



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-trimetiëlbut-1-een

Accept/Aanvaar:

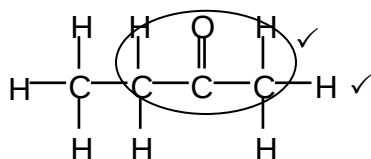
2,3,3- trimethyl ✓-1- butene /2,3,3-trimetiël-1-buteen

Marking criteria/Nasienriglyne:

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

(3)

2.3



Marking criteria/Nasienriglyne:

- Whole structure correct:/Hele struktuur korrek: $\frac{2}{2}$
- Only functional group correct/Slegs funksionele groep korrek: Max/Maks: $\frac{1}{2}$

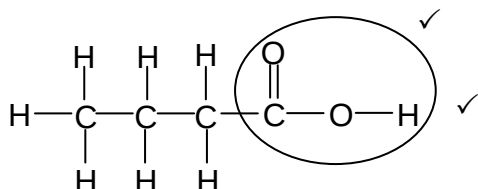
(2)

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: $\frac{2}{2}$
- Only functional group correct/Slegs funksionele groep korrek: Max/Max: $\frac{1}{2}$

(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-1-ol na heksan-1-ol. ✓

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 H₂O/water ✓

OR/OF

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

OR/OF

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

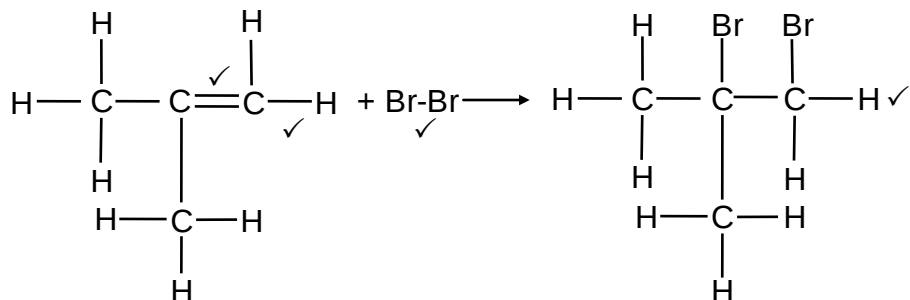
4.1.3 Tertiary / *Tersiêr* ✓ (1)

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 $\rightleftharpoons$
- 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 CuCO₃. / Toename in toestand van verdeeldheid van CuCO₃.
- Agitation / Stirring / Roer mengsel.

(2)

5.2 Accepted range / Aanvaarde gebied: 42 s to 50 s ✓

(1)

5.3

5.3.1 average / *gem.tempo* = $-\frac{\Delta m}{\Delta t}$

$$= -\frac{(169,76 - 170,00)}{(20 - 0)} \checkmark$$

$$= 0,012(\text{g} \cdot \text{s}^{-1}) \quad \checkmark$$

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

(3)

5.3.2 Pure sample/Suiwer monster:

$$m(\text{CO}_2)_{\text{formed/gevorm}} = \frac{170,00 - 169,73}{1} \checkmark$$

$$= 0,27 \text{ g}$$

Impure sample/Onsuiwer monster:

$$m(\text{CO}_2)_{\text{formed/gevorm}} = \frac{170,00 - 169,78}{1} \checkmark$$

$$= 0,22 \text{ g}$$

$$\% \text{Purity/suiwerheid} = \frac{0,22}{0,27} \times 100 \checkmark$$

$$= 81,48\% \checkmark$$

(4)

5.3.3 **POSITIVE MARKING FROM QUESTION 5.3.2.**

POSITIEWE NASIEN VAN VRAAG 5.3.2.

$$n(\text{CO}_2)_{\text{formed/ gevorm}} = \frac{m}{M}$$

$$= \frac{0,27}{44} \checkmark$$

$$= 6,13 \times 10^{-3} \text{ mol}$$

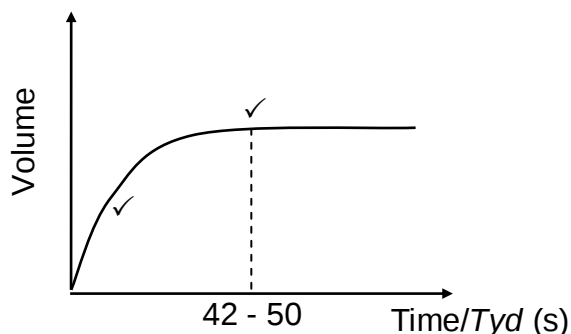
$$n(\text{CO}_2) = \frac{V}{V_m}$$

$$6,13 \times 10^{-3} = \frac{V}{22,4} \checkmark$$

$$V = 0,137 \text{ dm}^3 \checkmark$$

(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. <i>Grafiek geteken uit oorsprong met afnemende gradiënt.</i>	✓
Constant volume after (42 -50) s.or graph stops at (42 -50) s <i>Konstante volume na (42 – 50) s of grafiek stop by (42 – 50) s</i>	✓
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 $n(HI) = n(HI \text{ at equilibrium})$. ✓
Verandering in $n(HI) = n(HI \text{ by ewewig})$
- **USING** ratio/**GEBRUIK** verhouding: $H_2 : I_2 ; HI = 1 : 1 : 2$ ✓
- Initial $n(I_2) = \text{equilibrium } n(I_2) + \text{change in } n(I_2)$ ✓
Aanvanklike $n(I_2) = \text{ewewigs } n(I_2) + \text{verandering in } n(I_2)$
- Substitute $254\text{ g}\cdot\text{mol}^{-1}$ as molar mass for I_2 . ✓
Vervang $254\text{ g}\cdot\text{mol}^{-1}$ as molêre massa van for I_2 .
- Final answer/Finale antwoord: 24,89 - 24,92 (g) ✓

OPTION 1/OPSIE 1

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

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

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

No K_c expression, correct substitution/Geen K_c -uitdrukking, korrekte substitusie: Max./Maks. $\frac{8}{9}$

Wrong K_c expression/Verkeerde K_c -uitdrukking: Max./Maks. $\frac{6}{9}$

	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 ✓
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

Using ratio ✓

x 2

Divide by 2 ✓

OR/OF

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

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

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

No K_c expression, correct substitution/Geen K_c -uitdrukking, korrekte substitusie: Max./Maks. $\frac{8}{9}$

Wrong K_c expression/Verkeerde K_c -uitdrukking: Max./Maks. $\frac{6}{9}$

	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 ✓
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

Using ratio ✓

x 2

Divide by 2 ✓

$$\text{Initial quantity } I_2(\text{mol})/\text{Aanvangshoeveelheid } I_2(\text{mol}) = 0,08112 + 0,017 \\ = 0,09812 \text{ mol}$$

$$m(I_2) = nM \\ = (0,09812)(254) \checkmark \\ = 24,92 \text{ g} \checkmark$$

OPTION 2/OPSIE 2

$$\left. \begin{aligned} c(\text{H}_2) &= \frac{n}{V} \\ &= \frac{0,028}{2} \\ &= 0,014 \text{ mol} \cdot \text{dm}^{-3} \end{aligned} \quad \begin{aligned} c(\text{I}_2) &= \frac{n}{V} \\ &= \frac{0,017}{2} \\ &= 0,0085 \text{ mol} \cdot \text{dm}^{-3} \end{aligned} \right\} \text{Divide by } 2 \text{ dm}^3 \checkmark$$

$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} \checkmark$$

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

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

$$n(\text{HI at equilibrium/by ewewig}) = (0,08112)(2) = 0,1622 \text{ mol}$$

$$n(\text{HI formed/gevorm}) = n(\text{HI at equilibrium/by ewewig}) = 0,1622 \text{ mol} \checkmark$$

$$n(\text{I}_2 \text{ reacted/gereageer}) = \frac{1}{2}n(\text{HI formed/gevorm}) = 0,08112 \text{ mol} \checkmark$$

$$n(\text{I}_2 \text{ initial/ aanvanklik}) = n(\text{I}_2 \text{ reacted/gereageer}) + n(\text{I}_2 \text{ equilibrium/ewewig})$$

$$= 0,08112 + 0,017 \checkmark$$

$$= 0,09812 \text{ mol}$$

$$m(\text{I}_2 \text{ initial/aanvanklik}) = nM$$

$$= (0,09812)(254) \checkmark$$

$$= 24,92 \text{ (g)} \checkmark$$

CALCULATIONS USING CONCENTRATION

BEREKENINGE WAT KONSENTRASIE GEBRUIK

Mark allocation/Puntetoekenning:

- Divide equilibrium moles of H_2 and I_2 by 2 dm^3 . $\checkmark$
Deel ewewigshoeveelhede van H_2 en I_2 deur 2 dm^3 .
- Correct K_c expression (formulae in square brackets). $\checkmark$
Korrekte K_c -uitdrukking (formules in vierkanthakies).
- Substitution of equilibrium concentrations into K_c expression. $\checkmark$
Vervanging van ewewigskonsentrasies in K_c -uitdrukking.
- Substitution of K_c value/Vervanging van K_c -waarde. $\checkmark$
- Change in $n(\text{HI}) = n(\text{HI at equilibrium})$. $\checkmark$
Verandering in $n(\text{HI}) = n(\text{HI by ewewig})$
- **USING ratio/GEBRUIK verhouding:** $\text{H}_2 : \text{I}_2 : \text{HI} = 1 : 1 : 2$ $\checkmark$
- Initial $[\text{I}_2] = \text{equilibrium } [\text{I}_2] + \text{change in } [\text{I}_2]$ $\checkmark$
Aanvanklike $n(\text{I}_2) = \text{ewewigs } n(\text{I}_2) + \text{verandering in } n(\text{I}_2)$
- Substitute $254 \text{ g} \cdot \text{mol}^{-1}$ as molar mass for I_2 . $\checkmark$
Vervang $254 \text{ g} \cdot \text{mol}^{-1}$ as molêre massa van for I_2 .
- Final answer/Finale antwoord: 24,89 – 24,92 (g) $\checkmark$

OPTION 3/OPSIE 3

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

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

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

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

$$0,04905 = \frac{m}{(254)(2)} \checkmark$$

$$\therefore m = 24,89 \text{ g} \checkmark$$

No K_c expression, correct substitution/Geen K_c -uitdrukking, korrekte substitusie: Max./Maks. $\frac{8}{9}$

Wrong K_c expression/Verkeerde K_c -uitdrukking: Max./Maks. $\frac{6}{9}$

	H_2	I_2	HI
Initial concentration ($\text{mol}\cdot\text{dm}^{-3}$) <i>Aanvangskonsentrasie ($\text{mol}\cdot\text{dm}^{-3}$)</i>		0,04905	0
Change ($\text{mol}\cdot\text{dm}^{-3}$) <i>Verandering ($\text{mol}\cdot\text{dm}^{-3}$)</i>	0,04055	0,04055	0,08112
Equilibrium concentration ($\text{mol}\cdot\text{dm}^{-3}$) <i>Ewewigskonsentrasie ($\text{mol}\cdot\text{dm}^{-3}$)</i>	0,014	0,0085	0,08112

ratio $\checkmark$
verhouding

(9)

6.3 (Chemical/dynamic) equilibrium / (Chemiese/dinamiese) ewewig $\checkmark$

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. $\checkmark$
Increase in pressure. / Toename in druk. $\checkmark$

(2)

6.5.1 $\ominus$ Endothermic / Endotermies $\checkmark$

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

(3)

6.5.2 Decreases / Verlaag $\checkmark$

(1)

6.6 Reactants / H_2 / I_2 removed $\checkmark$
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 $K_w = [OH^-][H_3O^+]$ $1 \times 10^{-14} = (0,1)[H_3O^+] \checkmark$ $[H_3O^+] = 1 \times 10^{-13} \text{ mol} \cdot \text{dm}^{-3}$ $pH = -\log[H_3O^+] \checkmark$ $= -\log(1 \times 10^{-13}) \checkmark$ $= 13 \checkmark$	OPTION 2/OPSIE 2 $pOH = -\log[OH^-] \checkmark$ $= -\log(0,1) \checkmark$ $= 1$ $14 = pOH + pH$ $14 = 1 + pH \checkmark$ $pH = 13 \checkmark$	(4)
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7.5
7.5.1

OPTION 1/OPSIE 1 $\frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b} \checkmark$ $\frac{c_a \times 14,2}{0,1 \times 25,1} = \frac{1}{2} \checkmark$ $c_a = 0,09 \text{ mol} \cdot \text{dm}^{-3} \checkmark$	Marking guidelines/Nasienriglyne: - Formula/Formule - Substitution of 0,1 x 25,1. Substitusie van 0,1 x 25,1. - Use $V_a = 14,2 \text{ cm}^3$. Gebruik $V_a = 14,2 \text{ cm}^3$. - Use mol ratio 1:2. Gebruik molverhouding 1:2. - Final answer/Finale antwoord: $0,09 \text{ mol} \cdot \text{dm}^{-3}$
OPTION 2/OPSIE 2 $n(\text{NaOH}) = cV \checkmark$ $= (0,1)(0,0251) \checkmark$ $= 0,00251 \text{ mol}$ $\downarrow$ $n(\text{COOH})_2 = \frac{1}{2}(0,00251) \checkmark$ $= 0,00126 \text{ mol}$ $c_a = \frac{n}{V}$ $= \frac{0,00126}{0,0142} \checkmark$ $= 0,09 \text{ mol} \cdot \text{dm}^{-3} \checkmark$	Marking guidelines/Nasienriglyne: - 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 $V_a = 0,0142 \text{ dm}^3$. Gebruik $V_a = 0,0142 \text{ dm}^3$ - Final answer/Finale antwoord: $0,09 \text{ mol} \cdot \text{dm}^{-3}$ Accept range/Aanvaarde gebied: $0,088 \text{ to } 0,09 \text{ mol} \cdot \text{dm}^{-3}$

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

OR/OF

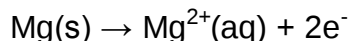
The endpoint will be at pH > 7 which is in the range of the indicator.
Die eindpunt sal by pH > 7 wees wat in die gebied van die indikator is.

(2)
[17]

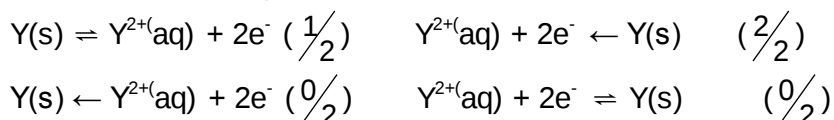
QUESTION 8/VRAAG 8

- 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



Notes/Aantekeninge



(2)

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

OR/OF



Accept/Aanvaar:



(3)

8.4

OPTION 1/OPSIE 1 $E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} \checkmark$ $0,7 \checkmark = -1,66 \checkmark - E_{\text{oxidation}}^{\theta}$ $E_{\text{oxidation}}^{\theta} = -2,36 \text{ (V)} \checkmark$ Y is Mg $\checkmark$	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. $E_{\text{cell}}^{\theta} = E_{\text{OA}}^{\theta} - E_{\text{RA}}^{\theta}$ followed by correct substitutions./Enige ander formule wat onkonvensionele afkortings gebruik bv. $E_{\text{sel}}^{\theta} = E_{\text{OM}}^{\theta} - E_{\text{RM}}^{\theta}$ gevolg deur korrekte vervangings. $\frac{4}{5}$
OPTION 2/OPSIE 2 $\text{Al}^{3+}(\text{aq}) + 3\text{e}^{-} \rightarrow \text{Al}(\text{s}) \checkmark$ $\text{Y}(\text{s}) \rightarrow \text{Y}^{2+}(\text{aq}) + 2\text{e}^{-} \checkmark$ $\text{Y}(\text{s}) + \text{Al}^{3+}(\text{aq}) \rightarrow \text{Y}^{2+}(\text{aq}) + \text{Al}(\text{s}) \checkmark$ Y is Mg $\checkmark$	$E^{\theta} = -1,66 \text{ V} \checkmark$ $E^{\theta} = +2,36 \text{ V} \checkmark$ $E^{\theta} = +0,7 \text{ V} \checkmark$

(5)
[14]

QUESTION 9/VRAAG 9

9.1 Bauxite / Bauxiet $\checkmark$ (1)

9.2 Oxidation / Oksidasie $\checkmark$ (1)

9.3 Reduce melting point ./ Verminder smeltpunt.

OR/OF

To lower the temperature / energy needed to melt the Al_2O_3 . $\checkmark$
Om die temperatuur / energie benodig om die Al_2O_3 te smelt, te verlaag.

ACCEPT/AANVAAR

To dissolve the Al_2O_3 so that it can electrolysed easier
Om die Al_2O_3 op te los sodat dit makliker elektroliseer

(1)

9.4 $\text{Al}^{3+}(\text{aq}) + 3\text{e}^{-} \rightarrow \text{Al}(\text{s}) \checkmark \checkmark$

Ignore phases./Ignoreer fases

Notes/Aantekeninge



(2)

9.5 $\text{C} + \text{O}_2 \checkmark \rightarrow \text{CO}_2 \checkmark$ Bal $\checkmark$

OR/OF

$2\text{Al}_2\text{O}_3 + 3\text{C} \checkmark \rightarrow 4\text{Al} + 3\text{CO}_2 \checkmark$ Bal $\checkmark$

Notes/Aantekeninge:

- Reactants/Reaktanse $\checkmark$ Products/Produkte $\checkmark$ Balancing/Balansering $\checkmark$
- 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 $3\text{NO}_2 + \text{H}_2\text{O} \rightleftharpoons 2\text{HNO}_3(\text{aq}) + \text{NO}$ ✓ Bal. ✓

Notes/Aantekeninge:

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

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/Nasiennriglyne:

- 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

$$\begin{aligned}\%K &= \frac{3}{8} \checkmark (x 25) \checkmark \\ &= 9,38\% \\ m(K) &= \frac{9,38}{100} (x 50 \text{ kg}) \checkmark \\ &= 4,69 \text{ kg}\end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}m(\text{nutrients/voedingstowwe}): \\ \frac{25}{100} \checkmark (x 50) \checkmark &= 12,5 \text{ kg} \\ \therefore m(K) &= \frac{3}{8} \checkmark x 12,5 \\ &= 4,69 \text{ kg}\end{aligned}$$

OPTION 3/OPSIE 3

$$\begin{aligned}m(K): \\ \frac{3}{8} \checkmark \times (50) \checkmark \left(\times \frac{25}{100} \right) \checkmark &= 4,69 \text{ kg}\end{aligned}$$

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

$$m(KCl) = nM = (120)(74,5) \checkmark = 8940 \text{ g} = 8,94 \text{ kg} \checkmark$$

OPTION 4/OPSIE 4

$$\begin{aligned}\%K &= \frac{3}{8} \checkmark \times 25 \checkmark = 9,38\% \\ m(K) &= \frac{9,38}{100} \times 50 \checkmark = 4,69 \text{ kg} \\ \%K \text{ in } KCl &= \frac{39}{74,5} \checkmark \checkmark \times 100 = 52,35\% \\ 52,35\% KCl: &4,69 \text{ kg} \\ m(100\% KCl) &= \frac{4,69}{52,35} \times 100 \\ &= 8,96 \text{ kg} \checkmark\end{aligned}$$

(6)
[14]

TOTAL/TOTAAL: 150