education

MPUMALANGA PROVINCE

REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY P2

SEPTEMBER 2022

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 homologous series below contains a formyl group?

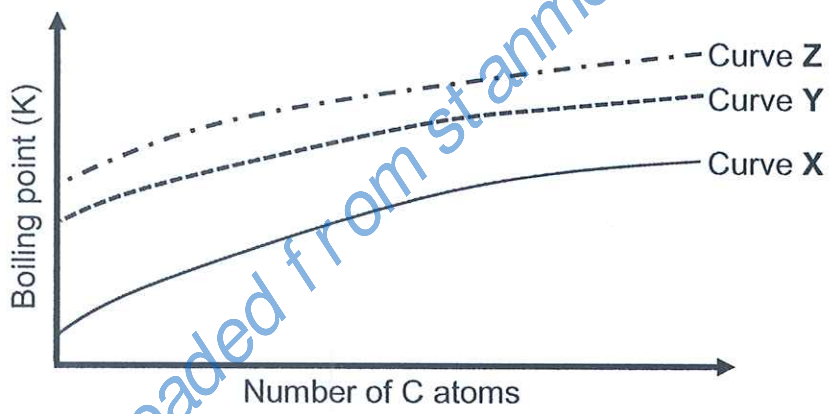
A Esters

B Carboxylic acid

C Aldehydes

D Ketones (2)

1.2 The relationship between the chain length of straight chain organic molecules of carboxylic acids, aldehydes, and primary alcohols and boiling points is investigated. Curves **X**, **Y** and **Z** are obtained.

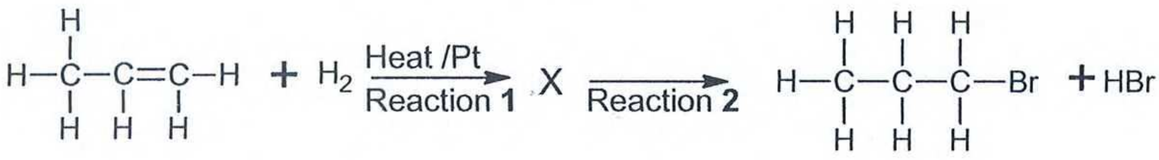


Which ONE of the following CORRECTLY identifies the homologous series against the chain length of the organic molecules

	Curve **X**	Curve **Y**	Curve **Z**
A	Carboxylic acids	Alcohols	Aldehydes
B	Alcohols	Carboxylic acids	Aldehydes
C	Carboxylic acids	Aldehydes	Alcohols
D	Aldehydes	Alcohols	Carboxylic acids

(2)

1.3 Consider the reaction **1** and **2** below. Compound **X** is an organic compound.



What type of reaction is REACTION 2?

A Halogenation

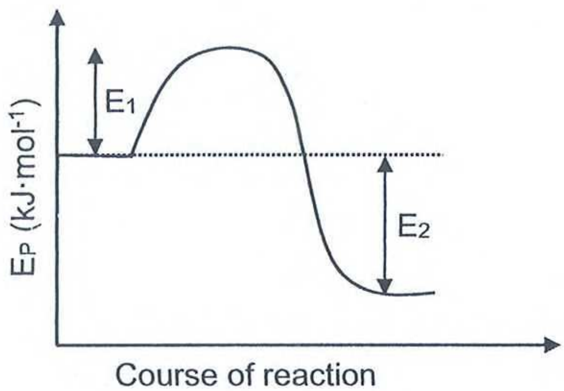
B Hydrolysis

C Hydration

D Hydrohalogenation (2)

1.4 Consider the potential energy diagram for a reversible hypothetical reaction represented by the balanced equation below.

$$X_2(g) \rightleftharpoons 2X(g)$$



The sum of (**E_1** + **E_2**) is equal to the …

A energy of the activated complex.

B activation energy for the reverse reaction.

C activation energy for the forward reaction.

D ΔH for the forward reaction. (2)

1.5 Consider the chemical reaction represented by the balanced equation below:

$$Zn(s) + 2HC\ell(aq) \rightarrow ZnC\ell_2(aq) + H_2(g)$$

Which ONE of the following changes will DECREASE the rate of production of $H_2(g)$?

A Decrease in pressure

B Increase in volume of $HC\ell(aq)$

C Increase in concentration of $HC\ell(aq)$

D Decrease in temperature (2)

1.6 One of the stages in the industrial preparation of iron from its ore is represented by the equilibrium equation below:

$$Fe_2O_3(s) + 3CO(g) \rightleftharpoons 2Fe(s) + 3CO_2(g)$$

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

A Fe is removed

B CO_2 is removed.

C CO is removed

D A suitable catalyst is added (2)

1.7 The table below shows pH ranges of some indicators.

INDICATORS	pH RANGES
Methyl orange	3,1 – 4,4
Methyl red	4,2 – 6,2
Bromothymol blue	6,0 – 7,8
Phenolphthalein	8,3 – 10,0

The indicator best suited for the titration of ethanoic acid against a solution of sodium hydroxide, is ...

A Methyl orange

B Methyl red

C Bromothymol blue

D Phenolphthalein (2)

1.8 Sulphuric acid, $H_2SO_4(aq)$ ionises in water according to the following balanced equation:

$$H_2SO_4(aq) + H_2O(\ell) \rightleftharpoons HSO_4^-(aq) + H_3O^+(aq)$$

Which ONE is the correct conjugate acid-base pair for this reaction:

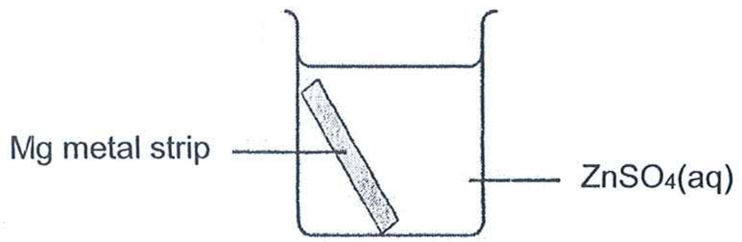
A H_2SO_4 and H_2O

B H_2SO_4 and H_3O^+

C H_2SO_4 and HSO_4^-

D HSO_4^- and H_3O^+ (2)

1.9 A strip of magnesium metal is placed in a zinc sulphate ($ZnSO_4$) solution.



The reaction that takes place is represented by the balanced equation below:

$$Mg(s) + ZnSO_4(aq) \rightarrow MgSO_4(g) + Zn(s)$$

Which ONE of the following statements is correct?

A Zn is the oxidising agent.

B Mg is the reducing agent.

C Mg is reduced.

D Zn is oxidised. (2)

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

A Ag

B Zn

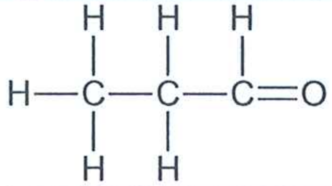
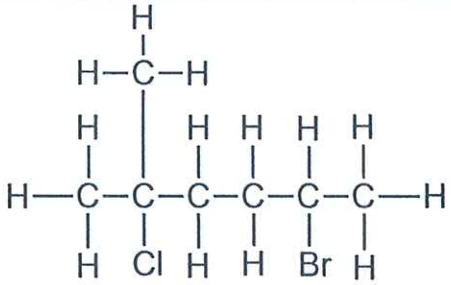
C Mg

D Fe (2)

[20]

QUESTION 2 (Start on a new page)

Consider the following six organic compounds represented by letters **A** to **F**.

A	$CH_3CH(CH_3)COCH(CH)_3CH_2CH_3$	**B**	2,2-dimethylpentan-3-ol
C		**D**	C_5H_{10} 
E		**F**	CH_3COOH

2.1 Define the term *functional group*. (2)

2.2 Write down the:

2.2.1 STRUCTURAL FORMULA of the FUNCTIONAL GROUP of compound **A** (1)

2.2.2 LETTER that represents a carboxylic acid (1)

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

2.2.4 IUPAC name for the FUNCTIONAL ISOMER of compound **C** (1)

2.2.5 Homologous series to which Compound **A** belong (1)

2.2.6 Draw the STRUCTURAL FORMULA of compound **B** (3)

2.2.7 Is compound **B** a PRIMARY, SECONDARY or TERTIARY alcohol? (1)

2.3 Consider compound **D**.

2.3.1 Is the compound SATURATED or UNSATURATED? Give a reason for the answer. (2)

2.3.2 Write down the NAME of a solution that can be used to test whether the compound is saturated or unsaturated. (1)

2.3.3 Write down the general formula of a saturated hydrocarbon (1)

[17]

QUESTION 3 (Start on a new page)

The boiling points of FIVE organic compounds, represented by the letters **A** to **E**, are given in the table below.

	COMPOUNDS	BOILING POINT (°C)
A	Ethane	– 88,6
B	Butane	– 1
C	Methylpropane	– 11,7
D	Pentan-1-ol	97
E	Butanoic acid	163,5

3.1 An unknown STRAIGHT CHAIN ALKANE has a boiling point of -42 °C. Write down the NAME of this alkane using the information in the table above. (1)

3.2 Compounds **B** and **C** are structural isomers

3.2.1 Define the term *structural isomer*. (2)

3.2.2 What type of structural isomers are compound **B** and **C**? (1)

3.2.3 Explain why Compound **B** has a higher boiling point than Compound **C**. (3)

3.3 Compounds **D** and **E** have the same molecular mass but different vapour pressure.

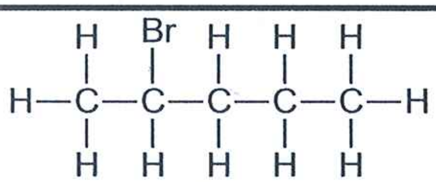
3.3.1 Define the term *vapour pressure*. (2)

3.3.2 Which compound, **D** or **E**, has the higher vapour pressure? (1)

3.3.3 Fully explain the answer in QUESTION 3.3.2. (4)
[14]

QUESTION 4 (Start on a new page)

4.1 Consider the following organic reactions **I** to **V** involving organic compounds.

I	**A** + HBr $\longrightarrow$  **B**
II	**B** + concentrated NaOH → **C** (main product) + NaBr + **D**
III	**A** + **D** $\xrightarrow[H_3PO_4]{\text{Dilute}}$ **E**
IV	C_5H_{12} $\xrightarrow[\text{high pressure}]{600\ ^\circ C}$ C_3H_6 + **F**

Write down the:

4.1.1 Name of the types of reactions represented by reaction **I** to **IV**. (4)

4.1.2 The IUPAC name of compound **B**. (2)

4.1.3 Homologous series to which compound **C** belong? (1)

4.1.4 Name or formula of the INORGANIC product **D** of reaction **II** (1)

4.1.5 STRUCTURAL FORMULA of compound **E** (2)

4.1.6 NAME and MOLECULAR FORMULA of compound **F** (2)

4.2 A group of learners in a school laboratory are preparing an ester using methanol and ethanoic acid. The balanced chemical equation for this reaction is given below:

$$CH_4O + C_2H_4O_2 \xrightarrow{H_2SO_4(conc)} C_3H_6O_2 + H_2O$$

4.2.1 Write down the IUPAC name of the ester formed. (2)

4.2.2 Give ONE function of the concentrated sulphuric acid in this reaction. (1)

4.2.3 When impure methanol completely reacts with excess ethanoic acid, 68,88 g $C_3H_6O_2$ is produced The percentage purity of methanol is 60%, calculate the mass of the impure methanol. (5)

[20]

QUESTION 5 (Start on a new page.)

A group of learners use the reaction of the decomposition of hydrogen peroxide to investigate one of the factors that affect the rate of a chemical reaction. The balanced equation for the reaction is given below.

$$2H_2O_2(aq) \rightarrow 2H_2O(\ell) + O_2(g)$$

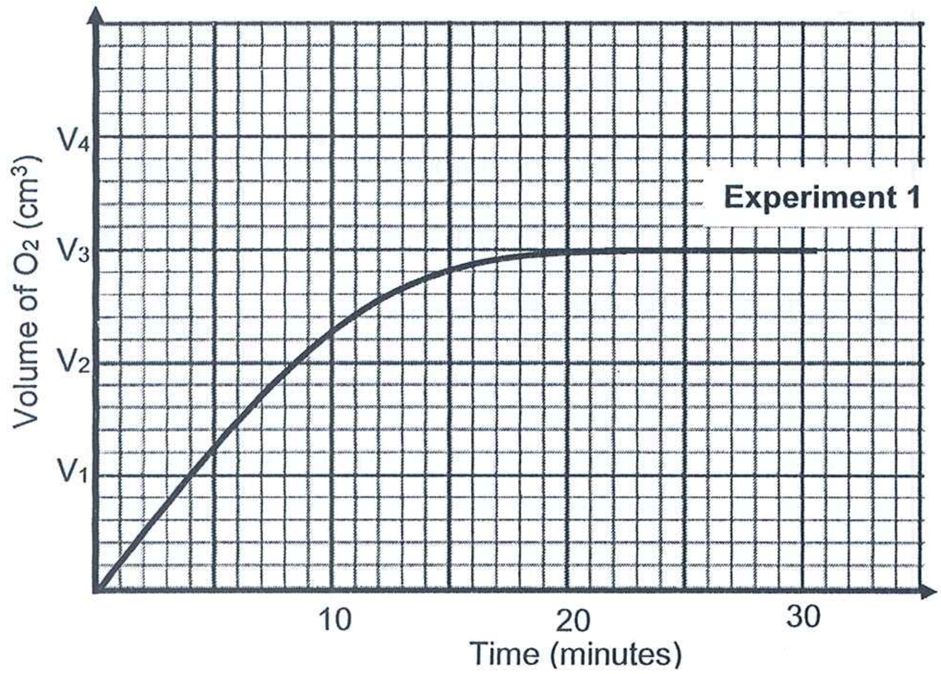
The learners collect the oxygen gas by the downward displacement of water. Four experiments are carried out.

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

The reaction conditions for each experiment **1** and **2** are summarised in the table below:

	Volume of H_2O_2 (cm^3)	Concentration of H_2O_2 ($mol \cdot dm^{-3}$)	Temperature (°C)
Experiment 1	40	x	25
Experiment 2	40	x	40

The results of experiment **1** are shown in the graph below.



5.2 For this investigation write down the dependent variable. (1)

5.3 What can be deduced from the graph regarding the RATE OF THE REACTION during the time interval:

5.3.1 10 minutes to 17 minutes (1)

5.3.2 20 minutes to 30 minutes (1)

5.4 The average rate of the production of oxygen gas in experiment **1** is 10 $cm^3 \cdot min^{-1}$. Use the information on the graph to calculate the initial concentration of the hydrogen peroxide (H_2O_2) used. Take the molar gas volume at 25 °C as 24 000 cm^3. (5)

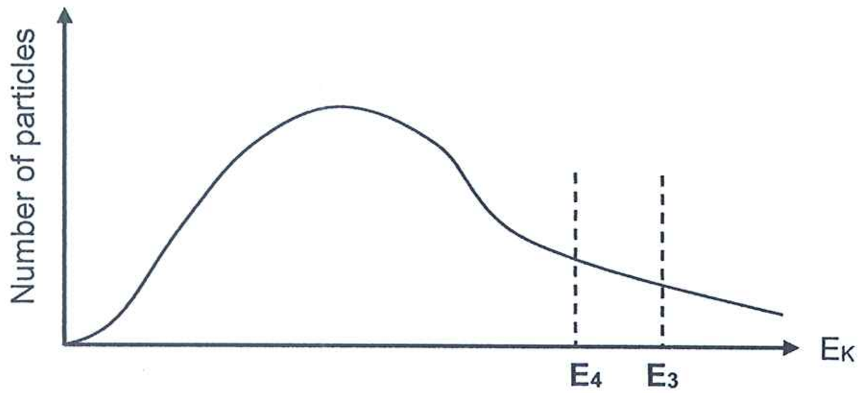
5.5 Copy the graph of EXPERIMENT **1** in your answer book. On the same set of axes, draw the graph for EXPERIMENT **2**. Assume this reaction goes to completion. (2)

5.6 In another Investigation, EXPERIMENT **1** is repeated under the same conditions, but MnO_2 is added to the reaction mixture.

The reaction conditions for each experiment **3** and **4** are summarised in the table below:

	Volume of H_2O_2 (cm^3)	**Temperature (°C)**	**MnO_2**
Experiment 3	40	25	absent
Experiment 4	40	25	present

The Maxwell-Boltzmann distribution curve for the hydrogen peroxide molecules in EXPERIMENT **3** is shown below. $\mathbf{E_3}$ and $\mathbf{E_4}$ represent the activation energy for experiment **3** and **4** respectively.



5.6.1 What is the function of MnO_2 in EXPERIMENT **4**? (1)

5.6.2 Use the collision theory to explain the effects of the MnO_2 on the reaction rate in EXPERIMENT 4. (3)
[16]

QUESTION 6 (Start on a new page)

10 g of hydrogen gas and 355 g of chlorine gas are heated together in a sealed 500 cm^3 container. A chemical equilibrium is reached at 450 °C. The balanced equation for the reaction is:

$$H_2(g) + C\ell_2(g) \rightleftharpoons 2HC\ell(g)$$

The equilibrium constant K_c for this reaction at 450 °C is 64.

6.1 Calculate the mass of chlorine gas present at equilibrium. (9)

The reaction is now carried out at a lower temperature. It is found that the K_c value increases.

6.2 Is the heat of the reaction (ΔH) POSITIVE or NEGATIVE? Use Le Chatelier's principle to explain the answer (4)

6.3 The pressure of the container is increased without affecting the temperature. How would the following be affected?

Choose from INCREASES, DECREASES or REMAINS THE SAME.

6.3.1 The yield of $HC\ell$ (1)

6.3.2 The K_c value (1)

[15]

QUESTION 7 (Start on a new page)

7.1 A laboratory technician prepares the following two dilute sulphuric acid solutions:

Solution **A**: 0,20 mol·dm^{-3} H_2SO_4

Solution **B**: 0,30 mol·dm^{-3} H_2SO_4

7.1.1 Explain the meaning of the term *dilute acid* (2)

7.1.2 Give a reason why sulphuric acid is classified as a *strong acid*. (2)

7.1.3 Sulphuric acid ionises in water according to the following equation:

$$H_2SO_4(aq) + H_2O(\ell) \rightleftharpoons HSO_4^-(aq) + H_3O^+(aq)$$

Write down the conjugate base of sulphuric acid (1)

7.1.4 Calculate the pH of solution **A** at 25 °C. (3)

7.2 A few crystals of sodium carbonate (Na_2CO_3) are added to water in a test tube.

7.2.1 Is the solution in the test tube ACIDIC, BASIC or NEUTRAL? (1)

7.2.2 Use a balanced ionic equation to explain the answer in QUESTION 7.2.1. (3)

7.3 7,6 g of impure commercial washing soda ($Na_2CO_3 \cdot 10H_2O$) is dissolved in 500 cm^3 of water. 25 cm^3 of this solution is titrated with a standard HCℓ solution of concentration 0,1 mol·dm^{-3}.

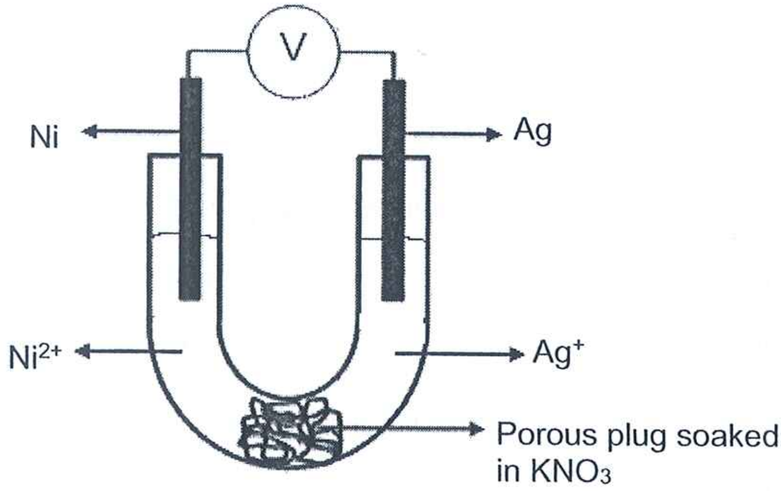
$$Na_2CO_3 \cdot 10H_2O(aq) \cdot + 2HC\ell(aq) \rightarrow 2NaC\ell(aq) + H_2O(\ell) + CO_2(g)$$

Calculate the mass of pure $Na_2CO_3 \cdot 10H_2O$ in commercial washing soda, if 24,8 cm^3 of the HCℓ solution was needed to reach the equivalence point in the titration. (6)

[18]

QUESTION 8 (Start on a new page)

The diagram represents a galvanic cell labeled **A**,



8.1 State TWO standard conditions under which this cell functions. (2)

8.2 Write down TWO functions of the porous plug. (2)

8.3 In which direction (from **Ni to Ag** or from **Ag to Ni)** do electrons flow in the external circuit? (1)

8.4 Write down the balanced equation for the overall (net) reaction for this cell. (3)

8.5 If 0,4 moles of electrons flow to the cathode, what will be the decrease in mass of the anode be? (3)

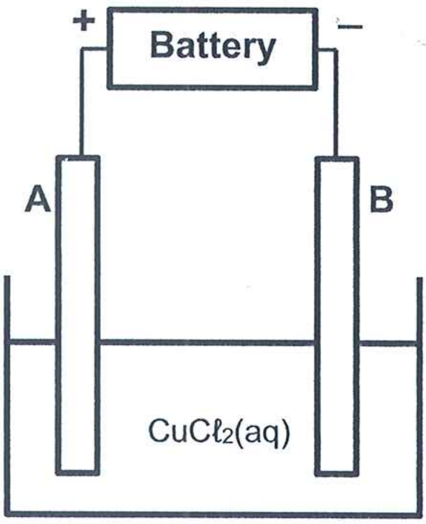
8.6 A SECOND galvanic cell **B** is constructed using Mg(s)/ $Mg(NO_3)_2$(aq) and Ag(s)/$AgNO_3$(aq) half-cells

Without any calculations, determine which ONE of the TWO galvanic cells (**A or B**) will result in the highest initial potential difference when it is operational under standard conditions.

Explain your answer by referring to the relative strengths of the reducing agents. (4)
[15]

QUESTION 9 (Start on a new page.)

The sketch below shows a cell used in the purification of copper.



9.1 Define the term *electrolysis* (2)

9.2 Which electrode **A** or **B** represents the impure copper? (1)

9.3 Which electrode **A** or **B** will increase in mass? (1)

9.4 Write down the equation for the reaction that takes place at the cathode. (3)

9.5 "The colour of the electrolyte remains unchanged." When the cell is in operation, is this statement TRUE or FALSE? Explain the answer. (2)

The two electrodes **A** and **B** are now replaced with carbon rods.

9.6 Write down TWO reasons why carbon is used as electrodes. (2)

9.7 At which electrode (**A** or **B**) will chlorine gas form when the cell is in operation?

Write down a half-reaction to show the formation of chlorine gas. (3)

9.8 State whether the concentration of the electrolyte will INCREASE, DECREASE or REMAIN THE SAME when carbon rods are used. (1)

[15]

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*

Key
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 POTENTIALS
TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE

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
$Cl_2(g) + 2e^-$	⇌	$2Cl^-$	+ 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
$Al^{3+} + 3e^-$	⇌	Al	– 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 oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* (down)

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

Increasing reducing ability/*Toenemende reduserende vermoë* (up)

education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY P2

SEPTEMBER 2022

MARKING GUIDELINES

MARKS/PUNTE: 150

This memorandum consists of 14 pages.

Hierdie memorandum bestaan uit 14 bladsye.

QUESTION 1 / VRAAG 1

1.1 C ✓✓

1.2 D ✓✓

1.3 A ✓✓

1.4 B ✓✓

1.5 D ✓✓

1.6 B ✓✓

1.7 D ✓✓

1.8 C ✓✓

1.9 B ✓✓

1.10 A ✓✓

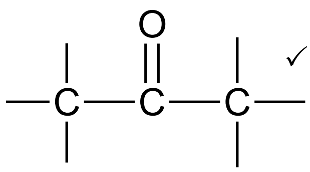
[20]

QUESTION 2 / VRAAG 2

2.1 A <u>bond</u> or an <u>atom</u> or a <u>group of atoms</u> that <u>determine(s) the physical and chemical properties of a group of organic compounds</u>.✓✓ **(2 or 0)**

'n <u>Binding</u> of 'n <u>atoom</u> of 'n <u>groep atome</u> wat die <u>fisiese en chemiese eienskappe</u> van 'n <u>groep organiese verbindings bepaal</u>. ✓✓ **(2 or 0)** (2)

2.2.1



(1)

2.2.2 F ✓ (1)

2.2.3 5-bromo-2-chloro-2-methylhexane
5-bromo-2-chloro-2-methylhexane

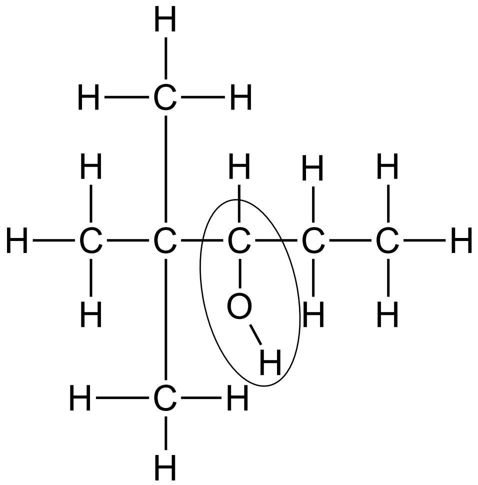
<u>Marking criteria/*Nasienriglyne*</u>: • Correct stem i.e. hexane./*Korrekte stam d.i. heksaan*. ✓ • All substituents (bromo, chloro and methyl) correctly identified./*Alle substituente (bromo, chloro en metiel) korrek geïdentifiseer*. ✓ • IUPAC name completely correct including numbering, sequence, hyphens and commas./*IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas* . ✓

(3)

2.2.4 Propanone / *Propanoon* ✓ (1)

2.2.5 Ketones/*Ketone* ✓ (1)

2.2.6



Marking criteria / *Nasienriglyne*

- Only functional group correct / *Slegs funksionele groep korrek* ✓
- Two methyl groups / Twee metielgroepe ✓
- Whole structure correct / *Hele struktuur korrek* ✓

(3)

2.2.7 Secondary/*Sekondêr*✓ (1)

2.3.1 Unsaturated/*Onversadig* ✓

It is a compound with <u>one or more multiple bonds between C atoms</u> in their hydrocarbon chains. ✓

Verbindings waarin <u>een of meer meervoudige bindings tussen C-atome</u> in hul koolwaterstofkettings voorkom. (2)

2.3.2 Bromine water / Br_2 (Accept $KMnO_4$) ✓
Broom water / Br_2 (Aanvaar $KMnO_4$) (1)

2.3.3 C_nH_{2n+2}✓ (1)
[17]

QUESTION 3 / VRAAG 3

3.1 Propane / *Propaan* ✓ (1)

3.2.1 Organic molecules with the same molecular formula, ✓ but different structural formulae.✓
Organiese molekule met dieselfde molekulêre formule, maar verskillende struktuurformules. (2)

3.2.2 Chain isomer / *Kettingisomeer*✓ (1)

3.2.3
- **Structure:**
  Compound B has a larger surface area than compound C. ✓
- **Intermolecular forces:**
  The intermolecular forces in B is stronger than in C. ✓
- **Energy**
  More energy required to overcome/break intermolecular forces in B than in C . ✓

- ***Struktuur:***
  Verbinding B het 'n groter kontak oppervlak as verbinding C.
- ***Intermolekulêre kragte:***
  Intermolekulêre kragte in verbinding B is sterker as in verbinding C.
- ***Energie:***
  Meer energie benodig om intermolekulêre kragte te oorkom/breek in B as in C.

OR

- **Structure:**
  Compound C is more compact or spherical as B, the surface area is smaller.✓
- **Intermolecular forces:**
  The intermolecular forces in C is weaker than in B.✓
- **Energy**
  Less energy needed to overcome/break intermolecular forces in C. ✓

- ***Struktuur:***
  Verbinding C is meer kompak of series as B, die kontak oppervlak is Kleiner
- ***Intermolekulêre kragte:***
  Die intermolekulêre kragte in C is swakker as in B
- ***Energie***
  Minder energie benodig om intermolekulêre kragte te oorkom/breek in C

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

Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem. (1)

3.3.2 D (1)

3.3.3
- Both compounds/**D** and **E** have (in addition to London forces and dipole-dipole forces) hydrogen bonding. ✓
  *Beide verbindings/**D** en **E** het waterstofbindings (behalwe Londonkragte en dipool-dipoolkragte).*

- Compound **D**/pentan-1-ol/alcohol has one site for hydrogen bonding and compound **E**/butanoic acid/carboxylic acid has two/more sites for hydrogen bonding. **OR D**/butanoic acid/carboxylic acid has two/more sites for hydrogen bonding.✓
  *Verbinding **D**/pentan-1-ol/alkohol het een punt vir waterstofbindings en verbinding B/buurutanoës/karboksielsuur het twee/meer punte vir waterstofbindings **OF** B/butanoësuur/karboksielsuur het twee/meer punte waterstofbindings*.

- Intermolecular forces in compound **E**/butanoic acid/carboxylic acid are stronger than intermolecular forces in compound **D**/ butan-1-ol/alcohol.✓
  Intermolekulêre kragte in verbinding **E**/butanoësuur/karboksielsuur is sterker as die intermolekulêre kragte in verbinding **D**/ pentan-1-ol/alkohol.
  OR/OF
  Intermolecular forces in compound **D**/pentan-1-ol/alcohol are weaker than intermolecular forces in compound **E**/butanoic acid/carboxylic acid.
  *Intermolekulêre kragte in verbinding **E**/pentan-1-ol/alkohol is swakker as intermolekulêre kragte in verbinding **D**/butanoësuur/karboksielsuur.*

- More energy is needed to overcome/break intermolecular forces in compound **E**/butanoic acid/carboxylic acid than in compound **D**/ pentan-1-ol/alcohol. ✓
  Meer energie word benodig om intermolekulêre kragte in verbinding **E**/butanoësuur as in verbinding **D**/ pentan-1-ol/alkohol te oorkom/breek.
  OR/*OF*
  Less energy is needed to overcome/break intermolecular forces in compound **D**/pentan-1-ol/alcohol than in compound **E**/butanoic acid/carboxylic acid. *Minder energie word benodig om intermolekulêre kragte in verbinding **D**/ pentan-1-ol/alkohol te oorkom/breek as in verbinding **E**/butanoësuur/karboksielsuur*. (4)

[14]

QUESTION 4/ *VRAAG 4*

4.1.1 **I:** Addition/ hydrohalogenation/hydrobromination✓
Addisie/Hidrohalogenering/Hidrobrominasie

II: Elimination/Dehydrohalogenation✓
Eliminasie/Dehidrohalogenering

III: Addition/Hydration✓
Addisie/Hidrasie/Hidratering

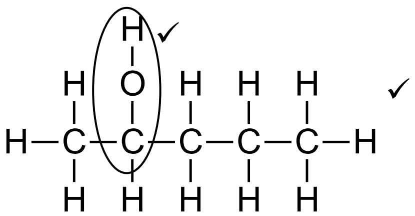
IV: Elimination/Cracking✓
Eliminasie / Kraking (4)

4.1.2 2-bromopentaan / *2-bromo*✓*pentaan* ✓ (2)

4.1.3 Alkene / *Alkeen* ✓ (1)

4.1.4 H_2O/water ✓ (1)

4.1.5



Marking criteria / *Nasienriglyne*
- Only functional group correct / *Slegs funksionele groep korrek* ✓
- Whole structure correct / *Hele struktuur korrek* ✓

(2)

4.1.6 C_2H_6 ✓ Ethane/*Etaan*✓ (2)

4.2.1 Methyl✓ ethanoate✓ / *Metieletanoaat* (2)

4.2.2 A dehydrating agent/catalyst ✓
Dehidreermiddel/katalisator (1)

4.2.3

Marking criteria:
- Substitute 74 g·mol^{-1} into the correct formula ✓
- Use ratio: $n(CH_4O) = n(C_3H_6O_2)$ ✓
- Substitute 32 g·mol^{-1} into the correct formula ✓
- 60% of mass of CH_4O ✓
- Final answer: 49,64 g ✓

Nasienkriteria:
- Vervang 74 g·mol^{-1} in korrekte formule ✓
- Gebruik verhouding: $n(CH_4O) = n(C_3H_6O_2)$ ✓
- Vervang 32 g·mol^{-1} in korrekte formule ✓
- 60% of mass of CH_4O✓
- Finale antwoord: 49,64 g ✓

$n = \frac{m}{M}$
$= \frac{68,88}{74 ✓}$
$= 0,9308$ mol

$n(CH_4O) = n(C_3H_6O_2)$✓
$= 0,09308$ mol

$m(CH_4O)_{pure/suiwer} = nM$
$= (0,09308)(32)$✓
$=29,79$ g

$\text{Impure}(CH_4O) = \frac{(29,79)(100)}{60}$ ✓
$= 49,69$ g ✓ (5)

[20]

QUESTION 5/ *VRAAG 5*

5.1

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

ANY ONE/ENIGE EEN

- <u>Change in concentration</u> ✓ of products/reactants <u>per (unit) time</u>. ✓
  <u>Verandering in konsentrasie</u> van produkte/reaktanse <u>per (eenheid) tyd</u>.

- Change in <u>amount/number of moles/volume/mass</u> of products or reactants <u>per (unit) time</u>.
  <u>Verandering in hoeveelheid/getal mol/volume/massa</u> van produkte of reaktanse <u>per (eenheid) tyd</u>.

- <u>Amount/number of moles/volume/mass of products formed/reactants used per (unit) time.</u>
- *<u>Hoeveelheid/getal mol/volume/massa van produkte gevorm/reaktanse gebruik per (eenheid) tyd</u>.*

- <u>Rate of change in concentration/amount/number of moles/volume/mass.</u>
  <u>Tempo van verandering in konsentrasie/ hoeveelheid/getal mol/ volume/massa</u>. ✓✓ **(2 or/of 0)** (2)

5.2 Volume **ACCEPT:** Rate of reaction/*Tempo van reaksie* ✓ (1)

5.3.1 (Decreasing gradient indicates) rate of reaction is <u>decreasing</u>. ✓
(Afnemende gradiënt dui aan dat) reaksietempo <u>afneem</u>. (1)

5.3.2 (Gradient is zero, indicates) reaction rate is <u>zero</u> ✓
(Gradiënt is nul, wat aandui dat) reaksietempo <u>nul</u> is. (1)

5.4

$$\text{Ave rate / } \textit{Gem. tempo} = \frac{\Delta V}{\Delta t}$$

$$10 = \frac{\Delta V}{20 - 0} \checkmark$$

$$V(O_2)_{produced/\textit{berei}} = 200 \text{ cm}^3$$

$$n(O_2)_{produced/\textit{berei}} = \frac{V}{V_m} = \frac{200}{24000 \checkmark} = 0{,}0083 \text{ mol}$$

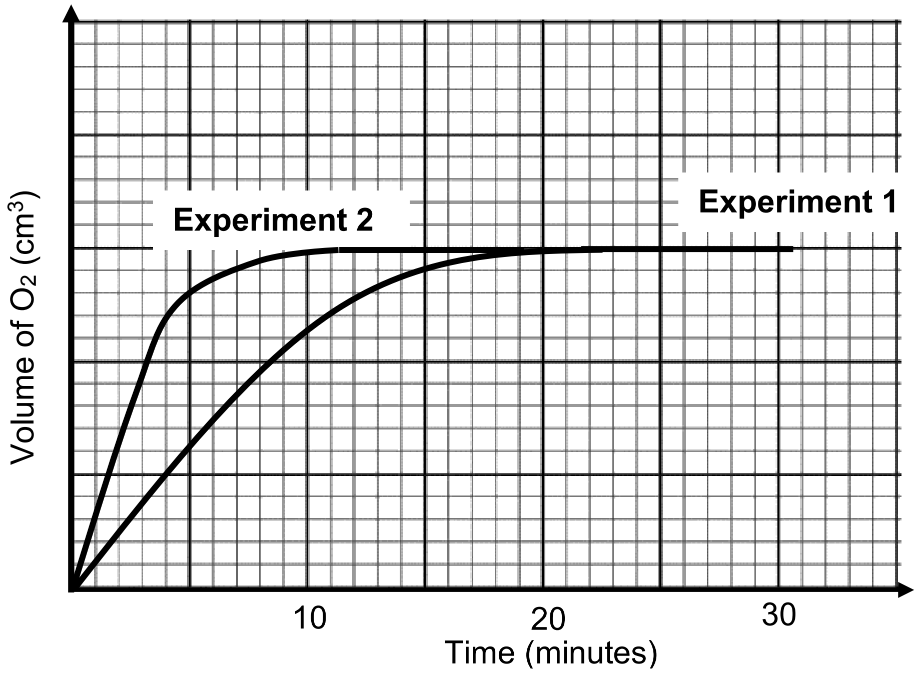
$$n(H_2O_2) = 2n(O_2) \checkmark = (2)(0{,}0083) = 0{,}017 \text{ mol}$$

$$c(H_2O_2)_{used/\textit{gebruik}} = \frac{n}{V} = \frac{0{,}017}{0{,}04 \checkmark} = 0{,}42 \text{ mol·dm}^{-3} \checkmark$$

(5)

5.5

<u>Marking criteria / *Nasienkriteria*</u>:
- Graph of Experiment 2 is steeper than gradient of Experiment 2/ *Grafiek van Eksperiment 2 het 'n styler gradient as Eksperiment 2*✓
- Both graphs ends at the same place/ *Beide grafieke eindig op dieselfde plek* ✓



(2)

5.6.1 Catalyst ✓ **OR** Increases reaction rate
Katalisator ***OF*** *Toename in reaksie-tempo* (1)

5.6.2
- Catalyst lowers activation energy/provides an alternative path of lower activation energy ✓
  Katalisator verlaag die aktiveringsenergie/ bied 'n alternatiewe pad van laer aktiveringsenergie
- More particles have sufficient E_K **OR** more particles have $E_K \geq E_A$ ✓
  Meer deeltjies het genoegsame E_K OF meer deeltjie het $E_K \geq E_A$
- More effective collisions per unit time/Frequency of effective collisions increase✓✓
  Meer effektiewe botsings per eenheidstyd/ Frekwensie van die effektiewe botsings neem toe (3)

[16]

QUESTION 6 / *VRAAG 6*

6.1

<u>Marking criteria</u>:

- Calculate number of moles of H_2 and $C\ell_2$ ✓
- Use mole ratio 1:1:2 ✓
- Moles at equilibrium✓
- Divide equilibrium moles by Volume (0,5) ✓
- Correct K_c expression (formulae in square brackets) ✓
- Substitute 64 as K_c value ✓
- Substitution of equilibrium concentrations into Kc expression. ✓
- Substitute moles of $C\ell_2$ and in correct formula.✓
- Final answer: 71 g ✓

<u>Nasienkriteria:</u>

- *Bereken die aantal mol van H_2 en $C\ell_2$* ✓
- *Gebruik verhouding 1:1:2* ✓
- *Mol by ewewig* ✓
- *Deel mol by ewewig met volume (0,5)* ✓
- *Korrekte Kc - uitdrukking (formules in vierkanthakies)* ✓
- *Vervang 64 as K_c-waarde* ✓
- *Vervanging van ewewigskonsentrasies in K_c -uitdrukking.* ✓
- *Vervang mol van $C\ell_2$ en 71 $g \cdot mol^{-1}$ in korrekte formule* ✓
- *Finale antwoord: 71 g*✓

$$n = \frac{m}{M} = \frac{10}{2} = 5 \text{ mol } H_2 \qquad n = \frac{m}{M} = \frac{355}{71} = 5 \text{ mol } Cl_2$$

	$H_2(g)$	$C\ell_2$ (g)	$HC\ell(g)$
Initial quantity (mol) Aanvangshoeveelheid (mol)	5	✓ 5	0
Change (mol) Verandering (mol)	x	x	2x
Quantity at equilibrium (mol)/ Hoeveelheid by ewewig (mol)	5 – x	5 – x	2x ✓
Equilibrium concentration (mol·dm^{-3}) Ewewigskonsentrasie (mol·dm^{-3})	$\frac{5-x}{0,5}$	$\frac{5-x}{0,5}$	$\frac{2x}{0,5}$ ✓

Ratio ✓

$$K_c = \frac{[HCl]^2}{[H_2][Cl_2]} \checkmark$$

$$64 \checkmark = \frac{(\frac{2x}{0,5})^2}{(\frac{5-x}{0,5})(\frac{5-x}{0,5})} \checkmark$$

$$x = 4$$

No Kc expression, correct substitution/*Geen Kc-uitdrukking, korrekte substitusie*: Max./Maks. 8/9

Wrong Kc expres[sion/*Verkeerde Kc uitdrukking*: Max./Maks. 6/9

$$n(Cl_2)_{\text{equilibrium/}\textit{ewewig}} = 5 - 4 = 1 \checkmark$$

$$m_{Cl_2} = nM = (1)(71) = 71 \text{ g} \checkmark$$

(9)

6.2 Negative/*Negatief* ✓

- Decrease in temperature favours the exothermic reaction. ✓
  Afname in temperatuur bevoordeel die eksotermiese reaksie.
- The forward reaction is favoured.✓
  Die voorwaartse reaksie word bevoordeel.
- Reaction is endothermic. ✓
  Die reaksie is eksotermies.

(4)

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

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

[15]

QUESTION 7 / *VRAAG 7*

7.1.1 Dilute acids contain a small amount (number of moles) of acid in proportion to the volume of water. ✓✓ **(2 or 0)**
Verdunde sure bevat 'n klein hoeveelheid (getal mol) suur in verhouding met die volume water. (2)

7.1.2 Strong acids ionise completely in water ✓to form a high concentration of H_3O^+ ions. ✓
Sterk sure ioniseer volledig in water om 'n hoë konsentrasie H_3O^+ -ione te vorm. (2)

7.1.3 HSO_4^- ✓ (1)

7.1.4 $[H_3O^+] = 2[H_2SO_4]$
$= 2(0,2)$
$= 0,4\ mol \cdot dm^{-3}$

$pH = -\log[H_3O^+]$✓
$= -\log[0,4]$✓
$= 0,398$✓ (3)

7.2.1 Basic/*Alkalies* ✓ (1)

7.2.2 $CO_3^{2-} + H_2O$ ✓→ $OH^- + HCO_3^-$ ✓ Balancing ✓

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

(3)

7.3

Marking criteria:
- Use of formula $c = \frac{n}{V}$ or $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$ ✓
- Substitute 0,1 $mol \cdot dm^{-3}$ and 0,0248 dm^3 in correct formula✓
- Use ratio: $n(NaOH) = 2n(Na_2CO_3)$ ✓
- Substitute 0,5 dm^3 in correct formula ✓
- Use 286 $g \cdot mol^{-1}$ in $n = \frac{m}{M}$ ✓
- Final answer: 7,09 g ✓

Nasienkriteria:
- Gebruik van formule $c = \frac{n}{v}$ or $\frac{CaVa}{CbVb} = \frac{na}{nb}$ ✓
- Vervang 0,1 $mol \cdot dm^{-3}$ en 0,0248 dm^3 in korrekte formule✓
- Gebruik ratio: $n(NaOH) = 2n(Na_2CO_3)$ ✓
- Vervang 0,5 dm^3 in korrekte formule ✓
- Gebruik 286 $g \cdot mol^{-1}$ in $n = \frac{m}{M}$ ✓
- Finale antwoord: 7,09 g ✓

$n(HCl) = cV$ ✓
$= (0,1)(0,0248)$ ✓
$= 2,48 \times 10^{-3}$ mol

$n(Na_2CO_3) = 2n(HCl)$
$n(Na_2CO_3) = 1,24 \times 10^{-3}$ mol ✓

$1,24 \times 10^{-3}$ mol (Na_2CO_3) in 0,025 dm^3

$\therefore$ in 0,5 dm^3 $n(Na_2CO_3) = 0,0248$ mol ✓

$$n = \frac{m}{M}$$
$$0,0248 = \frac{m}{286 ✓}$$
$$m_{(Na_2CO_3)} = 7,09 \text{ g} ✓$$

<u>OPTION 2 / *OPSIE 2*</u>

$$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b} ✓$$
$$\frac{(0,1)(24,8) ✓}{(c_b)(25)} = \frac{2}{1} ✓$$
$c_a = 0,0496$ mol·dm^3

$n_{(Na_2CO_3)} = cV$
$n = (0,0496)(0,5)$ ✓
$= 0,0248$ mol

$$n = \frac{m}{M}$$
$$0,0248 = \frac{m}{286 ✓}$$
$$m_{(Na_2CO_3)} = 7,09 \text{ g} ✓$$

(6)
[18]

QUESTION 8 / *VRAAG 8*

8.1 Concentration/*Konsentrasie*: 1 mol·dm^{-3} ✓
Temperature/*Temperatuur*: 25 °C ✓ (2)

8.2
- To ensure electrical neutrality / *Verseker elektriese neutraliteit* ✓
- To separate the two electrolytes/*Om die elektroliete te skei* ✓ (2)

8.3 Ni to Ag ✓ (1)

8.4 $Ni(s) + 2Ag^{+}(aq) \rightarrow Ni^{2+}(aq) + 2Ag(s)$ ✓ balancing ✓

Marking criteria / *Nasienkriteria*:
- Reactants ✓ Products ✓ Balancing ✓
  Reaktanse *Produkte* *Balansering*
- Ignore double arrows/*Ignoreer dubbel pyltjie*
- Ignore phases / *Ignoreer fases.* (3)

8.5 n(anode) = ½n(cathode)
n(anode) = ½(0,4)
= 0,2 mol✓

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

$$0,2 = \frac{m}{59✓}$$

$m_{decrease/afname} = 11,8$ g✓ (3)

8.6 B✓
Mg ✓is a stronger reducing agent than Ni.✓ Mg will be oxidized to Mg^{2+}✓
Mg is 'n sterker reduseermiddel as Ni en Mg sal dus geoksideer word tot Mg^{2+} (4)
[15]

QUESTION 9 / *VRAAG 9*

9.1 **ANY ONE/ENIGE EEN**

- The chemical process in which electrical energy is converted to chemical energy. ✓✓
- The use of electrical energy to produce a chemical change
- The process during which an electric current passes through a solution/ionic liquid/molten ionic compound.
- Decomposition of an ionic compound by means of electrical energy.

- *Die chemiese proses waarin elektriese energie gebruik word om 'n chemiese verandering te weeg te bring. ✓✓*
- *Die chemiese proses waarin elektriese energie omgeskakel word na chemiese energie*
- *Die proses waardeur 'n elektriese stroom deur 'n opplossing/ioniese vloeistof/gesmelte ioniese verbinding beweeg.*
- *Ontbinding van 'n ioniese verbinding met behulp van elektriese energie.*

(2)

9.2 A ✓ (1)

9.3 B ✓ (1)

9.4 $Cu^{2+} + 2e^-$✓ Cu ✓✓

Marking criteria/*Nasienriglyne*			
$Cu \leftarrow Cu^{2+} + 2e^-$	$(^3/_3)$	$Cu^{2+} + 2e^- \rightleftharpoons Cu$	$(^1/_3)$
$Cu \rightleftharpoons Cu^{2+} + 2e^-$	$(^0/_3)$	$Cu^{2+} + 2e^- \leftarrow Cu$	$(^0/_3)$

(3)

9.5 True/*Waar* ✓
Rate of oxidation is equal to the rate of reduction✓
Tempo van oksidasie is gelyk aan die tempo van reduksie (2)

9.6 Carbon is unreactive ✓and can conduct electricity ✓
Koolstof is onreaktief en kan elektrisiteit gelei. (2)

9.7 A✓
$2C\ell^- \rightarrow C\ell_2 + 2e^-$ ✓✓

Marking criteria/*Nasienriglyne*			
$C\ell_2 + 2e^- \leftarrow 2C\ell^-$	$(^2/_2)$	$2C\ell^- \leftarrow C\ell_2 + 2e^-$	$(^1/_2)$
$C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$	$(^0/_2)$	$2C\ell^- \leftarrow C\ell_2 + 2e^-$	$(^0/_2)$

(3)

9.8 Decrease/*Afneem* ✓ (1)

[15]

TOTAL: 150