



**NATIONAL
SENIOR CERTIFICATE/
NASIONALE
SENIORSERTIFIKAAT**

GRADE/GRAAD 11

NOVEMBER 2023

**PHYSICAL SCIENCES P2
MARKING GUIDELINE/
FISIESE WETENSKAPPE V2
NASIENRIGLYN**

MARKS/PUNTE: 150

This marking guideline consists of 12 pages./
Hierdie nasienriglyn bestaan uit 12 bladsye.

QUESTION/VRAAG 1

- | | | |
|------|------|-------------|
| 1.1 | D ✓✓ | (2) |
| 1.2 | A ✓✓ | (2) |
| 1.3 | A ✓✓ | (2) |
| 1.4 | C ✓✓ | (2) |
| 1.5 | B ✓✓ | (2) |
| 1.6 | C ✓✓ | (2) |
| 1.7 | C ✓✓ | (2) |
| 1.8 | A ✓✓ | (2) |
| 1.9 | C ✓✓ | (2) |
| 1.10 | C ✓✓ | (2) |
| | | [20] |

QUESTION/VRAAG 2

- 2.1 2.1.1 A group of two or more atoms covalently bonded ✓ that function as a unit. ✓
'n Groep van twee of meer atome wat kovalent verbind ✓ is en wat as 'n eenheid funksioneer. ✓ (2)
- 2.1.2 H_3O^+ ✓ (1)
- 2.1.3 NaCl ✓ (1)
- 2.1.4 NaCl ✓ (1)
- 2.2 2.2.1 $\text{H} : \underset{\text{H}}{\underset{\cdot\cdot}{\text{N}}} : \text{H}$ ✓✓ (2)
- 2.2.2 $\text{H} : \text{C} :: \underset{\cdot\cdot}{\text{N}}$ ✓✓ (2)
- 2.3 1 ✓ (1)
- 2.4 Non-polar ✓
 • B – Cl is a polar bond ✓ ($\Delta\text{EN} = 3,0 - 2,0 = 1$)
 • BCl_3 is a trigonal planar ✓
 • Charge distribution / molecular geometry / molecule is symmetrical ✓ /
 The polar bonds cancel each other out
- Nie-polêr*
 • B – Cl is 'n polêre binding ($\Delta\text{EN} = 3,0 - 2,0 = 1$)
 • BCl_3 het 'n trigonaal planêre vorm
 • Lading verspreiding / molekulêre vorm (geometrie) / molekule is simmetries / Die polêre bindings kanselleer mekaar uit. (4)
- 2.5 2.5.1 It is the energy needed to break one mole ✓ of a compound's molecules into separate atoms. ✓
Dit is die energie wat benodig word om een mol van 'n verbinding se molekules in aparte atome op te breek. (2)
- 2.5.2 B ✓ (1)
- 2.6 2.6.1 $\text{C} \equiv \text{C}$ ✓ (1)
- 2.6.2
 • The higher the bond energy the stronger the forces of attraction between the nuclei. ✓
 • The nuclei come closer resulting in a shorter length. ✓
 • Hoe hoër die bindingsenergie hoe sterker is die aantrekkingskragte tussen die kerne.
 • Die kerne kom nader aan mekaar wat na korter lengte lei. (2)

[20]

QUESTION/VRAAG 3

- 3.1 The temperature at which the vapour pressure ✓ of a liquid equals the atmospheric pressure ✓

Die temperatuur waarby die dampdruk van 'n vloeistof gelyk aan die atmosferiese druk is. (2)

- 3.2 Gas phase / Gasfase ✓ (1)

3.3 **From A to D / Van A tot D**

- The molecular size / surface area increases ✓
- The strength of the London forces / dispersion forces/ induced dipole forces increases ✓
- More energy is needed to overcome the intermolecular forces. ✓
- *Die molekulêre grootte / oppervlakte neem toe.*
- *Die sterkte van die London-krag / Dispersiekrag / geïnduseerde dipool-kragte neem toe.*
- *Meer energie word benodig om die intermolekulêre kragte te oorkom.*

OR / OF

From D to A / Van D tot A

- The molecular size / surface area decreases ✓
- The strength of the London forces / dispersion forces/ induced dipole forces decreases ✓
- Less energy is needed to overcome the intermolecular forces. ✓
- *Die molekulêre grootte / oppervlakte neem af*
- *Die sterkte van die London-krag / dispersiekrag / geïnduseerde dipool-kragte neem af*
- *Minder energie word benodig om die intermolekulêre kragte te oorkom.* (3)

- 3.4 CH₄ ✓
Lowest boiling point / Laagste kookpunt ✓ (2)

- 3.5 Higher than / Hoër as ✓ (1)

- 3.6
- HCl has dipole-dipole forces ✓
 - CH₄ have London/dispersion/induced dipole forces
 - Dipole forces are stronger than the London/dispersion/induced dipole forces ✓
 - More energy is needed to overcome the intermolecular forces in HCl ✓
 - *HCl het dipool-dipoolkragte*
 - *CH₄ het London / verpreidings / geïnduseerde dipool-kragte*
 - *Dipoolkragte is sterker as die London/verpreidings/geïnduseerde dipool-kragte*
 - *Meer energie word benodig om die intermolekulêre kragte in HCl te oorkom*

OR / OF

- HCl has dipole-dipole forces ✓
- CH_4 have London/dispersion/induced dipole forces
- The London/dispersion/induced dipole forces are weaker than the dipole-dipole forces ✓
- Less energy is needed to overcome the intermolecular forces in CH_4 ✓
- *HCl het dipool-dipoolkragte*
- *CH_4 het London/verspreidings/geïnduseerde dipoolkragte*
- *Die London/verpreidings/ geïnduseerde dipoolkragte is swakker as die dipool-dipoolkragte*
- *Minder energie word benodig om die intermolekulêre kragte in CH_4 te oorkom*

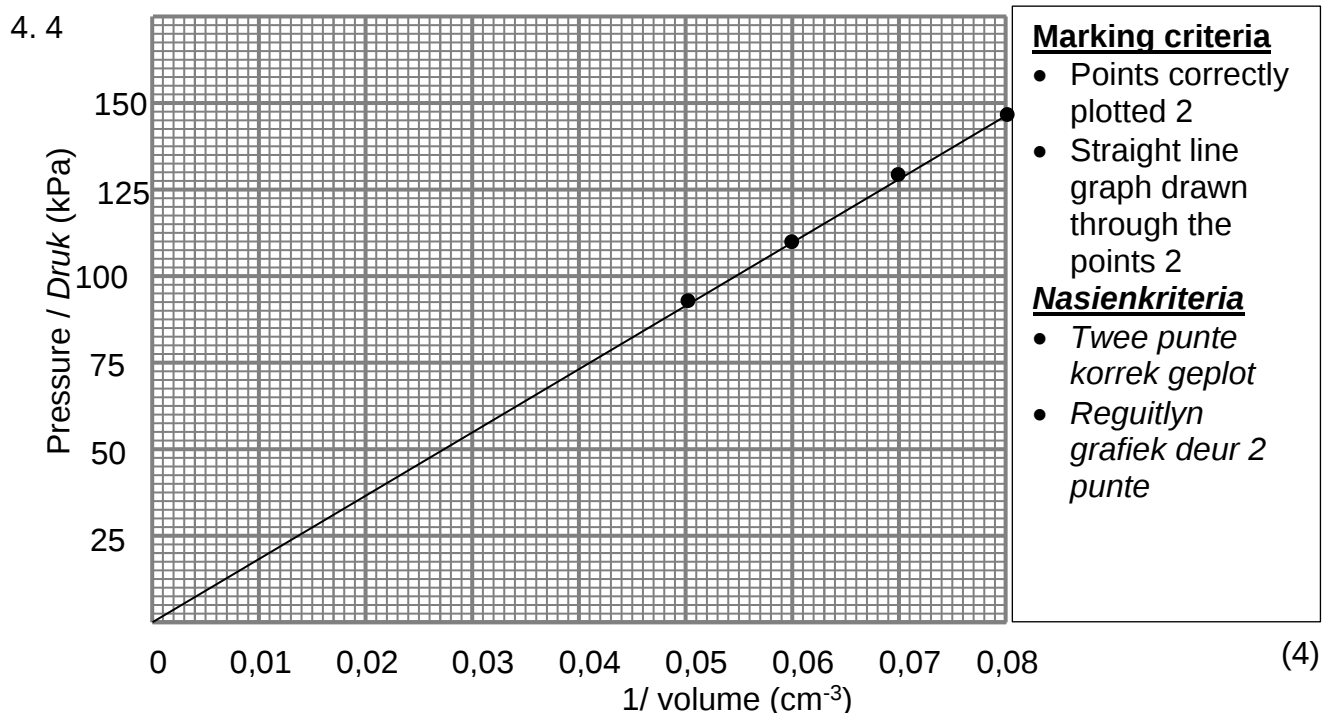
(3)
[12]

QUESTION/VRAAG 4

4.1 Boyles law / Boyle se wet ✓ (1)

4.2 Temperature or amount of gas / Temperatuur of hoeveelheid gas ✓ (1)

4.3 (Bourdon) Pressure gauge / (Bourdon) drukmeter ✓ (1)



4.5 Pressure is directly proportional to the inverse of volume ✓ / Pressure is inversely proportional to volume. ✓
Druk is direk eweredig aan die omgekeerde volume / Druk is omgekeerd eweredig aan die volume. (2)

4.6 $p_1V_1 = p_2V_2$ ✓
 $(148)(1/0,08) ✓ = (184)V_2 ✓$
 $V_2 = 10,05 \text{ cm}^3 ✓$ (Any other correct point / Enige ander punte wat korrek is) (4)

4.7 At high pressure ✓ the volume of (real gas) particles become significant. ✓
By hoë temperatuur sal die volume van 'n (egtegas) deeltjies aansienlik word. (2)

4.8 NH_3 has strong ✓ hydrogen bonds ✓ (and at low temperature it will easily liquify).
 NH_3 het sterk ✓ waterstofbindings ✓ (en by lae temperature sal dit maklik 'n vloeistof word.) (2)

[17]

QUESTION/VRAAG 5

5.1 5.1.1 ENDOTHERMIC/ENDOTERMIES ✓ (1)

5.1.2 $\Delta H > 0$ ✓✓/Net energy is absorbed/Energy of products greater than that of reactants.

$\Delta H > 0$ / Netto energie word geabsorbeer / Energie van die produkte is hoër as dié van die reaktanse. (2)

5.1.3 Number of particles / atoms / molecules / formula-units in one mole. ✓

Aantal deeltjies / atome / molekules / formule-eenhede in een mol. (1)

5.1.4 (a) $n = m / M$

$$n = 0,163 / 44 \checkmark$$

$$n = 0,0037 \text{ mol}$$

$$N = nN_A \checkmark$$

$$N = (0,0037)(6,02 \times 10^{23}) \checkmark$$

$$N = 2,227 \times 10^{21} \text{ particles/deeltjies} \checkmark \quad (4)$$

5.1.4 (b) Marking criteria / Nasienkriteria

- Mole ratio / Mol verhouding $\text{CO}_2 : \text{CaCO}_3$
- Subst. $n(\text{CaCO}_3)$ mole into/ Vervang $n(\text{CaCO}_3)$ in $m = nM$

$$n(\text{CO}_2) \text{ formed / gevorm} = 0,0037 \text{ mol}$$

$$n(\text{CaCO}_3) \text{ reacting / reageer} = 0,0037 \text{ mol} \checkmark$$

$$n(\text{CaCO}_3) \text{ initial / aanvanklik} = m/M = 1,56/100 \checkmark = 0,0156 \text{ mol}$$

OPTION 1 / OPSIE 1 <u>Marking criteria / Nasienkriteria</u>	OPTION 2 / OPSIE 2 <u>Marking criteria / Nasienkriteria</u>
• Subtraction of CaCO_3 mole/ Aftrekking van CaCO_3 mol • Mole remaining into / Mol oorbly in $m = nM$ • Final answer / Finale antwoord	• Mole reacting into / Mol reageer in $m = nM$ • Subtraction of CaCO_3 mass/ Aftrekking van CaCO_3 massa • Final answer / Finale antwoord
$n(\text{remaining / oorbly}) = 0,0156 - 0,0037 \checkmark$ $n(\text{remaining / oorbly}) = 0,0119 \text{ mol}$ $m(\text{remaining / oorbly}) = 0,0119 \times 100 \checkmark$ $m(\text{remaining / oorbly}) = 1,19 \text{ g} \checkmark$	$m(\text{react / reageer}) = 0,0037 \times 100 \checkmark$ $m(\text{react / reageer}) = 0,37 \text{ g}$ $m(\text{remaining / oorbly}) = 1,56 - 0,37 \checkmark$ $m(\text{remaining / oorbly}) = 1,19 \text{ g} \checkmark$

(5)

5.2 **Marking criteria**

- Subst. into $n = m / M$ e.g. $44,4 / 12$; $6,21 / 1$; $39,5 / 32$; $9,86 / 16$
- Dividing by the smallest mole number 0,62
- Ratio molecular mass: Formula mass
- Molecular formula

Nasienkriteria

- Vervanging in $n = m / M$ bv $44,4 / 12$; $6,21 / 1$; $39,5 / 32$; $9,86 / 16$
- Deel deur die kleinste mol getal 0,62
- Verhouding molekulêre massa : Formule massa
- Molekulêre formule

Element	Mass / Massa	Mole ($n = m / M$)	Simplest ratio/ Vereenvoudigste verhouding	Div. by / Deel deur 0,62 ✓
C	44,4	$44,4 / 12$ ✓ = 3,7	$3,7 / 0,62$ = 6	
H	6,21	$6,21 / 1$ ✓ = 6,21	$6,21 / 0,62$ = 10	
S	39,5	$39,5 / 32$ ✓ = 1,23	$1,23 / 0,62$ = 2	
O	9,86	$9,86 / 16$ ✓ = 0,62	$0,62 / 0,62$ = 1	

Empirical formula / *Emperiese formule*: $C_6H_{10}S_2O$

Formula mass/ *Formule massa* = $6(12) + 10(1) + 2(32) + 16 = 162$

Ratio = Molar mass: Empirical formula

Verhouding = Molekulêre massa: Emperiese formule

Ratio/ *Verhouding* = 1 : 1 ✓

Molecular formula / *Molekulêre formule*: $C_6H_{10}S_2O$ ✓

(7)
[20]

QUESTION/VRAAG 6

- 6.1 The substance that is completely used up/reacted ✓✓ during a chemical reaction.
Dit is die stof wat heeltemal opgebruik word / volledig gereageer tydens 'n chemiese reaksie. (2)

- 6.2 Avogadro's ✓ (law / se wet) (1)

6.3 **Marking criteria / Nasienkriteria**

- Formula / Formule $n = V / V_m$
- Subst. into / Vervanging in $n = V / V_m$
- Mole ratio / Mol verhouding $\text{CO}_2 : \text{HCl}$
- Compare required and available mole / Vergelyk die vereiste en beskikbare mol
- Correct identification of limiting reagent / Identifiseer die korrekte beperkende reagents

$$n(\text{CO}_2) = V / V_m \checkmark$$

$$n(\text{CO}_2) = 0,448 / 24,47 \checkmark$$

$$n(\text{CO}_2) = 0,018 \text{ mol}$$

$$n(\text{HCl}) \text{ required/benodig} = 1/2 n(\text{CO}_2)$$

$$n(\text{HCl}) \text{ required/benodig} = 1/2 n(0,018) \checkmark$$

$$n(\text{HCl}) \text{ required/benodig} = 0,009 \text{ mol}$$

$$n(\text{HCl}) \text{ available/beskikbaar} = 0,028 \text{ mol}$$

} ✓

$$\therefore \text{Na}_2\text{CO}_3 \text{ is the limiting reagent / is die beperkende reagents } \checkmark \quad (5)$$

- 6.4 $n(\text{CO}_2) = n(\text{Na}_2\text{CO}_3) = 0,018 \text{ mol } \checkmark$

$$m = nM \checkmark$$

$$m = (0,018)(106) \checkmark$$

$$m = 1,908 \text{ g } \checkmark$$

(4)
[12]

QUESTION/VRAAG 7

7.1 The minimum energy required ✓ for a chemical reaction to start. ✓
 Die minimum energy benodig vir 'n chemiese reaksie om te begin. (2)

7.2 7.2.1 **RP** = ΔH ✓ / Heat of reaction / Enthalpy / Reaksiewarmte / Entalpie (1)

7.2.2 **QP** = Activation energy / Aktiveringsenergie ✓ (1)

7.3 ΔH reaction / reaksie = H products / produkte – H reactants / reaktanse ✓

$$- 216,7 = H \text{ products / produkte} - 400 \checkmark$$

$$H \text{ products / produkte (X)} = 183,3 \checkmark \text{ (kJ} \cdot \text{mol}^{-1}) \quad (3)$$

7.4 DECREASES / NEEM AF ✓ (1)

7.5 **Marking Criteria**

- Use volume ratios to find $V(\text{O}_2)$, $V(\text{NO})$ and $V(\text{H}_2\text{O})$
- Finding $V(\text{O}_2)$ remaining
- Adding $V(\text{O}_2)$, $V(\text{NO})$ and $V(\text{H}_2\text{O})$
- Conversion to dm^3
- Final answer

Nasienkriteria

- Gebruik die volume verhouding om $V(\text{O}_2)$, $V(\text{NO})$ en $V(\text{H}_2\text{O})$ te vind.
- Vind $V(\text{O}_2)$ wat oorbly
- Tel $V(\text{O}_2)$, $V(\text{NO})$ en $V(\text{H}_2\text{O})$ bymekaar
- Herlei na dm^3
- Finale antwoord

$$V(\text{O}_2) \text{ reacting/reageer} = 5/4 \times 60 = 75 \text{ cm}^3$$

$$V(\text{NO}) \text{ formed/gevorm} = V(\text{NH}_3) \text{ reacting/reageer} = 60 \text{ cm}^3 \quad \checkmark$$

$$V(\text{H}_2\text{O}) \text{ formed/ gevorm} = 6/4 \times 60 = 90 \text{ cm}^3$$

$$V \text{ O}_2 \text{ remaining/oorbly} = (90 - 75) = 15 \text{ cm}^3 \checkmark$$

$$V \text{ total / totaal} = 15 + 60 + 90 \checkmark$$

$$V \text{ total / totaal} = 165/1\,000 \text{ dm}^3 \checkmark$$

$$= 0,165 \text{ dm}^3 \checkmark \quad (5)$$

7.6 HIGHER / HOËR ✓ (1)

[14]

QUESTION/VRAAG 8

- 8.1 8.1.1 Acid is a proton/ H^+ -ion donor ✓✓
'n Suur is 'n proton / H^+ -oonskenker (2)
- 8.1.2 Acid/ *Suur*. ✓
 Donates a proton / *Skenk 'n proton* ✓ / (H^+ -ion) (2)
- 8.1.3 H_3O^+ ✓ (1)
- 8.1.4 Blue / *Blou* ✓ (1)
- 8.2.1 The amount of solute ✓ per litre of solution ✓
Die hoeveelheid opgeloste stof per liter oplossing (2)
- 8.2 8.2.2 $n = cV$ ✓
 $n = (0,9) (0,1)$ ✓
 $n = 0,09 \text{ mol}$ ✓ (3)
- 8.2.3 **Positive marking from / Positiewe nasien vanaf 8.2.3**

Marking criteria / Nasienkriteria

- Subst. conc. and volume of / *Vervang kons. en volume van NaOH into $n = cV$*
- Use of mol ratio / *Gebruik mol verhouding NaOH : HCl*
- Subtract mol in reaction 2 with total mol / *Trek mol in reaksie 2 af van totale mol*
- Use mol ratio/ *Gebruik mol verhouding HCl:MCO₃*
- Subst into / *Vervang in $M = m / n$*
- Determine the molar mass of / *Bepaal die molêre massa van M*
- Correctly identify M / *Identifiseer M korrek*

$$n(\text{NaOH}) = cV$$

$$n(\text{NaOH}) = (0,8)(0,025) \checkmark$$

$$n(\text{NaOH}) = 0,02 \text{ mol}$$

$$n(\text{NaOH}) = n(\text{HCl}) \text{ in excess / in oormaat} = 0,02 \text{ mol } \checkmark$$

$$n(\text{HCl}) \text{ reacting with carbonate/reageer met karbonaat} = 0,09 - 0,02 \checkmark$$

$$n(\text{HCl}) = 0,07 \text{ mol}$$

$$n(\text{MCO}_3) = \frac{1}{2} (0,07) \checkmark$$

$$n(\text{MCO}_3) = 0,035 \text{ mol}$$

$$M = m / n$$

$$M = 3,5 / 0,035 \checkmark$$

$$M = 100 \text{ g} \cdot \text{mol}^{-1}$$

$$M + 12 + 3 (16) = 100 \checkmark$$

$$M = 40 \text{ g} \cdot \text{mol}^{-1}$$

$$M = \text{Ca} \checkmark$$

(7)
[18]

QUESTION/VRAAG 9

9.1.1 Gain of electrons / Wins aan elektrone $\checkmark\checkmark$ (2)

9.1.2 OXIDATION / OKSIDASIE $\checkmark$ (1)

Oxidation number of Cu increases $\checkmark$ from 0 to +2 $\checkmark$
Oksidasiegetal van Cu neem toe vanaf 0 na +2

(2)

9.1.3 $\text{NO}_3^- \checkmark$ (1)

9.1.4 $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag} \checkmark\checkmark$ (2)

9.2.1 $x + 4(-2) = -2 \checkmark$

$x = +6 \checkmark$ (2)

9.2.2 $\text{SO}_2(\text{g}) + 2\text{H}_2\text{O} \rightarrow \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \checkmark\checkmark$
 (1/2 if double arrow is used / as dubbelpyltjie gebruik is) (2)

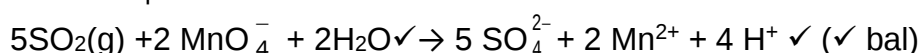
9.2.2 **Marking criteria / Nasienkriteria**

- Reduction half reaction / Reduksie halfreaksie $\checkmark\checkmark$
- Reactants / Reaktanse $\checkmark$
- Products / Produkte $\checkmark$
- Balanced / Gebalanseer $\checkmark$

Oxidation $\frac{1}{2}$ reaction / Oksidasie $\frac{1}{2}$ reaksie: $\text{SO}_2(\text{g}) + 2\text{H}_2\text{O} \rightarrow \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$

Reduction $\frac{1}{2}$ reaction / Reduksie $\frac{1}{2}$ reaksie: $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O} \checkmark\checkmark$

Net ionic equation/netto ioniese reaksie:



(5)
[17]

TOTAL/TOTAAL: 150