education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

PROVINCIAL ASSESSMENT

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

JUNE 2026

MARKS: 150

TIME: 3 hours

This question paper consists of 15 pages and 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of EIGHT questions. Answer ALL the questions in the ANSWER SHEET.
2. Start EACH question on a NEW page in the ANSWER SHEET.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. Show ALL formulae and substitutions in ALL calculations.
7. Round off your FINAL numerical answers to a minimum of TWO decimal places.
8. Give brief motivations, discussions, etc. where required.
9. You are advised to use the attached DATA SHEETS.
10. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various 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 numbers (1.1–1.10) in the ANSWER SHEET, e.g. 1.11 E.

1.1 The name of the CHAIN isomer of the compound but-2-ene is:

A But-1-ene

B 2-methylbut-2-ene

C 2-methylpropan-2-ene

D Methylpropene (2)

1.2 Which ONE of the following organic compounds is a tertiary haloalkane?

A 1-bromobutane

B 2-chloro-2-methylpentane

C 2-bromohexane

D 1,2,3-trichloropentane (2)

1.3 Which ONE of the following compounds forms hydrogen bonds between its molecules?

A CH_3CH_2CHO

B CH_3COOCH_3

C $CH_3CH_2CH_2OH$

D CH_3COCH_3 (2)

1.4 Magnesium ribbon of mass 2 g reacts with excess hydrochloric acid of concentration 0,1 mol·dm^{-3} at 20 °C below:

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

Which ONE of the following changes will NOT increase the initial rate of the reaction?

A Using 2 g of powdered magnesium

B Increasing the temperature of HCl to 30 °C

C Using a longer piece of the magnesium ribbon

D Doubling the volume of the hydrochloric acid used (2)

1.5 Which ONE of the following combinations of values for activation energy (E_a) and heat of reaction (ΔH) is possible for a reaction?

	ACTIVATION ENERGY (E_a)	**HEAT OF REACTION (ΔH)**
A	100	-50
B	100	+100
C	50	+50
D	50	+100

(2)

1.6 According to Collision Theory, the reaction rate increases when the … decreases.

A temperature

B concentration

C activation energy

D kinetic energy of particles (2)

1.7 Consider the following reaction that reaches equilibrium in a closed container:

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

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

A The addition of a catalyst

B An increase in temperature

C A decrease in the volume of the container

D A decrease in the concentration of N_2 (2)

1.8 Initially certain moles of NH_3 and H_2S are placed in a sealed 2 dm^3 at 300 °C. The reaction is allowed to reach equilibrium according to the following balanced equation:

$$NH_3(g) + H_2S(g) \rightleftharpoons NH_4HS(s)$$

The Kc values for the formation of $NH_4HS(s)$ at different temperatures are given in the table below.

TEMPERATURE (°C)	Kc VALUE
300	40×10^{-2}
250	18×10^{-2}
200	$7,5 \times 10^{-2}$

According to Le Chatelier's principle, when temperature is decreased the …

A forward reaction is endothermic and is favoured.

B reverse reaction is endothermic and is favoured.

C forward reaction is exothermic and concentration of reactants increases.

D reverse reaction is favoured and the mass of the product decreases. (2)

1.9 Which ONE of the following acids would ionise completely in water and form a high concentration of hydronium ions?

A Carbonic acid

B Phosphoric acid

C Nitric acid

D Ethanoic acid (2)

1.10 Which ONE of the following indicators is most suitable for the titration of ethanoic acid with sodium hydroxide?

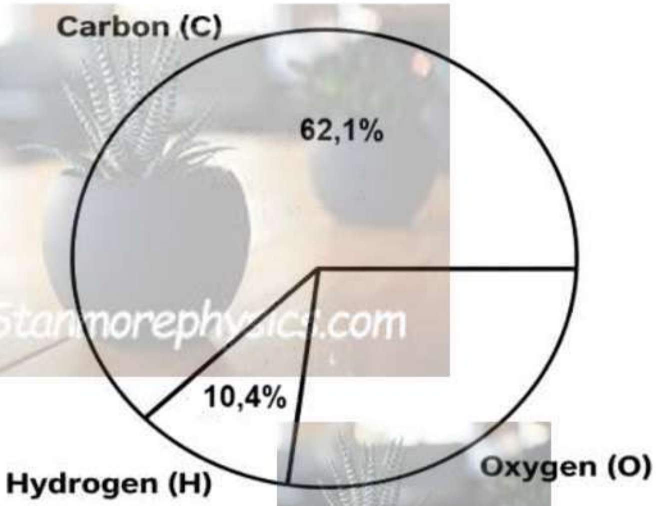
INDICATOR	**pH**
A	0,2 – 1,8
B	2,9 – 4,0
C	6,0 – 7,6
D	11,6 – 14,0

(2)
[20]

QUESTION 2 (Start on a new page.)

2.1 Define the term *organic molecules.* (2)

2.2 The pie chart below shows percentage composition of a certain compound with a molar mass of 116 g·mol^{-1}.



2.2.1 Write down the percentage of oxygen in the above compound. (1)

2.2.2 Determine by means of a calculation, the molecular formula of the compound. (5)

The compound with the molecular formula in QUESTION 2.2.2 is prepared using propanoic acid as one of the reactants.

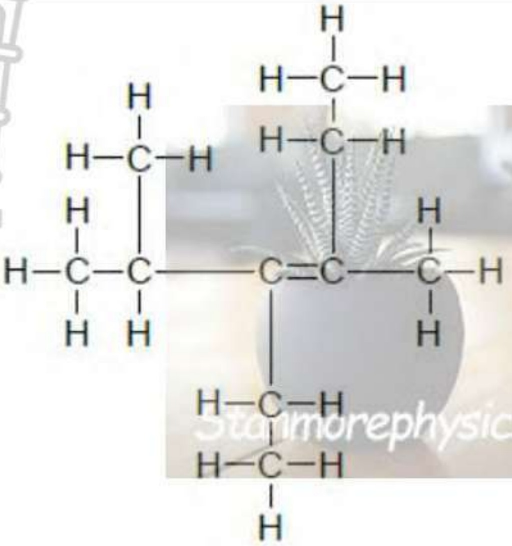
2.2.3 Draw the STRUCTURAL FORMULA of the FUNCTIONAL GROUP of the homologous series to which this compound belongs. (2)

2.2.4 Write down the IUPAC NAME of the compound. (2)

2.2.5 Write down the MOLECULAR FORMULA of the inorganic product formed when the compound named in QUESTION 2.2.4 was prepared. (1)

2.2.6 Draw the STRUCTURAL FORMULA of the other organic compound used to prepare the compound named in QUESTION 2.2.4. (2)

2.3 Consider compounds **A** and **B** below.

A		**B**	4-methylpentan-2-one

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

2.3.2 Which compound, **A** or **B** is unsaturated? Give a reason for the answer. (3)

Write down the:

2.3.3 IUPAC NAME of compound **A** (3)

2.3.4 GENERAL FORMULA of the homologous series to which compound **A** belongs (1)

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

2.3.6 STRUCTURAL FORMULA of compound **B** (3)

[28]

QUESTION 3 (Start on a new page.)

Compounds **A**, **B**, **C** and **D** are used to investigate one of the factors that influences the VAPOUR PRESSURE of organic compounds.

A	$CH_3CH_2CH_2CH_2OH$
B	$CH_3CH_2CH_2CH_3$
C	$CH_3CH_2COCH_3$
D	$CH_3CH_2CH_2COOH$

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

3.2 Which compound, **B** or **C**, has a higher vapour pressure? Give a reason for the answer by referring to the strength of intermolecular forces. (3)

3.3 Refer to the table above, which ONE of compounds has a FUNCTIONAL isomer? Write down only the letter. (1)

3.4 Write down the IUPAC NAME of the functional isomer of the compound mentioned in QUESTION 3.3. (2)

3.5 Explain what is *hydrogen bonding?* (2)

3.6 Which compound, **A** or **D**, has a lower boiling point? Fully explain the answer. (4)

3.7 The boiling point of compound **A** is measured again on another day when the atmospheric pressure is much lower.

How will the boiling point of this compound be affected? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

[15]

QUESTION 4 (Start on a new page.)

4.1 Explain the term *dehydrohalogenation.* (2)

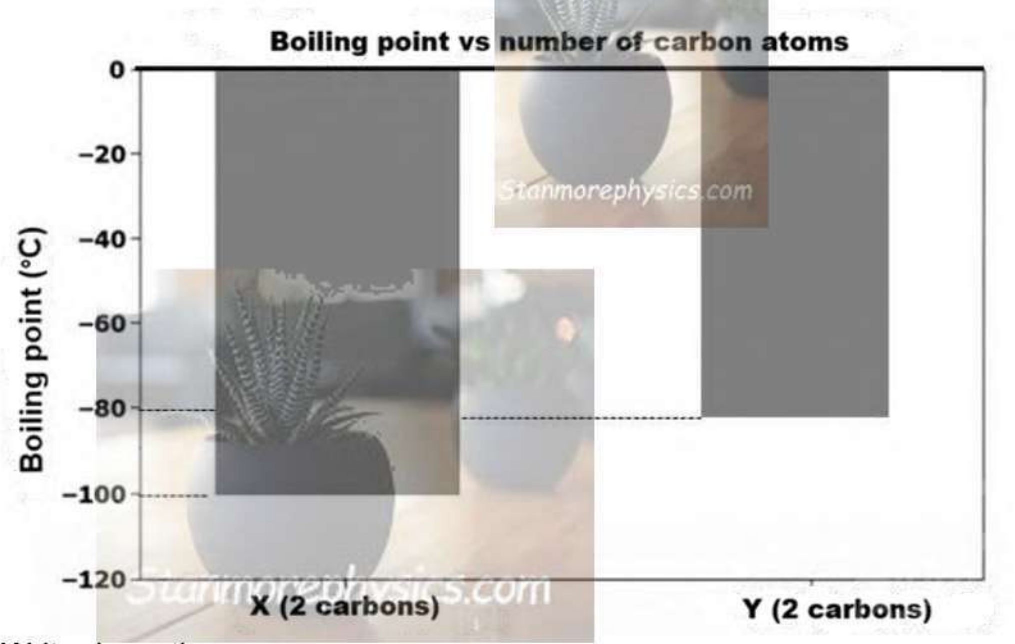
4.2 Hexane can be prepared from 2-bromohexane ($CH_3CH_2CH_2CH_2CHBrCH_3$) by a TWO STEP process. You are supplied with the following chemicals:

HCl	Concentrated NaOH	H_2	Pt	Concentrated H_2SO_4

Select appropriate chemicals from the table above to write down balanced equations for the TWO steps. Use CONDENSED STRUCTURAL FORMULAE and indicate the reaction conditions for each step. (8)

4.3 Write down the STRUCTURAL formula of the MINOR PRODUCT formed during step 1 in QUESTION 4.2. (2)

4.4 Hexane undergoes a cracking reaction, and the products (compounds **X** and **Y**) are shown in the graph below:



Write down the:

4.4.1 IUPAC NAME of compound **X** (2)

4.4.2 Homologous series to which compound **Y** belongs (1)

4.4.3 Balanced chemical equation for the cracking of hexane using MOLECULAR FORMULAE (3)

4.4.4 Write down the NAMES of the TWO products formed during the complete combustion of compound **Y** (2)

[20]

QUESTION 5 (Start on a new page.)

A learner investigates the reaction between zinc granules and excess dilute hydrochloric acid in a sealed 2,0 dm^3 container. The balanced equation is:

$$Zn(s) + 2HC\ell(aq) \rightarrow ZnC\ell_2(aq) + \mathbf{X}_2(g)$$

The volume of **X** gas produced is measured at regular time intervals at constant temperature. The results are recorded below:

TIME (s)	VOLUME OF X_2 (cm^3)
0	0
10	22
20	40
30	54
40	64
50	70
60	70

5.1 Write down the chemical NAME of gas $\mathbf{X}_2$. (1)

5.2 At what time does the reaction reach completion? Give a reason for the answer using data from the table. (3)

5.3 Explain what is meant by *dilute hydrochloric acid.* (2)

5.4 Which reactant is completely consumed during the reaction of zinc granules with the dilute hydrochloric acid, Zn or HCℓ? (1)

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

5.6 Calculate the average reaction rate between 30 s and 50 s. (3)

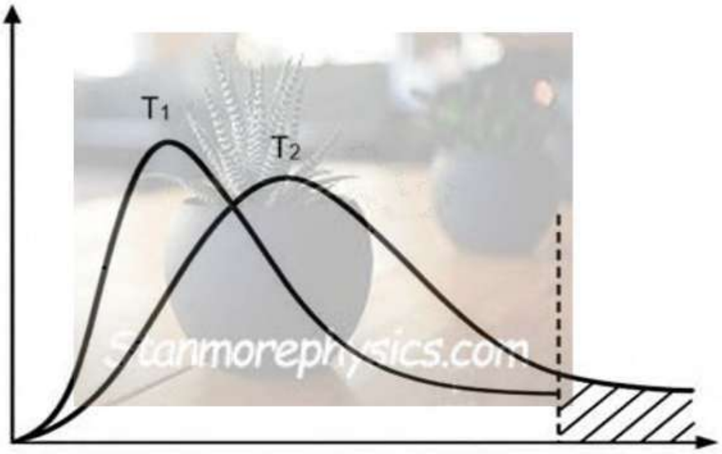
5.7 Using collision theory, explain the effect of a decreased surface area or state of division on the reaction rate. (4)

5.8 Define the term *catalyst.* (2)

5.9 The learner repeats the experiment using a suitable catalyst. Will the final volume of $\mathbf{X}_2$ gas INCREASE, DECREASE or REMAIN THE SAME? Explain the answer. (3)
[21]

QUESTION 6 (Start on a new page.)

The graph below represents the Maxwell-Boltzmann distribution of molecular energies for a gas at two different temperatures, **T_1** and **T_2**.



6.1 Label the following:

6.1.1 y-axis (1)

6.1.2 shaded area (1)

6.1.3 dotted vertical line (1)

6.2 Which curve, **T_1** or **T_2**, represents the gas at a higher temperature? Give a reason for the answer. (2)

6.3 A catalyst is added to the reaction.

How will the position of the dotted vertical line change? Choose from SHIFT TO THE LEFT or SHIFT TO THE RIGHT? Give a reason for the answer. (2)

6.4 Explain why the total area under the curves remains the same even when the temperature is increased and a catalyst is added. (3)
[10]

QUESTION 7 (Start on a new page.)

7.1 Give TWO conditions under which a dynamic equilibrium can be reached. (2)

7.2 State Le Chatelier's principle. (2)

7.3 A solid ammonium chloride decomposes in a sealed container according to the following equilibrium reaction:

$$NH_4C\ell\,(s) \leftrightharpoons NH_3(g) + HC\ell\,(g) \qquad \Delta H > 0$$

A mass of 64,2 g of $NH_4C\ell$ (s) is placed into a sealed container and heated to 480K. The system reaches equilibrium.

At equilibrium, it is found that 0,80 mol NH_3(g) is present.
The equilibrium constant (Kc) at 480K is 1,0.

7.3.1 Is the forward reaction ENDOTHERMIC or EXOTHERMIC? Give a reason for the answer. (2)

7.3.2 Calculate the volume of the container in dm^3. (8)

7.3.3 The temperature now is changed from 480K to 300K, how will this change in temperature affect the Kc value? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

7.3.4 Explain the answer to QUESTION 7.3.3 by using Le Chatelier's principle. (3)

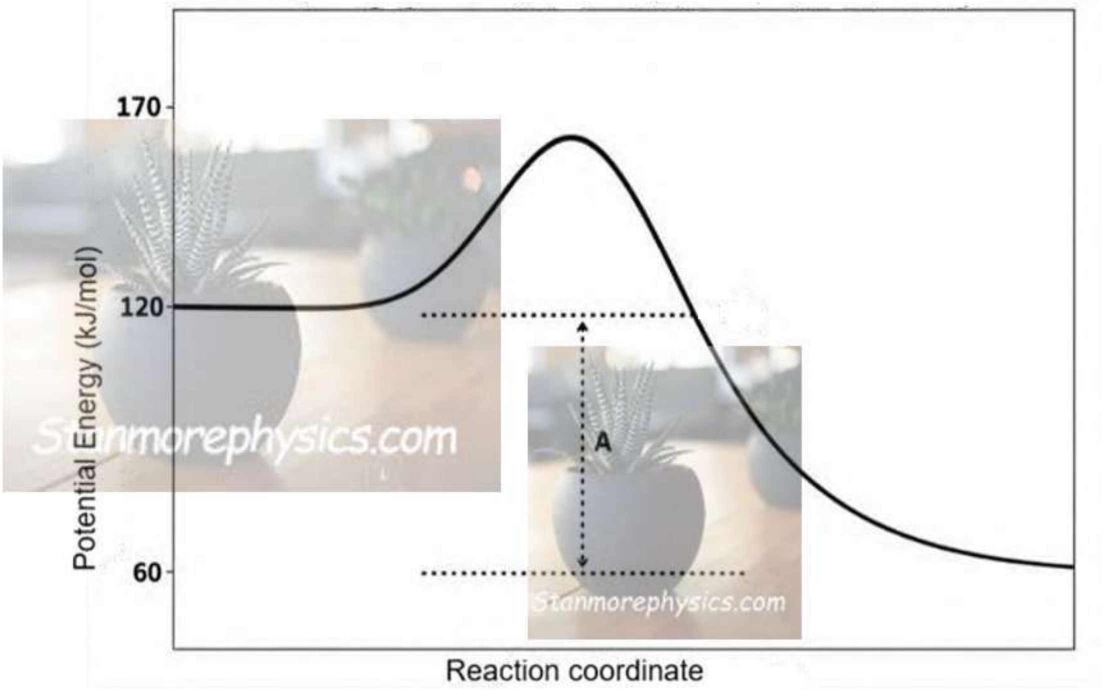
[18]

QUESTION 8 (Start on a new page.)

8.1 Equilibrium is established at 25 °C in an ionisation of hydrochloric acid according to the reaction:

$$HC\ell(g) + H_2O(l) \leftrightharpoons C\ell^-(aq) + H_3O^+(aq)$$

The graph below shows the energy profile for the ionisation of hydrochloric acid above.



8.1.1 Is the ionisation of hydrochloric acid an EXOTHERMIC or ENDOTHERMIC reaction? (1)

8.1.2 Define the term chosen in QUESTION 8.1.1. (1)

8.1.3 LABEL and write down the MAGNITUDE of section **A** in the graph. (2)

8.1.4 Define a *base* in terms of Arrhenius theory. (2)

8.1.5 Write down ONE conjugate acid-base pair from the ionisation of hydrochloric acid above. (2)

8.1.6 A few drops of concentrated nitric acid, HNO_3(conc.), are added to the equilibrium mixture. What effect does this addition have on the amount of $HC\ell$ (g)? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

8.1.7 Explain the answer to QUESTION 8.1.6 by using Le Chatelier's principle. (2)

8.2 A certain volume of a hydrochloric acid solution of concentration 0,5 mol·dm^{-3} is added to a sample of seashells of mass 8 g in a container. The seashell contains 95 % $CaCO_3$.

The hydrochloric acid solution (HCℓ) COMPLETELY reacts with the calcium carbonate ($CaCO_3$) in the sample according to the balanced equation:

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

Calculate the volume, in cm^3, of the hydrochloric acid (HCℓ) that was added to the sample inside the container. (7)

[18]

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

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ 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* $E^\theta_{cell} = E^\theta_{oxidising\ agent} - E^\theta_{reducing\ agent}$ /$E^\theta_{sel} = E^\theta_{oksideermiddel} - E^\theta_{reduseermiddel}$	
$I = \frac{Q}{\Delta t}$	$n = \frac{Q}{q_e}$ where n is the number of electrons/ *waar n die aantal elektrone is*

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

KEY/*SLEUTEL*

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

29 1,9 Cu 63,5

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

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

Half-reactions/*Halfreaksies*			E^θ (V)
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$Cl_2(g) + 2e^-$	⇌	$2Cl^-$	+ 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
$Br_2(l) + 2e^-$	⇌	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	⇌	$Hg(l)$	+ 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 strength of reducing agents /*Toenemende sterkte van reduseermiddels* ↓

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

Half-reactions/*Halfreaksies*			E^{θ}(V)
$Li^+ + e^-$	⇌	Li	− 3,05
$K^+ + e^-$	⇌	K	− 2,93
$Cs^+ + e^-$	⇌	Cs	− 2,92
$Ba^{2+} + 2e^-$	⇌	Ba	− 2,90
$Sr^{2+} + 2e^-$	⇌	Sr	− 2,89
$Ca^{2+} + 2e^-$	⇌	Ca	− 2,87
$Na^+ + e^-$	⇌	Na	− 2,71
$Mg^{2+} + 2e^-$	⇌	Mg	− 2,36
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$2H^+ + 2e^-$	⇌	**$H_2(g)$**	**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 strength of oxidising agents / *Toenemende sterkte van oksideermiddels* ↓

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

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education

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Education
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PROVINCIAL ASSESSMENT
PROVINSIALE ASSESSERING

GRADE/*GRAAD* 12

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

JUNE/*JUNIE* 2026

MARKING GUIDELINES/*NASIENRIGLYNE*

Marks/*Punte*: 150

These marking guidelines consist of 13 pages.
Hierdie nasienriglyne bestaan uit 13 bladsye.

QUESTION/*VRAAG* 1

1.1 D ✓✓ (2)

1.2 B ✓✓ (2)

1.3 C ✓✓ (2)

1.4 D ✓✓ (2)

1.5 A✓✓ (2)

1.6 C ✓✓ (2)

1.7 C ✓✓ (2)

1.8 D ✓✓ (2)

1.9 C ✓✓ (2)

1.10 D ✓✓ (2)
[20]

QUESTION/*VRAAG* 2

2.1 Molecules containing carbon atoms./
Molekules wat koolstofatome bevat ✓✓ ***(2 or/of 0)*** (2)

2.2.1 27,5 % ✓ (1)

2.2.2

$$n = \frac{m}{M}$$ ✓

$$n(C) = \frac{62,1}{12} = 5,175 \text{ mol}$$

$$n(H) = \frac{10,1}{1} = 10,1 \text{ mol}$$

$$n(O) = \frac{27,1}{16} = 1,71875 \text{ mol}$$

✓

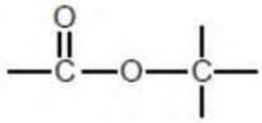
Ratio/*Verhouding*: C : H : O
3 : 6 : 1

Empirical formula/ *Empiriese formule*: C_3H_6O ✓

$$n \text{ (integer/}\textit{heelgetal}\text{)} = \frac{116}{58} = 2$$ ✓

Molecular formula/*Molekulêre formule*: $C_6H_{12}O_2$ ✓ (5)

2.2.3

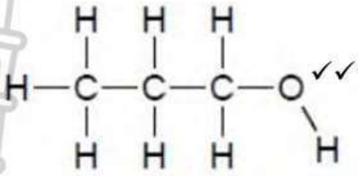


✓✓ (2)

2.2.4 Propyl propanoate/*Propielpropanoaat* ✓✓ (2)

2.2.5 H_2O ✓ (1)

2.2.6


✓✓

Marking criteria:
- Functional group correct.✓
- Whole structural formula correct.✓

NOTE: Penalise when hydrogen or bond is omitted

Nasienkriteria:
- *Funksionele groep korrek.* ✓
- *Hele struktuurformule korrek.*✓

***NOTA**: Penaliseer indien enige waterstowwe of bindings gemis is*

(2)

2.3.1 A bond or an atom or a group of atoms that determine(s) the physical or chemical properties of a group of organic compounds.✓✓
'n Binding of 'n atoom of 'n groep atome wat die fisiese en chemiese eienskappe van 'n groep organiese verbindings bepaal. **(2 or/*of* 0)** (2)

2.3.2 A ✓double bond or multiple bond between carbon/C atoms. ✓✓
A een of meer meervoudige bindings tussen C-atome in hul koolwaterstofkettings (3)

2.3.3 3-ethyl-2,4-dimethylhex-3-ene/*3-etiel-2,4-dimetielheks-3-een*. ✓✓✓

Marking criteria:
- Correct stem, i.e. hexane. ✓
- Correct substituents (ethyl and dimethyl) identified.✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas.✓

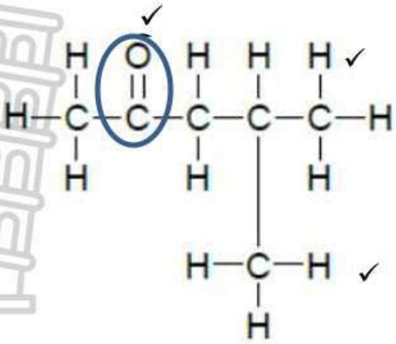
Nasienkriteria:
- *Korrekte stam d.i. heksaan.* ✓
- *Korrekte substituente (bromo en metiel) geïdentifiseer.*✓
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.*✓

(3)

2.3.4 C_nH_{2n} ✓ (1)

2.3.5 Carbonyl (group)/*Karboniel (groep)* ✓ (1)

2.3.6



Marking criteria	Nasien *kriteria*
• Carbonyl group on the 2nd C-atom. ✓ • Five C-atoms in the parent chain.✓ • Whole structure correct.✓ NOTE: Penalise when a hydrogen or a bond is ommitted	• Karboniel groep op die 2de C-atoom. • *Vyf koolstowwe in die hoofstam* • *Hele struktuur korrek* *LET WEL: Penaliseer indien enige waterstowwe of bindings gemis is*

(3)
[28]

QUESTION/*VRAAG* 3

3.1 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. **(2 or/*of* 0)** (2)

3.2 B✓, Compound B has weaker intermolecular forces (than compound C).✓✓
Verbinding B het swakker intermolekulêre kragte (as verbinding C)
OR/*OF*
Compound C has stronger intermolecular forces (than compound B)
Verbinding C het sterker intermolekulêre kragte (as verbinding B) (3)

3.3 C/D✓ (1)

3.4 C – Butanal/*Butanaal* ✓✓
OR/*OF*
D – methyl propanoate/propyl methanoate/ethyl ethanoate.
metielpropanoaat/propielmetanoaat/etieletanoaat (2)

3.5 Forces between molecules in which hydrogen is covalently bonded to nitrogen, oxygen or fluorine. ✓✓
Kragte tussen molekule waarin waterstof kovalent gebind is aan stikstof, suurstof of fluoor **(2 or/*of* 0)** (2)

3.6 D,

- compound D has two sites of hydrogen bonds ✓, compound A has one site of hydrogen bonds✓.
- compound D has stronger intermolecular forces/hydrogen bonds ✓than compound A/compound A has weaker intermolecular forces than compound D
- more energy is required to overcome the intermolecular forces✓ between molecules of compound D than between molecules of compound A/less energy is required to overcome intermolecular forces between molecules of compound A than compound D

- *verbinding D het twee plekke van waterstofbindings, verbinding A het een plek van waterstofbindings*
- *verbinding D het sterker intermolekulêre kragte/waterstofbindings as verbinding A/verbinding A het swakker intermolekulêre kragte as verbinding D*
- *meer energie is nodig om die intermolekulêre kragte tussen molekules van verbinding D te oorkom as tussen molekules van verbinding A/minder energie is nodig om intermolekulêre kragte tussen molekules van A te oorkom* (4)

3.7 Decreases/*Verlaag* ✓ (1)

[15]

QUESTION/*VRAAG* 4

4.1 The elimination of hydrogen and a halogen from a haloalkane. ✓✓
Die eliminasie van waterstof en 'n halogeen uit 'n haloalkaan **(2 or/*of* 0)** (2)

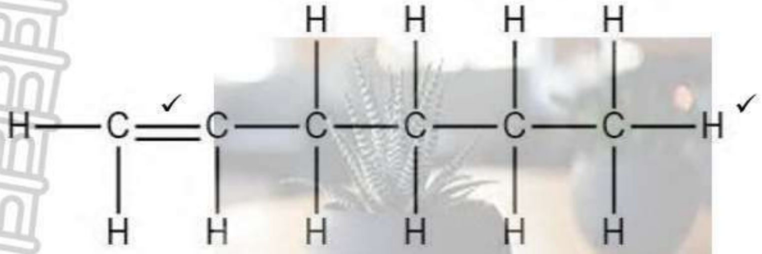
4.2 Step/*Stap* 1:

$$CH_3CH_2CH_2CH_2CHBrCH_3 \xrightarrow[\Delta]{NaOH(c)} \checkmark \rightarrow CH_3CH_2CH_2CH{=}CHCH_3 \checkmark\checkmark + H_2O \checkmark + NaBr \checkmark$$

Step/*Stap* 2: $CH_3CH_2CH_2CH{=}CHCH_3 + H_2 \checkmark \rightarrow CH_3CH_2CH_2CH_2CH_2CH_3 \checkmark\checkmark$

(8)

4.3



Criteria	***Kriteria***
• Correct functional group ✓	• *Korrekte funksionele groep*
• Six carbons on the parent chain✓ NOTE: Penalise when any hydrogen or bond is omitted	• *Ses koolstowwe in die hoofstam* *LET WEL: Penaliseer indien enige waterstowwe of bindings gemis is*

(2)

4.4.1 Ethane/*Etaan* ✓✓ (2)

4.4.2 Alkene/*Alkeen* ✓ (1)

4.4.3 C_6H_{12}✓ → $2C_2H_6 + C_2H_4$✓ ✓balancing/*balansering* (3)

4.4.4 Water ✓ and Carbon dioxide✓
Water en Koolstofdioksied (2)

[20]

QUESTION/*VRAAG* 5

5.1 Hydrogen/*Waterstof* (gas). ✓ (1)

5.2 <u>50s</u>✓, volume of gas produced remained constant from 50s.✓✓
die volume gas geproduseer het konstant gebly vanaf 50s (3)

5.3 Dilute HCl contain a <u>small amount (number of moles) of acid in proportion to the volume of water</u>. ✓✓
Verdunde HCl bevat 'n <u>klein hoeveelheid (aantal mol) suur in verhouding tot die volume water.</u> **(2 or/*of* 0)** (2)

5.4 Zn ✓ (1)

5.5

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

<u>ANY ONE:</u>

- <u>Change in concentration</u> ✓ of reactants or products <u>per unit time</u>.✓
- <u>Change in amount /number of moles/volume/mass</u> of products or reactants <u>per (unit) time</u>
- <u>Amount/number of moles/volume/mass of products formed/reactants used per (unit) time.</u> ✓✓ **(2 or 0)**
- <u>Rate of change in concentration/amount/number of moles/volume/ mass.</u> ✓✓ **(2 or 0)**

<u>ENIGE EEN:</u>

- *<u>Verandering in konsentrasie</u> van produkte/reaktante <u>per (eenheid) tyd.</u>*
- *<u>Verandering in hoeveelheid/getal mol/volume/massa</u> van produkte gevorm/reaktante gebruik <u>per (eenheid) tyd</u>.*
- *<u>Hoeveelheid/getal mol/volue/massa van produkte gevorm/reaktante gebruik per (eenheid) tyd.</u>* ***(2 or 0)***
- *<u>Tempo van verandering in konsentrasie/hoeveelheid/getal mol/volume/massa.</u>* ***(2 of 0)*** (2)

5.6

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

$$= \frac{(70-54)\ ✓}{(50-30)\ ✓}$$

$$= 0{,}8\ \text{cm}^3\cdot\text{s}^{-1}\ ✓$$ (3)

5.7
- Decrease in surface area provides <u>less surface</u> for collisions to occur✓
- <u>Less particles with sufficient kinetic energy/$E_K \geq E_A$</u>✓
- <u>Less effective collisions per unit time</u>✓/frequency of effective collisions decreases
- Reaction rate decreases✓
- *Afname in oppervlak gee <u>minder oppervlak</u> vir botsings om plaas te vind*
- *<u>Minder deeltjies met voldoende kinetiese energie/EK ≥ EA</u>*
- *<u>Minder effektiewe botsings per tydeenheid</u>/frekwensie van effektiewe botsings neem af*
- *Reaksietempo neem af* (4)

5.8 A substance that increases the rate of a chemical reaction without itself undergoing a permanent change.✓✓
'n Stof wat die tempo van 'n chemiese reaksie verhoog sonder om self 'n permanente verandering te ondergaan. **(2 or/*of* 0)** (2)

5.9 Remain the same/*Bly dieselfde*. ✓
A catalyst only increases the rate of reaction and does not affect the volume of the gas produced/ quantity of the products.✓✓
'n Katalisator verhoog slegs die reaksietempo maar affekteer nie die volume gas wat gevorm is/die hoeveelheid produk nie. (3)
[21]

QUESTION/*VRAAG* 6

6.1.1 Number of (given) particles.✓
Aantal deeltjies (1)

6.1.2 Particles with sufficient kinetic energy✓/ particles with $E_k \geq E_A$
Deeltjies met genoegsame kinetiese energie/ deeltjies met $E_k \geq E_A$ (1)

6.1.3 Activation energy/*Aktiverings energie*. ✓ **Accept/*Aanvaar:*** E_A (1)

6.2 T_2✓, more particles with sufficient kinetic energy✓/
more particles with $E_K \geq E_A$
meer deeltjies met genoegsame kinetiese energie/
meer deeltjies met $E_k \geq E_A$ (2)

6.3 Shift to left/*Skuif na links*✓, catalyst decreases activation energy/*katalisator verlaag aktiverings energie*.✓ (2)

6.4
- Increasing temperature, only increases the average speed/kinetic energy of particles✓
- Catalyst provides an alternative path of lower activation energy/ catalyst only increases the rate of reaction.✓
- Both increasing temperature and adding a catalyst have no effect on the number of particles✓ (area under the curve)
- *Temperatuur verhoging, verhoog net die gemiddelde spoed/kinetiese energie van deeltjies*
- *Katalisator bied 'n alternatiewe pad van laer aktiveringsenergie/katalisator verhoog net die reaksietempo.*
- *Beide die verhoging van die temperatuur en die byvoeging van 'n katalisator het geen effek op die aantal deeltjies (area onder die grafiek) nie* (3)

[10]

QUESTION/*VRAAG* 7

7.1 Closed system✓ and reversible reaction.✓
Geslote sisteem en 'n omkeerbare reaksie (2)

7.2

Marking criteria/*Nasienkriteria*:
If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./ *Indien enige van die onderstreepte frases in die* ***korrekte konteks*** *uitgelaat is, trek 1 punt af.*
The underlined phrases must be in the correct context./*Die onderstreepte frases moet in die korrekte konteks wees.*

When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance.✓✓
Wanneer die ewewig in 'n geslote sisteem versteur word, stel die sisteem 'n nuwe ewewig in deur die reaksie wat die versteuring teenwerk, te bevoordeel. (2)

7.3.1 Endothermic✓, Heat energy is absorbed or used up. $\Delta H > 0$/ΔH is positive ✓
Endotermies, Warmte energie is geabsorbeer of op gebruik./$\Delta H > 0$/ΔH *is positief* (2)

7.3.2 **Marking guidelines/*Nasien riglyne***

- Calculate number of moles/*Bereken aantal mol* NH_4Cl ($\frac{64,2}{53,5}$) ✓

  OR/*OF* 1,2 moles/*mol*
- n.(equil/*ewewig.*) NH_3 = 0,80 ✓
- mole ratio/*mol verhouding*: n(NH_4Cl) : n(NH_3) : n(HCl) = 1:1:1 ✓
- Divide n(equil) of both/*Deel n(ewewig) van albei* NH_3 and/*en* HCl ✓
- Correct Kc expression/*korrekte K_c vergelyking* ✓
- Substitute 0,1 in the Kc expression/*Vervang 0,1 in die K_c vergelyking* ✓
- Substitute equilibrium concentrations in the Kc expression/*Vervang die ewewigs konsentrasie in die Kc vergelyking* ✓
- Final answer/*Finale antwoord* in dm^3 = 0,80 dm^3 ✓ (Range: 0,78 – 0.82)

$$n = \frac{m}{M}$$
$$= \frac{64,2}{53,5} ✓$$
$$= 1,2 \text{ mol}$$

	$NH_4C\ell$	NH_3	$HC\ell$	
Ratio/*Verhouding*	1	1	1	
Initial quantity (mol) *Begin mol*	1,2	0	0	
Change (mol) *Verandering in mol*	0,80	0,80	0,80	✓
Quantiy at equilibrium (mol) *Hoeveelheid by ewewig*	0,4	0,80✓	0,80	
Equilibrium concentration ($mol·dm^{-3}$) *Ewewigs konsentrasie*		$\frac{0,80}{V}$	$\frac{0,80}{V}$	✓

$$Kc = [NH_3][HC\ell] ✓$$
$$1,0 ✓ = \left(\frac{0,80}{V}\right)\left(\frac{0,80}{V}\right) ✓$$
$$V = 0,80 \text{ dm}^3 ✓$$

(8)

7.3.3 Decreases/*Afname* ✓ (1)

7.3.4
- Decrease in temperature favours exothermic reaction✓
- Reverse reaction is exothermic and is favoured✓
- Concentration/amount/moles of products increases✓
- *Afname in temperatuur bevoordeel eksotermiese reaksie*
- *Terugwaartse reaksie is eksotermies en word bevoordeel*
- *Konsentrasie/hoeveelheid/mol van produkte neem toe* (3)

[18]

QUESTION/*VRAAG* 8

8.1.1 Exothermic/*Eksotermies* ✓ (1)

8.1.2 **POSITIVE MARKING FROM QUESTION 8.1.1/**
POSITIEWE NASIEN VAN VRAAG 8.1.1

Reaction that releases heat/*Reaksie wat hitte vrystel*✓ (1)

8.1.3 Heat of reaction✓/*Reaksiewarmte*/ΔH, -60 $kJ \cdot mol^{-1}$ ✓ (2)

8.1.4 A substance that produces hydroxide ions (OH^-) in aqueous solution/water. ✓✓
'n Stof wat hidroksiedione (OH^-) vorm wanneer dit in water oplos. **(2 or/*of* 0)** (2)

8.1.5 $HC\ell$✓ and/*en* $C\ell^-$ ✓ /H_2O and/*en* H_3O^+ (2)

8.1.6 Increases/*Verhoog* ✓ (1)

8.1.7
- [H_3O^+] increases, the reaction that decreases the [H_3O^+] will be favoured ✓
- Reverse reaction is favoured.✓/ Concentration or amount of reactants increases
- *[H3O⁺] neem toe, die reaksie wat die [H_3O^+] verminder, word bevoordeel*
- *Terugwaartse reaksie word bevoordeel./Konsentrasie of hoeveelheid reaktante neem toe* (2)

8.1.8 $m(CaCO_3) = 8 \times 0{,}95$ ✓
$= 7{,}6\ g$

$n(CaCO_3) = \frac{m}{M}$ ✓

$= \frac{7{,}6}{100}$ ✓

$= 0{,}076\ mol$

$n(HC\ell) = 2 \times 0{,}076$ ✓
$= 0{,}152\ mol$

$c(HC\ell) = \frac{n}{V}$

$0{,}5$ ✓ $= \frac{0{,}152}{V}$ ✓

$V(HC\ell) = 0{,}304\ dm^3$
$\therefore\ V(HC\ell) = 304\ cm^3$ ✓

(7)
[18]

TOTAL/*TOTAAL*: 150