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)

NOVEMBER 2015

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 17 pages.
Hierdie memorandum bestaan uit 17 bladsye.

QUESTION 1/*VRAAG 1*

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

QUESTION 2/*VRAAG 2*

2.1

2.1.1 B ✓ (1)

2.1.2 $-\overset{\overset{\displaystyle O}{\|}}{C}-H$ ✓ (1)

2.1.3 C_nH_{2n-2} ✓ (1)

2.1.4 4-ethyl-5-methylhept-2-yne / 4-ethyl-5-methyl-2-heptyne

4-etiel-5-metielhept-2-yn / 4-etiel-5-metiel-2-heptyn

Marking criteria/*Nasienriglyne:*
- 4-ethyl / *4-etiel* ✓ **OR/*OF*** 4 ethyl / *4 etiel*
- 5-methyl / *5-metiel* ✓ **OR/*OF*** 5 methyl / *5 metiel*
- hept-2-yne / 2-heptyne / *hept-2-yn / 2-heptyn* ✓
  OR/*OF* hept 2 yne / 2 heptyne / *hept 2 yn / 2 heptyn*

IF/*INDIEN:*
Any error e.g. hyphens omitted and/or incorrect sequence:
Enige fout bv. koppeltekens weggelaat en/of verkeerde volgorde: Max./*Maks.* $\frac{2}{3}$ (3)

2.1.5 Butan-2-one / 2-butanone / Butanone
Butan-2-oon / 2-butanoon / Butanoon

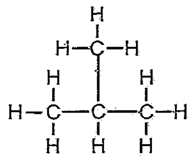
Marking criteria/*Nasienriglyne:*
- Functional group / *Funksionele groep* ✓
- Whole name correct / *Hele naam korrek* ✓ (2)

2.2
2.2.1 Alkanes / *Alkane* ✓ (1)

2.2.2 2-methylpropane ✓✓
2-metielpropaan

OR/*OF*

Methylpropane ✓✓
Metielpropaan



✓✓

Notes/*Aantekeninge:*
IF/*INDIEN:*
2 methylpropane / *2 metielpropaan* ✓ ½

IF sequence incorrect/***INDIEN*** *volgorde verkeerd:* Max./*Maks.* ½

Marking criteria structural formula:
Nasienriglyne struktuurformule:
- Three carbons in longest chain. ✓
  Drie koolstowwe in die langste ketting.
- Methyl group on second carbon.
  Metielgroep op tweede koolstof. ✓

Notes/*Aantekeninge:*
- One or more H atoms omitted:
  Een of meer H-atome uitgelaat: ½
- Condensed or semi-structural formula:
  Gekondenseerde of semi-struktuur-formule: ½

(4)

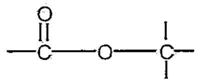
2.2.3 Chain / *Ketting* ✓ (1)

2.3
2.3.1 Haloalkanes / Alkyl halides ✓
Haloalkane / Alkielhaliede (1)

2.3.2 Substitution / halogenation / bromonation ✓
Substitusie / halogenering / halogenasie / bromonering (1)
[16]

QUESTION 3/*VRAAG 3*

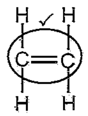
3.1
3.1.1 Esterification / Condensation ✓
Esterifikasie / Verestering / Kondensasie (1)

3.1.2  ✓ (1)

3.1.3 Propanoic acid / *Propanoësuur* ✓ (1)

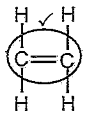
3.1.4 Dehydration / elimination ✓
Dehidrasie / dehidratering / eliminasie (1)

3.1.5 (Concentrated) H_2SO_4 / sulphuric acid / H_3PO_4 / phosphoric acid ✓
(Gekonsentreerde) H_2SO_4 / / *swaelsuur / swawelsuur* / H_3PO_4 / *fosforsuur* (1)

3.1.6  ✓

Notes/*Aantekeninge*
- Functional group: ✓
  Funksionele groep:
- Whole structure correct: ✓
  Hele struktuur korrek:

(2)

3.2
3.2.1  ✓

Notes/*Aantekeninge*
- Functional group: ✓
  Funksionele groep:
- Whole structure correct: ✓
  Hele struktuur korrek:

(2)

3.2.2 Addition / *Addisie* ✓ (1)
[10]

QUESTION 4/*VRAAG 4*

4.1 A bond/an atom or a group of atoms ✓ that determine(s) the (physical and chemical) properties of a group of organic compounds. ✓
'n Binding of 'n atoom of 'n groep atome wat die (fisiese en chemiese) eienskappe van 'n groep organiese verbindings bepaal. (2)

4.2

4.2.1 D / ethanoic acid / *etanoësuur* ✓
Lowest vapour pressure. ✓
Laagste dampdruk. (2)

4.2.2 A / butane / *butaan* ✓ (1)

4.3
- Between molecules of A / butane / alkanes are London / induced dipole / dispersion forces. ✓
  Tussen molekule van A / butaan / alkane is London / geïnduseerde dipole / dispersiekragte.
- Between molecules of B / propan-2-one / ketones are dipole-dipole forces ✓ in addition to London / induced dipole / dispersion forces.
  Tussen molekule van B / propan-2-oon / ketone is dipool-dipool-kragte tesame met London / geïnduseerde dipool /dispersiekragte.
- Intermolecular forces in A are weaker than those in B. / Less energy is needed in A to break/overcome intermolecular forces. ✓
  Intermolekulêre kragte in A is swakker as die in B./ Minder energie word by A benodig om intermolekulêre kragte te breek/oorkom.

  OR/*OF*
  Intermolecular forces in B are stronger than those in A. / More energy is needed in B to break/overcome intermolecular forces.
  Intermolekulêre kragte in B is sterker as die in A. / Meer energie word by B benodig om intermolekulêre kragte te breek/oorkom.

OR/*OF*
- Between molecules of A / butane / alkanes are weak London / induced dipole / dispersion forces.
  Tussen molekule van A / butaan/alkane is swak London / geïnduseerde dipool / dispersiekragte.
- Between molecules of B /propan-2-one / ketone are strong(er) dipole-dipole forces in addition to London/induced dipole / dispersion forces.
  Tussen molekule van B / propan-2-oon / ketone is sterk(er) dipool-dipool/dispersiekragte. (3)

4.4 London forces/dispersion forces/induced dipole forces/dipole-dipole forces. ✓
Londonkragte/dispersiekragte/geïnduseerde dipoolkragte/dipool-dipoolkragte.

OR/*OF*
A and B do not have hydrogen bonding./C and D have hydrogen bonding.
A en B het nie waterstofbinding nie./C en D het waterstofbinding. (1)

4.5 **OPTION 1/*OPSIE 1***
- D has more sites for hydrogen bonding than C / forms dimers / is more polar than C. ✓
  D het meer punte vir waterstofbinding as C / vorm dimere / is meer polêr as C.
- D has stronger / more intermolecular forces / dipole-dipole forces. ✓
  D het sterker / meer intermolekulêre kragte / dipool-dipoolkragte.

  OR/*OF*
  D needs more energy to overcome/break the intermolecular forces.
  D het meer energie nodig om die intermolekulêre kragte te oorkom/breek.

OPTION 2/*OPSIE 2*
- C has less sites for hydrogen bonding than D. / C does not form dimers / C is less polar.
  C het minder plekke vir waterstofbinding as D. / C vorm nie dimere nie / C is minder polêr.
- C has weaker / less intermolecular forces / dipole-dipole forces./ C needs less energy to overcome/break intermolecular forces / dipole-dipole forces.
  C het swakker / minder intermolekulêre kragte / dipool-dipoolkragte./ C benodig minder energie om intermolekulêre kragte / dipool-dipoolkragte te oorkom/breek. (2)

4.6 **Marking criteria/*Nasienriglyne***
- Mole ratio for $V(CO_2)$ correctly used. / *Molverhouding vir* $V(CO_2)$ *korrek gebruik.*
- Mole ratio for $V(H_2O)$ correctly used. / *Molverhouding vir* $V(H_2O)$ *korrek gebruik.*
- Mole ratio for $V(O_2$ reacted) correctly used. / *Molverhouding vir* $V(O_2$ *reageer) korrek gebruik.*
- $V(O_2$ excess/*oormaat*) = $V(O_2$ initial/*aanvanklik*) – $V(O_2$ change/*verandering*).
- $V_{tot} = 80\ cm^3$

OPTION 1/*OPSIE 1*

$V(CO_2) = 4V(C_4H_{10}) = (4)(8)$ ✓ $= 32\ cm^3$

$V(H_2O) = 5V(C_4H_{10}) = (5)(8)$ ✓ $= 40\ cm^3$

$V(O_2$ reacted/*reageer*):
$V(O_2) = \frac{13}{2}V(C_4H_{10}) = (\frac{13}{2})(8)$ ✓ $= 52\ cm^3$

$V(O_2$ excess/*oormaat*):
$V(O_2) = 60 - 52$ ✓ $= 8\ cm^3$

$V_{tot} = 32 + 40 + 8 = 80\ cm^3$ ✓

OPTION 2/*OPSIE 2*

	C_4H_{10}	O_2	CO_2	H_2O
Initial V (cm^3) *BeginV* (cm^3)	8	60	0	0
Change in V (cm^3) *Verandering* V (cm^3)	8	52 ✓	32 ✓	40 ✓
Final V (cm^3) *Finale* V (cm^3)	0	8 ✓	32	40

Total/*totale* volume = $8 + 32 + 40 = 80\ cm^3$ ✓

OPTION 3/*OPSIE 3*				
	C_4H_{10}	O_2	CO_2	H_2O
Initial V (dm^3) *Begin* V (dm^3)	0,008	0,06	0	0
Change in V (dm^3) *Verandering* V (dm^3)	0,008	0,052 ✓	0,032 ✓	0,04 ✓
Final V (dm^3) *Finale* V (dm^3)	0	0,008 ✓	0,032	0,04

Total/*totale* volume = 0,008 + 0,032 + 0,04 = 0,08 dm^3 ✓ (5)

[16]

QUESTION 5/*VRAAG 5*

5.1 Time/Tyd: (Stop) watch / *(Stop)horlosie* ✓

Volume: (Gas) syringe / Burette / Measuring cylinder / (Chemical) balance / Erlenmeyer flask / Graduated flask ✓
(Gas)spuit / Buret / Maatsilinder / (Chemiese) balans / Erlenmeyer fles / Gegradueerde fles

Notes/*Aantekeninge*
• Only one mark per type of apparatus. / *Slegs een punt per tipe apparaat.*

(2)

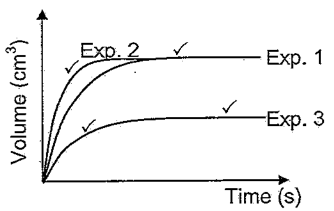
5.2

5.2.1 t_1 ✓ (1)

5.2.2 t_3 ✓ (1)

5.3 Between t_1 and t_2 ✓
Tussen t_1 en t_2 (1)

5.4



Marking criteria/*Nasienriglyne*		
Exp. 2	Initial gradient higher than that of Exp.1. *Aanvanklike gradient groter as die van Eksp 1.*	✓
	Curve reaches same constant volume as for Exp. 1 (but earlier). *Kurwe bereik dieselfde konstante volume as in Eksp 1 (maar gouer).*	✓
Exp. 3	Initial gradient lower than that of Exp.1. *Aanvanklike gradient kleiner as die van Eksp. 1.*	✓
	Curve reaches a smaller constant volume as for Exp. 1 (at a later stage). *Kurwe bereik (later) 'n kleiner konstante volume as vir Eksp. 1.*	✓

(4)

5.5.1

Marking criteria/*Nasienriglyne*
- $n(HC\ell) = (0,1)(100 \times 10^{-3})$
- Use mole ratio/*Gebruik molverhouding:* $n(Zn) = ½n(HC\ell)$
- Substitute 65 into/ Vervang 65 in $n = \frac{m}{M}$.
- $n(Zn_{final/finaal}) = n(Zn_{initial/aanvanklik}) - n(Zn_{used/gebruik})$
  $m(Zn_{final/finaal}) = m(Zn_{initial/aanvanklik}) - m(Zn_{used/gebruik})$
- Final answer/Finale antwoord: Range/*gebied*: 0,33 g – 0,48 g

OPTION/*OPSIE 1*

$n(HC\ell) = cV$
$= (0,1)(100 \times 10^{-3})$ ✓
$= 0,01$ mol

n(Zn reacted/*gereageer*):
$n(Zn) = ½n(HC\ell)$
$= ½(0,01)$ ✓
$= 5 \times 10^{-3}$ mol

n(Zn reacted/*gereageer*):
$m(Zn) = (5 \times 10^{-3})(65)$ ✓ $= 0,325$ g

$m(Zn_f) = 0,8 - 0,325$ ✓
$= 0,48$ g ✓ (0,475 g)

OPTION/*OPSIE 2*

$n(HC\ell) = cV$
$= (0,1)(100 \times 10^{-3})$ ✓
$= 0,01$ mol

n(Zn reacted/*gereageer*) $= ½n(HC\ell)$
$= ½(0,01)$ ✓
$= 5 \times 10^{-3}$ mol

$n(Zn)_i = \frac{m}{M}$
$= \frac{0,8}{65}$ ✓
$= 1,23 \times 10^{-2}$ mol

$n(Zn)_f = 1,23 \times 10^{-2} - 5 \times 10^{-3}$ ✓
$= 7,3 \times 10^{-3}$ mol

$m(Zn) = nM$
$= (7,3 \times 10^{-3})(65) = 0,47$ g ✓

(5)

5.5.2 Smaller than / *Kleiner as* ✓ (1)

[15]

QUESTION 6/*VRAAG 6*

6.1 Equal to / *Gelyk aan* ✓ (1)

6.2 $K_c = \frac{[X_3]^2}{[X_2]^3}$ ✓
$= \frac{(0,226)^2}{(0,06)^3}$ ✓ ✓
$= 236,46$ ✓

No K_c expression, correct substitution /*Geen K_c- uitdrukking, korrekte substitusie:* Max./*Maks.* $^3/_4$
Wrong K_c expression /*Verkeerde K_c-uitdrukking* Max./*Maks.* $^0/_4$
If one or more exponents are omitted in substitution step but correct answer obtained: Max $^3/_4$ *Indien een of meer eksponente uitgelaat by substitusie stap, maar korrekte antwoord verkry: Maks* $^3/_4$

(4)

6.3 (1)

6.3.1 Increases / *Vermeerder* ✓

6.3.2 -
- The increase in $[X_3]$ is opposed. / Change is opposed. ✓
  Die verhoging in $[X_3]$ word teengewerk. / Verandering word teenwerk.
- The reverse reaction is favoured. / X_3 is used / $[X_3]$ decreases. ✓
  Die terugwaartse reaksie word bevoordeel./X_3 word gebruik / $[X_3]$ neem af. (2)

6.4 Higher than / *Hoër as* ✓ (1)

6.5 Exothermic / *Eksotermies* ✓

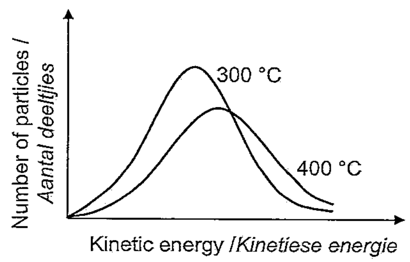
- The concentration of the product/$X_3(g)$ is lower / the concentration of the reactant / $X_2(g)$ is higher. ✓
  Die konsentrasie van die produkte/$X_3(g)$ is laer / die konsentrasie van die reaktans / $X_2(g)$ is hoër.
- The increase in temperature favoured the reverse reaction. ✓
  Die toename in temperatuur het die terugwaartse reaksie bevoordeel.
- According to Le Chatelier's principle an increase in temperature favours the endothermic reaction. ✓
  Volgens Le Chatelier se beginsel bevoordeel 'n toename in temperatuur die endotermiese reaksie.

OR/*OF*

Exothermic / *Eksotermies* ✓

- $[X_3]$ decreases and $[X_2]$ increases. / *$[X_3]$ neem af en $[X_2]$ neem toe.* ✓
- K_c decreases if temperature increases./*K_c neem af as die temperatuur afneem.* ✓
- Decrease in temperature favoured the forward reaction. / *Verlaging in temperatuur het die voorwaartse reaksie bevoordeel.* ✓ (4)

6.6



Marking criteria/*Nasienriglyne*	
Peak of curve at 400 °C lower than at 300 °C and shifted to the right. *Piek van kurwe by* 400 °C *laer as by* 300 °C *en skuif na regs.*	✓
Curve at 400 °C has larger area at the higher E_k. *Kurwe by 400 °C het groter oppervlak by hoë E_k.*	✓

(2)
[15]

QUESTION 7/VRAAG 7

7.1
7.1.1 Hydrolysis / *Hidrolise* ✓ (1)

7.1.2 Acidic / *Suur* ✓

Forms H_3O^+ ions during hydrolysis./*Vorm H_3O^+ ione gedurende hidrolise.* ✓

OR/*OF*
Salt of strong acid and weak base./*Sout van sterk suur en swak basis.*

OR/*OF*
(NH_4^+) acts as proton donor. / *(NH_4^+) tree op as 'n protonskenker.* (2)

7.2
7.2.1 $n = cV$ ✓
$= (0{,}1)(0{,}1)$ ✓
$= 0{,}01$ mol ✓ (3)

7.2.2 **POSITIVE MARKING FROM QUESTION 7.2.1.**
POSITIEWE NASIEN VAN VRAAG 7.2.1.

Marking criteria/*Nasienriglyne*

- Substitute volume and concentration to calculate n(HCℓ) ✓
  Vervang volume en konsentrasie om n(HCℓ) te bereken.
- Use mole ratio/*Gebruik molverhouding:* n(NaOH) = n(HCℓ) = 1:1 ✓
- n(NaOH) x 4 **OR/*OF*** V(HCℓ) x 4 **OR/*OF*** n(HCℓ) x 4 ✓
- Subtraction/*Aftrekking:* $n(NaOH_{initial/aanvanklik})$ - $n(NaOH_{excess/oormaat})$ ✓
- Use mole ratio/*Gebruik molverhouding:* n(NaOH) = $n(NH_4Cℓ)$ = 1:1 ✓
- Substitute/*Vervang* 53,5 g·mol^{-1} in $n = \frac{m}{M}$. ✓
- Percentage calculation/*Persentasieberekening* ✓
- Final answer/*Finale antwoord:* 0,11 g - 0,21 g ✓

OPTION 1/*OPSIE 1*

$n(HC\ell) = c_aV_a = (0,11)(14,55 \times 10^{-3})$ ✓ $= 1,6 \times 10^{-3}$ mol

$n(NaOH) = n(HC\ell) = 1,6 \times 10^{-3}$ mol ✓

n(NaOH excess/*oormaat*) in 100 cm^3 $= 1,6 \times 10^{-3} \times 4$ ✓
$= 6,4 \times 10^{-3}$ mol

n(NaOH reacted/*gereageer*) $= 0,01 - 6,4 \times 10^{-3}$ ✓
$= 3,6 \times 10^{-3}$ mol

$n(NH_4C\ell) = n(NaOH) = 3,6 \times 10^{-3}$ mol ✓ (0,003598 mol)

$m(NH_4C\ell) = nM$ $= (3,6 \times 10^{-3})(53,5)$✓ $= 0,193$ g 92% : 0,193 g 100% : x $\therefore x = \frac{0,193 \times 100}{92}$ ✓ $= 0,21$ g ✓	$n(NH_4C\ell) = 0,92 \frac{x}{53,5}$ ✓✓ $\therefore 3,6 \times 10^{-3} = 0,92 \frac{x}{53,5}$ $\therefore x = 0,21$ g ✓	$n(NH_4C\ell) = \frac{m}{53,5}$✓ $\therefore 3,6 \times 10^{-3} = \frac{m}{53,5}$ $n(NH_4C\ell) = 0,192$ g m(fertiliser/*kunsmis*): $m = \frac{0,192 \times 100}{92}$ ✓ $= 0,21$ g ✓

OPTION 2/*OPSIE 2*	OPTION 3/*OPSIE 3*
$V(HC\ell)$ to neutralise 100 cm^3 NaOH: *$V(HC\ell)$ neutraliseer* 100 cm^3 *NaOH:* $V(HC\ell) = 14,55 \times 4$ ✓ $= 58,2$ cm^3 $n(HC\ell) = cV$ $= (0,11)(0,0582)$ ✓ $= 0,006402$ mol $n(NaOH) = n(HC\ell)$ $= 0,006402$ mol ✓ n(NaOH reacted/*gereageer*): $n(NaOH) = 0,01 - 0,006402$ ✓ $= 0,003598$ mol $n(NH_4C\ell) = n(NaOH)$ $= 0,003598$ mol ✓ $m(NH_4C\ell) = nM$ $= (0,003598)(53,5)$ ✓ $= 0,192$ g 92% : 0,192 g 100% : $\frac{0,192 \times 100}{92}$ ✓$= 0,21$ g ✓	$n(HC\ell)$ to neutralise 100 cm^3 NaOH: *$n(HC\ell)$ neutraliseer* 100 cm^3 *NaOH:* $n(HC\ell) = cV$ $= (0,11)(0,01455 \times 4$✓) ✓ $= 0,006402$ mol ($6,4 \times 10^{-3}$ mol) n(NaOH excess/*oormaat*): $n(NaOH) = n(HC\ell) = 6,4 \times 10^{-3}$ mol ✓ n(NaOH reacted/*gereageer*): $n(NaOH) = 0,01 - 0,006402$ ✓ $= 0,003598$ mol $n(NH_4C\ell) = n(NaOH)$ $= 0,003598$ mol ✓ $m(NH_4C\ell) = nM$ $= (0,003598)(53,5)$ ✓ $= 0,192$ g 92% : 0,192 g 100% : $0,192 \times \frac{100}{92}$ ✓ $= 0,21$ g ✓

OPTION 4/*OPSIE 4*	OPTION 5/*OPSIE 5*
$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b} \therefore \frac{0,11 \times 14,55}{c_b \times 25}$ ✓ $= \frac{1}{1}$ ✓ $c_b = 0,064$ mol·dm^{-3} n(NaOH in excess in 100 cm^3): *n(NaOH in oormaat in 100 cm^3):* $n(NaOH) = cV$ $= (0,064)(0,1)$ ✓ $= 6,4 \times 10^{-3}$ mol n(NaOH reacted/*gereageer*): $n(NaOH) = 0,01 - 0,006402$ ✓ $= 0,003598$ mol $n(NH_4C\ell) = n(NaOH)$ $= 0,003598$ mol ✓ $m(NH_4C\ell) = nM$ $= (0,003598)(53,5)$ ✓ $= 0,192$ g 92% : 0,192 g 100% : $0,192 \times \frac{100}{92}$ ✓ $= 0,21$ g ✓	$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b} \therefore \frac{0,11 \times 14,55}{c_b \times 25}$ ✓ $= \frac{1}{1}$ ✓ $\therefore c_b = 0,064$ mol·dm^{-3} $\Delta c(NaOH) = 0,1 - 0,064$ ✓✓ $= 0,036$ mol·dm^{-3} n(NaOH reacted/*gereageer*): $n(NaOH) = cV$ $= 0,036 \times 0,1$ $= 0,0036$ mol $n(NH_4C\ell) = n(NaOH) = 0,0036$ mol ✓ $n = \frac{m}{M}$ $\therefore 0,0036 = \frac{\frac{92}{100}x}{53,5}$✓ ✓ $0,0036(53,5) = 0,92x$ $x = 0,21$ g ✓

(8)

7.3

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
$[OH^-] = [NaOH] = 0,5$ mol·dm^{-3} $K_w = [H_3O^+][OH^-]$ $1 \times 10^{-14} = [H_3O^+]0,5$ ✓ $\therefore [H_3O^+] = 2 \times 10^{-14}$ mol·dm^{-3} $pH = -\log[H^+]$ ✓ $= -\log(2 \times 10^{-14})$ ✓ $= 13,7$ ✓	$pOH = -\log[OH^-]$ ✓ $= -\log(0,5)$ ✓ $= 0,301$ $pH + pOH = 14$ $pH = 14 - 0,301$ ✓ $= 13,7$ ✓ (13,699)

Notes/*Aantekeninge*
IF/*INDIEN:*
Wrong formula/*Verkeerde formule*: $pH = -\log[OH^-]$; $pOH = -\log[NaOH]$
No marks for substitution and answer./*Geen punte vir vervanging en antwoord.*

(4)
[18]

QUESTION 8/*VRAAG 8*

8.1 Temperature/*Temperatuur*: 25 °C / 298 K ✓

Pressure/*Druk*: 101,3 kPa / 1,013 x 10^5 Pa / 1 atm / 100 kPa ✓

Concentration/*Konsentrasie*: 1 mol·dm^{-3} ✓ (3)

8.2

8.2.1 Cd(s) / Cadmium / *Kadmium* / Cd|Cd^{2+} / Cd^{2+}|Cd ✓

Notes/*Aantekeninge*
Ignore phases. / *Ignoreer fases.*

(1)

8.2.2 $E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ ✓

$0{,}13 = E^\theta_{cathode} - (-0{,}40)$ ✓ ✓

$E^\theta_{cathode} = 0{,}13 - 0{,}40$

$= -0{,}27$ (V) ✓

Q is Ni/nickel/*nikkel* ✓

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. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions: / *Enige ander formule wat onkonvensionele afkortings gebruik bv. $E°_{sel} = E°_{OM} - E°_{RM}$ gevolg deur korrekte vervangings:* $\frac{4}{5}$

(5)

8.3

8.3.1 Cd(s) → Cd^{2+}(aq) + $2e^-$ ✓✓

Ignore phases. / *Ignoreer fases.*

Notes/*Aantekeninge*			
$Cd^{2+} + 2e^- \leftarrow Cd$	$\left(\frac{2}{2}\right)$	$Cd \rightleftharpoons Cd^{2+} + 2e^-$	$\left(\frac{1}{2}\right)$
$Cd \leftarrow Cd^{2+} + 2e^-$	$\left(\frac{0}{2}\right)$	$Cd^{2+} + 2e^- \rightleftharpoons Cd$	$\left(\frac{0}{2}\right)$

(2)

8.3.2 Pt/Platinum ✓ (1)

8.4 **OPTION 1/*OPSIE 1***

Compare/*Vergelyk* **Q^{2+} & Cd^{2+}**	**Q^{2+}** is reduced / **Cd** is oxidised and therefore **Q^{2+}** is a stronger oxidising agent than **Cd^{2+}**. ***Q^{2+}** word gereduseer / **Cd** word geoksideer, en dus is **Q^{2+}** 'n sterker oksideermiddel as **Cd^{2+}**.*	✓
Compare/*Vergelyk* **R_2 & Cd^{2+}**	**R_2** *is reduced* / *Cd* is oxidised and therefore R_2 is a stronger oxidising agent than Cd^{2+}. ✓ ***R_2** word gereduseer / **Cd** word geoksideer, dus is **R_2** 'n sterker oksideermiddel as **Cd^{2+}**.*	✓
Compare/*Vergelyk* **R_2 & Q^{2+}**	The cell potential of combination **II** is higher than that of combination **I**, therefore R_2 is a stronger oxidising agent than Q^{2+}. *Die selpotensiaal van kombinasie **II** is hoër as dié van kombinasie **I** en dus is **R_2** 'n sterker oksideermiddel as Q^{2+}.*	✓
Final answer/ *Finale antwoord*	Cd^{2+}; Q^{2+};R_2 **OR/*OF*** Cd^{2+} ; Ni^{2+} ; Cl_2	✓

OPTION 2/*OPSIE 2*

- The reduction potential of Cl^-|Cl_2 = 1,36 V ✓ because the cell potential of combination II is 1,76 V and the reduction potential of Cd|Cd^{2+} is 0,4 V. *Die reduksiepotensiaal van Cl^-/Cl_2 = 1.36 V omdat die selpotensiaal van kombinasie II 1,76 V is en die reduksiepotensiaal van Cd/Cd^{2+} 0,4 V is.*

  OR/*OF*

  R_2 is Cl_2 because the cell potential of combination II is 1,76 V and the reduction potential of Cd|Cd^{2+} is 0,4 V./ *R_2 is Cl_2 omdat die selpotensiaal van kombinasie II 1,76 V is en die reduksiepotensiaal van Cd/Cd^{2+} 0,4 V is.*

- Cd|Cd^{2+} has the lowest reduction potential (-0,4 V) and therefore Cd^{2+} is the weakest oxidising agent. / Cd|Cd^{2+} *het die laagste reduksiepotensiaal (0,4 V) en dus is Cd^{2+} die swakste oksideermiddel.* ✓

- Cl^-|Cl_2 has the highest reduction potential and therefore Cl_2 is the strongest oxidising agent. / Cl^-|Cl_2 *het die hoogste reduksiepotensiaal en dus is Cl_2 die sterkste oksideermiddel.* ✓

- Final answer/*Finale antwoord*: Cd^{2+}; Q^{2+};R_2 ✓ **OR/*OF*** Cd^{2+} ; Ni^{2+} ; Cl_2 (4)

[16]

QUESTION 9/*VRAAG 9*

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

- The chemical process in which electrical energy is converted to chemical energy. ✓✓
  Die chemiese proses waarin elektriese energie omgeskakel word na chemiese energie.
- The use of electrical energy to produce a chemical change.
  Die gebruik van elektriese energie om 'n chemiese verandering te weeg te bring.
- Decomposition of an ionic compound by means of electrical energy.
  Ontbinding van 'n ioniese verbinding met behulp van elektriese energie.
- The process during which and electric current passes through a solution/ionic liquid/molten ionic compound.
  Die proses waardeur 'n elektriese stroom deur 'n oplossing/ioniese vloeistof/gesmelte ioniese verbinding beweeg. (2)

9.2 **ANY ONE/*ENIGE EEN:***

- To keep the polarity of the electrodes the same. ✓
  Om die polariteit van die elektrodes dieselfde te hou.
- To prevent the anode and cathode from swopping.
  Om te verhoed dat die anode en katode omruil.
- DC provides a one way flow of electrons ensuring that the same chemical reaction occurs all the time at the electrodes.
  GS verskaf 'n eenrigting vloei van elektrone en verseker dat dieselfde chemiese reaksie altyd by die elektrodes plaasvind.
- If you use AC the polarity of the electrodes will keep changing.
  Wanneer jy WS gebruik word hou die polariteit van die elektrodes aan om te verander.
- Pure copper deposited on only one electrode.
  Suiwer koper slaan slegs op een elektrode neer. (1)

9.3 $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ ✓✓
Ignore phases. / *Ignoreer fases.*

Notes/*Aantekeninge*			
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	$(\frac{1}{2})$	$Cu \leftarrow Cu^{2+} + 2e^-$	$(\frac{2}{2})$
$Cu \rightleftharpoons Cu^{2+} + 2e^-$	$(\frac{0}{2})$	$Cu^{2+} + 2e^- \leftarrow Cu$	$(\frac{0}{2})$

(2)

9.4
- Cu^{2+} is a stronger oxidising agent ✓ than Zn^{2+}. ✓
  Cu^{2+} is 'n sterker oksideermiddel as Zn^{2+}.
- Cu^{2+} will be reduced to Cu. / *Cu^{2+} sal gereduseer word na Cu.* ✓

OR/*OF*
- Zn is a stronger reducing agent than Cu.
  Zn is 'n sterker reduseermiddel as Cu.
- Cu^{2+} will be reduced to Cu. / *Cu^{2+} sal gereduseer word na Cu.*

OR/*OF*
- The standard reduction potential of $Cu^{2+}|Cu$ is higher than that of $Zn^{2+}|Zn$.
  Die standaard reduksie potensiaal van $Cu^{2+}|Cu$ is hoër as die van $Zn^{2+}|Zn$.
- Cu^{2+} will be reduced to Cu. / *Cu^{2+} sal gereduseer word na Cu.*

OR/*OF*
- The standard reduction potential of $Zn^{2+}|Zn$ is lower than that of $Cu^{2+}|Cu$.
  Die standaard reduksie potensiaal van $Zn^{2+}|Zn$ is laer as die van $Cu^{2+}|Cu$.
- Cu^{2+} will be reduced to Cu. / *Cu^{2+} sal gereduseer word na Cu.* (3)

9.5

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

$$2{,}85 \times 10^{-2} ✓ = \frac{m}{63{,}5 ✓}$$

$$m = 1{,}81\ g$$

$$\%\ purity = \frac{1{,}81}{2} \times 100 ✓$$

$$= 90{,}49\ \%\ ✓$$

Marking guidelines/*Nasienriglyne*
- Substitute 63,5 ✓and $2{,}85 \times 10^{-2}$ ✓ in $n = \frac{m}{M}$
  Vervang 63,5 en $2{,}85 \times 10^{-2}$ in $n = \frac{m}{M}$
- Percentage purity. ✓
  Persentasie suiwerheid.
- Final answer/*Finale antwoord:*
  90,49% ✓ (Accept/*Aanvaar: 90,5%*)

(4)

[12]

QUESTION 10/*VRAAG 10*

10.1

10.1.1 Haber (process) / *Haber(proses)* ✓ (1)

10.1.2 $N_2 + 3H_2$ ✓ $\rightleftharpoons 2NH_3$ ✓ bal ✓

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

(3)

10.1.3 Air / *Lug* ✓ (1)

10.2

10.2.1 40% ✓ (1)

10.2.2
- High yield / percentage ✓
  Hoë opbrengs / persentasie
- High rate due to higher concentration. ✓
  Hoë tempo weens hoër konsentrasie.

(2)

10.2.3 Low reaction rate / *Lae reaksietempo* ✓ (1)

10.3

Marking guidelines/*Nasienriglyne*	
$\frac{28}{80}$ ✓ $\times 50$ ✓ 17,5 kg ✓	
OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
% N in $NH_4NO_3 = \frac{28}{80}$ ✓ $\times 100$ $= 35\%$ m(N) in 50 kg: $\frac{35}{100} \times 50$ ✓ = 17,5 kg ✓	m(N in NH_4NO_3) = $\frac{28}{80}$ ✓ x 50 ✓ = 17,5 kg ✓

(3)

TOTAL/*TOTAAL*: 150