education

Department of Education
FREE STATE PROVINCE

EXAMINATION

GRADE 12

PHYSICAL SCIENCES
(PAPER 2: CHEMISTRY)

JUNE 2025

MARKS: 150

TIME: 3 HOURS

This paper consists of 16 pages and two information sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of eight questions. Answer ALL questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave one line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable pocket 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 where applicable.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 Which ONE of the following is the correct name of the functional group of the alkynes?

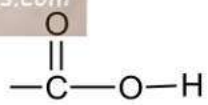
A Formyl group

B Carbonyl group

C Carbon-carbon triple bond

D Carbon-carbon double bond (2)

1.2 Consider the structural formula of the functional group below.



Which ONE of the following homologous series can be functional isomers of the homologous series having the above functional group?

A Esters

B Ketones

C Aldehydes

D Carboxylic acids (2)

1.3 Which ONE of the following decreases as the relative molecular masses of the straight chain alkanes increases?

A Melting point

B Boiling point

C Vapour pressure

D Strength of intermolecular forces (2)

1.4 Compound **Q** reacts with $C_3H_7C\ell$ according to the following balanced chemical equation.

$$Q + C_3H_7C\ell \rightarrow C_3H_7OH + HC\ell$$

What type of a reaction is represented above?

A Dehydrohalogenation

B Hydrohalogenation

C Hydration

D Hydrolysis (2)

1.5 The NAME of the catalyst used in esterification reaction is … acid.

A carbonic

B sulphuric

C phosphoric

D hydrochloric (2)

1.6 Which ONE of the following best describes the effect of temperature on the reaction rate?

A Hydrogen peroxide decomposes faster in the presence of manganese (IV) oxide.

B 5 g sodium reacts faster with the same volume oxygen than 5 g of copper.

C 10 g of calcium carbonate reacts faster with 0,4 $mol \cdot dm^{-3}$ hydrochloric acid than 0,04 $mol \cdot dm^{-3}$ of hydrochloric acid.

D 10 g of sodium reacts slower with 100 mℓ water at 50 °C than at 100 °C. (2)

1.7 Learners use the reaction between sodium thiosulphate and hydrochloric acid to determine the reaction rate according to the balanced chemical equation below.

$$Na_2S_2O_3(aq) + 2HC\ell(aq) \longrightarrow 2NaC\ell(aq) + SO_2(g) + H_2O(\ell) + S(s)$$

Which method will lead to the MOST inaccurate practical results?

A Measuring the rate at which the mass of the of reaction mixture decrease.

B Measuring the rate of change in concentration of hydrochloric acid.

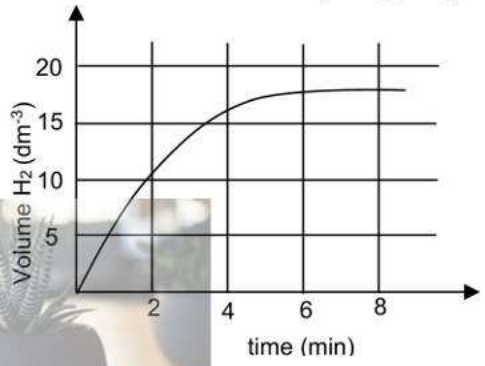
C Measuring the rate at which the precipitate is formed.

D Measuring the rate at which the gas is formed. (2)

1.8 The experiment was conducted by reacting a certain mass of zinc with an excess hydrochloric acid. The balance equation for the reaction is:

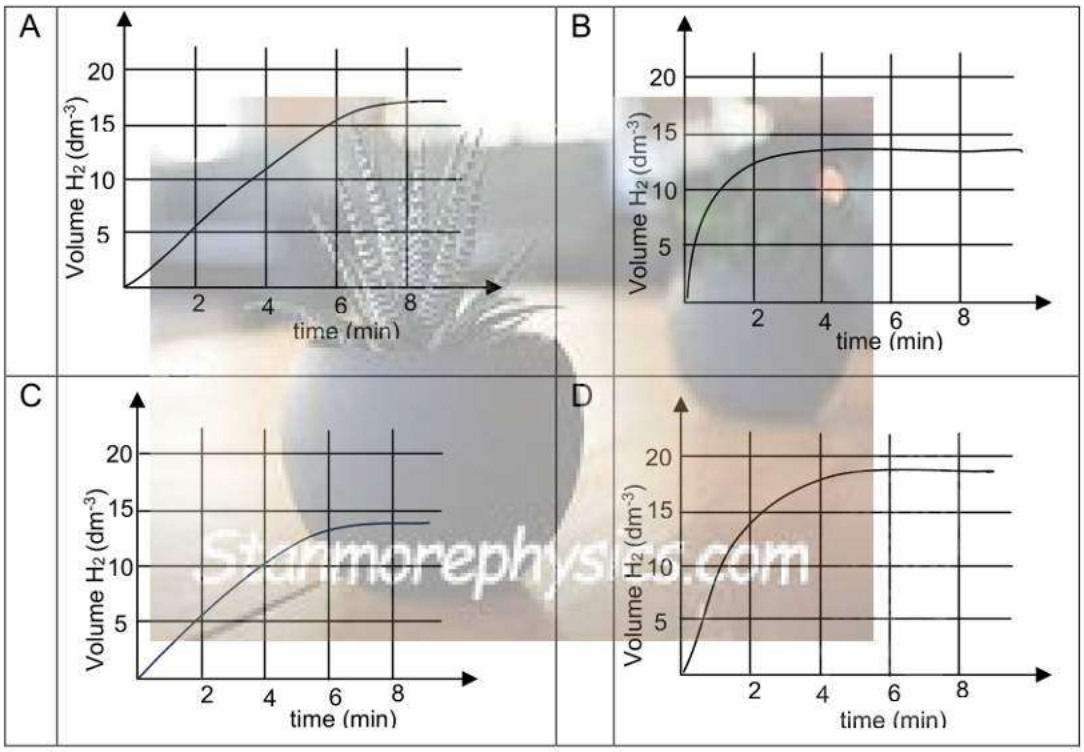
$$Zn(s) + 2HC\ell(aq) \rightarrow ZnC\ell_2(aq) + H_2(g)$$

The graph below shows the results of the hydrogen gas produced per unit time.



The experiment was repeated with the same amount of zinc reacting with same the volume of HCℓ with twice the concentration.

Which ONE of the graphs below represents the results of the second experiment?



(2)

1.9 A hypothetical reaction below reaches equilibrium in a closed container according to the following balanced chemical equation.

$$X_2(g) + Y_2(g) \rightleftharpoons 2XY(g) \qquad \Delta H > 0$$

The YIELD of XY can be increased by:

A Increasing the pressure

B Heating the container

C Addition of a catalyst

D Removing $X_2(g)$ (2)

1.10 The balanced chemical reaction below reaches equilibrium in a closed container.

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

Which ONE of the following is correct when you add concentrated HCℓ to the mixture?

A Concentration of $Cr_2O_7^{2-}$ decreases.

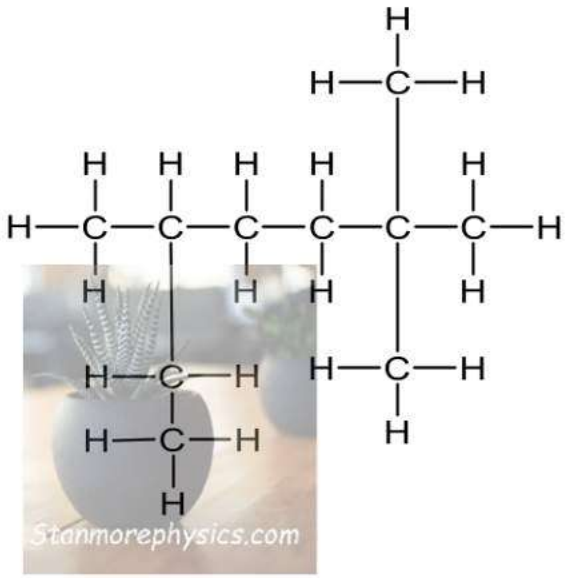
B Concentration of $2CrO_4^{2-}$ increases.

C Reverse reaction is favoured.

D The solution turns orange. (2)
[20]

QUESTION 2

2.1 Consider the structural formula of the hydrocarbon below.



2.1.1 Define the term *hydrocarbon*. (2)

2.1.2 Write down the general formula of the homologous series of the above compound. (1)

2.1.3 Give the IUPAC name of the compound. (3)

2.2 An unknown compound **X** is a functional isomer of compound **A** below.

A

Write down the:

2.2.1 Name of the homologous series of compound **A** (1)

2.2.2 Condensed structural formula of compound **X** (2)

2.2.3 IUPAC name of compound **X** (2)

2.3 Propanoic acid reacts with alcohol in the presence of concentrated acid to produce organic compound **E** as shown by the incomplete equation below.

Propanoic acid + alcohol → **E** + H_2O

The percentage composition of compound **E** is as follows

COMPOUND E		
Carbon	Hydrogen	Oxygen
58,82%	9,81%	31,37%

The molecular mass of compound **E** is EQUAL to its empirical formula mass.

2.3.1 Define the term *empirical formula*. (2)

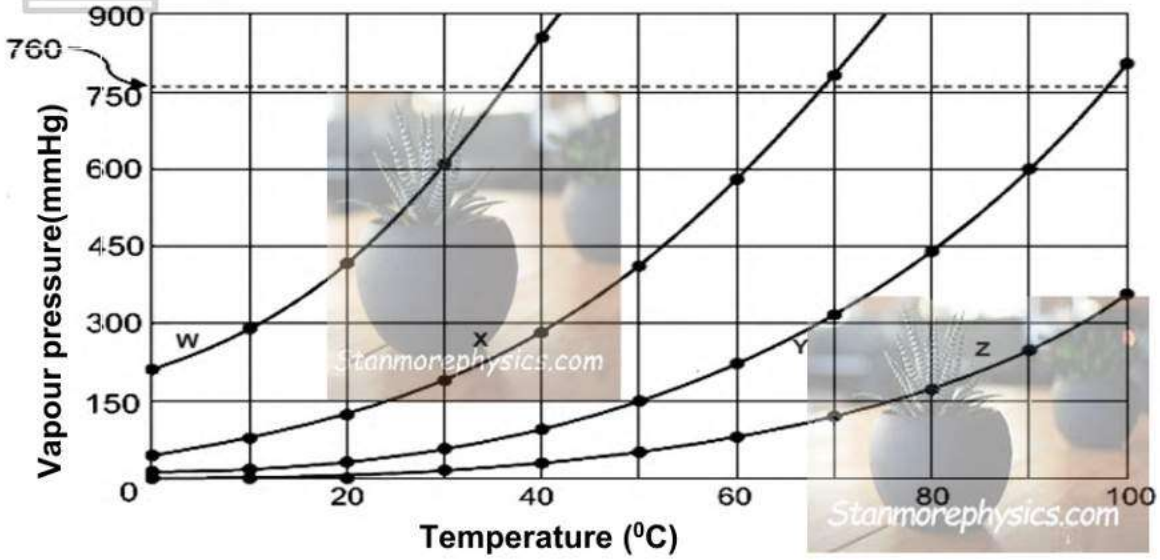
2.3.2 Determine by calculation, the molecular formula of compound **E**. (5)

2.3.3 Write down the molecular formula of the alcohol. (2)
[20]

QUESTION 3

A group of learners investigate the relationship between the strength of the intermolecular forces and the vapour pressure of four UNBRANCHED organic compounds W, X, Y and Z. The compounds have the SAME NUMBER of carbon atoms but belong to different homologous series. Their results are represented in the graph below. 760 mmHg is equal to 1atm.

Graph of the vapour pressure vs temperature



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

3.2 Formulate the investigative question for this investigation. (2)

3.3 Use the graph to determine the boiling point of **X**. (2)

3.4 Which ONE of the compounds **W** or **Y** has the strongest intermolecular forces? Explain the answer by referring to the vapour pressure and boiling point. (3)

3.5 Compound **Z** has two sites for hydrogen bonding. Write down the NAME of its functional group. (2)

3.6 Compound **X** is an aldehyde and **Y** is an alcohol. Refer to the TYPE of intermolecular forces to fully explain the difference in vapour pressure between compound **X** and **Y**. (4)

3.7 Compound **Y** is butan-2-ol.

3.7.1 Draw the structural formula of its CHAIN isomer. (2)

3.7.2 Identify the structure drawn in 3.7.1 as a primary, secondary or tertiary alcohol? Explain the answer. (2)

[19]

QUESTION 4

Four reactions of organic compounds are given in the table below.

Reaction **1**	Butane + Br_2 → 2-bromobutane + **P**
Reaction **2**	Pentane + O_2 → $CO_2(g)$ + $H_2O(\ell)$
Reaction **3**	Hexane → $3C_2H_4$ + **Q**
Reaction **4**	2-bromobutane + NaOH → **R** (major product) + NaBr(aq) + $H_2O(\ell)$

4.1 Consider **REACTION 1**:

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

4.1.2 Write down the NAME of the inorganic product **P**. (1)

4.1.3 Write down a complete balanced equation using STRUCTURAL formulae. (4)

4.2 Consider **REACTION 2**:

Write down the:

4.2.1 NAME of the chemical reaction that takes place. (1)

4.2.2 Balanced chemical equation using MOLECULAR formulae. (3)

4.3 Consider **REACTION 3**:

4.3.1 Except high temperature, write down ONE other reaction condition for this chemical reaction. (1)

4.3.2 Using CONDENSED STRUCTURAL formulae, write a complete chemical equation. (3)

4.3.3 The product C_2H_4 then reacts with an unknown substance in the presence of nickel as a catalyst. Identify the type of reaction that takes and hence write down the molecular formula of product formed. (2)

4.4 Consider **REACTION 4**:

4.4.1 Identify the type of reaction that takes place. (1)

4.4.2 Is the NaOH that reacted diluted or concentrated. (1)

4.4.3 Draw a STRUCTURAL formula of compound **R**. (2)

[21]

QUESTION 5

In the experiments to investigate factors that influence the reaction rate, 5 g of Mg reacts with excess hydrochloric acid.
The balanced chemical equation for the reaction is given below.

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

The same mass of Mg was used in all the experiments. Reaction condition for each experiment is summarised below.

EXPERIMENT	CONCENTRATION OF ACID ($mol \cdot dm^{-3}$)	STATE OF DIVISION OF Mg	VOLUME OF $HC\ell$ (cm^3)
A	0,6	granules	500
B	0,6	powder	500
C	0,9	granules	500

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

5.2 Will it be a fair comparison to compare reaction rate of experiment **B** and **C**? Explain the answer. (2)

5.3 Experiment **A** and **B** are compared.
Write down the following:

5.3.1 Dependant variable. (1)

5.3.2 Controlled variable. (1)

5.4 Use the collision theory and explain which experiment **A** or **C** will have a higher reaction rate. (5)

5.5 Calculate the number of moles of unreacted $HC\ell$ in experiment **C**. (6)

5.6 In another experiment **D**, 500 cm^3 excess HCℓ with a concentration of 0,6 $mol \cdot dm^{-3}$ reacts with 5 g of Ca powder.
The balanced equation for the reaction is represented below:

$$Ca(s) + 2HC\ell(aq) \rightarrow CaC\ell_2(aq) + H_2(g)$$

Experiment **D** is now compared with experiment **B**.

5.6.1 Identify the limiting reagent in experiment **D**.
Explain the answer. (2)

5.6.2 Write down the independent variable for these investigations. (1)

5.6.3 Which ONE of the reactions will produce more hydrogen gas?
Write down only **B** or **D**. (1)

5.6.4 Explain the answer in QUESTION 5.6.3. (2)

5.7 Which metal between Mg and Ca reacts faster with HCℓ?
Write down Mg or Ca. (1)

5.8 Explain the answer in QUESTION 5.7 above. (1)
[25]

QUESTION 6

Carbon reacts with carbon dioxide in a closed system at room temperature. The reaction reaches equilibrium according to the balanced chemical equation below.

$$2C(s) + CO_2(g) \rightleftharpoons 2CO(g)$$

6.1 State *Le Chatelier* principle. (2)

6.2 Carbon dioxide is added to the system at room temperature.
How will the following be affected?

6.2.1 The rate of the forward reaction. (1)

6.2.2 The yield of the CO. (1)

6.2.3 Explain the answer to QUESTION 6.2.2. (2)

6.3 At equilibrium, the pressure of the system is increased by decreasing the volume of the container at the same temperature.
How will this affect the:

6.3.1 Amount of CO_2? Explain the answer (3)

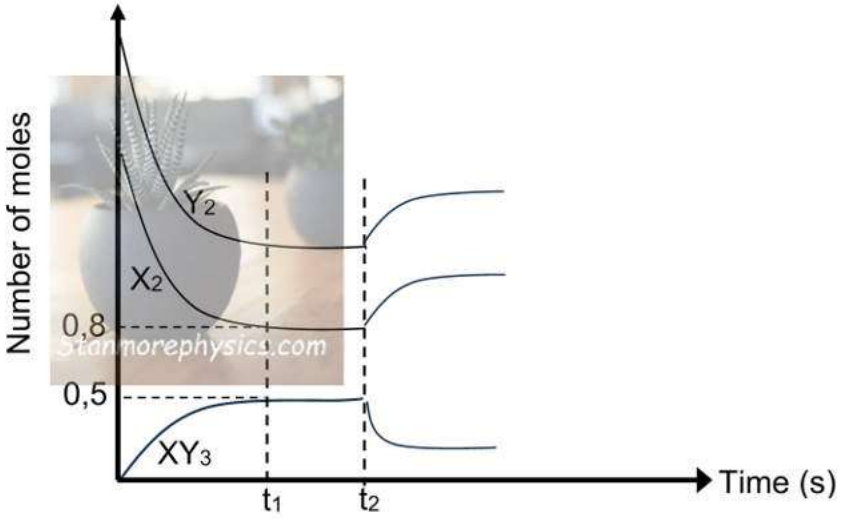
6.3.2 K_C value? (1)
[10]

QUESTION 7

Consider the hypothetical reaction below that takes place in a 2 dm^3 closed container. The balanced chemical equation for the reaction is as follows.

$$X_2(g) + 3Y_2(g) \rightleftharpoons 2XY_3(g) \qquad \Delta H < 0$$

The graph of the number of moles versus time for the reaction is shown below.



7.1 Define the following:

7.1.1 *closed system* (2)

7.1.2 *Chemical equilibrium* (2)

7.2 What is represented by the horizontal lines between t_1 and t_2 ? (1)

7.3 The Kc value between t_1 and t_2 is 0,2197. Calculate the concentration of Y_2 gas between t_1 and t_2. (5)

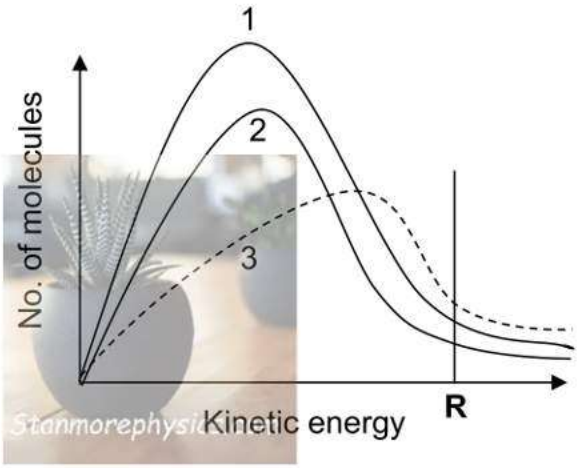
7.4 Calculate the volume of Y_2 injected in the system at STP. (6)

7.5 The size of the container is kept constant. Identify the disturbance at t_2. Explain the answer. (4)
[20]

QUESTION 8

8.1 Three energy distribution curves 1,2 and 3 for oxygen gas under different conditions are shown in the graph below:

Curve 2 represents 1 mol of oxygen gas at 70 °C



8.1.1 What does the line **R** represents? (1)

8.1.2 How will the addition of a suitable catalyst influence the position of **R**? Explain. (2)

8.1.3 Which curve best represents each of the following conditions?

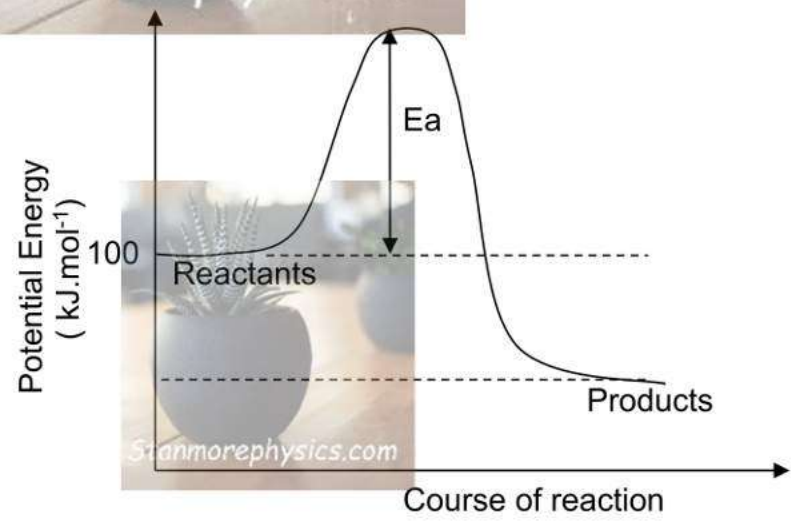
(a) 1 mol of oxygen gas at 90 °C (1)

(b) 2 mol of oxygen gas at 70 °C (1)

8.2 Consider the balanced chemical equation below:

$$Zn(s) + 2HC\ell(aq) \rightarrow ZnC\ell_2(aq) + H_2(g) \qquad \Delta H = -150 \text{ kJ·mol}^{-1}$$

The potential energy diagram for the reaction is drawn below.



8.2.1 Is the reaction exothermic or endothermic?
Explain the answer. (2)

8.2.2 How will the heat of the reaction (ΔH) change if the concentration of hydrochloric acid is decreased? Choose from INCREASES, DECREASES OR REMAINS THE SAME (1)

8.2.3 Calculate the energy of the product. (3)

8.2.4 Calculate the energy of the activated complex if the activation energy for the forward reaction is 90 kJ·mol^{-1}. (2)

8.2.5 Re-draw the potential energy diagram in the ANSWER BOOK, and on the same set of axes use dotted lines to indicate the effect of adding a catalyst on this reaction. (2)

[15]

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

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

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 1 H 1																	2 He 4
1,0 3 Li 7	1,5 4 Be 9											2,0 5 B 11	2,5 6 C 12	3,0 7 N 14	3,5 8 O 16	4,0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1,5 13 Aℓ 27	1,8 14 Si 28	2,1 15 P 31	2,5 16 S 32	3,0 17 Cℓ 35,5	18 Ar 40
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1,5 22 Ti 48	1,6 23 V 51	1,6 24 Cr 52	1,5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1,6 31 Ga 70	1,8 32 Ge 73	2,0 33 As 75	2,4 34 Se 79	2,8 35 Br 80	36 Kr 84
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1,4 40 Zr 91	41 Nb 92	1,8 42 Mo 96	1,9 43 Tc	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1,7 49 In 115	1,8 50 Sn 119	1,9 51 Sb 122	2,1 52 Te 128	2,5 53 I 127	54 Xe 131
0,7 55 Cs 133	0,9 56 Ba 137	57 La 139	1,6 72 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	1,8 81 Tℓ 204	1,8 82 Pb 207	1,9 83 Bi 209	2,0 84 Po	2,5 85 At	86 Rn
0,7 87 Fr	0,9 88 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

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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GRADE 12 / *GRAAD 12*

PHYSICAL SCIENCES / *FISIESE WETENSKAPPE*

JUNE / *JUNIE 2025*

MARKS / *PUNTE*: 150

MARKING GUIDELINES / *MERKRIGLYNE*.

This MEMO consists of 12 pages. / *Hierdie MEMO bestaan uit 12 bladsye.*

QUESTION /*VRAAG 1*

1.1 C ✓✓ (2)

1.2 A ✓✓ (2)

1.3 C ✓✓ (2)

1.4 D ✓✓ (2)

1.5 B ✓✓ (2)

1.6 D ✓✓ (2)

1.7 B ✓✓ (2)

1.8 D✓✓ (2)

1.9 B ✓✓ (2)

1.10 D ✓✓ (2)
[20]

QUESTION 2 / *VRAAG 2*

2.1.1 Organic compounds that consist of hydrogen and carbon atoms only ✓✓ (2)
Organiese verbindings wat slegs uit waterstof- en koolstofatome bestaan

2.1.2 C_nH_{2n+2} ✓ (1)

2.1.3 2,2,5-trimethylheptane
2,2,5-trimetielheptaan

Criteria/ *Kriteria*	Marks/ *Punte*
Heptane/*heptaan*	✓
trimethyl/*trimetiel*	✓
Correct numbers, commas and hyphens/ *Korrekte getalle, kommas en koppeltekens*	✓

(3)

2.2.1 Aldehyde ✓ (1)
Aldehied

2.2.2 CH_3COCH_3 ✓✓/ $CH_3\overset{O}{\overset{\|}{C}}CH_3$ (2)

Criteria/ *Kriteria*	Marks/Punte
Functional group/ *Funksionele groep*	✓
Whole structure correct/ *Hele struktuur korrek*	✓

2.2.3 Propanone ✓✓ accept: Propan-2-one / 2-Propanone (2/0) (2)
Propanoon aanvaar: Propaan-2-oon / 2-Propanoon

2.3.1 Simplest whole number ratio in which atoms combine in a compound✓✓ (2)
Eenvoudigste heelgetalverhouding waarin atome in 'n verbinding verbind

2.3.2

Mol of/*van* C	Mol of/*van* H	Mol of/*van* O
$\frac{58,82}{12}$ ✓	$\frac{9,81}{1}$ ✓	$\frac{31.37}{16}$ ✓
4,90	9,81	1,96
2,5	5	1
×2✓ 5	10	2

Molecular formula/*Molekulêre formule* : $C_5H_{10}O_2$ ✓

(5)

2.3.3 **POSITIVE MARKING FROM QUESTION 2.3.2/*POSITIEF NASIEN VANAF VRAAG 2.3.2***
C_2H_5OH ✓✓ / C_2H_6O (2)

[20]

QUESTION 3/ *VRAAG 3*

3.1 The pressure exerted by a vapour at equilibrium with its liquid in closed system.✓✓ (2)
Die druk wat deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem uitgeoefen word

3.2

Criteria/ *Kriteria*	Marks/ Punte
Dependent and independent variables correctly identified (intermolecular force/functional group & vapour pressure)/ *Afhanklike en onafhanklike veranderlikes korrek geïdentifiseer (intermolekulêre krag/funksionele groep en dampdruk)*	✓
There is a relationship between independent and dependent variable/ *Daar is 'n verband tussen onafhanklike en afhanklike veranderlike*	✓

If:
- No question mark indicated at the end of the investigative question, then penalise ONE mark. Max. 1/2
- Temperature is identified as one of the variables, then both marks are forfeited. Max. 0/2

Indien:
- Geen vraagteken word aan die einde van die ondersoekende vraag aangedui nie, dan word EEN punt gepenaliseer.
- Temperatuur word as een van die veranderlikes geïdentifiseer, dan word beide punte verbeur.

What is the effect of changing intermolecular force on vapour pressure?✓✓
Wat is die effek van die verandering van intermolekulêre krag op dampdruk?

OR

What is the relationship between the intermolecular force and vapour pressure? (2)
Wat is die verband tussen die intermolekulêre krag en dampdruk?

3.3 68°C ✓✓ (Range/ *Variansie (*67°C - 69°C) (2)

3.4 **Y**✓; because the vapour pressure of **W** is higher than that of **Y.**✓✓
/boiling point of **W** is lower than the boiling point of **Y.**✓✓
OR
vapour pressure of **Y** is lower than that of **W.**/ boiling point of **Y** is higher than the boiling point of **W.**
***Y** ; Die dampdruk van **W** is hoër as die van **Y.** / dus is die kookpunt van **W** laer as die van **Y**.*
OF
*Die dampdruk van **Y** is laer as die van **W.** / dus is die kookpunt van **Y** hoër as die van **W**.* (3)

3.5 Carboxyl (group)✓✓ (2)
Karboksiel (groep)

3.6

- X/aldehyde (in addition to London forces dispersion forces) has dipole-dipole forces✓
- Y/alcohol (in addition to London forces dispersion forces, dipole-dipole forces has one site) of hydrogen bonding✓
- Hydrogen bonding in Y/alcohol are stronger than dipole-dipole forces in X/aldehyde ✓

  OR

  Intermolecular forces in Y/alcohol are stronger than the intermolecular forces in X/aldehyde
- More energy is required to overcome the intermolecular force in Y/alcohol than in X/aldehydes✓

- *X/aldehied (benewens die dispersiekragte van Londense kragte) het dipool-dipool kragte*
- *Y/alkohol (benewens Londense kragte se verspreidingskragte, dipool-dipoolkragte het een plek) van waterstofbinding*
- *Waterstofbindings in Y/alkohol is sterker as dipool-dipoolbindings kragte in X/aldehied*

  OF
- *Intermolekulêre kragte in Y/alkohol is sterker as die intermolekulêre kragte in X/aldehied*
- *Meer energie word benodig om die intermolekulêre krag in Y/alkohol as in X/aldehiede te oorkom.*

OR/*OF*

- X/aldehyde in addition to London forces/dispersion forces has dipole-dipole forces✓
- Y/alcohol (in addition to London forces/dispersion forces/dipole-dipole forces has one site) of hydrogen bonding✓
- X/aldehyde has dipole-dipole forces which are weaker than hydrogen bonding in Y/alcohol✓

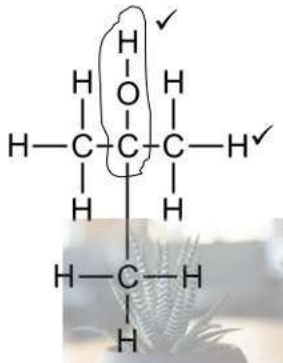
  OR
- Intermolecular forces in Y/alcohol are stronger than the intermolecular forces in X/aldehyde
- More energy is required to overcome the intermolecular force in Y/alcohol than in X/aldehydes✓

- *X/aldehied benewens Londense kragte/dispersiekragte het dipool-dipool kragte*✓
- *Y/alkohol (benewens Londense kragte/dispersiekragte/dipool-dipoolkragte het een plek) van waterstofbinding*✓
- *X/aldehied het dipool-dipoolkragte wat swakker is as waterstofbinding in Y/alkohol*✓

  OF
- *Intermolekulêre kragte in Y/alkohol is sterker as die intermolekulêre kragte in X/aldehied*
- *Meer energie word benodig om die intermolekulêre krag in Y/alkohol as in X/aldehiede te oorkom.*✓ (4)

3.7.1

Criteria/ *Kriteria*	Marks/Punte
Functional group/ *Funksionele groep*	✓
Whole structure correct/ *Hele struktuur korrek*	✓



(2)

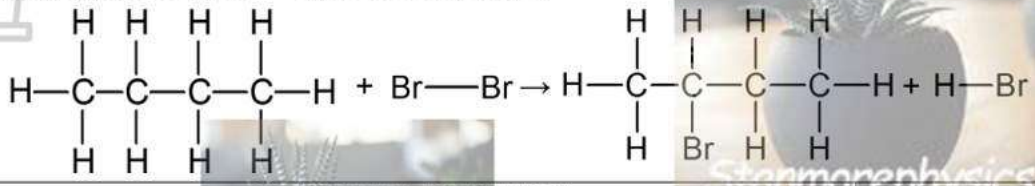
3.7.2 Tertiary alcohol✓, the carbon atom bonded to the hydroxyl group is bonded to three other carbon atoms✓ (2)
Tersiêre alkohol, die koolstofatoom gebind aan die hidroksielgroep is gebind aan drie ander koolstofatome

[19]

QUESTION 4/ *VRAAG 4*

4.1.1 Saturated ✓
It contains carbon-to-carbon single bonds only.✓ (2)
Versadig
Dit bevat slegs koolstof-tot-koolstofbindings, enkelbindings.

4.1.2 Hydrogen bromide ✓ *Waterstofbromied* (1)

4.1.3 

CRITERIA/ *KRITERIA*	Marks/ Punte
Correct structure of organic reactant/ *Korrekte struktuur van organiese reaktant*	✓
Correct functional group of organic product/ *Korrekte funksionele groep van organiese produk*	✓
Whole structure organic product is correct / *Hele struktuur organiese produk is korrek*	✓
Correct structure of the inorganic product/ *Korrekte struktuur van die anorganiese produk* Accept HBr/ *Aanvaar HBr*	✓
If condensed structures are used/ *Indien gekondenseerde strukture gebruik word*	¾ max/maks

(4)

4.2.1 Combustion/Oxidation (reaction) ✓ *Verbranding/Oksidasie (reaksie)* (1)

4.2.2 $C_5H_{12} + 8O_2$ ✓→ $5CO_2 + 6H_2O$ ✓ (bal) ✓ (3)

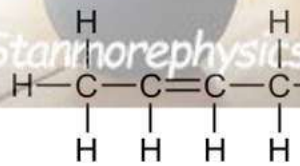
4.3.1 High pressure ✓ *Hoë druk* (1)

4.3.2 $CH_3CH_2CH_2CH_2CH_2CH_3$ ✓ → **3**CH_2CH_2 ✓ + H_2✓ (3)
(Give 2/3 if structural formulae are used/*Gee 2/3 indien strukturele formules gebruik word*)

4.3.3 Addition/Hydrogenation ✓/ *Addisie/Hidrogenering*
C_2H_6 ✓ (2)

4.4.1 Elimination/dehydrohalogenation ✓/ *Eliminasie/dehidrohalogenering* (1)

4.4.2 Concentrated ✓/ *Gekonsentreerd* (1)

4.4.3 

CRITERIA/ *KRITERIA*	Marks/ Punte
Correct functional group/ *Korrekte funksionele groep*	✓
Whole structure correct/ *Hele struktuur korrek*	✓

(2)
[21]

QUESTION 5 / *VRAAG 5*

5.1 Change in concentration of reactants or products per unit time.✓✓ (2)
Verandering in konsentrasie van reaktante of produkte per tydseenheid.
Accept/*Aanvaar*
Rate of change in concentration/*Tempo van verandering in konsentrasie*

5.2 No,✓ more than one independent variable ✓ (2)
Nee, meer as een onafhanklike veranderlike

5.3.1 Reaction rate ✓/ *Reaksietempo* (1)

5.3.2 Concentration (of the acid)✓/ *Konsentrasie (van die suur)* (1)
Accept/*Aanvaar:* Mass of Mg/ *Massa van Mg*

5.4 **C** will have a higher reaction rate ✓/ ***C** sal 'n hoër reaksietempo hê*

- HCℓ concentration in experiment A is less than in experiment C ✓
- Less particle available to react in experiment A than in experiment C per unit volume (according to c = $\frac{n}{v}$).✓
- Less particles with correct orientation/sufficient kinetic energy in experiment A than in experiment C. ✓
- Less effective collision per unit time in experiment A. ✓

- *HCℓ konsentrasie in eksperiment A is minder as in eksperiment C*
- *Minder deeltjie beskikbaar om in eksperiment A te reageer as in eksperiment C per eenheidsvolume (volgens c =$\frac{n}{v}$)*
- *Minder deeltjies met korrekte oriëntasie/voldoende kinetiese energie in eksperiment A as in eksperiment C.*
- *Minder effektiewe botsing per tydseenheid in eksperiment A.*

OR /*OF*

- HCℓ concentration in experiment C is greater than in experiment A.
- More particle available to react in experiment C than in experiment A per unit volume (according to c = $\frac{n}{v}$).
- More particles with correct orientation/sufficient kinetic energy in experiment C than in experiment A.
- More effective collision per unit time in experiment C.

- *HCℓ konsentrasie in eksperiment C is groter as in eksperiment A.*
- *Meer deeltjie beskikbaar om in eksperiment C te reageer as in eksperimen A per eenheidsvolume (volgens c = $\frac{n}{v}$).*
- *Meer deeltjies met korrekte oriëntasie/voldoende kinetiese energie in eksperiment C as in eksperiment A.*
- *Meer effektiewe botsing per tydseenheid in eksperiment C.* (5)

5.5

$$n_{(Mg)} = \frac{m}{M}$$

$$= \frac{5}{24} \checkmark$$

$$= 0,208 \text{ mol}$$

Mol ratio/ *Molverhouding*
Mg: HCℓ
1: 2✓

$n(HCℓ)_{reacted/gereageer} = 0,415$ mol

$$c = \frac{n}{V} \checkmark$$

$$0,9 = \frac{n}{0,5} \checkmark$$

$n(HCℓ)_{initial/aanvanklike} = 0,45$ mol

n (HCℓ) unreacted/*oormaat* = 0,45 – 0,415✓
= 0,035 mol ✓ (6)

Range/ *Reeks*: (0,033 – 0,037)

5.6.1 Ca ✓ HCℓ is in excess ✓/ *HCℓ is in oormaat* (2)

5.6.2 Nature of the reacting substance ✓/ *Aard van die reagerende stof* (1)

5.6.3 B ✓ (1)

5.6.4 Number of moles of Mg reacting with HCℓ is greater than number of moles of Ca reacting with HCℓ ✓✓ (2)
Aantal mol Mg wat reageer met HCℓ is groter as die aantal mol van Ca wat met HCℓ reageer

5.7 Ca ✓ (1)

5.8 Reactivity increases down the group ✓
Reaktiwiteit neem toe afwaarts in die groep (1)
[25]

QUESTION6 / *VRAAG 6*

6.1 When the equilibrium of an isolated system is disturbed, the system will reinstate the new equilibrium by favouring the reaction that opposes disturbance.✓✓ (2)
Wanneer die ewewig van 'n geïsoleerde sisteem versteur word, sal die sisteem die nuwe ewewig herstel deur die reaksie wat die versteuring teenstaan, te bevoordeel.

6.2.1 Increases ✓/ *Verhoog* (1)

6.2.2 Increases ✓/ *Verhoog* (1)

6.2.3 System will decrease $CO_2(g)$ by favouring the reaction that uses up $CO_2(g)$.✓
Forward reaction favoured.✓
Thus causes an increase in the yield of CO. (2)

Stelsel sal $CO_2(g)$ verminder deur die reaksie wat opgebruik, te bevoordeel. $CO_2(g)$.
Voorwaartse reaksie bevoordeel.
Dus veroorsaak dit 'n toename in die opbrengs van CO.

6.3.1 Increases✓/ *Verhoog*

- An increase in pressure favours the reaction which produces the least number of gas moles.✓
- The reverse reaction is favoured.✓ (3)

- *'n Toename in druk bevoordeel die reaksie wat die minste aantal gasmol.*
- *Die omgekeerde reaksie word bevoordeel.*

6.3.2 No effect✓ Temperature is the only factor affecting Kc value (1)
Geen effek nie, Temperatuur is die enigste faktor wat die Kc-waarde beïnvloed

[10]

QUESTION 7

7.1.1 A system that is isolated to its surroundings/ A system where substances cannot leave/escape the container.✓✓ (2)
'n Sisteem wat van sy omgewing geïsoleer is/ 'n Sisteem waar stowwe nie die houer kan verlaat/ontsnap nie.

7.1.2 Rate of the forward reaction is equal to the rate of the reverse reaction.✓✓ (2)
Die tempo van die voorwaartse reaksie is gelyk aan die tempo van die terugwaartse reaksie

7.2 Chemical equilibrium.✓/ *Chemiese ewewig.* (1)

7.3

Using moles
Marking criteria
- Divide the equilibrium moles by 2 dm^3✓
- Correct Kc expression.✓
- Substitution of Kc of 0,2197 value correctly.✓
- The correct value of X_2 concentration.✓
- Correct substitution of values on the numerator.

Gebruik van molle
Merkkriteria
- *Deel die ewewigsmolle deur 2 dm^3*
- *Korrekte Kc uitdrukking.*
- *Korrekte vervanging van Kc van 0,2197 waarde.*
- *Die korrekte waarde van X_2 konsentrasie.*
- *Korrekte vervanging van waardes op die teller.*

$K_c = \frac{[XY_3]^2}{[X_2][Y_2]^3}$ ✓

$0,2197$ ✓$= \frac{[0,25]^2}{[0,4][Y_2]^3}$ ✓ ✓

$[Y_2] = 0,89\ mol{\cdot}dm^{-3}$ ✓

(5)

7.4 **POSITIVE MARKING FROM QUESTION 7.3/*POSITIEF NASIEN VANAF VRAAG 7.3.***

Marking criteria:
- $n(Y_2)$ equilibrium × 2 dm^3. ✓
- Correct use of mole ratio between Y_2: XY_3 - 3:2 to find reacted moles of Y_2.✓
- Initial moles ($n(Y_2)$ equilibrium + $n(Y_2)$change/reacted).✓
- Formula $n(Y_2)=\frac{V}{Vm}$.✓
- Correct substitution into $n(Y_2)\text{initial}=\frac{V}{Vm}$.✓
- Final answer.✓

Merkkriteria:
- $n(Y_2)$ ewewig × 2 dm^3.✓
- Korrekte gebruik van molverhouding tussenY_2:XY_3 - 3:2 om gereageerde mol Y_2 te vind.✓
- Aanvanklike molle($n(Y_2)$ ewewig + $n(Y_2)$verander/gereageer).✓
- Formulen $(Y_2)=\frac{V}{Vm}$.✓
- Korrekte vervanging in $n(Y_2)\text{initial}=\frac{V}{Vm}$.✓
- Finale antwoord.✓

	X_2	Y_2	XY_3
Initial/*Aanvanklik* (mol)	1,05	2,53✓	0
Change/*Verandering* (mol)	0,25	0,75	0,5 ✓
Equilibrium/*Ewewig* (mol)	0,8	1,78✓	0,5
Equilibrium concentration/ *Ewewigskonsentrasie* $c=\frac{n}{v}$ (mol·dm^{-3})	0,4	0,89	0,25

$n(Y_2)=\frac{V}{Vm}$✓

$2,53=\frac{V}{22,4}$ ✓

V = 56,67 dm^3 ✓ (6)

Range/ *Reeks*: (56,5 – 56,8)

7.5 Increase in temperature.✓
- Increase in temperature favours the endothermic reaction✓
- Reverse reaction is favoured.✓
- The numbers of mole XY_3 decreases and the number of moles of X_2 and Y_2 increases.✓ (4)

Toename in temperatuur.
- *Toename in temperatuur bevoordeel die endotermiese reaksie.*
- *Omgekeerde reaksie word bevoordeel.*
- *Die aantal mol XY_3 neem af en die aantal mol X_2 en Y_2 neem toe.*

[20]

QUESTION 8/ *VRAAG 8*

8.1.1 Activation energy ✓/*Aktiveringenergie* (1)

8.1.2 Shifts to the left✓
It provides an alternative pathway of lower activation energy✓ (2)
Skuif na links
Dit bied 'n alternatiewe pad van laer aktiveringsenergie

8.1.3 (a) (curve/*kromme)* 3 ✓ (1)

(b) (curve/*kromme)* 1 ✓ (1)

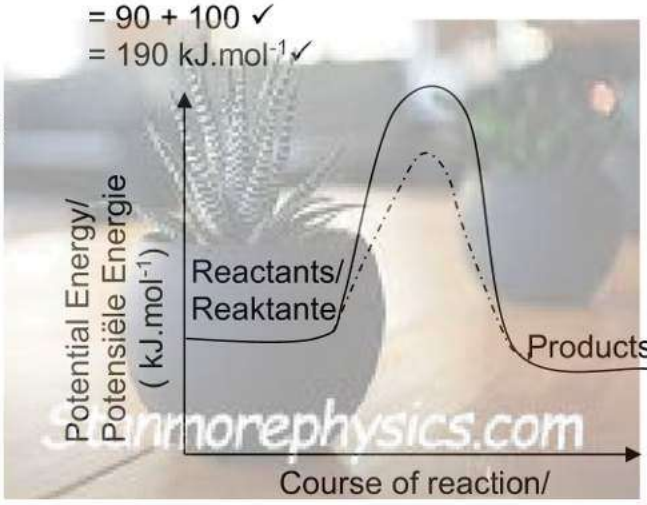
8.2.1 Exothermic ✓, ΔH is less than zero/energy of the reactants is more than the energy of the products ✓ (2)
Eksotermies, ΔH is minder as nul/energie van die reaktante is meer as die energie van die produkte

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

8.2.3 $\Delta H = H_P - H_R$
-150 ✓ $= H_P - 100$ ✓
$H_P = -50\ kJ.mol^{-1}$✓ (3)

8.2.4 $E_{AC} = E_A + H_R$
$= 90 + 100$ ✓
$= 190\ kJ.mol^{-1}$✓ (2)

8.2.5



CRITERIA /*KRITERIA*	
Energy of products and reactants stays the same/ *Energie van produkte en reaktante bly dieselfde*	✓
Lower activation energy for the catalysed reaction/ *Laer aktiveringsenergie vir die gekataliseerde reaksie*	✓

(2)

[15]

GRAND TOTAL *GROOTTOTAAL*: 150