Province of the
EASTERN CAPE
EDUCATION

Iphondo loMpuma Kapa: Isebe loMfundo
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NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2025

PHYSICAL SCIENCES P2: (CHEMISTRY)

MARKS: 150

TIME: 3 hours

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

INSTRUCTIONS AND INFORMATION

1. Write your name and surname in the appropriate space on the ANSWER BOOK.

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

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

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

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

6. You may use a non-programmable calculator.

7. You may use appropriate mathematical instruments.

8. Show ALL formulae and substitutions in ALL calculations.

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

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

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

12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

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

A Alcohols

B Aldehydes

C Esters

D Carboxylic acids (2)

1.2 The empirical formula of methyl propanoate is …

A $C_4H_8O_2$

B C_4H_8O

C C_2H_4O

D CH_2O (2)

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

Compounds	Boiling point (°C)
C_4H_8O	63
C_4H_8O	75

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

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

(2)

1.4 The organic molecule shown below undergoes thermal cracking.

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

A Hexane and butane

B Octane, ethane and hydrogen gas

C Pentane, propene and ethene

D Propane, butane and ethene (2)

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

A No energy is absorbed or released.

B The amount of energy released is greater than the amount of energy absorbed.

C The amount of energy absorbed is greater than the amount of energy released.

D The amount of energy absorbed is equal to the amount of energy released. (2)

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

$$3H_2 (g) + N_2 (g) \rightleftharpoons 2 NH_3 (g) \quad \Delta H < 0$$

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

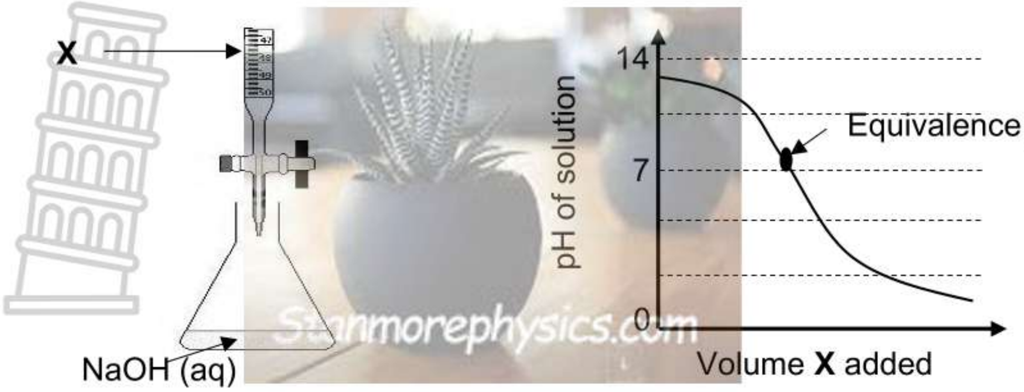
A Addition of a catalyst

B Increase temperature

C Decrease in the volume of the container

D Decrease in the concentration of N_2 (2)

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



Consider the statements regarding substance **X**.

I The K_a value for substance **X** is greater than 1.

II The amount of **X** is equal the amount of NaOH at the equivalence point.

III Substance **X** ionises in water to produce low concentration of H_3O^+

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

A **I** and **II** only

B **II** only

C **II** and **III** only

D **I** and **III** only (2)

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

$$C\ell_2\,(g) + H_2O\,(\ell) \rightleftharpoons C\ell^-\,(aq) + C\ell O^-\,(aq) + 2\,H^+\,(aq) \qquad \Delta H < 0$$

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

A Addition of hydrogen (H_2)

B Addition of potassium hydroxide (KOH)

C Decrease the pH of the equilibrium mixture

D Cool the equilibrium mixture (2)

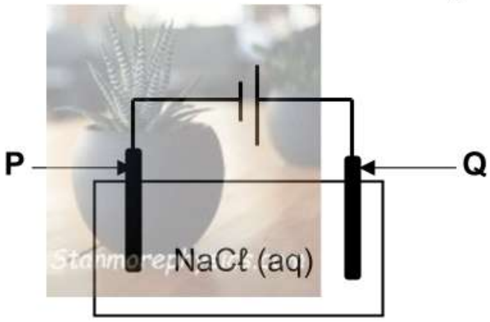
1.9 The standard hydrogen half-cell (H^+ | H_2 | Pt) is connected to Mn | Mn^{2+} half-cell to form a galvanic cell.

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

	Oxidising agent	Direction of flow of electrons	
		From half-cell	To half-cell
A	Mn	H^+ | H_2 | Pt	Mn | Mn^{2+}
B	Mn^{2+}	Mn | Mn^{2+}	H^+ | H_2 | Pt
C	H^+	H^+ | H_2 | Pt	Mn | Mn^{2+}
D	H^+	Mn | Mn^{2+}	H^+ | H_2 | Pt

(2)

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



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

I The pH of the electrolyte increases over time.
II H_2O is oxidised at electrode **P**.
III Chlorine gas ($C\ell_2$) is produced at electrode **Q**.

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

A **I** and **II** only

B **III** only

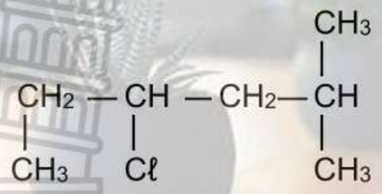
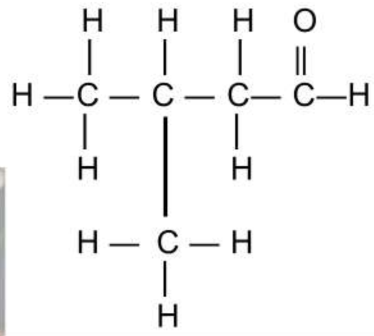
C **II** and **III** only

D **I** and **III** only (2)

[20]

QUESTION 2 (Start on a NEW page.)

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

A 	**B** 3,4-dimethylpentan-2-ol
C $CH_3CH(CH_3)CCCH_3$	**D** 
E 3-methylbutanone	**F** C_xH_Y

2.1 Define *homologous series.* (2)

2.2 Write down the LETTER that represents EACH of the following:

2.2.1 Unsaturated hydrocarbon (1)

2.2.2 A compound with a carbonyl group bonded to two saturated carbon atoms (1)

2.2.3 Compounds that are functional isomers (2)

2.3 Write down the IUPAC name of:

2.3.1 Compound **A** (3)

2.3.2 Compound **C** (2)

2.4 Draw the STRUCTURAL FORMULA of compound **B**. (2)

2.5 Compound **D** has a positional isomer.

2.5.1 Define the term *positional isomer.* (2)

2.5.2 Draw the positional isomer of compound **D**. (2)

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

$$C_xH_Y + 8\ O_2 \rightarrow \mathbf{P}\ CO_2 + 6\ H_2O$$

2.6.1 Determine the value **P**. (2)

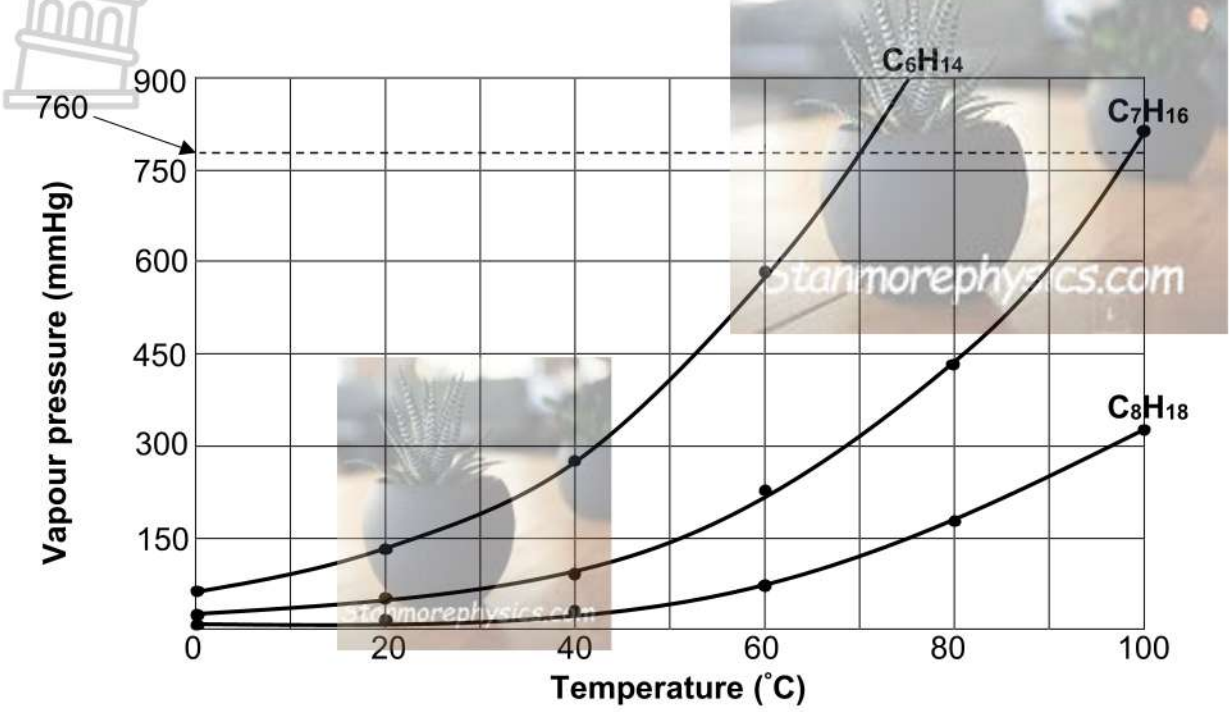
2.6.2 Write down the CONDENSED STRUCTURAL FORMULA of compound **F**. (2)

[21]

QUESTION 3 (Start on a NEW page.)

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

GRAPH OF VAPOUR PRESSURE VERSUS TEMPERATURE



3.1 Define *vapour pressure*. (2)

3.2 At what phase are the alkanes at room temperature?

Write down only GAS, LIQUID or SOLID.

Give a reason for the answer. (2)

3.3 How will the boiling points change if the atmospheric pressure decreases?

Choose from INCREASES, DECREASES or REMAIN THE SAME. (1)

3.4 What can be concluded from the curve regarding the relationship between intermolecular forces and vapour pressure? (2)

3.5 The table below shows the boiling point of propan-1-ol and propanoic acid.

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

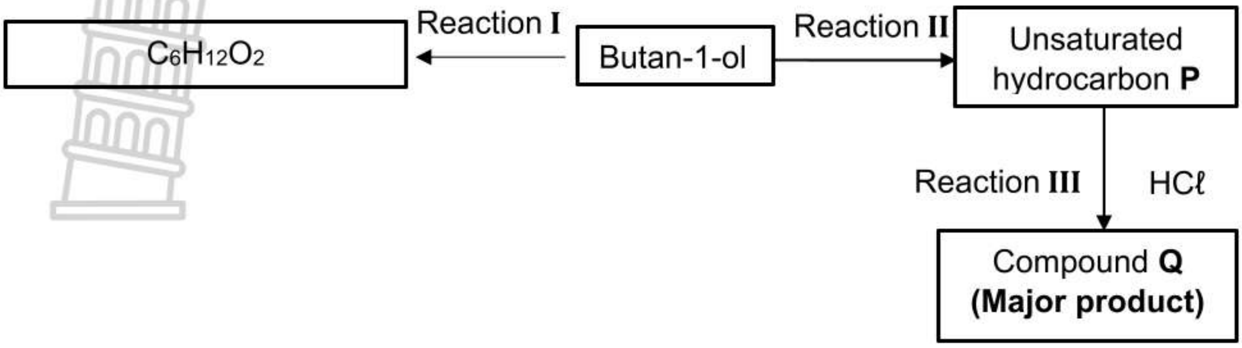
3.5.1 Define the term *boiling point*. (2)

3.5.2 Fully explain the difference in the boiling points. (4)

[13]

QUESTION 4 (Start on a NEW page.)

Consider the flow diagram below:



4.1 Consider reaction **I**.

Write down the:

4.1.1 Name of reaction (1)

4.1.2 STRUCTURAL FORMULA of the carboxylic acid need (2)

4.2 Consider reaction **II**.

Write down the:

4.2.1 NAME or FORMULA of the inorganic reagent needed (1)

4.2.2 IUPAC name of unsaturated hydrocarbon **P** (2)

4.3 Consider reaction **III**.

4.3.1 Write down the name of the type of addition reaction. (1)

4.3.2 Is compound **Q** a PRIMARY, SECONDARY or TERTIARY HALOALKANE? Give a reason for the answer. (2)

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

Write down the:

4.4.1 Type of reaction that occurred (1)

4.4.2 Balanced equation by using STRUCTURAL FORMULAE for the organic compounds and write the structural formula for the major product only in the reaction. (6)

[16]

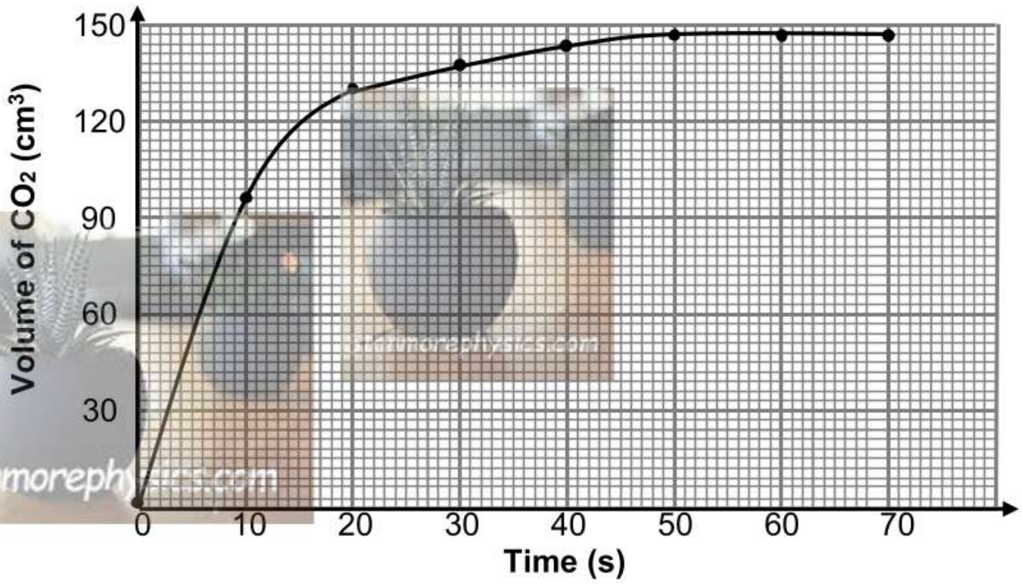
QUESTION 5 (Start on a NEW page.)

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

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

$$CaCO_3\,(s) + 2\,HC\ell\,(aq) \longrightarrow CaC\ell_2\,(aq) + H_2O\,(\ell) + CO_2\,(g)$$

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



5.2 How will the learners know that the reaction has reached completion? (1)

5.3 Calculate the:

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

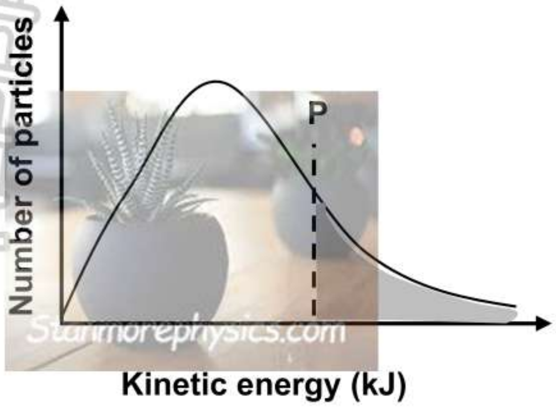
5.3.2 Percentage purity of $CaCO_3$ if the molar volume of CO_2 is 24 000 $cm^3\cdot mol^{-1}$ at 25 ^oC (5)

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

5.4.1 Will the reaction rate INCREASE, DECREASE or REMAIN THE SAME? (1)

5.4.2 Explain the answer to QUESTION 5.4.1 by referring to the collision theory. (3)

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



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

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

Choose from INCREASES, DECREASES or NO EFFECT.

Give a reason for the answer. (2)

[18]

QUESTION 6 (Start on a NEW page.)

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

$$\underset{\textbf{Blue}}{Cu(H_2O)_6^{2+}(aq)} + 4\,C\ell^-(aq) \rightleftharpoons \underset{\textbf{Green}}{CuC\ell_4^{2-}(aq)} + 6\,H_2O(\ell) \quad \Delta H > 0$$

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

6.2 State whether the solution will become **BLUE** or **GREEN** when the following changes are made.

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

6.2.1 The mixture is cooled. (1)

6.2.2 Addition of saturated sodium chloride solution. (1)

6.3 Fully explain the answer to QUESTION 6.2.2 by referring to Le Chatelier's principle. (3)

6.4 Calcium carbonate is allowed to decompose at 1 000 °C in a sealed container according to the balanced chemical equation below.

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g) \qquad \Delta H > 0$$

Initially 0,24 mol of calcium carbonate is placed in a 2 dm^3 container and heated. An equilibrium is established at 1 000 °C. At this temperature the equilibrium constant is 0,0385.

6.4.1 Will the Kc value INCREASE, DECREASE or REMAIN THE SAME if the temperature at which calcium carbonate decomposes is INCREASED?

Fully explain the answer. (3)

6.4.2 Calculate the mass of unreacted calcium carbonate that will remain in the container when the system reaches equilibrium at 1 000 °C. (7)

[17]

QUESTION 7 (Start on a NEW page.)

7.1 Consider the reactions below and answer questions that follow.

REACTION	**CHEMICAL EQUATIONS**
A	$HSO_4^- + H_2O \rightarrow SO_4^{2-} + H_3O^+$
B	$KOH + CH_3COOH \rightarrow CH_3COOK + H_2O$

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

From the reactions above:

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

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

7.2 Consider reaction **B**.

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

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

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

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

$$2\ NaOH\ (aq) + H_2SO_4\ (aq) \rightarrow Na_2SO_4\ (aq) + 2\ H_2O(\ell)$$

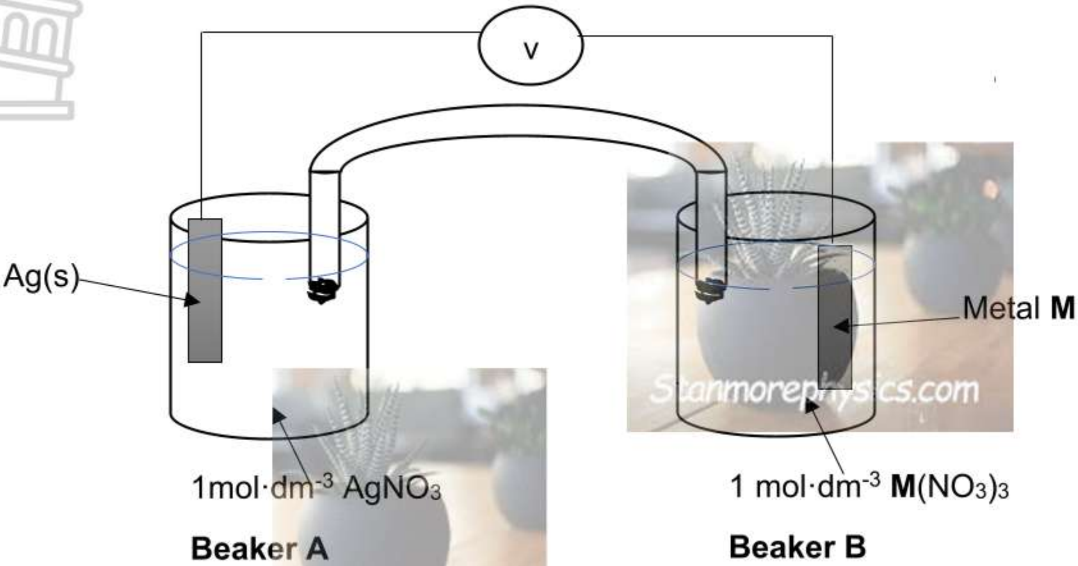
7.3.1 Write down the name of a suitable indicator for this neutralisation reaction. (1)

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

[18]

QUESTION 8 (Start on a NEW page.)

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



8.1.1 Write down the energy conversion in this cell. (2)

8.1.2 Which electrode is the anode in the cell (Ag or Metal **M**)?

Explain the answer. (3)

8.2 The initial potential difference for this cell is 1,54 V.

8.2.1 Identify metal **M** by calculation. (5)

8.2.2 Write down the cell notation for the cell. (3)

8.3 How will the initial reading on the voltmeter change when the following changes are made to the cell above?

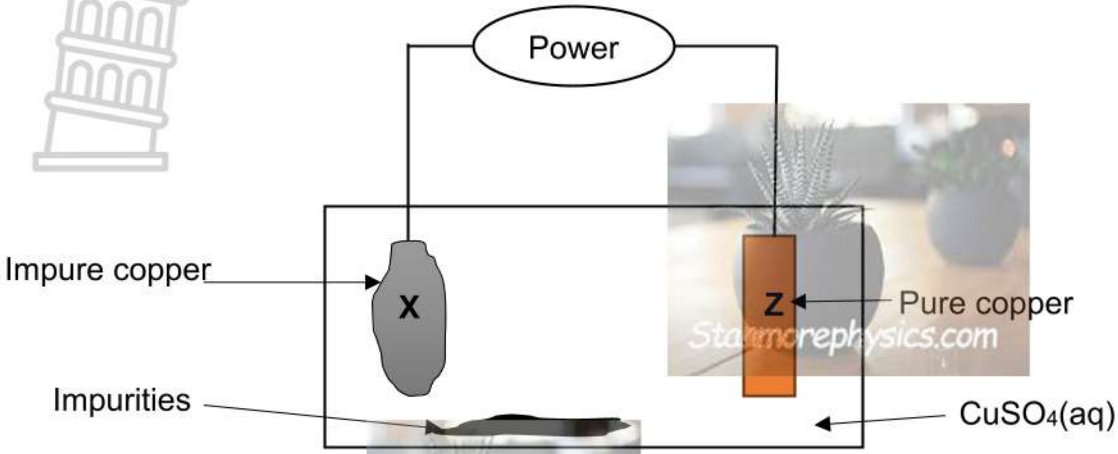
Write down only INCREASES, DECREASES or REMAINS THE SAME

8.3.1 Surface area of the Ag electrode is increased. (1)

8.3.2 The concentration of $AgNO_3$ solution is increased to 2 mol·dm^{-3}. (1)
[15]

QUESTION 9 (Start on a NEW page.)

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



9.1 Define the term *electrolyte*. (2)

9.2 Is this reaction ENDOTHERMIC or EXORTHEMIC? (1)

9.3 Which of the electrodes (**X** or **Z**) is connected to the positive terminal of the battery? (1)

9.4 Write down the half reaction that takes place at electrode **Z**. (2)

9.5 During the electrolysis it is observed that zinc is also oxidised but not silver.

Give a reason for this observation by referring to the relative strengths of the reducing agents. (1)

9.6 An unknown solution ($MC\ell_2$) was electrolysed using copper electrodes. After some time $1{,}806 \times 10^{22}$ electrons were gained at the cathode while the cathode gained 0,6 g.

Determine, by calculations, the formula of an unknown solution. (5)

[12]

TOTAL: 150

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DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE 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 teen 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 se konstante*	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$ or/of $n = \frac{N}{N_A}$ or/of $n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$ $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$ $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at /by 298K
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$		
$q = I\Delta t$ $n = \frac{Q}{e}$ or/of $n = \frac{Q}{q_e}$		

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

KEY/ *SLEUTEL*

Atoomgetal / Atomic number	29
Elektronegatiwiteit / Electronegativity	1,9
Simbool / Symbol	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)
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

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

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

Increasing reducing ability/*Toenemende reduserende vermoë* ↓

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

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
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87

Increasing oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*

Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo
Provinsie van die Oos Kaap: Department van Onderwys
Porafensie Ya Kapa Botjahabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

SEPTEMBER 2025

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

MARKS/*PUNTE*: 150

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

QUESTION/*VRAAG* 1

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

QUESTION/*VRAAG* 2

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

OR / *OF*

A series of organic compounds in which one member differs from the next with a CH_2 group. ✓✓
'n Reeks organiese verbindings waarin een lid van die volgende met 'n CH_2-groep verskil. (2)

2.2 2.2.1 C ✓ (1)

2.2.2 E ✓ (1)

2.2.3 D and/*en* E ✓✓ (2)

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

<u>Marking criteria/*Nasienkriteria*</u>:
- <u>hexane</u> / <u>*heksaan*</u> ✓
- chloro and methyl / *en metiel* ✓
- Whole name correct / *Hele naam korrek* ✓

(3)

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

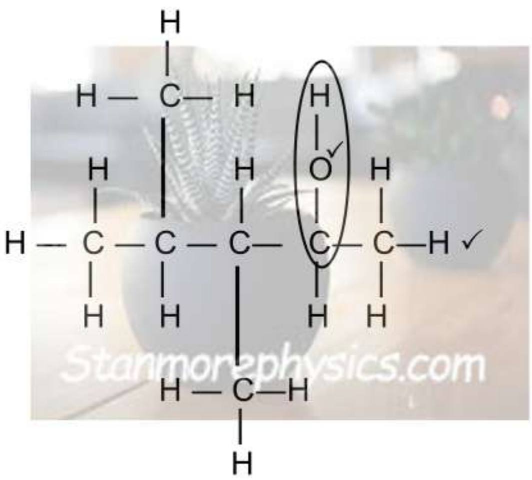
OR / *OF*

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

<u>Marking criteria/*Nasienkriteria*</u>:
- Pentyne / *Pentyn* ✓
- Whole name correct / *Hele naam korrek* ✓

(2)

2.4



<u>Marking criteria/*Nasienkriteria*</u>:
- Correct functional group. ✓
- Whole structure correct ✓
- *Korrek functionele groep*
- *Hele struktuur korrek*

(2)

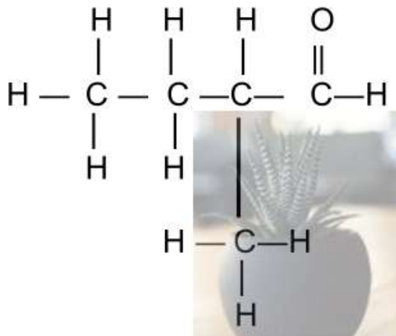
2.5 2.5.1

Marking criteria/ *Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.
*Indien enige van onderstreepte die sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase.*

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

Verbindings met dieselfde molekulêre formule, maar verskillende posisies van die syketting, substituente of funksionele groepe op die stamketting. (2)

2.5.2



✓✓

Marking criteria/*Nasienkriteria*:

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

NOTE: If position of functional group is changed then 0/2
LET WEL: *As die posisie van die funksionele groep verander dan 0/2*

(2)

2.6 2.6.1

Using oxygen/*gebruik suurstof*	Using hydrogen/gebruik waterstof
P (2) + 6(1) = 8(2) ✓ P = 5 ✓	6 x 2 = 12 C_xH_{12} ✓ ∴ C_5H_{12} P = 5 ✓

(2)

2.6.2 $CH_3CH_2CH_2CH_2CH_3$ ✓✓ (2)

[21]

QUESTION/*VRAAG* 3

Marking criteria/ *Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase. *Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase.*

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

Die druk wat deur damp uitgeoefen word by ewewig met sy vloeistof in 'n geslote sisteem. (2)

3.2 LIQUID ✓

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

OR

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

VLOEISTOF

Die kookpunt van die stowwe is hoër as kamertemperatuur.

OF

Die dampdruk van die stowwe by 25 °C is laer as die atmosferiese druk. (2)

3.3 DECREASES / *LAER AS*. ✓ (1)

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

Hoe langer die kettinglengte / sterker die intermolekulêrekragte hoe laer die dampdruk. (2)

3.5 3.5.1

Marking criteria/ *Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase. *Indien enige van die onderstrerepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase.*

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

Die temperatuur waarteen die dampdruk van 'n stof gelyk is aan die atmosferiese duk. (2)

3.5.2

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

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

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

OR

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

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

OF

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

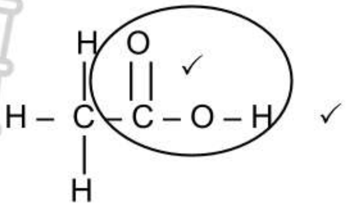
(4)

[13]

QUESTION/*VRAAG* 4

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

4.1.2



Marking criteria/*Nasienkriteria*
- Correct functional group ✓
  Funksionele groep korrek
- Whole structure correct ✓
  Hele struktuur korrek

(2)

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

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

4.3 4.3.1 Hydrohalogenation/*Hidrohalogenering* ✓ (1)

4.3.2 Secondary Halolalkane ✓

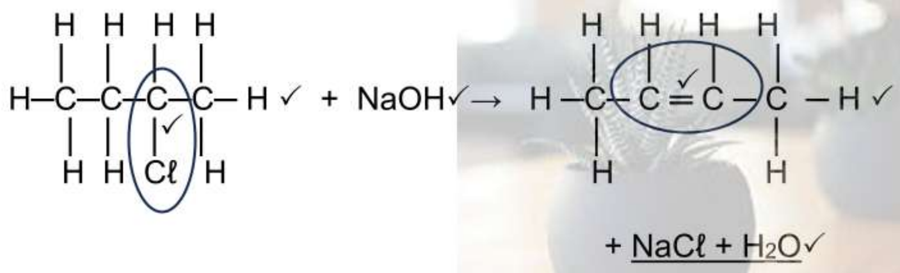
The halogen/Cℓ is bonded to a secondary carbon. /The halogen/Cℓ is bonded to a carbon that is bonded to two other carbon atoms. /The halogen/Cℓ is bonded to a carbon that contains one hydrogen atom. ✓

Sekondêre haloalkaan

Die halogeen/Cℓ is aan 'n sekondêre koolstof verbind. /Die halogeen/ Cℓ is verbind aan 'n koolstof wat verbind is aan twee ander koolstofatome./ Die halogeen/ Cℓ is verbind aan 'n koolstof wat een waterstof atoom bevat. (2)

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

4.4.2



Marking criteria for organic compounds/
Nasienkriteria vir organiese verbindings
- Correct functional group ✓
  Funksionele groep korrek
- Whole structure correct ✓
  Hele struktuur korrek

Inorganic reagent / Anorganiese reagense
- NaOH. ✓ NaBr and H_2O ✓

(6)
[16]

QUESTION/*VRAAG* 5

5.1

Marking criteria/ *Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase. *Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase.*

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

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

OR/*OF*

The rate of change in concentration/amount of moles/number of moles/volume /mass. ✓✓ **(2 or 0)**
Die tempo van verandering in konsentrasie/hoeveelheid mol/getal mo/volume/ massa. ***(2 of 0)*** (2)

5.2 Volume of carbon dioxide (CO_2) gas produced remains constant/No CO_2 gas bubbles produced ✓
Volume koolstof dioksied (CO_2) wat geproduseer word bly konstant/Geen CO_2 gasborrels word geproduseer. (1)

5.3 5.3.1

Reaction rate/*Reaksietempo* $= \frac{\Delta V}{\Delta t}$

$= \frac{147 - 0\ ✓}{50\ ✓}$

$= 2{,}94\ (cm\cdot s^{-1})$ ✓ (3)

5.3.2 **Marking criteria/ *Nasienkriteria***
(a) Substitution into/ *Vervanging in* n = V/ Vm
(b) Use of mole ratio/ *Gebruik van mol verhouding* $CaCO_3 : CO_2$
(c) Substitution into/ *Vervanging in* m = nM
(d) Substitution into *percentage purity equation/ Vervanging in persentasie suiwerheid vergelyking*
(e) Final answer/ *Finale Antwoord*

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

$= \frac{147}{24\ 000}$ (a) ✓

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

$n(CaCO_3) = n(CO_2) = 6{,}125 \times 10^{-3}$ mol (b) ✓

$m = nM$

$m(CaCO_3) = (6{,}125 \times 10^{-3})(100)$ (c) ✓

$m(CaCO_3) = 0{,}6125$ g

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

% purity/ *suiwerheid* $= 24{,}5$ % (e) ✓

(5)

5.4 5.4.1 INCREASES / *TOENEEM* ✓ (1)

5.4.2
- Powdered $CaCO_3$ will increase the surface area/contact area/ increases the state of division of $CaCO_3$. ✓
- More particles will collide with the correct orientation. ✓
- More effective collisions per unit time / Frequency of the effective collisions increase ✓

- *Gepoeierde $CaCO_3$ sal die oppervlakte/kontakarea vergroot/vergroot die toestand van verdeling van $CaCO_3$.*
- *Meer deeltjies sal met die korrekte oriëntasie bots*
- *Meer effektiewe botsings per eenheidstyd/ Frekwensie van die effektiewe botsings neem toe* (3)

5.5 5.5.1 Particles with sufficient kinetic energy for effective collisions. ✓
Deeltjies met genoeg kinetiese energie vir effektiewe botsings. (1)

5.5.2 INCREASE/ TOENEEM ✓

An increase in temperature increases the average kinetic energy of the particles. ✓
'n Toename in temperatuur verhoog die gemiddelde kinetiese energie van die deeltjies. (2)

[18]

QUESTION/*VRAAG* 6

6.1

Marking criteria/ *Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase. *Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per word/frase.*

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

Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n nuwe ewewig herstel deur die reaksie wat die versteuring sal teenwerk/ kanselleer, te bevoordeel. (2)

6.2 6.2.1 Blue/*Blou* ✓ (1)

6.2.2 Green/*Groen* ✓ (1)

6.3
- The addition of saturated sodium chloride solution increases the concentration of the chloride ions ($C\ell^-$). ✓
- According to Le Chatelier's principle the system will respond by consuming the $Cu(H_2O)_6^{2+}$ and $C\ell^-$ ✓
- The forward reaction will be favoured / the equilibrium position shifts towards right ✓

- *Die byvoeging van versadigde natriumchloriedoplossing verhoog die konsentrasie van die chloriedione ($C\ell^-$).*
- *Volgens Le Chatelier se beginsel sal die sisteem reageer deur die $Cu(H_2O)_6^{2+}$ en $C\ell^-$ op te gebruik*
- *Die voortwaartse reaksie word bevoordeel/Die ewewigsposisie verskuif na regs* (3)

6.4 6.4.1 INCREASES / *TOENEEM* ✓

- According to Le Chatelier's principle an increase in temperature favours the endothermic reaction. ✓
- The forward reaction is favoured / the equilibrium position shifts towards right. ✓
- More CO_2 is produced.

- *Volgens Le Chatelier se beginsel 'n toename in temperatuur bevoordeel die endotermiese reaksie.*
- *Die voortwaartse reaksie word bevoordeel/ die ewewigsposisie verskuif regs.*
- *Meer CO_2 word geproduseer.* (3)

6.4.2 **OPTION 1 / *OPSIE 1***

Marking criteria:

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

Nasienkriteria:

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

K_c = $[CO_2]$ (a) ✓

$[CO_2]$ = 0,0385 $mol{\cdot}dm^{-3}$ (b) ✓

$n(CO_2)$ = cV
= 0,0385 x 2 (c) ✓
= 0,077 mol

$n(CO_2)$ = $n(CaCO_3)$
$n(CaCO_3)$ = 0,077mol $CaCO_3$ reacted/reageer (d) ✓

n(unreacted / onreageerde $CaCO_3$) = n(Initial) – n(reacted/reageer)
= 0,24 – 0,077 ✓ (e)
= 0,163 mol

$m_{(unreacted/onreageerde)}$ = nM
= 0,163 x 100 ✓ (f)
= 16,3 g ✓ (g)

OPTION 2 / *OPSIE 2*

Marking criteria:

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

Nasienkriteria:

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

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

K_c = [CO] ✓ (c)

0,038 = $\frac{x}{2}$ ✓ (d)

x = 0,077

n_e = 0,24 – 0,077 ✓ (e)

n_e = 0,163 mol

m ($CaCO_3$) = nM

m($CaCO_3$) = (0,163)(100) ✓ (f)

($CaCO_3$) = 16,3 g ✓ (g) (7)

[17]

QUESTION/*VRAAG 7*

7.1 7.1.1 Bases produce hydroxide ions (OH^-) in aqueous solution. ✓✓ **(2 or 0)**

Basisse produseer hidroksiedione (OH^-) in waterige oplossing. ***(2 of 0)*** (2)

7.1.2 A ✓ (1)

7.1.3 SO_4^{2-} ✓ (1)

7.2 7.2.1 It ionises incompletely in water ✓ to form low concentration of H_3O^+ ions. ✓

Dit ioniseer onvolledig in water om lae konsentrasie H_3O^+-ione te vorm. (2)

7.2.2 Alkaline salt/Alkaliese sout ✓ (1)

7.2.3 $CH_3COO^- + H_2O \rightarrow CH_3COOH + OH^-$ ✓✓

(reactants / *reaktanse* and / *en* products / *produkte*)

Excess OH^- is produced/*Produseer oormaat OH^-*. ✓ (3)

7.3 7.3.1 Bromothymol blue/*Broomtimol blou* ✓ (1)

7.3.2 **<u>Marking criteria</u>**

(a) Substitution in c_aV_a
(b) Substitution in c_bV_b
(c) Subsitution in n_a/ n_b
(d) Use of mole ratio $H_2SO_4 : H_3O^+$
(e) Formula $pH = - \log [H_3O^+]$
(f) Substitution in $pH = - \log [H_3O^+]$
(g) Final answer

<u>Nasienkriteria</u>

(a) *Vervanging in* c_aV_a
(b) *Vervanging in* c_bV_b
(c) *Vervanging in* n_a/ n_b
(d) *Gebruik van mol verhouding* $H_2SO_4 : H_3O^+$
(e) *Formule* $pH = - \log [H_3O^+]$
(f) *Vervanging in* $pH = - \log [H_3O^+]$
(g) *Finale antwoord*

OPTION 1 / *OPSIE 1*

$$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$$

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

$c_a = 0,05 \text{ mol·dm}^{-3}$

OPTION 2 / *OPSIE 2*

$n(NaOH) = cV$

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

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

$n(H_2SO_4) = 2 \times n(NaOH)$

$n(H_2SO_4) = ½ \times (2,5 \times 10^{-3})$ (b) ✓

$n(H_2SO_4) = 1,25 \times 10^{-3}$ mol

$c = n/V$

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

$c_a = 0,05 \text{ mol·dm}^{-3}$

$H_2SO_4 + H_2O \rightarrow 2H_3O^+ + SO_4^{2-}$

$c(H_3O^+) = 2c(H_2SO_4)$

$c(H_3O^+) = 2(0,05)$ (d) ✓

$[H_3O^+] = 0,1 \text{ mol·dm}^{-3}$

pH $= -\log[H_3O^+]$ (e) ✓
$= -\log 0,1$ (f) ✓
$= 1$ (g) ✓

(7)

[18]

QUESTION 8/*VRAAG 8*

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

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

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

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

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

Metal is chromium (Cr) ✓

Metaal is chroom (Cr)

Marking criteria/*Nasienkriteria*
- Any other formula using unconventional abbreviation , e.g. / $E^{\theta}_{cell} = E^{\theta}_{OA} - E^{\theta}_{RA}$ followed by the correct substitution Max ¾
Enige ander formule wat onkonvensionele afkorting gebruik bv. $E^{\theta}_{sel} = E^{\theta}_{OM} - E^{\theta}_{RM}$ gevolg deur korrekte vervanging Maks ¾

(5)

8.2.2 Cr | Cr^{3+} ✓ || ✓ Ag^{+} | Ag ✓ (3)

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

8.3.2 INCREASES/*TOENEEM* ✓ (1)
[15]

QUESTION/*VRAAG* 9

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

OR / *OF*

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

9.2 ENDOTHERMIC/*ENDOTERMIES* ✓ (1)

9.3 X ✓ (1)

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

<u>Marking criteria / *Nasienkriteria*</u>
- $Cu(s) \leftarrow Cu^{2+}(aq) + 2e^-$ 2/2
- $Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$ 1/2
- $Cu(s) \rightleftharpoons Cu^{2+}(aq) + 2e^-$ 0/2
- $Cu^{2+}(aq) + 2e^- \leftarrow Cu(s)$ 0/2

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

9.5 Silver (Ag) is a weaker reducing agent than copper (Cu) and Zinc (Zn). ✓
Silver (Ag) will not be oxidized.
Silwer (Ag) is 'n swakker reduseermiddel as koper (Cu) en sink (Zn).
Silwer (Ag) word nie geoksideer nie. (1)

9.6 **<u>Marking criteria / *Nasienkriteria*</u>**
(a) Substitution in/ *Vervang in* $n = N/N_A$
(b) Use of mole ratio/ *Gerbuik van mol verhouding* M : e^-
(c) Formula/ *Formule* $n = m/M$
(d) Substitution into/ *Vervang in* $n = m/M$
(e) Formula/ *Formule* $CaC\ell_2$

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

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

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

n (M)= 0,03 x ½ (b) ✓

n (M)= 0,015 mol

M = $\frac{m}{n}$ (c) ✓

M = $\frac{0,6}{0,015}$ (d) ✓

M = 40 g·mol^{-1}

M = $CaC\ell_2$ (e) ✓ (5)

[12]

TOTAL/*TOTAAL:* 150