



education

**MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA**

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

**PHYSICAL SCIENCES: CHEMISTRY P2
SEPTEMBER 2022
MARKING GUIDELINES**

MARKS/PUNTE: 150

This memorandum consists of 14 pages.

Hierdie memorandum bestaan uit 14 bladsye.

QUESTION 1 / VRAAG 1

- 1.1 C ✓✓
1.2 D ✓✓
1.3 A ✓✓
1.4 B ✓✓
1.5 D ✓✓
1.6 B ✓✓
1.7 D ✓✓
1.8 C ✓✓
1.9 B ✓✓
1.10 A ✓✓

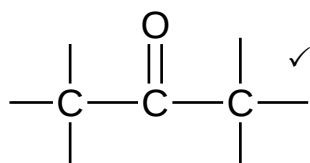
[20]

QUESTION 2 / VRAAG 2

- 2.1 A bond or an atom or a group of atoms that determine(s) the physical and chemical properties of a group of organic compounds. ✓✓ (2 or 0)

'n Binding of 'n atoom of 'n groep atome wat die fisiese en chemiese eienskappe van 'n groep organiese verbindings bepaal. ✓✓ (2 or 0) (2)

2.2.1



(1)
(1)

2.2.2 F ✓

2.2.3 5-bromo-2-chloro-2-methylhexane
5-bromo-2-chloro-2-methylhexane

Marking criteria/Nasienriglyne:

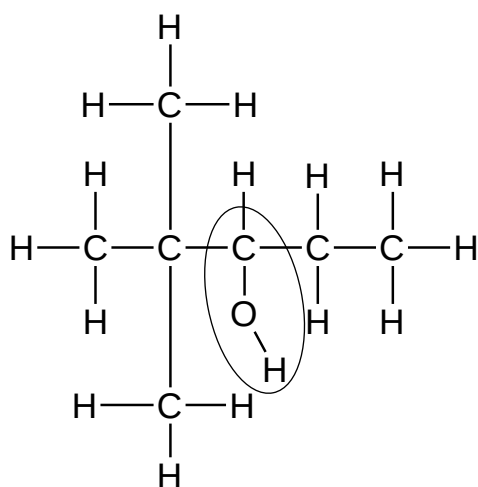
- Correct stem i.e. hexane./Korrekte stam d.i. heksaan. ✓
- All substituents (bromo, chloro and methyl) correctly identified./Alle substituenten (bromo, chloro en metiel) korrek geïdentifiseer. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas./IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas. ✓

(3)

2.2.4 Propanone / *Propanoon* ✓ (1)

2.2.5 Ketones/Ketone ✓ (1)

2.2.6



Marking criteria / Nasienriglyne

- Only functional group correct / *Slegs funksionele groep korrek* ✓
- Two methyl groups / *Twee metielgroepe* ✓
- Whole structure correct / *Hele struktuur korrek* ✓

(3)

2.2.7 Secondary/Sekondêr ✓ (1)

2.3.1 Unsaturated/Onversadig ✓

It is a compound with one or more multiple bonds between C atoms in their hydrocarbon chains. ✓

Verbindings waarin een of meer meervoudige bindings tussen C-atome in hul koolwaterstofkettings voorkom. (2)

2.3.2 Bromine water / Br₂ (Accept KMnO₄) ✓
Broom water / Br₂ (Aanvaar KMnO₄) (1)

2.3.3 C_nH_{2n+2} ✓ (1)
[17]

QUESTION 3 / VRAAG 3

3.1 Propane / Propaan ✓ (1)

3.2.1 Organic molecules with the same molecular formula, ✓ but different structural formulae. ✓
Organiese molekule met dieselfde molekulêre formule, maar verskillende struktuurformules. (2)

3.2.2 Chain isomer / Kettingisomeer ✓ (1)

- 3.2.3 • **Structure:**
Compound B has a larger surface area than compound C. ✓
- **Intermolecular forces:**
The intermolecular forces in B is stronger than in C. ✓
 - **Energy**
More energy required to overcome/break intermolecular forces in B than in C. ✓
 - **Struktuur:**
Verbinding B het 'n groter kontak oppervlak as verbinding C.
 - **Intermolekulêre kragte:**
Intermolekulêre kragte in verbinding B is sterker as in verbinding C.
 - **Energie:**
Meer energie benodig om intermolekulêre kragte te oorkom/breek in B as in C.

OR

- **Structure:**
Compound C is more compact or spherical as B, the surface area is smaller. ✓
- **Intermolecular forces:**
The intermolecular forces in C is weaker than in B. ✓
- **Energy**
Less energy needed to overcome/break intermolecular forces in C. ✓
- **Struktuur:**
Verbinding C is meer kompak of sferies as B, die kontak oppervlak is kleiner
- **Intermolekulêre kragte:**
Die intermolekulêre kragte in C is swakker as in B
- **Energie**
Minder energie benodig om intermolekulêre kragte te oorkom/breek in C

3.3.1 **Marking criteria/Nasienriglyne**

If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark. *Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af,*

The pressure exerted by a vapour at equilibrium with its liquid in a closed system. ✓✓

Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem.

(1)

3.3.2 D

(1)

- 3.3.3 • Both compounds/D and E have (in addition to London forces and dipole-dipole forces) hydrogen bonding. ✓

Beide verbindings/D en E het waterstofbindings (behalwe Londonkragte en dipool-dipoolkragte).

- Compound D/pentan-1-ol/alcohol has one site for hydrogen bonding and compound E/butanoic acid/carboxylic acid has two/more sites for hydrogen bonding. **OR** D/butanoic acid/carboxylic acid has two/more sites for hydrogen bonding. ✓

*Verbinding D/pentan-1-ol/alkohol het een punt vir waterstofbindings en verbinding B/buurutanoës/karboksielsuur het twee/meer punte vir waterstofbindings **OF** B/butanoësuur/karboksielsuur het twee/meer punte waterstofbindings.*

- Intermolecular forces in compound E/butanoic acid/carboxylic acid are stronger than intermolecular forces in compound D/ butan-1-ol/alcohol. ✓
Intermolekulêre kragte in verbinding E/butanoësuur/karboksielsuur is sterker as die intermolekulêre kragte in verbinding D/ pentan-1-ol/alkohol.

OR/OF

Intermolecular forces in compound D/pentan-1-ol/alcohol are weaker than intermolecular forces in compound E/butanoic acid/carboxylic acid.

Intermolekulêre kragte in verbinding E/pentan-1-ol/alkohol is swakker as intermolekulêre kragte in verbinding D/butanoësuur/karboksielsuur.

- More energy is needed to overcome/break intermolecular forces in compound E/butanoic acid/carboxylic acid than in compound D/ pentan-1-ol/alcohol. ✓
Meer energie word benodig om intermolekulêre kragte in verbinding E/butanoësuur as in verbinding D/ pentan-1-ol/alkohol te oorkom/breek.

OR/OF

Less energy is needed to overcome/break intermolecular forces in compound D/pentan-1-ol/alcohol than in compound E/butanoic acid/carboxylic acid.

Minder energie word benodig om intermolekulêre kragte in verbinding D/ pentan-1-ol/alkohol te oorkom/breek as in verbinding E/butanoësuur/karboksielsuur.

(4)

[14]

QUESTION 4/ VRAAG 4

4.1.1 I: Addition/ hydrohalogenation/hydrobromination✓
Addisie/Hidrohalogenering/Hidrobrominasie

II: Elimination/Dehydrohalogenation✓
Eliminasie/Dehidrohalogenering

III: Addition/Hydration✓
Addisie/Hidrasie/Hidratering

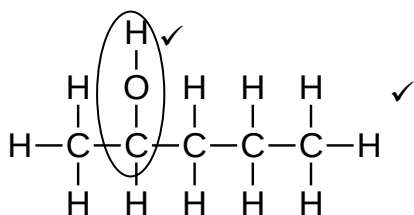
IV: Elimination/Cracking✓
Eliminasie / Kraking (4)

4.1.2 2-bromopentaaan / 2-bromo✓pentaan ✓ (2)

4.1.3 Alkene / Alkeen ✓ (1)

4.1.4 H₂O/water ✓ (1)

4.1.5



Marking criteria / Nasienriglyne

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

(2)

4.1.6 C₂H₆ ✓ Ethane/Etaan✓ (2)

4.2.1 Methyl✓ ethanoate✓ / Metieletanoaat (2)

4.2.2 A dehydrating agent/catalyst ✓
Dehidreermiddel/katalisator (1)

4.2.3

Marking criteria:

- Substitute 74 g·mol⁻¹ into the correct formula ✓
- Use ratio: $n(\text{CH}_4\text{O}) = n(\text{C}_3\text{H}_6\text{O}_2)$ ✓
- Substitute 32 g·mol⁻¹ into the correct formula ✓
- 60% of mass of CH₄O ✓
- Final answer: 49,64 g ✓

Nasienkriteria:

- Vervang 74 g·mol⁻¹ in korrekte formule ✓
- Gebruik verhouding: $n(\text{CH}_4\text{O}) = n(\text{C}_3\text{H}_6\text{O}_2)$ ✓
- Vervang 32 g·mol⁻¹ in korrekte formule ✓
- 60% of mass of CH₄O✓
- Finale antwoord: 49,64 g ✓

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

$$= \frac{68,88}{74} \checkmark$$

$$= 0,9308 \text{ mol}$$

$$n(\text{CH}_4\text{O}) = n(\text{C}_3\text{H}_6\text{O}_2) \checkmark$$

$$= 0,09308 \text{ mol}$$

$$m(\text{CH}_4\text{O})_{\text{pure/suiwer}} = nM$$

$$= (0,09308)(32) \checkmark$$

$$= 29,79 \text{ g}$$

$$\text{Impure}(\text{CH}_4\text{O}) = \frac{(29,79)(100)}{60} \checkmark$$

$$= 49,69 \text{ g} \checkmark$$

(5)
[20]

QUESTION 5/ VRAAG 5

5.1

NOTE/LET WEL

Give the mark for per unit time only if in context of reaction rate.
Gee die punt vir per eenheidtyd slegs indien in konteks met reaksietempo.

ANY ONE/ENIGE EEN

- Change in concentration ✓ of products/reactants per (unit) time. ✓
Verandering in konsentrasie van produkte/reaktante per (eenheid) tyd.
 - 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 reaktante per (eenheid) tyd.
 - Amount/number of moles/volume/mass of products formed/reactants used per (unit) time.
 - Hoeveelheid/getal mol/volume/massa van produkte gevorm/reaktante gebruik per (eenheid) tyd.
 - Rate of change in concentration/amount/number of moles/volume/mass.
Tempo van verandering in konsentrasie/ hoeveelheid/getal mol/
volume/massa. ✓✓ (2 orlof 0) (2)
- 5.2 Volume **ACCEPT:** Rate of reaction/*Tempo van reaksie* ✓ (1)
- 5.3.1 (Decreasing gradient indicates) rate of reaction is decreasing. ✓
(*Afnemende gradiënt dui aan dat*) reaksietempo afneem. (1)

5.3.2 (Gradient is zero, indicates) reaction rate is zero ✓
(Gradiënt is nul, wat aandui dat) reaksietempo nul is. (1)

5.4 Ave rate / Gem. tempo = $\frac{\Delta V}{\Delta t}$
 $10 = \frac{\Delta V}{20 - 0}$ ✓
 $V(O_2)_{\text{produced/berei}} = 200 \text{ cm}^3$

$$n(O_2)_{\text{produced/berei}} = \frac{V}{V_m}$$

$$= \frac{200}{24000}$$
 ✓
$$= 0,0083 \text{ mol}$$

$$n(H_2O_2) = 2n(O_2)$$
 ✓
$$= (2)(0,0083)$$

$$= 0,017 \text{ mol}$$

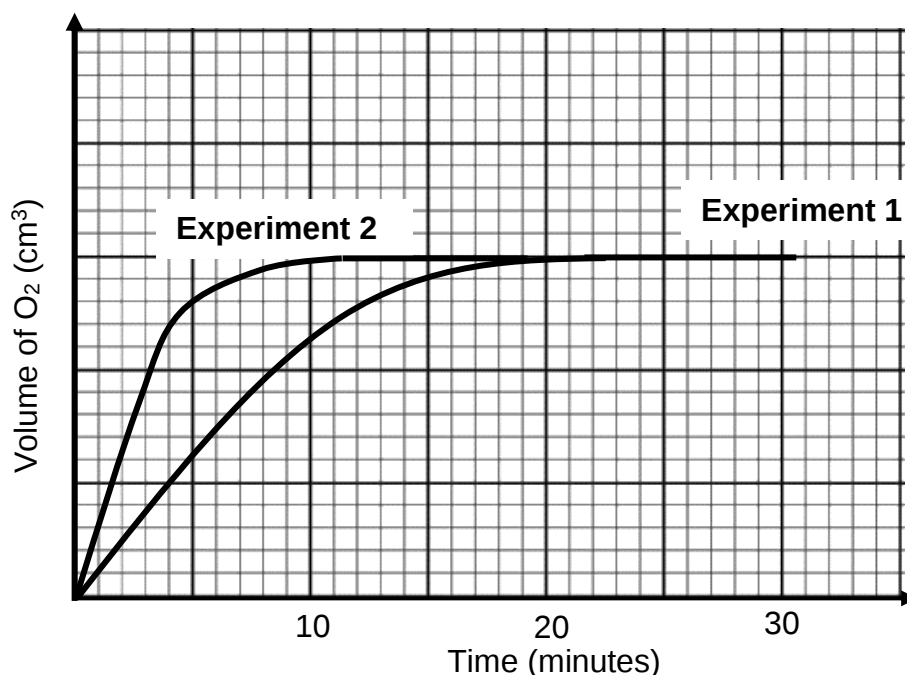
$$c(H_2O_2)_{\text{used/gebruik}} = \frac{n}{V}$$

$$= \frac{0,017}{0,04}$$
 ✓
$$= 0,42 \text{ mol} \cdot \text{dm}^{-3}$$
 ✓

(5)

5.5 **Marking criteria / Nasienkriteria:**

- Graph of Experiment 2 is steeper than gradient of Experiment 2 / Grafiek van Eksperiment 2 het 'n styler gradient as Eksperiment 2 ✓
Both graphs ends at the same place / Beide grafieke eindig op dieselfde plek ✓



(2)

5.6.1 Catalyst ✓ **OR** Increases reaction rate
Katalisator OF Toename in reaksie-tempo (1)

5.6.2 • Catalyst lowers activation energy/provides an alternative path of lower activation energy ✓

Katalisator verlaag die aktiveringsenergie/ bied 'n alternatiewe pad van laer aktiveringsenergie

- More particles have sufficient E_K **OR** more particles have $E_K \geq E_A$ ✓

Meer deeltjies het genoegsame E_K OF meer deeltjie het $E_K \geq E_A$

- More effective collisions per unit time/Frequency of effective collisions increase✓✓

Meer effektiewe botsings per eenheidstyd/ Frekwensie van die effektiewe botsings neem toe

(3)
[16]

QUESTION 6 / VRAAG 6

6.1

Marking criteria:

- Calculate number of moles of H_2 and Cl_2 ✓
- Use mole ratio 1:1:2 ✓
- Moles at equilibrium✓
- Divide equilibrium moles by Volume (0,5) ✓
- Correct K_c expression (formulae in square brackets) ✓
- Substitute 64 as K_c value ✓
- Substitution of equilibrium concentrations into K_c expression. ✓
- Substitute moles of Cl_2 and in correct formula.✓
- Final answer: 71 g ✓

Nasienkriteria:

- Bereken die aantal mol van H_2 en Cl_2 ✓
- Gebruik verhouding 1:1:2 ✓
- Mol by ewewig ✓
- Deel mol by ewewig met volume (0,5) ✓
- Korrekte K_c - uitdrukking (formules in vierkanthakies) ✓
- Vervang 64 as K_c -waarde ✓
- Vervanging van ewewigskonsentrasies in K_c -uitdrukking. ✓
- Vervang mol van Cl_2 en $71 \text{ g} \cdot \text{mol}^{-1}$ in korrekte formule ✓
- Finale antwoord: 71 g✓

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

$$= \frac{10}{2} = 5 \text{ mol H}_2$$

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

$$= \frac{355}{71} = 5 \text{ mol Cl}_2$$

	H ₂ (g)	Cl ₂ (g)	HCl(g)
Initial quantity (mol) Aanvangshoeveelheid (mol)	5	✓ 5	0
Change (mol) Verandering (mol)	x	x	2x
Quantity at equilibrium (mol)/ Hoeveelheid by ewewig (mol)	5 - x	5 - x	2x ✓
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	$\frac{5-x}{0,5}$	$\frac{5-x}{0,5}$	$\frac{2x}{0,5}$ ✓

Ratio ✓

$$K_c = \frac{[\text{HCl}]^2}{[\text{H}_2][\text{Cl}_2]}$$

$$64 \checkmark = \frac{\left(\frac{2x}{0,5}\right)^2}{\left(\frac{5-x}{0,5}\right)\left(\frac{5-x}{0,5}\right)} \checkmark$$

$$x = 4$$

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

Wrong K_c expres[sion]/*Verkeerde K_c uitdrukking*: Max./Maks. 6/9

$$n(\text{Cl}_2)_{\text{equilibrium/ewewig}} = 5 - 4$$

$$= 1 \checkmark$$

$$m_{\text{Cl}_2} = nM$$

$$= (1)(71)$$

$$= 71 \text{ g } \checkmark$$

(9)

6.2 Negative/Negatief ✓

- Decrease in temperature favours the exothermic reaction. ✓
Afname in temperatuur bevoordeel die eksotermiese reaksie.
- The forward reaction is favoured. ✓
Die voorwaartse reaksie word bevoordeel.
- Reaction is endothermic. ✓
Die reaksie is eksotermies.

(4)

6.3.1 Remains the same/Bly dieselfde ✓

(1)

6.3.2 Remains the same/Bly dieselfde ✓

(1)

[15]

QUESTION 7 / VRAAG 7

7.1.1 Dilute acids contain a small amount (number of moles) of acid in proportion to the volume of water. ✓✓ **(2 or 0)**
Verdunde sure bevat 'n klein hoeveelheid (getal mol) suur in verhouding met die volume water. (2)

7.1.2 Strong acids ionise completely in water ✓ to form a high concentration of H_3O^+ ions. ✓
Sterk sure ioniseer volledig in water om 'n hoë konsentrasie H_3O^+ -ione te vorm. (2)

7.1.3 HSO_4^- ✓ (1)

7.1.4 $[H_3O^+] = 2[H_2SO_4]$
 $= 2(0,2)$
 $= 0,4 \text{ mol} \cdot \text{dm}^{-3}$
 $\text{pH} = -\log[H_3O^+]$ ✓
 $= -\log[0,4]$ ✓
 $= 0,398$ ✓ (3)

7.2.1 Basic/Alkalies ✓ (1)

7.2.2 $\text{CO}_3^{2-} + \text{H}_2\text{O} \rightarrow \text{OH}^- + \text{HCO}_3^-$ ✓ Balancing ✓

Marking criteria / Nasienkriteria:

- Reactants ✓ Products ✓ Balancing ✓
Reaktanse Produkte Balansering
- Ignore phases / Ignoreer fases.

(3)

7.3

Marking criteria:

- Use of formula $c = \frac{n}{V}$ or $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$ ✓
- Substitute $0,1 \text{ mol} \cdot \text{dm}^{-3}$ and $0,0248 \text{ dm}^3$ in correct formula ✓
- Use ratio: $n(\text{NaOH}) = 2n(\text{Na}_2\text{CO}_3)$ ✓
- Substitute $0,5 \text{ dm}^3$ in correct formula ✓
- Use $286 \text{ g} \cdot \text{mol}^{-1}$ in $n = \frac{m}{M}$ ✓
- Final answer: $7,09 \text{ g}$ ✓

Nasienkriteria:

- Gebruik van formule $c = \frac{n}{V}$ or $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$ ✓
- Vervang $0,1 \text{ mol} \cdot \text{dm}^{-3}$ en $0,0248 \text{ dm}^3$ in korrekte formule ✓
- Gebruik ratio: $n(\text{NaOH}) = 2n(\text{Na}_2\text{CO}_3)$ ✓
- Vervang $0,5 \text{ dm}^3$ in korrekte formule ✓
- Gebruik $286 \text{ g} \cdot \text{mol}^{-1}$ in $n = \frac{m}{M}$ ✓
- Finale antwoord: $7,09 \text{ g}$ ✓

$$\begin{aligned}n(\text{HCl}) &= cV \checkmark \\&= (0,1)(0,0248) \checkmark \\&= 2,48 \times 10^{-3} \text{ mol}\end{aligned}$$

$$\begin{aligned}n(\text{Na}_2\text{CO}_3) &= 2n(\text{HCl}) \\n(\text{Na}_2\text{CO}_3) &= 1,24 \times 10^{-3} \text{ mol} \checkmark\end{aligned}$$

$$\begin{aligned}1,24 \times 10^{-3} \text{ mol } (\text{Na}_2\text{CO}_3) &\text{ in } 0,025 \text{ dm}^3 \\ \therefore \text{ in } 0,5 \text{ dm}^3 \quad n(\text{Na}_2\text{CO}_3) &= 0,0248 \text{ mol} \checkmark\end{aligned}$$

$$\begin{aligned}n &= \frac{m}{M} \\0,0248 &= \frac{m}{286} \checkmark \\m_{(\text{Na}_2\text{CO}_3)} &= 7,09 \text{ g} \checkmark\end{aligned}$$

OPTION 2 / OPSIE 2

$$\begin{aligned}\frac{c_a V_a}{c_b V_b} &= \frac{n_a}{n_b} \checkmark \\ \frac{(0,1)(24,8) \checkmark}{(c_b)(25)} &= \frac{2}{1} \checkmark \\ c_a &= 0,0496 \text{ mol} \cdot \text{dm}^3\end{aligned}$$

$$\begin{aligned}n_{(\text{Na}_2\text{CO}_3)} &= cV \\ n &= (0,0496)(0,5) \checkmark \\ &= 0,0248 \text{ mol}\end{aligned}$$

$$\begin{aligned}n &= \frac{m}{M} \\0,0248 &= \frac{m}{286} \checkmark \\m_{(\text{Na}_2\text{CO}_3)} &= 7,09 \text{ g} \checkmark\end{aligned}$$

(6)
[18]

QUESTION 8 / VRAAG 8

8.1 Concentration/Konsentrasie: $1 \text{ mol} \cdot \text{dm}^{-3}$ ✓
Temperature/Temperatuur: $25 \text{ }^{\circ}\text{C}$ ✓ (2)

8.2 • To ensure electrical neutrality / *Verseker elektriese neutraliteit* ✓
• To separate the two electrolytes / *Om die elektroliete te skei* ✓ (2)

8.3 Ni to Ag ✓ (1)

8.4 $\text{Ni(s)} + 2\text{Ag}^+(\text{aq}) \rightarrow \text{Ni}^{2+}(\text{aq}) + 2\text{Ag(s)}$ ✓ balancing ✓

Marking criteria / Nasienkriteria:

- Reactants ✓ Products ✓ Balancing ✓
Reaktanse Produkte Balansering
- Ignore double arrows / *Ignoreer dubbel pyltjie*
- Ignore phases / *Ignoreer fases.*

(3)

8.5 $n(\text{anode}) = \frac{1}{2}n(\text{cathode})$
 $n(\text{anode}) = \frac{1}{2}(0,4)$
 $= 0,2 \text{ mol}$ ✓

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

$$0,2 = \frac{m}{59}$$

$m_{\text{decrease/afname}} = 11,8 \text{ g}$ ✓

(3)

8.6 B ✓
Mg ✓ is a stronger reducing agent than Ni. ✓ Mg will be oxidized to Mg^{2+} ✓
Mg is 'n sterker reduseermiddel as Ni en Mg sal dus geoksideer word tot Mg^{2+}

(4)

[15]

QUESTION 9 / VRAAG 9

9.1 ANY ONE/ENIGE EEN

- The chemical process in which electrical energy is converted to chemical energy. ✓✓
- The use of electrical energy to produce a chemical change
- The process during which an electric current passes through a solution/ionic liquid/molten ionic compound.
- Decomposition of an ionic compound by means of electrical energy.
- *Die chemiese proses waarin elektriese energie gebruik word om 'n chemiese verandering te weeg te bring. ✓✓*
- *Die chemiese proses waarin elektriese energie omgeskakel word na chemiese energie*
- *Die proses waardeur 'n elektriese stroom deur 'n oplossing/ioniese vloeistof/gesmelte ioniese verbinding beweeg.*
- *Ontbinding van 'n ioniese verbinding met behulp van elektriese energie.*

(2)

9.2 A ✓

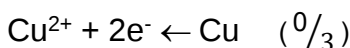
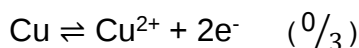
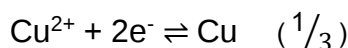
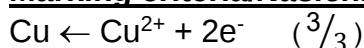
(1)

9.3 B ✓

(1)

9.4 $\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$ ✓✓

Marking criteria/Nasienriglyne



(3)

9.5 True/Waar ✓

Rate of oxidation is equal to the rate of reduction ✓

Tempo van oksidasie is gelyk aan die tempo van reduksie

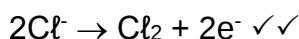
(2)

9.6 Carbon is unreactive ✓ and can conduct electricity ✓

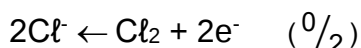
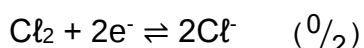
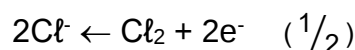
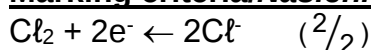
Koolstof is onreaktief en kan elektrisiteit gelei.

(2)

9.7 A ✓



Marking criteria/Nasienriglyne



(3)

9.8 Decrease/Afneem ✓

(1)

**TOTAL: [15]
150**