education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY P2

SEPTEMBER 2026

MARKS: 150

TIME: 3 hours

This question paper consists of 15 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 two sub questions, 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. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a MINIMUM of TWO decimal places.
11. Give brief motivations, discussions, et cetera 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 number (1.1 – 1.10) in the ANSWER BOOK, for example, 1.11 E.

1.1 Which ONE of the following compounds does NOT have the molecular formula C_4H_8O?

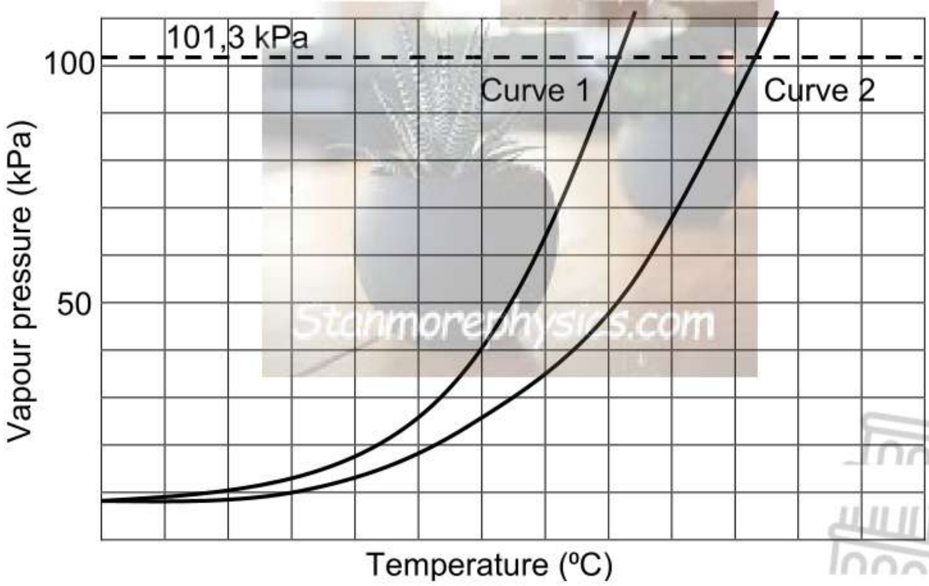
A Butanal

B Methylpropanal

C Butan-2-one

D Butan-2-ol (2)

1.2 The following graph shows the relationship between vapour pressure and temperature for two different organic compounds. The dotted line indicates the external atmospheric pressure.



Which combinations of organic compounds are represented by CURVES 1 and 2 respectively?

	CURVE 1	CURVE 2
A	Pentane	2,2-dimethylpropane
B	Butan-1-ol	Propanoic acid
C	Butan-1-ol	Butanal
D	Hexane	Propane

(2)

1.3 In the flow diagram below, **M** and **N** represents two organic compounds.

$$CH_2{=}CHCH_3 \xrightarrow{H_2O} \boxed{\mathbf{M}} \xrightarrow{\text{Concentrated } H_2SO_4} \boxed{\mathbf{N}}$$

Which ONE of the following is the CORRECT condensed structural formula for the main product of compound **N**?

A CH_2CHCH_3

B $CH_3CH_2CH_3$

C $CH_3CHBrCH_3$

D $CH_3CHOHCH_3$ (2)

1.4 The diagrams below show **A**, the Maxwell–Boltzmann distribution curve, and **B**, the energy profile graph, for the same chemical reaction.

The effect of a catalyst is shown on both graphs.

Diagram A

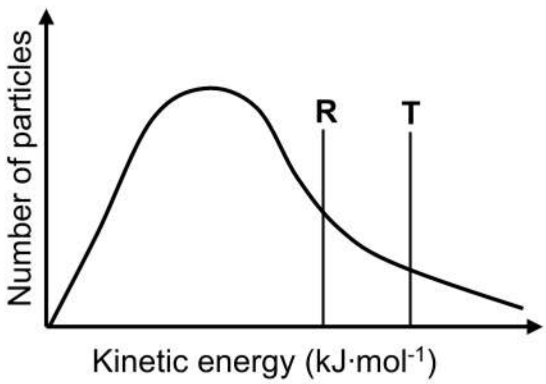
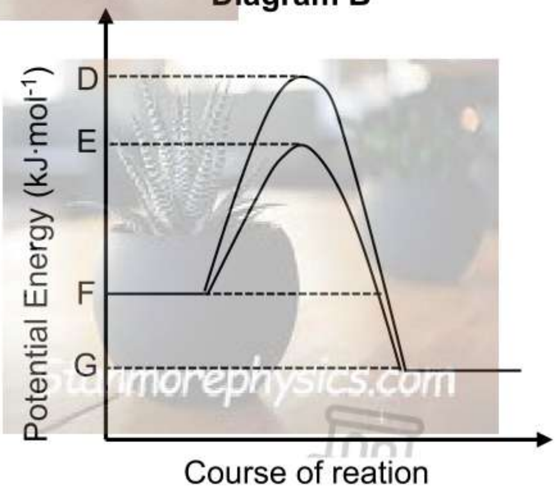


Diagram B



Which energy level in Diagram **B** corresponds to the activation energy indicated by **R** in Diagram **A**?

A D – F

B E – F

C F – G

D D – G (2)

1.5 The addition of a catalyst to a reversible reaction at equilibrium increases the ...

A Equilibrium constant of the forward reaction.

B Product produced at equilibrium

C The rate of both forward and reverse reactions

D Rate of only the forward reaction. (2)

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

$$CaO(s) + SO_2(g) \rightleftharpoons CaSO_3(s)$$

If the equilibrium concentration of $SO_2(g)$ at 25 ºC is x mol·dm^{-3}, the value of the equilibrium constant at this temperature is…

A x

B x^2

C $\frac{1}{x^2}$

D $\frac{1}{x}$ (2)

1.7 A 0,5 mol·dm^{-3} solution of each of the following acids is prepared. Which acid has the greatest electrical conductivity?

A H_2SO_4

B $HC\ell$

C CH_3COOH

D HNO_3 (2)

1.8 Which ONE of the following pairs represents the conjugate acid and the conjugate base of HPO_4^{2-}?

	CONJUGATE ACID	CONJUGATE BASE
A	PO_4^{3-}	$H_2PO_4^-$
B	$H_2PO_4^-$	PO_4^{3-}
C	$H_2PO_4^-$	H_2PO_4
D	HPO_4^{2-}	PO_4^{2-}

1.9 A solution of copper(II)chloride ($CuC\ell_2$) must be stored in a metal container. Which ONE of the following metals should be used?

A Ag

B Zn

C Mg

D Fe (2)

1.10 During the electrolysis of a concentrated sodium chloride solution, water is reduced and not sodium ions because ...

A Na^+ is a stronger reducing agent than H_2O.

B Na^+ is a stronger oxidising agent than H_2O.

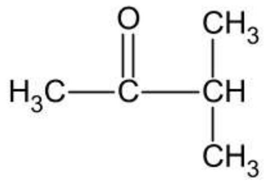
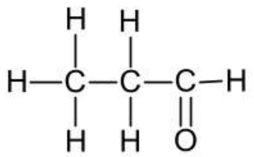
C H_2O is a stronger reducing agent than Na^+.

D H_2O is a stronger oxidising agent than Na^+. (2)

[20]

QUESTION 2 (Start on a new page)

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

A	CH_3CH_2COOH	**B**	
C		**D**	5-ethyl-2,3-dimethylhept-1-ene
E		**F**	Ethyl propanoate
		G	$CH_3CH(CH_3)CHOHCH_3$

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

2.1.1 A haloalkane (1)

2.1.2 A ketone (1)

2.1.3 A reactant in the preparation of compound **F** (1)

2.2 Write down the IUPAC name of:

2.2.1 Compound **B** (3)

2.2.2 Compound **E** (3)

2.3 Write down the structural formula of compound **D**. (3)

2.4 Consider compound **C**. Write down the structural formula of the:

2.4.1 Functional group. (1)

2.4.2 Functional isomer. (2)

2.5 Is compound **G** a PRIMARY, SECONDARY or TERTIARY alcohol? Give a reason for your answer. (2)

[17]

QUESTION 3 (Start on a new page.)

3.1 Learners use pent-2-ene and 2-methylbut-2-ene to investigate the factors that influence the boiling points of organic compounds.

The results are shown in the table below:

COMPOUND	BOILINGPOINT (°C)
X	39
Y	30

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

3.1.2 Which ONE of the two samples (**X** or **Y**) is pent-2-ene? (1)

3.1.3 Explain the answer to QUESTION 3.1.2. (3)

3.2 Another experiment was conducted to determine the boiling point of organic compounds from FOUR different homologous series, represented by letters **A** to **D**, under the same conditions.

The results are shown in the table below:

	COMPOUND	MOLAR MASS ($g \cdot mol^{-1}$)	BOILINGPOINT (°C)
A	$CH_3(CH_2)_2CH_3$	72	X
B	CH_3CH_2COOH	74	141,2
C	$CH_3(CH_2)_2CH_2OH$	74	117,7
D	$CH_3(CH_2)_2CHO$	72	74,8

3.2.1 What is the boiling point in °C of compound **A**? Choose from:

125	82	-0,5

(1)

Consider compounds **B**, **C** and **D**.

3.2.2 Which compound will have the lowest vapour pressure? Give a reason for the answer. (2)

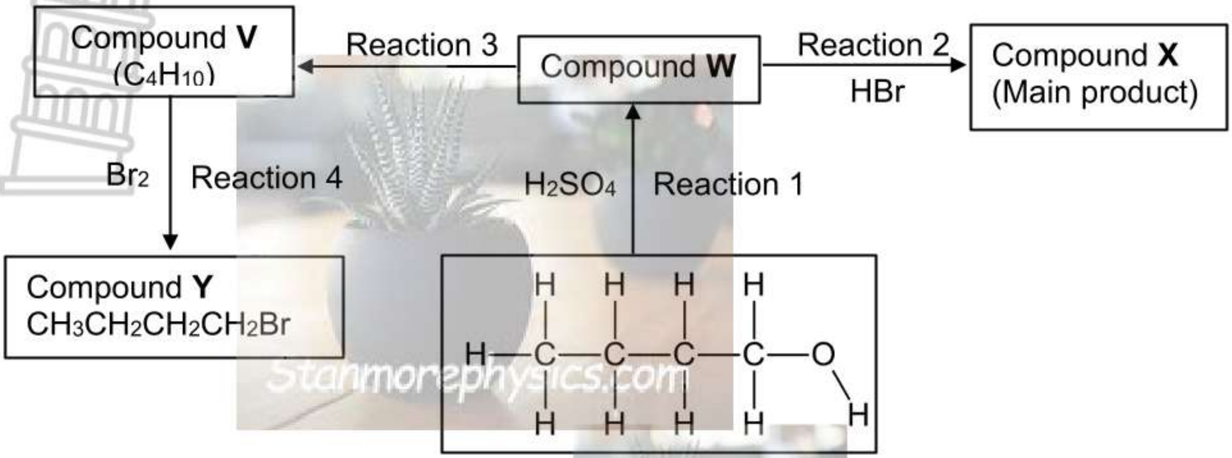
3.2.3 Write down the type of intermolecular forces that occur between the molecules of compound **D**. (1)

3.2.4 Explain the difference in boiling point between compound **B** and compound **C**. (3)

[13]

QUESTION 4 (Start on a new page.)

Study the flow diagram below that represents different organic reactions and answer the questions that follow.



4.1 Write down the type of reaction represented by Reaction 1 (1)

4.2 A hydrocarbon is formed during Reaction 3.

4.2.1 Is compound **V** SATURATED or UNSATURATED? (1)

4.2.2 Write down the formula of the catalyst required for this reaction. (1)

4.3 Write down the:

4.3.1 IUPAC name of compound **W**. (2)

4.3.2 Reaction condition required for Reaction 4 to take place. (1)

4.4 Reaction 2 is an addition reaction. Write down the:

4.4.1 Type of addition reaction. (1)

4.4.2 STRUCTURAL FORMULA of compound **X**. (2)

4.5 Consider the incomplete equations for Reactions 5 and 6.

Reaction 5	$C_{16}H_{34} \rightarrow$ Alkane **P** + 2**Q** + C_xH_8
Reaction 6	$CH_3CH_2CH_2Br + KOH \rightarrow$ **Q** + KBr + **A**

In Reaction 5, compound $C_{16}H_{34}$ undergoes cracking. **Q** is an organic compound while **A** is an inorganic compound.

The compounds **Q** and C_xH_8 have the same FUNCTIONAL GROUP.

4.5.1 Write down the IUPAC name of compound **Q**. (1)

4.5.2 Write down the NAME or FORMULA of inorganic compound **A**. (1)

4.5.3 Write the balanced equation for the complete combustion of ALKANE **P**. (4)
[15]

QUESTION 5 (Start on a new page.)

In the experiments to investigate factors that influence the reaction rate, Cu reacts with excess nitric acid.

The balanced chemical equation for the reaction is given below:

$$3Cu(s) + 8HNO_3(aq) \rightarrow 3Cu(NO_3)_2(aq) + 2NO_2(g) + 4H_2O(\ell)$$

The same mass of Cu was used in all the experiments. The reaction conditions for each experiment are summarised below:

Experiment	**Temperature (°C)**		**Concentration of HNO_3 ($mol \cdot dm^{-3}$)**	**State of Cu(s)**
	Before	**After**		
A	30	48	0,8	Powder
B	30	47	0,8	Pieces
C	35	59	0,8	Pieces
D	30	55	1,6	Powder

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

5.2 Is the reaction above EXOTHERMIC or ENDOTHERMIC? Give a reason for the answer by referring to the data in the table. (2)

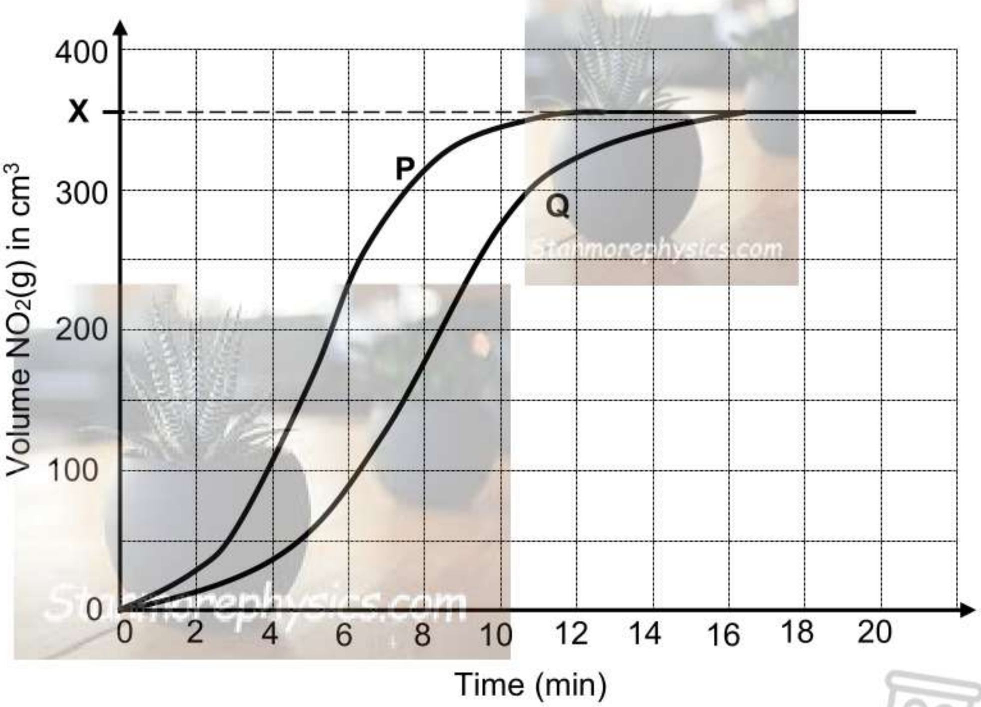
5.3 Would it be a fair comparison to compare the reaction rate of experiment **A** and **C**? Explain the answer. (2)

5.4 How does the reaction rate in Experiment **A** compare with that in Experiment **D**?

Write only HIGHER THAN, LOWER THAN or EQUAL. (1)

5.5 Explain the answer to QUESTION 5.4 by referring to the collision theory. (3)

5.6 The volume of NO_2 versus time for the reaction in Experiment **A** and **B** is shown below.



5.6.1 Which curve represents Experiment **B**? Write down only **P** or **Q**. (1)

5.6.2 Write down the dependent variable for Experiment **A**. (1)

5.6.3 Calculate the initial mass of copper used in Experiment **A**, if the average rate of the reaction in the time 0 to 12 minutes was 0,0294 $dm^3 \cdot min^{-1}$ at STP. (5)

[17]

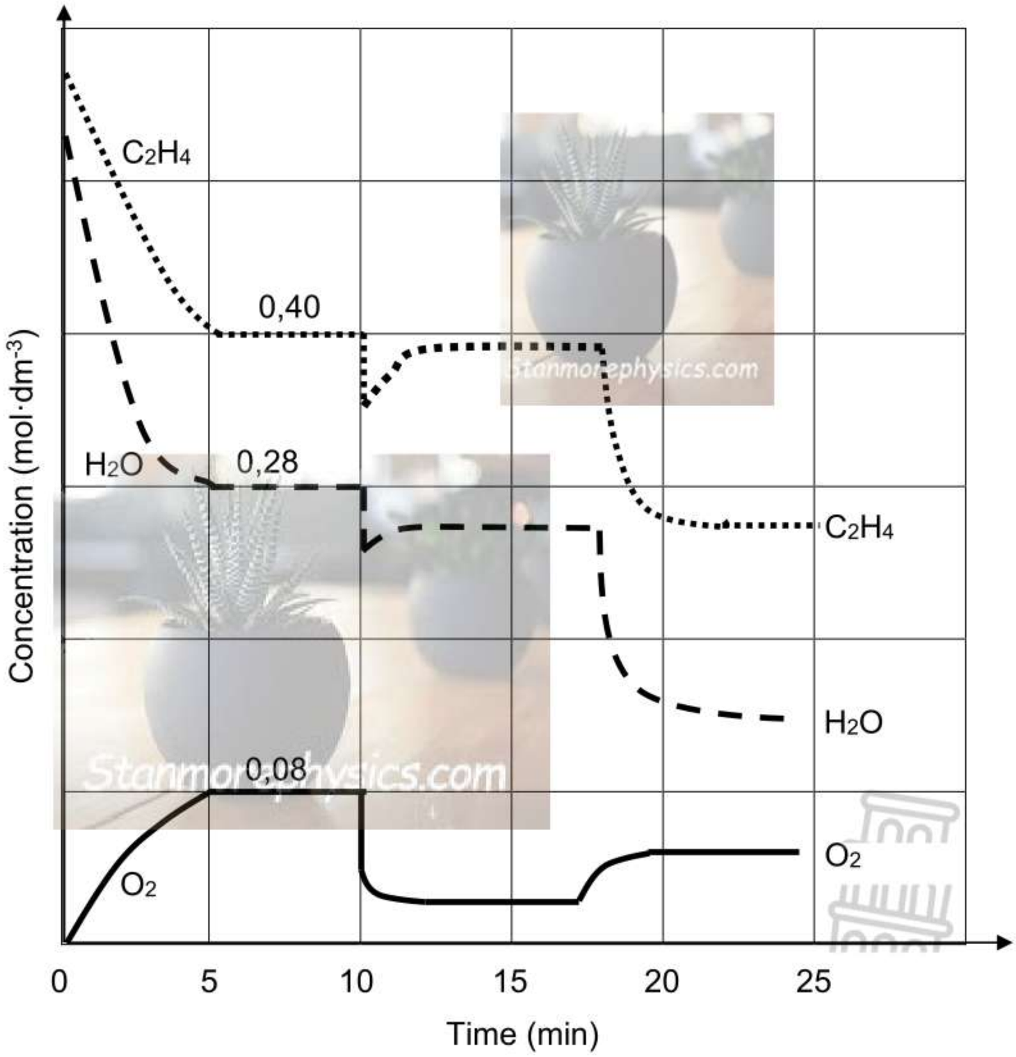
QUESTION 6 (Start on a new page)

Consider the reversible reaction of ethene with steam in the ABSENCE of an acid, as shown below:

$$2C_2H_4(g) + 2H_2O(g) \rightleftharpoons 2C_2H_6(g) + O_2(g)$$

The reaction was done in a 3 dm^3 closed container. The temperature was kept constant at T_1 for the first 18 minutes.

The graph below (NOT to scale) shows the changes in concentration of C_2H_4, H_2O and O_2 as a function of time.



6.1 State *Le Chatelier's principle*. (2)

6.2 Use *Le Chatelier's principle* to describe the change made to the system at 10 minutes. (4)

6.3 At 18 min, the temperature was INCREASED. With the use of *Le Chatelier's principle* and the graph, fully explain whether the forward reaction is ENDOTHERMIC or EXOTHERMIC. (4)

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

6.5 At 35 minutes, argon (an inert gas) is added to the container. What effect does this have on the amount of C_2H_6 at equilibrium? State only INCREASES, DECREASES, or NO EFFECT. (2)

6.6 N_2O_4 gas was pumped into a container until the concentration was 0,46 mol·dm^{-3}. The container was then sealed and heated to 100 °C. At equilibrium, 20,7% of the N_2O_4 gas had decomposed to NO_2 gas as shown in the reaction below.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

Calculate the equilibrium constant for this reaction at 100 °C. (6)

[20]

QUESTION 7 (Start on a new page)

7.1 A learner determined the pH of three solutions at 25 °C. The learner obtained the following results:

Solution	Battery acid	Orange juice	Baking soda
pH	1	4,12	12

7.1.1 Which solution contains the highest concentration of hydrogen/ hydronium ions? (2)

7.1.2 Calculate the concentration of hydroxide ions in orange juice. (4)

7.1.3 How will the pH of battery acid change when:
(Write INCREASES, DECREASES or STAYS THE SAME.)

a) Distilled water is added (1)

b) A certain amount of the baking soda solution is added (1)

7.2 Two beakers A and B contain the acid and a strong base respectively.

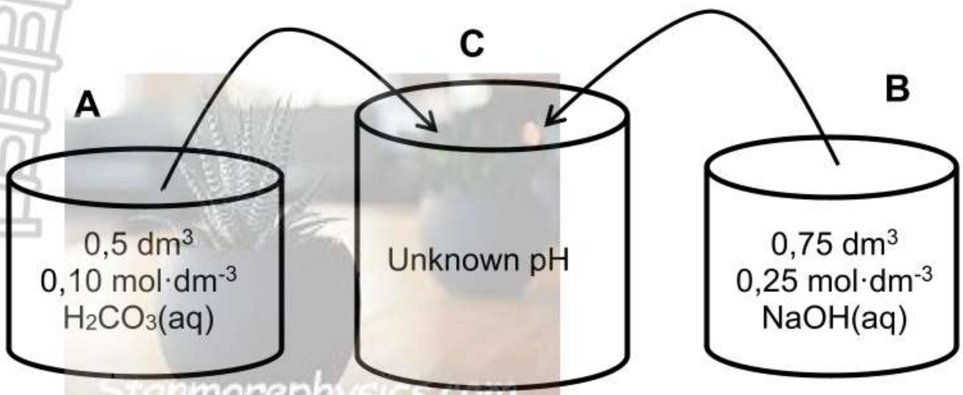
Beaker A: 0,5 dm^3 of carbonic acid, $H_2CO_3(aq)$ of concentration 0,10 mol·dm^{-3}.

Beaker B: 0,75 dm^3 of sodium hydroxide, NaOH(aq) of concentration 0,25 mol·dm^{-3}

When a 0,10 mol·dm^{-3} solution of H_2CO_3 is prepared, it is found that the concentration of $HCO_3^-(aq)$ ions is 0,012 mol·dm^{-3} at 25 °C.

7.2.1 Calculate the number of moles of $H_3O^+(aq)$ ions present in the H_2CO_3 solution in beaker A. (3)

The contents of beakers A and B are added together in beaker C. The solution in beaker C has an unknown pH.



The balanced equation for the reaction is:

$$H_2CO_3(aq) + NaOH(aq) \rightarrow NaHCO_3(aq) + H_2O(\ell)$$

7.2.2 Calculate the number of moles of hydroxide (OH^-) ions in beaker B. (3)

7.2.3 Calculate the pH of the solution at the completion of the reaction in beaker C. (7)
[21]

QUESTION 8 (Start on a new page)

8.1 The two half-cells, $Fe(s)/ Fe^{2+}(aq)$, and $O_2(g) /H_2O(\ell)$ in acid solution, are used to set up an electrochemical cell.

The cell operates under standard conditions.

8.1.1 Which half-cell represents the anode? (2)

8.1.2 Write down the balanced equation for the oxidation half-reaction. (2)

8.1.3 Write down the balanced equation for the overall nett reaction. (3)

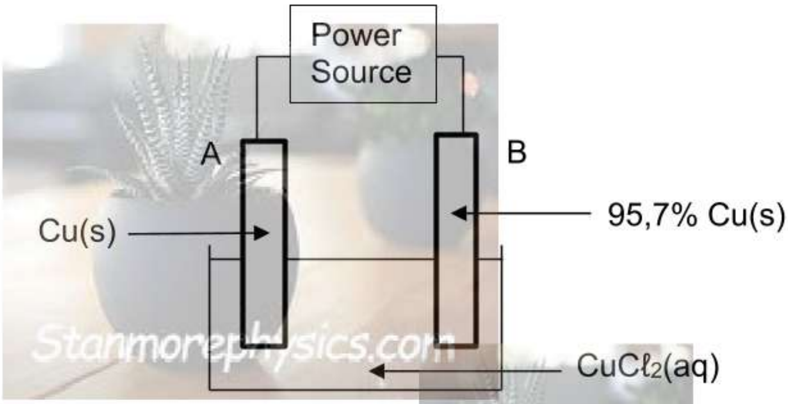
8.1.4 Calculate the emf of the cell. (4)

8.2 A magnesium bar is attached to a buried iron pipe. Use the Table of Standard Reduction Potentials to explain why the magnesium will be able to protect the iron from being oxidised. (3)

8.3 A strip of magnesium is lowered into a gas jar containing chlorine gas. Use the table of Standard Reduction Potentials to write down the reduction half-reaction. (2)
[16]

QUESTION 9 (Start on a new page)

The electrolytic cell, shown below is used to purify an IMPURE copper sample for use in electrical wires. Copper(II)chloride solution, $CuC\ell_2$, is used as the electrolyte. Electrode **B** contains 95,7% Cu.



9.1 Is electrode A, the POSITIVE or NEGATIVE electrode? (1)

9.2 While the cell is in operation, how will the concentration of the electrolyte change? Write down INCREASES, DECREASES or REMAIN THE SAME. Give a reason for the answer. (2)

9.3 Will the mass of electrode B INCREASE or DECREASE when the cell is in operation?

Write down a relevant half reaction to support the answer. (3)

9.4 After ALL the copper was purified, it was found that 2 moles of electrons were transferred from anode to cathode.

Calculate the mass of the IMPURE copper sample. (5)

[11]

GRAND 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	p^{θ}	$1{,}013 \times 10^{5}$ 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
Avogadro's constant	N_A	$6{,}023 \times 10^{23}\ mol^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{n_a}{n_b} = \frac{c_a V_a}{c_b V_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ 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* $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	
$n = \frac{Q}{e}$	$n = \frac{Q}{q_e}$

TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

Atomic number / *Atoomgetal*	29
Electronegativity / *Elektronegatiwiteit*	1,9
Symbol / *Simbool*	Cu
Approximate relative atomic mass / *Benaderde relatiewe atoommassa*	63,5

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

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

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

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

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

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

TABLE 4B: STANDARD REDUCTION POTENSTIALS

TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE

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

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

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

education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

SEPTEMBER 2026

MARKING GUIDELINES/*NASIENRIGLYNE*

APPROVED

MARKS/PUNTE: 150

09/09/2026

This memorandum consists of 13 pages.
Hierdie memorandum bestaan uit 13 bladsye.

QUESTION 1 / *VRAAG 1*

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

QUESTION 2 / VRAAG 2

2.1.1	E ✓	(1)
2.1.2	B ✓	(1)
2.1.3	A ✓	(1)

2.2.1 3-methylbutan-2-one/ *3-metielbutan-2-oon* ✓✓✓

<u>Marking criteria</u>*:*
- Correct stem i.e. butanone. ✓
- Substituent (methyl) correctly identified ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

<u>Nasienkriteria</u>:
- *Korrekte stam d.i. pentaan.* ✓
- *Substituent (metiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas.* ✓

(3)

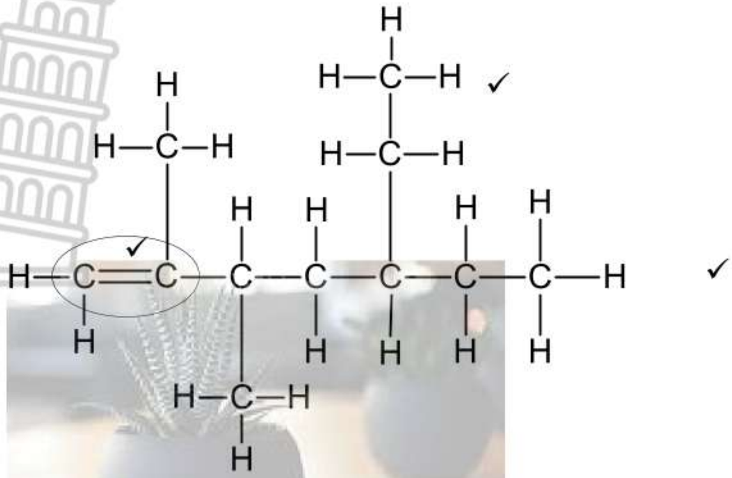
2.2.2 2,4-dichloro-2-methylhexane / *2,4-dichloor-2-metielheksaan* ✓✓✓

<u>Marking criteria</u>*:*
- Correct stem i.e. hexane ✓
- All substituents (dichloro and methyl) correctly identified ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

<u>Nasienkriteria</u>:
- *Korrekte stam d.i. heksaan.* ✓
- *Alle substituente (dichloro en metiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas.*

(3)

2.3



Marking criteria:

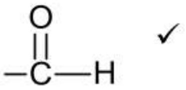
- Correct chain length (7Cs). ✓
- Functional group (double bond) on C1 ✓
- Methyl groups on C2 and C3 and ethyl group on C5 ✓

Nasienkriteria:

- *Funksionele groep (dubbelbinding op C1.* ✓
- *Metielgroepe op C2 en C3 asook etielgroep op C5* ✓
- *Res van die ketting korrek.* ✓

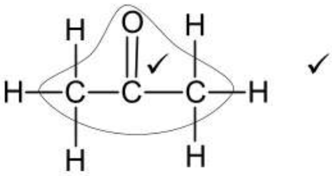
(3)

2.4.1

 ✓

(1)

2.4.2



Marking criteria:

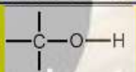
- Correct functional group. ✓
- Whole structure correct ✓

Nasienkriteria:

- *Korrekte funksionele groep* ✓
- *Hele struktuur korrek* ✓

(2)

2.5 Secondary (alcohol) / *Sekondêre (alcohol)* ✓

The <u>C-atom bonded to the hydroxyl/-OH is bonded to two other C-atoms/the functional group(</u>  <u>) is bonded to two other C-atoms</u>. ✓
Die <u>C-atoom wat aan die hidroksiel/-OH gebind</u> <u>is aan twee ander C-atome gebind.</u>

(2)
[17]

QUESTION 3 / VRAAG 3

3.1.1

Marking criteria/*Nasienriglyne*
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 temperature at which the vapour pressure (of a compound) equals atmospheric pressure. ✓✓
Die temperatuur waarby die dampdruk (van 'n verbinding) gelyk is aan die atmosferiese druk. (2)

3.1.2 X ✓ (1)

3.1.3
- X/Pent-2-ene has a longer chain length./is less branched./has a larger surface area/ contact area. ✓
- Strength of the intermolecular forces is greater./There are more sites for London forces. ✓
- More energy is needed to overcome/break intermolecular forces. ✓

- *Het 'n langer kettinglengte./is minder vertak./het 'n groter kontakoppervlak/reaksieoppervlak.* ✓
- *Sterkte van die intermolekulêre kragte verhoog./Daar is meer plekke vir Londonkragte.* ✓
- *Meer energie word benodig om die intermolekulêre kragte te oorkom/breek.* ✓

OR/OF
- Y/2-methylbut-2-ene has a shorter chain length./is more branched./ has a smaller surface area/contact area.
- Strength of the intermolecular forces is weaker./There are fewer sites for London forces.
- Less energy is needed to overcome/break intermolecular forces.

- *2-metielbut-2-een het 'n korter kettinglengte./is meer vertak./het 'n kleiner kontakoppervlak/reaksieoppervlak.*
- *Sterkte van die intermolekulêre kragte is swakker./Daar is minder plekke vir Londonkragte.*
- *Minder energie word benodig om intermolekulêre kragte te oorkom/breek.* (3)

3.2.1 -0,5 (°C) ✓ (1)

3.2.2 B/CH_3CH_2COOH/propanoic acid ✓
B has the highest boiling point/strongest intermolecular forces. ✓
B het die hoogste kookpunt/sterktste intermolekulêre kragte. (2)

3.2.3 Dipole-dipole (intermolecular forces) /*Dipool-dipool (intermolekulêre kragte)* ✓ (1)

3.2.4

Marking criteria:

- State that carboxylic acids have two sites for hydrogen bonding. ✓
- State that alcohols have one site for hydrogen bonding. ✓
- Comparing the strength of IMF's OR the energy needed to overcome IMF's. ✓

Nasienkriteria:

- *Stel dat karboksielsure twee plekke het vir waterstofbindings.*
- *Stel dat alkohole een plek het vir waterstofbinding.*
- *Vergelyk die sterkte van die IMK's / energie benodig om IMK's te oorkom.*

- Carboxylic acids/B have, (in addition to London forces and dipole-dipole forces), two sites for hydrogen bonding between molecules. ✓
- Alcohols/C have, (in addition to London forces and dipole-dipole forces), one site for hydrogen bonding between molecules. ✓
- Intermolecular forces in carboxylic acids are stronger./More energy needed to overcome/break intermolecular forces in carboxylic acid/B. OR intermolecular forces in alcohols are weaker/Less energy is required to overcome the forces. ✓

- *Karboksielsure/B het, in toevoeging tot Londonkragte en dipool-dipoolkragte, twee punte vir waterstofbinding tussen molekule.*
- *Alkohole/C het, in toevoeging tot Londonkragte en dipool-dipoolkragte, een punt vir waterstofbinding tussen molekule.*
- *Intermolekulêre kragte in karboksielsure is sterker./Meer energie word benodig om intermolekulêre kragte in karboksielsure te oorkom/breek.* (3)

[13]

QUESTION 4/ *VRAAG 4*

4.1 Elimination/Dehydration / *Eliminasie/Dehidrasie* ✓ (1)

4.2.1 Saturated/*Versadig* ✓ (1)

4.2.2 Pt/Ni/Pd ✓ (Do not accept chemical names) (1)

4.3.1 But-1-ene ACCEPT: 1-butene✓✓ **(2 or 0)** (2)

4.3.2 UV(sun) light or heat/hf/*UV(son)-lig en hitte* ✓ (1)

4.4.1 Hydrohalogenation/hydrobromination/*Hidrohalogenering/Hidrohalogenasie* ✓ (1)

4.4.2

Marking criteria:
- Correct functional group ✓
- Whole structure correct with Br on C2. ✓

Nasienkriteria:
- *Broom atoom op die tweede koolstof atoom.* ✓
- *Hele struktuur korrek* ✓

(2)

4.5.1 Propene/ Prop-1-ene/*Propeen/Prop-1-een* ✓ (1)

4.5.2 H_2O/ water/dihydrogen monoxide ✓ (1)

4.5.3 $2C_6H_{14}$✓ + $19O_2$ ✓→ $12CO_2 + 14H_2O$ ✓ (Marking Rule 6.3.10) Bal ✓ (4)
[Reactants (Any alkane + O_2) and products]

[15]

QUESTION 5/ *VRAAG 5*

5.1

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.*

ANY ONE

- The change in concentration ✓of reactants or products per unit time✓
- Rate of change in concentration/amount of moles/number of moles/volume/ mass. ✓✓**(2 or 0)**

ENIGE EEN

- *Die verandering in konsentrasie ✓van reaktante of produkte per eenheid tyd.* ✓
.
- *Tempo van verandering in konsentrasie/ hoeveelheid mol/getal mol/ volume/ massa.* ✓✓ ***(2 of 0)*** (2)

5.2 Exothermic/*Eksotermies*✓
Heat is released during the reaction/Temperature increases/ Reaction vessel becomes warmer✓
Hitte is vrygestel gedurende die reaksie/ Temperatuur verhoog/ Die houer waarin die reaksie plaasvind word warmer (2)

5.3 No,✓ more than one independent variable ✓
Nee, meer as een onafhanklike veranderlike (2)

5.4 Lower than /*Laer as* ✓ (1)

5.5
- In experiment A, the concentration (of the HNO_3) is lower. ✓
- Less particles per unit volume. ✓
- Less effective collisions per unit time will take place./less frequency of effective collisions ✓

OR

- In experiment D, the concentration (of the HNO_3) is higher. ✓
- More particles per unit volume. ✓
- More effective collisions per unit time will take place/ Higher frequency of effective collisions. ✓

- *Die konsentrasie (van die HNO_3) in Eksperiment A is laer*
- *Minder deeltjies per eenheidsvolume.*
- *Minder effektiewe botsings per tydseenheid sal plaasvind* (3)

5.6.1 Q ✓ (1)

5.6.2 Rate of reaction/*Tempo van reaksie* ✓ (1)

5.6.3 **Marking criteria / Nasienkriteria**:

a) Substitute/*Vervang* 0,0294 $dm^3 \cdot min^{-1}$ and/en 12 min in Tempo $= \frac{\Delta V}{\Delta t}$ ✓
b) Substitute/*Vervang* 22,4 $dm^3 \cdot mol^{-1}$ and $V(NO_2)$ in $n = \frac{V}{V_m}$ ✓
c) Use mol ratio/*Gebruik molverhouding* n(Cu) : $n(NO_2)$ 2:3 ✓
d) Substitute/*Vervang* nCu and/*en* 63,5 $g \cdot mol^{-1}$ in m=nM ✓
e) Final answer/*Finale antwoord* ✓

$$\text{Tempo} = \frac{\Delta V}{\Delta t}$$
$$0{,}0294 = \frac{\Delta V}{12-(0)} \checkmark \text{(a)}$$
$$\Delta V = 0{,}3528\ dm^3$$

$$n = \frac{V}{V_m}$$
$$= \frac{0{,}3528}{22{,}4} \checkmark \text{(b)}$$
$$= 0{,}01575\ mol$$

$$n(Cu) = \tfrac{3}{2} n(NO_2)$$
$$n(Cu) = \tfrac{3}{2}(0{,}01575)$$
$$= 0{,}02363\ mol \checkmark \text{(c)}$$

$$m(Cu) = nM$$
$$= (0{,}02363 \times 63{,}5) \checkmark \text{(d)}$$
$$= 1{,}50\ g \checkmark \text{(e)}$$

(5)
[17]

QUESTION 6 / *VRAAG 6*

6.1 **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.*

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

Wanneer die ewewig in 'n geslote sisteem versteur word, stel die sisteem 'n nuwe ewewig in deur die reaksie wat die versteuring teenwerk, te bevoordeel (2)

6.2
- Pressure decreased/volume of the container increased ✓
- Decrease in pressure favours the reaction that forms the most amount/number of moles (gas molecules). ✓
- The reverse reaction will be favoured. ✓
- $[C_2H_4]$ and $[H_2O]$ will increase and $[O_2]$ will decrease. ✓ (4)

- *Wanneer die druk afneem, sal die reaksie met die meeste mol bevoordeel word*
- *Die reaksie met die meeste mol sal bevoordeel*
- *Die terugwaartse reaksie word bevoordeel*
- *[C_2H_2] en [H_2O] sal toeneem en [O_2] sal afneem*

6.3
- ENDOTHERMIC ✓
- If the temperature increased the endothermic reaction will be favoured ✓
- [O_2] increases/[C_2H_4] and [H_2O] decreased ✓
- The forward reaction will be favoured ✓

- *ENDOTERMIES*
- *As die temperatuur verhoog sal die endotermiese reaksie bevoordeel*
- *[O_2] verhoog*
- *Die voorwaartse reaksie word bevoordeel* (4)

6.4 (It is a dynamic equilibrium) when the rate of the forward reaction equals the rate of the reverse reaction. ✓✓

OR

When the amount of products and reactants remains constant. **(2/0)**
Dit is 'n dinamiese ewewig wanneer die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie (2)

6.5 No effect ✓✓ / *geen effek* (2)

6.6 **CALCULATIONS USING NUMBER OF MOLES**
BEREKENINGE WAT AANTAL MOL GEBRUIK

Marking criteria/*Nasienriglyne*:
- a) Determine percentage and substitute 0,095x3 in table / *Bereken die persentasie en vervang 0,095x3 in die tabel* ✓
- b) Use of ratio/ *Gebruik die verhouding* ✓
- c) $n(N_2O_4)eq = n(N_2O_4)initial - \Delta n(N_2O_4)$, $n(NO_2)eq = n(NO_2)initial - \Delta n(NO_2)$✓,
- d) K_c expression / K_c-uitdrukking ✓
- e) Substitution of K_c value / Vervang K_c waarde ✓

Final answer/*Finale antwoord*: 0,0994 (0,1)✓

OPTION 1/*OPSIE 1*

	N_2O_4	$2NO_2$	
Initial quantity/Aanvanklike hoeveelheid (mol)	1,38	0	
Change/Verandering (mol)	-0,285 ✓(a)	0,5712	✓(b)
Quantity at equilibrium/ Hoeveelheid by ewewig (mol)	1,095	0,5713	✓ (c)
Concentration (mol/dm^3)	0,365	0,19044	

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} \checkmark \text{ (d)}$$

$$K_c = \frac{(0{,}19044)^2}{(0{,}365)} \checkmark \text{ (e)}$$

$$= 0{,}0994\ (0{,}1) \checkmark \text{ (f)}$$

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK

Marking criteria/*Nasienriglyne*:

- *f)* Determine percentage and substitute 0,095 in table / *Bereken die persentasie en vervang 0,095 in die tabel* ✓
- g) Use of ratio/ *Gebruik die verhouding* ✓
- h) $c(N_2O_4)eq = c(N_2O_4)$ initial – $\Delta c(N_2O_4)$, $c(NO_2)eq = c(NO_2)$initial – $\Delta c(NO_2)$✓,
- i) K_c expression / K_c-uitdrukking ✓
- j) Substitution of K_c value / Vervang K_c waarde ✓
- k) Final answer/*Finale antwoord*: 0,0994 (0,1)✓

OPTION 2/*OPSIE 2*

	N_2O_4	$2NO_2$	
Initial quantity/Aanvanklike hoeveelheid (concentration / konsentrasie)	0,46	0	
Change/Verandering (concentration / konsentrasie))	-0,095 ✓(a)	0,19044	✓(b)
Quantity at equilibrium/ Hoeveelheid by ewewig (concentration / konsentrasie)	0,365	0,19044	✓ (c)

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} \checkmark \text{ (d)}$$

$$K_c = \frac{(0{,}19044)^2}{(0{,}365)} \checkmark \text{ (e)}$$

$$= 0{,}0994\ (0{,}1) \checkmark \text{ (f)}$$

(6)
[20]

QUESTION 7 / VRAAG 7

7.1.1 Battery acid / Battery suur ✓✓ (2)

7.1.2
$$pH = -\log[H_3O^+] ✓$$
$$4{,}12 ✓ = -\log[H_3O^+]$$
$$[H_3O^+] = 7{,}585775 \times 10^{-5}\ mol \cdot dm^{-3}$$

$$K_w = [H_3O^+][OH^-]$$
$$1 \times 10^{-14} = (7{,}585775 \times 10^{-5})[OH^-] ✓$$
$$[OH^-] = 1{,}318 \times 10^{-10}\ mol \cdot dm^{-3}\ ✓$$ **Range** $(1{,}23 \times 10^{-10} - 1{,}32 \times 10^{-10})$ (4)

7.1.3 a) Increases / *toeneem* ✓ (1)

b) Increases / *toeneem* ✓ (1)

7.2.1 $[H_3O^+] = [HCO_3^-] = 0{,}012\ mol \cdot dm^{-3}$ ✓

$$n = cV$$
$$= (0{,}012)(0{,}5) ✓$$
$$= 0{,}006\ mol ✓$$ (3)

7.2.2 $n(NaOH) = cV$ ✓
$$= (0{,}25)(0{,}75) ✓$$
$$= 0{,}1875\ mol$$

Therefore/ *Dus* $n(OH^-) = 0{,}1875\ mol$ ✓ (3)

7.2.3

<u>Marking criteria / *Nasienriglyne*</u>:

a. Substituting 0,1 and 0,5 in n=cV✓
b. Using ratio / Gebruik verhouding 1 (OH^-) : 1 (HCO_3^-) correctly / korrek✓ (0,05 mol of acid neutralises 0,05 mol of base)
c. $n(OH^-)$ in excess / in oormaat 0,1875 - 0,05 ✓ = 0,1375mol
d. Substitution / invervanging✓ in c = n/v
e. $[H_3O^+] = 10^{-14}/0{,}102$ ✓
f. Substitution in formula / Vervang in formula ✓
g. Final answer / Finale antwoord ✓

$$n = cV$$
$$= (0{,}1)(0{,}5) ✓\ (a)$$
$$= 0{,}05\ mol$$

0,05 mol acid neutralises 0,05 mol of base ✓(b)/
0,05 mol suur neutraliseer 0,05mol basis

$$n(OH^-)_{\text{in excess/}oormaat} = 0{,}1875 - 0{,}05 ✓(c)$$
$$= 0{,}1375\ mol$$

$$c(OH^-) = \frac{n}{V}$$
$$= \frac{0,1375}{(0,5+0,75)} ✓ \text{ (d)}$$
$$= 0,11 \text{ mol}\cdot\text{dm}^{-3}$$

$$K_w = [H_3O^+][OH^-]$$
$$1\times10^{-14} = [H_3O^+](0,11) ✓ \text{ (e)}$$
$$[H_3O^+] = 9,0909\times10^{-14} \text{ mol}\cdot\text{dm}^{-3}$$

$$pH = -\log[H_3O^+]$$
$$= -\log(9,0909\times10^{-14}) ✓ \text{ (f)}$$
$$= 13,04 ✓ \text{ (g)}$$

(7)
[21]

QUESTION 8 / VRAAG 8

8.1.1 Fe / Fe^{2+} ✓✓ (2)

8.1.2 $Fe \rightarrow Fe^{2+} + 2e^-$ ✓✓ (2)

Marking guidelines/*Nasienriglyne:*

- $Fe \rightleftharpoons Fe^{2+} + 2e^-$ $\frac{1}{2}$ $Fe^{2+} + 2e^- \rightleftharpoons Fe$ $\frac{0}{2}$
  $Fe^{2+} + 2e^- \leftarrow Fe$ $\frac{2}{2}$ $Fe^{2+} + 2e^- \rightarrow Fe$ $\frac{0}{2}$
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on Cu^{2+} / *Indien lading (+) weggelaat op Cu^{2+}*: Max./*Maks:* $\frac{1}{2}$

Example/*Voorbeeld:* $Fe \rightarrow Fe^2 + 2e^-$ ✓

8.1.3 $2Fe + O_2 + 4H^+$ ✓ $\rightarrow 2Fe_2+ + 2H_2O$ ✓ bal✓ (3)

8.1.4 $E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ ✓
$= 1,23$ ✓ $- (-0,44)$ ✓
$= 1,67$ V ✓ (4)

8.2 Mg is a stronger reducing agent ✓than Fe✓ / *Mg is 'n sterker reduseermiddel as Fe*
OR
Fe is a weaker reducing agent than Mg. (3)

Mg will be oxidised to Mg^{2+}/Fe will not be oxidized to Fe^{2+} ✓ / *Mg sal geoksiedeer word na Mg^{2+}*

8.3 $C\ell_2 + 2e^- \rightarrow 2C\ell^-$ ✓✓ (2)

Marking guidelines/*Nasienriglyne:*

- $C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$ $\frac{1}{2}$ $2C\ell^- \rightleftharpoons C\ell_2 + 2e$ $\frac{0}{2}$
  $C\ell_2 + 2e^- \leftarrow 2C\ell^-$ $\frac{2}{2}$ $2C\ell^- \rightarrow C\ell_2 + 2e$ $\frac{0}{2}$
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on Cu^{2+} / *Indien lading (+) weggelaat op Cu^{2+}*: Max./*Maks:* $\frac{1}{2}$

Example/*Voorbeeld:* $C\ell_2 + 2e \rightarrow 2C\ell^-$ ✓

[16]

QUESTION 9 / VRAAG 9

9.1 Negative / *Negatief* ✓ (1)

9.2 Remain the same/*Bly dieselfde* ✓
The rate of oxidation (of Cu) is equal to the rate of reduction (of Cu^{2+})/*Die tempo van oksidasie is gelyk aan die tempo van reduksie.* ✓ (2)

9.3 Decrease / Verlaag ✓
$Cu \rightarrow Cu^{2+} + 2e^-$ ✓✓ (3)

Marking guidelines/*Nasienriglyne:*

- $Cu \rightleftharpoons Cu^{2+} + 2e^-$ $\frac{1}{2}$ $Cu^{2+} + 2e^- \rightleftharpoons Cu$ $\frac{0}{2}$
  $Cu^{2+} + 2e^- \leftarrow Cu$ $\frac{2}{2}$ $Cu^{2+} + 2e^- \rightarrow Cu$ $\frac{0}{2}$
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on Cu^{2+} / *Indien lading (+) weggelaat op Cu^{2+}*: Max./*Maks:* $\frac{1}{2}$

Example/*Voorbeeld:* $Cu \rightarrow Cu^{2} + 2e^-$ ✓

9.4
$$n(Cu) = \tfrac{1}{2}n(e^-) = \frac{2}{2} = 1 \text{ mol ✓}$$

$$m(Cu) = nM = (1)(63{,}5) \text{✓} = 63{,}5 \text{ g}$$

$$\text{mass impure Cu} = \frac{63{,}5 \times 100 \text{✓}}{95{,}7 \text{✓}} = 66{,}35 \text{ g ✓}$$

(5)

[11]

GRAND TOTAL/*GROOTTOTAAL* [150]