



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

See comments in memo - possible corrections.

**NATIONAL
SENIOR CERTIFICATE/
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 11

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

NOVEMBER 2015

MEMORANDUM

MARKS/PUNTE: 150

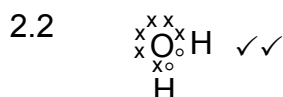
**This memorandum consists of 12 pages.
*Hierdie memorandum bestaan uit 12 bladsye.***

QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

- 2.1 The sharing of electrons ✓ between (two) atoms (to form a molecule). ✓
Die deling van elektrone tussen (twee) atome (om 'n molekule te vorm). (2)

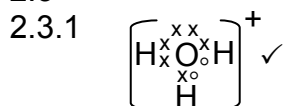


Marking criteria/Nasienriglyne:

- O atom shown with 8 electrons around it.
O-atoom getoon met 8 elektrone rondom dit.
- Two electron pairs on O atom shared with two H atoms as shown.
Twee elektronpare op O-atoom word gedeel met H-atome soos getoon.

(2)

2.3



(1)

- 2.3.2
- One atom/ion must have an empty valence shell / orbital. ✓
Een atoom/ion moet 'n leë valensskil/orbitaal hê.
 - The other atom must have a lone pair of electrons. ✓
Die ander atoom moet 'n alleenpaar-elektrone hê.
- (2)

2.4

- 2.4.1 The tendency of an atom in a molecule ✓ to attract bonding electrons closer to itself. ✓
Die neiging van 'n atoom in 'n molekule om bindingselektrone nader aan ditself aan te trek. (2)

2.4.2 (a) $\Delta EN(\text{between C and O/tussen C en O}) = 1 \checkmark$ (1)

(b) $\Delta EN(\text{between H and O/tussen H en O}) = 1,4 \checkmark$ (1)

2.4.3 • The bonds in both molecules are polar \checkmark due to the difference in electronegativities \checkmark between C and O and H and O.

Die bindings in beide molekule is polêr weens die verskil in elektronegatiwiteit tussen C en O en H en O.

• The shape of the H₂O molecule is angular \checkmark and therefore the molecule is polar \checkmark because one side of the molecule can be positive and the other side negative.

Die vorm van die H₂O-molekuul is hoekig en dus is die molekuul polêr omdat een kant van die molekuul positief en die anderkant negatief kan wees.

• The shape of the CO₂ molecule is linear \checkmark and thus it is non-polar \checkmark because the charge distribution is symmetrical.

Die vorm van die CO₂-molekuul is liniêr en dus is die molekuul nie-polêr omdat die ladingsverspreiding simmetries is.

(6)
[17]

QUESTION 3/VRAAG 3

3.1

3.1.1 The temperature \checkmark at which the vapour pressure of a liquid equals external (or atmospheric) pressure. \checkmark

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

(2)

3.1.2 $M = 6(12) + 14(1)$ Molecular mass was asked; hence 86 without unit should be OK.
 $= 86 \text{ g} \cdot \text{mol}^{-1} \checkmark$

(1)

3.1.3 Gas \checkmark

(1)

3.1.4 London/dispersion/induced dipole forces \checkmark

London-/dispersie-/geïnduseerde-dipoolkragte

(1)

- 3.1.5
- Molecular mass increases from A to E. ✓
Molekulêre massa neem toe van A tot E.
 - Strength of intermolecular forces/London forces/dispersion forces/induced dipole forces increases. ✓
Sterkte van intermolekulêre kragte/Londonkragte/dispersiekragte/geïnduseerde dipoolkragte neem toe.
 - More energy is needed to overcome/break the intermolecular forces. ✓
Meer energie benodig om intermolekulêre kragte/Londonkragte/dispersiekragte/geïnduseerde dipoolkragte te oorkom/breek.

OR/OF

- Molecular mass decreases from E to A. ✓
Molekulêre massa neem af van E tot A.
- Strength of intermolecular forces/London forces/dispersion forces/induced dipole forces decreases. ✓
Sterkte van intermolekulêre kragte/Londonkragte /dispersiekragte/geïnduseerde dipoolkragte neem af.
- Less energy is needed to overcome the intermolecular forces. ✓
Minder energie benodig om intermolekulêre kragte/Londonkragte/dispersiekragte/geïnduseerde dipoolkragte te oorkom/breek.

(3)

- 3.1.6 Higher than/Hoër as ✓

(1)

3.2

- 3.2.1 H_2S ✓

(1)

- 3.2.2 Hydrogen bonding/Waterstofbinding ✓

(1)

- 3.2.3 Hydrogen bonding between H_2O molecules ✓ is stronger ✓ than the London forces/dispersion forces/induced dipole forces or dipole-dipole forces between H_2S molecules. ✓
More energy is needed to overcome/break the intermolecular forces in water. ✓

Waterstofbinding tussen H_2O -molekule is sterker as die Londonkragte/dispersiekragte/geïnduseerde dipoolkragte of dipool-dipoolkragte tussen H_2S -molekule.

Meer energie benodig om intermolekulêre kragte in water te oorkom/breek.

(4)

[15]

QUESTION 4/VRAAG 4

- 4.1 Boyle's law / Boyle se wet ✓

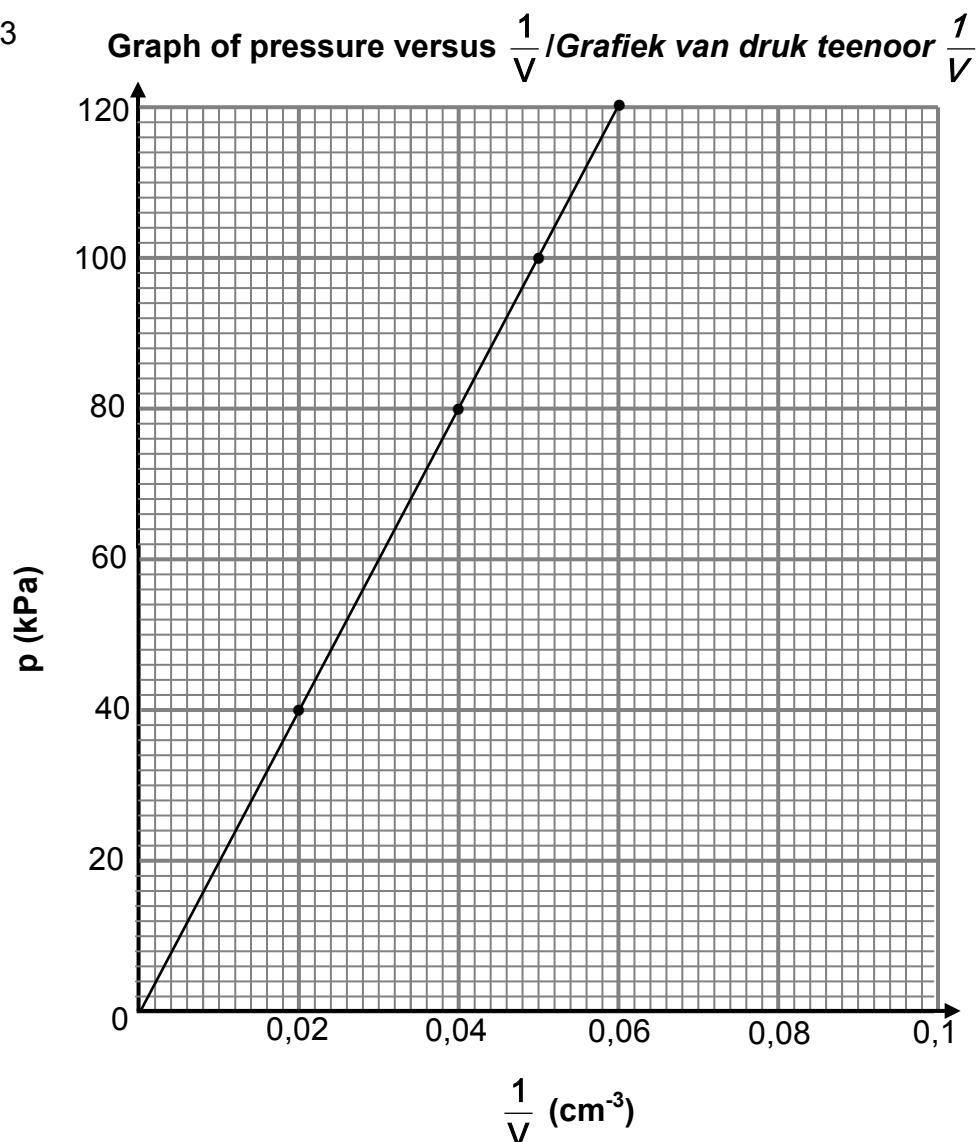
(1)

4.2

Pressure Druk (kPa)	Volume (cm ³)	$\frac{1}{V}$ (cm ⁻³)
40	43	0,02
80	27	0,04
100	22	0,05
120	18	0,06

(1)

4.3



Criteria for graph/Riglyne vir grafiek:	
Two points correctly plotted./Twee punte korrek gestip.	✓
Four points correctly plotted./Vier punte korrek gestip.	✓
Straight line of best fit drawn./ Reguitlyn van beste passing getrek.	✓
The straight line will intercept origin if extended. Reguitlyn gaan deur oorsprong wanneer dit verleng word.	✓

(4)

4.4

$$\frac{1}{V} = 0,034 \checkmark \therefore V = 29,41 \text{ cm}^3 \checkmark$$

Notes/Aantekeninge:

IF/INDIEN:

Only answer given, allocate 2 marks./Slegs antwoord gegee, ken 2 punte toe.

(2)

4.5

4.5.1

$$pV = nRT \checkmark$$

$$(100 \times 10^3) \checkmark (22 \times 10^{-6}) \checkmark = n(8,31)(298) \checkmark$$

$$\therefore n = 8,88 \times 10^{-4} \text{ mol}$$

20 x 10⁻⁶ should also be accepted, if one departs from 1/V = 0,05 as plotted on the graph.

$$n = \frac{m}{M}$$

$$\therefore 8,89 \times 10^{-4} = \frac{2,49 \times 10^{-2}}{M} \checkmark$$

$$\therefore M = 28,03 \text{ g} \cdot \text{mol}^{-1} \checkmark$$

(6)

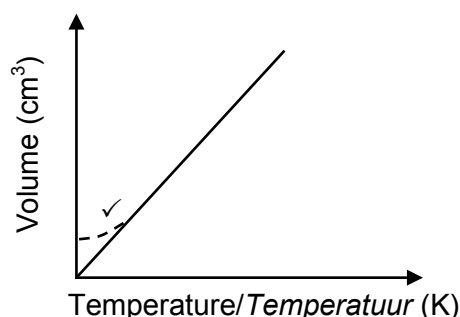
4.5.2

N₂ ✓

(1)

4.6

4.6.1



(1)

4.6.2

At low temperatures, molecules move slower/with less kinetic energy. ✓
Intermolecular forces become more effective. ✓

The gas liquifies and the volume (open space in container) is larger than predicted for ideal gases. ✓

*By lae temperature beweeg molekule stadiger/met minder kinetiese energie.
Intermolekulêre kragte word meer effektief.*

Die gas vervloei en die volume (oop ruimte in houer) is groter as voorspel vir ideale gasse.

(3)

[19]

QUESTION 5/VRAAG 5

5.1 CO_2 ✓ (1)

5.2 The amount of substance ✓ having the same number of particles as there are atoms in 12 g carbon-12. ✓
Die hoeveelheid stof wat dieselfde getal deeltjies het as wat daar atome is in 12 g koolstof-12. (2)

5.3
$$n(\text{NaHCO}_3) = \frac{m}{M} \checkmark$$
$$= \frac{3,36}{84} \checkmark$$
$$= 0,04 \text{ mol} \checkmark$$
 (3)

5.4 **POSITIVE MARKING FROM QUESTION 5.3.**
POSITIEWE NASIEN VAN VRAAG 5.3.

$$n(\text{H}_3\text{C}_6\text{H}_5\text{O}_7) = \frac{m}{M}$$
$$= \frac{1,8}{192} \checkmark$$
$$= 0,01 \text{ mol} \quad (9,38 \times 10^{-3} \text{ mol})$$
$$n(\text{NaHCO}_3 \text{ needed/benodig}) = 3n(\text{H}_3\text{C}_6\text{H}_5\text{O}_7)$$
$$= 3(0,01) \text{ mol} \checkmark$$
$$= 0,03 \text{ mol} \checkmark$$

$n(\text{NaHCO}_3) < n(\text{NaHCO}_3 \text{ in antacid/in teensuurmiddel})$

$\text{H}_3\text{C}_6\text{H}_5\text{O}_7$ /citric acid is the limiting reactant. ✓
 $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$ /sitroensuur is die beperkende reagens. (4)

5.5 **POSITIVE MARKING FROM QUESTION 5.3 & 5.4.**
POSITIEWE NASIEN VAN VRAAG 5.3 & 5.4.

$n(\text{NaHCO}_3 \text{ in excess/oormaat}) = 0,04 - 0,03 \checkmark$
$$= 0,01 \text{ mol}$$
$$m(\text{NaHCO}_3 \text{ in excess/oormaat}) = nM$$
$$= (0,01)(84) \checkmark$$
$$= 0,84 \text{ g} \checkmark$$

Q5.6

The excess NaHCO_3 must be added to this. Range of answers: 2,16 - 2,24

Solution only valid if all CO_2 is out of container. Not indicated in paper. (3)

5.6 **POSITIVE MARKING FROM QUESTION 5.3.1.**
POSITIEWE NASIEN VAN VRAAG 5.3.1.

$n(\text{CO}_2) = \frac{m}{M}$
$$\therefore 0,03 = \frac{m}{44} \checkmark$$
$$\therefore m(\text{CO}_2) = 1,32 \text{ g} \checkmark$$

Marking criteria/Nasiengiglyne:

- Using/Gebruik $M(\text{CO}_2) = 44 \text{ g} \cdot \text{mol}^{-1}$
- $3(\text{CO}_2) = n(\text{NaHCO}_3)$
- Final answer: 1,32 g
Finale antwoord: 1,32 g

(3)
[16]

QUESTION 6/VRAAG 6

6.1

6.1.1 The amount of solute ✓ per litre/cubic decimetre of solution. ✓
Hoeveelheid opgeloste stof per liter/kubieke desimeter oplossing. (2)

6.1.2

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

$$0,2 = \frac{n}{200 \times 10^{-3}} \checkmark$$

$$= 0,04 \text{ mol} \checkmark$$

(3)

6.1.3

POSITIVE MARKING FROM QUESTION 6.1.2.

POSITIEWE NASIEN VAN VRAAG 6.1.2.

$$n(\text{SO}_2) = \frac{1}{2}n(\text{HCl})$$

$$= \frac{1}{2}(0,04) \checkmark$$

$$= 0,02 \text{ mol}$$

$$n = \frac{V}{V_m}$$

$$\therefore V = (0,02)(22,4) \checkmark$$

$$= 0,45 \text{ dm}^3 \checkmark$$

(3)

6.2

6.2.1

Marking criteria/Nasienriglyne:

- Substitute/Vervang $44 \text{ g} \cdot \text{mol}^{-1}$. ✓
- $n(\text{C}) = n(\text{CO}_2)$ ✓
- Substitution/Vervang $12 \text{ g} \cdot \text{mol}^{-1}$. ✓
- Final answer/Finale antwoord: $7,68 \text{ g}$ ✓

OPTION 1/OPSIE 1

$$n = \frac{m}{M}$$

$$\therefore n(\text{CO}_2) = \frac{28,16}{44} \checkmark = 0,64 \text{ mol}$$

$$n(\text{C}) = n(\text{CO}_2) \checkmark = 0,64 \text{ mol}$$

$$m(\text{C}) = nM$$

$$= (0,64)(12) \checkmark$$

$$= 7,68 \text{ g} \checkmark$$

OPTION 2/OPSIE 2

$$\% \text{C in CO}_2 = \frac{12}{44} \times 100$$

$$= 27,27\%$$

$$m(\text{C}) \text{ in CO}_2 = 27,27\% \text{ of } 28,16 \text{ g} \checkmark$$

$$= 7,68 \text{ g} \checkmark$$

(4)

6.2.2 **POSITIVE MARKING FROM QUESTION 6.3.1.**
POSITIEWE NASIEN VAN VRAAG 6.3.1.

Marking criteria/Nasienriglyne:

- Substitute $M(H_2O)$ to calculate $n(H_2O)$. ✓
Vervang $M(H_2O)$ om $n(H_2O)$ te bereken.
- $n(H) = 2n(H_2O)$. ✓
- Substitution $M(H)$ to calculate $m(H)$. ✓
Vervang $M(H)$ om $m(H)$ te bereken.
- $M(O) = m(\text{menthol}) - (m(C) + m(H))$ ✓
- Substitution $M(O)$ to calculate $n(O)$. ✓
Vervang $M(O)$ om $n(O)$ te bereken.
- Ratio/*Verhouding*: mol C : mol H : mol O = 10 : 20 : 1 ✓
- Empirical formula/*Empiriese formule*: $C_{10}H_{20}O$ ✓

OPTION 1/OPSIE 1

$n(H)$ and $m(H)$

$$n = \frac{m}{M}$$

$$\therefore n(H_2O) = \frac{11,52}{18} = 0,64 \text{ mol}$$

$$n(H) = 2n(H_2O) = 2(0,64) = 1,28 \text{ mol}$$

$$m(H) = nM = (1,28)(1) = 1,28 \text{ g}$$

$n(O)$ and $m(O)$

$$m(O) = 9,984 - (7,68 + 1,28) = 1,024 \text{ g}$$

$$n(O) = \frac{1,024}{16} = 0,064 \text{ mol}$$

Ratio:

$$\begin{aligned} \text{mol C} : \text{mol H} : \text{mol O} \\ 0,64 : 1,28 : 0,064 \\ 10 : 20 : 1 \end{aligned}$$

Empirical formula: $C_{10}H_{20}O$ ✓
Empiriese formule: $C_{10}H_{20}O$

OPTION 2/OPSIE 2

$$\begin{aligned} \%H \text{ in } H_2O &= \frac{2}{18} \times 100 \\ &= 11,11\% \end{aligned}$$

$$m(H) \text{ in } H_2O = 11,11\% \text{ of } 11,52 \text{ g} = 1,28 \text{ g}$$

$$m(O) = 9,984 - (7,68 + 1,28) = 1,024 \text{ g}$$

$$\begin{array}{ccc} C & : & H & : & O \\ \frac{7,68}{12} & : & \frac{1,28}{1} & : & \frac{1,024}{16} \end{array}$$

$$0,64 : 1,28 : 0,064$$

$$10 : 20 : 1$$

Empirical Formula: $C_{10}H_{20}O$ ✓
Empiriese formule: $C_{10}H_{20}O$

(7)

6.2.3 **POSITIVE MARKING FROM QUESTION 6.2.2.**
POSITIEWE NASIEN VAN VRAAG 6.2.2.

$$M(C_{10}H_{20}O) = 10(12) + 20 + 16 = 156 \text{ g} \cdot \text{mol}^{-1}$$

Molecular formula/*Molekulêre formule*: $C_{10}H_{20}O$ ✓

(2)
[21]

QUESTION 7/VRAAG 7

- 7.1 Exothermic/*Eksotermies* ✓
Reactants at higher energy than products./Products at lower energy than reactants./Energy is released./ $\Delta H < 0$. ✓
Reaktanse by hoër energie as produkte./Produkte by laer energie as reakanse./Energie is vrygestel./ $\Delta H < 0$. (2)
- 7.2
- 7.2.1 A ✓ (1)
- 7.2.2 A – B ✓ (1)
- 7.2.3 B – C ✓ (1)
- 7.3 1 mol $\text{Ba}(\text{OH})_2$ releases/*stel* vry: 116 kJ ✓
0,18 mol $\text{Ba}(\text{OH})_2$ releases/ *stel* vry: $0,18 \times 116$ ✓ = 20,88 kJ ✓
(Accept answers in range/*Aanvaar antwoorde in gebied*: 20,3 – 20,88 kJ) (3)
[8]

QUESTION 8/VRAAG 8

- 8.1 An acid is a proton donor. ✓✓
'n Suur is 'n protondonor/protonskenker. (2)
- 8.2
- 8.2.1 $\text{SO}_4^{2-}(\text{aq})$ ✓ (1)
- 8.2.3 $\text{H}_2\text{SO}_4(\text{aq})$ ✓ (1)
- 8.2.3 $\text{HSO}_4^-(\text{aq})$ ✓ (1)
- 8.3
- 8.3.1 Neutralisation / *Neutralisasie* ✓ (1)
- 8.3.2 $\text{H}_2\text{SO}_4(\text{aq}) + \text{KOH}(\text{aq}) \checkmark \rightarrow \text{K}_2\text{SO}_4(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) \checkmark$ Bal. ✓
- Notes/Aantekeninge:**

 - Reactants ✓ Products ✓ Balancing: ✓
 Reaktanse Produkte Balansering
 - Ignore double arrows. / *Ignoreer dubbelpyle.*
 - Marking rule 6.3.10. / *Nasienreël 6.3.10.*
- (3)
- 8.3.3 Blue ✓ to yellow ✓
Blou na geel (2)
- 8.3.4 Potassium sulphate / *Kaliumsulfaat* ✓ (1)
[12]

QUESTION 9/VRAAG 9

9.1

9.1.1 Oxidation is an increase in oxidation number. ✓✓
Oksidasie is 'n toename in oksidasiegetal. (2)

9.1.2 $2\text{Cr} + 7\text{O} = -2$
 $2\text{Cr} + (-14) = 2$
 $\text{Cr} = +6$ ✓ (1)

9.1.3 $2\text{H} + 2\text{O} = 0$
 $2 + 2\text{O} = 0$
 $\text{O} = -1$ ✓ (1)

9.2

9.2.1 A reducing agent loses/donates electrons. ✓✓
'n Reduseermiddel verloor/skenk elektrone. (2)

9.2.2 $\text{Fe}^{2+}(\text{aq})$ ✓ (1)

9.2.3 $\text{Cl}_2(\text{g})$ ✓ (1)

9.2.4 $\text{Cl}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{Cl}^-$ ✓✓

Marking guidelines/Nasienriglyne:

• $\text{Cl}_2 + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$	$\frac{1}{2}$	$2\text{Cl}^- \rightleftharpoons \text{Cl}_2 + 2\text{e}^-$	$\frac{0}{2}$
• $2\text{Cl}^- \leftarrow \text{Cl}_2 + 2\text{e}^-$	$\frac{2}{2}$	$2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$	$\frac{0}{2}$

(2)

9.2.5 $\text{Fe}^{2+}(\text{aq}) \rightarrow \text{Fe}^{3+}(\text{aq}) + \text{e}^-$ ✓✓

Marking guidelines/Nasienriglyne:

• $\text{Fe}^{2+} \rightleftharpoons \text{Fe}^{3+} + \text{e}^-$	$\frac{1}{2}$	$\text{Fe}^{3+} + \text{e}^- \rightleftharpoons \text{Fe}^{2+}$	$\frac{0}{2}$
• $\text{Fe}^{3+} + \text{e}^- \leftarrow \text{Fe}^{2+}$	$\frac{2}{2}$	$\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}$	$\frac{0}{2}$

(2)

9.2.6 $2\text{Fe}^{2+}(\text{aq}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{Fe}^{3+}(\text{aq}) + 2\text{Cl}^-$ ✓✓

Notes/Aantekeninge:

• Ignore double arrows./Ignoreer dubbelpyle.

(2)

[14]

QUESTION 10/VRAAG 10

10.1

10.1.1 Remove impurities/*Verwyder onsuiverhede* ✓ (1)

10.1.2 Reducing agent/Formation of CO or CO₂ ✓
Reduseermiddel/Vorming van CO of CO₂ (1)

10.2

10.2.1 (Hot) air/*(Warm) lug* ✓ (1)

10.2.2 Molten iron/pig iron/Fe(l) ✓
Gesmelte yster/ru-yster/Fe(l) (1)

10.2.3 Slag/CaSiO₃/*metaalskuim* ✓ (1)

10.3 Carbon monoxide/carbon dioxide/nitrogen monoxide/nitrogen dioxide/nitrogen/
sulphur dioxide ✓
*Koolstofmonoksied/Koolstofdioksied/stikstofmonoksied/stikstofdioksied/swawel-
dioksied* (1)

10.4

10.4.1 Reducing agent/*Reduseermiddel* ✓ (1)

10.4.2 Fe₂O₃ ✓ (1)
[8]

TOTAL/TOTAAL: 150