basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

FEBRUARY/MARCH/*FEBRUARIE/MAART* 2016

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 16 pages.
Hierdie memorandum bestaan uit 16 bladsye.

QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 B ✓✓ (2)

1.3 A ✓✓ (2)

1.4 B ✓✓ (2)

1.5 D ✓✓ (2)

1.6 B ✓✓ (2)

1.7 C ✓✓ (2)

1.8 D ✓✓ (2)

1.9 A ✓✓ (2)

1.10 C ✓✓ (2)

[20]

QUESTION 2/*VRAAG 2*

2.1

2.1.1 Ketones/*ketone* ✓ (1)

2.1.2 3,5-dichloro✓-4-methyl✓octane ✓
3,5-dichloor-4-metieloktaan OF 3,5-dichloro-4-metieloktaan

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

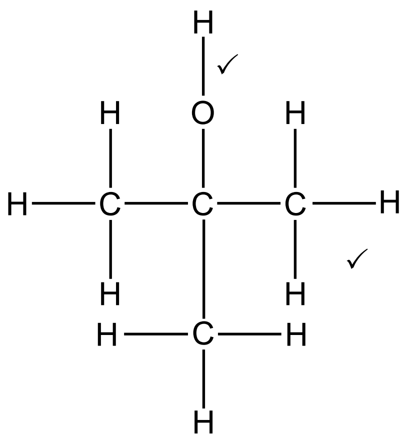
IF/*INDIEN*:

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

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

(3)

2.1.3



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

(2)

2.2

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

2.2.2 Water/H_2O ✓ (1)

2.2.3 mol C : mol H : mol O

$\frac{40}{12}$ ✓ : $\frac{6,67}{1}$ ✓ : $\frac{53,33}{16}$ ✓

3,33 : 6,67 : 3,33
1 : 2 : 1 ✓

Empirical formula/*Empiriese formule*:
CH_2O ✓

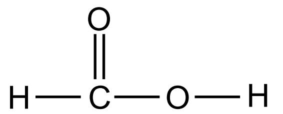
Marking criteria/*Nasienriglyne*:
- % divide by M(C). ✓
  % gedeel deur M(C).
- % divide by M(H). ✓
  % gedeel deur M(H).
- % divide by M(O). ✓
  % gedeel deur M(O).
- Simplest mole ratio. ✓
  Eenvoudigste molverhouding.
- CH_2O ✓

(5)

2.2.4 $M(CH_2O) = 30\ g\cdot mol^{-1}$ ✓
Formula-units/*Formule-eenhede:*
$\frac{60}{30} = 2$ ✓
Molecular formula/*Molekulêre formule:* $C_2H_4O_2$ ✓

Marking criteria/*Nasienriglyne*:
- 30 ($g\cdot mol^{-1}$) ✓
- Formula-units = 2 ✓
  Formule-eenhede = 2
- $C_2H_4O_2$ ✓

(3)

2.2.5  ✓

Notes/*Aantekeninge:*
- Accept –OH as condensed.
  Aanvaar –OH as gekondenseerd.

(1)

2.2.6 Methyl ✓ methanoate ✓ (2)
Metielmetanoaat **[19]**

QUESTION 3/*VRAAG 3*

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

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

Notes/*Aantekeninge*: **IF/*INDIEN*** Boiling point is directly proportional to strength of intermolecular forces: *Kookpunt direk eweredig aan sterkte van intermolekulêre kragte:* $^0/_1$

(1)

3.3

3.3.1
- In **A**/propane/alkanes: London forces/dispersion forces/induced dipole forces ✓
  *In **A**/propaan/alkane: Londonkragte/dispersiekragte/geïnduseerde dipoolkragte*
- In **B**/ propan-2-one/ketones: dipole-dipole forces ✓ in addition to London forces/dispersion forces/induced dipole forces
  *In **B**/propan-2-oon/ketone: dipool-dipoolkragte tesame met Londonkragte/ dispersiekragte/geïnduseerde dipoolkragte*
- Intermolecular forces in **A** are weaker ✓than in **B**./Intermolecular forces in **B** are stronger ✓ than in **A**./London forces are weaker than dipole-dipole forces.
  *Intermolekulêre kragte in **A** swakker as in **B**./Intermolekulêre kragte in **B** sterker as in **A**./Londonkragte is swakker as dipool-dipoolkragte.* (3)

3.3.2
- Both **C** and **D**: hydrogen bonding ✓
  *Beide **C** en **D**: waterstofbinding*
- **D** has two/more sites for hydrogen bonding./**D** forms dimers./**D** is more polar./**C** has one/less sites for hydrogen bonding. ✓
  ***D** het twee/meer plekke vir waterstofbinding./**D** vorm dimere./**D** is meer polêr./**C** het een/minder plekke vir waterstofbinding.*
- **D** has stronger intermolecular forces than **C**./**C** has weaker intermolecular forces than **D**. ✓
  ***D** het sterker intermolekulêre kragte as **C**./**C** het swakker intermolekulêre kragte as **D**.* (3)

3.4 Liquid/*Vloeistof* ✓ (1)

[10]

QUESTION 4/*VRAAG 4*

4.1

4.1.1 Addition/*Addisie* ✓ (1)

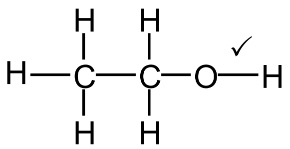
4.1.2 Polyethene/polythene/polyethelene ✓
Polieteen/politeen/polietileen (1)

4.2.

4.2.1 Chloro✓ethane✓
Chloroetaan/chlooretaan (2)

4.2.2 Hydrohalogenation/hydrochlorination ✓
Hidrohalogenering/hidrochloronering (1)

4.3

4.3.1  ✓

Notes/*Aantekeninge:*

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

(2)

4.3.2 HCℓ/hydrogen chloride/*waterstofchloried* ✓ (1)

4.4

4.4.1 Saturated/*Versadig* ✓

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

4.4.2 H_2/hydrogen (gas)/*waterstof(gas)* ✓ (1)

4.4.3 $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

Notes/*Aantekeninge*

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

(3)

[14]

QUESTION 5/*VRAAG 5*

5.1 **ONLY ANY TWO OF/*SLEGS ENIGE TWEE VAN*:**
- Increase temperature./*Verhoog die temperatuur.* ✓
- Increase concentration of acid./*Verhoog die konsentrasie van die suur.* ✓
- Add a catalyst./ *Voeg 'n katalisator by.* (2)

5.2 **ONLY ANY ONE OF/*SLEGS ENIGE EEN VAN*:**
- Change in concentration of products/reactants ✓ per (unit) time. ✓
  Verandering in konsentrasie van produkte/reaktanse per (eenheids)tyd.
- Rate of change in concentration. ✓✓
  Tempo van verandering in konsentrasie.
- Change in amount/number of moles/volume/mass of products or reactants per (unit) time.
  Verandering in hoeveelheid/getal mol/volume/massa van produkte of reaktanse per (eenheids)tyd.
- Amount/number of moles/volume/mass of products formed or reactants used per (unit) time.
  Hoeveelheid/getal mol/volume/massa van produkte gevorm of reaktanse gebruik per (eenheids)tyd. (2)

5.3

5.3.1

$$\text{average rate / } \textit{gemiddelde tempo} = -\frac{\Delta c}{\Delta t}$$

$$= -\frac{(1{,}45 - 1{,}90)\ ✓}{(15 - 0)\ ✓}$$

$$= 0{,}03\ (\text{mol}\cdot\text{dm}^{-3})\cdot\text{min}^{-1}\ ✓$$

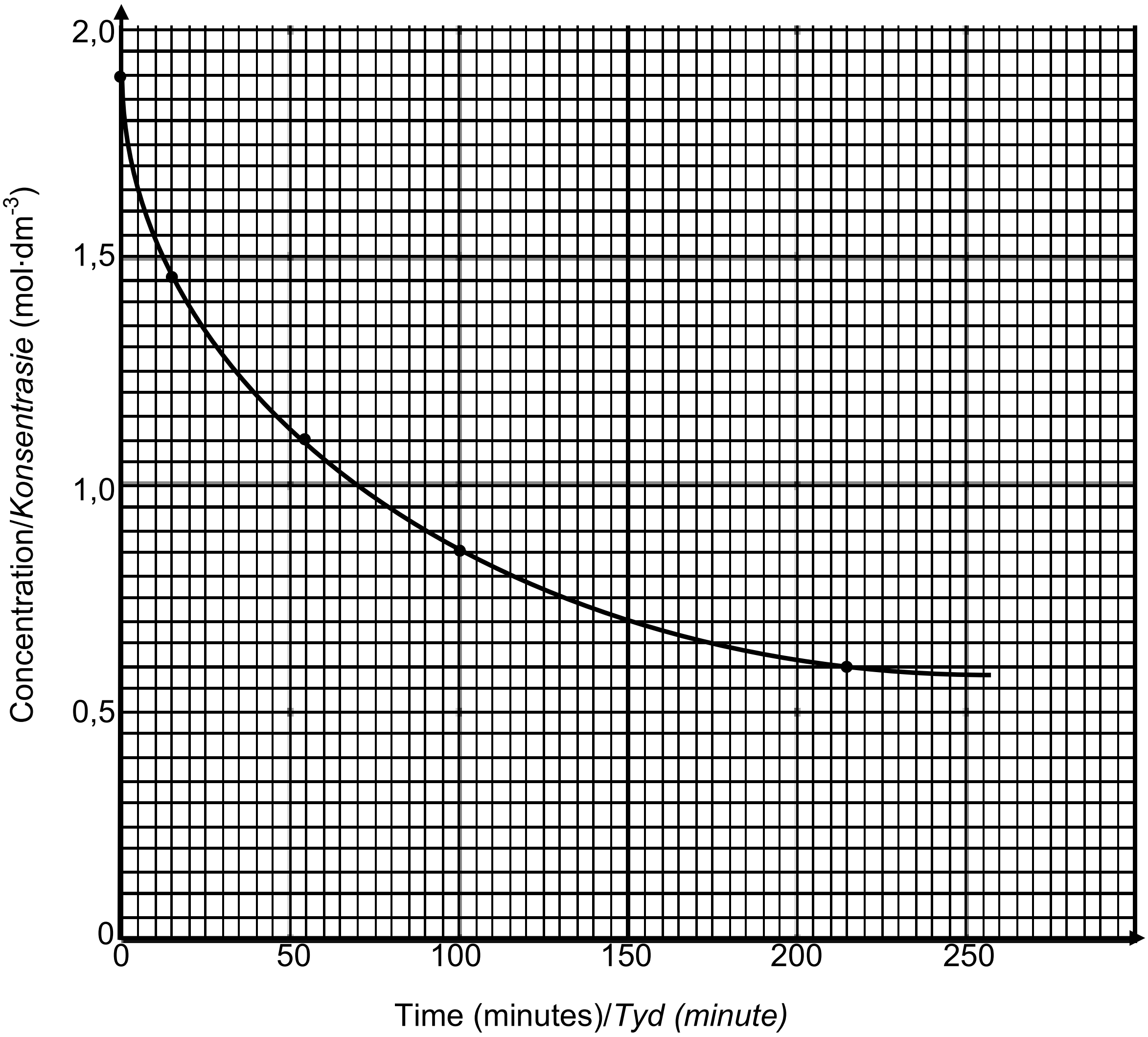
Notes/*Aantekeninge*
Accept /*Aanvaar:*
- If unit omitted/*Indien eenheid weggelaat is.*
- Rate/Tempo = $\frac{\Delta c}{\Delta t}$

$$= \frac{1{,}45 - 1{,}90}{15 - 0}$$

$$= -0{,}03\ (\text{mol}\cdot\text{dm}^{-3})\cdot\text{min}^{-1}$$

(3)

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



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

(3)

5.3.3 **POSITIVE MARKING FROM QUESTION 5.3.2.**
POSITIEWE NASIEN VANAF VRAAG 5.3.2.
1,2 mol·dm^{-3} ✓
Accept range/*Aanvaar gebied*: 1,15 to/*tot* 1,25 mol·dm^{-3} (1)

5.3.4
- Concentration of reactants decreases. ✓
  Konsentrasie van reaktanse neem af.
- Less particles per unit volume. ✓
  Minder deeltjies per volume.
- Less effective collisions per unit time. ✓
  Minder effektiewe botsings per eenheidstyd. (3)

5.3.5

Marking criteria/*Nasienriglyne*

- Use n = cV to calculate Δn/n(initial) & n(final).
  Gebruik n = cV *om* Δn/n(*aanvanklik*) & n(*finaal*) *te bereken*.
- Δn (HCℓ = n(final/*finaal*) – n(initial/*aanvanklik*).
  OR/*OF*
  Δc(HCℓ) = c(final/*finaal*) – c(initial/*aanvanklik*)
- Use ratio/*Gebruik verhouding* $n(CH_3C\ell) : n(HC\ell) = 1 : 1$
- Substitute/*Vervang* 50,5 g·mol^{-1} in $n = \frac{m}{M}$.
- Final answer/*Finale antwoord:* 3,54–4,0 g.

OPTION 1/*OPSIE 1*

Mol initially/*begin*:
n(HCℓ) = cV ✓
= (1,9)(60 x 10^{-3}) ✓
= 0,11 mol (0,114)
Mol final/*finaal*:
n(HCℓ) = cV
= (0,6)(60 x 10^{-3})
= 0,04 mol (0,036)

Δn(HCℓ) = 0,04 – 0,011 ✓
= - 0,07 mol (0,078 mol)
Δn(HCℓ) = 0,07 mol (0,078)

n(formed/*gevorm*) =n(reacted/*reageer)*
$n(CH_3C\ell)$ = n(HCℓ) ✓
= 0,07 mol

$m(CH_3C\ell)$ = nM
= (0,07)(50,5) ✓
= 3,54 g ✓
Accept range/*Aanvaar gebied*:
3,54 – 4,0 g

OPTION 2/*OPSIE 2*

Δc(HCℓ) = 0,6 – 1,9 ✓
= -1,3
= 1,3 mol·dm^{-3}

Δn(HCℓ) = ΔcV
= (1,3)(60 x 10^{-3}) ✓
= 0,08 mol (0,078)

n(formed/*gevorm*) = n(reacted/*reageer)*
$n(CH_3C\ell)$ = n(HCℓ) ✓
= 0,08 mol

$m(CH_3C\ell)$ = nM
= (0,08)(50,5) ✓
= 4 g ✓

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

(5)
[19]

QUESTION 6/*VRAAG 6*

6.1

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$c = \frac{m}{MV}$ ✓ $= \frac{2,2}{(44)(5)}$ ✓ ✓ $= 0,01\ mol \cdot dm^{-3}$ ✓	$n = \frac{m}{M}$ $= \frac{2,2}{44}$ ✓ $= 0,05\ mol$ $c = \frac{n}{V}$ ✓Both formulae/ *albei formules* $= \frac{0,05}{5}$ ✓ $= 0,01\ mol \cdot dm^{-3}$ ✓

(4)

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

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

OR/*OF*
If only CO_2 is present, the reverse reaction cannot take place.
Indien slegs CO_2 teenwoordig is, kan die terugwaartse reaksie nie plaasvind nie. (1)

6.3 CO_2 is a gas and will escape if the container is not sealed. ✓
CO_2 *is 'n gas en sal ontsnap as die houer nie geseël is nie.* (1)

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

Marking guidelines/*Nasienriglyne*

- K_c expression/*K_c-uitdrukking* ✓
- Substitute K_c value./*Vervang K_c-waarde.* ✓
- $n(CO_2)$ or $m(CO_2)$ at equilibrium/*$n(CO_2)$ of $m(CO_2)$ by ewewig.* ✓
- Change in $n(CO_2)$ or $m(CO_2)$/*Verandering in $n(CO_2)$ of $m(CO_2)$* ✓
- Mol ratio/*Molverhouding:* $n(CaCO_3) : n(CO_2) = 1 : 1$ ✓
- $n(CaCO_3)$ x 100 ✓
- Final answer/*Finale antwoord*: 0,4 g ✓

OPTION 1/*OPSIE 1*
POSITIVE MARKING FROM QUESTION 6.2.
POSITIEWE NASIEN VANAF VRAAG 6.2.

$K_c = [CO_2]$ ✓
$= 0,0108$
$\therefore [CO_2] = 0,0108\ (mol{\cdot}dm^{-3})$ ✓

$n(CO_2$ at equilibrium/*by ewewig*$) = cV$
$= (0,0108)(5)$ ✓
$= 0,054$ mol

$n(CO_2$ formed/*gevorm*$) = n(CO_2$ at equilibrium/by *ewewig*$) - n(CO_2$initially/*begin*$)$
$= 0,054 – 0,05$ ✓
$= 0,004$ mol

$n(CaCO_3) = n(CO_2$ formed$) = 0,004$ mol ✓

$m(CaCO_3) = nM$
$= (0,004)(100)$ ✓
$= 0,4$ g ✓

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM QUESTION 6.2.
POSITIEWE NASIEN VANAF VRAAG 6.2.

$K_c = [CO_2]$ ✓
$= 0,0108$ ✓
$\therefore [CO_2] = 0,0108\ (mol{\cdot}dm^{-3})$

	$CaCO_3$	CaO	CO_2	
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	0	0	0,05	
Change (mol) *Verandering (mol)*	0,004	x	0,004 ✓	✓Ratio/ *Verhouding*
Quantity at equilibrium (mol) *Hoeveelheid by ewewig (mol)*			0,054 ✓	
Equilibrium concentration ($mol{\cdot}dm^{-3}$) *Ewewigskonsentrasie ($mol{\cdot}dm^{-3}$)*			0,0108	

$m(CaCO) = nM$
$= (0,004)(100)$ ✓
$= 0,4$ g ✓

OPTION 3/*OPSIE3*
POSITIVE MARKING FROM QUESTION 6.2.
POSITIEWE NASIEN VANAF VRAAG 6.2.

	$CaCO_3$	CaO	CO_2	
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	0	0	0,05	
Change (mol) *Verandering (mol)*	x	x	x ✓	✓Ratio/ *Verhouding*
Quantity at equilibrium (mol) *Hoeveelheid by ewewig (mol)*			0,05 + x ✓	
Equilibrium concentration ($mol\cdot dm^{-3}$) *Ewewigskonsentrasie ($mol\cdot dm^{-3}$)*			$\frac{0,05 + x}{5}$	

$K_c = [CO_2]$ ✓

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

$\therefore x = 0,004$

m(CaCO) = nM
= (0,004)(100) ✓
= 0,4 g ✓

CALCULATIONS USING CONCENTRATIONS:
BEREKENINGE WAT KONSENTRASIE GEBRUIK:

OPTION 4/*OPSIE 4*

POSITIVE MARKING FROM QUESTION 6.2.
POSITIEWE NASIEN VANAF VRAAG 6.2.

$K_c = [CO_2]$ ✓
= 0,0108 ✓
$\therefore [CO_2] = 0,0108\ (mol\cdot dm^{-3})$

$\Delta c(CO_2)$ = c(CO_2 at equilibrium/*by ewewig*) - c(CO_2 initially/*begin*)
= 0,0108 – 0,01 ✓
= $8 \times 10^{-4}\ mol\cdot dm^{-3}$

n(CO_2 formed/*gevorm*) = cV
= $(8 \times 10^{-4})(5)$ ✓
= 4×10^{-3} mol

n($CaCO_3$ formed/*gevorm*) = n(CO_2 formed/*gevorm*) = 4×10^{-3} mol ✓

m($CaCO_3$) = nM
= $(4 \times 10^{-3})(100)$ ✓
= 0,4 g ✓

CALCULATIONS USING MASS: ***BEREKENINGE WAT MASSA GEBRUIK:***
OPTION 5/*OPSIE 5* $K_c = [CO_2]$ ✓ $= 0{,}0108$ ✓ $\therefore [CO_2] = 0{,}0108$ ($mol \cdot dm^{-3}$) $m(CO_2) = cMV$ $= (0{,}0108)(44)(5)$ ✓ $= 2{,}376$ g $\Delta m(CO_2)$ = $m(CO_2$ at equilibrium/*by ewewig*) - $m(CO_2$ initially/*begin*) $= 2{,}376 – 2{,}2$ ✓ $= 0{,}176$ g $n(CO_2 \text{formed / gevorm}) = \frac{m}{M}$ $= \frac{0{,}176}{44}$ $= 4 \times 10^{-3}$ mol $n(CaCO_3$ formed/*gevorm*) = $n(CO_2$ formed/*gevorm*) = 4×10^{-3} mol ✓ $m(CaCO_3) = nM$ $= (4 \times 10^{-4})(100)$ ✓ $= 0{,}4$ g ✓

(7)

6.5

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

6.5.2 Decreases/*Neem af* ✓ (1)

6.6 Endothermic/*Endotermies* ✓

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

OR/*OF*

Endothermic/*Endotermies* ✓

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

(4)

[19]

QUESTION 7/*VRAAG 7*

7.1 It is a proton/H_3O^+ ion/H^+ ion donor. ✓✓
Dit is 'n proton/H_3O^+-ioon/H^+-ioonskenker. (2)

7.2

7.2.1 CO_3^{2-} (aq) ✓

Note/*Aantekening:*
Ignore phase/*Ignoreer fase*

(1)

7.2.2 $H_2CO_3 + H_2O$ ✓ $\rightleftharpoons$ $HCO_3^-(aq) + H_3O^+(aq)$ ✓ ✓ bal

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

(3)

7.2.3

OPTION/*OPSIE 1*	**OPTION/*OPSIE 2***
pH =-log[H^+] ✓	pH + pOH = 14 ✓
3,4 =-log[H^+] ✓	3,4 + pOH = 14 ✓
[H^+] = $10^{-3,4}$ / 3,98 x 10^{-4} mol·dm^{-3}	pOH = 11,6
[H^+][OH^-] = 10^{-14} ✓	pOH =-log[OH^-] ✓
$\therefore [OH^-] = \frac{1\times10^{-14}}{3,98\times10^{-4}}$ ✓	11,6 =-log[OH^-] ✓
= 2,51x10^{-11} mol·dm^{-3} ✓	[OH^-] = $10^{-11,6}$/2,51x10^{-11} mol·dm^{-3} ✓

(5)

7.3

7.3.1 An acid that donates ONE proton/H^+/H_3O^+-ion. ✓
'n Suur wat EEN proton/H^+/H_3O^+-ioon skenk.

OR/*OF*
An acid of which ONE mol ionises to form ONE mol of protons/H^+ ions/H_3O^+ ions.
'n Suur waarvan EEN mol ioniseer om EEN mol protone/ H^+-ione/ H_3O^+-ione te vorm. (1)

7.3.2

OPTION/*OPSIE 1*	Marking guidelines/*Nasienriglyne:*
$\frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b}$ ✓ $\frac{c_a \times 25}{0{,}1 \times 27{,}5} = \frac{1}{1}$ ✓ ✓ ✓ $c_a = 0{,}11\ mol \cdot dm^{-3}$ ✓	• Formula./ *Formule*. • Substitution of/*Substitusie van* c_a x 25. • Substitution of/*Substitusie van* 0,1 x 27,5 • Use mol ratio/*Gebruik molverhouding* 1:1. • Final answer/*Finale antwoord:* 0,11 $mol \cdot dm^{-3}$
OPTION/*OPSIE 2*	**Marking guidelines/*Nasienriglyne:***
n(NaOH) = cV ✓ = 0,1 x 0,0275 ✓ = 0,00275 mol n(acid X) = n(NaOH) = 0,00275 mol ✓ $c(\text{acid X}) = \frac{n}{V}$ $= \frac{2{,}75 \times 10^{-3}}{0{,}025}$ ✓ $= 0{,}11\ mol \cdot dm^{-3}$ ✓	• n = cV • Substitution into n = cV to calculate n(NaOH). *Substitusie in n = cV om n(NaOH) te bereken.* • Use mol ratio 1:1. *Gebruik molverhouding* 1:1. • Substitution into $c = \frac{n}{V}$ to calculate c(acid). *Substitusie in* $c = \frac{n}{V}$ *om c(suur) te berei.* • Final answer: 0,11 $mol \cdot dm^{-3}$ *Finale antwoord*: : 0,11 $mol \cdot dm^{-3}$

(5)

7.3.3 Weak/*Swak* ✓

The $[H^+]$ OR $[H_3O^+]$ is lower than the concentration of acid X. ✓
Therefore the acid is incompletely ionised. ✓
Die $[H^+]$ OF $[H_3O^+]$ is laer as die konsentrasie van suur X.
Daarom is die suur onvolledig geïoniseer. (3)

[20]

QUESTION 8/*VRAAG 8*

8.1 B ✓ (1)

8.2

8.2.1 $C\ell_2(g) + 2e \rightarrow 2C\ell^-(aq)$ ✓✓

Notes/*Aantekeninge:*

$2C\ell^- \leftarrow C\ell_2 + 2e^-$ ($\frac{2}{2}$)	$C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$ ($\frac{1}{2}$)
$2C\ell^- \rightleftharpoons C\ell_2 + 2e^-$ ($\frac{0}{2}$)	$C\ell_2 + 2e^- \leftarrow 2C\ell^-$ ($\frac{0}{2}$)

(2)

8.2.2 $C\ell_2$ / Chlorine/*Chloor* ✓ (1)

8.3

OPTION 1/*OPSIE 1* $E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ ✓ $= 1,36$ ✓ $-(-2,36)$ ✓ $= 3,72$ V ✓ **OPTION 2/*OPSIE 2*** ✓ $Mg \rightarrow Mg^{2+} + 2e^-$ E° = +2,36 ✓ $C\ell_2 + 2e^- \rightarrow 2C\ell^-$ E° = +1,36 ✓ E° = 3,72 V ✓	**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:* $\frac{3}{4}$

(4)

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

[10]

QUESTION 9/*VRAAG 9*

9.1 Electrolytic cell/*Elektrolitiese sel* ✓ (1)

9.2 The substance/species which loses electrons. ✓✓
Die stof/spesie wat elektrone verloor. (2)

9.3 P ✓ (1)

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

Notes/*Aantekeninge:*

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

(2)

9.5 A ✓
<u>$C\ell^-$ ions</u> move to the positive electrode/anode where they are <u>oxidised</u> to $C\ell_2$. ✓✓
<u>$C\ell^-$ ione</u> beweeg na die positiewe electrode/anode waar dit geoksideer word na $C\ell_2$.

OR/*OF*

$2C\ell^- \rightleftharpoons C\ell_2 + 2e^-$ ✓✓ (3)
[9]

QUESTION 10/*VRAAG 10*

10.1 Ostwald process/*-proses* ✓ (1)

10.2 NO/nitrogen monoxide/*stikstofmonoksied* ✓ (2)
Water/H_2O ✓

10.3 $NH_3 + HNO_3$ ✓ $\rightarrow NH_4NO_3$ ✓ ✓ bal

<u>Notes/*Aantekeninge:*</u>
- Reactants ✓ Products ✓ Balancing ✓
  Reaktanse ✓ Produkte ✓ Balansering ✓
- Ignore/*Ignoreer* → and phases/*en fases*
- Marking rule 6.3.10/*Nasienreël 6.3.10*

(3)

10.4

<u>OPTION 1/*OPTION 1*</u>	**<u>OPTION 2/*OPSIE 2*</u>**
$n(NH_3) = \frac{m}{M}$ $= \frac{6,8 \times 10^7}{17}$ ✓ $= 4 \times 10^6$ mol ↓ $n(NH_4NO_3) = n(NH_3)$ $= 4 \times 10^6$ mol $m(NH_4NO_3) = nM$ $= (4 \times 10^6)(80)$ ✓ $= 3,2 \times 10^8$ g $= 3,2 \times 10^5$ kg ✓	$m(NH_4NO_3) = \frac{6,8 \times 10^4}{17✓} \times 80✓$ ✓ $= 3,2 \times 10^5$ kg✓ **<u>OPTION 3/*OPSIE 3*</u>** 17 g ✓ NH_3 forms/*vorm* 80 g ✓ NH_4NO_3 $6,8 \times 10^4$ kg forms/*vorm* *x* g NH_4NO_3 $x = 6,8 \times 10^4 \times \frac{80}{17}$ $= 3,2 \times 10^5$ kg✓

(3)

10.5 To make a NPK fertiliser/fertilisers which contain all <u>three primary nutrients</u>. ✓
Om 'n NPK-kunsmisstof/kunsmisstowwe wat al <u>drie primêre voedingstowwe</u> bevat, te maak. (1)
[10]

TOTAL/*TOTAAL*: 150