education

MPUMALANGA PROVINCE

REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY P2

JUNE 2025

MARKS: 150

TIME: 3 hours

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

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of SEVEN 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 is an alkyne?

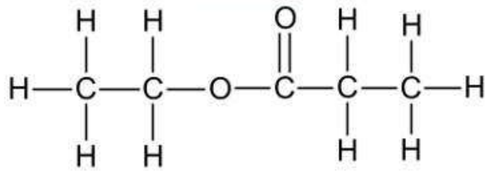
A C_6H_{12}

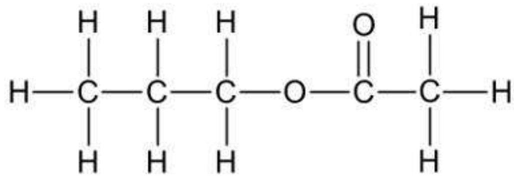
B C_4H_6

C $C_{10}H_{22}$

D C_4H_8O (2)

1.2 Which ONE of the following is a functional isomer of ethyl propanoate?

A 

B 

C 

D 

(2)

1.3 For which ONE of the following pairs of compounds will **X** have a higher boiling point than **Y**?

	X	**Y**
A	$CH_3CH(CH_3)CH_3$	$CH_3CH_2CH_2CH_3$
B	CH_3CH_3	$CH_3CH_2CH_3$
C	$CH_3CH_2CH_2CH_3$	$CH_3CH_2COCH_3$
D	CH_3COOH	$CH_3CH_2CH_2OH$

(2)

1.4 Ethanol can be converted into other carbon-containing compounds using the reactants as shown in the flow chart below.

$$\text{Ethanol} \xrightarrow[\text{reaction 1}]{H_2SO_4(c)} \text{Compound } \mathbf{P} \xrightarrow[\text{reaction 2}]{HBr} \text{Compound } \mathbf{Q}$$

Compounds P and Q are, respectively:

	P	**Q**
A	Ethene	Bromoethane
B	Ethanoic acid	Ethanol
C	Ethene	Bromoethene
D	Ethanol	Ethanoic acid

(2)

1.5 A piece of magnesium ribbon reacts with excess hydrochloric acid according to the following equation:

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

Which ONE of the following changes will NOT affect the reaction rate?

A Putting the reaction mixture in a hot water bath

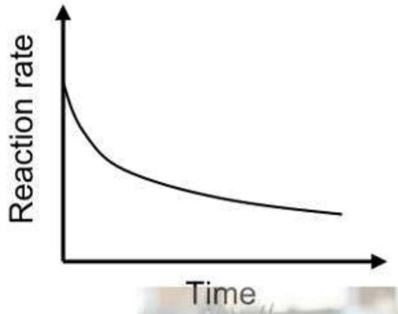
B Using the same mass of powdered magnesium

C Increasing the volume of the hydrochloric acid

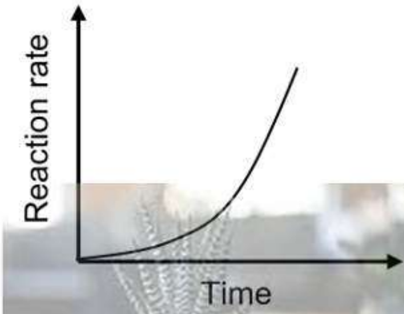
D Increasing the concentration of the hydrochloric acid. (2)

1.6 Which ONE of the reaction rate versus time graphs below best represents the reaction between magnesium and EXCESS dilute hydrochloric acid?

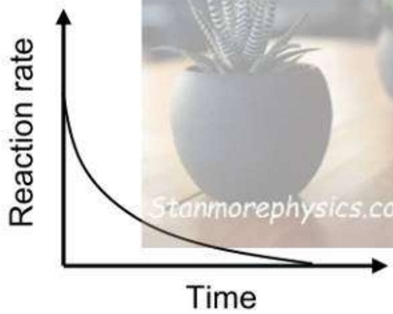
A



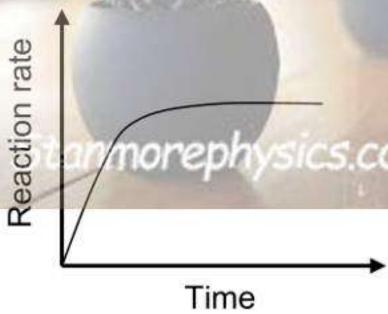
B



C



D



(2)

1.7 Which ONE of the following will NOT affect the equilibrium position of reversible chemical reactions?

A Temperature

B Catalyst

C Pressure

D Concentration (2)

1.8 The reaction given below reaches equilibrium in a closed container. The K_c value is 0,04 at a certain temperature.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \quad \Delta H < 0$$

Which ONE of the following factors will change the K_c value to 0,4?

A Increase in pressure

B Decrease in pressure

C Increase in temperature

D Decrease in temperature (2)

1.9 During a titration to determine the concentration of an acid using a standard solution of a base, a learner pipettes the base into a conical flask. The learner then uses a small amount of water to rinse the inside of the flask so that all the base is part of the solution in the flask.

How will the extra water added to the flask affect the results of this titration?

The concentration of the acid …

A cannot be determined.

B will be lower than expected.

C will be higher than expected.

D will be the same as expected. (2)

1.10 Which ONE of the following statements is ALWAYS true for monoprotic acids?

A The lower the concentration of the acid solution, the weaker the acid.

B There will be more H_3O^+ ions in 100 cm^3 of a strong acid solution than in 100 cm^3 of a weak acid solution.

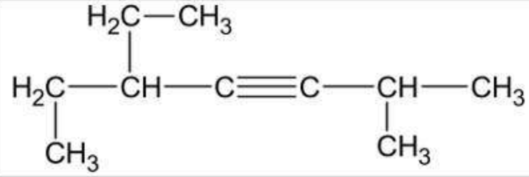
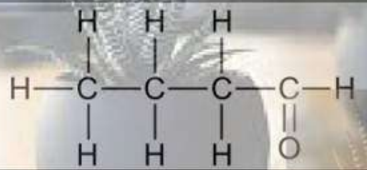
C The pH of a strong acid is lower than the pH of a weak acid.

D One mole of a strong acid will produce more H_3O^+ ions in water than one mole of a weak acid. (2)

[20]

QUESTION 2 (Start on a new page)

The letters **A** tot **H** in the table below represent EIGHT organic compounds.

A	2,4-dichloro-3-ethyl-6-methyloctane	**B**	
C		**D**	$CH_3CH_2CHOHCH_3$
E		**F**	C_5H_{12}
G	$CH_3COCH_2CH_3$	**H**	Butan-1-ol

2.1 Write down the LETTER(S) that represents the following

2.1.1 A functional isomer of compound **G**. (1)

2.1.2 A haloalkane (1)

2.1.3 Belongs to the same homologous series as compound **H**. (1)

2.2 Write down the:

2.2.1 IUPAC name of compound **B**. (3)

2.2.2 Structural formula of compound **A**. (3)

2.2.3 Name of the homologous series to which compound **C** belongs. (1)

2.2.4 Structural formula of the FUNCTIONAL GROUP of compound **G**. (1)

2.3 Consider compound **D**

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

2.3.2 Write down the STRUCTURAL FORMULA of the positional isomer of compound **D**. (2)

2.3.3 Is compound **D** a PRIMARY, SECONDARY or TERTIARY alcohol? Give a reason for the answer. (2)

2.4 Compound **E** and **H** are heated together in the presence of a catalyst in a test tube to produce an ESTER.

Write down the:

2.4.1 Name of the reaction that takes place. (1)

2.4.2 NAME or FORMULA of the catalyst used. (1)

2.4.3 STRUCTURAL FORMULA of the ester that is produced. (2)

2.4.4 IUPAC name of the ester that is produced. (2)

2.5 The reaction below illustrates the complete combustion of compound **F** in EXCESS oxygen.

$$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$$

45 g of compound **F** reacts completely with oxygen at standard temperature and pressure (STP). If the percentage yield of carbon dioxide (CO_2) is 76%, calculate the volume of carbon dioxide formed. (5)

[28]

QUESTION 3 (Start on a new page.)

Students use alcohols **A** to **C** to investigate a factor that affects the boiling point of alcohols.

They use equal volumes of each alcohol and heat them separately in a water bath.

Compounds	**Alcohols**
A	CH_3OH
B	CH_3CH_2OH
C	$CH_3CH_2CH_2OH$

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

3.2 What property of alcohols makes it necessary for them to be heated in a water bath? (1)

3.3 What structural requirements must the alcohols meet to make this a fair comparison? (2)

3.4 Write down the:

3.4.1 Independent variable. (1)

3.4.2 Name of the FUNCTIONAL GROUP of these compounds. (1)

3.4.3 IUPAC name of compound **B** (1)

3.5 Which ONE of the three compounds has the HIGHEST boiling point? (1)

3.6 Explain the answer to QUESTION 3.5 in full. (3)

3.7 The boiling point of compound **C** is now compared with that of compound **X**.

COMPOUND		**BOILING POINT (°C)**
C	$CH_3CH_2CH_2OH$	98
X	CH_3COOH	118

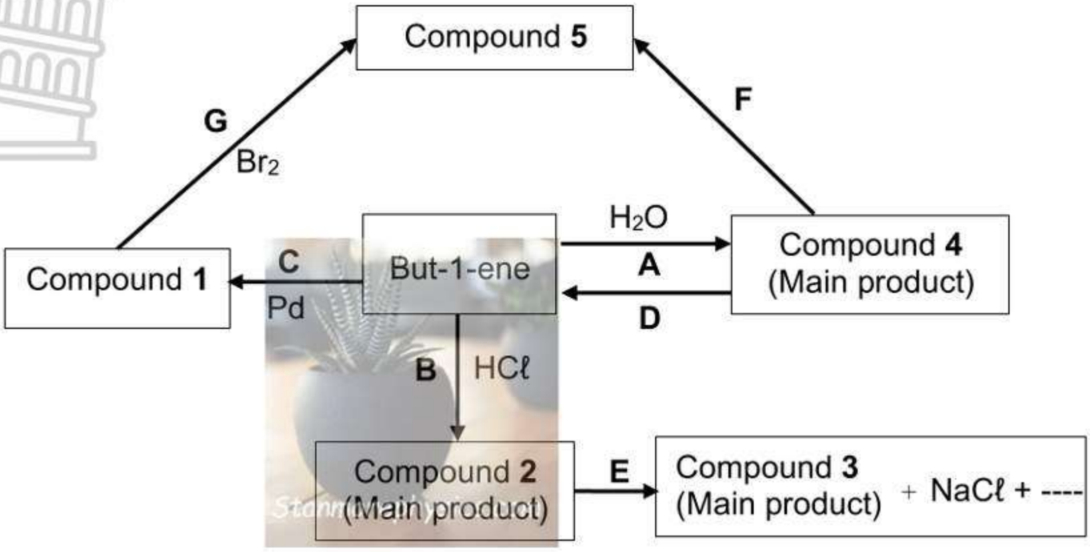
3.7.1 Besides the conditions used to determine boiling points, give a reason why this is a fair comparison. (1)

3.7.2 Fully explain the difference in the boiling points of compounds **C** and **X**. (4)

[17]

QUESTION 4 (Start on a new page.)

The flow chart below shows how alkenes can be used to prepare other organic compounds. The letters **A** to **G** represent different organic reactions.



4.1 Write down the type of reaction represented by:

4.1.1 C (1)

4.1.2 F (1)

4.1.3 D (1)

4.2 For reaction **A** write down the:

4.2.1 IUPAC name of compound **4**. (2)

4.2.2 NAME or FORMULA of the inorganic reactant needed for this reaction. (1)

4.2.3 Type of addition reaction. (1)

4.3 For reaction **G**, bromine water is added to compound **1**.

4.3.1 Is compound **1** a saturated or unsaturated? Give a reason for the answer. (2)

4.3.2 Write down the reaction condition for this reaction. (1)

4.4 Write down a balanced chemical equation using STRUCTURAL FORMULAE for reaction **E**. (6)

4.5 For reaction **B** write down two reaction conditions required for this reaction (2)
[18]

QUESTION 5 (Start on a new page.)

A student is asked to design an industrial process to produce sulphuric acid.

5.1 One of the reactions in the production of sulphuric acid is the roasting (heating in oxygen) of a metal ore that contains lead(II) sulphide:

$$2PbS(s) + 3O_2(g) \rightarrow 2PbO(s) + 2SO_2(g)$$

The student does a test experiment in which 36,8 g of O_2 gas completely reacts with 800 g of the metal ore. All of the PbS in the ore reacts, and ONLY the PbS in the ore reacts with the oxygen.

5.1.1 Calculate the amount (in moles) of O_2 that reacted. (3)

5.1.2 Calculate the mass of pure PbS in the metal ore. (3)

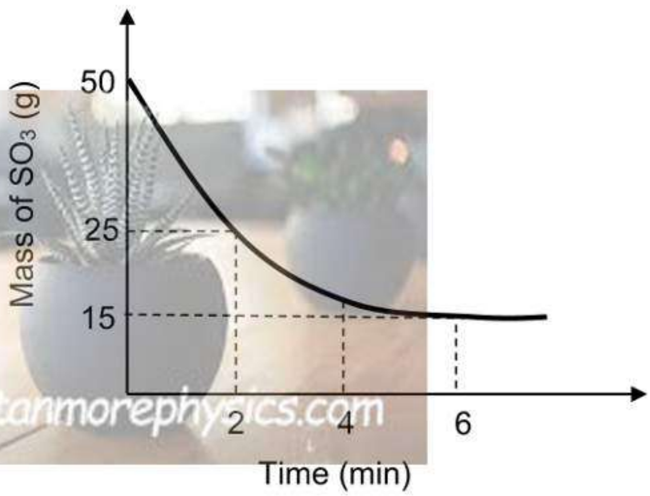
5.1.3 Calculate the percentage mass of the PbS in the metal ore. (2)

5.2 In another experiment, 50 g of sulphur trioxide reacts with water:

$$SO_3(g) + H_2O(\ell) \rightarrow H_2SO_4(\ell)$$

The amount of sulphur trioxide present in the container is monitored over time.

The following graph is plotted:



5.2.1 Write down the formula of the limiting reactant. (1)

5.2.2 At what time on the graph was the reaction rate the fastest. (1)

5.2.3 What happened at 6 minutes. (1)

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

5.2.5 Calculate the rate of the reaction in ($g \cdot s^{-1}$) during the first 2 minutes. (3)

5.2.6 Copy the above graph in your answer book. On the same set of axes, use a DOTTED LINE to show the curve that will be obtained when the temperature increases. No numerical values are required. (2)

5.2.7 In terms of the COLLISION THEORY, explain why the rate of a chemical reaction increases with increasing temperature. (3)

[23]

QUESTION 6 (Start on a new page)

6.1 Nitrosyl chloride ($NOC\ell$) is a yellow gas that decomposes into colourless nitrogen monoxide gas (NO) and green chlorine gas ($C\ell_2$) at temperatures above 100 °C.

$$\underset{\text{Yellow}}{2NOC\ell(g)} \rightleftharpoons 2NO(g) + \underset{\text{Green}}{C\ell_2(g)}$$

Consider an equilibrium mixture of $NOC\ell$, NO, and $C\ell_2$, which is initially yellow–green, in a sealed container.

6.1.1 Explain the term *closed system*. (1)

6.1.2 NO(g) is added to the container at constant volume. What colour change will be observed in the container. Explain the answer (4)

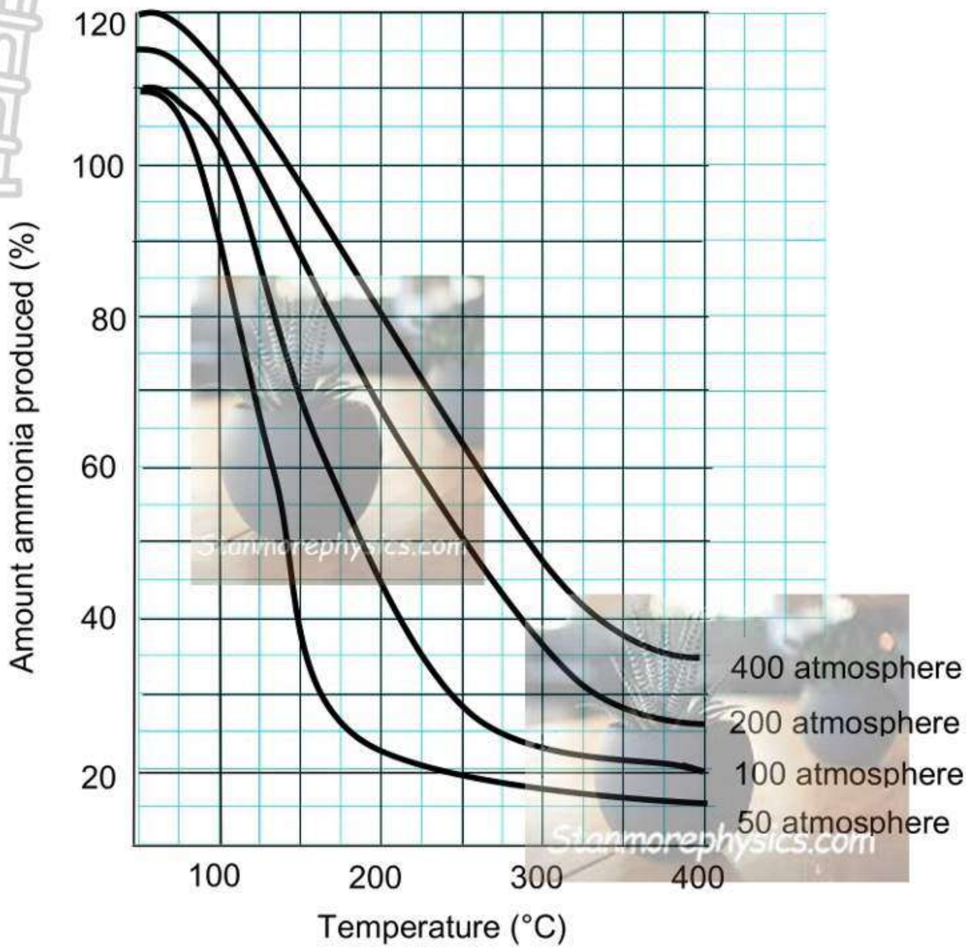
6.1.3 State *Le Chatelier's principle*. (2)

6.1.4 When the pressure in the container is changed, the colour becomes green. Use Le Chatelier's principle to explain whether the pressure was INCREASED or DECREASED. (4)

6.2 The Haber process uses nitrogen and hydrogen gases to produce ammonia gas, represented in the reversible reaction below.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The Haber process was researched. The graph (below) shows how the percentage yield of ammonia is affected by changes in temperature and pressure.



In industry, the Haber process is typically operated at a temperature of 250 °C and a pressure of 200 atmospheres (200 atm).

6.2.1 Is the forward reaction in the Haber process EXOTHERMIC or ENDOTHERMIC? (1)

6.2.2 Explain the answer to Question 6.2.1 in terms of Le Chatelier's principle by referring to the graph. (4)

6.2.3 What is the percentage yield of ammonia at 250 °C and 200 atmosphere? (1)

6.3 A solution is prepared by dissolving 4 mol of $CuC\ell_4^{2-}$ completely in water to make a solution of volume 2 dm^3. When equilibrium is established, there are 2,2 mol of $Cu(H_2O)_6^{2+}$ ions present at 25 °C.

$$Cu(H_2O)_6^{2+}(aq) + 4C\ell^-(aq) \rightleftharpoons CuC\ell_4^{2-}(aq) + 6H_2O(\ell)$$

Determine the value of the equilibrium constant, K_c, for this reaction at 25 °C. (8)

[25]

QUESTION 7 (Start on a new page.)

Consider the following balanced chemical equations showing some acid-base reactions.

A $HNO_3 + KOH \rightarrow KNO_3 + H_2O$

B $H_2SO_3 + H_2O \rightleftharpoons HSO_3^- + H_3O^+$

7.1 Define an acid according to the Lowry- Brønsted theory. (2)

7.2 Consider the chemical equations (**A** and **B**) above.

7.2.1 Describe the term *amphoteric substance.* (2)

7.2.2 Write down the formula of an amphoteric chemical substance (other than H_2O). (1)

7.2.3 Write down the formulae of the conjugate acid-base pairs in reaction **B**. (2)

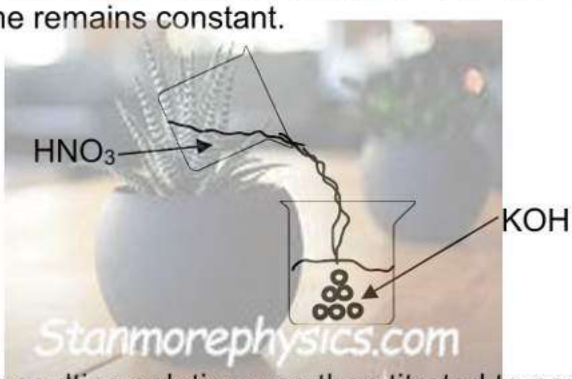
7.3 Which indicator must be used in reaction **A**. Choose from METHYL ORANGE, BROMOTHYMOL BLUE or PHENOLPHTHALEIN. Give a reason for the answer (3)

7.4 Consider reactions **A** and **C**, shown below.

A: $HNO_3 + KOH \rightarrow KNO_3 + H_2O$

C: $2HNO_3 + Na_2CO_3 \rightarrow 2NaNO_3 + CO_2 + H_2O$

A 13 g, impure sample of KOH is initially dissolved in 200 cm^3 of a 1,2 $mol \cdot dm^{-3}$ nitric acid solution. The nitric acid was in EXCESS. Assume that the volume remains constant.



50 cm^3 of the resulting solution was then titrated to neutralisation using 23,67 cm^3 of a standard 0,85 $mol \cdot dm^{-3}$ sodium carbonate solution.

7.4.1 Determine the amount (in mol) of nitric acid that was added to the KOH. (2)

7.4.2 Calculate the percentage purity of the KOH sample. (9)

[21]

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* $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	

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* ↑

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

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

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

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

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
$Cr_2O_7^{2-} + 14H^+ + 4e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 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 strength of reducing agents/*Toenemende sterkte van reduseermiddels*

education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIORSERTIFIKAAT

GRADE/GRAAD 12

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

JUNE/*JUNIE* 2025

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/PUNTE: 150

This marking guidelines consists of 15 pages.
Hierdie nasienryglyne bestaan uit 15 bladsye.

QUESTION 1 / VRAAG 1

1.1 B ✓✓

1.2 C ✓✓

1.3 D ✓✓

1.4 A ✓✓

1.5 C ✓✓

1.6 C ✓✓

1.7 B ✓✓

1.8 D ✓✓

1.9 D ✓✓

1.10 D ✓✓ **[20]**

QUESTION 2 / VRAAG 2

2.1.1 C ✓ (1)

2.1.2 A ✓ (1)

2.1.3 D ✓ (1)

2.2.1 5-ethyl-2-methylhept-3-yne /*5-etiel-2-metielhept-3-yn*

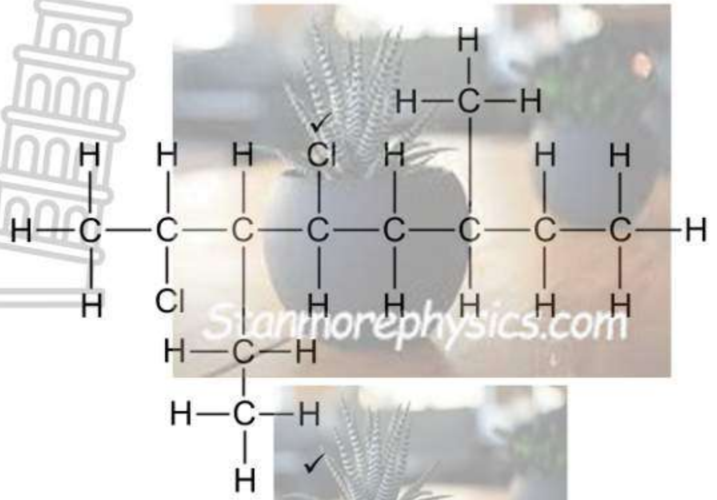
<u>Marking criteria</u>*:*

- Correct stem i.e. heptyne. ✓
- All substituents (ethyl and methyl) correctly identified. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

<u>Nasienkriteria</u>:

- *Korrekte stam d.i. heptyn.* ✓
- *Alle substituente (etiel en metiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas.* ✓

(3)

2.2.2  ✓

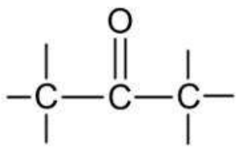
Marking criteria/*Nasienkriteria*

- Eight C atoms in longest chain/ *Agt C-atome in langste ketting*✓
- One Cl atom on C2 and one on C4./*Een Cl-atom op C2 en een op C4* ✓
- Ethyl substituent on C3 and methyl substituent on C6./*Etielsubstituent op C3 en metielsubstituent op C6*✓

IF/*INDIEN*

H-atom or bond omitted/*H-atoom of binding uitgelaat.* Max/*Maks:* $^2/_3$ (3)

2.2.3 Aldehyde/*Aldehied* ✓ (1)

2.2.4  ✓

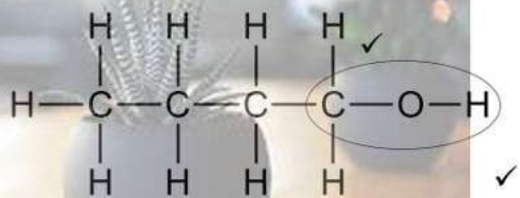
(1)

2.3.1 **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.*

Organic compound with the same molecular formula, but different positions of the side chain, substituents or functional groups on the parent chain. ✓✓
Organiese verbindings met dieselfde molekulêre formule, maar verskillende posisies van die syketting, substituente of funksionele groepe op die stamketting (2)

2.3.2  ✓

Marking criteria/*Nasienkriteria*

- OH-group on C1 ✓
- *OH-groep op C1*
- Whole structure correct. ✓
- *Hele struktuur korrek*

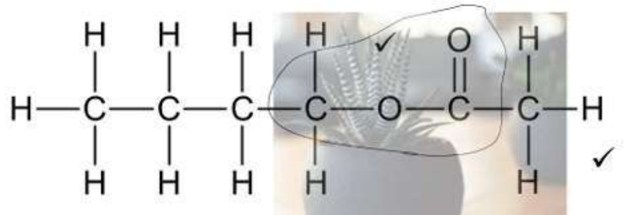
(2)

2.3.3 Secondary alcohol/*Sekondêre alkohol* ✓
The –OH group is (covalently) bonded to a carbon that is bonded to two other C-atoms ✓
Die –OH groep (kovalent) gebind is aan 'n koolstof wat gebind is aan twee ander C-atome (2)

2.4.1 Esterification /Condensation/*Esterifikasie/Kondensasie* ✓ (1)

2.4.2 H_2SO_4/ Sulphuric acid/*Swaelsuur* ✓ (a) (1)

2.4.3



Marking criteria/*Nasienkriteria*

- Functional group correct ✓
  Funksionelegroep korrek
- Whole structure correct. ✓
  Hele struktuur korrek (2)

2.4.4 Butyl ✓ethanoate✓/ *Butieletanoaat* (2)

2.5 **Marking criteria / Nasienkriteria:**

- Substitute / *Vervang* 72 g·mol⁻¹ $n = \frac{m}{M}$ ✓
- Use mole ration/ *gebruik molverhouding*✓
- Substitute number of moles and 22,4 $dm^3 \cdot mol^{-1}$ in $n = \frac{V}{V_m}$ ✓
- Substitute / *Vervang* 76% in $\%yield = \frac{actual}{theoretical}$ ✓
- Final answer / *Finale antwoord*: 53,2 dm^3 ✓

$$n = \frac{m}{M}$$
$$= \frac{45}{72✓}$$
$$= 0{,}625 \text{ mol}$$

$$nCO_2 = 5nC_5H_{12}$$
$$= 5(0{,}625)$$
$$= 3{,}125 \text{ mol ✓}$$

$V = nV_m$ $= 3{,}125 \times 22{,}4$✓ $= 70\ dm^3$ $76 = \frac{x}{70} \times 100$✓ $V_{actual/werklik} = 53{,}2\ dm^3$✓	OR/***OF***	$76 = \frac{x}{3{,}125} \times 100$✓ $n_{actual/werklik} = 2{,}375$ mol $V = nV_m$ $= 2{,}375 \times 22{,}4$✓ $= 53{,}2\ dm^3$✓

(5)
[28]

QUESTION 3 / VRAAG 3

3.1

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 substance equals atmospheric pressure. /*Die temperatuur waarby die dampdruk van die stof gelyk is aan atmosferiese druk.* ✓✓

IF Temperature is omitted 0/2. (2)

3.2 Flamable/*Vlambaar*✓ (1)

3.3 Use straight chain ✓ primary alcohols ✓
Gebruik reguitketting primêre alkohole (2)

3.4.1 Chain length/number of C-atoms/molecular mass/surface area ✓
Kettinglengte/aantal C-atome/molekulêre massa/oppervlak (1)

3.4.2 Hydroxyl (group)/*Hidroksiel(groep)* ✓ (1)

3.4.3 Ethanol/Etanol ✓ (1)

3.5 C/propan-1-ol/propan-1-ol ✓ **ACCEPT/ANVAAR**: Formula/*formule* (1)

3.6

Marking criteria:
- Compare the structures of the compounds
- Compare the strength of intermolecular forces
- Compare the energy required to overcome intermolecular forces

Nasienkriteria:
- *Vergelyk die struktuur van die verbindings*
- Vergelyk die sterkte van intermolekulêre kragte
- *Vergelyk die energie benodig om intermolekulêre kragte te oorkom*

C/$CH_3CH_2CH_2OH$/Propan-1-ol
- **Structure/*Struktuur***
  LONGEST chain length/largest surface area (over which intermolecular forces act ✓
- **Intermolecular forces**
  STRONGEST/MOST intermolecular forces/ *Van der Waals forces/London forces/ dipole-dipole forces* ✓
- **Energy**
  Most/more energy is needed to overcome or break intermolecular forces/Van der Waals forces/dipole-dipole forces ✓

OR

A/CH_3OH/methanol
- **Structure**
  Shortest chain length/smallest surface area (over which intermolecular forces act ✓
- **Intermolecular forces**
  Weakest/less intermolecular forces/ Van der Waals forces/London forces/ dipole-dipole forces ✓
- **Energy**
  Least energy is needed to overcome or break intermolecular forces/Van der Waals forces/dipole-dipole forces ✓

OR
From A to C
- **Structure**
  Chain length/ surface area inreases.✓
- **Intermolecular forces**
  The intermolecular forces/ Van der Waals forces/London forces/ dipole-dipole forces increase. ✓
- **Energy**
  The energy require to overcome the intermolecular forces /Van der Waals forces/London forces/ dipole-dipole forces increases ✓

OR
From C to A
- **Structure**
  Chain length/ surface area decreases.✓
- **Intermolecular forces**
  The intermolecular forces/ Van der Waals forces/London forces/ dipole-dipole forces decrease. ✓
- **Energy**
  The energy require to overcome the intermolecular forces /Van der Waals forces/London forces/ dipole-dipole forces decreases ✓

C/$CH_3CH_2CH_2OH$/Propan-1-ol
- ***Struktuur***
  Langste kettinglente/grootste oppervlak (waaroor intermolekulêre kragte werk) ✓
- ***Intermolekulêre kragte***
  Sterkste/meeste intermolekulêre kragte/ Van der Waalskragte/ Londonkragte/ dipool-dipoolkragte ✓
- ***Energie***
  Meeste energie benodig om die intermolekulêre kragte/Van der Waalskragte/ dipool-dipoolkragte te oorkom/breek. ✓

OF
C/CH_3OH/Metanol

- ***Struktuur***
  Kortste kettinglente/kleinste oppervlak (waaroor intermolekulêre kragte werk) ✓
- ***Intermolekulêre kragte***
  Swakste/minste intermolekulêre kragte/ Van der Waalskragte/ Londonkragte/ dipool-dipoolkragte ✓
- ***Energie***
  Minste energie benodig om die intermolekulêre kragte/Van der Waalskragte/ dipool-dipoolkragte te oorkom/breek. ✓

OF
Van A tot C

- **Struktuur**
  Kettinglengte/ oppervlakte *(waaroor intermolekulêre kragte werk)* verhoog.✓
- **Intermolekulêre kragte**
  Die intermolekulêre kragte/ Van der Waalskragte/ Londonkragte/ dipool-dipoolkragte verhoog.✓
- **Energie**
- *Die energie benodig om die intermolekulêre kragte/Van der Waalskragte/ dipool-dipoolkragte te oorkom/breek verhoog.* ✓ (3)

OF
Van C tot A

- **Struktuur**
  Kettinglengte/ oppervlakte *(waaroor intermolekulêre kragte werk)* verlaag.✓
- **Intermolekulêre kragte**
  Die intermolekulêre kragte/ Van der Waalskragte/ Londonkragte/ dipool-dipoolkragte verlaag.✓
- **Energie**
  Die energie benodig om die intermolekulêre kragte/Van der Waalskragte/ dipool-dipoolkragte te oorkom/breek verlaag. ✓

3.7.1 The two compounds have the same molecular mass/*Die twee verbindings het dieselfde molekulêre massa* (1)

3.7.2

Marking criteria:
- State that carboxylic acids have two sites for hydrogen bonding
- State that alcohols have one site for hydrogen bonding
- Compare the strength of intermolecular forces
- Compare the energy required to overcome intermolecular forces

Nasienkriteria:
- *Benoem die intermolekulêre kragte*
- *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*
- *Vergelyk die energie benodig om intermolekulêre kragte te oorkom*

- Compound **C**/ $CH_3CH_2CH_2OH$/ propan-1-ol/ alcohol has one site ✓for hydrogen bonding
- Compound **X**/CH_3COOH/ ethanoic acid/carboxylic acid has two/more sites for hydrogen bonding. ✓
- Intermolecular forces in Compound **X**/CH_3COOH/ ethanoic acid / carboxylic acid are stronger than the intermolecular forces in compound **C**/ $CH_3CH_2CH_2OH$/ propan-1-ol/ alcohol. ✓
- More energy is needed to overcome/break intermolecular forces in compound Compound **X**/CH_3COOH/ ethanoic acid / carboxylic acid than Compound **C**/ $CH_3CH_2CH_2OH$/ propan-1-ol/ alcohol ✓

- *Verbinding C/ $CH_3CH_2CH_2OH$/propan-1-ol/alkohol het een punt vir waterstofbindings en verbinding **X**/CH_3COOH/etanoësuur / karboksielsuur het twee/meer punte vir waterstofbindings.* ✓
- *Intermolekulêre kragte in verbinding **X**/CH_3COOH/ etanoësuur/ karboksielsuur is sterker as die intermolekulêre kragte in verbinding **C**/ $CH_3CH_2CH_2OH$/propan-1-ol/alkohol.* ✓
- *Meer energie word benodig om intermolekulêre kragte in verbinding **X**/CH_3COOH/etanoësuur/ karboksielsuur as in verbinding **C**/ $CH_3CH_2CH_2OH$/propan-1-ol/alkohol* ✓

(4)
[17]

QUESTION 4/ *VRAAG 4*

4.1.1 Addition/hydrogenation✓
Addisie/hidrogenasie/hidrogenering (1)

4.1.2 Substitution✓
Substitusie (1)

4.1.3 Elimination/dehydration✓
Eliminasie/dehidrasie (1)

4.2.1 Butan-2-ol/2-Butanol✓✓

Marking criteria: • Correct stem i.e. butanol ✓ • IUPAC name completely correct including numbering and hyphens.✓ ***Nasienkriteria*** • *Korrekte stam d.i. butanol* • *IUPAC-naam heeltemal korrek insluitende nommering en koppeltekens.*

(2)

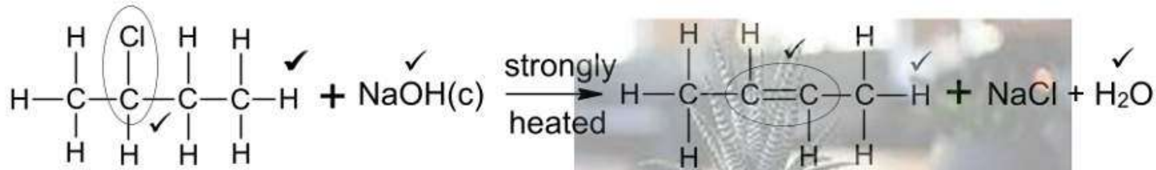
4.2.2 Water/H_2O ✓ (1)

4.2.3 Hydration/*Hidrasie*. ✓ (1)

4.3.1 Saturated/*Versadig* ✓
Compounds in which there are no multiple bonds between C atoms in their hydrocarbon chains. ✓
Verbindings waarin daar geen meervoudige bindings tussen C-atome in hul koolwaterstofkettings is nie (2)

4.3.2 Heat/UV light/hf/ *Hitte/UV lig/hf* ✓ (1)

4.4



Marking Criteria/*Nasienriglyne* • Chlorine on the second C for 2-chlorobutane✓ *Chloor atoom op die tweede C-atoom vir 2-chlorobutaan* • Whole structural formula correct ✓ *Hele struktuurformule vir 2-bromobutaan korrek* • NaOH as reactant ✓ *NaOH as 'n reaktant* • Water(H_2O) as part of the products✓ *Water (H_2O) as deel van die produkte* • The functional group on the second carbon for but-2-ene✓ *Die funksionele groep op die tweede koolstof atoom vir but-2-een* • Whole structural formula correct ✓ *Hele struktuur korrek*

(6)

NOTE/LET WEL
- Penalise only once for the use of condensed structural formulae or molecular formulae
- *Penaliseer slegs een keer vir die gebruik van gekondenseerde struktuurformules of molekulêre formule*

4.5 No water (H_2O)✓ and a non-reactive solvent/dissolve in ethanol✓
Geen water (H_2O) en onreaktiewe oplosmiddel/ los op in etanol (2)
[17]

QUESTION 5/ *VRAAG 5*

5.1.1
$$n(O_2) = \frac{m}{M} ✓$$
$$= \frac{36,8}{32} ✓$$
$$= 1,15 \text{ mol} ✓$$

Marking criteria/*Nasienriglyne*
- Formula /*Formule*
- Substitute 32 in formula / *Vervang 32 in formule*
- Answer / *Antwoord*

(3)

5.1.2 **POSITIVE MARKING FROM QUESTION 5.1.1**
$$n(PbS) = \frac{2}{3}n(O_2)$$
$$n(PbS) = \frac{2}{3}(1,15) ✓$$
$$= 0,7666 \text{ mol}$$
$$n = \frac{m}{M}$$
$$0,7666 = \frac{m}{239} ✓$$
$$m = 183,23 \text{ g} ✓$$

Marking criteria/*Nasienriglyne*
- Mol ratio/ *mol verhouding*
- Substitute 239 in formula / *Vervang 239 in formule*
- Answer / *Antwoord*

(3)

5.1.3 **POSITIVE MARKING FROM QUESTION 5.1.2**
$$\%Purity = \frac{183,23}{800} \times 100 ✓$$
$$= 22,9 \% ✓$$
(2)

5.2.1 H_2O ✓ (1)

5.2.2 2(min) ✓ (1)

5.2.3 The reaction stopped/The reaction reached completion/The limiting reactant has been used up.✓
Die reaksie het gestop/Die reaksie het voltooing bereik/ Die beperkende reaktant is opgebruik (1)

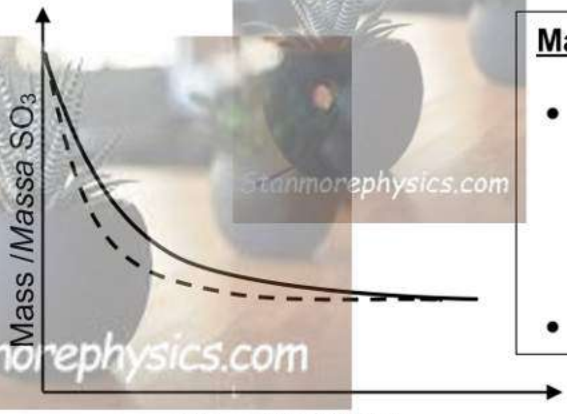
5.2.4 The change in concentration ✓of reactants or products per unit time✓
/Die verandering in konsentrasie ✓van reaktante of produkte per eenheid tyd✓. (2)

5.2.5 $\text{Rate} = -\frac{\Delta m}{\Delta t}$

$= -(\frac{25 - 50✓}{2(60)✓})$

$= 0{,}2083\ (g{\cdot}s^{-1})$✓ (3)

5.2.6



Marking criteria/*Nasienriglyne*

- Both curves start at the same point and have the same endpoint/ *Beide kurwes begin by dieselfde punt en het dieselfde eindpunt* ✓
- Steeper gradient / *steiler helling*✓

(2)

5.2.7
- Increase in temperature increases the average kinetic energy/molecules move faster. ✓
Toename in temperatuur verhoog die gemiddelde kinetiese energie/molekule beweeg vinniger.
- More molecules have enough/sufficient kinetic energy/More molecules have $E_k \geq E_a$. ✓
Meer molekule het genoeg/voldoende kinetiese energie/Meer molekule het $E_k \geq E_a$.
- More effective collisions per unit time/second. /Frequency of effective collisions increases. ✓
Meer effektiewe botsings per eenheidtyd/sekonde./Frekwensie van effektiewe botsings neem toe. (3)

[21]

QUESTION 6 / *VRAAG 6*

6.1.1 Close system is isolated from its surroundings./ *'n Geslote sisteem is geïsoleer van die omgewing*✓ (1)

6.1.2
- From green to <u>yellow</u>./ *Van groen na <u>geel</u>*✓
- When concentration is increased the reaction that decreases the concentration is favoured / *Wanneer konsentrasie verhoog sal die reaksie wat die konsentrasie verlaag bevoordeel word.* ✓
- [NO] increases/the reverse reaction is favoured/ *[NO] verhoog/die terugwaartse reaksie word bevoordeel.* ✓
- [NOCℓ] will increase / *[NOCℓ] sal toeneem*✓ (4)

6.1.3

<u>Marking criteria/*Nasienriglyne*</u> 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 <u>equilibrium in a closed system is disturbed</u>, the system will <u>re-instate a new equilibrium</u> by <u>favouring the reaction that will oppose the disturbance</u>. / *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)

6.1.4
- DECREASED / *VERLAAG*. ✓
- The concentration of $C\ell_2$ inceases. / *Die konsentrasie van $C\ell_2$ verhoog.* ✓
- The forward reaction is favoured.*Die voorwaartse reaksie is bevoordeel*✓
- The reaction that forms the most/greatest number of moles was favoured, thus the pressure was decreased. /*Die reaksie wat die meeste/grootste aantal mol vorm was bevoordeel.*✓ (4)

6.2.1 Exothermic / *Eksotermies* ✓ (1)

6.2.2
- From the graph, we can see that an increase in temperature decreases the yield of ammonia/ *Vanaf die grafiek kan afgelei word dat 'n toename in temperatuur die hoeveelheid ammoniak laat toeneem.* ✓
- An increase in temperature favours the endothermixc reaction/ *'n toename in temperatuur sal die endotermiese reaksie bevoordeel.* ✓
- Increase in temperature favours the reverse reaction/*Verhoging in temperatuur bevoordeel die terugwaarste reaksie.* ✓
- Thus, the forward reaction is exothermic / *die voorwaartse reaksie is eksotermies.* ✓ (4)

6.2.3 50 % ✓ (1)

6.3 **Marking criteria / Nasienkriteria:**

a. Substitute 4 in $nCuC\ell_4^{2-}$ initial and 2,2 in $nCu(H_2O)_6^{2+}$ final in table ✓
Vervang 4 in $nCuC\ell_4^{2-}$ aanvanklik en 2,2 in $nCu(H_2O)_6^{2+}$ finaal in tabel
b. Use mol ratio / *Gebruik mol verhouding* : 1:4:1 ✓
c. n Equilibrium/ n Ewewig = nReactants / *nReaktante* initial/begin + nReactants / *nReaktante* reacted/ reageer ✓
d. n Equilibrium/ *n Ewewig* = n Reactants initial/begin - n Reactants reacted/ reageer ✓
e. Divide by the volume (2)/ *Deel deur die volume (2)* ✓
f. Correct Kc expression / *Korrekte Kc uitdrukking* ✓
g. Correct substitute into Kc expression / *Korrekte invervanging in K_c – uitdrukking* ✓
h. Final answer / Finale antwoord (0,00218) ✓

	$Cu(H_2O)_6^{2+}$(aq)	$4C\ell^-$(aq)	$CuCl_4^{2-}$ (aq)	
Initial mol Aanvanklike mol	0	0	4	
Change in mol Verandering in mol	+2,2 ✓(a)	+8,8	-2,2	Ratio ✓(b)
Equilibrium mol Ewewigs mol	2,2	8,8	1,8	
Equilibrium concentration Ewewigskonstante	1,1 ✓(c)	4,4	0,9 ✓(d)	✓Divide by 2 (e)

$$K_c = \frac{[CuCl_4^{2-}]}{[Cu(H_2O)_6^{2+}][Cl^-]^4} \checkmark \text{(f)}$$

$$= \frac{(0,9)}{(1,1)(4,4)^4} \checkmark \text{ (g)}$$

$$= 0,00218 \checkmark \text{ (h)}$$

NB: If the chemical equation has been reversed in the table, award **7/8** marks, no mark for the answer.

(8)
[25]

QUESTION 7 / *VRAAG 7*

7.1 An Acid is a proton donor (H^+ -ion donor) /*'n Suur is 'n protonskenker (H^+ -ioon-skenker).* ✓✓ (2)

7.2.1 A substance that can act as either acid or base. ✓✓
'n Stof wat as óf 'n suur óf 'n basis kan reageer (2)

7.2.2 HSO_3^- ✓ (1)

7.2.3 H_2SO_3, HSO_3^- ✓and/*en*
H_2O, H_3O^+ ✓

ACCEPT: If arrows on the equation were used.   *AANVAAR: Indien pyle op die vergelyking gebruik is*

(2)

7.3 Bromothymol blue / *Broomtimolblou* ✓
- Is most suitable for a solution with a pH = 7/ *Mees geskik vir oplossing wat 'n pH =7 het.* ✓
- Reaction of a strong acid and a strong base/The equivalence pont is equal to pH 7/ *Reaksie van 'n sterk suur en 'n sterk basis/Die ekwivalente punt is gelyk aan 'n pH van 7*✓ (3)

7.4.1 n(NaOH) = cV
= (1,2)(0,2)✓
= 0,24 mol ✓ (2)

POSITIVE MARKING FROM QUESTION 7.4.1
POSITIEWE NASIEN VAN VRAAG 7.4.1

7.4.2 **Marking criteria / Nasienkriteria:**

a) Formula $c=\frac{n}{V}$ ✓
b) Substitute 0,85 and 0,02367 in correct formula / Vervang 0,85 en 0,02367 in regte formule✓
c) Mol ratio n (Na_2CO_3) : n (HNO_3) 1:2 ✓
d) V (HNO_3) in 0,05 dm^3 to 0,2 dm^3✓
e) $n_{initial}$ (HNO_3) - n_{excess} (HNO_3) ✓✓
f) Substitude 56 in correct formula ✓
g) %purity = $\frac{4,426464}{13}$ x 100% ✓
h) Final answer (34,0 – 34,5) ✓

n (Na_2CO_3) = cV✓ (a) = (0,85) (0,02367) ✓(b) = 0,0201195 mol n(HNO_3) = 2n(Na_2CO_3) =0,0201195 x 2✓ (c) = 0,040239 mol in 50cm^3	$\frac{C_aV_a}{C_bV_b}=\frac{n_a}{n_b}$ ✓(a $\frac{C_a \times 50}{(0,85)(23,67)}=\frac{2}{1}$ ✓(c) ✓(b =0,80478 $mol \cdot dm^{-3}$ n(HNO_3)=cV =0,80478x0,05 =0,040239 mol

Therefore (4 × 0,040239 mol) = 0,160956 mol in 200 cm^3 ✓ (d)

$n_{used}(HNO_3) = n_{inital}(HNO_3) - n_{excess}(HNO_3)$
$n_{used}(HNO_3) = 0,24 - 0,160956$ ✓✓ (e)
$n_{used}(HNO_3) = 0,079$ mol

$n(KOH) = \frac{m}{M}$

$0,079044 = \frac{m}{56✓}$ (f)

$m = 4,426464$ g

$\%purity/suiwerheid = \frac{4,426464}{13} \times 100$✓ (g)

$= 34,05\%$ ✓ (h)

(9)
[21]

GRAND TOTAL/*GROOTTOTAAL* **[150]**