Province of the EASTERN CAPE EDUCATION

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
```
     ••
H  : N : H ✓✓
     ••
     H
```
(2)

2.2.2
```
        ••
H : C ⋮⋮ N ✓✓
```
(2)

2.3 1 ✓ (1)

2.4 Non-polar ✓

- B – Cℓ is a polar bond ✓ (ΔEN = 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 (ΔEN = 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 C ≡ 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 intermolekulêrekragte 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 intermolekulêrekragte te oorkom.* (3)

3.4 CH_4 ✓
Lowest boiling point / *Laagste kookpunt* ✓ (2)

3.5 Higher than / *Hoër as* ✓ (1)

3.6
- HCℓ has dipole-dipole forces ✓
- CH_4 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*
- *CH_4 het London / verpreidings / geïnduseerde dipool-kragte*
- *Dipoolkragte is sterker as die London/verpreidings/geïnduseerde dipool-kragte*
- *Meer energie word benodig om die intermolekulêrekragte 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 intermolekulêrekragte in CH_4 te oorkom* (3)

[12]

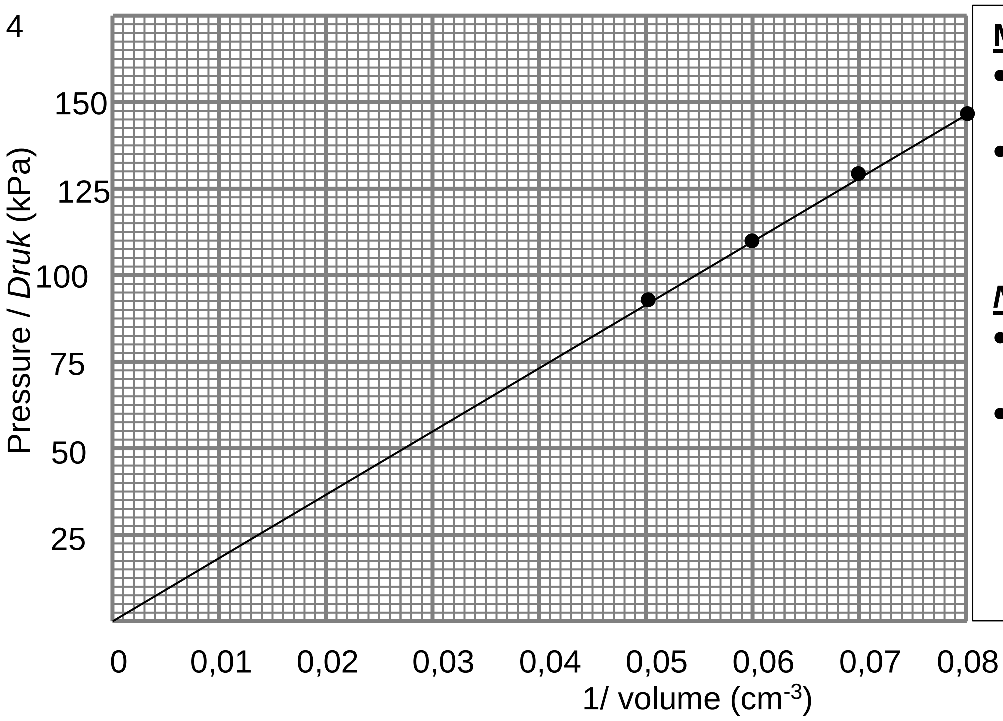
QUESTION/*VRAAG 4*

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)

4.4



Marking criteria
- Points correctly plotted 2
- Straight line graph drawn through the points 2

Nasienkriteria
- *Twee punte korrek geplot*
- *Reguitlyn grafiek deur 2 punte*

(4)

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 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) $n = m / M$

$n = 0,163 / 44$ ✓

$n = 0,0037$ mol

$N = nN_A$ ✓

$N = (0,0037)(6,02 \times 10^{23})$ ✓

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

5.1.4 (b) **Marking criteria / *Nasienkriteria***

- Mole ratio / *Mol verhouding* $CO_2 : CaCO_3$
- Subst. n($CaCO_3$) mole into/ *Vervang n ($CaCO_3$) in* m = nM

n(CO_2) formed /*gevorm* = 0,0037 mol

n($CaCO_3$) reacting / *reageer* = 0,0037 mol ✓

n($CaCO_3$) initial / *aanvanklik* = m/M = 1,56/100 ✓ = 0,0156 mol

OPTION 1 / *OPSIE 1* **Marking criteria / *Nasienkriteria*** • Subtraction of $CaCO_3$ mole/ *Aftrekking van $CaCO_3$ mol* • Mole remaining into / *Mol oorbly in* m = nM • Final answer / *Finale antwoord*	**OPTION 2 / *OPSIE 2*** **Marking criteria / *Nasienkriteria*** • Mole reacting into / *Mol reageer* in m = nM • Subtraction of $CaCO_3$ mass/ *Aftrekking van $CaCO_3$ massa* • Final answer / *Finale antwoord*
n (remaining / *oorbly*) = 0,0156 – 0,0037 ✓ n (remaining / *oorbly*) = 0,0119 mol m (remaining / *oorbly*) = 0,0119 x 100 ✓ m (remaining / *oorbly*) = 1,19 g ✓	m (react / reageer) = 0,0037 x 100 ✓ m (react / reageer) = 0,37 g m (remaining / *oorbly*) = 1,56 – 0,37✓ m (remaining / *oorbly*) = 1,19 g ✓

(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***	
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 / 21 ✓ = 1,23	1,23 / 0,62 = 2	Div. by / *Deel deur* 0,62 ✓
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: Emprical 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* CO_2 : HCℓ
- Compare required and available mole / *Vergelyk die vereiste en beskikbare mol*
- Correct identification of limiting reagent / *Identifiseer die korrekte beperkende reagens*

n (CO_2) = V / V_m ✓

n (CO_2) = 0,448 / 24,47 ✓

n (CO_2) = 0,018 mol

n (HCℓ) required/*benodig* = 1/2 n (CO_2)

n (HCℓ) required/*benodig* = 1/2 n (0,018) ✓

n (HCℓ) required/*benodig* = 0,009 mol

n (HCℓ) available/beskikbaar= 0,028 mol } ✓

∴ Na_2CO_3 is the limiting reagent / *is die beperkende reagens* ✓ (5)

6.4 n (CO_2) = n (Na_2CO_3) = 0,018 mol ✓

m = nM ✓

m = (0,018)(106) ✓

m = 1,908 g ✓ (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** = Δ H ✓/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 products / *produkte* – 400 ✓

H products / *produkte* (**X**) = 183,3✓ ($kJ·mol^{-1}$) (3)

7.4 DECREASES / *NEEM AF* ✓ (1)

7.5 **Marking Criteria**

- Use volume ratios to find $V(O_2)$, V(NO and $V(H_2O)$
- Finding $V(O_2)$ remaining
- Adding $V(O_2)$, V(NO and $V(H_2O)$
- Conversion to dm^3
- Final answer

Nasienkriteria

- *Gebruik die volume verhouding om $V(O_2)$, V(NO en $V(H_2O)$ te vind.*
- *Vind $V(O_2)$ wat oorbly*
- *Tel $V(O_2)$, V(NO en $V(H_2O)$ bymekaar*
- *Herlei na dm^3*
- *Finale antwoord*

$V(O_2)$ reacting/*reageer* = 5/4 x 60 = 75 cm^3

V (NO) formed/*gevorm* = $V(NH_3)$ reacting/reageer = 60 cm^3 ✓

$V(H_2O)$ formed/ *gevorm* = 6/4 x 60 = 90 cm^3

V O_2 remaining/*oorbly* = (90 – 75) = 15 cm^3 ✓

V total / *totaal* = 15 + 60 + 90 ✓

V total / *totaal* = 165/1 000 dm^3 ✓

= 0,165 dm^3 ✓ (5)

7.6 HIGHER / *HOËR* ✓ (1)

[14]

QUESTION/*VRAAG 8*

8.1 8.1.1 Acid is a proton/ H^+ -ion donor ✓✓
ŉ Suur is ŉ proton / H^+-oonskenker (2)

8.1.2 Acid/ *Suur*. ✓
Donates a proton / *Skenk ŉ 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 mol ✓ (3)

8.2.3 **<u>Positive marking from / *Positiewe nasien vanaf* 8.2.3</u>**

<u>Marking criteria / *Nasienkriteria*</u>

- 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:MCO_3
- 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(NaOH) = cV

n(NaOH) = (0,8)(0,025) ✓

n(NaOH) = 0,02 mol

n(NaOH) = n(HCℓ) in excess / *in oormaat* = 0,02 mol ✓

n(HCℓ) reacting with carbonate/reageer met karbonaat = 0,09 – 0,02 ✓

n(HCℓ) = 0,07 mol

n(MCO_3) = ½ (0,07) ✓

n(MCO_3) = 0,035 mol

M = m / n

M = 3,5 / 0,035 ✓
M = 100 g·mol^{-1}

M + 12 + 3 (16) = 100 ✓

M = 40 g·mol^{-1}

M = Ca ✓ (7)

[18]

QUESTION/*VRAAG 9*

9.1.1 Gain of electrons / *Wins aan elektrone* ✓✓ (2)

9.1.2 OXIDATION / *OKSIDASIE* ✓ (1)

Oxidation number of Cu increases ✓ from 0 to +2 ✓
Oksidasiegetal van Cu neem toe vanaf 0 na +2 (2)

9.1.3 NO_3^- ✓ (1)

9.1.4 $Ag^+ + e^- \rightarrow Ag$ ✓✓ (2)

9.2.1 $x + 4(-2) = -2$ ✓

$x = +6$ ✓ (2)

9.2.2 $SO_2(g) + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2e^-$ ✓✓
(*1/2* if double arrow is used / *as dubbelpyltjie gebruik is*) (2)

9.2.2

Marking criteria / *Nasienkriteria*

- Reduction half reaction / *Reduksie halfreaksie* ✓✓
- Reactants / *Reaktanse* ✓
- Products / *Produkte* ✓
- Balanced / *Gebalanseer* ✓

Oxidation ½ reaction / *Oksidasie ½ reaksie*: $SO_2(g) + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2e^-$

Reduction ½ reaction / Reduksie ½ reaksie: $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$ ✓✓

Net ionic equation/netto ioniese reaksie:

$5SO_2(g) + 2MnO_4^- + 2H_2O$ ✓ $\rightarrow 5SO_4^{2-} + 2Mn^{2+} + 4H^+$ ✓ (✓ bal) (5)

[17]

TOTAL/*TOTAAL*: 150