basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE/*SENIOR SERTIFIKAAT*
NATIONAL SENIOR CERTIFICATE/
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

NOVEMBER 2020

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 17 pages./
Hierdie nasienriglyne bestaan uit 17 bladsye.

QUESTION 1/*VRAAG 1*

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

QUESTION 2/*VRAAG 2*

2.1.1 Ketones/*Ketone* ✓ (1)

2.1.2 Pentanal/*Pentanaal* ✓✓

ACCEPT/*AANVAAR*
2,2-dimethylpropanal/*2,2-dimethylpropanaal*
2-methylbutanal/*2-metielbutanaal*
3-methylbutanal/*3-metielbutanaal*

Marking criteria/*Nasienriglyne*
- Correct functional group,i.e. – al / *Korrekte funksionele groep d.i. al* ✓
- Whole name correct/*Hele naam korrek* ✓

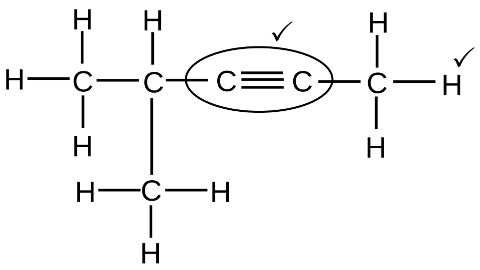
(2)

2.2.1 5 – bromo-2,3 – dimethylhexane/*5 – bromo-2,3 – dimetielheksaan*

Marking criteria/*Nasienriglyne:*
- Correct stem i.e. hexane./*Korrekte stam d.i. heksaan.* ✓
- All substituents (bromo and dimethyl) correctly identified./*Alle substituente (bromo en dimetiel) korrek geïdentifiseer.* ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas./*IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas .* ✓

(3)

2.2.2



Marking criteria/*Nasienriglyne*
- Whole structure correct/*Hele struktuur korrek:* $^{2}/_{2}$
- Only functional group correct:/*Slegs funksionele groep korrek:* Max/*Maks.*: $^{1}/_{2}$

IF/*INDIEN*
More than one functional group/*Meer as een funksionele groep* $^{0}/_{2}$

(2)

IF/*INDIEN*
Molecular formula/*Molekulêre formule* $^{0}/_{2}$
Condensed structural formula /*Gekondenseerde struktuurformule* $^{1}/_{2}$

2.3.1 The C atom bonded to the hydroxyl group is bonded to only one other C-atom. ✓✓ **(2 or 0)**
*Die C-atoom wat aan die hidroksielgroep gebind is, is aan slegs een ander C-atoom gebind.**(2 or 0)***

OR/*OF*
The hydroxyl group/-OH/ is bonded to a C atom which is bonded to two hydrogens atoms. **(2 or 0)**
Die hidroksielgroep/funksionele groep is gebind aan 'n C-atoom wat aan twee waterstofatome gebind is. ***(2 of 0)***

OR/*OF*
The hydroxyl group/functional group/-OH is bonded to:
a primary C atom / the first C atom **(2 or 0)**
Die hidroksielgroep/funksionele groep/-OH aan
'n primêre C-atoom gebind / die eerste C-atoom gebind ***(2 of 0)***

OR/*OF*

The functional group ($-\overset{|}{\underset{|}{C}}-OH$) is bonded to only one other C-atom.

Die funksionele groep ($-\overset{|}{\underset{|}{C}}-OH$) *is aan slegs een ander C-atoom gebind.* (2)

2.3.2 Esterification/condensation ✓
Verestering/esterifikasie/kondensasie (1)

2.3.3 <u>Butanoic acid</u>/<u>*Butanoësuur*</u> ✓ (1)
[12]

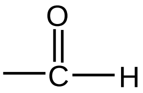
QUESTION 3/*VRAAG 3*

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 temperature at which the vapour pressure equals atmospheric (external) pressure. ✓✓
Die temperatuur waar die dampdruk gelyk is aan atmosferiese (eksterne) druk. (2)

3.2

 ✓ (1)

3.3

- Increase in the number of C-atoms increases molecular mass/size/chain length/surface area. ✓
- Strength of the intermolecular forces increases/More sites for London forces. ✓
- More energy is needed to overcome/break intermolecular forces. ✓

- *Toename in aantal C-atome verhoog molekulêre massa/molekulêre grootte/kettinglengte/reaksie-oppervlak.*
- *Sterkte van die intermolekulêre kragte verhoog./Meer punte vir Londonkragte.*
- *Meer energie benodig om intermolekulêre kragte te oorkom/breek.* (3)

3.4.1 C ✓ (1)

3.4.2 B ✓

> **Marking criteria/*Nasienriglyne***
> - Compare strength of intermolecular forces of A, B and C. ✓
> - Compare boiling points/energy required to overcome intermolecular forces of alcohols/A and aldehydes/B. ✓
>   **OR**
>   Alcohols have the highest boiling point.
> - Compare boiling points/ energy required to overcome intermolecular force of aldehydes/B and alkanes/C .✓
>   **OR**
>   Alkanes have the lowest boiling point.
>
> - *Vergelyk sterkte van intermolekulêre kragte van A, B en C.* ✓
> - *Vergelyk kookpunte /energie benodig om intermolekulêre kragte van alkohole/A en aldehiede/B te oorkom.* ✓
>   ***OF***
>   *Alkohole het die hoogste kookpunt.*
> - *Vergelyk kookpunte /energie benodig om intermolekulêre kragte van aldehiede/B en alkane/C.* ✓
>   ***OF***
>   *Alkane het die laagste kookpunt.*

Aldehydes/B have (in addition to London forces) dipole-dipole forces which are stronger than London forces, but weaker than hydrogen bonds. ✓
Therefore aldehydes/B have lower boiling points/require less energy to overcome intermolecular forces than alcohols/A,✓but higher boiling points / require more energy to overcome intermolecular forces than alkanes/C. ✓

Aldehiede/B het (in toevoeging tot Londonkragte) dipool-dipoolkragte wat sterker is as Londonkragte, maar swakker is as waterstofbinding.
Dus het aldehiede/B laer kookpunte/benodig minder energie om intermolekulêre kragte te oorkom as alkohole/A, maar hoër kookpunte/benodig meer energie om intermolekulêre kragte te oorkom as alkane/C.

OR/*OF*
Aldehydes/B have stronger intermolecular forces than alkanes, but weaker intermolecular forces than alcohols/A. ✓
Therefore aldehydes/B have higher boiling points/ more energy required to overcome intermolecular forces than alkanes/C, ✓ but lower boiling points/ less energy to overcome intermolecular forces than alcohols/A. ✓

Aldehiede/B het sterker intermolekulêre kragte as alkane/C, maar swakker intermolekulêre kragte as alkohole/A.
Dus het aldehiede/B laer kookpunte/ benodig minder energie om intermolekulêre kragte te oorkom as alkohole/A, maar hoër kookpunte/ benodig meer energie om intermolekulêre kragte te oorkom as alkane/C. (4)

3.5 Butanal ✓✓
Butanaal

Marking criteria/*Nasienriglyne*
• Correct stem, i.e. but/*Korrekte stam d.i. but* ✓
• Whole name correct/*Hele naam korrek* ✓

(2)

3.6 Pentan-1-ol ✓✓
OR/*OF*
1-pentanol ✓✓ (2)
[15]

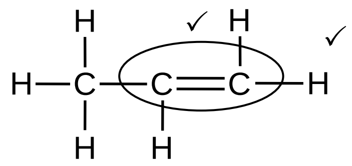
QUESTION 4/*VRAAG 4*

4.1

Marking criteria/*Nasienriglyne*
• Addition reaction / reaction of alkene / reaction of C – C double bond /reaction of unsaturated hydrocarbon✓ *Addisie reaksie / reaksie van 'n alkeen /reaksie van C – C dubbelbinding/reaksie van 'n onversadigde koolwaterstof.*
• (Addition of) hydrogen halide/HX/ hydrogen and halide. ✓ *(Addisie van) waterstofhalied/HX/waterstof en halied.*

The addition ✓of a hydrogen halide/HX ✓to an alkene.
Die addisie van 'n waterstofhalied/HX aan 'n alkeen. (2)

4.2



<u>Marking criteria/*Nasienriglyne*</u>

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

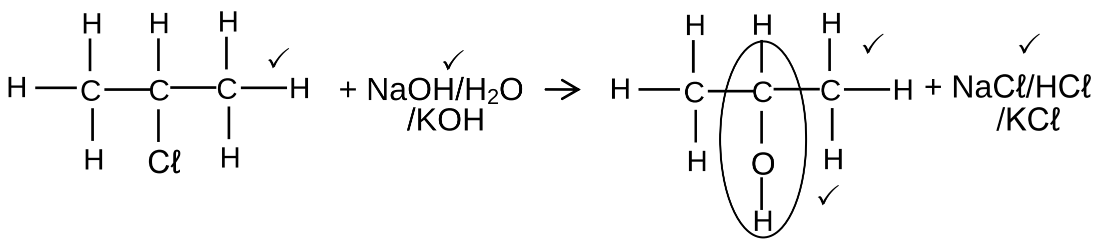
(2)

4.3.1 Cracking/*Kraking* ✓ (1)

4.3.2 C_8H_{18} ✓ (1)

4.4 <u>1,2–dibromo</u> ✓ <u>propane</u> ✓
<u>*1,2-dibromopropaan/1,2-dibroompropaan*</u> (2)

4.5.1



<u>Marking criteria for the alcohol/*Nasienriglyne vir die alkohol*</u>

- Whole structure of alcohol correct/*Hele struktuur van alkohol korrek:* $\frac{2}{2}$
- Only functional group correct/*Slegs funksionele groep korrek:* $\frac{1}{2}$

<u>Notes/*Aantekeninge:*</u>

- If 1-chloropropane used as reactant, 2 marks for the primary alcohol.
  Indien 1-chloropropaan as reaktanse gebruik is, 2 punte vir die primêre alkohol.
- Condensed or semi-structural formula: Max. $\frac{4}{5}$
  Gekondenseerde of semistruktuurformule: *Maks.* $\frac{4}{5}$
- Molecular formula/*Molekulêre formule*: $\frac{2}{5}$
- Any additional reactants or products: Max. $\frac{4}{5}$
  Enige addisionele reaktanse of produkte: Maks. $\frac{4}{5}$
- If arrow in completely correct equation omitted: Max. $\frac{4}{5}$
  Indien pyltjie in volledige korrekte vergelyking uitgelaat is: *Maks.* $\frac{4}{5}$
- The product NaCℓ/KCℓ/HCℓ must be marked in conjunction with reactant NaOH/KOH/H_2O.
  Die produk NaCℓ/KCℓ/HCℓ moet in samehang met die reaktans NaOH/KOH / H_2O nagesien word.

(5)

4.5.2
- (Mild) heat/*(Matige) hitte* ✓
- <u>Dilute strong base</u>/NaOH/LiOH/KOH **OR** water/H_2O ✓
  <u>*Verdunde sterk basis/*</u>*NaOH/LiOH/KOH* ***OF*** *water/H_2O*

(2)

[15]

QUESTION 5/*VRAAG 5*

5.1.1 (Reaction) rate/*Reaksietempo* ✓ (1)

5.1.2 Surface area/state of division /particle size ✓
Reaksie-oppervlak/*toestand van verdeeldheid/deeltjie grootte* (1)

5.2.1 (Decreasing gradient indicates) rate of reaction is decreasing. ✓
(*Afnemende gradiënt dui aan dat) reaksietempo afneem.* (1)

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

5.3

$$\text{ave rate/}\textit{gem tempo} = \frac{\Delta V}{\Delta t}$$

$$= \frac{500\checkmark(-0)}{60\checkmark(-0)} = 8{,}33\ (\text{cm}^3\cdot\text{s}^{-1})\ \checkmark$$

(3)

5.4 Equal to/*Gelyk aan* ✓ (1)

5.5 Greater than/*Groter as* ✓

Experiment C/*Eksperiment C*:

- Surface area of $CaCO_3$ powder is greater than that of $CaCO_3$ granules./ More particles are exposed /More particles with correct orientation ✓
- More effective collisions per unit time/Higher frequency of effective collisions. ✓
- Increase in reaction rate.✓

- *Reaksieoppervlak van $CaCO_3$-poeier is groter (as die van $CaCO_3$-korrels /Meer deeltjies met korrekte oriëntasie.*
- *Meer effektiewe botsings per eenheid tyd./Hoër frekwensie van effektiewe botsings*
- *Toename in reaksie tempo*

OR/*OF*
Experiment A/*Eksperiment A:*

- Surface area of $CaCO_3$ granules is smaller/Fewer particles are exposed (than that of powdered $CaCO_3$). Less particles with correct orientation ✓
- Less effective collisions per unit time./Lower frequency of effective collisions. ✓
- Decrease in reaction rate.✓.

- *Reaksieoppervlak van $CaCO_3$ is kleiner/Minder deeltjies is blootgestel (as die van die verpoeierde* $CaCO_3$)./ *Minder deeltjies met korrekte oriëntasie*
- *Minder effektiewe botsings per eenheidtyd./Laer frekwensie van effektiewe botsings.*
- *Afname in reaksie tempo* (4)

5.6

Marking criteria/*Nasienriglyne:*

- Divide volume by 25,7 in / *Deel volume deur 25,7 in* $n = \frac{V}{V_M}$. ✓

  If no substitution step shown, award mark for answer: 0,0195 mol
  Indien geen vervanging stap getoon is nie, ken punt toe vit antwoord: 0,0195 mol
- Ratio/*Verhouding*: $n(CO_2) = n(CaCO_3)$. ✓
- Substitute/*Vervang* 100 in $n = \frac{m}{M}$ or in ratio / *of in verhouding*. ✓
- Final answer/*Finale antwoord:* 1,95 g to/*tot* 2 g. ✓

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$n(CO_2) = \frac{V}{V_m} = \frac{0,5}{25,7}$ ✓ $= 0,0195$ mol $n(CaCO_3) = n(CO_2) = 0,0195$ mol ✓ $m(CaCO_3) = nM$ $= 0,0195(100)$ $= 1,95$ g ✓	25,7 dm^3 ....1 mol 0,5 dm^3 ....0,0195 mol ✓ 100 g ✓...........1 mol x ....0,0195 mol ✓ $x = m(CaCO_3) = 1,95$ g ✓

OPTION 3/*OPSIE 3*

$n(CO_2) = \frac{V}{V_m} = \frac{0,5}{25,7}$ ✓
$= 0,0195$ mol
0,0195 mol CO_2 ≡ 0,856 g CO_2 ✓
$m(CO_2)$ produced : $m(CaCO_3)$
44 g : 100 g ✓
0,856 : x
x = 1,95 g ✓$CaCO_3$

(4)
[16]

QUESTION 6/*VRAAG 6*

6.1 Products can be converted back to reactants. ✓
Produkte kan omgeskakel word na reaktanse.

OR/*OF*
Both forward and reverse reactions can take place.
Beide voor-en terugwaartse reaksies kan plaasvind.

OR/*OF*
A reaction which can take place in both directions.
'n Reaksie wat in beide rigtings kan plaasvind. (1)

6.2.1 Remains the same/*Bly dieselfde* ✓ (1)

6.2.2 Increases/*Toeneem* ✓ (1)

6.3
- (When pressure is increased) the reaction that leads to the smaller amount of gas / side with less molecules/number of moles is favoured. ✓
  (Wanneer die druk verhoog word,) word die reaksie wat tot die kleiner hoeveelheid gas /minder gas molekule/aantal mol lei, bevoordeel.
- The reverse reaction is favoured. ✓
  Die terugwaartse reaksie word bevoordeel. (2)

6.4 Endothermic/*Endotermies* ✓

- K_c decreases with decrease in temperature. ✓
- Reverse reaction is favoured. / Concentration of reactants increases. / Concentration of products decreases./Yield decreases ✓
- Decrease in temperature favours an exothermic reaction. ✓

- *K_c neem af met afname in temperatuur.*
- *Terugwaartse reaksie word bevoordeel./Konsentrasie van reaktanse neem toe./Konsentrasie van produkte neem af./Opbrengs neem af*
- *Afname in temperatuur bevoordeel 'n eksotermiese reaksie.*

OR/*OF*

- K_c increases with increase in temperature. ✓
- Forward reaction is favoured. / Concentration of reactants decreases. / Concentration of products increases./Yield increases ✓
- Increase in temperature favours an endothermic reaction. ✓

- *K_c neem toename met toename in temperatuur.*
- *Voorwaartse reaksie word bevoordeel./Konsentrasie van produkte neem toe./Konsentrasie van reaktanse neem af./Opbrengs neem toe*
- *Toename in temperatuur bevoordeel 'n endotermiese reaksie* (4)

6.5

<u>CALCULATIONS USING NUMBER OF MOLES</u>
Mark allocation

- Correct K_c expression (<u>formulae in square brackets</u>). ✓
- Substitution of equilibrium concentrations into K_c expression. ✓
- Substitution of K_c value. ✓
- Multiply equilibrium concentrations of I_2 <u>and</u> I by 12,3 dm^3. ✓ (**OPTION 1**)
- Multiply equilibrium concentrations of I by 12,3 dm^3 and divide equilibrium mol of I_2 by 12,3 dm^3. ✓(**OPTION 2**)
- Change in n(I) = n(I at equilibrium). ✓
- **<u>USING</u>** ratio/***<u>GEBRUIK</u>*** *verhouding:* $I_2 : I = 1 : 2$ ✓
- Initial n(I_2) = equilibrium n(I_2) + change in n(I_2). ✓
- Substitute 254 $g{\cdot}mol^{-1}$ as molar mass for I_2.✓
- Final answer: (26 g - 27,94 g). ✓

<u>BEREKENINGE WAT AANTAL MOL GEBRUIK</u>
Puntetoekenning:

- *Korrekte K_c-uitdrukking (<u>formules in vierkanthakies</u>).*
- *Vervanging van ewewigskonsentrasies in K_c-uitdrukking.*
- *Vervanging van K_c-waarde.* ✓
- *Vermenigvuldig ewewigskonsentrasies van I_2 <u>en</u> I met 12,3 dm^3.(**OPSIE 1**)*
  *Vermenigvuldig ewewigskonsentrasies van I met 12,3 dm^3 en deel ewewigsmol I_2 met 12,3 dm^3(**OPSIE 2**)*
- *Verandering in n(I) = n(I by ewewig)*
- ***<u>GEBRUIK</u>*** *verhouding:* $I_2 : I = 1 : 2$ ✓
- *Aanvanklike n(I_2) = ewewigs n(I_2) + verandering in n(I_2).*
- *Vervang 254 $g{\cdot}mol^{-1}$ as molêre massa van I_2.*
- *Finale antwoord: (26 g – 27,94 g)*

OPTION 1/*OPSIE 1*

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

$$3{,}76 \times 10^{-3} \checkmark = \frac{(4{,}79 \times 10^{-3})^2}{[I_2]} \checkmark$$

$\therefore$ $[I_2]$ = 6,102 x 10^{-3} mol·dm^{-3}

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

	I_2	I	
Initial mass (g) *Aanvangsmassa (g)*	(0,1045)(254) ✓ = 26,543 g ✓		
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	0,1045	0	
Change (mol) *Verandering (mol)*	✓ 0,0295	0,0589 ✓	Using ratio ✓
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	0,0751	0,0589	
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	6,102 x 10^{-3}	4,79 x 10^{-3}	x12,3 ✓

OPTION 2/*OPSIE 2*

	I_2	I	
Initial amount (moles) *Aanvangshoeveelheid (mol)*	x	0	
Change in amount (moles) *Verandering in hoeveelheid* (mol)	0,0295 ✓	0,0589	ratio ✓ *verhouding*
Equilibrium amount (moles) *hoeveelheid* (mol)	x - 0,0295	0,0589 ✓	
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	$\frac{x - 0{,}0295}{12{,}3}$	4,79 x 10^{-3}	x 12,3 and divide by 12,3✓

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

$$3{,}76 \times 10^{-3} \checkmark = \frac{(4{,}79 \times 10^{-3})^2}{\frac{x - 0{,}0295}{12{,}3}} \checkmark$$

x = 0,1045 mol

$\therefore$ m = nM ✓
= (0,1045)(254)
= 26,543 g ✓

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

CALCULATIONS USING CONCENTRATION

Mark allocation

- Correct K_c expression (formulae in square brackets). ✓
- Substitution of equilibrium concentrations into K_c expression. ✓
- Substitution of K_c value ✓
- Change in n(I) = n(I at equilibrium). ✓
- **USING** ratio: $I_2 : I = 1 : 2$ ✓
- Initial $[I_2]$ = equilibrium $[I_2]$ + change in $[I_2]$. ✓
- Divide by 12,3 dm^3. ✓
- Substitute 254 $g{\cdot}mol^{-1}$ as molar mass for I_2. ✓
- Final answer 26,543 g. ✓

BEREKENINGE WAT KONSENTRASIE GEBRUIK

Puntetoekenning

- *Korrekte K_c-uitdrukking (formules in vierkanthakies).*
- *Vervanging van ewewigskonsentrasies in K_c-uitdrukking.*
- *Vervanging van K_c-waarde.*
- *Verandering in n(I) = n(I by ewewig).*
- ***GEBRUIK*** *verhouding* $I_2 : I = 1 : 2$
- *Aanvanklike* $[I_2]$ = *ewewigs* $[I_2]$ + *verandering in* $[I_2]$.
- *Deel deur 12,3 dm^3.* ✓
- *Vervang 254 $g{\cdot}mol^{-1}$ as molêre massa van I_2.*
- *Finale antwoord: 26,543 g*

OPTION 3/*OPSIE 3*

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

$$3{,}76\times10^{-3} \checkmark = \frac{(4{,}79\times10^{-3})^2}{[I_2]} \checkmark$$

$[I_2] = 6{,}102 \times 10^{-3}\ mol{\cdot}dm^{-3}$

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

	I_2	I	
Initial concentration ($mol{\cdot}dm^{-3}$) *Aanvangskonsentrasie ($mol{\cdot}dm^{-3}$)*	$8{,}497\times10^{-3}$ ✓	0	
Change ($mol{\cdot}dm^{-3}$) *Verandering* ($mol{\cdot}dm^{-3}$)	$2{,}395\times10^{-3}$	$4{,}79\times10^{-3}$ ✓	Using ratio ✓
Equilibrium concentration ($mol{\cdot}dm^{-3}$) *Ewewigskonsentrasie ($mol{\cdot}dm^{-3}$)*	$6{,}102 \times 10^{-3}$	$4{,}79 \times 10^{-3}$	

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

$$8{,}497\times10^{-3} = \frac{m}{(254)\checkmark(12{,}3)} \checkmark$$

$$\therefore m = 26{,}546\ g \checkmark$$

(9)
[18]

QUESTION 7/*VRAAG 7*

7.1.1 Weak/*Swak* ✓

Ionises/Dissociates incompletely/partially (in water) ✓
Ioniseer/Dissosieer/onvolledig/gedeeltelik (in water) (2)

7.1.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$pH = -\log[H_3O^+]$ ✓	$[H_3O^+] = 10^{-pH}$ ✓
$3{,}85$ ✓ $= -\log[H_3O^+]$	$= 10^{-3{,}85}$ ✓
$[H_3O^+] = 1{,}41 \times 10^{-4}\ mol \cdot dm^{-3}$ ✓	$= 1{,}41 \times 10^{-4}\ mol \cdot dm^{-3}$ ✓

(3)

7.1.3 Greater than/*Groter as* ✓ (1)

7.1.4 $CH_3COO^-(aq) + H_2O(\ell)$ ✓ $\rightleftharpoons$ $CH_3COOH(aq) + OH^-(aq)$ ✓

OR/*OF*

$CH_3COONa(aq) + H_2O(\ell)$ ✓ $\rightleftharpoons$ $CH_3COOH(aq) + NaOH(aq)$ ✓

Due to formation of hydroxide/OH^- / the solution is basic/alkaline /pH > 7. ✓
As gevolg van die vorming van hidroksied/OH^- is die oplossing basies/ alkalies /pH > 7 (3)

7.2.1

Marking criteria/*Nasienriglyne*

- Substitute/*vervang*: 1 x 0,0145 **OR/*OF*** 1 x 14,5 in $c = \frac{n}{V}$ / $\frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b}$. ✓
- Use/*Gebruik*: $n(CH_3COOH) : n(NaOH) = 1:1$ ✓
- Final answer/*Finale antwoord*: 0,0145 mol ✓

OPTION 1/*OPSIE 1*

$n(NaOH)_{reacted} = cV$
$= 1(0{,}0145)$ ✓
$= 0{,}0145$ mol

$n(CH_3COOH)_{diluted} = n(NaOH)$ ✓
$= 0{,}0145$mol ✓

(3)

7.2.2 **POSITIVE MARKING FROM 7.2.1./*POSITEWE NASIEN VANAF VRAAG 7.2.1.***

Marking criteria/*Nasienriglyne*

- Calculate mass/*Bereken massa* CH_3COOH in 25 cm^3 (1,13 g). ✓
- Formula/*Formule*: $n = \frac{m}{M}$. ✓
- Substitute/*Vervang*: M = 60 $g·mol^{-1}$. ✓
- $n(CH_3COOH)_{reacted/reageer} = n_{initial/begin} - n_{unreacted/nie\ reageer}$ ✓
- USE mol ratio/*GEBRUIK molverhouding*: $n(CaCO_3) : n(CH_3COOH) = 1 : 2$.✓
- Substitution of/*Vervanging van* 100 $g·mol^{-1}$ in m = nM. ✓
- Calculate percentage/*Bereken persentasie*: $\frac{0,217}{1,2} \times 100$ ✓
- Final answer/*Finale antwoord*: 18,08% ✓ (17,92 – 22,92)

$$m(CH_3COOH) = \frac{4,52}{100} \times 25 \checkmark = 1,13\ g$$

$$n(CH_3COOH)_{ini/aanv.} = \frac{m}{M} \checkmark$$

$$= \frac{1,13}{60 \checkmark} = 0,01883\ mol$$

$$n(CH_3COOH)_{rea} = 0,01883 \overset{\checkmark}{-} 0,0145 = 0,0043\ mol$$

$$n(CaCO_3) = \frac{1}{2} n(CH_3COOH)$$

$$= 0,5(0,0043) \checkmark$$

$$= 0,00217\ mol$$

$$m(CaCO_3) = nM$$

$$= 0,00217(1\overset{\checkmark}{0}0) = 0,217\ g$$

$$\% \ CaCO_3 = \frac{0,217}{1,2} \times 100 \checkmark$$

$$= 18,08\ \% \checkmark$$

(8)

[20]

QUESTION 8/*VRAAG 8*

8.1 Provides path for movement of ions./Ensures(electrical)neutrality in the cell. ✓
Verskaf pad vir beweging van ione./Verseker (elektriese) neutraliteit in die sel. (1)

8.2 (The electrode) where oxidation takes place/electrons are lost. ✓✓
(Die elektrode) waar oksidasie plaasvind/elektrone verloor word. (2)

8.3 Mg/Magnesium ✓ (1)

8.4.1 $2H^+ + 2e^- \rightarrow H_2$ ✓✓

Marking criteria/*Nasienriglyne*	
$H_2 \leftarrow 2H^+ + 2e^-$ ($\frac{2}{2}$)	$2H^+ + 2e^- \rightleftharpoons H_2$ ($\frac{1}{2}$)
$H_2 \rightleftharpoons 2H^+ + 2e^-$ ($\frac{0}{2}$)	$2H^+ + 2e \leftarrow H_2$ ($\frac{0}{2}$)
• Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.* • If charge (+) omitted on H^+/*Indien lading (+) weggelaat op* H^+*:* Example/*Voorbeeld:* $2H + 2e^- \rightarrow H_2$ ✓ Max./*Maks:* $\frac{1}{2}$	

(2)

8.4.2 Magnesium/Mg ✓ (1)

8.5

OPTION 1/*OPSIE 1*	**Notes/*Aantekeninge***
$E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ ✓ $= 0$ ✓ $- (-2{,}36)$ ✓ $E^\theta_{cell} = 2{,}36\ V$ ✓	• Accept any other correct formula from the data sheet./*Aanvaar enige ander korrekte formule vanaf gegewensblad.* • Any other formula using unconventional abbreviations, e.g. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions:/*Enige ander formule wat onkonvensionele afkortings gebruik bv. $E°_{sel} = E°_{OM} - E°_{RM}$ gevolg deur korrekte vervangings:* $\frac{3}{4}$

OPTION 2/*OPSIE 2*	
✓ $2H^+ + 2e^- \rightarrow H_2$	$E^\theta = 0\ V$ ✓
$Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$	$E^\theta = +2{,}36\ V$ ✓
$Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$	$E^\theta = +2{,}36\ V$ ✓

(4)

8.6 H_2 is a stronger reducing agent ✓ than Cu ✓ and therefore Cu^{2+}/Cu ions are reduced/H_2 is oxidised ✓ Electrons flow from H_2 to Cu.

H_2 is 'n sterker reduseermiddel as Cu en dus word Cu^{2+}/Cu-ione gereduseer/H_2 is geoksideer. Elektrone vloei vanaf H_2 na Cu. (3)

[14]

QUESTION 9/*VRAAG 9*

9.1 **ANY ONE/*ENIGE EEN:***

- The chemical process in which electrical energy is converted to chemical energy. ✓✓ **(2 or 0)**
- The use of electrical energy to produce a chemical change. **(2 or 0)**
- Decomposition of an ionic compound by means of electrical energy. **(2 or 0)**
- The process during which and electric current passes through a solution/ionic liquid/molten ionic compound. **(2 or 0)**

- *Die chemiese proses waarin elektriese energie omgeskakel word na chemiese energie.* ***(2 of 0)***
- *Die gebruik van elektriese energie om 'n chemiese verandering te weeg te bring.* ***(2 of 0)***
- *Ontbinding van 'n ioniese verbinding met behulp van elektriese energie.* ***(2 of 0)***
- *Die proses waardeur 'n elektriese stroom deur 'n oplossing/ioniese vloeistof/gesmelte ioniese verbinding beweeg.* ***(2 of 0)*** (2)

9.2 Battery/cell/ power source ✓
Battery/sel/kragbron (1)

9.3 Silver nitrate/$AgNO_3$/ Silver ethanoate/CH_3COOAg / Silver fluoride /AgF/ Silver perchlorate $AgC\ell O_4$. ✓
Silwernitraat/$AgNO_3$/ Silweretanoaat/CH_3COOAg / Silwerfloried / AgF / Silwerperchloraat / $AgC\ell O_4$ (1)

9.4 Remains the same/*Bly dieselfde* ✓

Rate of oxidation is equal to the rate of reduction. ✓
Tempo van oksidasie is gelyk aan die tempo van reduksie. (2)

9.5 $Ag \rightarrow Ag^+ + e^-$ ✓✓

Notes/*Aantekeninge*

$Ag^+ + e^- \leftarrow Ag$ (2/2)	$Ag \rightleftharpoons Ag^+ + e^-$ (1/2)
$Ag \leftarrow Ag^+ + e^-$ (0/2)	$Ag^+ + e^- \rightleftharpoons Ag$ (0/2)

- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on Ag^+/*Indien lading (+) weggelaat op* Ag^+*:*

  Example/*Voorbeeld:* $Ag \rightarrow Ag + e^-$ ✓

(2)
[8]

QUESTION 10/*VRAAG 10*

10.1.1 (Liquid) Air/*(Vloeibare)Lug* ✓ (1)

10.1.2 Natural gas/methane/oil/coal/coke✓
Aardgas/metaan/olie/steenkool/kooks (1)

10.1.3 Iron/iron oxide/Fe/FeO ✓
Yster/ysteroksied/Fe/FeO (1)

10.1.4 NH_3/Ammonia/*Ammoniak* ✓ (1)

10.1.5 Ostwald (process)/*Ostwald(proses)* ✓ (1)

10.1.6 $NH_3 + HNO_3$ ✓ $\rightarrow$ NH_4NO_3 ✓ Bal ✓

<u>Marking criteria/*Nasienriglyne*</u>		
• Reactants ✓ *Reaktanse*	Products ✓ *Produkte*	Balancing ✓ *Balansering*
• Ignore double arrows./*Ignoreer dubbelpyle.*		
• Marking rule 6.3.10./*Nasienreël 6.3.10.*		

(3)

10.2.1 NPK ratio/Ratio of primary nutrients ✓
NPK-verhouding/Verhouding van primêre voedingstowwe (1)

10.2.2

<u>OPTION 1/*OPSIE 1*</u>	**<u>OPTION 2/*OPSIE 2*</u>**
$\frac{4}{9}$ ✓ x $\frac{X}{100}$ x 20 ✓ = 2,315 kg X = 26 ✓ (26,04)	m(P) = 2,315 kg Mass of 1 part P = $\frac{2,315}{4}$ = 0,57575 Mass of N = (0,57575)(2) = 1,1575 kg Mass of K = (0,57575)(3) = 1,73625 kg Total mass of fertiliser: 1,1575 + 2,315 + 1,73625 = 5,20875 kg ✓ X = $\frac{5,20875}{20}$ x 100 ✓= 26,04 ✓

(3)
[12]

TOTAL/*TOTAAL*: 150