basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

NOVEMBER 2025

MARKS: 150

TIME: 3 hours

This question paper consists of 16 pages and 4 data sheets.

INSTRUCTIONS AND INFORMATION

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

A Carboxyl

B Carbonyl

C Hydroxyl

D Formyl (2)

1.2 The organic compound C_2H_4 is converted to an alkane as shown by the reaction below.

$$C_2H_4 \rightarrow \text{Alkane}$$

Which ONE of the following is a suitable catalyst for this reaction?

A Lead

B Platinum

C Hydrogen

D Iron (2)

1.3 Which of the following statements ALWAYS apply to compounds that are structural isomers of one another?

(i) They belong to the same homologous series.
(ii) They have the same structural formula.
(iii) They have the same molecular formula.

A (iii) only

B (i) and (iii) only

C (i) and (ii) only

D (i), (ii) and (iii) (2)

1.4 Magnesium ribbon of mass 2 g reacts with excess hydrochloric acid of concentration 0,1 mol·dm^{-3} at 20 °C:

$$Mg(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2(g)$$

Which ONE of the following changes will NOT increase the initial rate of the reaction?

A Using 2 g of powdered magnesium

B Increasing the temperature of $HC\ell$ to 30 °C

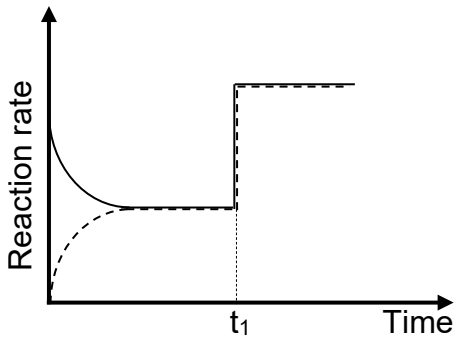
C Using a longer piece of the magnesium ribbon

D Doubling the volume of the hydrochloric acid used (2)

1.5 The following reaction reaches equilibrium in a closed container:

$$H_2(g) + S(s) \rightleftharpoons H_2S(g) \qquad \Delta H < 0$$

The reaction rate versus time graph for the reaction is given below.



What change was made to the system at time t_1?

A The pressure was increased at a constant temperature.

B The volume of the container was increased.

C The temperature was increased.

D More hydrogen was added to the system. (2)

1.6 A hypothetical endothermic reaction is given below.

$$A(g) + B(g) \rightleftharpoons AB(g)$$

The activation energy for the reverse reaction is 50 kJ·mol^{-1}.

Which ONE of the following is possible for the reaction above?

A The heat of the reaction is +70 kJ·mol^{-1}.

B The activation energy for the forward reaction is 50 kJ·mol^{-1}.

C The energy of the activated complex is 40 kJ·mol^{-1}.

D The activation energy for the forward reaction is 40 kJ·mol^{-1}. (2)

1.7 The products for the reaction between a metal oxide and an acid are …

A a salt and water.

B a salt and hydrogen gas.

C a salt and carbon dioxide.

D a salt, water and carbon dioxide. (2)

1.8 The concentration of each of the four solutions below is 0,1 mol·dm^{-3}.

$HNO_3(aq)$, $NH_3(aq)$, NaOH(aq) and $H_2CO_3(aq)$

Which ONE of the following CORRECTLY places the solutions in order of INCREASING pH?

A H_2CO_3 ; HNO_3 ; NH_3 ; NaOH

B HNO_3 ; H_2CO_3 ; NH_3 ; NaOH

C NaOH ; NH_3 ; H_2CO_3 ; HNO_3

D HNO_3 ; H_2CO_3 ; NaOH; NH_3 (2)

1.9 A galvanic cell consists of the following half-cells:

$Fe^{3+}(aq)|Fe^{2+}(aq)$

$Ni^{2+}(aq)|Ni(s)$

Which ONE of the following statements is CORRECT for this cell?

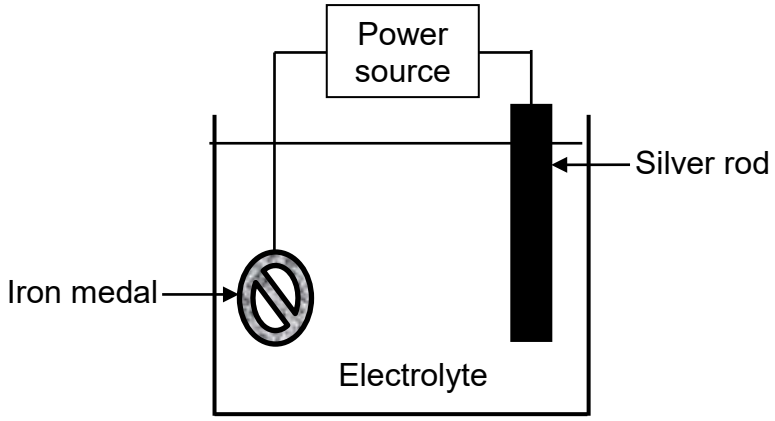
A Ni^{2+} is reduced and Fe^{2+} is oxidised.

B Ni^{2+} is oxidised and Fe^{3+} is reduced.

C Pt is the electrode at the cathode.

D Ni is the electrode at the cathode. (2)

1.10 The set-up for electroplating an iron medal with silver is shown in the simplified diagram below.



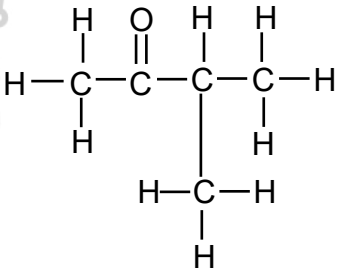
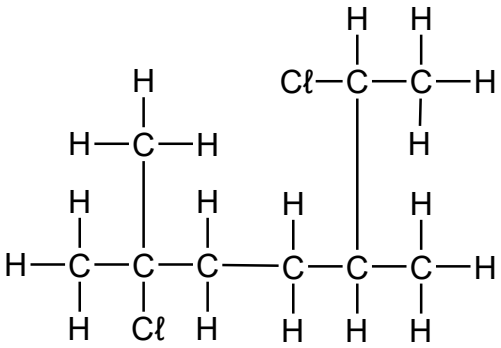
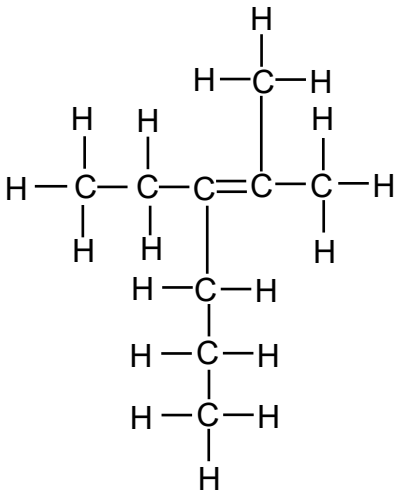
Which ONE of the following combinations for the ANODE and REACTION AT THE CATHODE is CORRECT?

	ANODE	REACTION AT THE CATHODE
A	Iron medal	$Ag^+(aq) + e^- \rightarrow Ag(s)$
B	Silver rod	$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$
C	Iron medal	$Ag(s) \rightarrow Ag^+(aq) + e^-$
D	Silver rod	$Ag^+(aq) + e^- \rightarrow Ag(s)$

(2)
[20]

QUESTION 2 (Start on a new page.)

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

A		**B**	
C	$CH_3CH(CH_3)CH_2CHO$	**D**	$C_4H_{10}O$
E	C_3H_8	**F**	Pentane
G			

2.1 Write down the LETTER(S) that represent(s) EACH of the following:

2.1.1 An alcohol (1)

2.1.2 TWO compounds that are functional isomers of one another (1)

2.1.3 TWO compounds that belong to the same homologous series (1)

2.2 Write down the:

2.2.1 IUPAC name of compound **A** (3)

2.2.2 IUPAC name of compound **B** (3)

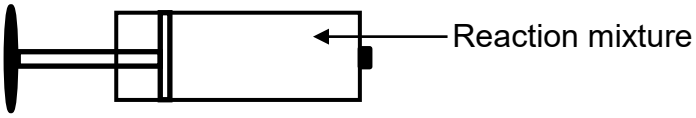
2.2.3 IUPAC name of compound **G** (3)

2.2.4 STRUCTURAL FORMULAE of two STRAIGHT CHAIN positional isomers of compound **D** (4)

2.3 Compound **E**, $C_3H_8(g)$, reacts with oxygen, $O_2(g)$, according to the balanced equation:

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$$

Initially 8 cm^3 of compound **E** and 50 cm^3 of oxygen were injected into a container of adjustable volume and allowed to react.

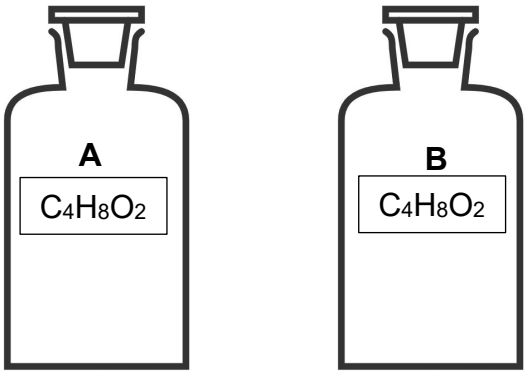


2.3.1 Write down the name for this type of reaction. (1)

2.3.2 Calculate the TOTAL volume of the GASES present in the container at the end of the reaction. (5)
[22]

QUESTION 3 (Start on a new page.)

Two bottles contain compounds **A** and **B** with the same molecular formula, $C_4H_8O_2$. These compounds are straight chain organic molecules that belong to two different homologous series.



The boiling points are used to distinguish between the two compounds.

3.1 Define the term *homologous* series. (1)

3.2 Identify the TWO homologous series to which these compounds belong. (2)

The following are the vapour pressures of these compounds at a given temperature:

Compound **A**	0,071 kPa	Compound **B**	9,7 kPa

3.3 Write down the:

3.3.1 STRUCTURAL FORMULA of compound **A** (2)

3.3.2 IUPAC name for a possible compound **B** (2)

3.4 Write down the strongest type of Van der Waal's forces between the molecules in:

3.4.1 Compound **A** (1)

3.4.2 Compound **B** (1)

3.5 Which compound, **A** or **B**, has a higher boiling point? Give a reason for the answer by referring to the strength of the intermolecular forces. (2)

3.6 The boiling point of compound **A** is measured again on another day when the atmospheric pressure is much lower.

How will the boiling point of this compound now be affected? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

[12]

QUESTION 4 (Start on a new page.)

4.1 Study the three organic reactions **I**, **II** and **III** below. Compounds **T** and **W** are organic compounds. **R** and **S** are inorganic substances. Consider only the major products.

I	$HBr(g) + \mathbf{T} \longrightarrow \mathbf{W}$
II	$\mathbf{W} + NaOH(aq) \longrightarrow CH_3CH(OH)CH_2CH_3 + \mathbf{R}$
III	$CH_3CH(OH)CH_2CH_3 \xrightarrow{\mathbf{S}} \mathbf{T} + H_2O(\ell)$

Write down the:

4.1.1 IUPAC name of compound **W** (2)

4.1.2 NAME or FORMULA of **R** (1)

4.1.3 TWO names for the type of reaction in reaction **I** (2)

4.1.4 NAME or FORMULA of **S** (1)

4.1.5 STRUCTURAL formula of compound **T** (2)

Compound **W** can be converted to compound **T** in one step.

4.1.6 State, besides heat, ONE other reaction condition for this conversion. (1)

4.2 A compound with the formula $C_{10}H_{22}$ undergoes a cracking reaction according to the equation:

$$C_{10}H_{22}(\ell) \rightarrow 2\mathbf{X}(g) + C_4H_{10}(g)$$

The mixture of the two products is bubbled in bromine water, $Br_2(aq)$, in a darkened room.

4.2.1 Define the term *cracking.* (2)

4.2.2 State ONE change, besides a change in temperature, that will be observed when the mixture is bubbled in $Br_2(aq)$. (1)

4.2.3 Write down the STRUCTURAL FORMULA of **X**. (2)

4.2.4 Which compound, **X** or C_4H_{10}, reacts faster with $Br_2(aq)$? Explain the answer. (3)

[17]

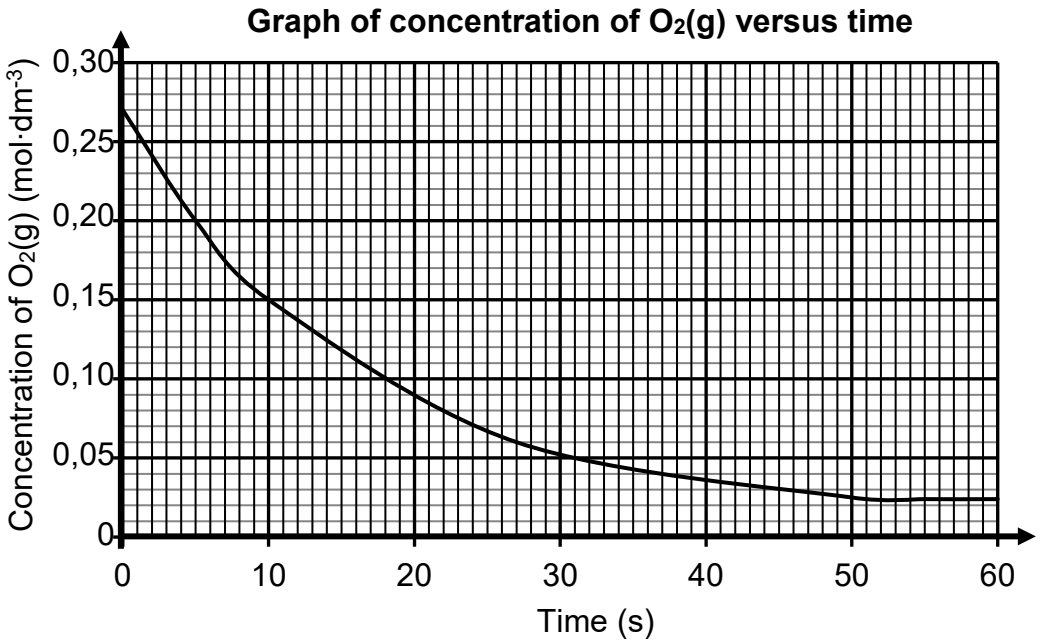
QUESTION 5 (Start on a new page.)

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

5.2 Carbon monoxide, CO(g), reacts with oxygen, $O_2(g)$, to form carbon dioxide, $CO_2(g)$, in a sealed container according to the balanced equation:

$$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$$

The graph below shows the concentration of $O_2(g)$ versus time.



5.2.1 At which time, 10 s or 30 s, is the reaction rate higher? (1)

5.2.2 The reaction takes place in a 3 dm^3 container. Calculate the average rate (in $mol \cdot s^{-1}$) at which $CO_2(g)$ is formed in the first 10 s. (5)

5.2.3 Which reactant is in excess, CO or O_2? (1)

5.2.4 This reaction was repeated using a smaller sealed container. How will this affect the magnitude of the gradient of the graph at the beginning of the reaction? Choose from INCREASES, DECREASES or REMAINS THE SAME.
Give a reason for the answer. (2)

5.3 The reaction between sulphur dioxide, $SO_2(g)$, and oxygen, $O_2(g)$, takes place in a sealed container according to the balanced equation below.

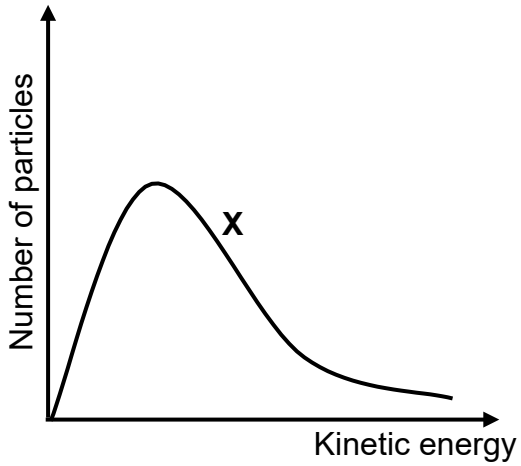
$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -196 \text{ kJ·mol}^{-1}$$

5.3.1 Was there a net release or net absorption of energy during the REVERSE reaction? (1)

5.3.2 Define the term *activated complex*. (2)

5.3.3 A catalyst, vanadium pentoxide, is added to the reaction. Explain, in terms of the collision theory, why the rate of the reaction will increase. (3)

Curve **X** is the Maxwell Boltzmann distribution curve for the reaction above.



More $SO_2(g)$ is now added to the container at constant temperature.

5.3.4 How will this change affect the heat of the reaction? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

5.3.5 Redraw the above graph in the ANSWER BOOK. On the same set of axes, draw the curve that will now be obtained. Label this as curve **Y**. (2)

[20]

QUESTION 6 (Start on a new page.)

6.1 Equilibrium is established at 25 °C in a saturated calcium hydroxide solution according to the reaction:

$$Ca(OH)_2(s) \rightleftharpoons Ca^{2+}(aq) + 2OH^-(aq)$$

6.1.1 State Le Chatelier's principle. (2)

6.1.2 A few drops of concentrated hydrochloric acid, HCℓ(conc.), are added to the equilibrium mixture. What effect does this addition have on the mass of $Ca(OH)_2(s)$? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

6.1.3 Explain the answer to QUESTION 6.1.2 by using Le Chatelier's principle. (2)

6.2 Initially 70 g of $NH_4HS(s)$ is placed in a 3 dm^3 container at 250 °C. The container is sealed and the reaction is allowed to reach equilibrium according to the balanced equation:

$$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$$

The K_c values for the decomposition of $NH_4HS(s)$ at different temperatures are given in the table below.

TEMPERATURE (°C)	K_c
200	$7,5 \times 10^{-2}$
250	18×10^{-2}
300	40×10^{-2}

6.2.1 Is the decomposition of $NH_4HS(s)$ an EXOTHERMIC or ENDOTHERMIC reaction? (1)

6.2.2 Explain the answer to QUESTION 6.2.1 by using Le Chatelier's principle. (3)

6.2.3 Calculate the mass of $NH_4HS(s)$ that will be present at equilibrium at 250 °C. (8)
[17]

QUESTION 7 (Start on a new page.)

7.1 Phosphoric acid, $H_3PO_4(aq)$, is an example of an acid that can ionise in three steps, as shown below.

$$H_3PO_4(aq) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + H_2PO_4^-(aq) \quad K_a = 6,9 \times 10^{-3}$$

$$H_2PO_4^-(aq) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + HPO_4^{2-}(aq) \quad K_a = 6,2 \times 10^{-8}$$

$$HPO_4^{2-}(aq) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + PO_4^{3-}(aq) \quad K_a = 4,8 \times 10^{-13}$$

7.1.1 Which one is the stronger acid, $H_2PO_4^-$ or HPO_4^{2-}?
Give a reason for the answer by referring to the data above. (2)

7.1.2 Write down the FORMULA for the conjugate base of $H_2PO_4^-(aq)$. (1)

7.1.3 Identify a substance behaving as an ampholyte in the reactions above. (1)

Sodium hydrogen phosphate, $Na_2HPO_4(s)$, is dissolved in water.

7.1.4 Will the resulting solution be ACIDIC or BASIC? (1)

7.1.5 Write a balanced equation to explain the answer to QUESTION 7.1.4. (3)

7.2 Barium hydroxide, $Ba(OH)_2$, dissolves in water according to the balanced equation:

$$Ba(OH)_2(s) \rightarrow Ba^{2+}(aq) + 2OH^-(aq)$$

A 100 cm^3 solution is prepared by dissolving an unknown amount of $Ba(OH)_2$ at 25 °C.

25 cm^3 of this $Ba(OH)_2$ solution is reacted with 15 cm^3 of a 0,2 $mol \cdot dm^{-3}$ $HC\ell$ solution in a flask, according to the balanced equation:

$$Ba(OH)_2(aq) + 2HC\ell(aq) \rightarrow BaC\ell_2(aq) + 2H_2O(\ell)$$

The final pH of the solution is 12,62 at 25 °C.

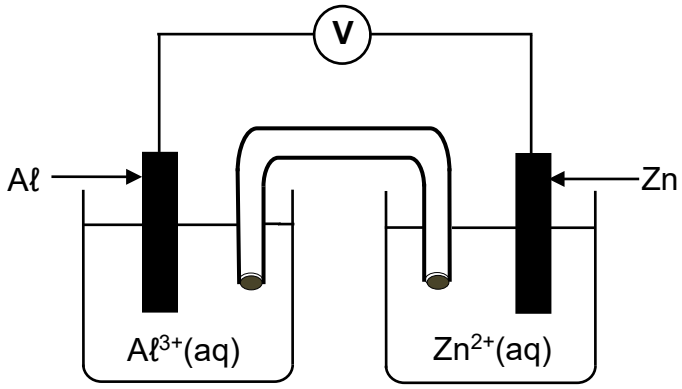
Calculate the:

7.2.1 Final concentration of the hydroxide ions in the flask (4)

7.2.2 Number of moles of $Ba(OH)_2$ used to prepare the 100 cm^3 solution (8)
[20]

QUESTION 8 (Start on a new page.)

The diagram below represents a cell that operates initially under standard conditions.



8.1 Define the term *electrolyte*. (2)

8.2 Which ion concentration, $A\ell^{3+}(aq)$ or $Zn^{2+}(aq)$, will increase? Give a reason for the answer. (2)

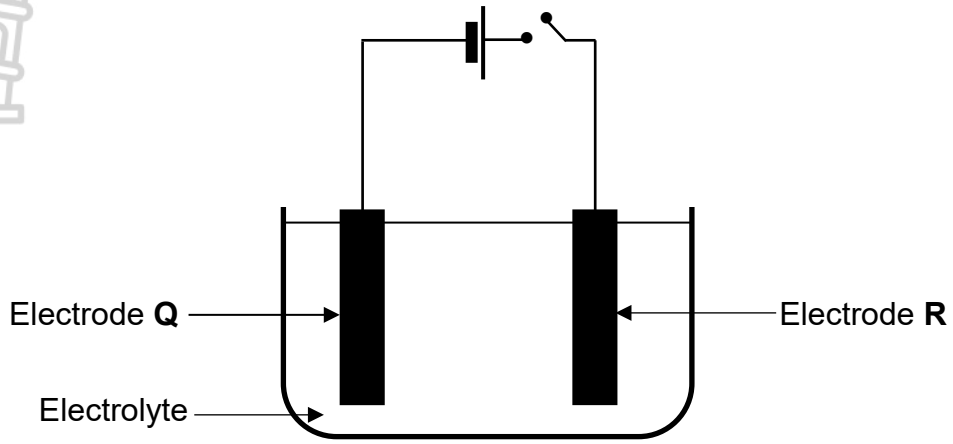
8.3 Write down the cell notation for this cell. (3)

The electrolyte in the aluminium half-cell is prepared by dissolving some aluminium sulphate, $A\ell_2(SO_4)_3(s)$, in water.

8.4 Calculate the mass of $A\ell_2(SO_4)_3(s)$ needed to prepare 250 cm^3 of this solution so that the cell operates initially under STANDARD CONDITIONS. (4)
[11]

QUESTION 9 (Start on a new page.)

The diagram below represents a cell used for the refining of copper.



The unrefined copper contains zinc as the only impurity.

9.1 Is this an ELECTROLYTIC or a GALVANIC cell? (1)

9.2 When the switch is closed, it is found after **T** hours that the amount of $Cu^{2+}(aq)$ ions in the electrolyte changed by 0,05 moles and 0,15 moles of Cu(s) were deposited on electrode **Q**.

9.2.1 How will the concentration of the zinc ions in the electrolyte be affected during the refining of the copper? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

9.2.2 Will the amount of $Cu^{2+}(aq)$ ions INCREASE or DECREASE?

Explain the answer in terms of the relative strengths of the oxidising agents present. (3)

9.2.3 Calculate the change in mass of electrode **R** after **T** hours. (6)
[11]

TOTAL: 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 *Standaarddruk*	1	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^θ	273 K
Charge on electron *Lading op elektron*	e	$1{,}6 \times 10^{-19}$ C
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/*by* 298 K	
$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ / $E^\theta_{sel} = E^\theta_{katode} - E^\theta_{anode}$ or/*of* $E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ / $E^\theta_{sel} = E^\theta_{reduksie} - E^\theta_{oksidasie}$ or/*of* $E^\theta_{cell} = E^\theta_{oxidising\ agent} - E^\theta_{reducing\ agent}$ / $E^\theta_{sel} = E^\theta_{oksideermiddel} - E^\theta_{reduseermiddel}$	

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

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 **1** **H** 1																	**2** **He** 4
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	**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	**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**	2,5 **85** **At**	**86** **Rn**
0,7 **87** **Fr**	0,9 **88** **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*

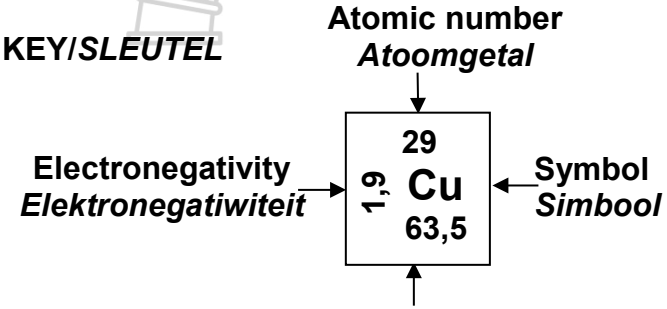


TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE

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

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

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

Increasing strength of oxidising agents /*Toenemende sterkte van oksideermiddels*

Increasing strength of reducing agents /*Toenemende sterkte van reduseermiddels*

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

NOVEMBER 2025

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 22 pages.
Hierdie nasienriglyne bestaan uit 22 bladsye.

QUESTION 1/*VRAAG 1*

1.1 C ✓✓ (2)

1.2 B ✓✓ (2)

1.3 A ✓✓ (2)

1.4 D ✓✓ (2)

1.5 A ✓✓ (2)

1.6 A ✓✓ (2)

1.7 A ✓✓ (2)

1.8 B ✓✓ (2)

1.9 C ✓✓ (2)

1.10 D ✓✓ (2)

[20]

QUESTION 2/*VRAAG 2*

2.1

2.1.1 D ✓ (1)

2.1.2 A and/*en* C ✓ (1)

2.1.3 E and/*en* F ✓ (1)

2.2

2.2.1

Marking criteria:
- Correct stem i.e. butanone. ✓
- Substituents (methyl) correctly identified. ✓
- IUPAC name is completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:
- *Korrekte stam, d.i. butanoon.*
- *Substituente (metiel) korrek geïdentifiseer.*
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.*

3-methylbutan-2-one ✓✓✓/3-methylbutanone

3-metielbutan-2-oon/3-metielbutanoon

ACCEPT/*AANVAAR*

3-methyl-2-butanone/ methylbutanone/*3-metiel-2-butanoon/metielbutanoon* (3)

2.2.2

Marking criteria:
- Correct stem i.e. heptane. ✓
- Substituents (dichloro and dimethyl) correctly identified. ✓
- IUPAC name is completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:
- *Korrekte stam, d.i. heptaan.*
- *Substituente (dichloro en dimetiel) korrek geïdentifiseer.*
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.*

2,6-dichloro-2,5-dimethylheptane ✓✓✓

2,6-dichloro-2,5-dimetielheptaan (3)

2.2.3

Marking criteria:
- Correct stem i.e. hexene. ✓
- Substituents (ethyl and methyl) correctly identified. ✓
- IUPAC name is completely correct including numbering, sequence, hyphens and commas. ✓

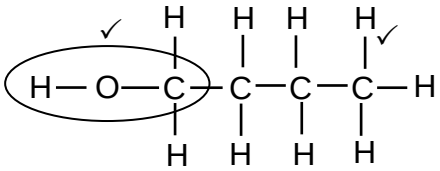
Nasienkriteria:
- *Korrekte stam, d.i. hekseen.*
- *Substituente (etiel en metiel) korrek geïdentifiseer.*
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.*

3-ethyl-2-methylhex-2-ene ✓✓✓/3-ethyl-2-methyl-2-hexene

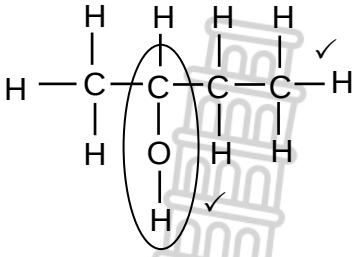
3-etiel-2-metielheks-2-een/3-etiel-2-metiel-2-hekseen (3)

2.2.4

Marking criteria/*Nasienkriteria:*
- Hydroxyl group on the 1st C-atom. ✓
  Hidroksiel groep op 1ste C-atoom.
- Whole structure correct. ✓
  Hele struktuur korrek.



Marking criteria/*Nasienkriteria:*
- Hydroxyl group on the 2nd C-atom. ✓
  Hidroksiel groep op 2de C-atoom.
- Whole structure correct. ✓
  Hele struktuur korrek.



IF/*INDIEN*
- More than one functional group/wrong functional group: $^0/_2$ per molecule/*molekule*
  Meer as een funksionele groep/foutiewe funksionele groep:
- Condensed structural formulae used
  Gekondenseerde struktuurformules gebruik: Max/*Maks.* $^2/_4$
- Bond between O and H not shown, accept.
  Binding tussen O en H nie gewys nie, aanvaar.

(4)

2.3.1 Combustion/oxidation/*Verbranding/oksidasie* ✓ (1)

2.3.2

Marking criteria:	***Nasienkriteria:***
(a) Volume O_2 and C_3H_8 used. ✓	*(a) Volume O_2 en C_3H_8 gebruik.* ✓
(b) Volume CO_2 and H_2O produced ✓	*(b) Volume CO_2 en H_2O gevorm* ✓
(c) Volume O_2 remaining ✓	*(c) Volume O_2 wat oorbly* ✓
(d) Addition of the three volumes ✓	*(d) Optel van drie volumes* ✓
(e) Correct final answer 66 cm^3 or 0,066 dm^3 ✓	*(e) Korrekte finale antwoord 66 cm^3 of 0,066 dm^3* ✓

OPTION 1/*OPSIE 1*:

$V(O_2)_{used/gebruik} = 5V(C_3H_8)$
$= (5)(8)$
$= 40\ cm^3$ ✓ **(a)**

$V(CO_2)_{formed/gevrom} = 3V(C_3H_8)$
$= (3)(8)$
$= 24\ cm^3$

$V(H_2O)_{formed/gevrom} = 4V(C_3H_8)$
$= (4)(8)$
$= 32\ cm^3$ ✓ **(b)**

$V(O_2)_{unused} = 50 - 40 = 10\ cm^3$ ✓ **(c)**

Volume gas in the container = 10 + 24 + 32 ✓ **(d)**
Total volume gas in the container = 66 cm^3 ✓ **(e)**

OPTION 2/ *OPSIE 2*:

	C_3H_8	O_2	CO_2	H_2O
Initial volume (cm^3) *Aanvanklike volume (cm^3)*	8	50	0	0
Change volume (cm^3) ✓ **(a)** *Verandering in volume (cm^3)*	-8	-40	24	32 ✓ **(b)**
Final volume (cm^3) *Finale volume (cm^3)*	0	10 ✓ **(c)**	24	32
Total volume of gases in container (cm^3) *Totale volume gas in houer (cm^3)*		10 + 24 +32 ✓ **(d)** = 66 cm^3 ✓ **(e)**		

ACCEPT/AANVAAR:
If subtraction not shown, give mark for the 10 *cm^3*/
Indien aftrekking nie getoon, gee punt vir 10 cm^3.

$n(C_3H_8) : n(O_2) : n(CO_2) : n(H_2O)$
1 : 5 : 3 : 4

V = 8 ✓ **(a)** 40 24 ✓ **(b)** 32

✓ **(c)**
Total volume = 10 + 24 + 32 ✓ **(d)**
= 66 cm^3 ✓ **(e)**

ACCEPT/ *AANVAAR*:
Moles calculated using 22,4 dm^3 or any other molar gas volume.
Mol bereken deur 22,4 dm^3 of ander molêre gasvolume te gebruik.

Marking criteria:	***Nasienkriteria:***
(a) $V(O_2)$ and $V(C_3H_8)$/ $n(O_2)$ and $n(C_3H_8)$ used. ✓ (b) $V(CO_2)$ and $V(H_2O)$/ $n(CO_2)$ and $n(H_2O)$ produced. ✓ (c) $V(O_2)$/ $n(O_2)$ remaining ✓ (d) Addition of the three volumes/moles ✓ (e) Correct final answer 66 cm^3 or 0,066 dm^3 ✓	*(a) $V(O_2)$ en $V(C_3H_8)$/ $n(O_2)$ en $n(C_3H_8)$ gebruik.* ✓ *(b)* $V(CO_2)$ en $V(H_2O)$/ $n(CO_2)$ en $n(H_2O)$ gevorm.✓ *(c) $V(O_2)$/ $n(O_2)$ wat oorbly* ✓ *(d) Optel van drie volumes/moles* ✓ *(e) Korrekte finale antwoord 66 cm^3* of 0,066 dm^3 ✓

$n(C_3H_8) = \frac{V}{V_m}$
$= \frac{0,008}{22,4}$
$= 3,571\times10^{-4}$ mol

$n(O_2)_{change} = (5)3,571 \times 10^{-4}$
$= 1,7855 \times 10^{-3}$ mol ✓ **(a)**

$n(O_2)_{change} = \frac{V}{V_m}$
$1,7855 \times 10^{-3} = \frac{V}{22,4}$
$V(O_2)_{change} = 0,04\ dm^3$

$V(O_2)_{remaining} = 0,05 - 0,04$
$= 0,01\ dm^3$ ✓ **(c)**

$n(CO_2) = (3)\ 3,571\times10^{-4}$
$= 1,0713 \times 10^{-3}$ mol

$n(CO_2) = \frac{V}{V_m}$
$1,0713 \times 10^{-3} = \frac{V}{22,4}$
$V(CO_2) = 0,024\ dm^3$

$n(H_2O) = (4)3,571\times10^{-4}$
$= 1,43 \times 10^{-3}$ mol ✓ **(b)**

$n(H_2O) = \frac{V}{V_m}$
$1,43 \times 10^{-3} = \frac{V}{22,4}$
$V(H_2O) = 0,032\ dm^3$

$V_{Total} = 0,01 + 0,024 + 0,032$ ✓ **(d)**
$= 0,066\ dm^3$ ✓ **(e)**

$n(C_3H_8) = \frac{V}{V_m}$
$= \frac{0,008}{22,4}$
$= 3,571\times10^{-4}$ mol

$n(O_2)_{change} = (5)3,571 \times 10^{-4}$
$= 1,7855 \times 10^{-3}$ mol ✓ **(a)**

$n(O_2)_{ini} = \frac{V}{V_m}$
$= \frac{0,05}{22,4}$
$= 2,232 \times 10^{-3}$ mol

$n(O_2)_{remaining}$
$= 2,232 \times 10^{-3} - 1,7855 \times 10^{-3}$
$= 4,465 \times 10^{-4}$ mol ✓ **(c)**

$n(CO_2) = (3)3,571\times10^{-4}$
$= 1,0713 \times 10^{-3}$ mol

$n(H_2O) = (4)x\ 3,571\times10^{-4}$
$= 1,43 \times 10^{-3}$ mol ✓ **(b)**

n_{Total}
$= 4,465 \times 10^{-4} + 1,0713 \times 10^{-3} + 1,43 \times 10^{-3}$ ✓ **(d)**
$= 2,95 \times 10^{-3}$ mol

$n_{Total} = \frac{V}{V_m}$
$2,95 \times 10^{-3} = \frac{V}{22,4}$
$V_{Total} = 0,066\ dm^3$ ✓ **(e)**

(5)
[22]

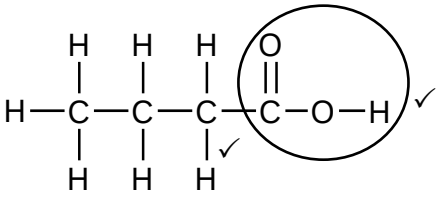
QUESTION 3/*VRAAG 3*

3.1 A series of organic compounds that can be described by the same general formula. ✓ **(1 OR 0)**
OR
A series of organic compounds in which one member differs from the next by a CH_2 group.

'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word. **(1 OF 0)**
OF
'n Reeks organiese verbindings waarin die een lid van die volgende verskil met 'n CH_2-groep (1)

3.2 Ester ✓ and carboxylic acid ✓/*Ester en karboksielsuur* (2)

3.3
3.3.1



Marking criteria/*Nasienkriteria:*
(a) Functional group correct. ✓
Funksionele groep korrek.
(b) Whole structure correct. ✓
Hele struktuur korrek. (2)

3.3.2 Methyl propanoate/Propyl methanoate/Ethyl ethanoate ✓✓ **(2 OR/*OF* 0)**
Metielpropanoaat/Propielmetanoaat/Etieletanoaat (2)

3.4.1 Hydrogen bonds / *Waterstofbindings* ✓ (1)

3.4.2 Dipole-dipole forces /*Dipool-dipoolkragte* ✓ (1)

3.5 A ✓
The hydrogen bond is stronger than the dipole-dipole force. ✓
OR
The dipole-dipole force is weaker than the hydrogen bonds.
OR
Compound A has stronger intermolecular forces (than B).
OR
Compound B has weaker intermolecular forces (than A).

Die waterstofbinding is sterker as die dipool-dipoolkrag.
OF
Die dipool-dipoolkragte is swakker as die waterstofbinding.
OF
Verbinding A het sterker intermolekulêre kragte (as B).
OF
Verbinding B het swakker intermolekulêre kragte (as A). (2)

3.6 Decreases/*Afneem* ✓ (1)
[12]

QUESTION 4/*VRAAG 4*

4.1

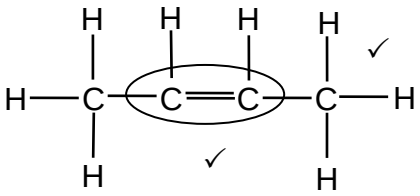
4.1.1 2-bromo✓butane✓/*2-bromobutaan* (2)

4.1.2 NaBr/Sodium bromide/*Natriumbromied* ✓ (1)

4.1.3 Addition/*Addisie* ✓
Hydrohalogenation/Hydrobromination/*Hydrohalogenering/Hidrobrominering* ✓ (2)

4.1.4 (Concentrated) sulphuric acid/ H_2SO_4/Phosphoric acid/H_3PO_4/
(Gekonsentreerde) swaelsuur/Fosforsuur ✓ (1)

4.1.5



Marking criteria/*Nasienkriteria:*
(a) Correct functional group. ✓
Funksionele groep korrek.
(b) Whole structure correct. ✓
Hele struktuur korrek.
IF/*INDIEN*
- More than one functional group/wrong functional group:
- *Meer as een funksionele groep/foutiewe funksionele groep:* $^0/_2$
- Correct condensed formula:
Korrekte gekondenseerde formule Max: $^1/_2$

(2)

4.1.6 Concentrated strong base/*Gekonsentreerde sterk basis* ✓
Concentrated/*Gekonsentreerde* NaOH/KOH/LiOH (1)

4.2

4.2.1

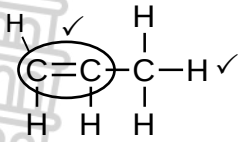
Marking criteria/*Nasienkriteria*
If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./*Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*
The underlined phrases must be in the correct context. / *Die onderstreepte frases moet in die korrekte konteks wees.*

The chemical process/reaction in which longer chain hydrocarbon/alkane molecules/ are broken down to shorter (more useful) molecules. ✓✓

Die chemiese proses/reaksie waarin langer kettingkoolwaterstof/alkaan-molekule afgebreek word in korter (meer bruikbare) molekules. (2)

4.2.2 Decolourisation/colour fades/becomes lighter in colour/colourless ✓
Ontkleuring/kleur raak dowwer/word ligter van kleur/kleurloos (1)

4.2.3



Marking criteria/*Nasienkriteria:*
(a) Correct functional group. ✓
Funksionele groep korrek.
(b) Whole structure correct. ✓
Hele struktuur korrek. (2)

4.2.4 **X** / C_3H_6 / Propene / *Propeen* ✓

- **X** is unsaturated/has a double bond/is an alkene. ✓

ANY ONE

- **X** undergoes addition. ✓

OR

Alkenes are more reactive than alkanes/Unsaturated compounds react faster than saturated compounds.
Addition reaction is faster than substitution
Addition reaction does not need UV/light.

- ***X** is onversadig/besit 'n dubbelbinding/is 'n alkeen.*

ENIGE EEN

- ***X** ondergaan addisie.*

OF

Alkene is meer reaktief as alkane./Onversadigde verbindings reageer vinniger as versadigde verbindings.
Addisiereaksie is vinniger as substitusie.
Addisiereaksie benodig nie UV/lig. (3)
[17]

QUESTION 5/*VRAAG 5*

5.1

NOTE/*LET WEL*
Give the mark for per unit time only if in context of reaction rate.
Gee die punt vir per eenheid tyd slegs indien in konteks met reaksietempo.

ANY ONE:

- Change in concentration ✓ of products/reactants per (unit) time. ✓
- Change in amount/number of moles/volume/mass of products or reactants per (unit) time.
- Amount/number of moles/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/reaktanse per (eenheid) tyd.*
- *Verandering in hoeveelheid/getal mol/volume/massa van produkte of reaktanse per (eenheid) tyd.*
- *Hoeveelheid/getal mol/volume/massa van produkte gevorm/reaktanse gebruik per (eenheid) tyd.*
- *Tempo van verandering in konsentrasie/ hoeveelheid/aantal mol/ volume/massa.* ***(2 of 0)*** (2)

5.2.1 10 (s) ✓ (1)

5.2.2

Marking criteria	***Nasienkriteria:***
(a) Calculate the change: $[O_2]_{final} - [O_2]_{initial}$ / $n(O_2)_{final} - n(O_2)_{initial}$ / $n(CO_2)_{final} - n(CO_2)_{initial}$. ✓ Accept: 0,265 to 0,27 for $[O_2]_{initial}$ (b) Substitute 10 s in rate formula. ✓ (c) Multiply rate / concentration of O_2 by 3 dm^3. ✓ (d) USE mol ratio: $n(O_2) : n(CO_2) = 1 : 2$ ✓ (e) Final correct answer = 0,072 ($mol \cdot s^{-1}$) ✓ RANGE: 0,06 – 0,072	(a) *Bereken die verandering:* $[O_2]_{finale} - [O_2]_{aanvank}$ / $n(O_2)_{finale} - n(O_2)_{aanvanklik}$ / $n(CO_2)_{finale} - n(CO_2)_{aanvanklik}$ ✓ *Aanvaar: 0,265 tot 0,27 vir* $[O_2]_{aanvank}$ (b) *Vervang 10 s in tempoformule.* ✓ (f) *Vermenigvuldig tempo/konsentrasie* O_2 *met 3* dm^3. ✓ (c) *Gebruik molverhouding:* $n(O_2) : n(CO_2) = 1 : 2$ ✓ (d) *Finale korrekte antwoord* = 0,072 ($mol \cdot s^{-1}$) ✓ GEBIED: 0,06 – 0,072

OPTION 1/*OPSIE 1*:

$$\text{Rate/}\textit{Tempo} = -\frac{\Delta c(O_2)}{\Delta t}$$

$$= -\left(\frac{0,15 - 0,27}{10 - 0}\right) \checkmark\textbf{(a)} \checkmark\textbf{(b)}$$

$$= 0,012 \text{ mol} \cdot dm^{-3} \cdot s^{-1}$$

Rate/*Tempo* (O_2) in $mol \cdot s^{-1}$
= cV
= (0,012)(3) ✓**(c)**
= 0,036 $mol \cdot s^{-1}$

Rate/*Tempo* (CO_2) = 2 x rate (O_2)
= 2 x 0,036 ✓**(d)**
= 0,072 ($mol \cdot s^{-1}$) ✓**(e)**

OPTION 2/*OPSIE 2*:

$\Delta c(O_2) = \boxed{0,27 - 0,15}$ ✓**(a)**
= 0,12 $mol \cdot dm^{-3}$

$\Delta n(O_2)$ = cV
= 0,12(3) ✓**(c)**
= 0,36 mol

$\Delta n(CO_2) = 2n(O_2)$ ✓**(d)**
= 2(0,36)
= 0,72 mol

$$\text{Rate}(CO_2) = \frac{\Delta n}{\Delta t}$$

$$= \frac{0,72}{10 - 0} \checkmark\textbf{(b)}$$

= 0,072 ($mol \cdot s^{-1}$) ✓**(e)**

OPTION 3/*OPSIE 3*:

$n(O_2)_{at\ 0s}$ = cV
= 0,27 x 3 ✓**(c)**
= 0,81 mol

$n(O_2)_{at\ 10s}$ = cV
= 0,15 x 3
= 0,45 mol

$$\text{Rate } (O_2) = -\frac{\Delta n}{\Delta t}$$

$$= -\left(\frac{0,45 - 0,81}{10 - 0}\right) \checkmark\textbf{(a)} \checkmark\textbf{(b)}$$

= 0,036 $mol \cdot s^{-1}$

Rate (CO_2) = 2 x rate (O_2)
= 2 x 0,036 ✓**(d)**
= 0,072 ($mol \cdot s^{-1}$) ✓**(e)**

(5)

5.2.3 O_2/Oxygen/*Suurstof* ✓ (1)

5.2.4 Increases/*Neem toe* ✓

Higher reaction rate./Concentration of reactants are higher. ✓
Hoër reaksietempo./Konsentrasie van die reaktanse is hoër.

ACCEPT/AANVAAR: pressure increased/*druk verhoog*. (2)

5.3.1 Absorption ✓
Absorpsie (1)

5.3.2

Marking criteria/*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.*
The underlined phrases must be in the correct context. / *Die onderstreepte frases moet in die korrekte konteks wees.*

Unstable (high energy) transition state from reactants to products. ✓✓
Onstabiele (hoë energie) oorgangs-toestand van reaktanse na produkte

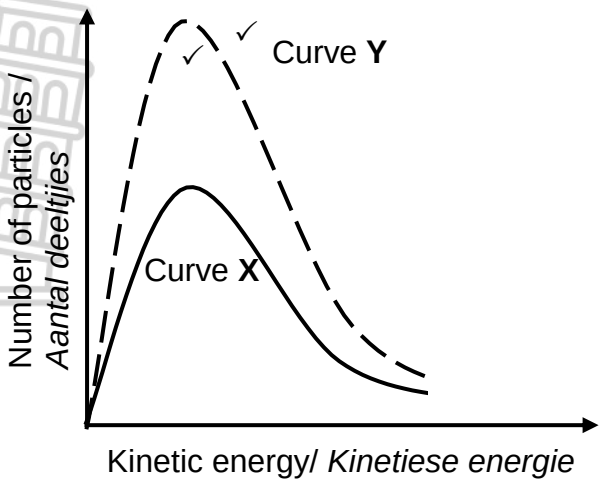
ACCEPT/AANVAAR:
Unstable (high energy) transition state between reactants and products. ✓✓
Onstabiele (hoë energie) oorgangs-toestand tussen reaktanse en produkte. (2)

5.3.3
- Catalyst provides an alternative path with lower activation energy / lowers the activation energy. ✓
- More particles have sufficient (kinetic) energy / kinetic energy greater (or equal to) activation energy. ✓
- More effective collisions per unit time/second. ✓
  OR
  Higher frequency of effective collisions.

- *Katalisator verskaf 'n alternatiewe roete met 'n laer aktiveringsenergie/ Verlaag die aktiveringsenergie.*
- *Meer deeltjies het genoeg (kinetiese) energie/kinetiese energie groter (of gelyk aan) aktiveringsenergie.*
- *Meer effektiewe botsings per eenheid tyd/sekonde.*
  OF
  Hoër frekwensie van effektiewe botsings. (3)

5.3.4 Remains the same/*Bly dieselfde* ✓ (1)

5.3.5



Marking criteria:

- Both curves start at origin and have correct shape with peaks at same E_k. ✓
- Peak of curve Y must be higher than curve X with peaks at same E_k. ✓

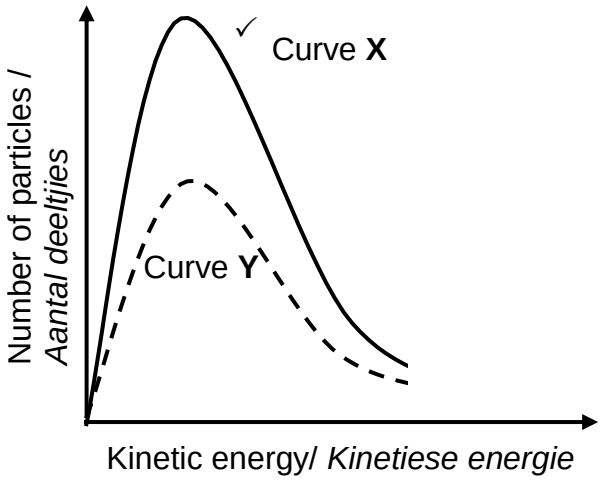
Nasienkriteria:

- *Beide kurwes begin by die oorsprong en het dieselfde vorm met maksimums by dieselfde E_k.*
- *Maksimum van kurwe Y moet hoër wees as kurwe X met maksimums by dieselfde E_k.*

IF/*INDIEN:*

- Both curves not labelled./ Beide kurwes nie benoem $0/2$
- Curves intersect at any other point, beside the origin. Kurwes kruis by enige ander punt as oorsprong. Max: $1/2$.

IF/*INDIEN:*



Max/Maks: $1/2$

(2)
[20]

QUESTION 6/*VRAAG 6*

6.1
6.1.1

Marking criteria/*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.*
The underlined phrases must be in the correct context. / *Die onderstreepte frases moet in die korrekte konteks wees.*

When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will cancel/oppose the disturbance. ✓✓
Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n nuwe ewewig instel deur die reaksie te bevoordeel wat die versteuring kanselleer/teenwerk. (2)

6.1.2 (Mass) decreases./(*Massa) Afneem.* ✓ (1)

6.1.3
- Decrease in amount of OH^- ions /concentration of OH^- ions, favours the reaction that increases the amount/concentration of OH^- ions. ✓ **OR**
  Acid/ HCℓ/H^+ reacts with OH^- ions.
- The forward reaction is favoured ✓ **OR**
  The amount/concentration of the products increases.
- *'n Afname in hoeveelheid* OH^--ione */konsentrasie* OH^--ione *bevoordeel die reaksie wat die hoeveelheid/konsentrasie van* OH^-*-ione laat toeneem.* ***OF***
  *Suur /*HCℓ/H^+ *reageer met* OH^- *ione.*
- *Die voorwaartse reaksie is bevoordeel.* ***OF***
  Die hoeveelheid/konsentrasie van die produkte neem toe. (2)

6.2.1 Endothermic/*Endotermies* ✓ (1)

6.2.2
- With an increase in the temperature the Kc value increases. ✓
- The concentration of the products increases. **OR** Concentration of reactants decreases. **OR** The forward reaction is favoured. ✓
- (According to Le Chatelier's principle) an increase in temperature favours the endothermic reaction. ✓

- *Met 'n toename in temperatuur neem die Kc-waarde toe.*
- *Die konsentrasie van die produkte neem toe*. **OF** *Konsentrasie van die reaktante neem af.* **OF** *Voorwaartse reaksie is bevoordeel*.
- *(Volgens Le Chatelier se beginsel) sal 'n toename in temperatuur die endotermiese reaksie bevoordeel.* (3)

6.2.3

CALCULATIONS USING MOLES
BEREKENINGE WAT MOL GEBRUIK
Marking criteria*:*

(a) Calculate number of moles NH_4HS ($\frac{70}{51}$) ✓ **OR** 1,37 moles
(b) **USING RATIO**: $NH_4HS : NH_3 : H_2S : = 1 : 1 : 1$ ✓
(c) Calculate $c(NH_3)$ and $c(H_2S)$ at equilibrium (divide equilibrium moles by 3) ✓
(d) Correct K_c expression ✓
(e) Substitute $K_c = 18 \times 10^{-2}$ ✓
(f) $n(NH_4HS)_{eq} = n(NH_4HS)_{in} - n(NH_4HS)_{change}$ OR
$m(NH_4HS)_{eq} = m(NH_4HS)_{in} - m(NH_4HS)_{change}$ ✓
(g) Substitute 51 in $n = \frac{m}{M}$ ✓
(h) ***CORRECT*** final answer: m = 5,61 g ✓
Range: 4,96 – 5,74 g

***Nasienkriteria*:**

(a) *Bereken aantal mol NH_4HS ($\frac{70}{51}$)* ✓ ***OF** 1,37 mol*
(b) ***GEBRUIK VERHOUDING**: $NH_4HS : NH_3 : H_2S : = 1 : 1 : 1$* ✓
(c) *Bereken $c(NH_3)$ en $c(H_2S)$ by ewewig (deel ewewig mol met 3)* ✓
(d) *Korrekte K_c uitdrukking* ✓
(e) *Vervang $K_c = 18 \times 10^{-2}$* ✓
(f) *$n(NH_4HS)_{eq} = n(NH_4HS)_{in} - n(NH_4HS)_{change}$ OF*
$m(NH_4HS)_{eq} = m(NH_4HS)_{in} - m(NH_4HS)_{change}$ ✓
(g) *Vervang 51 in $n = \frac{m}{M}$* ✓
(h) ***KORREKTE** finale antwoord: m = 5,61 g* ✓
Gebied: 4,95 – 5,74 g

OPTION 1/*OPSIE 1*:

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

$= \frac{70}{51}$ ✓**(a)**

	$NH_4HS(s)$	$NH_3(g)$	$H_2S(g)$	
Initial amount (mol) Aanvanklike *hoeveelheid* (mol)	1,37	0	0	
Change (mol) *Verandering (mol)*	x	x	x	✓**(b)**
Equilibrium amount (mol) *Ewewig hoeveelheid (mol)*	1,37 - x	x	x	
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*		$\frac{x}{3}$	$\frac{x}{3}$	✓**(c)**

$K_c = [NH_3][H_2S]$ ✓**(d)**

✓**(e)** $18 \times 10^{-2} = \left(\frac{x}{3}\right)^2$

$x = 1,27$

$n(NH_4HS)_{eq} = 1,37 - 1,27$ ✓**(f)**
$= 0,1$ mol

$m(NH_4HS)_{eq} = nM$
$= 0,1 \times 51$ ✓**(g)**
$= 5,1$ g ✓**(h)**

No K_c expression, correct substitution
Geen K_c- uitdrukking, korrekte substitusie: Max./*Maks.* $^7/_8$

Wrong K_c expression/
Verkeerde K_c-uitdrukking: Max./*Maks.* $^6/_8$

OPTION 2/*OPSIE 2*:

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

$= \frac{70}{51}$ ✓**(a)**

$K_c = [NH_3][H_2S]$ ✓**(d)**

✓**(e)** $18 \times 10^{-2} = x^2$

$x = 0,42$

	$NH_4HS(s)$	$NH_3(g)$	$H_2S(g)$	
Initial amount (mol) Aanvanklike *hoeveelheid* (mol)	1,37	0	0	
Change (mol) *Verandering (mol)*	1,26	1,26	1,26	✓**(b)**
Equilibrium amount (mol) Ewewig hoeveelheid (mol)	✓**(f)** 0,11	1,26	1,26	
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)		0,42	0,42	✓**(c)**

$m(NH_4HS)_{eq} = nM$

$= 0,11 \times 51$ ✓**(g)**

$= 5,61$ g ✓**(h)**

OR/*OF*

$m(NH_4HS)_{change} = nM$

$= 1,26 \times 51$ ✓**(g)**

$= 64,26$ g

$m(NH_4HS)_{eq} = 70 - 64,26$ ✓**(f)**

$= 5,74$ g ✓**(h)**

No K_c expression, correct substitution
Geen K_c- uitdrukking, korrekte substitusie:
Max./*Maks.* $^7/_8$

Wrong K_c expression/
Verkeerde K_c-uitdrukking: Max./*Maks.* $^6/_8$

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK

	$NH_4HS(s)$	$NH_3(g)$	$H_2S(g)$
Initial concentration ($mol \cdot dm^{-3}$) Aanvanklike konsentrasie ($mol \cdot dm^{-3}$)		0	0
Change ($mol \cdot dm^{-3}$) *Verandering ($mol \cdot dm^{-3}$)*		✓**(b)** x	x
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)		x	x

✓**(d)** $K_c = [NH_3][H_2S]$

✓**(e)** $18 \times 10^{-2} = x^2$

$x = 0,424 \text{ mol} \cdot dm^{-3}$

$nNH_{3(change)} = cV$

$= (0,424)(3)$ ✓**(c)**

$= 1,272 \text{ mol}$

$n(NH_4HS)_{change} = nNH_{3(change)} = 1,272 \text{ mol}$

✓**(a)**

$n(NH_4HS)_{eq} = \frac{70}{51} - 1,272$ ✓**(f)**

$= 0,098 \text{ mol}$

$m(NH_4HS)_{eq} = nM$

$= 0,098 \times 51$ ✓**(g)**

$= 4,998 \text{ g}$ ✓**(h)**

OR/*OF*

$m(NH_4HS)_{change} = nM$

$= 1,272 \times 51$ ✓**(g)**

$= 64,872 \text{ g}$

$m(NH_4HS)_{eq} = 70 - 64,872$ ✓**(f)**

$= 5,128 \text{ g}$ ✓**(h)**

No K_c expression, correct substitution
Geen K_c- uitdrukking, korrekte substitusie: Max./*Maks.* $^7/_8$

Wrong K_c expression/
Verkeerde K_c-uitdrukking: Max./*Maks.* $^6/_8$

(8)
[17]

QUESTION 7/*VRAAG 7*

7.1.1 $H_2PO_4^-$ ✓
K_a of $H_2PO_4^-$ greater/higher than K_a of HPO_4^{2-} ✓
Accept: K_a of $H_2PO_4^-$ greater (2)

7.1.2 HPO_4^{2-} ✓ (1)

7.1.3 $H_2PO_4^-$ **OR/*OF*** HPO_4^{2-} ✓ (1)

7.1.4 Basic/*Basies* ✓ (1)

7.1.5

Marking criteria/*Nasienkriteria:*
- Reactants ✓ Products ✓ Balancing ✓
  Reaktanse ✓ *Produkte* ✓ Balansering ✓
- Ignore/*Ignoreer* → and phases/*en fases*

Marking rule 6.3.10/*Nasienreël 6.3.10*

$HPO_4^{2-}(aq) + H_2O(\ell) \rightleftharpoons H_2PO_4^-(aq) + OH^-(aq)$ bal ✓
✓ ✓

OR/*OF*

$HPO_4^{2-}(aq) + 2H_2O(\ell) \rightleftharpoons H_3PO_4(aq) + 2OH^-(aq)$

ACCEPT/AANVAAR:

$Na_2HPO_4(aq) + H_2O(\ell) \rightleftharpoons NaH_2PO_4(aq) + NaOH(aq)$

$Na_2HPO_4(aq) + H_2O(\ell) \rightleftharpoons H_2PO_4^-(aq) + 2Na^+(aq) + OH^-(aq)$

$Na_2HPO_4(aq) + H_2O(\ell) \rightleftharpoons NaH_2PO_4(aq) + NaOH(aq)$

$Na_2HPO_4(aq) + 2H_2O(\ell) \rightleftharpoons H_3PO_4(aq) + 2Na^+(aq) + 2OH^-(aq)$

$Na_2HPO_4(aq) + 2H_2O(\ell) \rightleftharpoons H_3PO_4(aq) + 2NaOH(aq)$ (3)

7.2.1

Marking criteria:	***Nasienkriteria:***
a) Any formula: pH = -log[H_3O^+] / pH = -log[H^+] / [H_3O^+] = 10^{-pH}/ pOH = -log[OH^-] / [H_3O^+][OH^-] = 10^{-14} / pH + pOH = 14 ✓ **b)** Substitute 12,62 in pH = -log[H_3O^+]/ pH + pOH = 14 ✓ **c)** Substitute calculated [H_3O^+] in [H_3O^+][OH^-] / 1,38 in pOH = -log[OH^-] ✓ **d)** Final answer: 0,04 mol·dm^{-3} ✓ RANGE: 0,04 – 0,042 mol·dm^{-3}	***a)*** Enige formule: pH = - log[H_3O^+] / pH = - log[H^+] /[H_3O^+] = 10^{-pH} / pOH = - log[OH^-] / [H_3O^+][OH^-] = 10^{-14} / pH + pOH = 14 ✓ ***b)*** *Vervang* 12,62 in pH = - log[H_3O^+]/ pH + pOH = 14 ✓ ***c)*** *Vervang berekende* [H_3O^+] in [H_3O^+][OH^-] / 1,38 in pOH = -log[OH^-] ✓ ***d)*** *Finale antwoord: 0,04 mol·dm^{-3}* ✓ GEBIED: 0,04 – 0,042 mol·dm^{-3}

OPTION 1/*OPSIE 1*

pH = - log[H_3O^+]

12,62 ✓**(b)** = - log[H_3O^+] **OR/*OF*** [H_3O^+] = $10^{-12,62}$

[H_3O^+] = 2,4 x 10^{-13}

Any one/*Enige een* ✓**(a)**

[H_3O^+][OH^-] = 10^{-14}

✓**(c)**

(2,4 x 10^{-13})[OH^-] = 1 x 10^{-14}

[OH^-] = 0,0417 mol·dm^{-3} ✓**(d)** (0,04)

OPTION 2/*OPSIE 2*

pH + pOH = 14

✓**(b)** 12,62 + pOH = 14

pOH = 1,38

Any one/*Enige een* ✓**(a)**

pOH = -log[OH^-]

1,38 ✓**(c)** = -log[OH^-]

[OH^-] = 0,042 mol·dm^{-3} ✓**(d)** (0,04)

(4)

7.2.2

POSITIVE MARKING FROM QUESTION 7.2.1/
POSITIEWE NASIEN VANAF VRAAG 7.2.1

Marking criteria

(a) Substitute: 0,2 mol·dm^{-3} **AND** 0,015 dm^3 in n = cV ✓

(b) **USING RATIO**: n(OH^-) : nHCℓ = 1 : 1 / n($Ba(OH)_2$) : n(HCℓ) = 1 : 2 ✓

(c) Substitute: c(OH^-) **AND** 0,04 in n = cV ✓

(d) Calculate $n(OH^-)_{ini}$ = $n(OH^-)_{reacted\ with\ HCl}$ + $n(OH^-)_{fin}$ ✓✓

(e) **USING RATIO**: $n(Ba(OH)_2)$: $n(OH^-)$ = 1 : 2 ✓

(f) Multiply n$Ba(OH)_2$ in 25 cm^3 by 4 **OR** Divide by 0,025 dm^3 **AND** multiply by 0,1 dm^3 ✓

(g) Final correct answer: 9,34 x 10^{-3} mol ✓
Range: 9,2 x 10^{-3} – 9,36 x 10^{-3}

Nasienkriteria:

*(a) Vervang: 0,2 mol·dm^{-3} **EN** 0,015 dm^3 in n = cV ✓*

*(b) **GEBRUIK VERHOUDING**: n(OH^-) : nHCℓ = 1 : 1 / $n(Ba(OH)_2$) : n(HCℓ) = 1 : 2 ✓*

*(c) Vervang: c(OH^-) **EN** 0,04 in n = cV ✓*

(d) Bereken $n(OH^-)_{ini}$ = $n(OH^-)_{reageer\ met\ HCl}$ + $n(OH^-)_{finale}$ ✓✓

*(e) **GEBRUIK VERHOUDING**: $n(Ba(OH)_2)$: $n(OH^-)$ = 1 : 2 ✓*

(f) Vermenigvuldig n$Ba(OH)_2$ in 25 cm^3 met 4 ***OF*** Deel deur 0,025 dm^3 **EN** vermenigvuldig met 0,1 dm^3

(g) Finale korrekte antwoord: 9,34 x 10^{-3} mol ✓
Gebied: 9,2 x 10^{-3} – 9,36 x 10^{-3}

OPTION 1/*OPSIE 1*

nHCℓ = cV
= (0,2)(0,015) ✓**(a)**
= 3 x 10^{-3} mol

nOH^- = nHCℓ ✓**(b)**
= 3 x 10^{-3} mol

nOH^-_{final} = cV
= (0,0417)(0,04) ✓**(c)**
= 1,67 x 10^{-3} mol

nOH^-_{ini} = 3 x 10^{-3} + 1,67 x 10^{-3} ✓✓ **(d)**
= 4,67 x 10^{-3} mol

$n(Ba(OH)_2) = \frac{1}{2} nOH^-_{ini}$
= $\frac{1}{2}$ (4,67 x 10^{-3}) ✓**(e)**
= 2,33 x 10^{-3} mol in 25 cm^3

In 100 cm^3 = (4)(2,33 x 10^{-3}) ✓**(f)**
= 9,34 x 10^{-3} mol ✓**(g)**

OPTION 2/*OPSIE 2*

nHCℓ = cV
= (0,2)(0,015) ✓**(a)**
= 3 x 10^{-3} mol

$n(Ba(OH)_2) = \frac{1}{2} nHCl$
= $\frac{1}{2}$ (3 x 10^{-3}) ✓**(b)**
= 1,5 x 10^{-3} mol

nOH^-_{final} = cV
= (0,0417)(0,04) ✓**(c)**
= 1,67 x 10^{-3} mol

$n(Ba(OH)_2) = \frac{1}{2} nOH^-_{ini}$
= $\frac{1}{2}$ (1,67 x 10^{-3}) ✓**(e)**
= 8,33 x 10^{-4} mol

$n(Ba(OH)_2)_{ini}$ = 1,5 x 10^{-3} + 8,33 x 10^{-4} ✓✓ **(d)**
= 2,33 x 10^{-3} mol in 25 cm^3

In 100 cm^3 = (4)(2,33 x 10^{-3}) ✓**(f)**
= 9,34 x 10^{-3} mol ✓**(g)**

OPTION 3/*OPSIE 3:*

$nHC\ell = cV$

$= \boxed{(0,2)(0,015)}$ ✓**(a)**

$= 3 \times 10^{-3}$ mol

$nBa(OH)_2 = \frac{1}{2} nHC\ell$

$= \frac{1}{2}(3 \times 10^{-3})$ ✓**(b)**

$= 1,5 \times 10^{-3}$ mol

$cBa(OH)_2 = \frac{1}{2} cOH^-_{final}$ ✓**(e)**

$= \frac{1}{2}(0,0417)$

$= 0,02085$ mol·dm^{-3}

$nBa(OH)_2 = cV$

$= \boxed{0,02085 \times 0,04}$ ✓**(c)**

$= 8,34 \times 10^{-4}$ mol

$nBa(OH)_{2\ ini} = 1,5 \times 10^{-3} + 8,34 \times 10^{-4}$ ✓✓ **(d)**

$= 2,34 \times 10^{-3}$ mol in 25 cm^3

In 100 cm^3 $= (4)(2,34 \times 10^{-3})$ ✓**(f)**

$= 9,36 \times 10^{-3}$ mol ✓**(g)**

✓**(g) in all options/*in alle opsies*:**

$nBa(OH)_2$ in 25 cm^3 $= cV$

$2,33 \times 10^{-3}$ mol $= c(0,025)$

$cBa(OH)_2$ in 25 cm^3 $= 0,0936$ mol·dm^{-3}

$nBa(OH)_2$ in 100 cm^3 $= cV$

$= (0,0936)(0,1)$

$= 0,0936$ mol

(8)
[20]

QUESTION 8/*VRAAG 8*

8.1 **ANY ONE**/*:*

- A substance whose (aqueous) solution contains ions. ✓✓ (**2 OR/*OF* 0**)
- Substance that dissolves in water to give a solution that conducts electricity (through movement of ions).

OR

- A substance that dissociates to form ions in water/in molten state.

***ENIGE EEN**:*

- *'n Stof waarvan die (waterige) oplossing ione bevat.*
- *'n Stof wat in water oplos om 'n oplossing te vorm wat elektrisiteit gelei (deur die beweging van ione).*

OF

- *'n Stof wat dissosieer om ione in water te vorm/in gesmelte toestand* (2)

8.2 $A\ell^{3+}$/Aluminium ion/*ioon* ✓

Aℓ is oxidised **OR** Aℓ is a stronger reducing agent. ✓

*Aℓ is geoksideer **OF** Aℓ is 'n sterker reduseermiddel.* (2)

8.3 $A\ell(s) \mid A\ell^{3+}(aq) \parallel Zn^{2+}(aq) \mid Zn(s)$ ✓ ✓ ✓

OR/*OF*

$A\ell(s) \mid A\ell^{3+}\ (1\ mol\cdot dm^{-3}) \parallel Zn^{2+}(aq)\ (1\ mol\cdot dm^{-3}) \mid Zn(s)$

ACCEPT/*AANVAAR*

$A\ell \mid A\ell^{3+} \parallel Zn^{2+} \mid Zn$ (3)

8.4

Marking criteria	***Nasienkriteria:***
(a) Calculate $n(A\ell^{3+})$ ✓ (b) USE mol ratio: $nA\ell_2(SO_4)_3 : nA\ell^{3+} = 1 : 2$ ✓ (c) Multiply $nA\ell_2(SO_4)_3$ by M = 342 ✓ (d) Final correct answer = 42,75 g ✓	(a) *Bereken* $n(A\ell^{3+})$ ✓ (b) *Gebruik molverhouding:* $nA\ell_2(SO_4)_3 : nA\ell^{3+} = 1 : 2$ ✓ (c) *Vermenigvuldig* $nA\ell_2(SO_4)_3$ *met* *M = 342* ✓ (d) *Finale korrekte antwoord* = *42*,75 g ✓

OPTION 1/*OPSIE 1:*

$n(A\ell^{3+}) = cV$

$= \boxed{(1)(0,25)}$ ✓**(a)**

$= 0,25\ mol$

$nA\ell_2(SO_4)_3 = \frac{1}{2}\,n(A\ell^{3+})$

$= \frac{1}{2}\,(0,25)$ ✓**(b)**

$= 0,125\ mol$

$nA\ell_2(SO_4)_3 = \frac{m}{M}$

$0,125 = \frac{m}{342}$ ✓**(c)**

$m = 42,75\ g$ ✓**(d)**

OPTION 2/*OPSIE 2:*

$c = \frac{m}{VM}$

✓**(a)** $1 = \frac{m}{(0,25)(342)}$ ✓**(c)**

$m = 85,5\ g$

$Al_2(SO_4)_3 \rightarrow 2\ mol\cdot dm^{-3}\ Al^{3+}$

$m(Al_2(SO_4)_3) = \frac{1}{2}(85,5)$ ✓**(b)**

$= 42,75\ g$ ✓**(d)**

(4)
[11]

QUESTION 9/*VRAAG 9*

9.1 Electrolytic/*Elektrolitiese* ✓ (1)

9.2.1 Increases/*Neem toe* ✓ (1)

9.2.2 Decrease ✓
- More copper (II) ions/Cu^{2+} are reduced than formed./ Only copper (II) ions/Cu^{2+} are reduced. ✓
- Copper (II) ion/Cu^{2+} is a stronger oxidising agent than the zinc (II) ion/Zn^{2+} ✓

OR

Zinc (II) ion/Zn^{2+} is a weaker oxidising agent than the copper (II) ion/Cu^{2+}

Afneem
- *Meer koper(II)ione/Cu^{2+} word gereduseer as wat gevorm word./ Slegs koper(II)ione/Cu^{2+} word gereduseer.*
- *Koper(II)ioon/Cu^{2+} is 'n sterkter oksideermiddel as die sink(II)ioon/Zn^{2+}*

OF

Sink(II)ioon/Zn^{2+} is 'n swakker oksideermiddel as die koper(II)ioon/Cu^{2+} (3)

9.2.3

Marking criteria	***Nasienkriteria:***
(a) **USING RATIO**: $n(Cu^{2+}) : n(Zn^{2+}) = 1 : 1$ ✓	(a) ***GEBRUIK VERHOUDING*** ✓ *$n(Cu^{2+}) : n(Zn^{2+}) = 1 : 1$*
(b) Formula: $n = \frac{m}{M}$ ✓	(b) Formule: $n = \frac{m}{M}$ ✓
(c) Substitute 65 AND $n(Zn^{2+})$ in $n = \frac{m}{M}$ ✓	(c) *Vervang 65 EN* $n(Zn^{2+})$ *in* $n = \frac{m}{M}$ ✓
(d) Subtraction of moles ✓	(d) *Aftrek van aantal mol* ✓
(e) Substitute 63,5 AND n(Cu) in $n = \frac{m}{M}$ ✓	(e) *Vervang 63,5 EN* n(Cu) *in* $n = \frac{m}{M}$ ✓
(f) Final correct answer: 9,6 g ✓ (**NO RANGE**)	(f) *Finale korrekte antwoord: 9,6 g* ✓ (***GEEN GEBIED***)

$n(Zn^{2+}) = n(Cu^{2+})$
$= 0,05$ mol ✓**(a)**

$m(Zn) = nM$ ✓**(b)**
$= (0,05)(65)$ ✓**(c)**
$= 3,25$ g Zn from R

$0,15 - 0,05$ ✓**(d)** $= 0,1$ mol Cu
$m(Cu) = nM$
$= 0,1(63,5)$ ✓**(e)**
$= 6,35$ g Cu from R

Change in mass $= 6,35 + 3,25$
$= 9,6$ g ✓**(f)** (decrease in mass) (6)

[11]

TOTAL/*TOTAAL*: 150