



# 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 2016**

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

### QUESTION 2/VRAAG 2

- 2.1  
2.1.1 Ketones/ketone ✓ (1)  
2.1.2 3,5-dichloro ✓ -4-methyl ✓ octane ✓  
3,5-dichloor-4-metieloktaan OF 3,5-dichloro-4-metieloktaan

**Marking criteria/Nasienriglyne**

- 3,5-dichloro **OR/OF** 3,5 dichloro ✓
- -4-methyl/-4-metiel **OR/OF** 4 methyl/4 metiel ✓
- octane/oktaan ✓

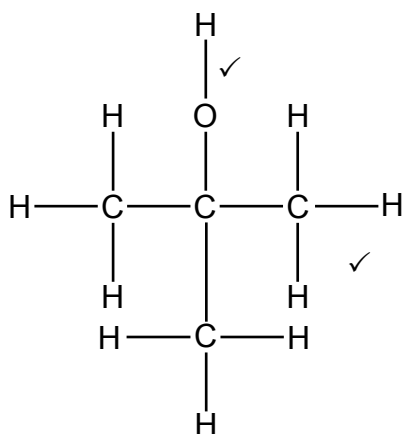
**IF/INDIEN:**

Any error, e.g. hyphens omitted and/or incorrect sequence. Max  $\frac{2}{3}$

Enige fout, bv. uitlaat van koppeltekens en/of verkeerde volgorde. Maks  $\frac{2}{3}$

(3)

2.1.3



**Notes/Aantekeninge:**

- Functional group (-OH) on **second C atom.** ✓  
*Funksionele groep (-OH) op tweede C-atoom.*
- Whole structure correct ✓  
*Hele struktuur korrek*

(2)

2.2

2.2.1 Acts as catalyst./Increases the rate of reaction./Act as dehydrating agent. ✓  
*Tree as katalisator op./Verhoog die tempo van die reaksie./Tree as dehidreermiddel op.* (1)

2.2.2 Water/H<sub>2</sub>O ✓ (1)

2.2.3 mol C : mol H : mol O  
 $\frac{40}{12} \checkmark : \frac{6,67}{1} \checkmark : \frac{53,33}{16} \checkmark$

$\frac{3,33}{1} : \frac{6,67}{2} : \frac{3,33}{1} \checkmark$

Empirical formula/*Empiriese formule*:  
CH<sub>2</sub>O ✓

**Marking criteria/Nasienriglyne:**

- % divide by M(C). ✓  
% gedeel deur M(C).
- % divide by M(H). ✓  
% gedeel deur M(H).
- % divide by M(O). ✓  
% gedeel deur M(O).
- Simplest mole ratio. ✓  
*Eenvoudigste molverhouding.*
- CH<sub>2</sub>O ✓

(5)

2.2.4 M(CH<sub>2</sub>O) = 30 g·mol<sup>-1</sup> ✓  
Formula-units/*Formule-eenhede*:

$$\frac{60}{30} = 2 \checkmark$$

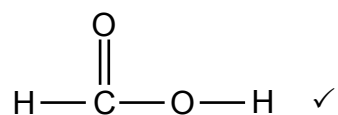
Molecular formula/*Molekulêre formule*: C<sub>2</sub>H<sub>4</sub>O<sub>2</sub> ✓

**Marking criteria/Nasienriglyne:**

- 30 (g·mol<sup>-1</sup>) ✓
- Formula-units = 2 ✓  
*Formule-eenhede = 2*
- C<sub>2</sub>H<sub>4</sub>O<sub>2</sub> ✓

(3)

2.2.5



**Notes/Aantekeninge:**

- Accept –OH as condensed.  
*Aanvaar –OH as gekondenseerd.*

(1)

2.2.6 Methyl ✓ methanoate ✓  
*Metielmetanoaat*

(2)

[19]

### QUESTION 3/VRAAG 3

3.1 Temperature ✓ at which the vapour pressure equals atmospheric pressure. ✓  
Temperatuur waar die dampdruk gelyk is aan atmosferiese druk. (2)

3.2 The stronger the intermolecular forces, the higher the boiling point./The boiling point is proportional to the strength of intermolecular forces. ✓  
*Hoe sterker die intermolekulêre kragte, hoe hoër die kookpunt./Die kookpunt is eweredig aan die sterkte van intermolekulêre kragte.*

**Notes/Aantekeninge:**

**IF/INDIEN**

Boiling point is directly proportional to strength of intermolecular forces:

*Kookpunt direk eweredig aan sterkte van intermolekulêre kragte:*  $\frac{0}{1}$

(1)

3.3

3.3.1 • In **A**/propane/alkanes: London forces/dispersion forces/induced dipole forces ✓  
*In **A**/propaan/alkane: Londonkragte/dispersiekragte/geïnduseerde dipoolkragte*

• In **B**/propan-2-one/ketones: dipole-dipole forces ✓ in addition to London forces/dispersion forces/induced dipole forces  
*In **B**/propan-2-oon/ketone: dipool-dipoolkragte tesame met Londonkragte/dispersiekragte/geïnduseerde dipoolkragte*

• Intermolecular forces in A are weaker ✓ than in **B**./Intermolecular forces in **B** are stronger ✓ than in **A**./London forces are weaker than dipole-dipole forces.  
*Intermolekulêre kragte in A swakker as in B./Intermolekulêre kragte in B sterker as in A./Londonkragte is swakker as dipool-dipoolkragte.* (3)

3.3.2 • Both **C** and **D**: hydrogen bonding ✓  
*Beide C en D: waterstofbinding*

• **D** has two/more sites for hydrogen bonding./**D** forms dimers./**D** is more polar./**C** has one/less sites for hydrogen bonding. ✓  
*D het twee/meer plekke vir waterstofbinding./D vorm dimere./D is meer polêr./C het een/minder plekke vir waterstofbinding.*

• **D** has stronger intermolecular forces than **C**./**C** has weaker intermolecular forces than **D**. ✓  
*D het sterker intermolekulêre kragte as C./C het swakker intermolekulêre kragte as D.* (3)

3.4 Liquid/Vloeistof ✓ (1)  
**[10]**

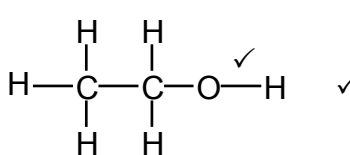
### QUESTION 4/VRAAG 4

4.1  
4.1.1 Addition/Addisie ✓ (1)

4.1.2 Polyethene/polythene/polyethelene ✓  
Polieteen/politeen/polietileen (1)

4.2.  
4.2.1 Chloro✓ethane✓  
Chloroetaan/chlooretaan (2)


4.2.2 Hydrohalogenation/hydrochlorination ✓  
Hidrohalogenering/hidrochloronering (1)

4.3  
4.3.1  ✓ (2)

**Notes/Aantekeninge:**

- Functional group. ✓  
*Functional group.*
- Whole structure correct ✓  
*Hele struktuur korrek*

4.3.2 HCl/hydrogen chloride/waterstofchloried ✓ (1)

4.4  
4.4.1  Saturated/Versadig ✓  
There are no double/multiple bonds between C atoms./Carbon atoms are bonded to the maximum number of H atoms. ✓  
*Daar is geen dubbel- of meervoudige bindings tussen C-atome.*/Koolstof-atome gebind aan maksimum aantal H-atome. (2)

4.4.2 H<sub>2</sub>/hydrogen (gas)/waterstof(gas) ✓ (1)

4.4.3 2C<sub>2</sub>H<sub>6</sub> + 7O<sub>2</sub> → 4CO<sub>2</sub> + 6H<sub>2</sub>O (3)

**Notes/Aantekeninge**

• Reactants ✓	Products ✓	Balancing ✓
<i>Reaktanse ✓</i>	<i>Produkke ✓</i>	<i>Balansering ✓</i>
• Ignore/Ignoreer ⇌ and phases/en fases		
• Marking rule 6.3.10./Nasienreël 6.3.10.		

[14]

### QUESTION 5/VRAAG 5

5.1 **ONLY ANY TWO OF/SLEGS ENIGE TWEE VAN:**

- Increase temperature./Verhoog die temperatuur. ✓
- Increase concentration of acid./Verhoog die konsentrasie van die suur. ✓
- Add a catalyst./ Voeg 'n katalisator by.

(2)

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

- Change in concentration of products/reactants ✓ per (unit) time. ✓  
Verandering in konsentrasie van produkte/reaktanses 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/getal mol/volume/massa van produkte of reaktanses per (eenheids)tyd.
- Amount/number of moles/volume/mass of products formed or reactants used per (unit) time.  
Hoeveelheid/getal mol/volume/massa van produkte gevorm of reaktanses gebruik per (eenheids)tyd.

(2)

5.3

5.3.1

$$\begin{aligned}\text{average rate / gemiddelde tempo} &= -\frac{\Delta c}{\Delta t} \\ &= -\frac{(1,45 - 1,90)}{(15 - 0)} \checkmark \\ &= 0,03 \text{ (mol} \cdot \text{dm}^{-3}) \cdot \text{min}^{-1} \checkmark\end{aligned}$$

**Notes/Aantekeninge**

**Accept /Aanvaar:**

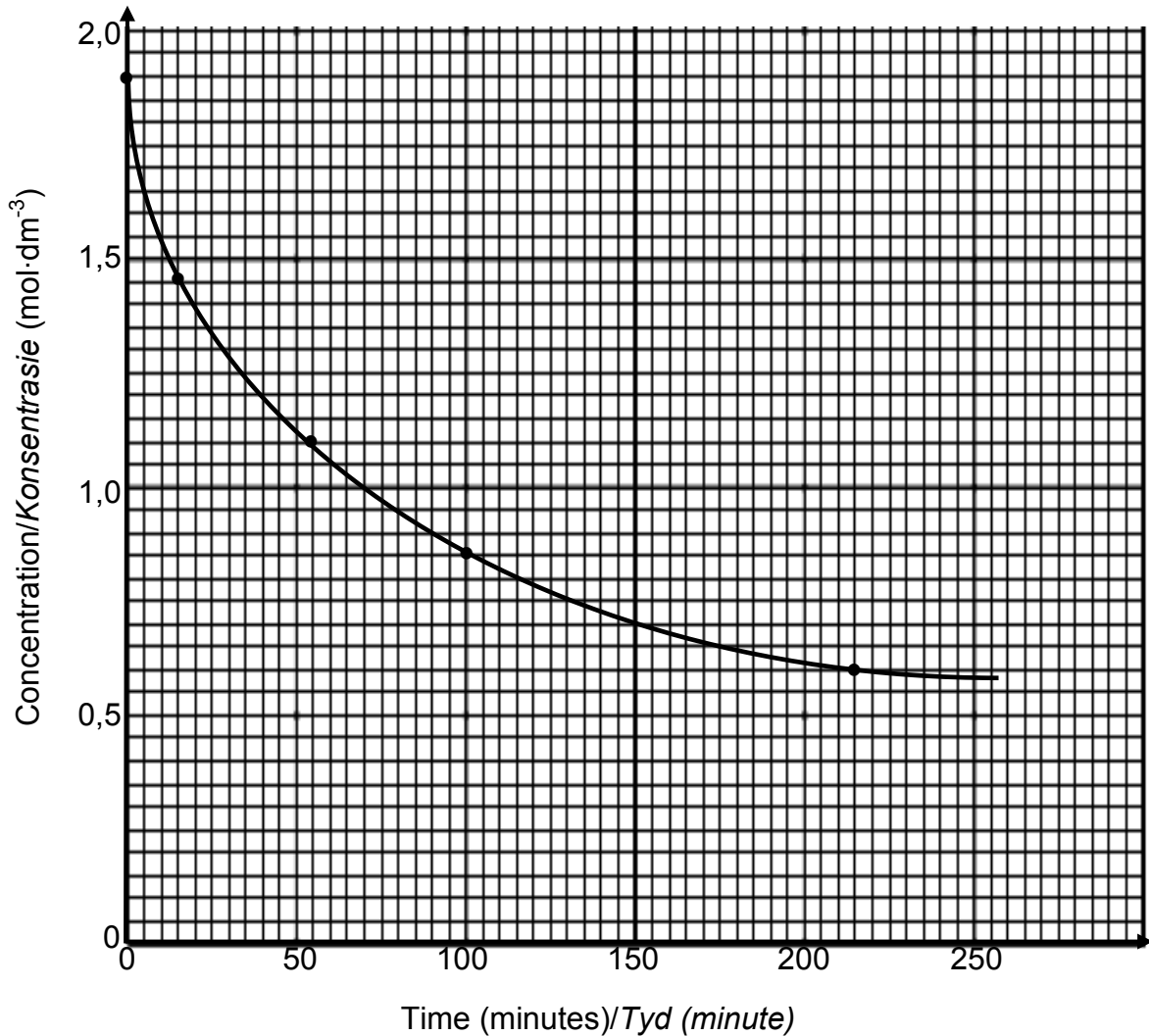
- If unit omitted/Indien eenheid weggelaat is.

- Rate/Tempo =  $\frac{\Delta c}{\Delta t}$   
$$= \frac{1,45 - 1,90}{15 - 0}$$
$$= -0,03 \text{ (mol} \cdot \text{dm}^{-3}) \cdot \text{min}^{-1}$$

(3)

5.3.2

**Graph of concentration versus time**  
**Grafiek van konsentrasie teenoor tyd**



<b>Marking criteria/Nasienriglyne</b>	
Four points correctly plotted./Vier punte korrek gestip.	✓✓
Curve drawn as shown./Kurwe getrek soos getoon.	✓

(3)

5.3.3

**POSITIVE MARKING FROM QUESTION 5.3.2.**

**POSITIEWE NASIEN VANAF VRAAG 5.3.2.**

1,2 mol·dm<sup>-3</sup> ✓

Accept range/Aanvaar gebied: 1,15 to/tot 1,25 mol·dm<sup>-3</sup>

(1)

- 5.3.4
- Concentration of reactants decreases. ✓  
*Konsentrasie van reaktanse neem af.*
  - Less particles per unit volume. ✓  
*Minder deeltjies per volume.*
  - Less effective collisions per unit time. ✓  
*Minder effektiewe botsings per eenheidstyd.*

(3)

5.3.5

**Marking criteria/Nasienriglyne**

- Use  $n = cV$  to calculate  $\Delta n/n(\text{initial})$  &  $n(\text{final})$ .  
*Gebruik  $n = cV$  om  $\Delta n/n(\text{aanvanklik})$  &  $n(\text{finaal})$  te bereken.*
- $\Delta n(\text{HCl}) = n(\text{final/finaal}) - n(\text{initial/aanvanklik})$ .  
**OR/OF**  
 $\Delta c(\text{HCl}) = c(\text{final/finaal}) - c(\text{initial/aanvanklik})$
- Use ratio/*Gebruik verhouding*  $n(\text{CH}_3\text{Cl}) : n(\text{HCl}) = 1 : 1$
- Substitute/*Vervang*  $50,5 \text{ g} \cdot \text{mol}^{-1}$  in  $n = \frac{m}{M}$ .
- Final answer/*Finale antwoord*: 3,54–4,0 g.

**OPTION 1/OPSIE 1**

Mol initially/begin:

$$n(\text{HCl}) = cV \checkmark$$

$$= (1,9)(60 \times 10^{-3}) \checkmark$$

$$= 0,11 \text{ mol (0,114)}$$

Mol final/finaal:

$$n(\text{HCl}) = cV$$

$$= (0,6)(60 \times 10^{-3})$$

$$= 0,04 \text{ mol (0,036)}$$

$$\Delta n(\text{HCl}) = 0,04 - 0,11 \checkmark$$

$$= -0,07 \text{ mol (0,078 mol)}$$

$$\Delta n(\text{HCl}) = 0,07 \text{ mol (0,078)}$$

$$n(\text{formed/gevorm}) = n(\text{reacted/reageer})$$

$$n(\text{CH}_3\text{Cl}) = n(\text{HCl}) \checkmark$$

$$= 0,07 \text{ mol}$$

$$m(\text{CH}_3\text{Cl}) = nM$$

$$= (0,07)(50,5) \checkmark$$

$$= 3,54 \text{ g} \checkmark$$

Accept range/*Aanvaar gebied*:  
3,54 – 4,0 g

**OPTION 2/OPSIE 2**

$$\Delta c(\text{HCl}) = 0,6 - 1,9 \checkmark$$

$$= -1,3$$

$$= 1,3 \text{ mol} \cdot \text{dm}^{-3}$$

$$\Delta n(\text{HCl}) = \Delta cV$$

$$= (1,3)(60 \times 10^{-3}) \checkmark$$

$$= 0,08 \text{ mol (0,078)}$$

$$n(\text{formed/gevorm}) = n(\text{reacted/reageer})$$

$$n(\text{CH}_3\text{Cl}) = n(\text{HCl}) \checkmark$$

$$= 0,08 \text{ mol}$$

$$m(\text{CH}_3\text{Cl}) = nM$$

$$= (0,08)(50,5) \checkmark$$

$$= 4 \text{ g} \checkmark$$

Accept range/*Aanvaar gebied*:  
3,54 – 4,0 g

(5)  
[19]



**QUESTION 6/VRAAG 6**

6.1

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
$c = \frac{m}{MV} \checkmark$ $= \frac{2,2}{(44)(5)} \checkmark$ $= 0,01 \text{ mol} \cdot \text{dm}^{-3} \checkmark$	$n = \frac{m}{M}$ $= \frac{2,2}{44} \checkmark$ $= 0,05 \text{ mol}$ $c = \frac{n}{V}$ $= \frac{0,05}{5} \checkmark$ $= 0,01 \text{ mol} \cdot \text{dm}^{-3} \checkmark$ <p style="text-align: right;">Both formulae/ albei formules</p>

(4)

6.2

For equilibrium, a forward and a reverse reaction are needed. ✓  
*Vir ewewig word 'n voorwaartse en terugwaartse reaksie benodig.*

**OR/OF**

Without CaO(s), the reverse reaction is not possible.  
*Sonder CaO(s) is die terugwaartse reaksie nie moontlik nie.*

**OR/OF**

If only CO<sub>2</sub> is present, the reverse reaction cannot take place.  
*Indien slegs CO<sub>2</sub> teenwoordig is, kan die terugwaartse reaksie nie plaasvind nie.*

(1)

6.3

CO<sub>2</sub> is a gas and will escape if the container is not sealed. ✓  
CO<sub>2</sub> is 'n gas en sal ontsnap as die houer nie geseël is nie.

(1)

6.4

**CALCULATIONS USING NUMBER OF MOLES:**  
**BEREKENINGE WAT GETAL MOL GEBRUIK:**

**Marking guidelines/Nasienriglyne**

- K<sub>c</sub> expression/K<sub>c</sub>-uitdrukking ✓
- Substitute K<sub>c</sub> value./Vervang K<sub>c</sub>-waarde. ✓
- n(CO<sub>2</sub>) or m(CO<sub>2</sub>) at equilibrium/n(CO<sub>2</sub>) of m(CO<sub>2</sub>) by ewewig. ✓
- Change in n(CO<sub>2</sub>) or m(CO<sub>2</sub>)/Verandering in n(CO<sub>2</sub>) of m(CO<sub>2</sub>) ✓
- Mol ratio/Molverhouding: n(CaCO<sub>3</sub>) : n(CO<sub>2</sub>) = 1 : 1 ✓
- n(CaCO<sub>3</sub>) x 100 ✓
- Final answer/Finale antwoord: 0,4 g ✓

**OPTION 1/OPSIE 1**

**POSITIVE MARKING FROM QUESTION 6.2.**

**POSITIEWE NASIEN VANAF VRAAG 6.2.**

$$K_c = [\text{CO}_2] \checkmark$$

$$= 0,0108$$

$$\therefore [\text{CO}_2] = 0,0108 \text{ (mol}\cdot\text{dm}^{-3}) \checkmark$$

$$n(\text{CO}_2 \text{ at equilibrium/by ewewig}) = cV$$

$$= (0,0108)(5) \checkmark$$

$$= 0,054 \text{ mol}$$

$$n(\text{CO}_2 \text{ formed/gevorm}) = n(\text{CO}_2 \text{ at equilibrium/by ewewig}) - n(\text{CO}_2 \text{ initially/begin})$$

$$= 0,054 - 0,05 \checkmark$$

$$= 0,004 \text{ mol}$$

$$n(\text{CaCO}_3) = n(\text{CO}_2 \text{ formed}) = 0,004 \text{ mol} \checkmark$$

$$m(\text{CaCO}_3) = nM$$

$$= (0,004)(100) \checkmark$$

$$= 0,4 \text{ g} \checkmark$$

**OPTION 2/OPSIE 2**

**POSITIVE MARKING FROM QUESTION 6.2.**

**POSITIEWE NASIEN VANAF VRAAG 6.2.**

$$K_c = [\text{CO}_2] \checkmark$$

$$= 0,0108 \checkmark$$

$$\therefore [\text{CO}_2] = 0,0108 \text{ (mol}\cdot\text{dm}^{-3})$$

	CaCO <sub>3</sub>	CaO	CO <sub>2</sub>
Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i>	0	0	0,05
Change (mol) <i>Verandering (mol)</i>	0,004	x	0,004 ✓
Quantity at equilibrium (mol) <i>Hoeveelheid by ewewig (mol)</i>			0,054 ✓
Equilibrium concentration (mol·dm <sup>-3</sup> ) <i>Ewewigskonsentrasie (mol·dm<sup>-3</sup>)</i>			0,0108

✓ Ratio/  
Verhouding

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

$$= (0,004)(100) \checkmark$$

$$= 0,4 \text{ g} \checkmark$$

**OPTION 3/OPSIE 3**

**POSITIVE MARKING FROM QUESTION 6.2.**

**POSITIEWE NASIEN VANAF VRAAG 6.2.**

	CaCO <sub>3</sub>	CaO	CO <sub>2</sub>
Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i>	0	0	0,05
Change (mol) <i>Verandering (mol)</i>	x	x	x ✓
Quantity at equilibrium (mol) <i>Hoeveelheid by ewewig (mol)</i>			0,05 + x ✓
Equilibrium concentration (mol·dm <sup>-3</sup> ) <i>Ewewigskonsentrasie (mol·dm<sup>-3</sup>)</i>			$\frac{0,05 + x}{5}$

✓ Ratio/  
Verhouding

$$K_c = [\text{CO}_2] \checkmark$$

$$\therefore 0,0108 \checkmark = \frac{0,05 + x}{5}$$

$$\therefore x = 0,004$$

$$\begin{aligned} m(\text{CaCO}) &= nM \\ &= (0,004)(100) \checkmark \\ &= 0,4 \text{ g} \checkmark \end{aligned}$$

**CALCULATIONS USING CONCENTRATIONS:**

**BEREKENINGE WAT KONSENTRASIE GEBRUIK:**

**OPTION 4/OPSIE 4**

**POSITIVE MARKING FROM QUESTION 6.2.**

**POSITIEWE NASIEN VANAF VRAAG 6.2.**

$$\begin{aligned} K_c &= [\text{CO}_2] \checkmark \\ &= 0,0108 \checkmark \end{aligned}$$

$$\therefore [\text{CO}_2] = 0,0108 \text{ (mol·dm}^{-3}\text{)}$$

$$\begin{aligned} \Delta c(\text{CO}_2) &= c(\text{CO}_2 \text{ at equilibrium/by ewewig}) - c(\text{CO}_2 \text{ initially/begin}) \\ &= 0,0108 - 0,01 \checkmark \\ &= 8 \times 10^{-4} \text{ mol·dm}^{-3} \end{aligned}$$

$$\begin{aligned} n(\text{CO}_2 \text{ formed/gevorm}) &= cV \\ &= (8 \times 10^{-4})(5) \checkmark \\ &= 4 \times 10^{-3} \text{ mol} \end{aligned}$$

$$n(\text{CaCO}_3 \text{ formed/gevorm}) = n(\text{CO}_2 \text{ formed/gevorm}) = 4 \times 10^{-3} \text{ mol} \checkmark$$

$$\begin{aligned} m(\text{CaCO}_3) &= nM \\ &= (4 \times 10^{-3})(100) \checkmark \\ &= 0,4 \text{ g} \checkmark \end{aligned}$$

**CALCULATIONS USING MASS:**

**BEREKENINGE WAT MASSA GEBRUIK:**

**OPTION 5/OPSIE 5**

$$K_c = [\text{CO}_2] \checkmark$$

$$= 0,0108 \checkmark$$

$$\therefore [\text{CO}_2] = 0,0108 \text{ (mol}\cdot\text{dm}^{-3}\text{)}$$

$$m(\text{CO}_2) = cMV$$

$$= (0,0108)(44)(5) \checkmark$$

$$= 2,376 \text{ g}$$

$$\Delta m(\text{CO}_2) = m(\text{CO}_2 \text{ at equilibrium/by ewewig}) - m(\text{CO}_2 \text{ initially/begin})$$

$$= 2,376 - 2,2 \checkmark$$

$$= 0,176 \text{ g}$$

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

$$= \frac{0,176}{44}$$

$$= 4 \times 10^{-3} \text{ mol}$$

$$n(\text{CaCO}_3 \text{ formed/gevorm}) = n(\text{CO}_2 \text{ formed/gevorm}) = 4 \times 10^{-3} \text{ mol} \checkmark$$

$$m(\text{CaCO}_3) = nM$$

$$= (4 \times 10^{-3})(100) \checkmark$$

$$= 0,4 \text{ g} \checkmark$$

(7)

6.5

6.5.1 Remains the same/*Bly dieselfde* ✓

(1)

6.5.2 Decreases/*Neem af* ✓

(1)

6.6 Endothermic/*Endotermies* ✓



- $K_c$  decreases at lower temperature. /  $K_c$  neem af by laer temperatuur. ✓
- Therefore the product of the concentration of products decreases. / The reverse reaction is favoured. ✓  
*Daarom neem die produk van die konsentrasie van die produkte af./die terugwaartse reaksie word bevoordeel.*
- A decrease in temperature favours the exothermic reaction. ✓  
*Afname in temperatuur bevoordeel die eksotermiese reaksie.*

**OR/OF**

Endothermic/*Endotermies* ✓

- $K_c$  increases with increase in temperature. ✓  
*Kc neem toe met toename in temperatuur.*
- Increase in temperature favours the forward reaction. ✓  
*Toename in temperatuur bevoordeel die voorwaartse reaksie.*
- Increase in temperature favours the endothermic reaction. ✓  
*Toename in temperatuur bevoordeel die endotermiese reaksie.*

(4)  
[19]

**QUESTION 7/VRAAG 7**

7.1 It is a proton/ $\text{H}_3\text{O}^+$  ion/ $\text{H}^+$  ion donor. ✓✓  
*Dit is 'n proton/ $\text{H}_3\text{O}^+$ -ioon/ $\text{H}^+$ -ioonskenker.* (2)

7.2

7.2.1  $\text{CO}_3^{2-}(\text{aq})$  ✓ **Note/Aantekening:**  
Ignore phase/Ignoreer fase (1)

7.2.2  $\text{H}_2\text{CO}_3 + \text{H}_2\text{O} \rightleftharpoons \text{HCO}_3^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$  ✓ ✓ bal

**Notes/Aantekeninge**

- Reactants ✓ Products ✓ Balancing ✓  
*Reaktanse ✓ Produkte ✓ Balansering ✓*
- Ignore/Ignoreer → and phases/en fases
- Marking rule 6.3.10/Nasienreël 6.3.10

(3)

7.2.3

<b>OPTION/OPSIE 1</b>	<b>OPTION/OPSIE 2</b>
<p>pH = -log[<math>\text{H}^+</math>] ✓                      3,4 = -log[<math>\text{H}^+</math>] ✓  <math>[\text{H}^+] = 10^{-3,4} / 3,98 \times 10^{-4} \text{ mol}\cdot\text{dm}^{-3}</math></p> <p><math>[\text{H}^+][\text{OH}^-] = 10^{-14}</math> ✓  <math>\therefore [\text{OH}^-] = \frac{1 \times 10^{-14}}{3,98 \times 10^{-4}}</math> ✓  <math>= 2,51 \times 10^{-11} \text{ mol}\cdot\text{dm}^{-3}</math> ✓</p>	<p>pH + pOH = 14 ✓                      3,4 + pOH = 14 ✓                      pOH = 11,6</p> <p style="text-align: center;">↙</p> <p>pOH = -log[<math>\text{OH}^-</math>] ✓                      11,6 = -log[<math>\text{OH}^-</math>] ✓  <math>[\text{OH}^-] = 10^{-11,6} / 2,51 \times 10^{-11} \text{ mol}\cdot\text{dm}^{-3}</math> ✓</p>

(5)

7.3

7.3.1 An acid that donates ONE proton/ $\text{H}^+$ / $\text{H}_3\text{O}^+$ -ion. ✓  
*'n Suur wat EEN proton/ $\text{H}^+$ / $\text{H}_3\text{O}^+$ -ioon skenk.*

**OR/OF**

An acid of which ONE mol ionises to form ONE mol of protons/ $\text{H}^+$  ions/ $\text{H}_3\text{O}^+$  ions.

*'n Suur waarvan EEN mol ioniseer om EEN mol protone/  $\text{H}^+$ -ione/  $\text{H}_3\text{O}^+$ -ione te vorm.*

(1)

7.3.2

<p><b>OPTION/OPSIE 1</b></p> $\frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b} \checkmark$ $\frac{c_a \times 25}{0,1 \times 27,5} = \frac{1}{1} \checkmark$ $c_a = 0,11 \text{ mol} \cdot \text{dm}^{-3} \checkmark$	<p><b>Marking guidelines/Nasienriglyne:</b></p> <ul style="list-style-type: none"> <li>• Formula./ Formule.</li> <li>• Substitution of/Substitusie van <math>c_a \times 25</math>.</li> <li>• Substitution of/Substitusie van <math>0,1 \times 27,5</math></li> <li>• Use mol ratio/Gebruik molverhouding 1:1.</li> <li>• Final answer/Finale antwoord: <math>0,11 \text{ mol} \cdot \text{dm}^{-3}</math></li> </ul>
<p><b>OPTION/OPSIE 2</b></p> $n(\text{NaOH}) = cV \checkmark$ $= 0,1 \times 0,0275 \checkmark$ $= 0,00275 \text{ mol} \checkmark$ $n(\text{acid X}) = n(\text{NaOH})$ $= 0,00275 \text{ mol} \checkmark$ $c(\text{acid X}) = \frac{n}{V}$ $= \frac{2,75 \times 10^{-3}}{0,025} \checkmark$ $= 0,11 \text{ mol} \cdot \text{dm}^{-3} \checkmark$	<p><b>Marking guidelines/Nasienriglyne:</b></p> <ul style="list-style-type: none"> <li>• <math>n = cV</math></li> <li>• Substitution into <math>n = cV</math> to calculate <math>n(\text{NaOH})</math>. <i>Substitusie in <math>n = cV</math> om <math>n(\text{NaOH})</math> te bereken.</i></li> <li>• Use mol ratio 1:1. <i>Gebruik molverhouding 1:1.</i></li> <li>• Substitution into <math>c = \frac{n}{V}</math> to calculate <math>c(\text{acid})</math>. <i>Substitusie in <math>c = \frac{n}{V}</math> om <math>c(\text{suur})</math> te berei.</i></li> <li>• Final answer: <math>0,11 \text{ mol} \cdot \text{dm}^{-3}</math> <i>Finale antwoord: : <math>0,11 \text{ mol} \cdot \text{dm}^{-3}</math></i></li> </ul>

(5)

7.3.3 Weak/Swak ✓



The  $[\text{H}^+]$  OR  $[\text{H}_3\text{O}^+]$  is lower than the concentration of acid X. ✓  
Therefore the acid is incompletely ionised. ✓

*Die  $[\text{H}^+]$  OF  $[\text{H}_3\text{O}^+]$  is laer as die konsentrasie van suur X.  
Daarom is die suur onvolledig geïoniseer.*

(3)  
[20]

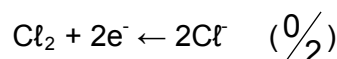
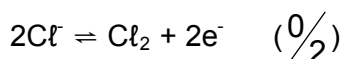
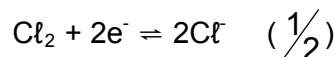
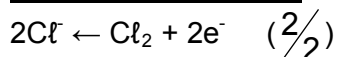
**QUESTION 8/VRAAG 8**

8.1 B ✓ (1)

8.2

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

**Notes/Aantekeninge:**



(2)

8.2.2  $\text{Cl}_2$  / Chlorine / Chloor ✓

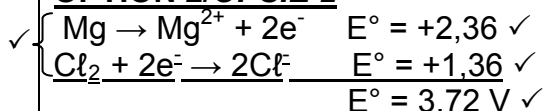
(1)

8.3

**OPTION 1/OPSIE 1**

$E_{\text{cell}}^{\theta} = E_{\text{cathode}}^{\theta} - E_{\text{anode}}^{\theta}$  ✓  
 $= 1,36$  ✓  $-(-2,36)$  ✓  
 $= 3,72 \text{ V}$  ✓

**OPTION 2/OPSIE 2**



**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.  $E^{\circ}_{\text{cell}} = E^{\circ}_{\text{OA}} - E^{\circ}_{\text{RA}}$  followed by correct substitutions. /Enige ander formule wat onkonvensionele afkortings gebruik, bv.  $E^{\circ}_{\text{sel}} = E^{\circ}_{\text{OM}} - E^{\circ}_{\text{RM}}$  gevolg deur korrekte vervangings:  $\frac{3}{4}$

(4)

- 8.4
- The Mg electrode becomes smaller. /The mass of the Mg electrode decreases. /Mg electrode being corroded. ✓  
*Die Mg elektrode word kleiner. /Die massa van die Mg-elektrode neem af. /Mg elektrode word weggevreet.*
  - Magnesium is oxidised. / $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^-$  ✓  
*Magnesium word geoksideer. / $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^-$*

(2)  
[10]

**QUESTION 9/VRAAG 9**

9.1 Electrolytic cell / Elektrolitiese sel ✓

(1)

9.2 The substance/species which loses electrons. ✓✓  
*Die stof/spesie wat elektrone verloor.*

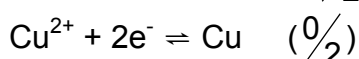
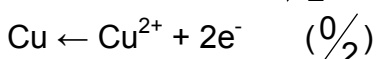
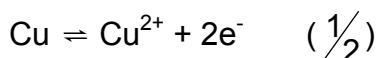
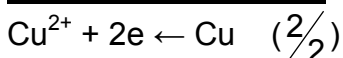
(2)

9.3 P ✓

(1)

9.4  $\text{Cu}(\text{s}) \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{e}^-$  ✓✓

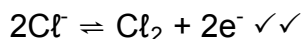
**Notes/Aantekeninge:**



(2)

- 9.5 A ✓  
Cl<sup>-</sup> ions move to the positive electrode/anode where they are oxidised to Cl<sub>2</sub>. ✓✓  
Cl<sup>-</sup> ione beweeg na die positiewe electrode/anode waar dit geoksideer word na Cl<sub>2</sub>.

**OR/OF**



(3)  
[9]

**QUESTION 10/VRAAG 10**

- 10.1 Ostwald process/-proses ✓ (1)
- 10.2 NO/nitrogen monoxide/stikstofmonoksied ✓ (2)  
 Water/H<sub>2</sub>O ✓
- 10.3 NH<sub>3</sub> + HNO<sub>3</sub> ✓ → NH<sub>4</sub>NO<sub>3</sub> ✓ ✓ bal

**Notes/Aantekeninge:**

- Reactants ✓ Products ✓ Balancing ✓  
 Reaktanse ✓ Produkte ✓ Balansering ✓
- Ignore/Ignoreer → and phases/en fases
- Marking rule 6.3.10/Nasienreël 6.3.10

(3)

- 10.4

<p><b>OPTION 1/OPTION 1</b></p> $n(\text{NH}_3) = \frac{m}{M}$ $= \frac{6,8 \times 10^7}{17} \checkmark$ $= 4 \times 10^6 \text{ mol}$ <p style="text-align: center;">↓</p> $n(\text{NH}_4\text{NO}_3) = n(\text{NH}_3)$ $= 4 \times 10^6 \text{ mol}$ $m(\text{NH}_4\text{NO}_3) = nM$ $= (4 \times 10^6)(80) \checkmark$ $= 3,2 \times 10^8 \text{ g}$ $= 3,2 \times 10^5 \text{ kg} \checkmark$	<p><b>OPTION 2/OPSIE 2</b></p> $m(\text{NH}_4\text{NO}_3) = \frac{6,8 \times 10^4}{17} \times 80 \checkmark \checkmark$ $= 3,2 \times 10^5 \text{ kg} \checkmark$ <hr/> <p><b>OPTION 3/OPSIE 3</b></p> <p>17 g ✓ NH<sub>3</sub> forms/vorm 80 g ✓ NH<sub>4</sub>NO<sub>3</sub>          6,8 x 10<sup>4</sup> kg forms/vorm x g NH<sub>4</sub>NO<sub>3</sub></p> $x = 6,8 \times 10^4 \times \frac{80}{17}$ $= 3,2 \times 10^5 \text{ kg} \checkmark$
--	--

(3)

- 10.5 To make a NPK fertiliser/fertilisers which contain all three primary nutrients. ✓  
 Om 'n NPK-kunsmisstof/kunsmisstawwe wat al drie primêre voedingstawwe bevat, te maak.

(1)  
[10]

**TOTAL/TOTAAL: 150**