basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

FEBRUARY/MARCH/*FEBRUARIE/MAART* 2017

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 16 pages.
Hierdie memorandum bestaan uit 16 bladsye.

QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 B ✓✓ (2)

1.3 A ✓✓ (2)

1.4 A ✓✓ (2)

1.5 C ✓✓ (2)

1.6 D ✓✓ (2)

1.7 C ✓✓ (2)

1.8 B ✓✓ (2)

1.9 C ✓✓ (2)

1.10 A ✓✓ (2)

[20]

QUESTION 2/*VRAAG 2*

2.1

2.1.1 B ✓ (1)

2.1.2 D **OR/*OF*** E ✓ (1)

2.1.3 F ✓ (1)

2.2

2.2.1 Butanal / *Butanaal* ✓ (1)

2.2.2 2,3,3-trimethyl✓but-1-ene ✓ / *2,3,3-trimetielbut-1-een*

Accept/Aanvaar:

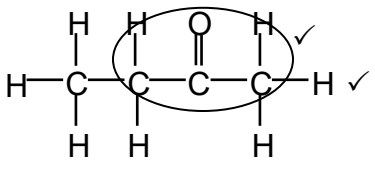
2,3,3- trimethyl ✓-1- butene /*2,3,3-trimetiel-1-buteen*

Marking criteria/*Nasienriglyne:*

- Correct stem i.e. but-1-ene / 1-butene. ✓
  Korrekte stam d.i. but-1-een / 1-buteen.
- Substituents correctly identified. / *Substituente korrek geïdentifiseer.* ✓
- Substituents correctly numbered, hyphens and commas correctly used. ✓
  Substituente korrek genommer, koppeltekens en kommas korrek gebruik.

(3)

2.3



Marking criteria/*Nasienriglyne:*

- Whole structure correct:/*Hele struktuur korrek:* 2/2
- Only functional group correct/*Slegs funksionele groep korrek:* Max/*Maks*: 1/2

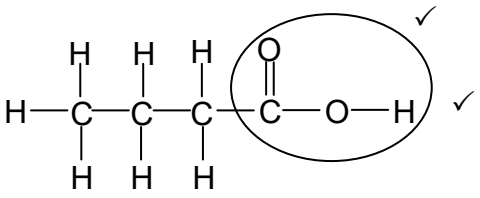
(2)

2.4

2.4.1 Esterification / Condensation ✓
Esterifikasie / Verestering/Kondensasie (1)

2.4.2 Propan-1-ol ✓✓
If propanol (1 mark) / *Indien propanol (1 punt)* (2)

2.4.3



✓ ✓

Marking criteria/*Nasienriglyne:*
- Whole structure correct:/*Hele struktuur korrek:* 2/2
- Only functional group correct/*Slegs funksionele groep korrek:* Max/*Max*: 1/2

(2)

2.4.4 Propyl ✓ butanoate ✓/*Propielbutanoaat* (2)
[16]

QUESTION 3/*VRAAG 3*

3.1 The temperature at which the vapour pressure equals atmospheric (external) pressure. ✓✓ (2 or 0)
Die temperatuur waar die dampdruk gelyk is aan atmosferiese (eksterne) druk. (2 of 0) (2)

3.2 Flammable / Catch fire easily. / Volatile ✓
Vlambaar / Vat maklik vlam. / Vlugtig (1)

3.3

3.3.1 Use straight chain ✓ primary alcohols ✓
Gebruik reguitketting primêre alkohole (2)

3.3.2. **OPTION 1/*OPSIE 1***

- **Structure/*Struktuur*:**
  Chain length / more C atoms in chain / molecular size / molecular mass / surface area increases from top to bottom / butan-1-ol to hexan-1-ol. ✓
  Kettinglengte / meer C-atome in ketting) / molekulêre grootte / molekulêre massa / oppervlak neem toe van bo na onder / butan-1-ol na heksan-1-ol.
- **Intermolecular forces/*Intermolekulêre kragte:***
  Intermolecular forces / Van der Waals forces / London forces / dispersion forces increases from top to bottom / butan-1-ol to hexan-1-ol. ✓
  Intermolekulêre kragte / Van der Waalskragte / Londonkragte / dispersiekragte neem toe van bo na onder / butan-1-ol na heksan-1-ol.
- **Energy/*Energie*:**
  Energy needed to overcome / break intermolecular forces increases from top to bottom / butan-1-ol to hexan-1-ol.
  Energie benodig om intermolekulêre kragte te oorkom / breek neem toe van bo na onder / butan-1ol na heksan-1ol. ✓

OPTION 2/*OPSIE 2*

- **Structure/*Struktuur*:**
  Chain length / number of C atoms in the chain / molecular size / molecular mass/surface area decreases from bottom to top / hexan-1-ol to butan-1-ol. ✓
  Kettinglengte / aantal C-atome in ketting / molekulêre grootte / molekulêre massa / oppervlak neem af van onder na bo / heksan-1-ol na butan-1-ol.
- **Intermolecular forces/*Intermolekulêre kragte:***
  Intermolecular forces / Van der Waals forces/London forces / dispersion forces decreases from bottom to top/hexan-1-ol to butan-1-ol. ✓
  Intermolekulêre kragte / Van der Waalskragte / Londonkragte / dispersiekragte neem af van bo na onder / heksan-1-ol na butan-1-ol.
- **Energy/*Energie*:**
  Energy needed to overcome / break intermolecular forces decreases from bottom to top / hexan-1-ol to butan-1-ol.
  Energie benodig om intermolekulêre kragte te oorkom / breek neem af vanonder na bo / heksan-1-ol na butan-1ol. ✓ (3)

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

3.5

3.5.1 Functional group / Type of homologous series ✓
Funksionele groep / Soort homoloë reeks (1)

3.5.2
- **Type of intermolecular forces/*Tipe intermolekulêre kragte*:**
  Between molecules of aldehyde / hexanal are dipole-dipole forces. ✓
  Tussen molekule van aldehyde / heksanaal is dipool-dipoolkragte.
- Between molecules of alcohols / hexan-1ol are (in addition to dipole-dipole forces and London forces) hydrogen bonds. ✓
  Tussen molekule van alkohole / heksan-1-ol is (in toevoeging tot dipool-dipoolkragte en Londonkragte) waterstofbindings.
- **Strength of intermolecular forces/*Sterkte van intermolekulêre kragte*:**
  Dipole-dipole forces are weaker than hydrogen bonds. ✓
  Dipool-dipoolkragte is swakker as waterstofbindings.
  OR/*OF*
  Hydrogen bonds are stronger than dipole-dipole forces.
  Waterstofbindings is sterker as dipool-dipoolkragte.
- **Energy/*Energie*:**
  More energy needed to overcome / break intermolecular forces in hexan-1-ol. ✓
  Meer *energie benodig om intermolekulêre kragte in heksan-1-ol te oorkom / breek.*
  OR/*OF*
  Less energy needed to overcome / break intermolecular forces in hexanal.✓
  Minder energie benodig om intermolekulêre kragte in heksanaal te oorkom / breek (4)

[14]

QUESTION 4/*VRAAG 4*

4.1

4.1.1 Substitution / hydrolysis ✓
Substitusie / hidrolise (1)

4.1.2 H_2O/water ✓

OR/*OF*
Dilute sodium hydroxide /NaOH(aq) / *Verdunde natriumhidroksied*

OR/*OF*
Dilute potassium hydroxide/KOH(aq) / *Verdunde kaliumhidroksied* (1)

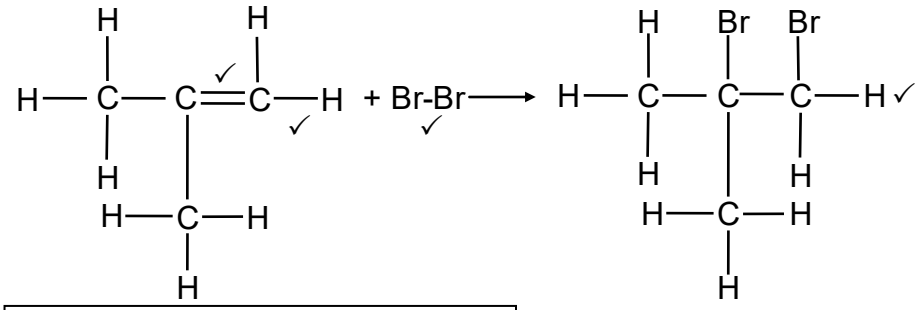
4.1.3 Tertiary / *Tersiêr* ✓ (1)

4.1.4 Elimination / dehydrohalogenation / dehydrobromination ✓
Eliminasie / dehidrohalogenering / dehidrohalogenasie / dehidrobrominering / dehidrobrominasie (1)

4.1.5 2-methylprop-1-ene ✓ ✓ / methylpropene / 2-methylpropene
2-metielprop-1-ene / metielpropeen / 2-metielpropeen (2)

4.1.6 Halogenation / bromination ✓
Halogenering / halogenasie / brominering / brominasie (1)

4.1.7



- Whole structure correct. ✓✓
  Hele struktuur korrek.
- Only functional group correct. ✓
  Slegs funksionele groep korrek.

Notes/*Aantekeninge*:

- Ignore/*Ignoreer* ⇌
- Accept Br_2 if condensed./*Aanvaar Br_2 as gekondenseerd.*
- Marking rule 3.9/*Nasienreël 3.9*
- Condensed or semi-structural formula:
  Gekondenseerde of semi-struktuurformule: Max./*Maks.* $\frac{3}{4}$
- Molecular formula/*Molekulêre formule*: $\frac{1}{4}$
- Any additional reactants or products:
  Enige addisionele reaktanse of produkte: Max./*Maks.* $\frac{3}{4}$
- Everything correct, arrow in equation omitted:
  Alles korrek, pyltjie in vergelyking uitgelaat is: Max./*Maks.* $\frac{3}{4}$

(4)

4.2

4.2.1 Monomers / *Monomere* ✓ (1)

4.2.2 Alkenes / *Alkene* ✓ (1)

4.2.3 Addition (polymerisation) / *Addisie (polimerisasie)* ✓ (1)

[14]

QUESTION 5/*VRAAG 5*

5.1 **ANY TWO/*ENIGE TWEE*:**

- Increase temperature of HCℓ. / *Toename in temperatuur van HCℓ.* ✓
- Add a catalyst. / *Voeg 'n katalisator by.* ✓
- Increase the concentration of HCℓ. / *Toename in konsentrasie van HCℓ.*
- Increase the state of division of $CuCO_3$. / *Toename in toestand van verdeeldheid van $CuCO_3$.*
- Agitation / Stirring / *Roer mengsel.* (2)

5.2 Accepted range / *Aanvaarde gebied:* 42 s to 50 s ✓ (1)

5.3

5.3.1 $$\text{average/ } gem.tempo = -\frac{\Delta m}{\Delta t}$$
$$= -\frac{(169{,}76 - 170{,}00)}{(20 - 0)} \checkmark \checkmark$$
$$= 0{,}012 (g \cdot s^{-1}) \quad \checkmark$$

If answer is negative (minus 1 mark) / *Indien antwoord negatief is (minus 1 punt)* (3)

5.3.2 Pure sample/*Suiwer monster*:
$m(CO_2)_{formed/gevorm}$ = 170,00 – 169,73 ✓
= 0,27 g

Impure sample/*Onsuiwer monster*:
$m(CO_2)_{formed/gevorm}$ = 170,00 - 169,78 ✓
= 0,22 g

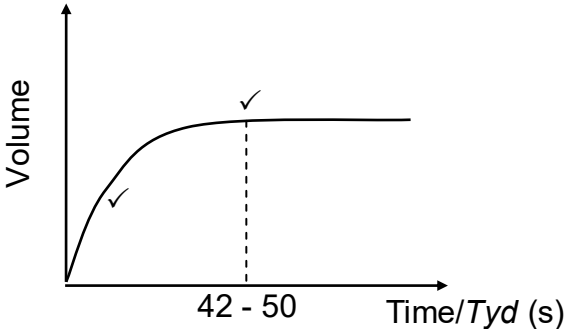
$$\%\text{Purity/}suiwerheid = \frac{0{,}22}{0{,}27} \times 100 \checkmark$$
= 81,48% ✓ (4)

5.3.3 **POSITIVE MARKING FROM QUESTION 5.3.2.**
POSITIEWE NASIEN VAN VRAAG 5.3.2.

$$n(CO_2)_{formed\,/\,gevorm} = \frac{m}{M}$$
$$= \frac{0{,}27}{44} \checkmark$$
$$= 6{,}13 \times 10^{-3} \text{ mol}$$

$$n(CO_2) = \frac{V}{V_m}$$
$$6{,}13 \times 10^{-3} = \frac{V}{22{,}4} \checkmark$$
$$V = 0{,}137 \text{ dm}^3 \checkmark$$ (3)

5.4 **POSITIVE MARKING FROM QUESTION 5.2.**
POSITIEWE NASIEN VAN VRAAG 5.2.



Marking criteria for sketch graph: ***Nasienriglyne vir sketsgrafiek:***	
Graph drawn from origin with decreasing gradient. *Grafiek geteken uit oorsprong met afnemende gradiënt.*	✓
Constant volume after (42 -50) s.**or** graph stops at (42 -50) s *Konstante volume na (42 – 50) s* ***of*** *grafiek stop by (42 – 50) s*	✓
If no labels on axes: minus 1./***Indien*** *geen benoemings op asse: minus 1*	

(2)
[15]

QUESTION 6/*VRAAG 6*

6.1 Amount / number of moles / volume of (gas) reactants equals amount/number of moles/volume of (gas) products. ✓
Hoeveelheid / Aantal mol van gas-reaktanse is gelyk aan die hoeveelheid/getal mol gasprodukte.

OR/*OF*
A change in pressure will change the concentration of the reactants and products equally.
'n Verandering in die druk sal die konsentrasie van die reaktanse en produkte dieselfde verander. (1)

6.2

CALCULATIONS USING NUMBER OF MOLES
BEREKENINGE WAT GETAL MOL GEBRUIK

Mark allocation/*Puntetoekenning:*

- Divide equilibrium amounts of H_2 and I_2 by 2 dm^3. ✓
  Deel ewewigshoeveelhede van H_2 en I_2 deur 2 dm^3.
- Correct K_c expression (formulae in square brackets). ✓
  Korrekte K_c-uitdrukking (formules in vierkanthakies).
- Substitution of equilibrium concentrations into K_c expression. ✓
  Vervanging van ewewigskonsentrasies in K_c-uitdrukking.
- Substitution of K_c value/*Vervanging van K_c-waarde*. ✓
- Change in n(HI) = n(HI at equilibrium). ✓
  Verandering in n(HI) = n(HI by ewewig)
- **USING** ratio/***GEBRUIK*** *verhouding:* $H_2 : I_2$; HI = 1 : 1 : 2 ✓
- Initial $n(I_2)$ = equilibrium $n(I_2)$ + change in $n(I_2)$ ✓
  Aanvanklike $n(I_2)$ = ewewigs $n(I_2)$ + verandering in $n(I_2)$
- Substitute 254 $g \cdot mol^{-1}$ as molar mass for I_2.✓
  Vervang 254 $g \cdot mol^{-1}$ as molêre massa van for I_2.
- Final answer/*Finale antwoord*: 24,89 - 24,92 (g) ✓

OPTION 1/*OPSIE 1*

$$K_c = \frac{[HI]^2}{[H_2][I_2]} \checkmark$$

$$\therefore 55,3 \checkmark = \frac{[HI]^2}{(0,014)(0,0085)} \checkmark$$

$$\therefore [HI] = 0,08112 \text{ mol·dm}^{-3}$$

No K_c expression, correct substitution/*Geen K_c-uitdrukking, korrekte substitusie*: Max./*Maks.* 8/9

Wrong K_c expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* 6/9

	H_2	I_2	HI	
Initial mass (g) Aanvangsmassa (g)		(0,09812)(254) ✓ = 24,92 g ✓		
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	0,1091	0,09812	0	
Change (mol) *Verandering (mol)*	0,08112	✓ 0,08112	0,1622 ✓	Using ratio ✓
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	0,028	0,017	0,1622	
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	0,014	0,0085	0,08112	x 2

Divide by 2 ✓

OR/*OF*

$$K_c = \frac{[HI]^2}{[H_2][I_2]} \checkmark$$

$$\therefore 55,3 \checkmark = \frac{x^2}{(0,014)(0,0085)} \checkmark$$

$$\therefore x = 0,08112 \text{ mol·dm}^{-3}$$

No K_c expression, correct substitution/*Geen K_c-uitdrukking, korrekte substitusie*: Max./*Maks.* 8/9

Wrong K_c expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* 6/9

	H_2	I_2	HI	
Initial mass (g) Aanvangsmassa (g)				
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	x+0,028	x + 0,017	0	
Change (mol) *Verandering (mol)*	x	✓ x	2x✓	Using ratio ✓
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	0,028	0,017	2x	
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	0,014	0,0085	x	x 2

Divide by 2 ✓

Initial quantity I_2(mol)/*Aanvangshoeveelheid I_2* (mol) = 0,08112 + 0,017
= 0,09812 mol

$m(I_2)$ = nM
= (0,09812)(254) ✓
= 24,92 g ✓

OPTION 2/*OPSIE 2*

$c(H_2) = \frac{n}{V}$ $= \frac{0,028}{2}$ $= 0,014\ mol \cdot dm^{-3}$

$c(I_2) = \frac{n}{V}$ $= \frac{0,017}{2}$ $= 0,0085\ mol \cdot dm^{-3}$

} Divide by 2 dm^3 ✓

$K_c = \frac{[HI]^2}{[H_2][I_2]}$ ✓

55,3 ✓ = $\frac{[HI]^2}{(0,014)(0,0085)}$ ✓

[HI] = 0,08112 mol·dm^{-3}

n(HI at equilibrium/*by ewewig*) = (0,08112)(2) = 0,1622 mol
n(HI formed/*gevorm*) = n(HI at equilibrium/*by ewewig*) = 0,1622 mol ✓
n(I_2 reacted/*gereageer*) = ½n(HI formed/*gevorm*) = 0,08112 mol ✓

n(I_2 initial/ *aanvanklik*) = n(I_2 reacted/*gereageer*) + n(I_2 equilibrium/*ewewig*)
= 0,08112 + 0,017 ✓
= 0,09812 mol
m(I_2 initial/*aanvanklik*) = nM
= (0,09812)(254) ✓
= 24,92 (g) ✓

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK
Mark allocation/*Puntetoekenning:*

- Divide equilibrium moles of H_2 and I_2 by 2 dm^3. ✓
  Deel ewewigshoeveelhede van H_2 en I_2 deur 2 dm^3.
- Correct K_c expression (formulae in square brackets). ✓
  Korrekte K_c-uitdrukking (formules in vierkanthakies).
- Substitution of equilibrium concentrations into K_c expression. ✓
  Vervanging van ewewigskonsentrasies in K_c-uitdrukking.
- Substitution of K_c value/*Vervanging van K_c-waarde*. ✓
- Change in n(HI) = n(HI at equilibrium). ✓
  Verandering in n(HI) = n(HI by ewewig)
- **USING** ratio/***GEBRUIK*** *verhouding:* $H_2 : I_2 : HI = 1 : 1 : 2$ ✓
- Initial [I_2] = equilibrium [I_2] + change in [I_2] ✓
  Aanvanklike n(I_2) = ewewigs n(I_2) + verandering in n(I_2)
- Substitute 254 g·mol^{-1} as molar mass for I_2.✓
  Vervang 254 g·mol^{-1} as molêre massa van for I_2.
- Final answer/*Finale antwoord*: 24,89 – 24,92 (g) ✓

OPTION 3/*OPSIE 3*

$K_c = \frac{[HI]^2}{[H_2][I_2]}$ ✓

$55,3$ ✓ $= \frac{[HI]^2}{(0,014)(0,0085)}$ ✓

$[HI] = 0,08112 \text{ mol·dm}^{-3}$

No K_c expression, correct substitution/*Geen K_c-uitdrukking, korrekte substitusie*: Max./*Maks.* $^8/_9$

Wrong K_c expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* $^6/_9$

$c = \frac{m}{MV}$

$0,04905 = \frac{m}{(254)(2)}$ ✓

$\therefore m = 24,89 \text{ g}$ ✓

	H_2	I_2	HI
Initial concentration (mol·dm^{-3}) *Aanvangskonsentrasie (mol·dm^{-3})*		0,04905	0
Change (mol·dm^{-3}) *Verandering (*mol·dm^{-3}*)*	0,04055	0,04055	0,08112 ✓
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	0,014	0,0085	0,08112

ratio ✓ *verhouding*

(9)

6.3 (Chemical/dynamic) equilibrium / *(Chemiese/dinamiese) ewewig* ✓

OR/*OF*

The rate of the forward reaction equals the rate of the reverse reaction.
Die tempo van die voorwaartse reaksie is gelyk aan die tempo van die terugwaartse reaksie. (1)

6.4 Addition of a catalyst. / *Byvoeging van 'n katalisator.* ✓
Increase in pressure. / *Toename in druk.* ✓ (2)

6.5.1 Endothermic / *Endotermies* ✓

- The rate of the forward reaction decreases more. / The rate of the reverse reaction decreases less. ✓
  Die tempo van die voorwaartse verminder meer. / Die tempo van die terugwaartse reaksie verminder minder.
- A decrease in temperature favours the exothermic reaction. ✓
  'n Afname in temperatuur bevoordeel die eksotermiese reaksie. (3)

6.5.2 Decreases / *Verlaag* ✓ (1)

6.6 Reactants / H_2 / I_2 removed ✓
Reaktanse / H_2 / I_2 verwyder (1)
[18]

QUESTION 7/*VRAAG 7*

7.1 A substance that ionises incompletely/to a small extent. ✓✓
'n Stof wat onvolledig ioniseer / in 'n klein mate ioniseer. (2)

7.2 Oxalic acid / *Oksaalsuur* ✓
Higher K_a value / *Hoër K_a-waarde* ✓

OR/*OF*
Carbonic acid has a lower K_a value ./ *Koolsuur het 'n laer K_a-waarde.* (2)

7.3
H_2O ✓
$(COO)_2^{2-}$ ✓ (2)

7.4

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$K_w = [OH^-][H_3O^+]$ $1 \times 10^{-14} = (0,1)[H_3O^+]$ ✓ $[H_3O^+] = 1 \times 10^{-13}$ mol·dm^{-3} pH = -log$[H_3O^+]$ ✓ = -log(1×10^{-13}) ✓ = 13 ✓	pOH = -log$[OH^-]$ ✓ = -log(0,1) ✓ = 1 14 = pOH + pH 14 = 1 + pH ✓ pH = 13 ✓

(4)

7.5
7.5.1

OPTION 1/*OPSIE 1*	**Marking guidelines/*Nasienriglyne:***
$\frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b}$ ✓ $\frac{c_a \times 14,2}{0,1 \times 25,1} = \frac{1}{2}$ ✓✓ $c_a = 0,09\ mol \cdot dm^{-3}$ ✓	• Formula/*Formule* • Substitution of 0,1 x 25,1. *Substitusie van* 0,1 x 25,1. • Use V_a = 14,2 cm^3. Gebruik V_a = 14,2 cm^3. • Use mol ratio 1:2. *Gebruik molverhouding 1:2.* • Final answer/*Finale antwoord:* 0,09 mol·dm^{-3}

OPTION 2/*OPSIE 2*	**Marking guidelines/*Nasienriglyne:***
n(NaOH) = cV ✓ = (0,1)(0,0251) ✓ = 0,00251 mol n$(COOH)_2$ = $\frac{1}{2}$(0,00251) ✓ = 0,00126 mol $c_a = \frac{n}{V}$ $= \frac{0,00126}{0,0142}$ ✓ $= 0,09\ mol \cdot dm^{-3}$ ✓	• Any ONE of formulae. *Enige EEN van formules* • Substitution of 0,1 x 0,0251. *Substitusie van* 0,1 x 0,0251. • Use mol ratio 1:2. *Gebruik molverhouding 1:2.* • Use V_a = 0,0142 dm^3. Gebruik V_a = 0,0142 dm^3 • Final answer/*Finale antwoord:* 0,09 mol·dm^{-3} Accept range/*Aanvaarde gebied:* 0,088 to 0,09 mol·dm^{-3}

(5)

7.5.2 C / phenolphthalein / *fenolftaleïen* ✓
Titration of weak acid and strong base. ✓
Titrasie van swak suur en sterk basis.

OR/*OF*
The endpoint will be at pH > 7 which is in the range of the indicator.
Die eindpunt sal by pH > 7 wees wat in die gebied van die indikator is. (2)
[17]

QUESTION 8/*VRAAG 8*

8.1
8.1.1 Salt bridge /*soutbrug* ✓ (1)

8.1.2 Voltaic / Galvanic cell ✓
Voltaïese / Galvaniese sel (1)

8.2
8.2.1 Decreases/*Verlaag* ✓ (1)

8.2.2 Increases / *Verhoog* ✓ (1)

8.3
8.3.1 $Y(s) \rightarrow Y^{2+}(aq) + 2e^-$ ✓✓ Ignore phases/*Ignoreer fases*

OR/*OF*
$Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$

Notes/*Aantekeninge*
$Y(s) \rightleftharpoons Y^{2+}(aq) + 2e^-$ ($^1/_2$) $Y^{2+}(aq) + 2e^- \leftarrow Y(s)$ ($^2/_2$)
$Y(s) \leftarrow Y^{2+}(aq) + 2e^-$ ($^0/_2$) $Y^{2+}(aq) + 2e^- \rightleftharpoons Y(s)$ ($^0/_2$) (2)

8.3.2 $Y(s) \mid Y^{2+}(aq) \parallel Al^{3+}(aq) \mid Al(s)$ ✓ ✓ ✓ **OR/*OF*** $Mg(s) \mid Mg^{2+}(aq) \parallel Al^{3+}(aq) \mid Al(s$

OR/*OF*
$Y(s) \mid Y^{2+}\ (1\ mol{\cdot}dm^{-3}) \parallel Al^{3+}(1\ mol{\cdot}dm^{-3}) \mid Al(s)$

Accept/Aanvaar:
$Y \mid Y^{2+} \parallel Al^{3+} \mid Al$ (3)

8.4

OPTION 1/*OPSIE 1*

$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ ✓

$0,7$ ✓ $= -1,66$ ✓ $- E^{\theta}_{oxidation}$

$E^{\theta}_{oxidation} = -2,36$ (V) ✓

Y is Mg ✓

Notes/*Aantekeninge*

- Accept any other correct formula from the data sheet./*Aanvaar enige ander korrekte formule vanaf gegewensblad.*
- Any other formula using unconventional abbreviations, e.g. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions:/*Enige ander formule wat onkonvensionele afkortings gebruik bv.* $E°_{sel} = E°_{OM} - E°_{RM}$ *gevolg deur korrekte vervangings*: $^{4}/_{5}$

OPTION 2/*OPSIE 2*

$A\ell^{3+}(aq) + 3e^- \rightarrow A\ell(s)$ ✓ $E^{\theta} = -1,66$ V ✓

$Y(s) \rightarrow Y^{2+}(aq) + 2e^-$ $E^{\theta} = +2,36$ V ✓

$Y(s) + A\ell^{3+}(aq) \rightarrow Y^{2+}(aq) + A\ell(s)$ $E^{\theta} = +0,7$ V ✓

Y is Mg ✓

(5)
[14]

QUESTION 9/*VRAAG 9*

9.1 Bauxite / *Bauxiet* ✓ (1)

9.2 Oxidation / *Oksidasie* ✓ (1)

9.3 Reduce melting point ./ *Verminder smeltpunt.*

OR/OF

To lower the temperature / energy needed to melt the $A\ell_2O_3$. ✓
Om die temperatuur / energie benodig om die $A\ell_2O_3$ te smelt, te verlaag.

ACCEPT/*AANVAAR*
To dissolve the $A\ell_2O_3$ so that it can electrolysed easier
Om die $A\ell_2O_3$ op te los sodat dit makliker elektroliseer (1)

9.4 $A\ell^{3+}(aq) + 3e^- \rightarrow A\ell(s)$ ✓✓

Ignore phases/*Ignoreer fases*

Notes/*Aantekeninge*

$A\ell \leftarrow A\ell^{3+} + 3e^-$ $(^{2}/_{2})$ $A\ell^{3} + 3e^- \rightleftharpoons A\ell$ $(^{1}/_{2})$

$A\ell \rightleftharpoons A\ell^{2+} + 3e^-$ $(^{0}/_{2})$ $A\ell^{3} + 3e \leftarrow A\ell$ $(^{0}/_{2})$

(2)

9.5 $C + O_2$ ✓ $\rightarrow CO_2$ ✓ Bal ✓

OR/OF

$2A\ell_2O_3 + 3C$ ✓ $\rightarrow 4A\ell + 3CO_2$ ✓ Bal ✓

Notes/*Aantekeninge:*

- Reactants/*Reaktanse* ✓ Products/*Produkte* ✓ Balancing/*Balansering* ✓
- Ignore double arrows./*Ignoreer dubbelpyle.*
- Marking rule 6.3.10./*Nasienreël 6.3.10.*

(3)
[8]

QUESTION 10/*VRAAG 10*

10.1

10.1.1 Ostwald (process) / *Ostwald(proses)* ✓ (1)

10.1.2 Catalyst/Speeds up the rate of the reaction ✓
Katalisator / Versnel die reaksietempo (1)

10.1.3 Nitrogen dioxide / *Stikstofdioksied* ✓ (1)

10.1.4 $3NO_2 + H_2O \rightleftharpoons 2HNO_3(aq) + NO$ ✓ Bal. ✓

Notes/*Aantekeninge:*
- Products ✓ Balancing ✓
  Produkte *Balansering*
- Ignore double arrows./*Ignoreer dubbelpyle.*
- Marking rule 6.3.10./*Nasienreël 6.3.10.* (2)

10.1.5 Decrease pressure / Increase volume / *Verlaag druk* / *Verhoog volume*✓
Decrease temperature / *Verlaag temperatuur* ✓ (2)

10.2

10.2.1 (Ratio of the) nitrogen, phosphorous and potassium in the fertiliser. ✓
Verhouding van die stikstof, fosfor en kalium in die kunsmis. (1)

10.2.2

Marking criteria/*Nasienriglyne:*

- Use ratio/*Gebruik verhouding:* $\frac{3}{8}$ ✓
- x 50 kg ✓
- x 25 / 25 % ✓
- Divide previous answer by/*Deel vorige antwoord deur* 39 ✓
- Multiply by/*Vermenigvuldig met* 74,5 ✓
- Final answer/*Finale antwoord:* 8,94 kg ✓

OPTION 1/*OPSIE 1*

$\%K = \frac{3}{8}$ ✓ (x 25) ✓

= 9,38%

$m(K) = \frac{9{,}38}{100}(\times 50\text{ kg})$ ✓

= 4,69 kg

OPTION 2/*OPSIE 2*

m(nutrients/*voedingstowwe*):

$\frac{25}{100}$ ✓ (x 50 ✓) = 12,5 kg

$\therefore m(K) = \frac{3}{8}$ ✓ x 12,5

= 4,69 kg

OPTION 3/*OPSIE 3*

m(K):

$\frac{3}{8}^{\checkmark} \times (\ 50)^{\checkmark} (\times \frac{25}{100})^{\checkmark} = 4{,}69\text{ kg}$

$$n(K) = \frac{m}{M} = \frac{4{,}69 \times 10^3}{39\ \checkmark} = 120\text{ mol}$$

m(KCℓ) = nM = (120)(74,5) ✓= 8940 g = 8,94 kg ✓

OPTION 4/*OPSIE 4*

$\%K = \frac{3}{8}$ ✓ x 25 ✓= 9,38%

$m(K) = \frac{9{,}38}{100}$ x 50 ✓= 4,69 kg

$\%K \text{ in } KC\ell = \frac{39}{74{,}5}$ ✓✓ x 100 = 52,35%

52,35% KCℓ: 4,69 kg

$m(100\%\ KC\ell) = \frac{4{,}69}{52{,}35}$ x 100

= 8,96 kg ✓

(6)
[14]

TOTAL/*TOTAAL*: 150