



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS SENIORSERTIFIKAAT-EKSAMEN

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

2016

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 14 pages.
*Hierdie memorandum bestaan uit 14 bladsye.***

QUESTION/VRAAG 1

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

QUESTION/VRAAG 2

2.1

2.1.1 E ✓ (Accept/Aanvaar: methyl propanoate/*metiel propanoaat*) (1)

2.1.2 C ✓ (Accept/Aanvaar: butan-1-ol) (1)

2.1.3 D ✓ (Accept/Aanvaar: 2,2-dimethylpropane/*2,2-dimietielpropaan*) (1)

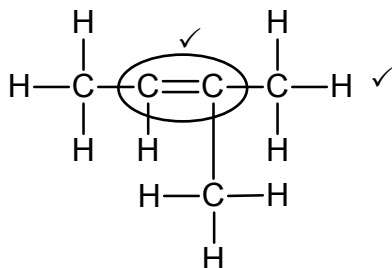
2.2

2.2.1 Pent-2[✓]-yne[✓] / Pent-2-yn**OR/OF**2[✓]-pentyne[✓] / 2-pentyn**Marking criteria/Nasienriglyne:**

- Stem i.e. pentyne./*Stam d.i. pentyn.* 1/2
- Whole name correct./*Hele naam korrek.* 2/2

(2)

2.2.2

**Marking criteria/Nasienriglyne:**

- Functional group correct./*Funksionele groep korrek.* 1/2
- Whole structure correct./*Hele struktuur korrek.* 2/2

(2)

2.2.3 2-methylbut-1-ene/*2-mietielbut-1-een***OR/OF**3-methylbut-1-ene/*3-mietielbut-1-een***Accept/Aanvaar** 2-methyl-1-butene / *2-mietiel-1-buteen***Marking criteria/Nasienriglyne:**

- Correct stem i.e. but-1-ene/*1-butene.* / *Korrekte stam d.i. but-1-een / 1-buteen.* ✓
- Only one type substituent, methyl, correctly identified./*Slegs een tipe substituent metiel, korrek geïdentifiseer.* ✓
- Entire name correct./*Hele naam korrek.* ✓

(3)

2.3

2.3.1 Esters ✓ (1)

2.3.2 Sulphuric acid/ H_2SO_4 /*Swawelsuur* ✓ (1)2.3.3 Methyl[✓] propanoate[✓]
*Metiel[✓] propanoaat[✓]***Marking criteria/Nasienriglyne:**

- Ignore spelling, e.g. methylpropanoate.
Ignoreer spelling, bv. metiel propanoaat.

(2)

[14]

QUESTION/VRAAG 3

- 3.1 The temperature at which the vapour pressure equals the atmospheric pressure (external pressure). ✓✓ **(2 marks or no marks)**
*Die temperatuur waarby die dampdruk gelyk is aan die atmosferiese druk (eksterne druk). **(2 punte of geen punte nie)*** (2)

3.2	Criteria for conclusion/Riglyne vir gevolgtrekking:	
	Dependent and independent variables correctly identified. <i>Afhanklike en onafhanklike veranderlikes korrek geïdentifiseer.</i>	✓
	Relationship between the independent and dependent variables correctly stated./ <i>Verwantskap tussen die afhanklike en onafhanklike veranderlikes korrek genoem.</i>	✓

Examples/Voorbeelde:

- Boiling point increases with increase in number of (C) atoms/chain length/molecular size/molecular mass.
Kookpunt neem toe met styging in getal (C)-atome/kettinglengte/molekulêre grootte/molekulêre massa.
- Boiling point decreases with decrease in number of C atoms/chain length/molecular size/molecular mass.
Kookpunt neem af met daling in getal C-atome/kettinglengte/molekulêre grootte/molekulêre massa.
- Boiling point is proportional to number of C atoms/chain length/molecular size/molecular mass.
Kookpunt is eweredig aan getal C-atome/kettinglengte/molekulêre grootte/molekulêre massa.

IF/INDIEN:

Boiling point is DIRECTLY proportional to number of C atoms/chain length/molecular size/molecular mass: Max. $\frac{1}{2}$
Kookpunt is DIREK eweredig aan getal C-atome/kettinglengte/molekulêre grootte/molekulêre massa: Maks. $\frac{1}{2}$ (2)

- 3.3
 3.3.1 P ✓ (1)
 3.3.2 R ✓ (1)

- 3.4
- Between alkane molecules are London forces/dispersion forces/induced dipole forces.
Tussen alkaanmolekule is London-kragte/dispersiekragte/geïnduseerde dipoolkragte. ✓
 - In addition to London forces and dipole-dipole forces each alcohol molecule has (one site) for hydrogen bonding. ✓
Behalwe London-kragte en dipool-dipoolkragte het elke alkohol-molekuul een punt vir waterstofbindings.
 - In addition to London forces and dipole-dipole forces each carboxylic acid molecule has two sites for hydrogen bonding. ✓ (Accept: more sites/Aanvaar meer punte)
Behalwe London-kragte en dipool-dipoolkragte het elke karboksielsuur-molekuul twee punte vir waterstofbindings.
 - Intermolecular forces in carboxylic acids are stronger than intermolecular forces in alkanes and alcohols./Intermolecular forces between alkane and alcohol molecules are weaker than intermolecular forces between carboxylic acid molecules. ✓
Intermolekulêre kragte in karboksielsure is sterker as intermolekulêre kragte in alkane en alkohole./Intermolekulêre kragte tussen alkane en alkohole is swakker as intermolekulêre kragte tussen karboksielsuur-molekule.
 - More energy is needed to overcome/break intermolecular forces in carboxylic acids than in the other two compounds. ✓
Meer energie word benodig om intermolekulêre kragte in karboksielsure as in die ander twee verbindings te oorkom/breek.

(5)
[11]**QUESTION/VRAAG 4**

4.1

4.1.1 Addition/Hydrogenation ✓
Addisie/Hidrogenasie/Hidrogenering (1)

4.1.2 Elimination/Dehydrohalogenation/Dehydrobromination ✓
Eliminasie/Dehidrohalogenering/Dehidrohalogenasie/Dehidrobrominerig (1)

4.1.3 Substitution/Halogenation/Bromination ✓
Substitusie/Halogenering/Halogenasie/Brominerig (1)

4.2

4.2.1 Pt/Ni/Pd/platinum/nickel/*nikkell*/palladium ✓ (1)

4.2.2 H₂SO₄/H₃PO₄/sulphuric acid/phosphoric acid ✓
H₂SO₄/H₃PO₄/swawelsuur/fosforsuur (1)

4.2.3 Hydration/*Hidrasie/Hidratering* ✓ (1)

4.2.4 2✓-bromopropane ✓

Marking criteria/Nasienriglyne:

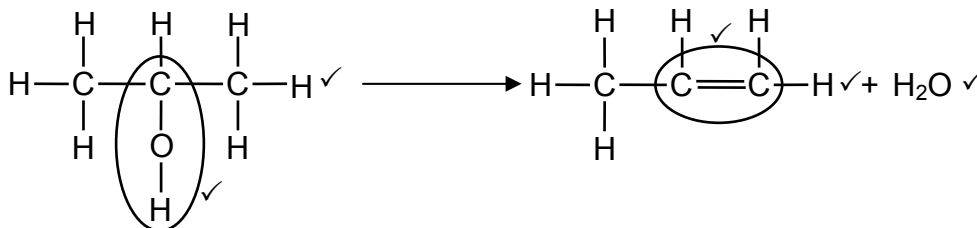
• Bromopropane/*Bromopropaan*: $\frac{1}{2}$

• 2-bromopropane

2-bromopropaan $\frac{2}{2}$

(2)

4.3

**Notes/Aantekeninge:**Whole structure of alkene correct/*Hele struktuur van alkeen korrek:* ✓✓Only functional group correct/*Slegs funksionele groep korrek:* ✓**Notes/Aantekeninge:**

- Condensed or semistructural formula: Max. $\frac{4}{5}$

Gekondenseerde of semistruktuurformule: Maks. $\frac{4}{5}$

- Molecular formula/*Molekulêre formule:* $\frac{1}{5}$

- Marking rule 3.9/*Nasienreël 3.9*

- Any additional reactants or products: Max. $\frac{4}{5}$

Enige addisionele reaktanse of produkte: Maks. $\frac{5}{5}$

- If arrow in equation omitted: Max. $\frac{4}{5}$

Indien pyltjie in vergelyking uitgelaat is: Maks. $\frac{4}{5}$

(5)

4.4

- Higher temperature/*Hoër temperatuur* ✓
- Concentrated base/*Base dissolved in ethanol* ✓
Gekonsentreerde basis/*Basis opgelos in etanol*

(2)

[15]**QUESTION/VRAAG 5**5.1 **ANY TWO/ENIGE TWEE:**Temperature (of reaction mixture)/*Temperatuur (van reaksiemengsel)* ✓(Addition of a) catalyst/*(Byvoeging van 'n) katalisator* ✓Concentration (of reactants)/*Konsentrasie (van reaktanse)*

(2)

5.2 Sulphur/S/*Swawel* ✓

(1)

5.3 Water is used to dilute/change the concentration (of the $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$) ✓*Water word gebruik (om die $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$) te verdun/se konsentrasie te verander.*

(1)

5.4

Criteria for investigative question/Kriteria vir ondersoekende vraag:	
The <u>dependent</u> and <u>independent</u> variables are stated correctly. <i>Die <u>afhanklike</u> en <u>onafhanklike</u> veranderlikes word korrek genoem.</i>	✓
Asks a question about the relationship between <u>dependent</u> and <u>independent</u> variables./Vra 'n vraag oor die verwantskap tussen <u>afhanklike</u> en <u>onafhanklike</u> veranderlikes.	✓

Dependent variable: rate (of reaction)/(reaction rate)

Afhanklike veranderlike: (reaksie)tempo

Independent variable: concentration

Onafhanklike veranderlike: konsentrasie

Examples/Voorbeelde:

- What is the relationship between concentration and reaction rate?
Wat is die verwantskap tussen konsentrasie en reaksietempo?
- How does the reaction rate change with change in concentration?
Hoe verander die reaksietempo met verandering in konsentrasie? (2)

5.5

A ✓

(1)

5.6

Experiment B/Eksperiment B:

- The concentration of $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$ is higher./More $\text{Na}_2\text{S}_2\text{O}_3$ particles per unit volume. ✓ Accept: higher volume of $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$ is used
Die konsentrasie van $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$ is hoër./Meer $\text{Na}_2\text{S}_2\text{O}_3$ -deeltjies per eenheid volume. Aanvaar: Groter volume $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$ is gebruik
- More particles with correct orientation / Meer deeltjies met korrekte oriëntasie. ✓
- More effective collisions per unit time / Higher frequency of effective collisions. ✓
Meer effektiewe botsings per eenheid tyd./Hoër frekwensie van effektiewe botsings.

OR/OF

Experiment D/Eksperiment D:

- The concentration of $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$ is lower./Less $\text{Na}_2\text{S}_2\text{O}_3$ particles per unit volume. ✓
Die konsentrasie van $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$ is laer./Minder $\text{Na}_2\text{S}_2\text{O}_3$ -deeltjies per eenheid volume.
- Less particles with correct orientation./Minder deeltjies met korrekte oriëntasie. ✓
- Less effective collisions per unit time./Lower frequency of effective collisions. ✓
Minder effektiewe botsings per eenheid tyd./Laer frekwensie van effektiewe botsings. (3)

5.7

Marking guidelines for Option 1 and 2/Nasienriglyne vir Opsie 1 en 2:

- Formula/Formule: $c = \frac{m}{MV}$ / Both/Beide $n = \frac{m}{M}$ and/enc $c = \frac{n}{V}$ or/of ratio / verhouding ✓
- Use/Gebruik $158 \text{ g} \cdot \text{mol}^{-1}$ ✓
- Use volume (250 cm^3) to calculate $c(\text{Na}_2\text{S}_2\text{O}_3)$ or $m(\text{Na}_2\text{S}_2\text{O}_3)$. ✓
Gebruik volume (250 cm^3) om $c(\text{Na}_2\text{S}_2\text{O}_3)$ of $m(\text{Na}_2\text{S}_2\text{O}_3)$ te bereken.
- Calculate $n(\text{Na}_2\text{S}_2\text{O}_3)$. /Bereken $n(\text{Na}_2\text{S}_2\text{O}_3)$. ✓
- Use ratio/Gebruik verhouding: $n(\text{S}) = (\text{Na}_2\text{S}_2\text{O}_3) = 1:1$ ✓
- Use/Gebruik $32 \text{ g} \cdot \text{mol}^{-1}$. ✓
- Final answer/Finale antwoord: $0,51 \text{ g}$ ✓
- Accepted range/Aanvaarde gebied: $0,50$ to $0,51 \text{ g}$

Marking guidelines for Option 3 and 4/Nasienriglyne vir Opsie 3 en 4:

- Use volume (250 cm^3) / Gebruik volume (250 cm^3)
- Use $m(\text{Na}_2\text{S}_2\text{O}_3)$. $62,5 \text{ g}$ ✓ / Gebruik $m(\text{Na}_2\text{S}_2\text{O}_3) = 62,5 \text{ g}$
- Use/Gebruik $158 \text{ g} \cdot \text{mol}^{-1}$ ✓
- Calculate $n(\text{Na}_2\text{S}_2\text{O}_3)$ or $m(\text{Na}_2\text{S}_2\text{O}_3)$. /Bereken $n(\text{Na}_2\text{S}_2\text{O}_3)$ of $m(\text{Na}_2\text{S}_2\text{O}_3)$. ✓
- Use ratio/Gebruik verhouding: $n(\text{S}) = (\text{Na}_2\text{S}_2\text{O}_3) = 1:1$ ✓
- Use/Gebruik $32 \text{ g} \cdot \text{mol}^{-1}$. ✓
- Final answer/Finale antwoord: $0,51 \text{ g}$ ✓
- Accepted range/Aanvaarde gebied: $0,50$ to $0,51 \text{ g}$

OPTION/OPSIE 1	OPTION/OPSIE 2	OPTION/OPSIE 3	OPTION/OPSIE 4
$c = \frac{m}{MV} \checkmark$ $= \frac{62,5}{(158)(0,25)} \checkmark$ $= 1,58 \text{ mol} \cdot \text{dm}^{-3}$	$n = \frac{m}{M} \checkmark$ $= \frac{62,5}{158} \checkmark$ $= 0,396 \text{ mol}$ $c = \frac{n}{V}$ $= \frac{0,396}{0,25} \checkmark$ $= 1,58 \text{ mol} \cdot \text{dm}^{-3}$	$250 \text{ cm}^3 \dots\dots 62,5 \text{ g}$ $10 \text{ cm}^3 \dots\dots \frac{10}{250} \checkmark \times 62,5 \checkmark$ $\therefore m(\text{Na}_2\text{S}_2\text{O}_3 \text{ in D})$ $= 2,5 \text{ g}$ $n(\text{Na}_2\text{S}_2\text{O}_3 \text{ in D}) = \frac{m}{M}$ $= \frac{2,5}{158} \checkmark \checkmark$ $= 0,0158 \text{ mol}$	$250 \text{ cm}^3 \dots\dots 62,5 \text{ g}$ $10 \text{ cm}^3 \dots\dots \frac{10}{250} \checkmark \times 62,5 \checkmark$ $\therefore m(\text{Na}_2\text{S}_2\text{O}_3 \text{ in D})$ $= 2,5 \text{ g}$ $158 \text{ g} \dots\dots 32 \text{ g S} \checkmark$ $2,5 \text{ g} \dots\dots x \text{ g}$ $m(x) = \frac{2,5 \times 32}{158} \checkmark \checkmark$ $= 0,51 \text{ g} \checkmark$
	$n(\text{Na}_2\text{S}_2\text{O}_3 \text{ in D}) = cV$ $= (1,58)(0,01) \checkmark$ $= 0,0158 \text{ mol}$		
		$n(\text{S}) = (\text{Na}_2\text{S}_2\text{O}_3) \checkmark$ $= 0,0158$ $n = \frac{m}{M}$ $0,0158 = \frac{m}{32} \checkmark$ $m = 0,51 \text{ g} \checkmark$	

(7)
[17]

QUESTION/VRAAG 6

6.1 Reversible reaction/Omkeerbare reaksie ✓ (1)

6.2 Endothermic/Endotermies ✓

⊖

ΔH is positive./ΔH > 0/(Net) energy is absorbed./More energy is absorbed than released/Energy of product > energy of reactant. ✓

ΔH is positief./ΔH > 0/(Netto) energie word opgeneem./Meer energie word geabsorbeer as vrygestel./Energie van produk > Energie van reaktans (2)

6.3 Larger than/Groter as ✓

⊖

$K_c > 1$ ✓ (2)

6.4

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

Mark allocation/Punttoekenning:

- Calculate $n(\text{CO})_{\text{equilibrium}}$ i.e. divide m by $28 \text{ g} \cdot \text{mol}^{-1}$ OR substitute 6 mol for equilibrium mole of CO. ✓
Bereken $n(\text{CO})_{\text{ewewig}}$ d.i. deel m deur $28 \text{ g} \cdot \text{mol}^{-1}$ OF vervang 6 mol vir ewewigsmol van CO.
- Change in $n(\text{CO}) = \text{equilibrium } n(\text{CO}) - \text{initial } n(\text{CO})$ ✓
Verandering in $n(\text{CO}) = \text{ewewig } n(\text{CO}) - \text{aanvanklike } n(\text{CO})$
- **USING** ratio/**GEBRUIK** verhouding: $\text{CO}_2 : \text{CO} = 1 : 2$ ✓
- Equilibrium $n(\text{CO}_2) = \text{initial } n(\text{CO}_2) - \text{change } n(\text{CO}_2)$. ✓
Ewewig $n(\text{CO}_2) = \text{aanvanklike } n(\text{CO}_2) - \text{verandering } n(\text{CO}_2)$.
- Equilibrium mole of both CO_2 and CO divided by 2 dm^3 . ✓
Ewewigsmol van beide CO_2 en CO gedeel deur 2 dm^3
- Correct K_c expression (formulae in square brackets). ✓
Korrekte K_c -uitdrukking (formules in vierkanthakies).
- Substitution of concentrations into K_c expression. ✓
Vervanging van konsentrasies in K_c -uitdrukking.
- Substitution of K_c value/Vervanging van K_c -waarde. ✓
- Final answer/Finale antwoord: 4,28–4,29 (mol) ✓

OPTION 1/OPSIE 1

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

$$= \frac{168}{28} \checkmark$$

$$= 6 \text{ mol}$$

	CO ₂	CO	
Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i>	x	0	
Change (mol) <i>Verandering (mol)</i>	3	6 ✓	ratio ✓ verhouding
Quantity at equilibrium (mol)/ <i>Hoeveelheid by ewewig (mol)</i>	x - 3 ✓	6	
Equilibrium concentration (mol·dm ⁻³) <i>Ewewigskonsentrasie (mol·dm⁻³)</i>	$\frac{x-3}{2}$	3	Divide by 2 ✓

$$K_c = \frac{[\text{CO}]^2}{[\text{CO}_2]} \checkmark$$

$$14 \checkmark = \frac{(3)^2}{\frac{x-3}{2}} \checkmark$$

$$\therefore x = 4,29 \text{ mol} \checkmark$$

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

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

OPTION 2/OPSIE 2

$$n = \frac{m}{M} \qquad c = \frac{n}{V}$$

$$= \frac{168}{28} \checkmark \qquad = \frac{6}{2} \text{ Divide by/Deel deur 2} \checkmark$$

$$= 6 \text{ mol} \qquad = 3 \text{ mol} \cdot \text{dm}^{-3}$$

	CO ₂	CO	
Initial concentration (mol·dm ⁻³) <i>Aanvangskonsentrasie (mol·dm⁻³)</i>	x	0	
Change (mol·dm ⁻³) <i>Verandering (mol·dm⁻³)</i>	1,5	3 ✓	ratio ✓ verhouding
Equilibrium concentration (mol·dm ⁻³) <i>Ewewigskonsentrasie (mol·dm⁻³)</i>	x - 1,5 ✓	3	

$$K_c = \frac{[\text{CO}]^2}{[\text{CO}_2]} \checkmark$$

$$14 \checkmark = \frac{[3]^2}{x-1,5} \checkmark$$

$$\therefore x = 2,14 \text{ mol} \cdot \text{dm}^{-3}$$

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

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

$$n(\text{CO}_2) = cV$$

$$= (2,14)(2)$$

$$= 4,29 \text{ mol} \checkmark$$

OPTION 3/OPSIE 3

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

$$= \frac{168}{28} \checkmark$$

$$= 6 \text{ mol}$$

	CO ₂	CO
Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i>	4,28✓	0
Change (mol) <i>Verandering (mol)</i>	3	6
Quantity at equilibrium (mol)/ Hoeveelheid by ewewig (mol)	1,28 ✓	6✓
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	0,64	3

ratio ✓
verhoudingmultiply by 2✓
vermenigvuldig met 2

$$K_c = \frac{[\text{CO}]^2}{[\text{CO}_2]} \checkmark$$

$$14 \checkmark = \frac{[3]^2}{[0,64]} \checkmark$$

$$\therefore [\text{CO}_2] = 0,64 \text{ mol}\cdot\text{dm}^{-3}$$

No K_c expression, correct substitution/*Geen K_c-uitdrukking, korrekte substitusie: Max./Maks. 8/9*Wrong K_c expression/*Verkeerde K_c-uitdrukking: Max./Maks. 6/9*

(9)

6.5

6.5.1 Remains the same/*Bly dieselfde* ✓

(1)

6.5.2 Decreases/*Verminder* ✓

(1)

6.5.3 Increases/*Vermeerder* ✓

(1)

[17]**QUESTION/VRAAG 7**

7.1

7.1.1 An acid is a *proton/ H⁺ donor*. ✓✓ **NOTE:** not H₃O⁺ (2 or/of 0)
'n Suur is 'n protondonor/ H⁺ skenker. LET WEL nie H₃O⁺ nie

(2)

7.1.2 H₂O ✓H₂CO₃ ✓

(2)

7.1.3 H₂O ✓**OR/OF**HCO₃⁻

(1)

7.2

7.2.1

$$\begin{aligned} n(\text{HCl}) &= cV \checkmark \\ &= (0,1)(0,5) \checkmark \\ &= 0,05 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{NaHCO}_3) &= cV \\ &= (0,25)(0,8) \checkmark \\ &= 0,2 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{NaHCO}_3)_{\text{reacted/gereageer}} &= n(\text{HCl}) \\ &= 0,05 \text{ mol} \checkmark \end{aligned}$$

$$\begin{aligned} n(\text{NaHCO}_3)_{\text{excess/oormaat}} &= \frac{0,2 - 0,05}{1} \checkmark \\ &= 0,15 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{OH}^-) &= n(\text{NaHCO}_3) \checkmark \\ &= 0,15 \text{ mol} \end{aligned}$$

$$\begin{aligned} c(\text{OH}^-) &= \frac{n}{V} \\ &= \frac{0,15}{1,3} \checkmark \\ &= 0,12 \text{ mol} \cdot \text{dm}^{-3} \checkmark \end{aligned}$$

Marking guidelines/Nasienglyne:

- Formula/Formule:

$$c = \frac{n}{V} / n = cV \checkmark$$

- Substitution of (0,1)(0,5). ✓
Vervanging van (0,1)(0,5).
- Substitution of (0,8)(0,25). ✓
Vervanging van (0,8)(0,25).
- Use $n(\text{NaHCO}_3) = n(\text{HCl}) = 1:1$. ✓
Gebruik $n(\text{NaHCO}_3) = n(\text{HCl}) = 1:1$.
- $n_{\text{b(in excess)}} = n_{\text{b(initial)}} - n_{\text{b(reacted)}}$
 $n_{\text{b(in oormaat)}} = n_{\text{b(aanvanklik)}} - n_{\text{b(gereageer)}}$
- Use $n(\text{OH}^-) = n(\text{NaHCO}_3) = 1:1$. ✓
Gebruik $n(\text{OH}^-) = n(\text{NaHCO}_3) = 1:1$.
- Substitute $V = 1,3 \text{ dm}^3$ in $c = \frac{n}{V}$
Vervang $V = 1,3 \text{ dm}^3$ in $c = \frac{n}{V}$
- Final answer/Finale antwoord:
 $0,12 \text{ mol} \cdot \text{dm}^{-3}$ ✓

(8)

7.2.2

POSITIVE MARKING FROM QUESTION 7.2.1
POSITIEWE NASIEN VAN VRAAG 7.2.1

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14}$ $1 \times 10^{-14} = [\text{H}_3\text{O}^+](0,12) \checkmark$ $[\text{H}_3\text{O}^+] = 8,33 \times 10^{-14} \text{ mol} \cdot \text{dm}^{-3}$ $\text{pH} = -\log [\text{H}_3\text{O}^+] \checkmark$ $= -\log(8,33 \times 10^{-14}) \checkmark$ $= 13,08 \checkmark$	$\text{pOH} = -\log[\text{OH}^-] \checkmark$ $= -\log(0,12) \checkmark$ $= 0,92$ $\text{pH} + \text{pOH} = 14$ $\text{pH} + 0,92 = 14 \checkmark$ $\text{pH} = 13,08 \checkmark$

(4)
[17]**QUESTION/VRAAG 8**8.1 Electrons are transferred./Elektrone word oorgedra. ✓**OR/OF**The oxidation number of Mg/H changes.
Die oksidasiegetal van Mg/H verander.**OR/OF**Mg is oxidised / H^+ is reduced.
Mg word geoksideer / H^+ word gereduseer. (1)8.2 H^+ ions/HCl/H⁺(aq)/HCl(aq) ✓ (1)

- 8.3 Ag is a weaker reducing agent ✓ (than H₂) and will not be oxidised ✓ to Ag⁺ ✓
Ag is 'n swakker reduseermiddel (as H₂) en sal nie na Ag⁺ geoksideer word nie.

OR/OF

H₂ is a stronger reducing agent ✓ (than Ag) and will be oxidised ✓ to H⁺. ✓
H₂ is 'n sterker reduseermiddel (as Ag) en sal na H⁺ geoksideer word.

(3)

- 8.4 Electrode/Conductor of electrons (in hydrogen half-cell) ✓
Elektrode/Geleier van elektrone in waterstofhalfsel.

(1)

8.5

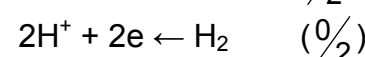
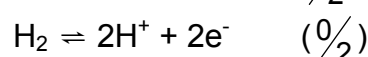
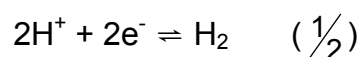
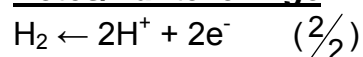
- 8.5.1 Chemical energy to electrical energy ✓
Chemiese energie na elektriese energie

(1)

- 8.5.2 Provides path for movement of ions./Completes the circuit./Ensures electrical neutrality in cell. ✓
Verskaf pad vir die beweging van ione./Voltooi die stroombaan./Verseker elektriese neutraliteit in sel.

(1)

- 8.5.3 $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ ✓✓

Notes/Aantekeninge

(2)

- 8.5.4 $\text{Mg(s)} \left| \text{Mg}^{2+}(\text{aq}) \right| \left| \text{H}^+(\text{aq}) \right| \text{H}_2(\text{g}) \left| \text{Pt} \right.$

OR/OF

$\text{Mg(s)} \left| \text{Mg}^{2+}(1 \text{ mol} \cdot \text{dm}^{-3}) \right| \left| \text{H}^+(1 \text{ mol} \cdot \text{dm}^{-3}) \right| \text{H}_2(\text{g}) \left| \text{Pt} \right.$

Accept/Aanvaar

$\text{Mg} \left| \text{Mg}^{2+} \right| \left| \text{H}^+ \right| \text{H}_2 \left| \text{Pt} \right.$

(3)

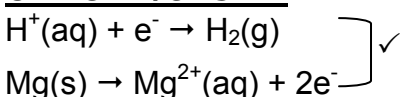
8.6

OPTION 1/OPSIE 1

$$\begin{aligned} E_{\text{cell}}^{\circ} &= E_{\text{reduction}}^{\circ} - E_{\text{oxidation}}^{\circ} \quad \checkmark \\ &= 0,00 \quad \checkmark - (-2,36) \quad \checkmark \\ &= 2,36 \text{ V} \quad \checkmark \end{aligned}$$

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

OPTION 2/OPSIE 2

$$E^{\circ} = 0,00\text{V} \quad \checkmark$$

$$E^{\circ} = +2,36 \text{ V} \quad \checkmark$$

$$E^{\circ} = +2,36 \text{ V} \quad \checkmark$$


(4)

- 8.7 Increases/Verhoog ✓

(1)

[18]

QUESTION/VRAAG 9

- 9.1
- 9.1.1 Electrolyte/*Elektroliet* ✓ (1)
- 9.1.2 Electrolytic (cell)/*Elektrolitiese (sel)* ✓
- Electrolysis / *Elektroliese* $\frac{0}{1}$ (1)
- 9.2 A to/na B ✓ (1)
- 9.3
- 9.3.1 B ✓ (1)
- 9.3.2 A ✓ (1)
- 9.4  Decreases/*Verminder* ✓
- Copper (Cu) is oxidised to Cu^{2+} /Oxidation takes place at A/Electrons are lost. ✓
- Koper (Cu) word na Cu^{2+} geoksideer/Oksidasie vind by A plaas/Verlies van elektrone* (2)
- [7]

QUESTION/VRAAG 10

10.1

10.1.1 Air/Lug ✓ (1)

10.1.2 Natural gas/methane/oil/coal ✓
Aardgasse/metaan/olie/steenkool (1)

10.1.3 Sulphur/iron pyrite/iron sulphide ✓
Swawel/ysterpiriet/ystersulfied (1)

10.2

10.2.1 Haber ✓ (1)

10.2.2 Ammonia/Ammoniak ✓ (1)

10.2.3 H_2SO_4 ✓ (1)

10.2.4 $SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$ ✓ Bal. ✓

Notes/Aantekeninge:

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

(3)

10.3

10.3.1 $\%N[\text{NH}_4\text{NO}_3] = \frac{28}{80} \checkmark \times 100 = 35\%$
 $\%N[(\text{NH}_4)_2\text{SO}_4] = \frac{28}{132} \checkmark \times 100 = 21,21\%$ } \checkmark

Ammonium nitrate (has the highest percentage of nitrogen) \checkmark
Ammoniumnitraat (het die hoogste persentasie) stikstof.

(4)

10.3.2 Ostwald (process/proses) \checkmark

(1)

[14]

TOTAL/TOTAAL: 150