GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2024

10842

PHYSICAL SCIENCES: CHEMISTRY

(PAPER 2)

PHYSICAL SCIENCES: Paper 2

10842E

TIME: 3 hours

MARKS: 150

16 pages + 4 information sheets

X05

P.T.O.

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.

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

5. Leave ONE line between subquestions, 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. 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, etc. where required.

12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A – D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 Consider the flow diagram below:

$$\boxed{\text{Propene}} \xrightarrow[P_t]{H_2} \boxed{\text{Compound } \mathbf{X}}$$

Compound **X** is:

A Propyne

B Propan-1-ol

C Propane

D Propan-2-ol (2)

1.2 Which of the following compounds has the highest vapour pressure?

A Ethane

B Propane

C Butane

D Pentane (2)

1.3 During the dehydration of butan-2-ol represented below, a major organic compound (Y) is formed.

$$CH_3CH_2CH(OH)CH_3 \xrightarrow{\text{dehydration}} Y$$

Which of the following is the correct condensed structural formula for compound **Y**?

A $CH_3CH_2CH_2CH_3$

B $CH_3CHCHCH_3$

C $CH_3CH_2CH(OH)CH_3$

D $CH_3CH_2CHCH_2$ (2)

1.4 The complete combustion of ONE MOLE of butane needs at least:

A 18 mol O_2

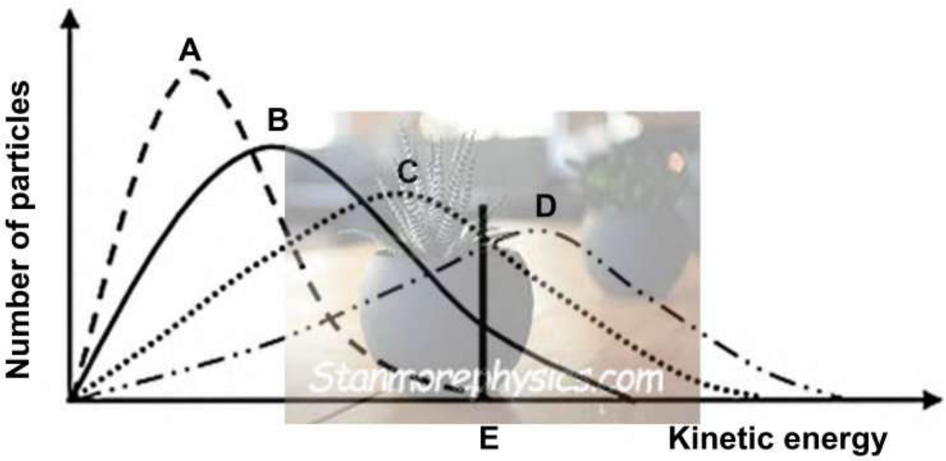
B 5 mol O_2

C 7 mol O_2

D 13 mol O_2 (2)

1.5 The Maxwell-Boltzmann energy distribution curves below show the number of particles as a function of their kinetic energy, for a reaction at four different temperatures.

The minimum kinetic energy needed for effective collisions to occur is represented by **E**.



Which of these curves represents the reaction with the highest rate?

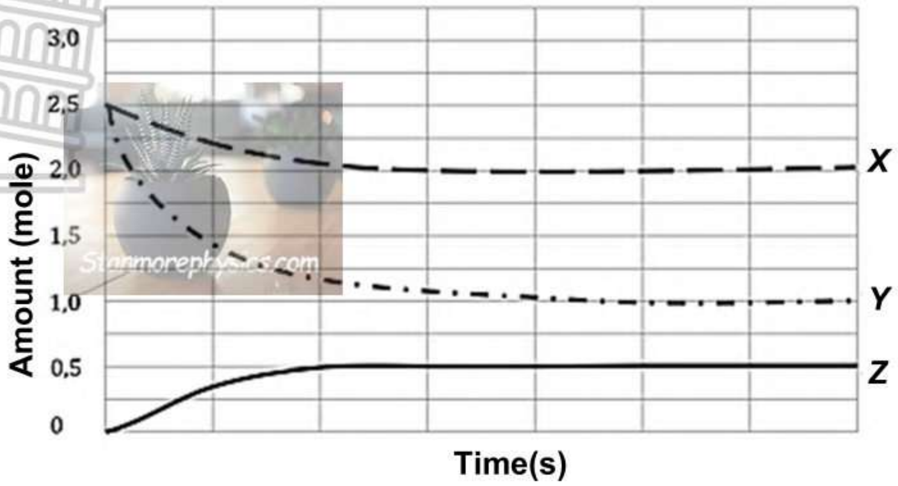
A Curve **A**

B Curve **B**

C Curve **C**

D Curve **D** (2)

1.6 The graph below shows the changes in **X**, **Y** and **Z** over time during a reaction.



Which of the following balanced chemical equations is correct for this reaction?

A $X + 3Y \rightarrow Z$

B $4X + 2Y \rightarrow Z$

C $5X + 3Y \rightarrow 2Z$

D $2X + 3Y \rightarrow 2Z$ (2)

1.7 HPO_4^{2-} is an ampholyte.

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

	CONJUGATE ACID	CONJUGATE BASE
A	PO_4^{3-}	$H_2PO_4^{1-}$
B	$H_2PO_4^{1-}$	PO_4^{3-}
C	$H_2PO_4^{1-}$	H_3PO_4
D	$H_2PO_4^{2-}$	PO_4^{2-}

(2)

1.8 If the concentration of a sulphuric acid solution is 1×10^{-3} mol·dm^{-3}, what will the pH and [OH$^-$] of the solution be, respectively?

	pH	**[OH$^-$] (mol·dm^{-3})**
A	2,7	1×10^{-11}
B	2,7	5×10^{-12}
C	3,0	5×10^{-12}
D	3,0	1×10^{-11}

(2)

1.9 Which of the following containers can be used to store an iron(II) sulphate solution?

A Aℓ

B Mg

C Ni

D Zn (2)

1.10 Consider the following reaction which takes place in a galvanic cell:

$$2Cr^{2+}(aq) + Sn^{4+}(aq) \rightleftharpoons 2Cr^{3+}(aq) + Sn^{2+}(aq)$$

The net cell potential (in V) when this cell reaches equilibrium will be …

A + 0,56.

B 0,00.

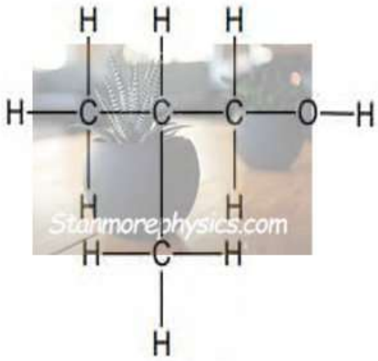
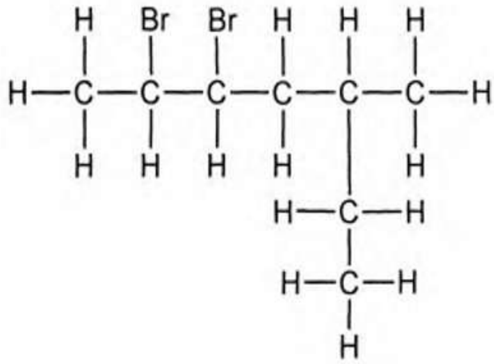
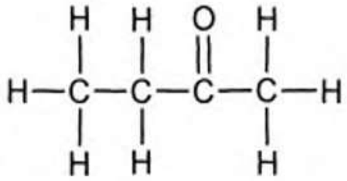
C – 0,26.

D – 0,56. (2)

[20]

QUESTION 2 (Start on a new page.)

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

A	$CH_3CH_2CH_2CH_3$	**B**	Butanal
C		**D**	
E		**F**	CxHyOz

2.1 Is compound **A**, a SATURATED or an UNSATURATED hydrocarbon? Give a reason for the answer. (2)

2.2 Write down the LETTER/S that represent(s) each of the following:

2.2.1 A ketone (1)

2.2.2 A haloalkane (1)

2.2.3 The two functional isomers (1)

2.3 Consider compound **C**:

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

2.3.2 Write down the STRUCTURAL FORMULA and IUPAC name of a chain isomer of compound **C**. (2)

2.4 Write down the:

2.4.1 IUPAC name for compound **D** (2)

2.4.2 NAME of the functional group of compound **B** (1)

2.5 A sample of compound **F** contains 40% C; 53,3% O and X% H.

2.5.1 If the molar mass is 60 $g·mol^{-1}$, calculate the MOLECULAR FORMULA of compound **F**. (4)

2.5.2 Write down the IUPAC names of the two organic compounds that will have this molecular formula. (2)

[18]

QUESTION 3 (Start on a new page.)

The table below shows the boiling points of four organic compounds, represented by the letters **A** to **D**, of comparable molecular masses.

COMPOUND	IUPAC NAME	MOLAR MASS ($g•mol^{-1}$)	BOILING POINT (°C)
A	2,3-dimethylbutane	86	57,9
B	Hexane	86	68,7
C	Methyl propanoate	88	79,8
D	Pentan-1-ol	88	X or Y

3.1 Compounds **A** and **B** are structural isomers.

3.1.1 Define the term *structural isomers*. (2)

3.1.2 The boiling point of compound **B** is higher than the boiling point of compound **A**. Explain the difference in the boiling points. (3)

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

3.3 Which ONE of the compounds **B** or **C**, will have a higher vapour pressure? Give a reason for the answer. (2)

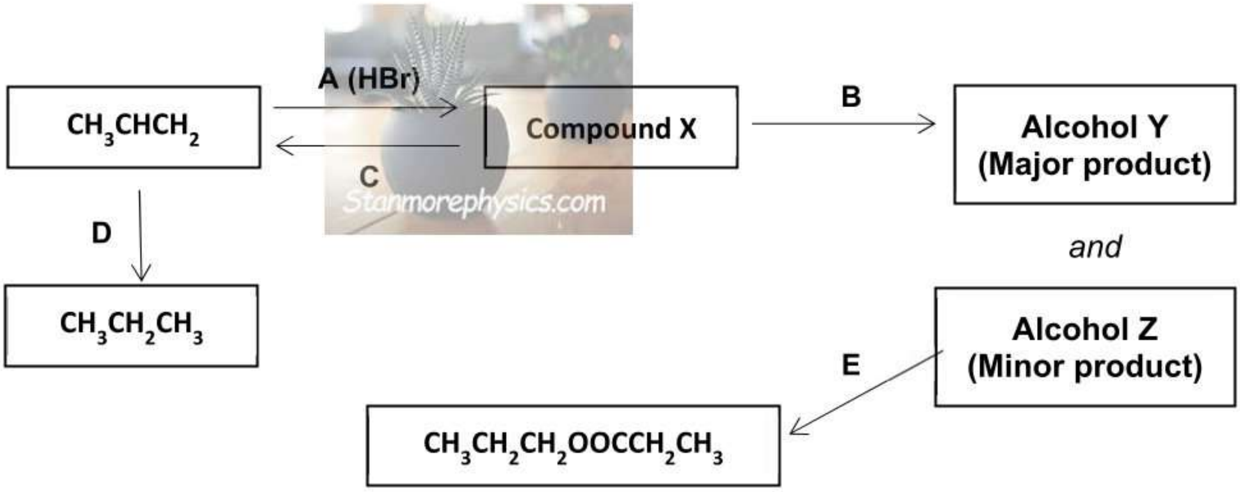
3.4 Consider compounds **C** and **D**.

3.4.1 Will the boiling point of compound **D** be X = 75,5 °C OR Y = 135,5 °C? Write down only X or Y. (1)

3.4.2 Explain the answer to QUESTION 3.4.1. (3)
[13]

QUESTION 4 (Start on a new page.)

Consider the following sequence of organic reactions labelled **A** to **E**.



4.1 Write down the type of reaction that occurs at:

4.1.1 **A** (1)

4.1.2 **C** (1)

4.2 Write down the NAME or FORMULA of the catalyst for reaction **D**. (1)

4.3 Reaction **B** is a substitution reaction that takes place in the presence of water.

Write down the:

4.3.1 Type of substitution reaction for **B** (1)

4.3.2 TWO other reaction conditions for this reaction (2)

4.3.3 IUPAC name of the major product **Y** (2)

4.4 Use the structural formulae to write a balance equation for reaction **B**, showing the formation of alcohol **Y**. (3)

4.5 Reaction **E** is a reaction between minor product, alcohol **Z** and a carboxylic acid to form an ester.

Write down the:

4.5.1 Name of this type of reaction (1)

4.5.2 Name of the inorganic compound formed during this reaction (1)

4.5.3 Name of the catalyst needed for this reaction (1)

4.5.4 IUPAC name for the functional isomer of the ester formed (2)

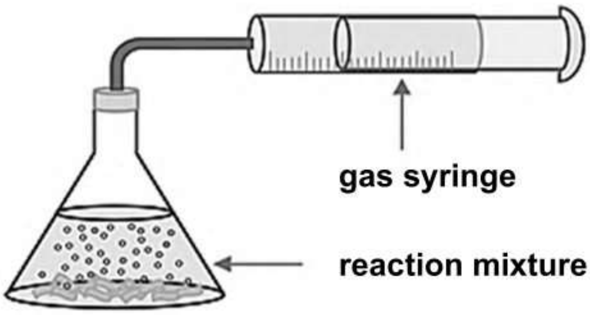
4.6 Draw the STRUCTURAL FORMULA of the functional group of the carboxylic acid. (1)
[17]

QUESTION 5 (Start on a new page.)

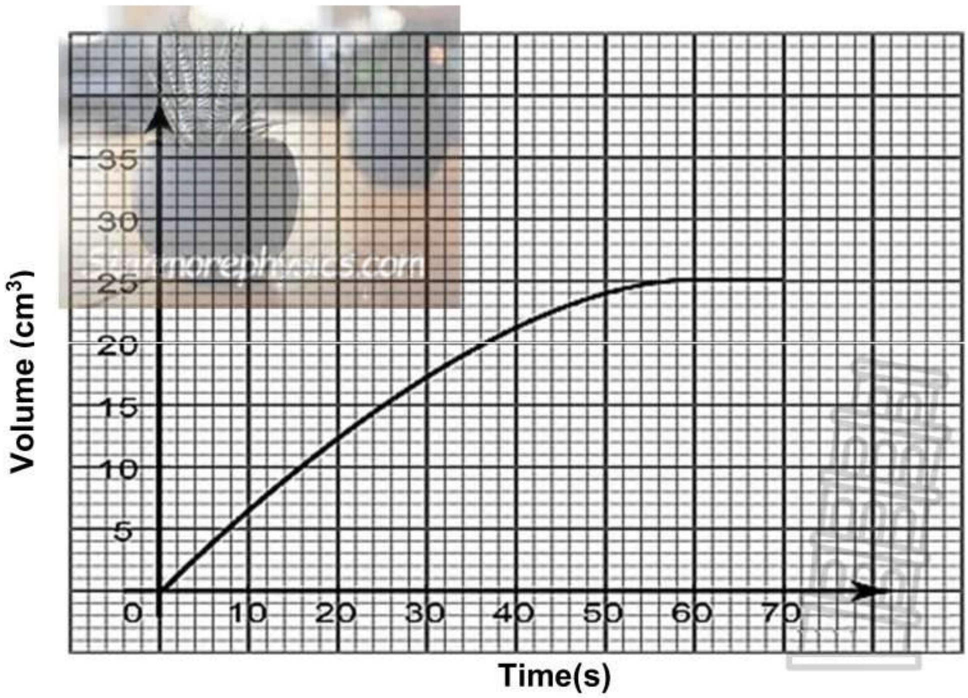
Learners are asked to investigate the rate at which 0,3 g of impure calcium carbonate will react with an excess of 1 mol·dm^{-3} hydrochloric acid at room temperature to produce CO_2 gas.

The equation for the reaction is:

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



The graph below represents the volume of CO_2(g) produced at regular time intervals.



5.1 Write down:

5.1.1 An investigative question for this experiment (2)

5.1.2 A controlled variable (1)

5.1.3 The dependent variable for this investigation (1)

5.2 With reference to the graph, how will the rate of reaction between the time 0 s to 20 s compare with the reaction rate between time 30 s to 50 s? (1)

5.3 What conclusion can be drawn from the graph between the time 60 s and 70 s? (1)

5.4 Use the graph to calculate the mass of calcium carbonate that reacted. The molar volume is 24 dm^3 at room temperature. (5)

5.5 Calculate the percentage purity of the calcium carbonate which reacted in the above reaction. (2)

5.6 The learners repeat their investigation by using 0,3 g of the same impure calcium carbonate but increased the concentration of hydrochloric acid to 2 $mol \cdot dm^{-3}$.

5.6.1 How will the gradient of the graph change when the concentration of the acid is increased? (1)

5.6.2 Use the *Collision Theory* to explain how an increase in concentration affects the rate of reaction. (3)

[17]

QUESTION 6 (Start on a new page.)

Potassium dichromate is formed when nitric acid is slowly added to a potassium chromate solution. The chromate ions (CrO_4^{2-}) in the solution reach equilibrium with the dichromate ions ($Cr_2O_7^{2-}$) according to the following balanced ionic equation:

$$2CrO_4^{2-}(aq) + 2H^+(aq) \rightleftharpoons Cr_2O_7^{2-}(aq) + H_2O(\ell)$$

Yellow Orange

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

6.2 A concentrated nitric acid solution is now added to this reaction mixture.

6.2.1 What colour change will be observed in the mixture? Choose from MORE YELLOW or MORE ORANGE. (1)

6.2.2 Explain the answer to QUESTION 6.2.1 in terms of Le Chatelier's principle. (3)

6.3 When the temperature of the original reaction mixture is increased, it is observed that the colour of the mixture changes to yellow.

6.3.1 Is the forward reaction ENDOTHERMIC or EXOTHERMIC? (1)

6.3.2 Explain the answer to QUESTION 6.3.1 in terms of Le Chatelier's principle. (3)

6.4 11 mol CrO_4^{2-}(aq) and **x** mol H^+(aq) are initially added together to make a 0,5 dm³ solution and allowed to react.

When the reaction reaches equilibrium, the solution contains 9 mol·dm⁻³ $Cr_2O_7^{2-}$ (aq).

Calculate the initial mole of H^+(aq) placed in the container if the equilibrium constant is 0,09. (8)

[18]

QUESTION 7 (Start on a new page.)

7.1 A solution of carbonic acid has a pH of 4,2 and the following Ka value:

$$K_a = 4{,}30 \times 10^{-7}$$

A solution of sulphuric acid has the following Ka value:

$$K_a = 1{,}0 \times 10^{3}$$

7.1.1 Calculate the concentration of the hydronium ions in the carbonic acid solution. (3)

7.1.2 How will the strength of the carbonic acid compare to that of sulphuric acid if both acids have a concentration of 0,02 mol·dm⁻³?

Write only that the carbonic acid is STRONGER THAN, WEAKER THAN or THE SAME AS sulphuric acid. Give a reason for the answer. (2)

7.2 A solution of vinegar can be neutralised with a solution of sodium hydroxide. The reaction takes place according to the following balanced equation:

$$CH_3COOH(aq) + NaOH(aq) \rightarrow CH_3COONa(aq) + H_2O(\ell)$$

The sodium acetate produced during this reaction can undergo hydrolysis.

7.2.1 Define the term *hydrolysis*. (1)

7.2.2 Will the pH of the sodium acetate solution be GREATER THAN or LESS THAN 7? (1)

7.2.3 Explain the answer to QUESTION 7.2.2 by referring to a balanced equation. (3)

7.3 An unknown carbonate has a chemical formula of $\mathbf{Y}_2CO_3$. A learner is asked to identify element **Y**.

The learner adds 0,5865 g of the carbonate in a conical flask containing 25 cm^3 hydrochloric acid solution with a concentration of 0,3 mol·dm^{-3}. The balanced equation for the reaction that takes place is:

$$2HC\ell(aq) + Y_2CO_3(aq) \quad \rightarrow \quad 2YC\ell(aq) + CO_2(g) + H_2O\,(\ell)$$

The hydrochloric acid is in EXCESS.

7.3.1 Calculate the initial mole of hydrochloric acid in the conical flask. (3)

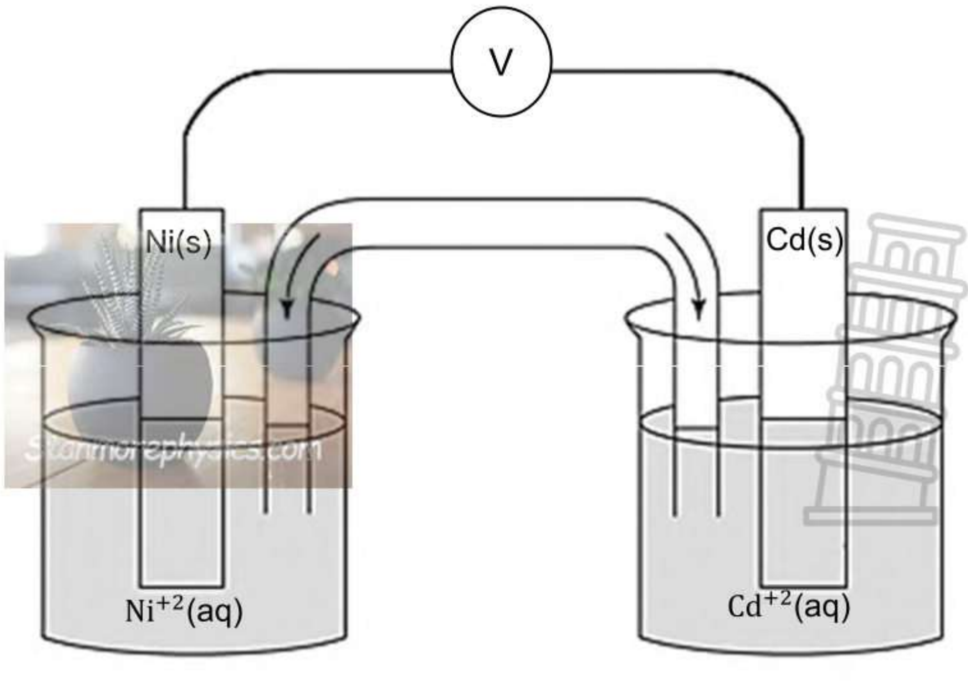
Once the mixture has stopped fizzing, 15 cm^3 of a 0,1 mol·dm^{-3} NaOH(aq) is added to the mixture to neutralise any remaining hydrochloric acid.

7.3.2 Calculate the amount of hydrochloric acid (in mole) that reacted with the unknown carbonate. (4)

7.3.3 Identify element **Y**. Show ALL calculations. (5)
[22]

QUESTION 8 (Start on a new page.)

8.1 A galvanic cell is constructed as shown in the diagram below.



8.1.1 Which electrode is cathode? Write only NICKEL or CADMIUM. (1)

8.1.2 Write down the equation for the oxidation half-reaction of this cell. (2)

8.1.3 How will the reading on the voltmeter be affected if the concentration of the nickel ions is increased after the cell has reached equilibrium?

Choose from INCREASE, DECREASE or REMAIN THE SAME.

Give a reason for the answer. (2)

8.2 Consider the following standard electrochemical cell:

$$Cu(s)|Cu^{2+}(aq)(1mol \cdot dm^{-3}) \parallel Ag^{1+}(aq)(1mol \cdot dm^{-3})|Ag(s)$$

Initially each half cell contains 200 cm^3 electrolyte.

The cell is connected to a circuit and allowed to produce current until the concentration of the electrolyte in the cathode half-cell is reduced to 0,5 $mol \cdot dm^{-3}$.

The cell is then disconnected.

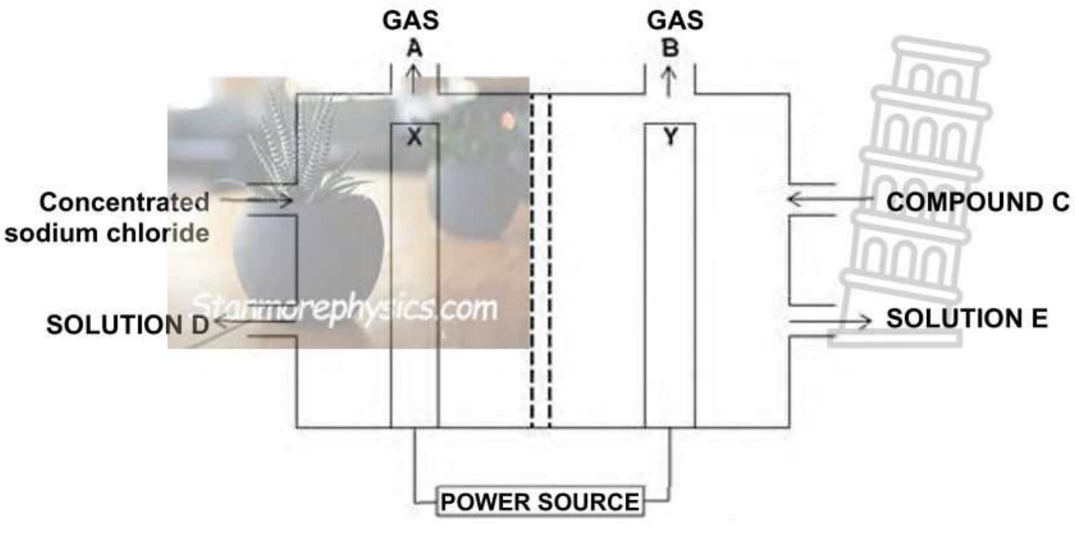
8.2.1 Write a balanced equation for the net ionic cell reaction. (3)

8.2.2 Calculate the concentration of the electrolyte in the anode half-cell when the cell is disconnected. (7)

[15]

QUESTION 9 (Start on a new page.)

Electrolysis is generally used in industry to produce chemicals through the decomposition of compounds.The simplified diagram below represents an electrolytic cell used in the electrolysis of a concentrated sodium chloride solution.



9.1 Define the term *anode* in terms of oxidation or reduction. (1)

9.2 Which electrode, **X** or **Y**, is connected to the positive terminal of the power source? Give a reason for the answer. (2)

9.3 Write down the NAME or CHEMICAL FORMULA of:

9.3.1 Gas **A** (1)

9.3.2 Compound **C** (1)

9.4 Write down the equation for the half-reaction that takes place at the cathode of the cell. (2)

9.5 Refer to the relative strength of the oxidising agents to explain the answer to QUESTION 9.4. (3)
[10]

TOTAL: 150

END

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
Charge on electron *Lading op elektron*	q_e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02\times10^{23}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n=\frac{m}{M}$	$n=\frac{N}{N_A}$
$c=\frac{n}{V}$ **or/*of*** $c=\frac{m}{MV}$	$n=\frac{V}{V_m}$
$\frac{c_aV_a}{c_bV_b}=\frac{n_a}{n_b}$	$pH = -log[H_3O^+]$

$$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode} \ / \ E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$$

$$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation} \ / \ E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$$

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

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

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 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

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

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

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
$2H^+ + 2e^-$	⇌	**$H_2(g)$**	**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

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN

2024

MARKING GUIDELINES
NASIENRIGLYNE

10842

PHYSICAL SCIENCES: CHEMISTRY
FISIESE WETENSKAPPE: CHEMIE

(PAPER/*VRAESTEL* 2)

15 pages/*bladsye*

QUESTION/*VRAAG* 1

1.1	C ✓✓	(2)
1.2	A ✓✓	(2)
1.3	B ✓✓	(2)
1.4	C ✓✓ (Accept A and D/*Aanvaar A en D*)	(2)
1.5	D ✓✓	(2)
1.6	A ✓✓	(2)
1.7	B ✓✓	(2)
1.8	B ✓✓ (Accept A/*Aanvaar A*)	(2)
1.9	C ✓✓	(2)
1.10	B ✓✓	(2)
		[20]

QUESTION/*VRAAG* 2

2.1 Saturated ✓
Only single bonds between C-atoms/No multiple bonds between C-atoms. ✓

Versadig
Slegs enkelbindings tussen C-atome/Geen meervoudige bindings tussen C-atome nie. (2)

2.2.1 E ✓ (1)

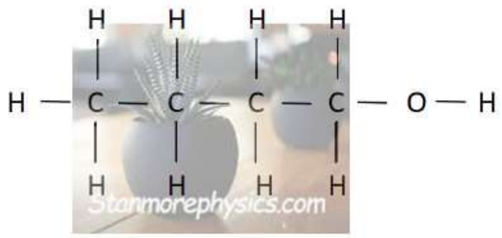
2.2.2 D ✓ (1)

2.2.3 B & E ✓ (1)

2.3.1 Primary ✓
The carbon that is bonded to the hydroxyl group (OH) is bonded to one carbon atom. ✓

Primêre
Die koolstof wat aan die hidroksielgroep (OH) gebind is, is gebind aan een ander koolstofatoom. (2)

2.3.2



butan-1-ol

MARKING CRITERIA/
NASIENKRITERIA
✓ correct whole structure
✓ correct IUPAC name
Korrekte volledige struktuur
Korrekte IUPAC naam

(2)

2.4.1 2,3-dibromo-5-methyl ✓ ✓ heptane

2,3-dibromo-5-metielheptaan (2)

2.4.2 Formyl ✓ group

Formiel groep (1)

2.5.1 100 – (40 + 53,3) = 6,7

	C:	H :	O
$n = \frac{m}{M}$	$\frac{40}{12}$	$\frac{6,7}{1}$	$\frac{53,3}{16}$
	$\frac{3,33}{3,33}$	$\frac{6,67}{3,33}$	$\frac{3,33}{3,33}$
	1	2	1

CH_2O

MARKING CRITERIA/ NASIENRIGLYNE

✓6,7

✓Divide by smallest number/ *deel deur kleinste getal*

Molar mass of/*Molêre massa van* CH_2O = 30 g·mol^{-1}

60 ÷ 30 = 2 ✓

∴ $C_2H_4O_2$ ✓

(NOTE: If only formula given, $\frac{1}{4}$)

(NOTA: As slegs formule gegee word, $\frac{1}{4}$*)* (4)

2.5.2 Ethanoic acid/*Etanoësuur* ✓

Methyl methanoate/*Metielmetanoaat* ✓ (2)

[18]

QUESTION/*VRAAG* 3

3.1 3.1.1 Organic molecules with the same molecular formula, but different structural formulae. ✓✓ (2 or 0)

Organiese molekule met dieselfde molekulêre formule, maar verskillende struktuurformules. (2)

3.1.2 **OPTION 1:**

- B (Hexane) has a larger surface area/longer straight chain than A (2,3-dimethylbutane) ✓
- Stronger intermolecular forces/London forces/Van Der Waals forces ✓
- More energy required to overcome/weaken the intermolecular forces (IMF) ✓

OR

OPTION 2:

- A (2,3-dimethylbutane) has a smaller surface area/more branched than B (hexane) (Accept: more spherical)
- Weaker intermolecular forces/London forces/Van Der Waals forces
- Less energy required to overcome/weaken the intermolecular forces (IMF)

OPSIE 1:

- *B (Heksaan) het 'n groter oppervlakarea/langer reguitketting as A (2,3-dimetielbutaan)*
- *Sterker intermolekulêre kragte/London kragte/Van der Waals kragte*
- *Meer energie benodig om intermolekulêre kragte (IMK) te oorkom/verswak*

OF

OPSIE 2:

- *A (2,3-dimetielbutaan) het 'n kleiner oppervlaksarea/meer vertakkings as B (heksaan) (Aanvaar: meer sferies)*
- *Swakker intermolekulêre kragte/London kragte/Van der Waals kragte*
- *Minder energie benodig om intermolekulêre kragte (IMK) te oorkom/verswak.* (3)

3.2 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.

Marking criteria **If any one of the underlined key words phrases in the correct context (vapour pressure) is omitted, deduct 1 mark.** ***Nasienkriteria*** ***Indien enige een van die onderstreepte woorde /frases in die korrekte konteks uitgelaat word, trek 1 punt af.***

(2)

3.3 B (Hexane) ✓
Has weaker/less London (dispersion) forces than C (methyl propanoate)
OR
Has a lower boiling point than C (methyl propanoate) ✓

B (Heksaan)
Het swakker/minder London (dispersie) kragte as C (metielpropanoaat)
OF
Het 'n laer kookpunt as C (metielpropanoaat) (2)

3.4 3.4.1 Y ✓ (1)

3.4.2
- C (methyl propanoate) has dipole-dipole forces and D (pentan-1-ol) has hydrogen bonding between molecules. ✓
- D has stronger intermolecular forces than C. ✓
- More energy required to overcome/weaken the intermolecular forces in D. ✓

- *C (metielpropanoaat) het dipool-dipoool kragte en D (pentan-1-ol) het waterstofbinding tussen molekules.*
- *D het sterker intermolekulêre kragte as C.*
- *Meer energie benodig om intermolekulêre kragte te oorkom/verswak in D.*

(3)
[13]

QUESTION/*VRAAG* 4

4.1 4.1.1 Addition/Hydrohalogenation/Hydrobromination ✓
Addisie/Hidrohalogenering/Hidrobrominering (1)

4.1.2 Elimination/Dehydrohalogenation/Dehydrobromination ✓
Eliminasie/Dehidrohalogenering/Dehidrobrominering (1)

4.2 Pt/platinum ✓ (Also accept/*Aanvaar ook*: Pd or/of Ni) (1)

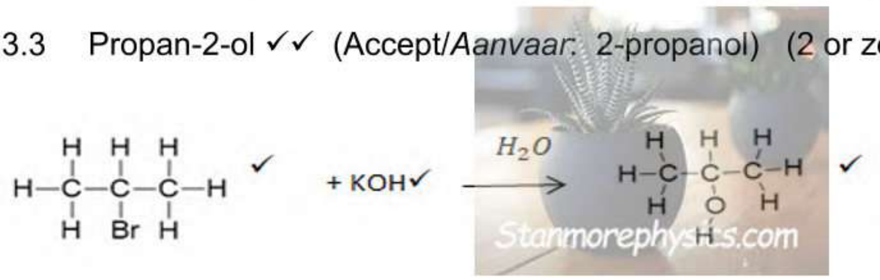
4.3 4.3.1 Hydrolysis ✓
Hidrolise (1)

4.3.2
- Dilute strong base (NaOH(aq)/KOH(aq)/LiOH(aq)/sodium hydroxide(aq)/potassium hydroxide(aq)/lithium hydroxide(aq))✓
- Heat ✓ (NOTE: Do NOT accept temperature)

- *Verdunde sterk basis (NaOH(aq)/KOH(aq)/LiOH(aq)/natriumhidroksied(aq)/kaliumhidroksied (aq)/ litiumhidroksied(aq))*
- *Hitte (NOTA: Moet NIE temperatuur aanvaar NIE)* (2)

4.3.3 Propan-2-ol ✓✓ (Accept/*Aanvaar*: 2-propanol) (2 or zero) (2)

4.4



+ KBr (optional) (3)

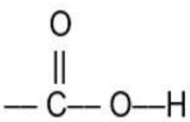
4.5 4.5.1 Esterification/Condensation ✓
Esterifikasie/Kondensasie (1)

4.5.2 Water ✓
(NOTE: Do NOT accept chemical formula)
(NOTA: Moet NIE die chemiese formule aanvaar nie) (1)

4.5.3 (Concentrated) sulphuric acid/ *(Gekonsentreerde) swawelsuur* ✓
(NOTE: Do NOT accept chemical formula)
(NOTA: Moet NIE die chemiese formule aanvaar nie) (1)

4.5.4 Hexanoic acid ✓✓ (2 or zero)
Heksanoësuur (2)

4.6



✓
(NOTE: Indicate all four bonds around carbon)
(NOTA: Dui al vier bindings rondom koolstof aan) (1)

[17]

QUESTION/*VRAAG* 5

5.1 5.1.1 **OPTION 1:**
What is the relationship between the concentration and rate of reaction? ✓✓
OR
OPTION 2:
What is the relationship between the state of division and rate of reaction? ✓✓
OR
OPTION 3:
How is the rate of the reaction affected by the degree of purity?

OPSIE 1:
Wat is die verband tussen die konsentrasie en die reaksietempo?
OF
OPSIE 2:
Wat is die verband tussen die toestand van verdeeldheid en die reaksietempo?
OF
OPSIE 3:
Hoe word die reaksietempo beïnvloed deur die graad van suiwerheid? (2)

5.1.2 **IF OPTION 1 IN 5.1.1:**
Temperature/state of division (surface area)/mass of impure $CaCO_3$ ✓

IF OPTION 2 IN 5.1.1:
Temperature/concentration/mass of impure $CaCO_3$ ✓

IF OPTION 3 IN 5.1.1:
Temperature/concentration/state of division (surface area)/mass of impure $CaCO_3$ ✓

INDIEN OPSIE 1 IN 5.1.1:
Temperatuur/toestand van verdeeldheid (oppervlakarea)/massa onsuiwer $CaCO_3$

INDIEN OPSIE 2 IN 5.1.1:
Temperatuur/konsentrasie/massa onsuiwer $CaCO_3$

INDIEN OPSIE 3 IN 5.1.1:
Temperatuur/konsentrasie/massa onsuiwer $CaCO_3$ (1)

5.1.3 Rate of reaction/volume of gas per unit time ✓
Reaksietempo/volume gas per eenheid tyd (1)

5.2 Rate between time 0 s and 20 s is faster(higher)/rate between time 30 s and 50 s is slower(lower) ✓

Tempo tussen 0 s en 20 s is vinniger(hoër)/tempo tussen 30 s en 50 s is stadiger(laer) (1)

5.3 Reaction stop/**calcium carbonate** is used up/reaction is complete. ✓
(**NOTE:** Hydrochloric acid is in excess)

*Die reaksie stop/**kalsiumkarbonaat** is opgebruik/reaksie is voltooi.*
*(**LET WEL:** Soutsuur is in oormaat)* (1)

5.4

MARKING CRITERIA/*NASIENKRITERIA*	
(a)	Any applicable formula *Enige toepaslike formule*
(b)	Dividing volume of CO_2 (from graph) by 24 dm^3 *Deel volume CO_2 (vanaf grafiek) deur 24 dm^3*
(c)	Using mole ratio for CO_2 to $CaCO_3$ (1:1) *Gebruik molverhouding vir CO_2 tot $CaCO_3$ (1:1)*
(d)	Multiplying n($CaCO_3$) with 100 in the correct formula *Vermenigvuldig n(CaCO3) met 100 in die korrekte formule*
(e)	Final answer *Finale antwoord*

$n = \frac{V}{Vm}$ ✓[a]

$= \frac{0,025}{24}$ ✓[b]

$= 1,042 \times 10^{-3}$ mol

From the balanced equation/*van die gebalanseerde vergelyking*:

n(CO_2) : n($CaCO_3$)

1 : 1 ✓[c]

n($CaCO_3$) = $1,042 \times 10^{-3}$ mol

m($CaCO_3$) = nM

= $1,042 \times 10^{-3} \times 100$ ✓[d]

= 0,104 g ✓[e] (0,10g) (5)

5.5 ***Positive marking from QUESTION 5.4/ Positiewe nasien vanaf VRAAG 5.4***

% purity/*suiwerheid* = $\frac{\text{pure mass sample/suiwer massa monster}}{\text{impure mass sample/onsuiwer massa monster}} \times 100$

$= \frac{0,104}{0,3} \times 100$ ✓

= 34,67 % ✓ (33,33-34,67%) (2)

5.6 5.6.1 Steeper gradient/*Steiler gradiënt* ✓

(1)

5.6.2

- Increase in concentration increases the number of particles per unit volume. ✓
- More effective collisions per unit time. /Frequency of effective collisions increases. ✓
- Rate of reaction increases. ✓

- *Verhoging in konsentrasie verhoog die aantal deeltjies per eenheid volume.*
- *Meer effektiewe botsings per eenheid tyd./Frekwensie van effektiewe botsings neem toe*
- *Reaksietempo neem toe* (3)

[17]

QUESTION/*VRAAG* 6

6.1 (Chemical equilibrium is a dynamic equilibrium) when the rate of the forward reaction equals the rate of the reverse reaction. (2 or 0) ✓✓

(Chemiese ewewig is 'n dinamiese ewewig) wanneer die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie. (2)

6.2 6.2.1 More orange/*Meer oranje* ✓ (1)

6.2.2
- Nitric acid ionises completely in the solution thereby increasing the concentration of hydrogen ions ✓
- Forward reaction is favoured to decrease the concentration of hydrogen ions ✓
- Thus the concentration of (yellow) CrO_4^{2-} ions decrease and the concentration of (orange) $Cr_2O_7^{2-}$ ions increase ✓

- *Salpetersuur ioniseer volledig in oplossing, dus verhoog die konsentrasie waterstofione.*
- *Die voorwaartse reaksie word bevoordeel om die konsentrasie van die waterstofione te verminder.*
- *Dus sal die konsentrasie van die (geel) CrO_4^{2-} ione afneem en die konsentrasie van die (oranje) $Cr_2O_7^{2-}$ ione toeneem.* (3)

6.3 6.3.1 Exothermic/*Eksotermies* ✓ (1)

6.3.2
- An increase in temperature favours an endothermic reaction. ✓
- The mixture turns yellow, indicates that reverse reaction was favoured. ✓
- Thus the reverse reaction is endothermic✓ and forward reaction is exothermic.

- *'n Toename in temperatuur bevoordeel 'n endotermiese reaksie.*
- *Die mengsel word geel, dui daarop dat die terugwaartse reaksie bevoordeel was.*
- *Dus is die terugwaartse reaksie endotermies en die voorwaartse reaksie is eksotermies.* (3)

6.4 **MARKING CRITERIA/*NASIENKRITERIA*:**

(a)	Calculate equilibrium moles $Cr_2O_7^{2-}$ *Bereken die ewewigsmol $Cr_2O_7^{2-}$*
(b)	USE ratio **2**CrO_4^{2-}: **2**H^{1+}: **1**$Cr_2O_7^{2-}$ *GEBRUIK die verhouding **2**CrO_4^{2-}: **2**H^{1+}: **1**$Cr_2O_7^{2-}$*
(c)	Calculate equilibrium moles of CrO_4^{2-} **and** H^{1+} by subtraction. *Bereken die ewewigsmol van CrO_4^{2-} **en** H^{1+} deur aftrekking.*
(d)	Divide equilibrium moles by 0,5 ($mol \cdot dm^{-3}$) *Deel ewewigsmolle deur 0,5 ($mol \cdot dm^{-3}$)*
(e)	Correct Kc expression (formulae in square brackets) *Korrekte Kc uitdrukking (formules in blokhakies)*
(f)	Substitution of Kc value into expression *Vervang Kc waarde in Kc uitdrukking*
(g)	Substitution of concentrations into correct Kc expression *Vervang konsentrasies in korrekte Kc uitdrukking*
(h)	Final answer: 10,25 mol *Finale antwoord: 10,25 mol*

	CrO_4^{2-}	H^+	$Cr_2O_7^{2-}$
Initial amount (moles) *Aanvanklike hoeveelheid (mol)*	11	x	0
Change in amount (moles) *Verandering in hoeveelheid (mol)*	9	9	4,5 ✓ **b**
Equilibrium amount (moles) *Ewewigshoeveelheid (mol)*	2 ✓**c**	x-9	(9x0,5) =4,5 ✓ **a**
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*	2÷0,5 =4 ✓**d**	(x-9)÷0,5 =2x-18	9

$$Kc = \frac{[Cr_2O_7^{2-}]}{[CrO_4^{2-}]^2 [H^{1+}]^2} \checkmark e$$

$$(0,09) \checkmark f = \frac{(9)}{(4)^2 (2x-18)^2} \checkmark g$$

$$(0,3)^2 = \frac{(3)^2}{(4)^2 (2x-18)^2}$$

$$x = 10,25 \text{ (mol)} \checkmark h$$

- No Kc expression, correct substitution
  Max: 7/8
- Wrong Kc expression
  Max: 5/8
- *Geen Kc uitdrukking, korrekte vervanging*
  Maks: 7/8
- *Verkeerde Kc uitdrukking*
  Maks: 5/8

(8)
[18]

QUESTION/*VRAAG* 7

7.1 7.1.1 pH = -log[H_3O^+] ✓ or [H_3O^+] = 10^{-pH}
4,2✓= -log[H_3O^+]
[H_3O^+] = $10^{-4,2}$
[H_3O^+] = 6,31 x 10^{-5} mol·dm^{-3} ✓ (3)

7.1.2 WEAKER THAN✓

- H_2CO_3 has smaller Ka value than H_2SO_4, indicating that it ionises incompletely/partially.
  OR
- H_2CO_3 has a concentration of 0,02 mol·dm^{-3}, but [H_3O^+] is calculated at 6,31 x 10^{-5} mol·dm^{-3}. Therefore carbonic acid ionises incompletely/partially and is weaker than sulphuric acid that will ionise completely.
  OR
- H_2CO_3 has a pH of 4,2. Sulphuric acid has a lower pH.

(ACCEPT ANY ONE OF THE OPTIONS AS MOTIVATION) ✓

SWAKKER AS

- *H_2CO_3 het 'n laer Ka waarde as H_2SO_4 wat aandui dat dit onvolledig ioniseer.*
  OF
- *H_2CO_3 het 'n konsentrasie van 0,02 mol·dm^{-3}, maar [H_3O^+] is bereken as 6,31 x 10^{-5} mol·dm^{-3}. Dus het koolsuur/karbonaatsuur onvolledig ioniseer en is swakker as swawelsuur wat wel volledig ioniseer.*
  OF
- *H_2CO_3 het 'n pH van 4,2. Swawelsuur het 'n laer pH.*

(AANVAAR ENIGE EEN VAN DIE OPSIES AS MOTIVERING) (2)

7.2 7.2.1 Hydrolysis is the reaction of a salt with water. ✓
Hidrolise is die reaksie van 'n sout met water. (1)

7.2.2 GREATER THAN 7/*GROTER AS 7*✓ (1)

7.2.3 CH_3COO^- + H_2O ✓→ CH_3COOH + OH^- ✓
(Accept/Aanvaar: CH_3COONa + H_2O → CH_3COOH + NaOH)

- Hydrolysis of acetate forms hydroxide ions✓

OR

- An increased concentration of hydroxide ions will make the solution more alkaline/increase pH

OR

- A weak acid (vinegar) reacting with a strong base (NaOH) results in an alkaline solution. (3)

- *Hidrolise van asetaat vorm hidroksied-ione*

OF

- *'n Toename in die konsentrasie hidroksied-ione sal die oplossing meer alkalies maak/die pH verhoog*

OF

- *As swak suur (asyn) reageer met 'n sterk basis (NaOH) sal die oplossing alkalies wees*

7.3 7.3.1

OPTION 1/*OPSIE 1:*

$n_{(HCl)\ initially/aanvanklik} = cV$ ✓
$= (0,3)(0,025)$ ✓
$= 0,01$ mol ✓

OPTION 2/*OPSIE 2:*

$n_{(HCl)\ initially/aanvanklik} = cV$ ✓
$= (0,3)(0,025)$ ✓
$= 0,0075$ mol ✓ (3)

7.3.2

OPTION 1/*OPSIE 1:*
Positive marking from 7.3.1

$n_{(NaOH)\ added/bygesit}$
$= cV$
$= (0,1)(0,015)$ ✓
$= 0,0015$ mol

$n_{(NaOH)}: n_{(HCl)\ left/oor}$
1:1 ✓
$n_{(HCl)\ left/oor} = 0,0015$ mol

$n_{(HCl)\ reacted/gereageer}$
$= n_{(HCl)\ initially/aanvanklik} - n_{(HCl)\ left/oor}$
$= (0,01) – (0,0015)$ ✓
$= 0,0085$ mol ✓

OPTION 2/*OPSIE 2:*
Positive marking from 7.3.1

$n_{(NaOH)\ added/bygesit}$
$= cV$
$= (0,1)(0,015)$ ✓
$= 0,0015$ mol

$n_{(NaOH)}: n_{(HCl)\ left/oor}$
1:1 ✓
$n_{(HCl)\ left/oor} = 0,0015$ mol

$n_{(HCl)\ reacted/gereageer}$
$= n_{(HCl)\ initially/aanvanklik} - n_{(HCl)\ left/oor}$
$= (0,0075) – (0,0015)$ ✓
$= 0,006$ mol ✓

(4)

7.3.3 **OPTION 1/*OPSIE 1*:**
Positive marking from 7.3.2

n(Y2CO3): n(HCl) reacted with Y2CO3/ *gereageer met* Y2CO3
1:2✓
$n_{(Y2CO3)}$ = 0,0085÷2
= 0,00425 mol

$$n = \frac{m}{M}$$
$$0{,}00425 = \frac{0{,}5865}{M}$$ ✓
= 138 g·mol^{-1}

Mr (CO_3) = 12+(3x16)
= 60 g·mol^{-1}

Mr (Y_2) = 138 – 60 ✓
= 78 g·mol^{-1}

Ar (Y) = 78÷2 = 39 g·mol^{-1}✓

Element Y is POTASSIUM/K✓
Element Y is KALIUM/K

OPTION 2/*OPSIE 2*:
Positive marking from 7.3.2

n(Y2CO3): n(HCl) reacted with Y2CO3/ *gereageer met* Y2CO3
1:2✓
$n_{(Y2CO3)}$ = 0,006÷2
= 0,003 mol

$$n = \frac{m}{M}$$
$$0{,}003 = \frac{0{,}5865}{M}$$ ✓
= 195,5 g·mol^{-1}

Mr (CO_3) = 12+(3x16)
= 60 g·mol^{-1}

Mr (Y_2) = 195,5 – 60 ✓
= 135,5 g·mol^{-1}

Ar (Y) = 135,5÷2 = 67,75 g·mol^{-1}✓

Element Y is ZINC/Zn (Ar=65)✓
Element Y is SINK/Zn

OR/OF

Element Y is GALLIUM/Ga (Ar=70)

OR/OF

Element Y cannot be identified from periodic table/
Element Y kan nie vanaf die periodieke tabel identifiseer word nie (5)

[22]

QUESTION/*VRAAG* 8

8.1 8.1.1 NICKEL/*NIKKEL* ✓ (1)

8.1.2 $Cd \rightarrow Cd^{2+} + 2e^-$ ✓✓

Marking criteria/*Nasienkriteria:*

- Reactants ✓ Products ✓
  Reaktanse ✓ *Produkte* ✓
- Ignore phases/*Ignoreer fases*
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- Marking rule 6.3.10/*Nasienreël 6.3.10:*
  $Cd^{2+} + 2e^- \leftarrow Cd$ $(\frac{2}{2})$
  $Cd \rightleftharpoons Cd^{2+} + 2e^-$ $(\frac{1}{2})$
  $Cd^{2+} + 2e^- \rightleftharpoons Cd$ $(\frac{0}{2})$
  $Cd \leftarrow Cd^{2+} + 2e^-$ $(\frac{0}{2})$

(2)

8.1.3 INCREASE ✓
Increasing the Ni^{2+} ion concentration will favour the forward reaction✓

TOENEEM
Deur Ni^{2+} ioon konsentrasie te verhoog sal die voorwaartse reaksie bevoordeel word (2)

8.2 8.2.1 $Cu(s) + 2Ag^+(aq)$ ✓ $\rightarrow 2Ag(s) + Cu^{2+}(aq)$ ✓ bal ✓ (3)

8.2.2 <u>CATHODE/*KATODE*: ($2Ag^+ + 2e^- \rightarrow 2Ag$)</u>

$n_{(Ag^+)\ reacted/gereageer} = cV$
$= (0,5)(0,2)$ ✓
$= 0,1$ mol

$n_{(Cu)\ reacted/gereageer} : n_{(Ag^+)\ reacted/gereageer}$
1:2 ✓
$n_{(Cu)\ reacted/gereageer} = 0,1 \div 2$
$= 0,05$ mol

ANODE: ($Cu \rightarrow Cu^{2+} + 2e^-$)

$n_{(Cu)\ reacted/gereageer} : n_{(Cu^{2+})\ released/vrygestel}$

1:1

$n_{(Cu^{2+})\ released/vrygestel}$ = 0,05 mol

$n_{(Cu^{2+})\ initially/aanvanklik}$ = cV

= (1) ✓ x (0,2) ✓

= 0,2 mol

$n_{(Cu^{2+})\ fina/finaal} = n_{(Cu^{2+})\ initially/aanvanklik} + n_{(Cu^{2+})\ released/vrygestel}$

= (0,2) + (0,05) ✓

= 0,25 mol

$c_{(Cu^{2+})\ final/finaal} = \frac{n_{(Cu^{2+})\ final/finaal}}{V}$

$c = \frac{0,25}{0,2}$ ✓

= 1,25 mol·dm⁻³ ✓ (7)

[15]

QUESTION/*VRAAG* 9

9.1 The anode is the electrode where oxidation takes place. ✓✓
Die anode is die elektrode waar oksidasie plaasvind. (2)

9.2 **DO NOT MARK 9.2**
X
Concentrated sodium chloride/brine contains chlorine ions that will oxidise at electrode X/positive electrode OR
Concentrated sodium chloride/brine enters the membrane cell on the anode side OR
Chlorine ions are negative and will be attracted by a positive electrode
(ANY ONE OF THE MOTIVATIONS FOR ONE MARK)
X
Gekonsentreerde natriumchloried/pekel bevat chloriedione wat sal oksideer by elektrode X/positiewe elektrode OF
Gekonsentreerde natriumchloried/pekel dring die membraansel aan die anode kant binne OF
Chloriedione is negatief en sal deur die positiewe elektrode aangetrek word
(ENIGE EEN VAN DIE MOTIVERINGS VIR EEN PUNT)

9.3 9.3.1 Chlorine gas/$C\ell_2$ ✓✓ (ACCEPT: Hydrogen gas/H_2) (2)
Chloorgas/$C\ell_2$ (AANVAAR: Waterstof gas/H_2)

9.3.2 **DO NOT MARK 9.3.2**
Water/H_2O

9.4 $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$

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

- Reactants ✓ *Reaktanse* Products ✓ *Produkte* Balancing ✓ *Balansering*
- Ignore phases/*Ignoreer fases*
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- Marking rule 6.3.10/*Nasienreël 6.3.10:*
  $2H_2O + 2e^- \leftarrow H_2 + 2OH^-$ (1/3)
  $H_2 + 2OH^- \rightleftharpoons 2H_2O + 2e^-$ (1/3)
  $2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$ (2/3)
  $H_2 + 2OH^- \leftarrow 2H_2O + 2e^-$ (3/3)

(3)

9.5
- <u>H_2O is a stronger oxidising agent</u> ✓<u>than Na^+</u> ✓and is <u>reduced</u> (to H_2)✓
  OR
- <u>Na^+ is a weaker oxidising agent</u> <u>than</u> H_2O and therefore <u>H_2O is reduced</u>

- *<u>H_2O is 'n sterker oksideermiddel</u> <u>as Na^+</u> en sal dus <u>reduseer</u> (tot H_2)*
  OF
- *<u>Na^+ is 'n swakker oksideermiddel</u> <u>as H_2O</u> en sal dus <u>reduseer H_2O</u>* (3)

[10]

TOTAL/*TOTAAL*: 150