



# basic education

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Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

## **SENIOR CERTIFICATE EXAMINATIONS SENIORSERTIFIKAAT-EKSAMEN**

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

**2018**

**MARKING GUIDELINES/NASIENRIGLYNE**

**MARKS/PUNTE: 150**

**These marking guidelines consist of 15 pages.  
Hierdie nasienriglyne bestaan uit 15 bladsye.**

**QUESTION 1/VRAAG 1**

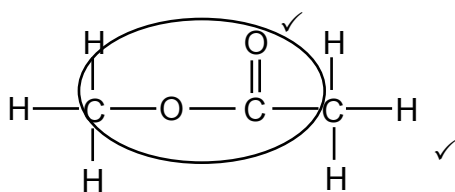
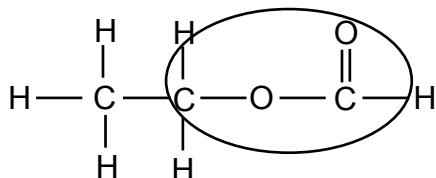
- 1.1 D ✓✓ (2)
- 1.2 A ✓✓ (2)
- 1.3 B ✓✓ (2)
- 1.4 B ✓✓ (2)
- 1.5 D ✓✓ (2)
- 1.6 C ✓✓ (2)
- 1.7 B ✓✓ (2)
- 1.8 D ✓✓ (2)
- 1.9 D ✓✓ (2)
- 1.10 C ✓✓ (2)
- [20]**

**QUESTION 2/VRAAG 2**

- 2.1
- 2.1.1 A ✓ (1)
- 2.1.2 D ✓ (1)
- 2.1.3 B ✓ (1)
- 2.1.4 E ✓ (1)
- 2.1.5 B ✓ (1)

2.2

2.2.1

**OR/OF**

2.2.2

**ANY ONE/ENIGE EEN:**

Methyl ✓ ethanoate ✓ / metietanoaat

**OR/OF**

Ethyl ✓ methanoate ✓ // etielmetanoaat

**Marking criteria/Nasienriglyne**

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

**Accept/Aanvaar**

Any correct arrangement of correct number of atoms

*Enige korrekte struktuur met die korrekte aantal atome.*

(2)

2.3

- 2.3.1 A large molecule ✓ composed of smaller monomer units covalently bonded to each other in a repeating pattern. ✓  
 'n Groot molekule ✓ wat uit kleiner monomeer-eenhede bestaan wat kovalent aan mekaar in 'n herhalende patroon gebind is. ✓ (2)

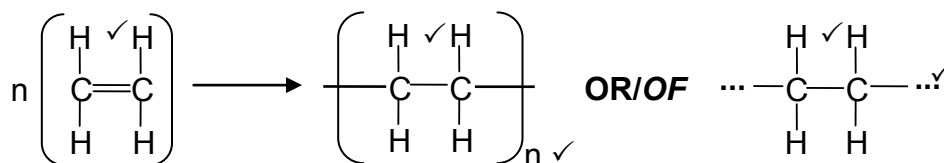
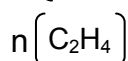
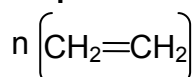
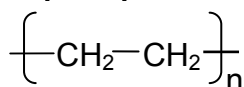
2.3.2 Polyethene ✓  
 Polieteen

**Accept/Aanvaar:**

Polyethylene/polythene

Poli-eteen/poli-etileen/politeen (1)

2.3.3

**Accept as reactant/Aanvaar as reaktans:****Accept as product/Aanvaar as produk:****Marking guidelines/Nasienglyne**

- Structure shows TWO C atoms with four bonds (ethene) each and FOUR H atoms./Struktuur toon TWEE C-atome met vier bindings (eteen) elk na VIER H-atome. ✓
- Structure of product / Struktuur van produk. ✓
- Multiple n and brackets correctly shown for reactant and product./Veelvoud n en hakie korrek getoon vir reaktans en produk. ✓

2.4 Hydrolysis/Substitution ✓  
 Hidrolise/Substitusie (1)

- 2.5
- Use concentrated strong base/NaOH/KOH/LiOH OR ethanolic/alcoholic strong base/NaOH/KOH/LiOH. ✓/Use ethanol instead of water./No water. *Gebruik gekonsentreerde sterk basis*/NaOH/KOH/LiOH OF *etanoliese / alkoholiese sterk basis*/NaOH/KOH/LiOH /*Gebruik etanol in plaas van water./Geen water nie.*
  - Heat strongly/*Verhit sterk* ✓  
**Accept/Aanvaar:** Increase temperature/*Verhoog temperatuur* (2)

**[18]**

**QUESTION 3/VRAAG 3**

- 3.1
- **Structure/Struktuur:**  
The chain length/molecular size /molecular structure/molecular mass/ surface area increases. ✓  
*Die kettinglengte/molekulêre grootte/molekulêre struktuur/molekulêre massa/oppervlakte neem toe.*
  - **Intermolecular forces/Intermolekulêre kragte:**  
Increase in strength of intermolecular forces/induced dipole /London/ dispersion /Van der Waals forces/momentary dipoles. ✓  
*Toename in sterkte van intermolekulêre kragte/geïnduseerde dipoolkragte/Londonkragte/dispersiekragte/Van der Waalskragte / momentele dipool.*
  - **Energy/Energie:**  
More energy needed to overcome/break intermolecular forces. ✓  
*Meer energie benodig om intermolekulêre kragte te oorkom/breek.*

**OR/OF**

- **Structure/Struktuur:**  
From 4 C atoms to 1 C atom/bottom to top the chain length/molecular size/molecular structure/molecular mass/surface area decreases. ✓  
*Van 4 C-atome na 1 C-atoom/onder na bo neem die kettinglengte/ molekulêre grootte/molekulêre struktuur/molekulêre massa/oppervlakte af.*
- **Intermolecular forces/Intermolekulêre kragte:**  
Decrease in strength of intermolecular forces/ induced dipole forces/ London forces/dispersion forces. ✓  
*Afname in sterkte van intermolekulêre kragte/geïnduseerde dipoolkragte/ Londonkragte/dispersiekragte.*
- **Energy/Energie:**  
Less energy needed to overcome/break intermolecular forces. ✓  
*Minder energie benodig om intermolekulêre kragte te oorkom/breek.* (3)

- 3.2
- Alkanes have London/dispersion/induced dipole forces. ✓  
*Alkane het London-/dispersie-/geïnduseerde dipoolkragte.*
  - Alcohols have hydrogen bonding (in addition to London/dispersion/ induced dipole forces and dipole dipole forces). ✓  
*Alkohole het waterstofbinding (in toevoeging tot London-/dispersie-/ geïnduseerde dipoolkragte en dipoolkragte).*
  - Hydrogen bonding are stronger intermolecular forces than London/ dispersion/ induced dipole forces. ✓  
*Waterstofbindings is sterker intermolekulêre kragte as London-/dispersie-/geïnduseerde dipoolkragte.*

**OR/OF**

More energy needed to overcome/break intermolecular forces in alcohols  
*Meer energie benodig om intermolekulêre kragte te oorkom/breek in alkohole.*

- Alcohols have higher boiling points than alkanes. ✓  
*Alkohole het hoër kookpunte as die alkane.* (4)

- 3.3 Decrease/Neem af ✓ (1)

3.4 Lower than/Laer as ✓



2-methylpropane/It is more branched/has a smaller surface area/has a shorter chain length (than butane/chain isomer) ✓

2-metielpropaan/Dit is vertak/het 'n kleiner oppervlakte/het 'n korter kettinglengte (as butaan/ketting-isomeer).

**OR/OF**

Butane/chain isomer is less branched /has larger surface area/longer chain length (than 2-methylpropane).

Butaan/ketting-isomeer is minder vertak/het 'n groter oppervlakte/het 'n langer kettinglengte (as 2-metielpropaan).

(2)  
[10]

**QUESTION 4/VRAAG 4**

4.1

4.1.1 Substitution/halogenation/bromonation ✓

Substitusie/halogenering/halogenasie/brominerig/brominasie

(1)

4.1.2 Elimination/dehydration ✓

Eliminasie/dehidrasie/dehidratering

(1)

4.1.3 Esterification/condensation ✓

Esterifikasie/verestering/kondensasie

(1)

4.1.4 Addition/hydrohalogenation/hydrobromonation ✓

Addisie/hidrohalogenasie/hidrohalogenering/hidrobrominasie/hidrobromonering

(1)

4.2

4.2.1 Catalyst/dehydrating agent/speeds up reaction ✓

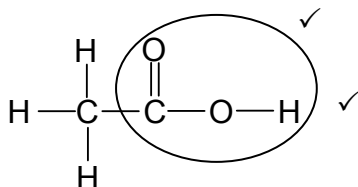
Katalisator/dehidreermiddel/versnel die reaksie

(1)

4.2.2 Propyl ✓ ethanoate ✓ /Propieletanoaat

(2)

4.2.3



**Marking criteria/Nasienriglyne:**

- Whole structure correct

Hele struktuur korrek:  $\frac{2}{2}$

- Only functional group correct

Slegs funksionele groep korrek:  $\frac{1}{2}$

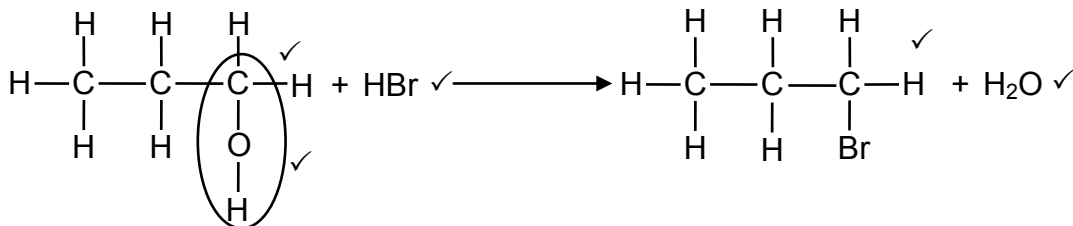
**IF/INDIEN:**

More than one functional group/Meer as een funksionele groep

$\frac{0}{2}$

(2)

4.3

**Notes/Aantekeninge:**

- Ignore/Ignoreer  $\Rightarrow$
- Accept HBr and H<sub>2</sub>O as condensed. /Aanvaar HBr en H<sub>2</sub>O as gekondenseerd.
- Any additional reactants and/or products

*Enige addisionele reaktanse en/of produkte:*

Max./Maks.  $\frac{4}{5}$

- Accept coefficients that are multiples.  
Aanvaar koëffisiënte wat veelvoude is.

- Incorrect balancing/Verkeerde balansering:

Max./Maks.  $\frac{4}{5}$

- Molecular/condensed formulae

*Molekulêre/gekondenseerde formule:*

Max./Maks.  $\frac{2}{5}$

(5)  
[14]

**QUESTION 5/VRAAG 5**

5.1

**ONLY ANY ONE OF/SLEGS ENIGE EEN VAN:**

- Change in concentration of products/reactants ✓ per (unit) time. ✓  
Verandering in konsentrasie van produkte/reaktanse per (eenheids)tyd.
- Rate of change in concentration. ✓✓  
Tempo van verandering in konsentrasie.
- Change in amount/number of moles/volume/mass ✓ of products or reactants per (unit) time. ✓  
Verandering in hoeveelheid/aantal mol/volume/massa van produkte of reaktanse per (eenheids)tyd.
- Amount/number of moles/volume/mass (of products) formed/(reactants) used ✓ per (unit) time. ✓  
Hoeveelheid/aantal mol/volume/massa (van produkte) gevorm/(reaktanse) gebruik per (eenheids)tyd.

(2)

5.2

5.2.1

Surface area/State of division ✓  
Oppervlakte/Toestand van verdeeldheid

(1)

5.2.2

**ANY ONE/ENIGE EEN:**

- Amount/mass of magnesium ✓  
Hoeveelheid/massa magnesium
- Concentration of HCl/acid/Konsentrasie van HCl /suur
- (Initial) temperature/(Aanvanklike) temperatuur

(1)

5.3

5.3.1

**Marking criteria/Nasienglyne**

- Calculate change in  $m(\text{Mg})$  or  $n(\text{Mg})$  ✓  
*Bereken verandering in  $m(\text{Mg})$  of  $n(\text{Mg})$*
- Substitute/Vervang  $24 \text{ g} \cdot \text{mol}^{-1}$  in  $n = \frac{m}{M}$  ✓
- Use mol ratio/Gebruik molverhouding:  $n(\text{Mg}) = n(\text{H}_2) = 1:1$  ✓
- Substitute/Vervang  $25 \text{ dm}^3$  in  $n = \frac{V}{V_m}$  ✓
- Final answer/Finale antwoord:  $2,5 \text{ dm}^3$  ✓

**OPTION 1/OPSIE 1**

$$\Delta m(\text{Mg}) = 2,6 - 0,2 \checkmark$$

$$= 2,4 \text{ g}$$

$$n(\text{Mg}_{\text{used/gebruik}}) = \frac{m}{M}$$

$$= \frac{2,4}{24} \checkmark$$

$$= 0,1 \text{ mol}$$

$$n(\text{H}_2) = n(\text{Mg}) = 0,1 \text{ mol} \checkmark$$

$$V(\text{H}_2) = nV_m$$

$$V(\text{H}_2) = (0,1)(25) \checkmark$$

$$= 2,5 \text{ dm}^3 \checkmark$$

**OPTION 2/OPSIE 2**

$$n(\text{Mg})_{t=2s} = \frac{m}{M} = \frac{2,6}{24} \checkmark = 0,1083 \text{ mol}$$

$$n(\text{Mg})_{t=10s} = \frac{0,2}{24} = 0,0083 \text{ mol}$$

$$\Delta n(\text{Mg}) = 0,1083 - 0,0083 \checkmark$$

$$= 0,1 \text{ mol}$$

$$n(\text{H}_2) = n(\text{Mg}) = 0,1 \text{ mol} \checkmark$$

$$V(\text{H}_2) = nV_m$$

$$V(\text{H}_2) = (0,1)(25) \checkmark$$

$$= 2,5 \text{ dm}^3 \checkmark$$

**OPTION 3/OPSIE 3**

$$24 \text{ g Mg} \checkmark \longrightarrow 25 \text{ dm}^3 \text{ H}_2$$

$$\therefore 2,4 \text{ g} \checkmark \longrightarrow x \text{ dm}^3 \text{ H}_2$$

$$x = \frac{2,4 \times 25}{24} \checkmark$$

$$= 2,5 \text{ dm}^3 \checkmark$$

(5)

## 5.3.2

**Marking criteria/Nasienriglyne**

- Substitute/Vervang  $2,08 \times 10^{-4}$  in ave rate / *gem. tempo* =  $\frac{\Delta n}{\Delta t}$  ✓
- Substitute/Vervang  $10 \times 60$  s (600 s) in ave rate / *gem. tempo* =  $\frac{\Delta n}{\Delta t}$  ✓
- Use mol ratio/Gebruik *molverhouding*:  $n(\text{Mg}) = n(\text{H}_2) = 1:1$  ✓
- Substitute/Vervang  $24 \text{ g} \cdot \text{mol}^{-1}$  in  $m = nM$ . ✓
- Final answer/Finale antwoord: 3 g ✓ (Range/Gebied 2,995 – 3,12 g)

$$\text{ave rate / gem. tempo} = \frac{\Delta n}{\Delta t}$$

$$\therefore 2,08 \times 10^{-4} = \frac{\Delta n}{(10 \times 60) - 0} \checkmark$$

$$\therefore \Delta n = 0,125 \text{ mol}$$

$$n(\text{Mg}) = n(\text{H}_2) = 0,125 \text{ mol} \checkmark$$

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

$$m(\text{Mg}) = 0,125 \times 24 \checkmark$$

$$= 3 \text{ g} \checkmark \text{ (2,995 g)}$$

(5)

## 5.4

- Larger surface area/state of division. ✓  
*Groter reaksieoppervlak/toestand van verdeeldheid*
- More particles (per volume) with correct orientation/Meer deeltjies (per volume) met korrekte oriëntasie. ✓  
**OR/OF**  
More contact points./Meer kontakpunte.
- More effective collisions per (unit) time./Frequency of effective collisions increases./More particles collide with sufficient kinetic energy & correct orientation per (unit) time. ✓✓  
*Meer effektiewe botsings per (eenheids)tyd./Frekwensie van effektiewe botsings verhoog./Meer deeltjies bots met genoeg kinetiese energie & korrekte oriëntasie per tyd(seenheid).*

(3)  
[17]



**QUESTION 6/VRAAG 6**

- 6.1 The stage in a chemical reaction when the rate of forward reaction equals the rate of reverse reaction./Both forward and reverse reactions take place at same rate. ✓✓

*Die stadium in 'n chemiese reaksie wanneer die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie./Beide voor- en terugwaartse reaksies vind teen dieselfde tempo plaas.*

**OR/OF**

The stage in a chemical reaction when the concentrations of reactants and products remain constant. ✓✓

*Die stadium in 'n chemiese reaksie wanneer die konsentrasies van reaktanse en produkte konstant bly.*

(2)

6.2

6.2.1 2 ✓

(1)

6.2.2 1 ✓

(1)

6.2.3 3 ✓

(1)

6.3 **POSITIVE MARKING FROM QUESTION 6.2.****POSITIEWE NASIEN VANAF VRAAG 6.2.****Marking criteria/Nasienriglyne:**

- Substitute/Vervang 8 mol in  $c = \frac{n}{V}$  ✓
- Substitute/Vervang 4 mol in  $c = \frac{n}{V}$  ✓
- Substitute/Vervang 12 mol in  $c = \frac{n}{V}$  ✓
- Substitute/Vervang  $V = 3 \text{ dm}^3$  in the above THREE formulae/in die bostaande DRIE formules. ✓
- $K_c$  expression/uitdrukking ✓
- Substitution of concentrations into  $K_c$  expression ✓  
Vervanging van konsentrasies in  $K_c$ -uitdrukking.
- Final answer/Finale antwoord: 6,75 ✓

**OPTION 1/OPSIE 1**

$$[A] = \frac{8}{3} = 2,67 \text{ mol} \cdot \text{dm}^{-3}$$

$$[B] = \frac{4}{3} = 1,33 \text{ mol} \cdot \text{dm}^{-3} \quad \text{Divide by/Deel deur } 3 \text{ dm}^3 \checkmark$$

$$[C] = \frac{12}{3} = 4 \text{ mol} \cdot \text{dm}^{-3}$$

$$K_c = \frac{[C]^3}{[A]^2[B]} \checkmark$$

$$= \frac{(4)^3}{(2,67)^2(1,33)} \checkmark$$

$$= 6,75 \checkmark$$

No  $K_c$  expression, correct substitution /Geen  $K_c$ -uitdrukking, korrekte substitusie: Max./Maks.  $\frac{6}{7}$

Wrong  $K_c$  expression /Verkeerde  $K_c$ -uitdrukking:  
Max./Maks.  $\frac{4}{7}$

**OPTION 2/OPSIE 2**

	<b>A</b>	<b>B</b>	<b>C</b>
Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i>	16	8	0
Change (mol) <i>Verandering (mol)</i>	8	4	12
Quantity at equilibrium (mol) <i>Hoeveelheid by ewewig (mol)</i>	8 ✓	4 ✓	12 ✓
Equilibrium concentration (mol·dm <sup>-3</sup> ) <i>Ewewigkonsentrasie (mol·dm<sup>-3</sup>)</i>	$\frac{8}{3}$	$\frac{4}{3}$	$\frac{12}{3}$

Divide by  
/deel deur  
3 dm<sup>3</sup> ✓

$$K_c = \frac{[C]^3}{[A]^2[B]} \checkmark$$

$$= \frac{(4)^3}{(2,67)^2(1,33)} \checkmark$$

$$= 6,75 \checkmark$$

No K<sub>c</sub> expression, correct substitution / *Geen K<sub>c</sub>-uitdrukking, korrekte substitusie: Max./Maks.  $\frac{6}{7}$* Wrong K<sub>c</sub> expression / *Verkeerde K<sub>c</sub>-uitdrukking: Max./Maks.  $\frac{4}{7}$* 

(7)

**USING CONCENTRATION/GEBRUIK KONSENTRASIE****OPTION 3/OPSIE 3**

	<b>A</b>	<b>B</b>	<b>C</b>
Initial concentration (mol·dm <sup>-3</sup> ) <i>Aanvangskonsentrasie (mol·dm<sup>-3</sup>)</i>	$\frac{16}{3} = 5,33$	$\frac{8}{3} = 2,67$	0
Change (mol·dm <sup>-3</sup> ) <i>Verandering (mol·dm<sup>-3</sup>)</i>	$\frac{8}{3} = 2,67$	$\frac{4}{3} = 1,33$	$\frac{12}{3} = 4$
Equilibrium concentration (mol·dm <sup>-3</sup> ) <i>Ewewigkonsentrasie (mol·dm<sup>-3</sup>)</i>	$\frac{8}{3} = 2,67 \checkmark$	$\frac{4}{3} = 1,33 \checkmark$	$\frac{12}{3} = 4 \checkmark$

÷3  
dm<sup>3</sup> ✓

$$K_c = \frac{[C]^3}{[A]^2[B]} \checkmark$$

$$= \frac{(4)^3}{(2,67)^2(1,33)} \checkmark$$

$$= 6,75 \checkmark$$

No K<sub>c</sub> expression, correct substitution / *Geen K<sub>c</sub>-uitdrukking, korrekte substitusie: Max./Maks.  $\frac{6}{7}$* Wrong K<sub>c</sub> expression / *Verkeerde K<sub>c</sub>-uitdrukking: Max./Maks.  $\frac{4}{7}$* 

(7)

## 6.4 Endothermic/Endotermies ✓



- (An increase in temperature) favours the reverse reaction. ✓  
(*'n Toename in temperatuur*) bevoordeel die terugwaartse reaksie.
- An increase in temperature favours an endothermic reaction. ✓  
(*'n Toename in temperatuur*) bevoordeel 'n endotermiese reaksie.

(3)

**[15]**

**QUESTION 7/VRAAG 7**

7.1 Titration/Volumetric analysis ✓  
 Titrasië/Volumetriese analise (1)

7.2 To measure the (exact) volume of acid needed to reach endpoint/to neutralise the base. ✓  
 Om die (presiese) volume suur te meet wat benodig word om die eindpunt te bereik/om die basis te neutraliseer. (1)

7.3 Acids produce hydrogen ions ( $H^+$ )/hydronium ions ( $H_3O^+$ ) in solution/when dissolved in water. ✓✓  
 Sure vorm waterstofione( $H^+$ )/hidroniumione ( $H_3O^+$ ) in oplossing/wanneer opgelos in water.

**IF/INDIEN:**

Acids produce hydrogen ions ( $H^+$ )/hydronium ions ( $H_3O^+$ ). ✓  
 Sure vorm waterstofione( $H^+$ )/hidroniumione ( $H_3O^+$ ). (2)

7.4  $H_2SO_4$  ionises completely./  $H_2SO_4$  ioniseer volledig. ✓ (1)

7.5 Blue to yellow/Blou na geel ✓ (1)

7.6

**Marking guidelines/Nasienriglyne:**

- Formula/Formule:  $c = \frac{n}{V} / n = cV / \frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b}$  ✓
- Substitution of/Vervanging van: (0,1)(25)/(0,1)(0,025) ✓
- Use mol ratio/Gebruik molverhouding:  $n_a : n_b = 1 : 2$  ✓
- Final answer/Finale antwoord: 12,5 cm<sup>3</sup> / 0,0125 dm<sup>3</sup> ✓

**OPTION 1/OPSIE 1**

$$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \quad \checkmark$$

$$\frac{(0,1)V_a}{(0,1)(25)} = \frac{1}{2} \quad \checkmark$$

$$\therefore V_a = 12,5 \text{ cm}^3 \quad \checkmark$$

**OPTION 2/OPSIE 2**

$$c_b = \frac{n}{V} \quad \checkmark$$

$$0,1 = \frac{n}{0,025} \quad \checkmark$$

$$n_b = 2,5 \times 10^{-3} \text{ mol}$$

$$n_a = \frac{1}{2} n_b = \frac{1}{2} (2,5 \times 10^{-3}) \quad \checkmark$$

$$= 1,25 \times 10^{-3} \text{ mol}$$

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

$$0,1 = \frac{1,25 \times 10^{-3}}{V}$$

$$\therefore V_a = 0,0125 \text{ dm}^3 / 12,5 \text{ cm}^3 \quad \checkmark$$

(4)

7.7

**POSITIVE MARKING FROM QUESTION 7.6.****POSITIEWE NASIEN VANAF VRAAG 7.6.****Marking guidelines/Nasienriglyne:**

- Formula/Formule:  $c = \frac{n}{V}$  ✓
- Substitution of/Vervanging van:  $(0,1)(0,005)/0,0175$  in  $n = cV$  ✓
- Substitute/Vervang  $V = 0,0425 \text{ dm}^3$  ✓
- Use/Gebruik  $[\text{H}_3\text{O}^+] : [\text{H}_2\text{SO}_4] = 2 : 1$  ✓
- Formula/Formule:  $\text{pH} = -\log[\text{H}_3\text{O}^+]$  ✓
- Substitute/Vervang  $[\text{H}^+]$  ✓
- Final answer/Finale antwoord: 1,63 ✓

**OPTION 1/OPSIE 1**

$$\begin{aligned} n_{\text{a(excess/oormaat)}} &= cV \checkmark \\ &= (0,1)(0,005) \checkmark \\ &= 5 \times 10^{-4} \text{ mol} \end{aligned}$$

$$\begin{aligned} c_{\text{a}} &= \frac{n}{V} \\ &= \frac{5 \times 10^{-4}}{4,25 \times 10^{-2}} \checkmark \\ &= 1,18 \times 10^{-2} \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} c(\text{H}^+) &= 2c_{\text{a}} \\ &= 2(1,18 \times 10^{-2}) \checkmark \\ &= 2,36 \times 10^{-2} \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} \text{pH} &= -\log[\text{H}_3\text{O}^+] \checkmark \\ &= -\log(2,36 \times 10^{-2}) \checkmark \\ &= 1,63 \checkmark \end{aligned}$$

**OPTION 2/OPSIE 2**

$$\begin{aligned} n_{\text{a(final/finaal)}} &= cV \checkmark \\ &= (0,1)(0,0175) \checkmark \\ &= 1,75 \times 10^{-3} \text{ mol} \end{aligned}$$

$$\begin{aligned} n_{\text{a(exs/oor)}} &= n_{\text{a(final/finaal)}} - n_{\text{a(react/reageer)}} \\ &= 1,75 \times 10^{-3} - 1,25 \times 10^{-3} \\ &= 5 \times 10^{-4} \text{ mol} \end{aligned}$$

$$\begin{aligned} c_{\text{a}} &= \frac{n}{V} \\ &= \frac{5 \times 10^{-4}}{4,25 \times 10^{-2}} \checkmark \\ &= 1,18 \times 10^{-2} \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} c(\text{H}^+) &= 2c_{\text{a}} \\ &= 2(1,18 \times 10^{-2}) \checkmark \\ &= 2,36 \times 10^{-2} \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} \text{pH} &= -\log[\text{H}_3\text{O}^+] \checkmark \\ &= -\log(2,36 \times 10^{-2}) \checkmark \\ &= 1,63 \checkmark \end{aligned}$$

(7)

**OPTION 3/OPSIE 3**

$$\begin{aligned} n_{\text{a(excess/oormaat)}} &= cV \checkmark \\ &= (0,1)(0,005) \checkmark \\ &= 5 \times 10^{-4} \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{H}^+) &= 2n_{\text{a(excess/oormaat)}} \\ &= 2(5 \times 10^{-4}) \checkmark \\ &= 1 \times 10^{-3} \text{ mol} \end{aligned}$$

$$\begin{aligned} c(\text{H}^+) &= \frac{n}{V} \\ &= \frac{1 \times 10^{-3}}{4,25 \times 10^{-2}} \checkmark \\ &= 2,36 \times 10^{-2} \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} \text{pH} &= -\log[\text{H}_3\text{O}^+] \checkmark \\ &= -\log(2,36 \times 10^{-2}) \checkmark \\ &= 1,63 \checkmark \end{aligned}$$

[17]

**QUESTION 8/VRAAG 8**

8.1

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

8.1.2 Indicates phase boundary./Interphase /phase separator✓  
Dui faseskeiding aan/Interfase /fase onderskeier (1)

8.1.3  $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-$  ✓✓

**Notes/Aantekeninge**

- $\text{Fe}^{3+} + \text{e}^- \leftarrow \text{Fe}^{2+}$  (2/2)       $\text{Fe}^{3+} + \text{e}^- \rightleftharpoons \text{Fe}^{2+}$  (0/2)
- $\text{Fe}^{2+} \rightleftharpoons \text{Fe}^{3+} + \text{e}^-$  (1/2)       $\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}$  (0/2)
- Ignore if charge on electron is omitted./Ignoreer indien lading op elektron uitgelaat is.
- If a charge of an ion is omitted e.g.  $\text{Fe}^2 \rightarrow \text{Fe}^3 + \text{e}^-$ /Indien lading op ion uitgelaat is bv.  $\text{Fe}^2 \rightarrow \text{Fe}^3 + \text{e}^-$  Max./Maks: 1/2

(2)

8.1.4

**OPTION/OPSIE 1**

$$E_{\text{cell}}^{\ominus} = E_{\text{reduction}}^{\ominus} - E_{\text{oxidation}}^{\ominus} \quad \checkmark$$

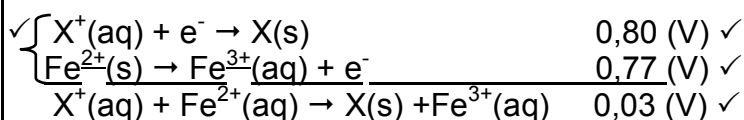
$$0,03 \checkmark = E_{\text{X}/\text{X}^{2+}}^{\ominus} - (0,77) \checkmark$$

$$E_{\text{X}/\text{X}^{2+}}^{\ominus} = 0,80 \text{ (V)} \checkmark$$

X = Silver / Ag ✓

**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.  $E_{\text{cell}}^{\ominus} = E_{\text{OA}}^{\ominus} - E_{\text{RA}}^{\ominus}$  followed by correct substitutions:/Enige ander formule wat onkonvensionele afkortings gebruik bv.  $E_{\text{sel}}^{\ominus} = E_{\text{OM}}^{\ominus} - E_{\text{RM}}^{\ominus}$  gevolg deur korrekte vervangings: Max/Maks: 4/5

**OPTION/OPSIE 2**

X = Silver/Ag/Silwer ✓

(5)

8.2

8.2.1 Pt ✓ (1)

8.2.2 Iron(III) (ions) Ferric ions ✓  
Yster(III)-(ione)/Ferri ione (1)

8.2.3  $2\text{Fe}^{3+} + \text{Cu} \checkmark \rightarrow 2\text{Fe}^{2+} + \text{Cu}^{2+} \checkmark$  Bal. ✓

**Notes/Aantekeninge**

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

(3)

**[14]**

**QUESTION 9/VRAAG 9**

9.1

9.1.1 Electrolyte/*Elektroliet* ✓ (1)9.1.2 Conduct electricity/*Carry charges* ✓  
*Gelei elektrisiteit/Dra ladings.* (1)9.2  $\text{Cu}(\text{NO}_3)_2$  ✓ (1)9.3 Iron rod/*Ysterstaaf* ✓  
Reduction takes place./*Reduksie vind plaas.* ✓ (2)9.4  $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$  ✓✓**Notes/Aantekeninge**

- $\text{Cu}^{2+} + 2\text{e}^- \leftarrow \text{Cu}$  (2/2)       $\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$  (0/2)  
 $\text{Cu} \rightleftharpoons \text{Cu}^{2+} + 2\text{e}^-$  (1/2)       $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$  (0/2)
- Ignore if charge on electron is omitted./*Ignoreer indien lading op elektron uitgelaat is.*
- If a charge of an ion is omitted e.g.  $\text{Cu} \rightarrow \text{Cu}^2 + 2\text{e}^-$ /Indien lading op ioon uitgelaat is bv.  $\text{Cu} \rightarrow \text{Cu}^2 + 2\text{e}^-$  Max./Maks: 1/2

9.5

9.5.1 Copper(II) (ions)/ $\text{Cu}^{2+}$  ✓ and silver (ions)/ $\text{Ag}^+$  ✓  
*Koper(II)-(ione) / $\text{Cu}^{2+}$  en silwer-(ione) / $\text{Ag}^+$*   
**Accept/Aanvaar**  
Cu (ions) and Ag (ions) (Ions are stated in the question.)  
*Cu(-ione) en Ag(-ione) (Ione word in vraag genoem.)* (2)9.5.2  $\text{Ag}^+$ /silver(I) ions is a stronger oxidising agent ✓ than  $\text{Cu}^{2+}$ /Copper(II) ions  
and will be reduced (more readily) ✓ to form silver/Ag on the iron rod.  
 *$\text{Ag}^+$ /silwer(I) ione is 'n sterker oksideermiddel as  $\text{Cu}^{2+}$ /Copper(II) ione en sal*  
*(meer geredelik) gereduseer word om silwer/Ag op die ysterstaaf te vorm.* (2 )  
**[11]**

**QUESTION 10/VRAAG 10**

10.1

10.1.1 (Catalytic) oxidation (of ammonia)/(Katalitiese) oksidasie (van ammoniak)✓ (1)

10.1.2 Neutralisation/acid-base reaction ✓  
Neutralisasie/suur-basisreaksie (1)

10.2

10.2.1 Nitrogen/N<sub>2</sub>/Stikstof ✓ (1)10.2.2 NO<sub>2</sub>/nitrogen dioxide/Stikstofdioksied ✓ (1)10.2.3 Nitric acid/HNO<sub>3</sub>/Salpetersuur ✓ (1)

10.3

10.3.1  $2\text{NH}_3 + \text{H}_2\text{SO}_4 \checkmark \rightarrow (\text{NH}_4)_2\text{SO}_4 \checkmark$  Bal. ✓**Notes/Aantekeninge:**

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

(3)

10.3.2  $4\text{NH}_3 + 5\text{O}_2 \checkmark \rightarrow 4\text{NO} + 6\text{H}_2\text{O} \checkmark$  Bal. ✓**Notes / Aantekeninge:**

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

(3)

10.4

$$\% \text{ N} = \frac{28}{80} \times 100 \checkmark$$

$$= 35\% \checkmark$$

(3)

**[14]****TOTAL/TOTAAL: 150**