education

Department of Education
FREE STATE PROVINCE

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 ✓✓/ $CH_3\overset{\overset{\displaystyle O}{\|}}{C}CH_3$ (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.*

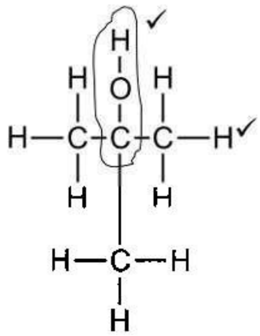
OR/*OF*

- 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)

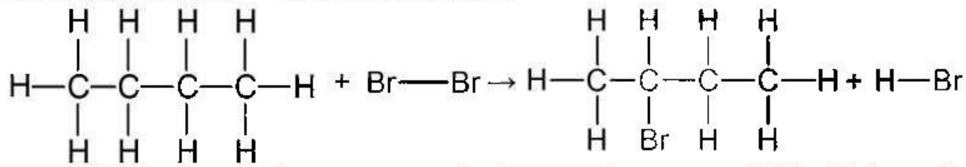
3.7.2 Tertiary alcohol✓, the carbon atom bonded to the hydroxyl group is bonded to three other carbon atoms✓ (2)
Tersiêre alkohol, die koolstofatoom gebind aan die hidroksielgroep is gebind aan drie ander koolstofatome

[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)

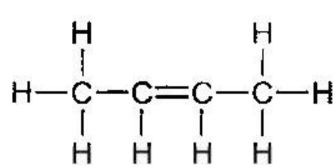
4.3.1 High pressure ✓ *Hoë druk* (1)

4.3.2 $CH_3CH_2CH_2CH_2CH_2CH_3$ ✓ → $\mathbf{3}CH_2CH_2$ ✓ + 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* $c=\frac{n}{v}$ ($mol\cdot dm^{-3}$)	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)

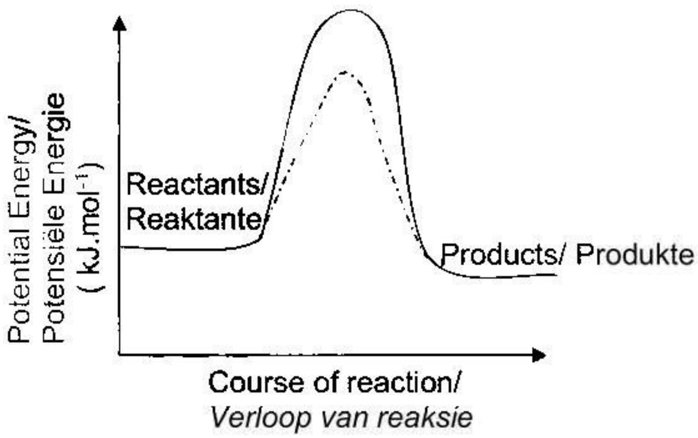
8.2.1 Exothermic ✓, ΔH is less than zero/energy of the reactants is more than the energy of the products ✓ (2)
Eksotermies, ΔH is minder as nul/energie van die reaktante is meer as die energie van die produkte

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