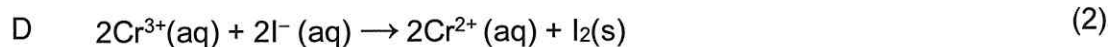
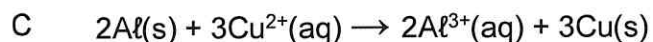
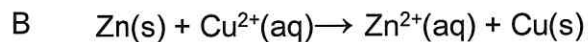
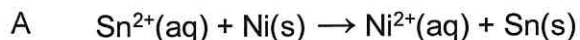
- 1.8 10 cm^3 soutsuur met 'n konsentrasie van $0,01\text{ mol}\cdot\text{dm}^{-3}$ word by 10 cm^3 ammoniumhidroksied met gelyke konsentrasie gevoeg, volgens die volgende vergelyking:



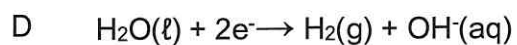
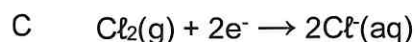
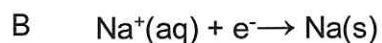
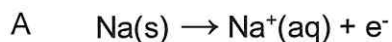
Die pH van die finale oplossing sal ...

- A nie verander nie.
- B gelyk wees aan 7.
- C laer wees as 7.
- D groter wees as 7. (2)

1.9 Watter EEN van die volgende reaksies, wanneer dit in 'n voltaïese sel gebruik word, sal 'n emk van 2,00 V lewer?



1.10 Watter EEN van die halfreaksies hieronder sal die reaksie by die KATODE wees gedurende die elektrolise van 'n GEKONSENTRIEERDE OPLOSSING van natriumchloried, $\text{NaCl}(\text{aq})$?



(2)
[20]

VRAAG 2 (Begin op 'n nuwe bladsy.)

Die letters **A** tot **G** in die tabel hieronder verteenwoordig sewe organiese verbindings.

A	$\text{CH}_3\text{CH}_2\text{COOCH}_3$	B	$\text{C}_3\text{H}_8\text{O}$
C	<pre> H H H O H - C - C - C - C - H H H H </pre>	D	3,3-difluoroheksaan
E	<pre> CH₃ H CH₃ H H H - C - C - C - C - C - H Cl Cl H CH₃ CH₃ </pre>	F	$\text{CH}_3(\text{CH})_2\text{CH}_2\text{CH}_3$
G	3-metielbutan-2-oon		

- 2.1 Definieer die term *funksionele groep*. (2)
- 2.2 Skryf die STRUKTUURFORMULE neer van die FUNKSIONELE GROEP waaraan verbinding **A** behoort. (1)
- 2.3 Skryf neer die:
- 2.3.1 Letter wat 'n ONVERSADIGDE koolwaterstof verteenwoordig (1)
- 2.3.2 IUPAC-naam van verbinding **C** (2)
- 2.3.3 IUPAC-naam van verbinding **E** (3)
- 2.3.4 STRUKTUURFORMULE van verbinding **G** (2)
- 2.3.5 STRUKTUURFORMULE van verbinding **D** (2)
- 2.4 **B** het twee STRUKTUUR ISOMERE.
- 2.4.1 Definieer die term *struktuur isomere*. (2)
- 2.4.2 Skryf die IUPAC-name van hierdie verbindings neer. (2)
- 2.5 Skryf die NAME neer van enige twee HOMOLOË REEKSE wat FUNKSIONELE ISOMERE kan wees. (2)

[19]

VRAAG 3 (Begin op 'n nuwe bladsy.)

Die kookpunt van vier reguitketting organiese verbindings word in die tabel hieronder getoon.

	VERBINDING	MOLEKULÊRE MASSA (g·mol ⁻¹)	KOOKPUNT (°C)
A	CH ₃ COOH	60	118
B	CH ₃ CH ₂ COOH	74	141
C	CH ₃ CH ₂ CH ₂ COOH	88	163
D	CH ₃ CH ₂ CH ₂ CH ₂ COOH	102	185

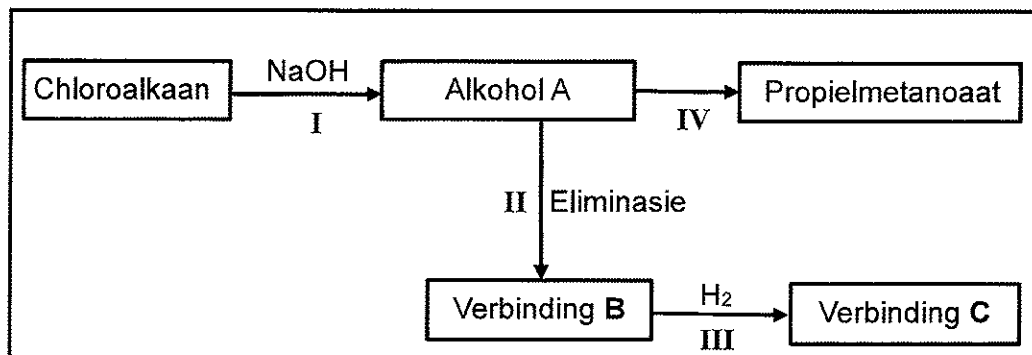
- 3.1 Definieer die term *kookpunt*. (2)
- 3.2 Skryf neer die:
- 3.2.1 Naam van die HOMOLOË REEKS waaraan die verbindings behoort (1)
- 3.2.2 Tipe Van der Waalskragte verantwoordelik vir die hoër kookpunt van die organiese verbindings (1)
- 3.3 Wat is die tendens van die kookpunte van die verbindings?
- Verduidelik volledig die verskil in die kookpunte van hierdie verbindings. (4)
- 3.4 Watter EEN van die verbindings, **A**, **B** of **C**, het die laagste dampdruk?
- Verduidelik die antwoord. (2)
- 3.5 Skryf die IUPAC-naam van verbinding **D** neer. (2)
- 3.6 Die kookpunt van verbinding **D** word vergelyk met 'n ESTER met dieselfde aantal koolstofatome.
- Verduidelik die verskil in die kookpunte van hierdie verbindings volledig. (4)
- [16]**

VRAAG 4 (Begin op 'n nuwe bladsy.)

Die vloeiagram hieronder toon hoe 'n chloroalkaan gebruik kan word om ander organiese verbindings te berei.

A, B en C verteenwoordig organiese verbindings.

I, II, III en IV verteenwoordig vier organiese reaksies.



Beskou reaksie I.

4.1 Skryf neer die:

4.1.1 TIPE reaksie (1)

4.1.2 IUPAC-naam van die chloroalkaan (2)

4.2 Is alkohol **A** primêr, sekondêr or tersiêr?

Verduidelik die antwoord. (3)

Reaksie II is 'n eliminasië reaksie.

4.3 Skryf neer die:

4.3.1 TIPE eliminasië reaksie (1)

4.3.2 Gebalanseerde vergelyking deur gebruik te maak van
GEKONSENTEERDE STRUKTUURFORMULES vir die reaksie (3)

4.4 Skryf die IUPAC-naam neer van verbinding **C** wat gevorm word in reaksie III. (2)

Beskou reaksie IV.

4.5 Skryf neer die:

4.5.1 NAAM of FORMULE van die katalisator wat gebruik is (1)

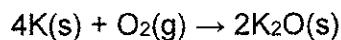
4.5.2 Gebalanseerde vergelyking deur gebruik te maak van
STRUKTUURFORMULES (4)

[17]

VRAAG 5 (Begin op 'n nuwe bladsy.)

Twee eksperimente, I en II, word uitgevoer om een van die faktore wat die reaksietempo beïnvloed te ondersoek, deur gebruik te maak van die reaksie tussen kalium, K(s) en 'n OORMAAT suurstof O₂(g) by 'n sekere temperatuur.

Die gebalanseerde vergelyking vir die reaksie is:



Die reaksietoestande vir die volgende eksperimente is soos volg:

EKSPERIMENT I

6,92 g kalium korrels reageer met 4,28 g suurstof by 30 °C.

EKSPERIMENT II

6,92 g kalium poeier reageer met 4,28 g suurstof by 30 °C.

5.1 Definieer die term *reaksietempo*. (2)

5.2 Skryf die onafhanklike veranderlike vir die reaksie neer. (1)

5.3 In watter eksperiment is die reaksietempo hoër?

Skryf slegs Eksperiment I of Eksperiment II. (1)

5.4 Gebruik die BOTSINGSTEORIE om jou antwoord op VRAAG 5.3 te verduidelik. (3)

7,36 g kaliumoksied is geproduseer wanneer die reaksie in EKSPERIMENT II volledig in 5,2 s verloop het.

5.5 Bereken die:

5.5.1 Gemiddelde tempo waarteen kaliumoksied geproduseer is, in g·s⁻¹ (3)

5.5.2 Persentasie suiwerheid van kalium (6)

5.6 Is ΔH vir die eksperimente POSITIEF of NEGATIEF?

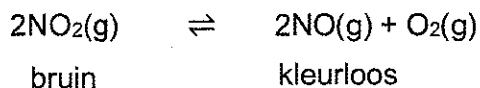
Verduidelik die antwoord. (2)

[18]

VRAAG 6 (Begin op 'n nuwe bladsy.)

Stikstofdoksied, $\text{NO}_2(\text{g})$ ontbind om stikstofoksied, $\text{NO}(\text{g})$ en suurstof, $\text{O}_2(\text{g})$ by $330\text{ }^\circ\text{C}$ in 'n 2 dm^3 houer te vorm.

Die reaksie bereik ewewig volgens die gebalanseerde vergelyking:



6.1 Definieer die term *chemiese ewewig*. (2)

Wanneer die houer afgekoel word, word die reaksiemengsel bruin.

6.2 Is die voorwaartse reaksie EKSOTERMIES of ENDOTERMIES? (2)

6.3 Gebruik Le Chatelier se beginsel om die antwoord op VRAAG 6.2 te verduidelik. (3)

Aanvanklik word $x\text{ mol NO}_2(\text{g})$ in die houer gevoeg. By ewewig is daar gevind dat die konsentrasie van $\text{NO}_2(\text{g})$ $0,3\text{ mol}\cdot\text{dm}^{-3}$ is. Die ewewigskonstante, K_c , vir hierdie reaksie by $330\text{ }^\circ\text{C}$ is $0,48$.

6.4 Bereken die aanvanklike aantal mol $\text{NO}_2(\text{g})$. (8)
[15]

VRAAG 7 (Begin op 'n nuwe bladsy.)

- 7.1 'n Leerder berei 'n standaard oplossing deur 4 g natriumhidroksied, NaOH in 500 cm³ water op te los.

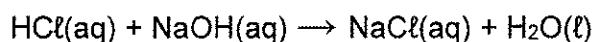
7.1.1 Definieer die term *standaard oplossing*. (2)

7.1.2 Bereken die konsentrasie van die natriumhidroksiedoplossing. (4)

Die leerder gebruik die standaard oplossing hierbo om die konsentrasie van soutsuur te bepaal.

In een van die titrasies neutraliseer presies 30 cm³ natriumhidroksied, NaOH 35 cm³ van die soutsuur, HCl.

Die gebalanseerde vergelyking vir die reaksie is:



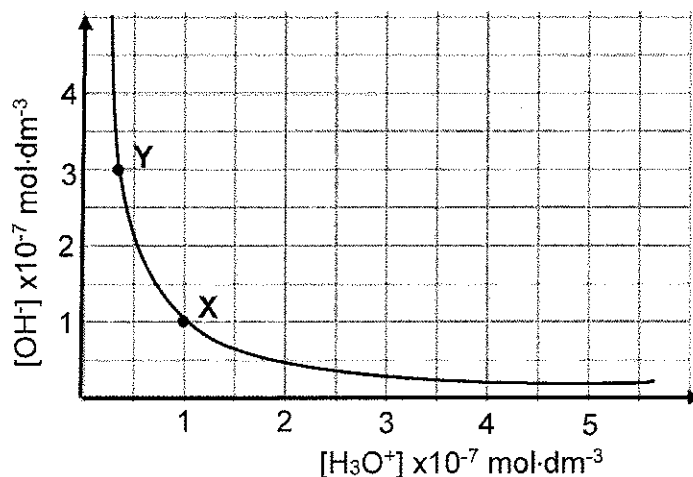
7.1.3 Bereken die konsentrasie van HCl. (4)

7.1.4 Sal die sout wat in die reaksie hierbo gevorm word HIDROLISE ondergaan?

Skryf slegs JA of NEE.

Gee 'n rede vir die antwoord. (2)

- 7.2 Die grafiek hieronder toon pare van H₃O⁺(aq) en OH⁻(aq) ioon konsentrasies wat saam kan bestaan by ewewig in water teen 25 °C.



7.2.1 Is die verbinding by punt X, SUUR, BASIES of NEUTRAAL?

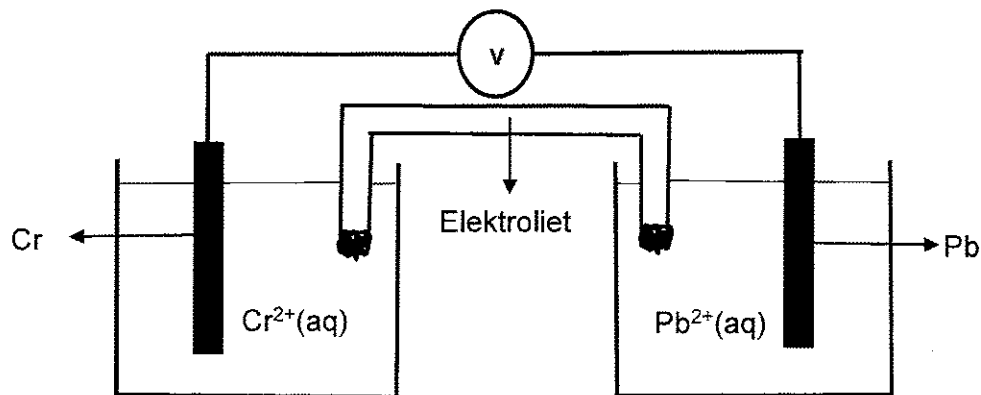
Gee 'n rede vir die antwoord. (2)

7.2.2 Bereken die pH van die verbinding by punt Y. (5)

[19]

VRAAG 8 (Begin op 'n nuwe bladsy.)

'n Elektrochemiese sel is opgestel onder standaard toestande deur gebruik te maak van twee halfselle. 'n Vereenvoudigde diagram van die sel word hieronder getoon.



- 8.1 Gee die standaard toestande waaronder die sel funksioneer. (2)
- 8.2 Skryf die NAAM of FORMULE van die elektroliet wat gebruik is in die soutbrug neer. (1)
- 8.3 Definieer die term *katode*. (2)
- 8.4 Skryf die halfreaksie neer wat by die KATODE plaasvind. (2)
- 8.5 Bereken die aanvanklike emk van die sel. (4)
- 8.6 Skryf die selnotasie van die sel hierbo neer. (3)
- 8.7 Hoe sal die konsentrasie van Cr^{2+} geaffekteer word as die sel pap word.

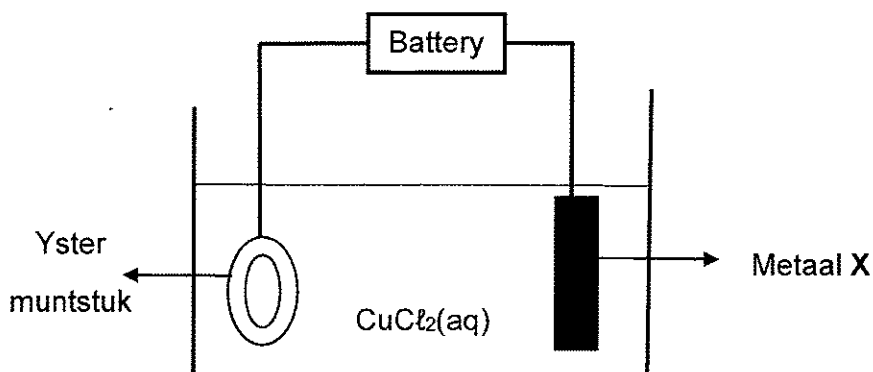
Kies uit TOENEEM, AFNEEM of DIESELFDE BLY.

Gee 'n rede vir die antwoord.

(2)
[16]

VRAAG 9 (Begin op 'n nuwe bladsy.)

Die vereenvoudigde diagram hieronder verteenwoordig die sel wat gebruik is vir die elektroplatering van die yster muntstuk met metaal X.



9.1 Definieer die term *elektrolitiese sel*. (2)

9.2 Skryf die NAAM of FORMULE van metaal X neer. (1)

9.3 Watter elektrode is POSITIEF?

Skryf slegs X of muntstuk.

Gee 'n rede vir die antwoord. (2)

9.4 Skryf die halfreaksie neer wat by die yster muntstuk plaasvind. (2)

Die twee elektrodes in die elektrolitiese sel hierbo word vervang met koolstofelektrodes.

9.5 Skryf die gebalanseerde vergelyking vir die reaksie wat in die nuwe sel plaasvind neer. (3)

[10]

TOTAAL: 150

**DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^θ	273 K
Charge on electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro-konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{C_a V_a}{C_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at/by } 298 \text{ K}$	
$E_{\text{cell}}^\theta = E_{\text{cathode}}^\theta - E_{\text{anode}}^\theta / E_{\text{sel}}^\theta = E_{\text{katode}}^\theta - E_{\text{anode}}^\theta$ or/of $E_{\text{cell}}^\theta = E_{\text{reduction}}^\theta - E_{\text{oxidation}}^\theta / E_{\text{sel}}^\theta = E_{\text{reduksie}}^\theta - E_{\text{oksidasie}}^\theta$ or/of $E_{\text{cell}}^\theta = E_{\text{oxidising agent}}^\theta - E_{\text{reducing agent}}^\theta / E_{\text{sel}}^\theta = E_{\text{oksideermiddel}}^\theta - E_{\text{reduseermiddel}}^\theta$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABEL 3: 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)
1 2,1 H																	2 4 He
3 1,0 Li	4 9 Be															9 4,0 F	10 20 Ne
11 6,9 Na	12 24 Mg															17 35,5 Cl	18 40 Ar
19 0,8 K	20 40 Ca	21 45 Sc	22 48 Ti	23 51 V	24 52 Cr	25 55 Mn	26 56 Fe	27 59 Co	28 59 Ni	29 63,5 Cu	30 65 Zn	31 70 Ga	32 73 Ge	33 75 As	34 79 Se	35 80 Br	36 84 Kr
37 0,8 Rb	38 88 Sr	39 89 Y	40 91 Zr	41 92 Nb	42 96 Mo	43 96 Tc	44 101 Ru	45 103 Rh	46 106 Pd	47 108 Ag	48 112 Cd	49 115 In	50 119 Sn	51 122 Sb	52 128 Te	53 127 I	54 131 Xe
55 133 Cs	56 137 Ba	57 139 La	72 179 Hf	73 181 Ta	74 184 W	75 186 Re	76 190 Os	77 192 Ir	78 195 Pt	79 197 Au	80 201 Hg	81 204 Tl	82 207 Pb	83 209 Bi	84 209 Po	85 210 At	86 222 Rn
87 0,7 Fr	88 226 Ra	89 227 Ac															
				58 140 Ce	59 141 Pr	60 144 Nd	61 147 Pm	62 150 Sm	63 152 Eu	64 157 Gd	65 159 Tb	66 163 Dy	67 165 Ho	68 167 Er	69 169 Tm	70 173 Yb	71 175 Lu
				90 232 Th	91 231 Pa	92 238 U	93 237 Np	94 239 Pu	95 244 Am	96 243 Cm	97 247 Bk	98 251 Cf	99 252 Es	100 252 Fm	101 257 Md	102 289 No	103 289 Lr

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE

Half-reactions/Halfreaksies	E ⁰ (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
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 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
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 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
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	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
$Al^{3+} + 3e^- \rightleftharpoons Al$	- 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

Increasing strength of oxidising agents/Toenemende sterkte van oksideermiddels

Increasing strength of reducing agents/Toenemende sterkte van reduseermiddels

TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE

Increasing strength of oxidising agents/Toenemende sterkte van oksideermiddels

Half-reactions/Halfreaksies	E^{θ} (V)
$\text{Li}^{+} + \text{e}^{-} \rightleftharpoons \text{Li}$	-3,05
$\text{K}^{+} + \text{e}^{-} \rightleftharpoons \text{K}$	-2,93
$\text{Cs}^{+} + \text{e}^{-} \rightleftharpoons \text{Cs}$	-2,92
$\text{Ba}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ba}$	-2,90
$\text{Sr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sr}$	-2,89
$\text{Ca}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ca}$	-2,87
$\text{Na}^{+} + \text{e}^{-} \rightleftharpoons \text{Na}$	-2,71
$\text{Mg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mg}$	-2,36
$\text{Al}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Al}$	-1,66
$\text{Mn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}$	-1,18
$\text{Cr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,91
$2\text{H}_2\text{O} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^{-}$	-0,83
$\text{Zn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Zn}$	-0,76
$\text{Cr}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,74
$\text{Fe}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,44
$\text{Cr}^{3+} + \text{e}^{-} \rightleftharpoons \text{Cr}^{2+}$	-0,41
$\text{Cd}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cd}$	-0,40
$\text{Co}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Co}$	-0,28
$\text{Ni}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ni}$	-0,27
$\text{Sn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}$	-0,14
$\text{Pb}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pb}$	-0,13
$\text{Fe}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,06
$2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}^{2+}$	+0,15
$\text{Cu}^{2+} + \text{e}^{-} \rightleftharpoons \text{Cu}^{+}$	+0,16
$\text{SO}_4^{2-} + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cu}$	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^{-} \rightleftharpoons 4\text{OH}^{-}$	+0,40
$\text{SO}_2 + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^{+} + \text{e}^{-} \rightleftharpoons \text{Cu}$	+0,52
$\text{I}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{I}^{-}$	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{O}_2$	+0,68
$\text{Fe}^{3+} + \text{e}^{-} \rightleftharpoons \text{Fe}^{2+}$	+0,77
$\text{NO}_3^{-} + 2\text{H}^{+} + \text{e}^{-} \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^{+} + \text{e}^{-} \rightleftharpoons \text{Ag}$	+0,80
$\text{Hg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Hg}(\ell)$	+0,85
$\text{NO}_3^{-} + 4\text{H}^{+} + 3\text{e}^{-} \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\ell) + 2\text{e}^{-} \rightleftharpoons 2\text{Br}^{-}$	+1,07
$\text{Pt}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pt}$	+1,20
$\text{MnO}_2 + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^{+} + 6\text{e}^{-} \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{Cl}^{-}$	+1,36
$\text{MnO}_4^{-} + 8\text{H}^{+} + 5\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + \text{e}^{-} \rightleftharpoons \text{Co}^{2+}$	+1,81
$\text{F}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{F}^{-}$	+2,87

Increasing strength of reducing agents/Toenemende sterkte van reduseermiddels





education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE NASIONALE SENIOR SERTIFIKAAT

GRADE/GRAAD 12

**PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)**

MARKING GUIDELINES/NASIENRIGLYNE

SEPTEMBER 2025

MARKS/PUNTE: 150

**These marking guidelines consist of 13 pages
Hierdie nasienriglyne bestaan uit 13 bladsy**

QUESTION/VRAAG 1

1.1.	D	✓✓	(2)
1.2	B	✓✓	(2)
1.3	D	✓✓	(2)
1.4	A	✓✓	(2)
1.5	B	✓✓	(2)
1.6	A	✓✓	(2)
1.7	D	✓✓	(2)
1.8	C	✓✓	(2)
1.9	C	✓✓	(2)
1.10	D	✓✓	(2)
			[20]

QUESTION/VRAAG 2

- 2.1. A bond or an atom or a group of atoms that determine(s) the physical and chemical properties of a group of organic compounds. ✓✓ (2 or 0)
'n Chemiese binding of 'n atome of 'n groep atome wat die fisiese en chemiese eienskappe van 'n groep organiese verbindings bepaal. (2 of 0) (2)



- 2.3. 2.3.1 F ✓ (1)

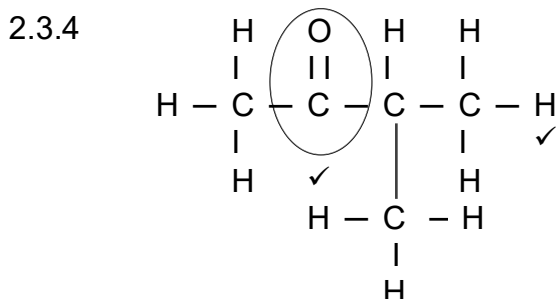
- 2.3.2 Butanal/Butanaal ✓✓ (2)

- 2.3.3 2,3-dichloro-4,5-dimethylheptane ✓✓✓
2,3-dichloro-4,5-dimetielheptaan

Marking criteria/Nasienkriteria:

- Correct stem i.e. heptane. ✓
- All substituents (dichloro and dimethyl) correctly identified. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓
- *Korrekte stam d.i heptaan* ✓
- *Alle sunstituente (dichloro en dimetiel) korrek geïdentifiseer*
- *IUPAC naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.*

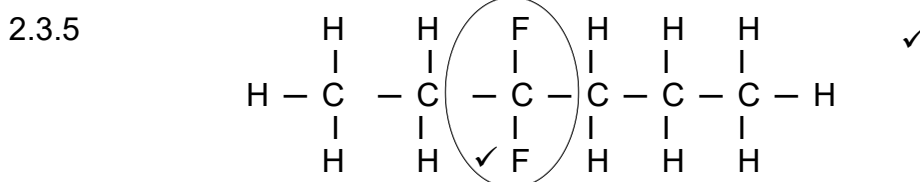
(3)



Marking criteria/Nasienkriteria

- Functional group ✓
- Whole structure correct ✓
- Funksionele groep ✓
- Hele struktuur korrek ✓

(2)



Marking criteria/Nasienkriteria

- Fluorines on C₃ ✓
- Whole structure correct ✓
- *Fluore op C₃* ✓
- *Hele struktuur korrek* ✓

(2)

- 2.4.1 Organic molecules with the same molecular formula, ✓but different structural formulae ✓
Organiese molekules met dieselfde molekulêre formule, maar verskillende struktuurformules ✓ (2)
- 2.4.2 Propan-1-ol/ 1-propanol ✓ and Propan-2-ol/ 2-propanol ✓
Propan-1-ol/ 1-propanol en Propan-2-ol/ 2-propanol ✓ (2)
- 2.5 Aldehyde ✓ and ketone ✓ **OR** carboxylic acid and ester
Aldehyd ✓ en *ketoen* ✓ **OF** *karboksielsuur en ester* (2)
[19]

QUESTION/VRAAG 3

- 3.1 The temperature at which the vapour pressure of a substance equals atmospheric pressure ✓✓
Die temperatuur waarby die dampdruk van 'n stof gelyk is aan die atmosferiese druk.

Markingcriteria/Nasienkriteria

If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark. *Indien enige van die onderstreepte frases in die korrekte konteks uitgelaat is, trek 1 punt af.* (2)

- 3.2
- 3.2.1 Carboxylic acid/*Karboksielsuur* ✓ (1)
- 3.2.2 Hydrogen bond or dipole-dipole bond. ✓
Waterstofbinding of dipool-dipool binding (1)
- 3.3 From A to D boiling point increases ✓
- **Structure:**
The chain length/number of carbon atoms/molar mass/ surface area/ contact area increases ✓ from compound A to D.
 - **Intermolecular forces:**
The strength of the London forces/induced dipole/Van der Waals/ intermolecular forces increase. ✓
 - **Energy:**
More energy needed to overcome/break the intermolecular forces from A to D. ✓
OR
Boiling point decrease from D to A ✓
 - **Structure:**
The chain length/number of carbon atoms/molar mass/ surface area/ contact area decreases from compound D to A. ✓
 - **Intermolecular forces:**
The strength of the intermolecular forces/London forces decrease from D to A ✓
 - **Energy:**
Lesser energy needed to weaken/overcome/break the intermolecular forces from D to A. ✓
Van A na D neem die kookpunt toe

- **Struktuur:**
Die kettinglengte/aantal koolstowwe/molêre massa/reaksieoppervlak/kontakarea neem toe van verbinding A na D.
- **Intermolekulêre kragte:**
Die sterkte van die Londonkragte/geïnduseerde dipoolkragte/Van der Waalskragte neem toe.
- **Energie:**
Meer energie benodig om intermolekulêre kragte te oorkom/breek van A na D.

Van D na A neem die kookpunt af

- **Struktuur:**
Die kettinglengte/ aantal koolstowwe/molêre massa/reaksieoppervlak/kontakarea neem af van verbinding D na A..
- **Intermolekulêre kragte:**
Die sterkte van die Londonkragte/geïnduseerde dipoolkragte/Van der Waalskragte neem af.
- **Energie:**
Minder energie benodig om intermolekulêre kragte te oorkom/breek van D (4) na A.

3.4 C/butanoic acid ✓ it has the highest/higher boiling point✓
C/butanoësuur ✓ dit het die hoogste/hoër kookpunt ✓ (2)

3.5 Pentanoic acid/Pentanoësuur ✓✓ (2)

- 3.6
- Compound D/Pentanoic acid/carboxylic acid has two sites for hydrogen bond ✓
 - Esters has dipole-dipole forces✓
 - Intermolecular forces in compound D/pentanoic acid are stronger than Intermolecular forces in esters ✓
OR
Intermolecular forces in ester are weaker than in compound D
 - Less energy needed to overcome/break the intermolecular forces in ester than in compound D/pentanoic acid.✓
OR
More energy needed to overcome/break the intermolecular forces in D than in ester.
 - Verbinding D/Pentanoësuur/carboksielsuur het twee plekke vir waterstofbinding ✓
 - Ester het dipool-dipoolkragte✓
 - Intermolekulêrekragte in verbinding D/pentanoësuur is sterker as die intermolekulêrekragte in esters ✓
OF
Intermolekulêrekragte in ester is swakker as in vebinding D
Minder energie benodig om die intermolekulêre kragte te oorkom/breek in esters as in verbinding D/pentanoësuur.✓
OF
Meer energie benodig om die intermolekulêre kragte te oorkom/breek in verbinding D/pentanoësuur as in esters.✓

(4)
[16]

QUESTION/VRAAG 4

- 4.1.1 Substitution/Hydrolysis reaction. ✓
Substitusie/Hidrolise reaksie (1)

- 4.1.2 **NOTE/NOTA**
Penalise 1 mark if a hyphen is missing/*Penaliseer as daar 'n koppelteken uitgelaat is.*

1-chloropropane/*1-chloropropaan* ✓✓ (2)

- 4.2 Primary alcohol ✓
Alcohol in which the carbon atom bonded to the functional group(-OH) is attached to one carbon atom. ✓✓
Primêre alkohol
Alkohol waar die koolstofatoom gebind aan die funksionele groep(-OH) gebind is aan een ander koolstofatoom. (3)

- 4.3.1 Dehydration reaction/*Dehidrasie reaksie* ✓ (1)

- 4.3.2 $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ✓ $\rightarrow$ CH_3CHCH_2 ✓ + H_2O ✓ (3)

- 4.4 Propane/*Propaan* ✓✓ (2)

- 4.5.1 **NOTE/NOTA**
No mark for dilute H_2SO_4 /*Geen punt vir verdunde H_2SO_4*

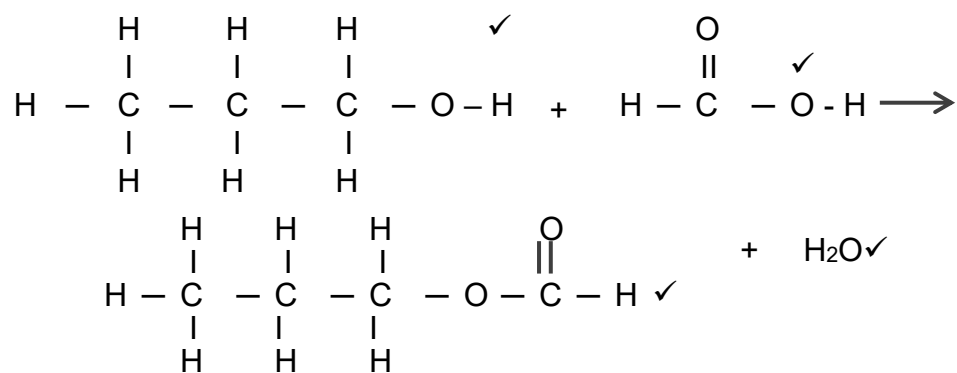
Sulphuric acid/Hydrogen sulphate/ H_2SO_4 /Phosphoric acid/ H_3PO_4 ✓
Swawelsuur/Waterstofsulfaat/ H_2SO_4 /Fosforsuur/ H_3PO_4 (1)

- 4.5.2 **Marking criteria/Nasienkriteria:**

- Correct structural formula for methanoic acid ✓
- Correct structural formula for alcohol ✓
- The whole structural formula for ester correct ✓
- H_2O ✓
- *Korrekte struktuurformule vir metanoësuur* ✓
- *Korrekte struktuurformule vir alkohol* ✓
- *Die hele struktuurformule vir die ester is korrek* ✓
- H_2O ✓

IF/INDIEN

Condensed structural formula used/*Gekondenseerde struktuur formule gebruik* Max/**Maks** ¼



(4)
[17]

QUESTION/VRAAG 5

5.1 **ANY ONE:**

- Change in concentration ✓ of products/reactants per unit time. ✓
- Change in amount/number of mole/volume/mass ✓ of products/reactants per unit time. ✓
- Amount/number of mole/volume/mass of products formed/reactants used ✓ per unit time. ✓
- Rate of change in concentration/amount/number of moles/volume/mass. ✓✓
(2 or 0)

ENIGE EEN:

- Verandering in konsentrasie ✓ van produkte/reaktante per eenheidtyd. ✓
- Verandering in hoeveelheid/getal mol/volume/massa ✓ van produkte/reaktante per eenheidtyd. ✓
- Hoeveelheid/getal mol/volume/massa produkte gevorm/reaktante gebruik ✓ per eenheidtyd. ✓
- Tempo van verandering in konsentrasie/hoeveelheid/getal mol/volume/massa. ✓✓ (2 or 0) (2)

NOTE/NOTA

Give the mark for per unit time only if in correct context of reaction rate
Gee die punt vir per eenheidtyd slegs indien in korrekte konteks met reaksietempo.

5.2 Surface area/State of division ✓
Kontakoppervlak/Toestand van verdeeldheid (1)

5.3 Experiment/Eksperiment II ✓ (1)

5.4

- The surface area increase/Experiment 2 has a larger surface area/ more particles exposed (to oxygen gas) ✓
- More particles will have enough kinetic energy ✓
- More effective collision per unit time/second/Higher frequency of effective collisions ✓
- *Die kontakoppervlak vergroot/Eksperiment 2 het 'n groter kontakoppervlak/meer deeltjies word blootgestel (aan suurstofgas)*
- *Meer deeltjies het genoeg/voldoende kinetiese energie*
- *Meer effektiewe botsings per eenheidtyd/sekonde/hoër frekwensie van effektiewe botsings* (3)

5.5.1

Marking criteria/Nasienkriteria:

- Δm (7,36-0) ✓ & Δt (5,2-0) ✓
- Answer/Antwoord 1,42 ($\text{g}\cdot\text{s}^{-1}$) ✓

$$\begin{aligned}\text{Rate/Tempo} &= \Delta m / \Delta t \\ &= (7,36-0) \checkmark / (5,2-0) \checkmark \\ &= 1,42 (\text{g}\cdot\text{s}^{-1}) \checkmark\end{aligned}\quad (3)$$

5.5.2

Marking criteria:	Nasienkriteria:
- Formula $n = \frac{m}{M}$ ✓ - Substituting $94 \text{ g} \cdot \text{mol}^{-1}$ ✓ in $n = \frac{m}{M}$ - USE mol ratio $n(\text{K}) = 2n(\text{K}_2\text{O})$ ✓ - Substitution of $39 \text{ g} \cdot \text{mol}^{-1}$ and reacting mole in $n = \frac{m}{M}$ ✓ - Substitution of $\frac{6,11}{6,92} (100)$ ✓ - Answer 88,25% ✓ Range: 88,25% - 89,05%	- Formule $n = \frac{m}{M}$ ✓ - Vervanging van $94 \text{ g} \cdot \text{mol}^{-1}$ ✓ in $n = \frac{m}{M}$ - GEBRUIK molverhouding $n(\text{K}) = 2n(\text{K}_2\text{O})$ ✓ - Vervanging van $39 \text{ g} \cdot \text{mol}^{-1}$ en reagerende mol in $n = \frac{m}{M}$ ✓ - Vervanging van $\frac{6,11}{6,92} (100)$ ✓ - Antwoord 88,25% ✓ Range: 88,25% - 89,05%

$$n = \frac{m}{M} \checkmark$$

$$n = \frac{7,36}{94} \checkmark$$

$$= 0,0783 \text{ mol}$$

$$n(\text{K}) = 2 \times 0,0783 \checkmark$$

$$= 0,1566 \text{ mol}$$

$$n(\text{K}) = m/M$$

$$m(\text{K}) = \frac{0,1566 \times 39}{1} \checkmark$$

$$= 6,11 \text{ g}$$

$$\% \text{ purity/suiwerheid} = \frac{6,11}{6,92} (100) \checkmark$$

$$= 88,25\% \checkmark$$

(6)

- 5.6 Negative ✓ Exothermic reaction/energy of the product < energy of the reactant/
energy of the reactant > energy of the product ✓
Negatief ✓ Eksotermiese reaksie/energie van die produkte < energie van die
reaktanse/ energie van die reaktanse > energie van die produkte ✓

ACCEPT/AANVAAR

More energy is released than absorbed/Meer energie word vrygestel as wat
geabsorbeer word.

Combustion reaction. It releases energy/Verbrandingsreaksie. Stel energie vry (2)

[18]

QUESTION/VRAAG 6

- 6.1 The dynamic equilibrium when) the rate of the forward reaction equals the rate of the reverse reaction. ✓✓ (2 or 0)

OR

The stage in a chemical reaction when the concentration of reactants and products remain constant

(Die dinamiese ewewig wanneer) die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie. (2 of 0)

OF

Die stadium in 'n chemiese reaksie waar die konsentrasie van die reaktanse en produkte konstant bly.

(2)

- 6.2 Endothermic/Eksotermies ✓✓

- 6.3
- Decrease in temperature favours the the reaction that decreases temperature (exothermic reaction) ✓
 - The reverse reaction is favoured ✓
 - Concentration of reactant/ NO_2 increases ✓

OR

Concentration of products/ NO and O_2 decreases

- Afname in temperatuur bevoordeel die eksotermiese reaksie ✓
- Die terugwaartse reaksie word bevoordeel ✓
- Konsentrasie van reaktanse/ NO_2 neem toe ✓

OF

Konsentrasie van produkte/ NO en O_2 neem af

(3)

- 6.4 **CALCULATIONS USING NUMBER OF MOLES/BEREKENING DEUR MOL TE GEBRUIK**

Marking criteria:

- Change in $n(\text{NO}_2)$ = equilibrium $n(\text{NO}_2)$ - initial $n(\text{NO}_2)$ = $x - 0,6$ ✓
- Using ratio: $\text{NO} : \text{N}_2\text{O} : \text{O}_2 = 2: 2: 1$ ✓
- Equilibrium $n(\text{NO})$ = initial $n(\text{NO})$ + change in $n(\text{NO})$ }
Equilibrium $n(\text{O}_2)$ = initial $n(\text{O}_2)$ + change in $n(\text{O}_2)$ } ✓
- Dividing by 2 ✓
- Correct K_c expression in square brackets ✓
- Substitution of equilibrium constant ✓
- Substitution of equilibrium concentrations into K_c expressions ✓
- Final answer. 1,48 mol ✓

Nasienkriteria:

- Verandering in $n(\text{NO}_2)$ = ewewig $n(\text{NO}_2)$ - aanvanklike $n(\text{NO}_2)$ = $x - 0,6$ ✓
- gebruik verhouding: $\text{NO} : \text{N}_2\text{O} : \text{O}_2 = 2: 2: 1$ ✓
- Ewewig $n(\text{NO})$ = aanvanklike $n(\text{NO})$ + verandering in $n(\text{NO})$ }
Ewewig $n(\text{O}_2)$ = aanvanklike $n(\text{O}_2)$ + verandering in $n(\text{O}_2)$ } ✓
- Korrekte K_c uitdrukking in vierkantige hakies ✓
- Deel deur 2 ✓
- Vervanging van ewewigskonstante ✓
- Vervanging van ewewigskonsentrasies in K_c uitdrukking ✓
- Finale antwoord. 1,48 mol ✓

Mol	2NO ₂	2NO	O ₂
Initial mole <i>Aanvanklike mol</i>	x	0	0
Change in mole <i>Verandering in mol</i>	x-0,6 ✓	x-0,6	x-0,6)/2 ✓
Equilibrium mole <i>Mol by ewewig</i>	0,6	x-0,6	(x-0,6)/2 ✓
Concentration	0,3	(x-0,6)/2	x-0,6/2 ÷ 2 ✓

$$K_c = \frac{[\text{NO}]^2 \times [\text{O}_2]}{[\text{NO}_2]^2} \quad \checkmark$$

$$0,48 \quad \checkmark = \frac{(x-0,6)/2)^2 \times (x-0,6/4)}{(0,3)^2} \quad \checkmark \quad x = 1,48 \text{ mol} \quad \checkmark \quad (8)$$

[15]

QUESTION/VRAAG 7

- 7.1.1 Solution with known concentration ✓✓
Oplossing met bekende konsentrasie

(2)

7.1.2 **Marking criteria/Nasienkriteria:**

- Formula $c = \frac{m}{MV}$ ✓ or $n = n/M$ or $c = n/V$
- Substituting/vervanging van 40 g·mol⁻¹ and 4g ✓
- Dividing by/deel deur 0,5dm³ ✓
- Answer/Antwoord ✓

OPTION 1/OPSIE 1

$$c = m/MV \quad \checkmark$$

$$c = 4/(40 \times 0,5) \quad \checkmark \quad \checkmark$$

$$c = 0,2 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark$$

OPTION 2/OPSIE 2

$$n = n/M$$

$$= 4/40 \quad \checkmark$$

$$= 0,1 \text{ mol} \quad \left. \begin{array}{l} \\ \end{array} \right\} \text{Any one/Enige een} \quad \checkmark$$

$$c = n/V$$

$$= 0,1/0,5 \quad \checkmark$$

$$= 0,2 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark$$

(4)

7.1.3 **Marking criteria/Nasienkriteria:**

- Formula $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \quad \checkmark$
- Substitution on $C_a V_a$ and Substitution on $C_b V_b$ ✓ / Substitution on $n = cV$ and $n = cV$
- Ratio 1:1 ✓
- Final answer 0,17 mol·dm⁻³ ✓
- Formule $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \quad \checkmark$
- Vervanging in $C_a V_a$ & vervanging in $C_b V_b$ ✓ Vervanging van $n = cV$ en $n = cV$
- Verhouding 1:1 ✓
- Finale antwoord 0,17 mol·dm⁻³ ✓

OPTION 1/OPSIE 1:	OPTION 2/OPSIE 2:
$\frac{c_a v_a}{c_b v_b} = \frac{n_a}{n_b}$ $\frac{c_a \times 35}{0,2 \times 30} = \frac{1}{1}$ $c_a = 0,17 \text{ mol} \cdot \text{dm}^{-3} \checkmark$	$n(\text{NaOH}) = cV \checkmark$ $= 0,2 \times 0,03$ $= 0,006 \text{ mol}$ Ratio: 1 : 1 $n(\text{HCl}) = 0,006 \text{ mol} \checkmark$ $c = \frac{n}{V}$ $= \frac{0,006}{0,035}$ $= 0,17 \text{ mol} \cdot \text{dm}^{-3} \checkmark$

(4)

- 7.1.4 NO $\checkmark$
It is a salt of strong acid and a strong base. $\checkmark$
Dit is 'n sout van 'n sterk suur en 'n sterk basis

(2)

- 7.2.1 Neutral $\checkmark$
 $[\text{H}_3\text{O}^+] = [\text{OH}^-] = 1 \times 10^{-7} \text{ mol} \cdot \text{dm}^{-3}$ or pH = 7 $\checkmark$

ACCEPT/AANVAAR

$[\text{H}_3\text{O}^+] = [\text{OH}^-]$

(2)

OPTION 1/OPSIE 1:	OPTION 2/OPSIE 2:
$\text{pOH} = -\log [\text{OH}^-] \checkmark$ $\text{pOH} = -\log (3 \times 10^{-7}) \checkmark$ $\text{pOH} = 6,52 \checkmark$ $\text{pH} + \text{pOH} = 14$ $\text{pH} + 6,52 = 14 \checkmark$ $\text{pH} = 14 - 6,52$ $\text{pH} = 7,48 \checkmark$	$[\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \checkmark$ $[\text{H}_3\text{O}^+][3 \times 10^{-7}] = 1 \times 10^{-14} \checkmark$ $[\text{H}_3\text{O}^+] = 3.33 \times 10^{-8} (\text{mol} \cdot \text{dm}^{-3}) \checkmark$ $\text{pH} = -\log [\text{H}_3\text{O}^+]$ $= -\log [3.33 \times 10^{-8}] \checkmark$ $= 7.48 \checkmark$

Any one $\checkmark$

(5)
[19]

QUESTION/VRAAG 8

- 8.1
- Concentration must be $1 \text{ mol} \cdot \text{dm}^{-3}$ $\checkmark$
 - Temperature must be $25^\circ\text{C}/298\text{K}$ $\checkmark$
 - Konsentrasie moet $1 \text{ mol} \cdot \text{dm}^{-3}$ wees $\checkmark$
 - Temperatuur moet $25^\circ\text{C}/298\text{K}$ wees $\checkmark$

(2)

- 8.2 Sodium chloride/ NaCl /Potassium chloride/ KCl or any suitable electrolyte $\checkmark$
Natriumchloried/ NaCl /Kaliumchloried/ KCl / of enige geskikte elektroliet

ACCEPT/AANVAAR

Any metal nitrates/Enige metal *nitrate*

(1)

- 8.3 Electrode where reduction takeplace $\checkmark\checkmark$
Elektrode waar reduksie plaasvind

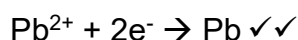
(2)

8.4

Marking guidelines/Nasienkriteria:

- $\text{Pb}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pb}$ ($\frac{1}{2}$)
- $\text{Pb} \leftarrow \text{Pb}^{2+} + 2\text{e}^-$ ($\frac{2}{2}$)
- $\text{Pb} \rightleftharpoons \text{Pb}^{2+} + 2\text{e}^-$ ($\frac{0}{2}$)
- $\text{Pb} \rightarrow \text{Pb}^{2+} + 2\text{e}^-$ ($\frac{0}{2}$)
- Ignore charges omitted on electron/*Ignoreer indien lading weggelaat is op elektron*
- If charge (+) omitted on Pb^{2+} / *Indien (+) lading weggelaat is op Pb^{2+}* Max. ($\frac{1}{2}$)

Example/Voorbeeld: $\text{Pb}^{2+} + 2\text{e}^- \rightarrow \text{Pb}$ ✓



(2)

8.5

$E^\ominus_{\text{cell}} = E^\ominus_{\text{reduction}} - E^\ominus_{\text{oxidation}}$ ✓

$E^\ominus_{\text{cell}} = -0,13 \text{ ✓} - (-0,91) \text{ ✓}$

$= 0,78\text{V}$ ✓

(4)

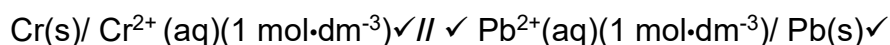
Notes/Aantekeninge:

- Accept any other correct formula from the data sheet./*Aanvaar enige ander korrekte formule vanaf gegewensblad*
- Any other formula using unconventional abbreviations, e.g. $E^\ominus_{\text{cell}} = E^\ominus_{\text{OA}} - E^\ominus_{\text{RA}}$ followed by correct substitutions/*Enige ander formule wat onkonvensionele afkortings gebruik bv.*
 $E^\ominus_{\text{sel}} = E^\ominus_{\text{OM}} - E^\ominus_{\text{RM}}$ gevolg deur korrekte vervangings: $\frac{3}{4}$

8.6

Marking criteria/Nasienkriteria:

- | | | |
|---------------|---------------|-------------|
| • oxidation ✓ | double line ✓ | reduction ✓ |
| • oksidasie ✓ | dubbellyn ✓ | reduksie ✓ |



(3)

8.7

Increases/*Verhoog* ✓

Cr is oxidised to Cr^{2+} ✓

Cr is geoksideer na Cr^{2+}

(2)

[16]

QUESTION/VRAAG 9

9.1 Cell in which electric energy is converted to chemical energy. ✓✓ (2 or 0)
Sel/ waarin elektriese energie omgeskakel is na chemiese energie. ✓✓ (2 or 0) (2)

9.2 Copper/Koper (Cu) ✓ (1)

9.3 X ✓
Oxidation takes place at X/ X loses electrons ✓
Oksidasie vind by X plaas/X verloor elektrone (2)

9.4

Marking guidelines/Nasienkriteria:

- $\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$ (1/2)
- $\text{Cu} \leftarrow \text{Cu}^{2+} + 2\text{e}^-$ (2/2)
- $\text{Cu} \rightleftharpoons \text{Cu}^{2+} + 2\text{e}^-$ (0/2)
- $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$ (0/2)
- Ignore charges omitted on electron/*Ignoreer indien lading weggelaat is op elektron*
- If charge (+) omitted on Cu^{2+}
Indien lading (+) lading weggelaat is op Cu^{2+} Max. (1/2)

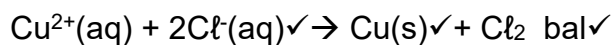
Example/Voorbeeld: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ ✓

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

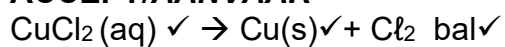
9.5

Marking criteria/Nasienkriteria:

- Reactants✓ Products✓ Balancing✓
- Ignore double arrows
- Ignore phases
- Marking rule 6.3.10
- *Reaktanse✓ Produkte✓ Balansering✓*
- *Ignoreer dubbel pyle*
- *Ignoreer fases*
- *Nasienreël 6.3.10*



ACCEPT/AANVAAR



(3)
[10]

TOTAL/TOTAAL: 150