LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)
PREPARATORY EXAMINATION
SEPTEMBER 2026

MARKS: 150

TIME: 3 hours

This question paper consists of 19 pages, 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and surname (and centre number if applicable) in the appropriate spaces on the ANSWER BOOK/ANSWER SHEET.
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. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Leave ONE line between two sub questions, e.g. between QUESTION 2.1 and QUESTION 2.2.
7. Number the answers correctly according to the numbering system used in this question paper.
8. Data sheets are attached for your use.
9. Wherever motivations, discussions, et cetera are required, be brief.
10. Show ALL formulae and substitutions in ALL calculations.
11. Write neatly and legibly.

QUESTION1: MULTIPLE CHOICE QUESTIONS

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

1.1 Which one of the following formulae represents a ketone?

A. C_3H_6O

B. $C_3H_6O_2$

C. C_3H_8O

D. $C_3H_8O_2$ (2)

1.2 Which one of the following has the lowest vapour pressure?

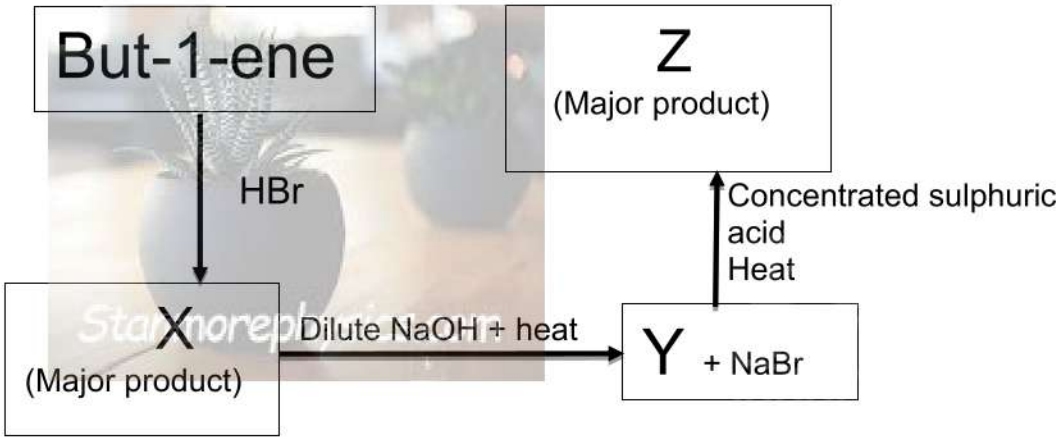
A. $CH_3CH_2CH_2CH_3$

B. $CH_3CH(CH_3)_2$

C. $CH_3CH_2CH_2OH$

D. CH_3COOH (2)

1.3 Consider the following diagram.

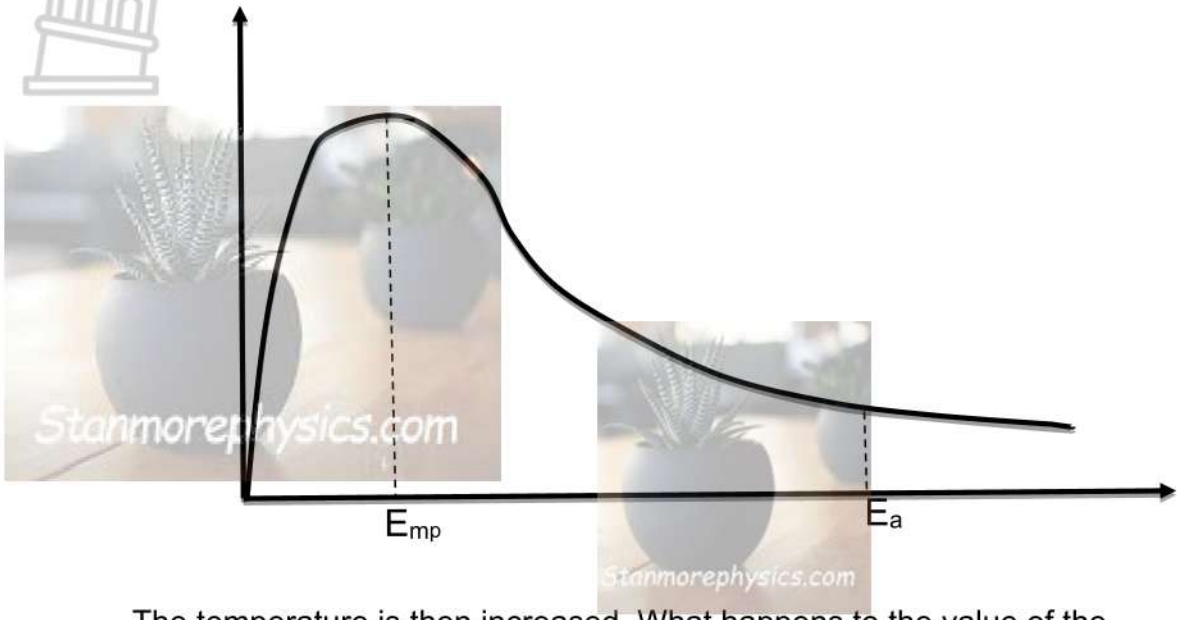


The compounds X and Z may be respectively,

	Compound X	Compound Z
A	$CH_3CH_2CH_2CHBr$	$CH_3CH_2CHCH_2$
B	$CH_3CH_2CHBrCH_3$	$CH_3CH_2CHCH_2$
C	$CH_3CH_2CH_2CHBr$	$CH_3CHCHCH_3$
D	$CH_3CH_2CHBrCH_3$	$CH_3CHCHCH_3$

(2)

1.4 The diagram below shows the Maxwell-Boltzmann distribution of molecular energies, at a constant temperature, in a gas at the start of a reaction. On this graph the most probable energy (E_{mp}) and the activation energy (E_a) are shown.

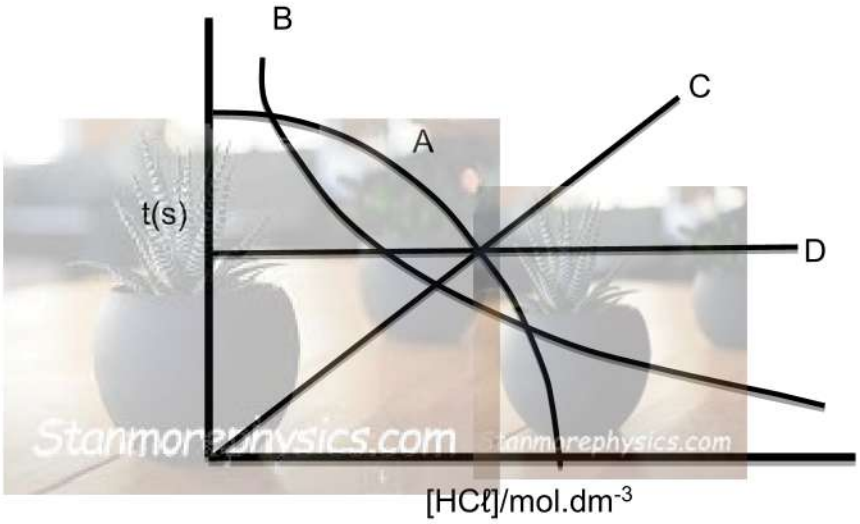


The temperature is then increased. What happens to the value of the most probable energy, E_{mp} and the activation energy, E_a?

	E_{mp}	**E_a**
A	Increases	Decreases
B	Decreases	Increases
C	Increases	Remains the same
D	Remains the same	Increases

(2)

1.5 In an experiment to determine the effect of concentration on the rate of a chemical reaction, a constant mass of zinc granules is added to a constant volume of HCℓ (aq) of varying concentrations.
Which of the graphs A, B, C or D represents the graph of time verses concentration of HCℓ(aq)?



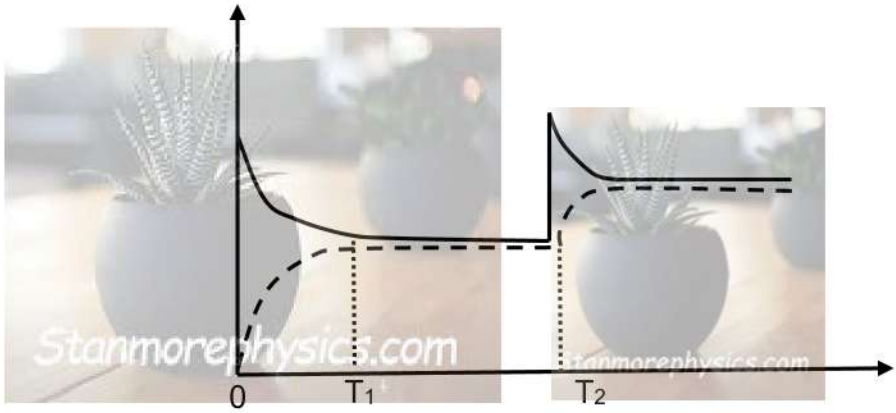
A. A
B. B
C. C
D. D

(2)

1.6 The decomposition reaction of a hypothetical compound $AX_3(g)$, which is represented by the equation below, first reaches equilibrium in a closed container at a temperature T_1.

$$2AX_3(g) \rightleftharpoons 2AX_2(g) + X_2(g)$$

When the temperature is increased, the system regains equilibrium at temperature T_2. The changes in the rate of this reaction are represented in the graph below:



Which ONE of the following statements is correct?

	Conclusion	Change in K_c
A	The forward reaction is exothermic.	K_c at T_1 < K_c at T_2
B	The forward reaction is exothermic.	K_c at T_1 > K_c at T_2
C	The forward reaction is endothermic.	K_c at T_1 < K_c at T_2
D	The forward reaction is endothermic.	K_c at T_1 > K_c at T_2

(2)

1.7 The following equilibrium exists in pure water at 25°C;

$$2H_2O(\ell) \rightleftharpoons H_3O^+(aq) + OH^-(aq) \qquad \Delta H > 0$$

At this temperature, pH = 7 and $K_w = 1 \times 10^{-14}$. The temperature of the water is decreased to 10°C. Which of the following is true at the new temperature of 10°C?

A. pH = 7

B. pH >7

C. pH < 7

D. $K_w > 1 \times 10^{-14}$

(2)

1.8 Which one of the following molecules and ions cannot be an ampholyte?

A. HNO_3

B. H_2O

C. HSO_4^-

D. HCO_3^- (2)

1.9 The Emf of a galvanic cell is found to be 1.6 V under standard conditions. Which one of the substances A, B, C or D will act as the cathode and the anode respectively?

$N^{2+} + 2e^- \rightleftharpoons N \quad E^\ominus = +0,5\ V$

$O^+ + e^- \rightleftharpoons O \quad E^\ominus = -2,0\ V$

$P^+ + e^- \rightleftharpoons P \quad E^\ominus = -1,1\ V$

$Q^{2+} + 2e^- \rightleftharpoons Q \quad E^\ominus = -0,5\ V$

	Cathode	Anode
A	N	P
B	O	Q
C	P	N
D	Q	O

(2)

1.10 The following reaction takes place in an electrochemical cell.

$2NaC\ell(aq) + 2H_2O(\ell) \rightarrow C\ell_2(g) + H_2(g) + 2NaOH(aq)$

Which one of the following is true for this cell?

A. Water acts as the reducing agent.

B. The cell reaction is spontaneous.

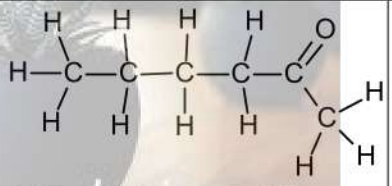
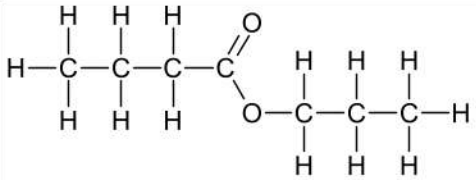
C. It is a galvanic cell.

D. The cell reaction is endothermic. (2)

[20]

QUESTION 2

The table below is a list of organic compounds. Study the table and answer the questions that follow.

A	Octane	**B**	$CH_3C(CH_3)_2CH_2CH(CH_3)CH_3$
C	$CH_3CH_2CHBrCHC\ell CCCH_3$	**D**	$CH_3CH_2CH_2CH_2CH_2CHO$
E		**F**	
G	Heptanoic acid		

2.1 Write down the IUPAC name of:

2.1.1 Compound B (3)

2.1.2 Compound C (3)

2.1.3 Compound E (2)

2.2 Write down the letters of **two pairs** of compounds that represent functional isomers. (2)

2.3 To which homologous series does compound F belong? (1)

2.4 Draw the structural formula of the carboxylic acid which was used for the preparation of compound F. (2)

2.5 Using molecular formulae, write down a balanced chemical equation for the reaction of compound B with excess oxygen. (3)

2.6 Is the reaction in 2.5 above endothermic or exothermic? Give a reason for your answer. (2)

[18]

QUESTION 3

Learners from a certain high school perform an experiment to determine the effect of intermolecular forces on the vapour pressure and boiling point. Below is a table of results from the experiment. This data was taken at 20^0C.

Compound	MOLAR MASS	Vapour Pressure
Experiment 1		
A	**116.2**	**0.04 mmHg**
B	**116.2**	**14.00 mmHg**
Experiment 2		
		Boiling point (^{0}C)
C. Hexan – 2 - one	**100.2**	**127**
D. 4 – methylpentan – 2 one	**100.2**	**117**

3.1 Define the term vapour pressure. (2)

3.2 For **Experiment 1**, write down the:

3.2.1 Dependant variable. (1)

3.2.2 Controlled variable. (1)

3.3 It is known that the compounds A and B are an aldehyde and a carboxylic acid respectively. Compounds C and D are ketones. Using the information on the table, write down the letter that represents a carboxylic acid. (1)

3.4 Consider compounds A and B:

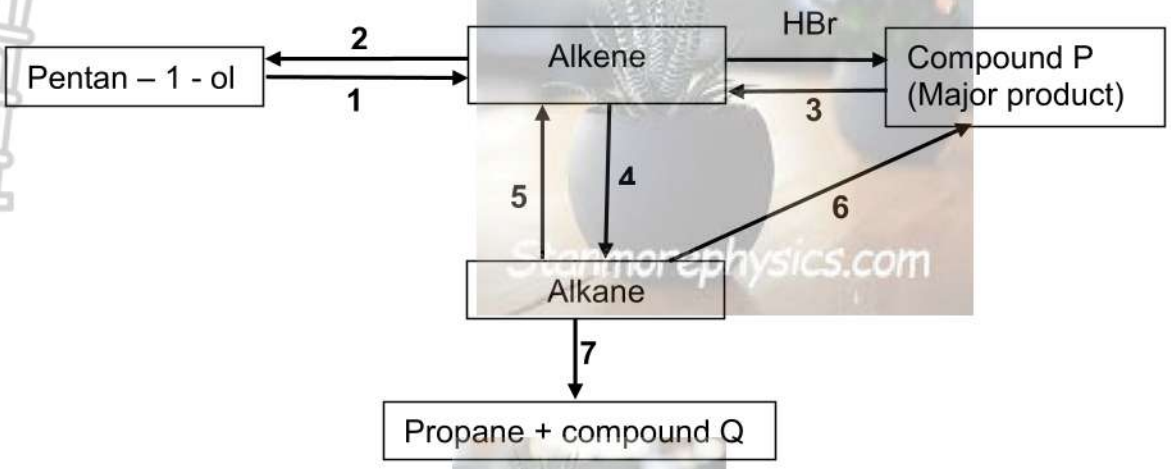
Which one has the highest boiling point? Explain your answer by comparing these compounds' intermolecular forces. (5)

3.5 Explain the difference in boiling points between compounds C and D. (4)

[14]

QUESTION 4

The flow diagram below is a schematic representation of some organic reactions. Study the diagram and answer the questions that follow.



4.1 Write the type reactions represented by 1, 3, 5 and 7. (4)

4.2 Is compound **P** a PRIMARY, SECONDARY or TERTIARY haloalkane? Explain your answer. (3)

4.3 Draw the structural formulae of:

4.3.1 The alkene formed in reaction 1. (2)

4.3.2 Compound P. (2)

4.3.3 Compound Q. (2)

4.4 Write down the reaction conditions for reaction 7. (2)

4.5 A company that produces fragrances react **propanoic acid** and **ethanol** in the presence of a catalyst. Using structural formulae, write a balanced chemical equation for the reaction that takes place. Write down the name of the product formed. (5)

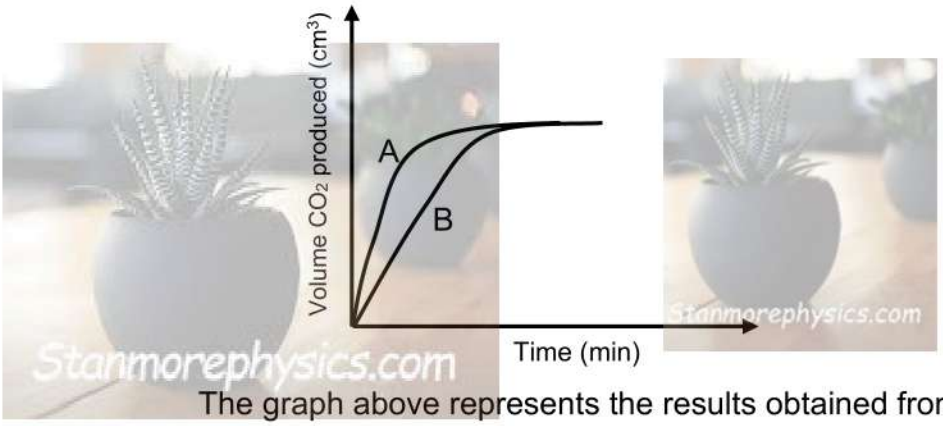
4.6 Write down the name of the type of reaction that takes place in Question 4.5. (1)

[21]

QUESTION 5

Marble ($CaCO_3$) was used in experiments to teach students factors that affect the rate of reaction. The same mass of marble chips reacted with hydrochloric acid of the same concentration. In one experiment the temperature of the acid was 20^0C while in the next experiment the temperature was raised to 30^0C by boiling the acid in a water bath. The chemical equation for the reaction is:

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



The graph above represents the results obtained from the experiment (not drawn to scale).

5.1 Define the term reaction rate. (2)

5.2 What does the underlined phrase represent? (1)

5.3 Which factor affecting the rate of reaction were they investigating? (1)

5.4 Which graph, **A** or **B**, represents the experiment done at 30^0C? Give a reason for your choice. (3)

5.5 If after 6 minutes, the volume of carbon dioxide produced is 200 dm^3, calculate the rate of reaction in mol/s. The reaction takes place under STP conditions. (5)

[12]

QUESTION 6

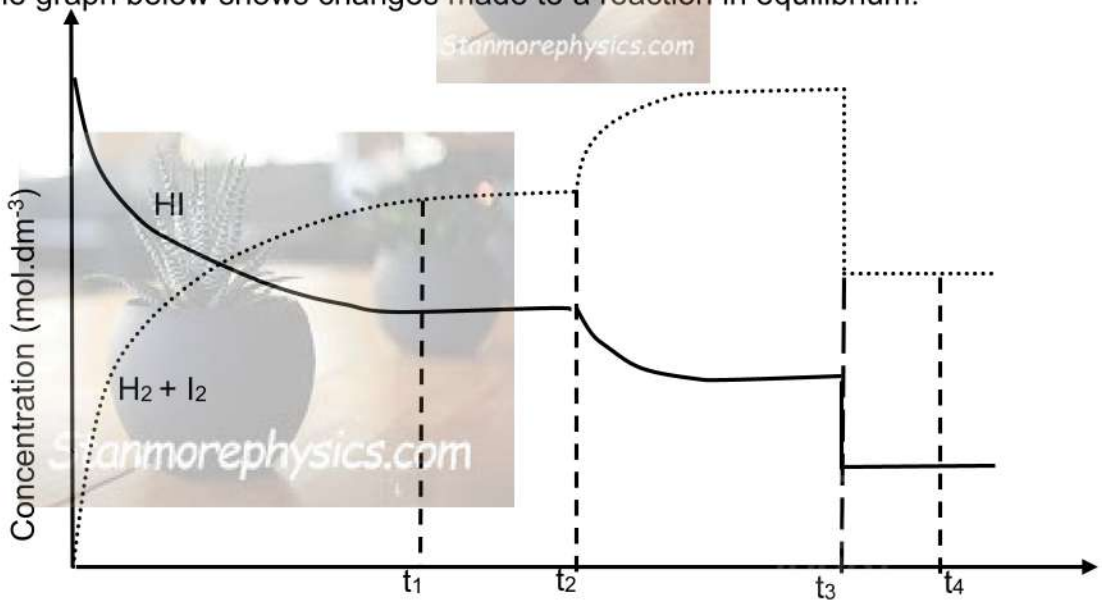
6.1 The following chemical equation represents the step of the Haber process for the formation ammonia:

$N_2 + 3H_2 \rightleftharpoons 2NH_3 \quad \triangle H = -92.4 kJ/mol.$

6.1.1 Define the term dynamic equilibrium. (2)

6.1.2 0.50g of hydrogen gas was pumped into a 2 dm^3 reaction vessel with an unknown number of moles (x) of nitrogen gas. When equilibrium was attained, analysis of the reaction mixture showed that there was 0.2 mol hydrogen remaining in the container. Calculate the initial number of moles of nitrogen that was pumped into the reaction vessel. The equilibrium constant value for this reaction is 50. (8)

6.2 The graph below shows changes made to a reaction in equilibrium.



The balanced equation for the reaction is:

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

6.2.1 What change was made at t_2? Explain your answer. (4)

6.2.2 At time t_1 K_c = 0,020. Is the K_c value at t_2 GREATER THAN, LESS THAN or EQUAL TO 0,020? (1)

6.2.3 Identify the change at t_3. (1)

6.2.4 Write down the K_c value for the reverse reaction at t_4. (1)

[17]

QUESTION 7

7.1 Define an acid in terms of Lowry - Bronsted theory. (2)

7.2 $H_2SO_4 + NH_3 \rightarrow HSO_4^- + NH_4^+$

7.2.1 Identify the conjugate acid-base pairs in the above reaction. (4)

7.2.2 Define an ampholyte. (2)

7.2.3 Choose a substance(s) that can act as an ampholyte in the above reaction. (1)

7.3 An impure sample with 72% of sodium carbonate is added to 100 cm^3 of 0.2 $mol.dm^{-3}$ solution of sulphuric acid. The reaction is according to the chemical equation below.

$$Na_2CO_3 + H_2SO_4 \rightarrow \mathbf{X} + H_2O + CO_2$$

The acid is in excess.

7.3.1 Calculate the pH of sulphuric acid solution. (4)

7.3.2 Write down the NAME or FORMULA of the salt **X.** (1)

The excess acid neutralises 25 cm^3 of a 0.1 $mol.dm^{-3}$ of magnesium hydroxide solution.

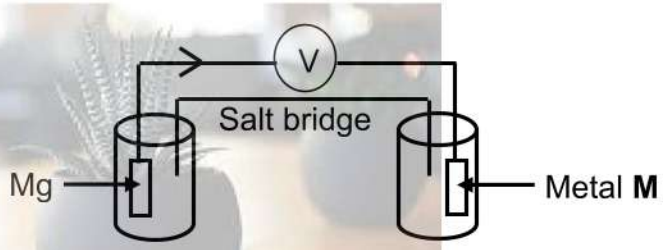
$$H_2SO_4 + Mg(OH)_2 \rightarrow MgSO_4 + 2\,H_2O$$

7.3.3 Calculate the mass of the sodium carbonate solution that reacted with sulphuric acid. (8)

[22]

QUESTION 8

The following diagram represents a galvanic cell that operates under **standard conditions**.



8.1 Define galvanic cell. (2)

8.2 Write down the standard conditions under which this cell operates. (2)

8.3 State one function of the salt bridge. (1)

8.4 If the initial reading on the voltmeter is 2.51V. use calculations to determine the name of metal M. (5)

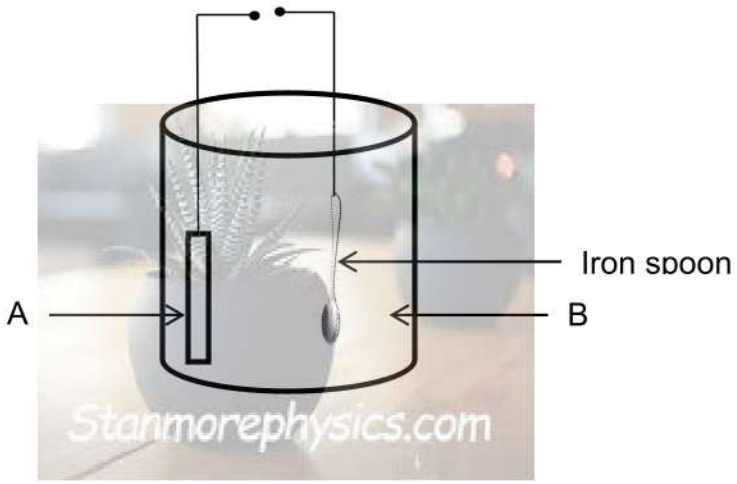
8.5 After some few hours of operation, what do you think will happen to the mass of the magnesium electrode? Choose from INCREASE, DECREASE, NO CHANGE. Give a reason for your answer. (3)

8.6 Is the reaction in this cell spontaneous? Give a reason for your answer. (2)

[15]

QUESTION 9

The electrochemical cell below was used for the electroplating of an iron spoon with nickel.



9.1 State the energy conversion that occurs in this cell. (1)

9.2 Write down the chemical formula for solution B. (1)

9.3 Is electrode A the cathode or anode of the cell? (1)

9.4 Write down a balanced chemical equation for the reaction which takes place on the surface of the iron spoon (2)

9.5 The initial mass of the spoon is 15g. During the process a charge of 2000C was passed through the solution. Calculate the mass of the spoon after the process was completed. (6)

[11]

TOTAL: 150

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DATA FOR PHYSICAL SCIENCES GRADE 12

PAPER 2 (CHEMISTRY)
GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12

VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS / *TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	**SYMBOL/*SIMBOOL***	**VALUE/*WAARDE***
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant *Avogadro se konstante*	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{Q}{e}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$		$n = \frac{V}{V_M}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$		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 $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseer\ middel}$		

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

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

Ce 140	**Pr** 141	**Nd** 144	**Pm**	**Sm** 150	**Eu** 152	**Gd** 157	**Tb** 159	**Dy** 163	**Ho** 165	**Er** 167	**Tm** 169	**Yb** 173	**Lu** 175
Th 232	**Pa**	**U** 238	**Np**	**Pu**	**Am**	**Cm**	**Bk**	**Cf**	**Es**	**Fm**	**Md**	**No**	**Lr**

KEY/*SLEUTEL*

Atomic number *Atoomgetal*

Electronegativity *Elektronegatiwiteit* → 29 / 1,9 Cu / 63,5 ← **Symbol** *Simbool*

Approximate relative atomic mass *Benaderde relatiewe atoommassa*

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

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

Increasing oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*

NSC

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

Increasing oxidising ability/*Toenemende oksiderende 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

Increasing reducing ability/*Toenemende reduserende vermoë* ↑

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES MARKING GUIDELINES
(AMENDED/*AANGEPAS*)

PREPARATORY EXAMINATION

SEPTEMBER 2026

NASIENRIGLYNE VIR FISIESE WETENSKAPPE
REKORD EKSAMEN

MARKS / *PUNTE*: 150

TIME / *TYD*: 3 Hours / *Ure*

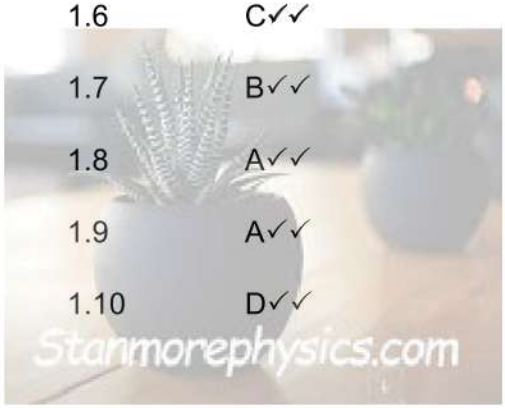
These Marking Guidelines consist of 16 pages including the cover page

Hierdie merkriglyne bestaan uit 16 bladsye, insluitend die voorblad.

QUESTION 1 / *VRAAG 1*

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

[20]



QUESTION 2 / *VRAAG 2*

Marking criteria/*Nasien kriteria*
- ✓ trimethyl/*trimetiel*
- ✓ pentane/*pentaan*
- ✓ everything is correct/*alles korrek*

2.1.1 2,2,4 - trimethylpentane✓✓✓
2,2,4 - trimetielpentaan✓✓✓ (3)

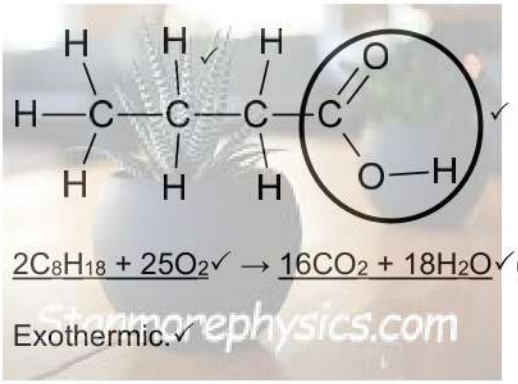
Marking criteria/*Nasien kriteria*
- ✓ bromo, chloro
- ✓ heptyne/*heptyn*
- ✓ everything is correct/*alles korrek*

2.1.2 5 – bromo - 4 - chlorohept - 2 - yne✓✓✓
5 – bromo – 4 – chlorohept – 2 – yn ✓✓✓ (3)

2.1.3 Hexan - 2 - one✓✓ Accept: 2-hexanone
Heksan – 2 – oon ✓✓ Aanvaar: 2-heksanoon (2)

2.2 D **and / *en*** E✓
F **and / *en*** G✓ (2)

2.3 Esters✓ (1)

2.4 
(2)

2.5 $\underline{2C_8H_{18} + 25O_2}$✓ → $\underline{16CO_2 + 18H_2O}$✓(✓ balancing / *balansering*) (3)

2.6 Exothermic.✓
Energy/heat is released/ energy is one of the products.✓Heat of reaction is negative/△H< 0

Eksotermies. ✓
Energie word vrygestel/ energie is een van die produkte. ✓/Die reaksiewarmte is negatief//△H< 0 (2)

[18]

QUESTION 3 / *VRAAG 3*

3.1 Vapour pressure is the pressure exerted by vapour in equilibrium with its liquid in a closed system.✓✓

Dampdruk is die druk wat deur damp in ewewig met sy vloeistof in 'n geslote sisteem uitgeoefen word. ✓✓ (2)

3.2.1 Vapour pressure.✓

Damp druk ✓ (1)

3.2.2 Molar mass/size of molecule.✓

Molêre massa/grootte van molekule✓ (1)

3.3 A.✓ (1)

3.4 A.✓

- A has hydrogen bonding✓
- B has dipole – dipole forces.✓
- Hydrogen bonds are stronger than dipole – dipole forces.✓
- More energy needed to overcome intermolecular forces in compound A than in compound B.✓ see answer structure of 3.5/point format

A✓

- *A het waterstofbindings* ✓
- *B dipool-dipoolkragte het.* ✓
- *Waterstofbindings is sterker as dipool-dipoolkragte.* ✓
- *Meer energie benodig om intermolekulêre kragte in verbinding A te oorkom as in verbinding B.* ✓ (5)

3.5 Compound D is more branched/compact/spherical or shorter than compound C✓ resulting in compound D having a smaller surface area than compound C.✓ Compound D has weaker intermolecular forces than compound C/similar forces but over smaller surface area.✓ Hence, less energy is needed to overcome intermolecular forces in compound D than in compound C.✓

OR

Compound C is longer than compound D✓ resulting in compound C having a larger surface area.✓ Compound C has stronger intermolecular forces than compound D.✓ More energy needed to overcome intermolecular forces in compound C than in compound D✓

Verbinding D is meer vertak/kompak/sferies as verbinding C, ✓

wat daartoe lei dat verbinding D 'n kleiner oppervlakarea het as verbinding C. ✓

Verbinding D het swakker intermolekulêre kragte as verbinding C. ✓

Gevolglik is minder energie nodig om intermolekulêre kragte in verbinding D te oorkom as in verbinding C. ✓

OF

Verbinding C is langer as verbinding D, wat tot gevolg het dat verbinding C 'n groter oppervlakte het.

Verbinding C het sterker intermolekulêre kragte as verbinding D.

Meer energie word benodig om die intermolekulêre kragte in verbinding C te oorkom as in verbinding D.

(4)

[14]

QUESTION 4 / *VRAAG 4*

4.1 Reaction 1: Elimination/dehydration✓

Reaction 3: Elimination/dehydrohalogenation/dehydrobromination

Reaction 5: Elimination✓/dehydrogenation

Reaction 7: Cracking✓/elimination

Reaksie 1: Dehidrasie/eliminasie✓

Reaksie 3: Dehidrohalogenering/eliminasie/ Dehidrobromering ✓

Reaksie 5: Eliminasie/Dehidrogenasie✓

Reaksie 7: Kraking✓/Eliminasie (4)

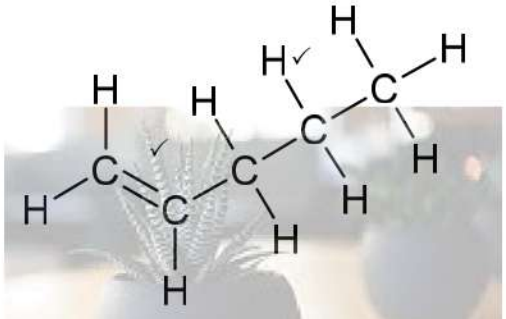
4.2 SECONDARY✓

The Carbon atom that carries the Br is bonded to two other carbon atoms.✓✓

SEKONDÊRE ✓

Die koolstofatoom wat die Br dra, is aan twee ander koolstofatome gebind. ✓✓ (3)

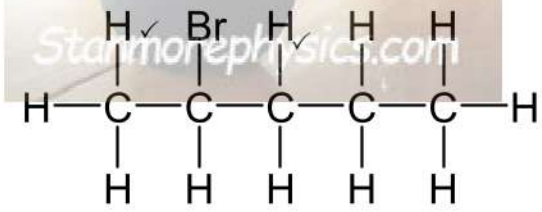
4.3.1



Marking criteria
✓ Functional group
✓ Whole structure correct
Merk kriteria
✓*Funksionele groep*
✓*Hele struktuur korrek*

(2)

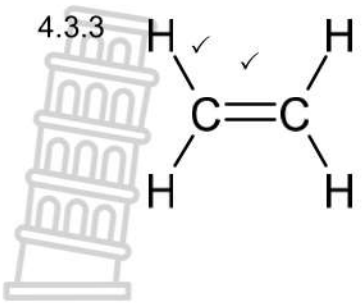
4.3.2



Marking criteria
✓ Br on second C
✓ Whole structure correct
Merk kriteria
✓*Br op tweede C*
✓*Hele struktuur korrek*

(2)

4.3.3



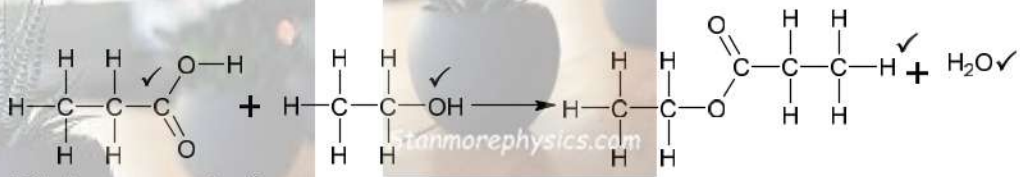
Marking criteria
✓ Functional group
✓ Whole structure correct
Merk kriteria
✓*Funksionele groep*
✓*Hele struktuur korrek*

(2)

4.4 High temperature✓ and high pressure.✓ **Accept**: Catalyst at low pressure

Hoë temperatuur ✓ en hoë druk✓ ***Aanvaar**: katalisator teen lae druk* (2)

4.5



Ethyl propanoate✓

Etielpropanoaat✓ (5)

4.6 Esterification✓/condensation

Esterifikasie ✓/kondensasie (1)

[21]

QUESTION 5 / *VRAAG 5*

5.1 Reaction rate is the change in amount/number of moles/concentration of reactants/products per unit time.✓✓

Reaksiespoed is die verandering in hoeveelheid/konsentrasie/aantal mol van reaktante/produkte per tydseenheid. ✓✓ (2)

5.2 Controlled variable.✓

Gekontroleerde veranderlike✓ (1)

5.3 Temperature.✓

Temperatuur✓ (1)

5.4 Graph A.✓

The gradient of graph A is steeper than graph B.✓✓

OR

At higher temperatures, the particles' kinetic energy is higher.✓

More effective collisions occur per unit time.✓

Grafiek A. ✓

Die gradiënt van grafiek A is steiler as grafiek B. ✓✓

OF

By hoër temperature is die deeltjies se kinetiese energie hoër. ✓

Meer effektiewe botsings vind per tydseenheid plaas. ✓ (3)

5.5 $n = \frac{V}{V_m}$✓

$= \frac{200}{22.4}$✓

$= 8.929mol$

$rate\ /tempo = \frac{\triangle n}{\Delta t}$

$= \frac{8.929}{360}$✓✓

$= 0,02(mol/s)$✓ (5)

[12]

QUESTION 6 / *VRAAG 6*

6.1.1 Dynamic equilibrium is a stage during a chemical reaction when the rate of the forward reaction is equal to the rate of the reverse reaction.✓✓
Dinamiese ewewig is 'n stadium tydens 'n chemiese reaksie wanneer die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie. ✓✓ (2)

6.1.2

Marking Criteria

a. Substitution of 0.5 and 2 into n= $\frac{m}{M}$ OR 0.25 in the table
b. Change in mol of N_2 and NH_3
c. Using mol ratio 3 : 1 : 2
d. Divide equilibrium mol by 2
e. Correct K_c expression
f. Substitution of 50 into the K_c expression
g. Substitution of equilibrium concentrations into K_c expression
h. Correct answer

Merk kriteria

a. *Vervanging van 0.5 en 2 in n= m/M*
b. *Verandering in mol van N_2 en NH_3*
c. *Gebruik molverhouding 3 : 1 : 2*
d. *Deel ewewig mol deur 2*
e. *Korrekte K_c-uitdrukking*
f. *Vervanging van 50 in die K_c-uitdrukking*
g. *Vervanging van ewewigskonsentrasies in Kc-uitdrukking*
h. *Korrekte antwoord*

$$n = \frac{m}{M}$$
$$= \frac{0.5}{2} \checkmark(a)$$
$$= 0.25mol$$

(8)

	$3H_2$	N_2	$2NH_3$	
Ratio / *Verhouding*	3	1	2	
Initial / *Aanvanklike*	0.25	x	0	
Change / *Verandering*	0.05	0.017	0.034	✓(b) ✓(c)
Equilibrium / *Ewewig*	0.20	$x - 0.017$	0.034	
Concentration / *Konsentrasie*	0.10	$\frac{x - 0.017}{2}$	0.017	✓(d)

$K_c = \frac{[NH_3]^2}{[H_2]^3[N_2]}$ ✓(e)

50 ✓(f) $= \frac{(0.017)^2}{(0.1)^3(\frac{x-0.017}{2})}$ ✓(g)

$\frac{x - 0.017}{2} = 0.00578$

$x = 0,03mol$ ✓(h)

6.2.1
- Temperature was increased.✓
- The forward reaction is endothermic.✓
- An increase in temperature favours the endothermic reaction.✓
- The forward reaction was favoured.✓
- *Temperatuur is verhoog.* ✓
- *Die voorwaartse reaksie is endotermies.* ✓
- *'n Toename in temperatuur bevoordeel die endotermiese reaksie.* ✓
- *Die voorwaartse reaksie is bevoordeel.* ✓

(4)

6.2.2 GREATER THAN✓
GROTER AS✓ (1)

6.2.3 Pressure was decreased.✓/*Druk was verminder*✓ (1)

6.2.4 50✓ (1)

[17]

QUESTION 7 / VRAAG 7

7.1 Proton (H^+) donor.✓✓

Proton (H^+) skenker✓✓ (2)

7.2.1 H_2SO_4 **and** / ***en*** HSO_4^- ✓✓,

NH_4^+ **and** / ***en*** NH_3✓✓ (4)

7.2.2 Ampholyte is a substance that can act as either an acid or a base. ✓✓

Amfoliet is 'n stof wat as 'n suur of 'n basis kan optree ✓✓ (2)

7.2.3 HSO_4^-✓ (1)

7.3.1 $[H_3O^+] = 2[H_2SO_4]$

$= 2(0.2)$ ✓

$= 0.4$ mol.dm^3

$pH = -\log[H_3O^+]$ ✓

$= -\log(0.4)$✓

$= 0.398$✓ (4)

7.3.2 Sodium sulphate/Na_2SO_4✓

Natrium sulfaat (1)

7.3.3

Marking criteria

a. Using the equation $c = \frac{n}{V}$
b. Substitution of concentration and volume of H_2SO_4
c. Substitution of concentration and volume of $Mg(OH)_2$
d. Number of moles of H_2SO_4 in excess.
e. Subtraction of excess mole from the initial mole of H_2SO_4
f. Substitution of 106 into m = n x M
g. Substitution of $^{72}/_{100}$ OR 0.72 into m = n x M
h. Final answer

Merk kriteria

a. *Gebruik die vergelyking c = n/V*
b. *Vervanging van konsentrasie en volume van H_2SO_4*
c. *Vervanging van konsentrasie en volume van $Mg(OH)_2$*
d. *Aantal mol H_2SO_4 in oormaat.*
e. *Aftrekking van oortollige mol van die aanvanklike mol H_2SO_4*
f. *Vervanging van 106 in m = n x M*
g. *Vervanging van $^{72}/_{100}$ OF 0.72 in m = n x M*
h. *Finale antwoord*

$$Na_2CO_3 + H_2SO_4 \rightarrow X + H_2O + CO_2$$

$n_{H_2SO_4} = cV$ ✓**(a)**

$= (0.01)(0.02)$ ✓**(b)**

$= 0.002mol$

$n(Mg(OH)_2) = (0.025)(0.1)$ ✓**(c)**

$= 0.0025mol$

$n(MgSO_4) = n(H_2SO_4)$

$n(H_2SO_4)$in excess/ *in oormaat* $= 0.0025mol$ ✓**(d)**

$n(H_2SO_4)$ reacted with/ *reageer met* $Na_2CO_3 = 0.02 - 0.0025$ ✓**(e)**

$= 0.0175mol$

$n(H_2SO_4) = n(Na_2CO_3)$

$n(Na_2CO_3) = 0.0175mol$

$m(Na_2CO_3) = (0.0175)(106)$ ✓(f) $\frac{72}{100}$ ✓**(g)**

$= 1.335g$ ✓**(h)**

(8)

[22]

QUESTION 8 / VRAAG 8

8.1 Cell that converts chemical energy to electrical energy. ✓✓

Sel wat chemiese energie omskakel na elektriese energie✓✓ (2)

8.2 Concentration of 1 mol/dm^3✓

Temperature of 25^{0}C✓

Konsentrasie van 1 mol/dm^3✓

Temperatuur van 25^{0}C✓ (2)

8.3 To complete the circuit/To maintain cell neutrality✓/To allow movement of ions

Om die stroombaan te voltooi/Om selsneutraliteit te handhaaf✓*/om beweging van ione toe te laat* (1)

8.4 **Note:**

- Accept any other correct formula from the data sheet.
- Any other formula using unconventional abbreviations, e.g. $E_{cell} = E_{OA} – E_{RA}$ Max 4/5
- Followed by correct substitutions

Nota:

- *Aanvaar enige ander korrekte formule uit die datablad.*
- *Enige ander formule wat onkonvensionele afkortings gebruik, bv. $E_{sel} = E_{OM} – E_{RM}$ Maks 4/5*
- *Gevolg deur korrekte substitusies*

$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$✓ OF $E^{\theta}_{sel} = E^{\theta}_{kathode} - E^{\theta}_{anode}$✓

2.51✓ $= E^{\theta}_{cathode} – (-2.36)$ ✓ OF 2.51✓ $= E^{\theta}_{cathode} – (-2.36)$ ✓

$E^{\theta}_{cathode} = 2.51 – 2.36$ OF $E^{\theta}_{kathode} = 2.51 – 2.36$

$= 0.15V$✓

M is platinum✓ (5)

8.5 Decrease.✓

In this cell, Mg is the anode.✓/Mg is stronger reducing agent than Sn

Oxidation occurs on the Mg electrode.✓/Mg is oxidised

Verlaag✓

In die sel,is Mg die anode✓*/Mg is 'n sterker reduseermiddel as Sn*

Oksidasie vind plaas op die Mg elektrode✓*/Mg word geoksideer*

(3)

8.6 Yes.✓

The reaction does not need energy/external source/power supply to take place.✓

OR

Emf/initial reading on voltmeter is positive.

Ja✓

Die reaksie het nie energie/eksterne bron/kragbron nodig om te kan plaasvind nie✓

OF

Emf/oorspronklike voltmeter lesing is positief

(2)

[15]

QUESTION 9 / VRAAG 9

9.1 Electrical energy to chemical energy.✓

Elektriese energie na chemiese energie✓ (1)

9.2 $NiCl_2$ / $Ni(NO_3)_2$✓ (1)

9.3 Anode.✓ (1)

9.4 $Ni^{2+} + 2e^- \rightarrow Ni$✓✓ (2)

9.5

Marking criteria

a. Substitution of 2000 and 1.6×10^{-19} into the $n = \frac{Q}{e}$
b. Dividing by Avogadro's constant
c. Mole ratio 1 : 2
d. Using Molar mass of Ni of 59 $g.mol^{-1}$
e. Addition of mass of spoon and mass of Nickel
f. Final answer

Merk kriteria

a. Vervanging van 2000 en 1.6×10^{-19} in die n = Q/e
b. Deling deur Avogadro se konstante
c. Molverhouding 1 : 2
d. Gebruik molêre massa van Ni van 59 $g.mol^{-1}$
e. Optelling van massa van lepel en massa van nikkel
f. Finale antwoord

$$n = \frac{Q}{e}$$

$$= \frac{2000}{1.6 \times 10^{-19}}$$✓**(a)**

$$= 1.25 \times 10^{22}$$ electrons/*elektrone*

(6)

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

$= \frac{1.25\times10^{22}}{6.02\times10^{23}}$✓**(b)**

$= 2.0764 \times 10^{-2} mol$

$n(Ni) = \frac{2.0764\times10^{-2}}{2}$ ✓**(c)**

$= 1.0382 \times 10^{-2} mol$

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

$1.0382 \times 10^{-2} = \frac{m}{59}$✓**(d)**

$m = 0.613g$

$total\ mass\ OF\ totale\ massa = 15 + 0.613$✓**(e)**

$= 15.613g$✓**(f)**

[11]

TOTAL/*TOTAAL*: 150