Hillcrest High School

PHYSICAL SCIENCE P2

Grade 12

Sept 2025 P2 **MEMO**

MARKS: 150
TIME: 3 Hours

EXAMINER: Mrs J. Knox-Whitehead
MODERATOR: Ms N. Badenhorst

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

[20]

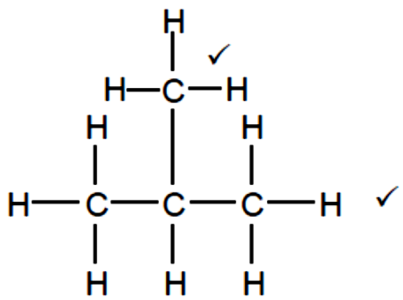
Question 2

2.1.1

a) B √ (1)

b) C √ (1)

2.1.2

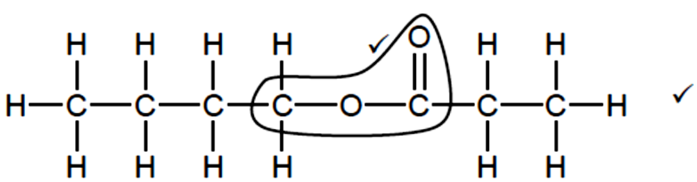


Marking criteria/*Nasienriglyne:*
• Three C atoms in longest chain. ✓ *Drie C-atome in langste ketting.*
• One methyl substituent on C2. ✓ *Een metielsubstituent op C2.*
IF/INDIEN
Any error e.g. omission of H atoms, condensed or semi structural formula/*Enige fout bv weglating van H-atome, gekondenseerde of semi-struktuurformule.* Max/*Maks.*: $\frac{1}{2}$

(2)

2.1.3 butan-2√-one√ (2)

2.1.4



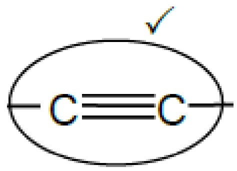
(2)

Marking criteria/*Nasienriglyne:*	
• Whole structure correct: *Hele struktuur korrek:*	$\frac{2}{2}$
• Only functional group correct:/*Slegs funksionele groep korrek:* Max/*Maks.*:	$\frac{1}{2}$
IF/*INDIEN*:	
• More than one functional group/*Meer as een funksionele groep:*	$\frac{0}{2}$
• If condensed or semi structural formula used:/*Indien gekondenseerde of semi-struktuurformule gebruik:* Max/*Maks.*	$\frac{1}{2}$

2.1.5

a) A bond or an atom or a group of atoms that determines the physical and chemical properties of a group of organic compounds. √√ (2)

b) (1)



c) Hydroxyl√ (1)

2.2.1 The vapours from the alcohol are flammable. √ (1)

2.2.2 c. H_2SO_4 √ (1)

2.2.3 Ester √ (1)

2.2.4

$$\frac{M(\text{ester})}{M(C_4H_8O)} = \frac{144}{72 ✓} = 2$$

$\therefore$ 2 x C_4H_8O = $C_8H_{16}O_2$ ✓

<u>Marking guidelines/*Nasienriglyne*</u>
- If only answer given, award 2 marks on final answer./*Indien slegs antwoord gegee, ken 2 punte toe vir finale antwoord.*
- If 72 $g{\cdot}mol^{-1}$ calculated without substituting, no mark is awarded./*Indien 72 $g{\cdot}mol^{-1}$ bereken is sonder om te vervang word geen punt toegeken nie.*

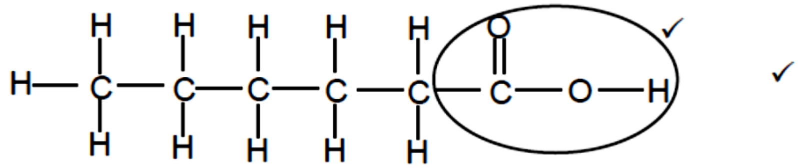
(2)

2.2.5 Ethyl ✓ hexanoate ✓
Etielheksanoaat

<u>Note/*Aantekening*</u>
Accept any other ethyl ESTER from QUESTION 2.3.
Aanvaar enige ander etiel ESTER vanaf VRAAG 2.3.

(2)

2.2.6 **POSITIVE MARKING FROM QUESTION 2.4.**
POSITIEWE NASIEN VANAF VRAAG 2.4.



Marking criteria/*Nasienriglyne*	
• Whole structure correct/*Hele struktuur korrek:*	$\frac{2}{2}$
• Only functional group correct/*Slegs funksionele groep korrek:* Max/*Maks.*:	$\frac{1}{2}$
• Accept/*Aanvaar* -OH as condensed/*gekondenseerd.*	
IF/*INDIEN*	
• More than one functional group/wrong functional group/*Meer as een funksionele groep/foutiewe funksionele groep:* $\frac{0}{2}$	
• If condensed structural formulae used/*Indien gekondenseerde struktuur-formules gebruik:* Max/*Maks.*: $\frac{1}{2}$	

(2)

[21]

Question 3 – organic properties

3.1

Marking criteria/*Nasienkriteria*
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 underlined phrases must be in the correct context. / *Die onderstreepte frases moet in die korrekte konteks wees.*

The temperature at which the vapour pressure (of a substance) equals atmospheric pressure. ✓✓
Die temperatuur waarby die dampdruk (van die stof) gelyk is aan atmosferiese druk. (2)

3.2

Marking criteria:

- Compare structures. ✓
- Compare the strength of intermolecular forces. ✓
- Compare the energy required to overcome intermolecular forces. ✓

Nasienkriteria:

- *Vergelyk strukture.* ✓
- *Vergelyk die sterkte van intermolekulêre kragte.* ✓
- *Vergelyk die energie benodig om intermolekulêre kragte te oorkom.* ✓

Accept: IMF for this exam/***Aanvaar***: *IMK vir hierdie eksamen*

A/$CH_3CH_2CH_2CH_2C\ell$ /1-chlorobutane

- **Structure:**
  Longer chain length/larger surface area (over which intermolecular forces act). ✓
- **Intermolecular forces:**
  Stronger/more intermolecular forces/Van der Waals forces/London forces/dipole-dipole forces. ✓
- **Energy:**
  More energy needed to overcome or break intermolecular forces/Van der Waals forces/dipole-dipole forces. ✓

OR

B/$CH_3CH(CH_3)CH_2C\ell$/1-chloro-2-methylpropane

- **Structure:**
  Shorter chain length / branched / compact / more spherical / smaller surface area (over which intermolecular forces act). ✓
- **Intermolecular forces:**
  Weaker/less intermolecular forces/Van der Waals forces/*London forces/* dipole-dipole forces. ✓
- **Energy:**
  Less energy needed to overcome or break intermolecular forces/Van der Waals forces/dipole-dipole forces. ✓

(3)

3.3.1 164˚C √ (1)

3.3.2 Compound C (alcohol) has hydrogen bonding (1 site) while Compound D has hydrogen bonding (2 sites). √ Compound D also has a larger molecular size therefore stronger van der Waals London forces. √

Compound D therefore has stronger intermolecular forces√ therefore more energy is needed to overcome the intermolecular forces in Compound D. √ (4)

3.4 Decrease √ (1)

3.5 Van der Waal's London √ and van der Waal's dipole-dipole forces √ (2)

[13]

Question 4 – organic reactions

4.1

4.1.1 (A series of organic) compounds that can be described by the <u>same general formula/functional group</u>. ✓✓ **(2 or 0)**
('n Reeks organiese) verbindings wat deur <u>dieselfde algemene formule/ funksionele groep</u> beskryf kan word. ***(2 of 0)***
OR/*OF*
(A series of organic) compounds in which one member <u>differs from the next by a CH_2 group</u>./*('n Reeks organiese) verbindings waarin een lid van die volgende <u>verskil met 'n CH_2-groep</u>.* **(2 or/*of* 0)** (2)

4.1.2 Substitution/halogenation/bromination ✓
Substitusie/halogenasie/halogenering/brominasie/brominering (1)

4.1.3 HBr ✓ (1)

4.1.4 Needs UV light √ (1)

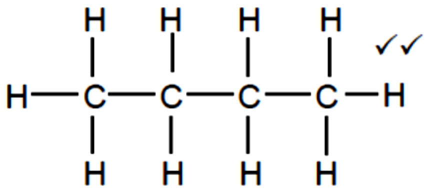
4.1.5 C_5H_{12} + $8O_2$ ✓ → $5CO_2$ + $6H_2O$ ✓ Bal ✓

<u>Marking guidelines/*Nasienriglyne*</u>
- Reactants ✓ *Reaktanse* Products ✓ *Produkte* Balancing ✓ *Balansering*
- Ignore double arrows and phases./*Ignoreer dubbelpyle en fases.*
- Marking rule 6.3.10/*Nasienreël 6.3.10.*
- If condensed structural formulae used/*Indien gekondenseerde struktuurformules gebruik:* Max/*Maks:* $\frac{2}{3}$

(3)

4.1.6 Cracking √ (1)

4.1.7



<u>Marking guidelines/*Nasienriglyne*</u>

- One or more H atoms omitted/*Een of meer H-atome uitgelaat:* Max/*Maks*: $\frac{1}{2}$
- Condensed or semi-structural formula: *Gekondenseerde of semi-struktuur-formule:* Max/*Maks*: $\frac{1}{2}$

(2)

4.2

4.2.1 Butan-2-ol ✓✓ **OR/*OF*** 2-butanol ✓✓

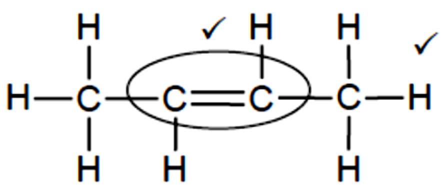
<u>IF/*INDIEN:*</u>

Butanol or/*of* butan-1-ol $\frac{1}{2}$

(2)

4.2.2 a) Elimination (dehydration) √ (1)

b)



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

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

(2)

[16]

Question 5

5.1.1 temperature ✓ (1)

5.1.2 As temperature increases, particles have more Ek therefore they move more ✓. Therefore more collisions, therefore more effective collisions per unit time ✓, therefore experiment 5 will have faster rate ✓. (3)

5.2 14 (min) ✓ (1)

5.3.1 Graph/*grafiek* **B** ✓
(Experiment **3)** has the highest (acid) concentration/more particles/higher number of moles. ✓
(*Eksperiment **3)** het die hoogste (suur)konsentrasie/meer deeltjies/groter aantal mol.* (2)

5.3.2 (Graph/*grafiek*) **C** ✓
(Experiment 5) is at highest temperature/more particles with sufficient kinetic energy/HCℓ is at 35°C ✓
(*Eksperiment 5) is by die hoogste temperatuur/meer deeltjies met genoeg kinetiese energie/HCℓ is by 35°C.* (2)

5.4

$$n(Zn) = \frac{m}{M}$$

$$= \frac{1,5}{65} \checkmark$$

$$= 0,023 \text{ mol}$$

$$\text{rate}/tempo = -\frac{\Delta n}{\Delta t}$$

$$= -\left(\frac{0 - 0,023 \checkmark}{14 \checkmark 0}\right)$$

$$= 1,65 \times 10^{-3} \ (\text{mol} \cdot \text{min}^{-1})$$

✓

Marking guidelines/*Nasienriglyne*

- Substitute/*vervang* 65 g·mol^{-1} in $n = \frac{m}{M}$ ✓
- Substitute change in mol to calculate rate./*Vervang verandering in mol om tempo te bereken.* ✓
- Substitute change in time to calculate rate./*Vervang verandering in tyd om tempo te bereken.* ✓
- Final answer/*Finale antwoord*: $1,65 \times 10^{-3}$ mol·min^{-1} ✓
  Range/*Gebied:*
  $1,43 \times 10^{-3}$ to/*tot* $1,65 \times 10^{-3}$ (mol·min^{-1})

Notes/*Aantekeninge*

- Ignore if zeros omitted in calculation of reaction rate./*Ignoreer indien nulle uitgelaat in berekening van reaksietempo.*
- Accept negative answer i.e. $-1,65 \times 10^{-3}$ mol·min^{-1}/*Aanvaar negatiewe antwoord d.i. $-1,65 \times 10^{-3}$ mol·min^{-1}.* (4)

[13]

QUESTION 6

6.1 When the equilibrium in a closed system is disturbed, the system will re-instate a (new) equilibrium ✓ by favouring the reaction that will cancel/oppose the disturbance. ✓
Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n (nuwe) ewewig instel deur die reaksie te bevoordeel wat die versteuring kanselleer/teenwerk. (2)

6.2 Endothermic/*Endotermies* ✓

- Decrease in temperature favours the exothermic reaction. ✓
  Afname in temperatuur bevoordeel die eksotermiese reaksie.
- The reverse reaction is favoured./*Die terugwaartse reaksie word bevoordeel.* ✓
  OR/*OF*
  Number of moles/amount/concentration of N_2O_4/colourless gas increases.
  Aantal mol/hoeveelheid/konsentrasie van N_2O_4/kleurlose gas neem toe.
  OR/*OF*
  Number of moles/amount of NO_2/brown gas decreases./*Aantal mol/ hoeveelheid NO_2 /bruin gas neem af.* (3)

6.3

6.3.1 Increases/*Verhoog* ✓ (1)

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

6.3.3 Increases/*Verhoog* ✓ (1)

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

Marking guidelines/*Nasienriglyne*

- $\Delta n(N_2O_4)$ = 20% of/*van* **x**/0,2**x**. ✓
- **USE** ratio/***GEBRUIK*** *verhouding:* $N_2O_4 : NO_2 : = 1 : 2$. ✓
- $n(N_2O_4)_{eq/ewe} = n(N_2O_4)_{initial/begin} - \Delta n(N_2O_4)$.
  $n(NO_2)_{eq/ewe} = n(NO_2)_{initial/begin} + \Delta n(NO_2)$. ✓
- Divide equilibrium moles by 2 dm^3/*Deel ewewigsmol deur 2 dm^3*. ✓
- Correct K_c expression (formulae in square brackets). ✓
  Korrekte K_c uitdrukking (formules in vierkanthakies).
- Substitution of K_c value/*Vervanging van K_c-waarde.* ✓
- Substitution of concentrations into correct K_c expression. ✓
  Vervanging van konsentrasies in korrekte K_c-uitdrukking.
- Final answer/*Finale antwoord*: 1,6 (mol) ✓

OPTION 1/*OPSIE 1*

	N_2O_4	NO_2	
Initial amount (moles) *Aanvangshoeveelheid (mol)*	**x**	0	
Change in amount (moles) *Verandering in hoeveelheid* (mol)	0,2**x** ✓	0,4**x**	ratio ✓ *verhouding*
Equilibrium amount (moles) *hoeveelheid* (mol)	0,8**x**	0,4**x**	✓
Equilibrium concentration ($mol\cdot dm^{-3}$) *Ewewigskonsentrasie ($mol\cdot dm^{-3}$)*	0,4**x**	0,2**x**	Divide by 2 dm^3 ✓

$K_c = \frac{[NO_2]^2}{[N_2O_4]}$ ✓

$0,16$ ✓ $= \frac{(0,2\mathbf{x})^2}{(0,4\mathbf{x})}$ ✓

$\mathbf{x}$ = 1,6 (mol) ✓

No K_c expression, correct substitution/*Geen K_c-uitdrukking, korrekte substitusie*: Max./*Maks.* $\frac{7}{8}$
Wrong K_c expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* $\frac{5}{8}$

OPTION 2/*OPSIE 2*

$\Delta n(N_2O_4) = \frac{20}{100}\mathbf{x}$ ✓ $= 0,2\mathbf{x}$

$\Delta n(NO_2) = 2\Delta n(N_2O_4) = 0,4\ \mathbf{x}$ ✓

$n(N_2O_4)_{eq/ewe} = \mathbf{x} - 0,2\mathbf{x} = 0,8\mathbf{x}$ **AND** $n(NO_2)_{eq/ewe} = 0 + 0,4\mathbf{x}$ ✓

$c(N_2O_4)_{eq/ewe} = \frac{0,8\mathbf{x}}{2} = 0,4\mathbf{x}$

$c(NO_2)_{eq/ewe} = \frac{0,4\mathbf{x}}{2} = 0,2\mathbf{x}$ ✓

$K_c = \frac{[NO_2]^2}{[N_2O_4]}$ ✓

$0,16$ ✓ $= \frac{(0,2\mathbf{x})^2}{(0,4\mathbf{x})}$ ✓

$\mathbf{x}$ = 1,6 (mol) ✓

No K_c expression, correct substitution/*Geen K_c-uitdrukking, korrekte substitusie*: Max./*Maks.* $\frac{7}{8}$
Wrong K_c expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* $\frac{5}{8}$

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK

Marking guidelines/*Nasienriglyne*

- Initial $n(N_2O_4)$/**x** divide by 2 dm^3. ✓
  *Aanvanklike $n(N_2O_4)$/**x** gedeel deur 2 dm^3.*
- $\Delta c(N_2O_4)$ = 20% of initial concentration/0,1x. ✓
- **USE** ratio/***GEBRUIK*** *verhouding:* $c(N_2O_4) : c(NO_2) = 1 : 2$. ✓
- $c(N_2O_4)_{eq/ewe} = c(N_2O_4)_{initial/begin} - \Delta c(N_2O_4)$.
  $c(NO_2)_{eq/ewe} = c(NO_2)_{initial/begin} + \Delta c(NO_2)$. ✓
- Correct K_c expression (formulae in square brackets). ✓
  Korrekte K_c uitdrukking (formules in vierkanthakies).
- Substitution of K_c value/*Vervanging van K_c-waarde.* ✓
- Substitution of concentrations into K_c expression. ✓
  Vervanging van konsentrasies in K_c-uitdrukking.
- Final answer/*Finale antwoord*: 1,6 (mol) ✓

OPTION 3/*OPSIE 3*

	N_2O_4	NO_2	
Initial concentration ($mol{\cdot}dm^{-3}$) *Aanvanklike konsentrasie ($mol{\cdot}dm^{-3}$)*	$\frac{x}{2} = 0{,}5\mathbf{x}$	0	Divide by 2 dm^3 ✓
Change ($mol{\cdot}dm^{-3}$) *Verandering ($mol{\cdot}dm^{-3}$)*	0,1**x** ✓	0,2**x**	ratio ✓ *verhouding*
Equilibrium concentration ($mol{\cdot}dm^{-3}$) *Ewewigskonsentrasie ($mol{\cdot}dm^{-3}$)*	0,4**x**	0,2**x**	✓

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} \checkmark$$

$$0{,}16 \checkmark = \frac{(0{,}2\mathbf{x})^2}{0{,}4\mathbf{x}} \checkmark$$

$$\mathbf{x} = 1{,}6 \text{ (mol)} \checkmark$$

No K_c expression, correct substitution/*Geen K_c-uitdrukking, korrekte substitusie:* Max./*Maks.* $\frac{6}{8}$
Wrong K_c expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* $\frac{5}{8}$

(8)
[16]

Question 7

7.1.1 **ANY ONE:**

- A substance whose aqueous solution contains ions. ✓✓ **(2 or 0)**
- Substance that dissolves in water to give a solution that conducts electricity.
- A substance that forms ions in water/forms ions when molten.

(2)

7.1.2 B, A, C √√ (2)

7.2.1 The end point is the point at which the indicator changes colour. √ (1)

7.2.2 methyl orange. √ Reaction of a strong acid and weak base, √ so the equivalence point will be acidic. Methyl orange changes colour in the pH range 3,1 - 4,4. √ (3)

7.2.3

Marking criteria/*Nasienkriteria:*

- Substitute/*Vervang* 0,04 mol·dm^{-3} and 25 x 10^{-3} dm^3 (25 cm^3) and 19,5 x 10^{-3} dm^3 (19,5 cm^3). ✓
- USE mol ratio:/*GEBRUIK molverhouding:* n(Na_2CO_3) : n(HCℓ) = 1 : 2 ✓
- Final answer/*Finale antwoord:* 0,10 to/*tot* 0,103 mol·dm^{-3} ✓

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$ $\frac{c_a(19,5)}{(0,04)(25)}$ ✓ $= \frac{2}{1}$ ✓ c_a = 0,10 mol·dm^{-3} ✓ (0,103)	n(Na_2CO_3) = cV = 0,04 x 0,025 = 0,001 mol n(HCℓ) = 2n(Na_2CO_3) = 0,002 mol ✓ [HCℓ] = $\frac{n}{V}$ = $\frac{0,002}{0,0195}$ ✓ = 0,10 mol·dm^{-3} ✓ (0,103)

(3)

7.2.4

POSITIVE MARKING FROM Q7.2.1/*POSITIEWE NASIEN VANAF V7.2.1*	
Marking criteria: (a) Substitute 0,1 $mol\cdot dm^{-3}$ & $18,7 \times 10^{-3}$ dm^3 (18,7 cm^3). ✓ (b) Use mole ratio: 1:1 ✓ (c) Calculate $n(NH_3)$ / $m(NH_3)$ in 250 cm^3: Substitute 0,25 dm^3 (250 cm^3) ✓ (d) Substitute 0,022 dm^3 (22 cm^3). ✓ (e) Substitute 0,02 dm^3 (20 cm^3) to calculate mole/mass in initial solution. ✓ (f) Use 17 $g\cdot mol^{-1}$ in $n = \frac{m}{M}$. ✓ (g) Final answer: 18,06 g ✓ Range: 17 to 19,13 g	***Nasienkriteria:*** (a) *Vervang 0,1 $mol\cdot dm^{-3}$ & $18,7 \times 10^{-3}$ dm^3 (18,7 cm^3).* ✓ (b) *Gebruik molverhouding: 1:1* ✓ (c) *Bereken $n(NH_3)$ / $m(NH_3)$ in 250 cm^3: Vervang 0,25 dm^3 (250 cm^3).* ✓ (d) *Vervang 0,022 dm^3 (22 cm^3).* ✓ (e) *Vervang 0,02 dm^3 (20 cm^3) om mol/massa van oorspronklike oplossing te bereken.* ✓ (f) *Gebruik 17 $g\cdot mol^{-1}$ in* $n = \frac{m}{M}$. ✓ (g) *Finale antwoord:* 18,06 g ✓ *Gebied*: 17 *tot* 19,13 g
OPTION 1/*OPSIE 1* $n(HC\ell) = cV$ $= (0,1)(18,7 \times 10^{-3})$ ✓ **(a)** $= 1,87 \times 10^{-3}$ mol $n(NH_3)_{reacted/reageer} = n(HC\ell)_{reacted/reageer}$ $= 1,87 \times 10^{-3}$ mol ✓**(b)** $n(NH_3)$ in 22 cm^3 = $1,87 \times 10^{-3}$ mol $n(NH_3)$ in 250 cm^3 = $\frac{(1,87 \times 10^{-3})(250)}{22}$ ✓**(c)** ✓**(d)** = 0,021 mol ($2,13 \times 10^{-2}$) $n(NH_3)$ in initial 20 cm^3 = 0,021 mol $n = \frac{m}{M}$ $0,021 = \frac{m}{17}$ ✓ **(f)** $m(NH_3)$ = 0,357 g in 20 cm^3 $m(NH_3) = \frac{(0,357)(1000)}{20}$ ✓**(e)** = 17,85 g✓**(g)** (18,06)	**OPTION 2/*OPSIE 2*** $n(HC\ell) = cV$ $= (0,1)(18,7 \times 10^{-3})$ ✓**(a)** $= 1,87 \times 10^{-3}$ mol $(NH_3)_{reacted/reageer} = n(HC\ell)_{reacted/reageer}$ $= 1,87 \times 10^{-3}$ mol ✓**(b)** $n(NH_3)$ in 22 cm^3 = $1,87 \times 10^{-3}$ mol $n = \frac{m}{M}$ $1,87 \times 10^{-3} = \frac{m}{17}$ ✓ **(f)** $m(NH_3) = 3,72 \times 10^{-3}$ g in 22 cm^3 $m(NH_3)$ in 250 cm^3 = $\frac{(3,72 \times 10^{-3})(250)}{22}$ ✓**(c)** ✓**(d)** = 0,361 g $m(NH_3)$ in initial 20 cm^3 = 0,361 g $m(NH_3)$ in 1 000 cm^3 = $\frac{(0,361)(1000)}{20}$ ✓**(e)** = 18,06 g✓**(g)**

(7)

OPTION 3/*OPSIE 3*

$$\frac{c_bV_b}{c_aV_a} = \frac{n_b}{n_a}$$

$$\frac{c_b(22)\ \checkmark\text{(d)}}{(0,1)(18,7)\ \checkmark\text{(a)}} = \frac{1}{1}\ \checkmark\text{(b)}$$

$c_1 = 0{,}085\ mol\cdot dm^{-3}$

$[NH_3]$ in 22 cm^3 = $0{,}085\ mol\cdot dm^{-3}$

$[NH_3]$ in 250 cm^3 = $0{,}085\ mol\cdot dm^{-3}$

$c_1V_1 = c_2V_2$

$c_1(0{,}02)$ ✓ (e) = $\underline{(0{,}085)(0{,}25)}$ ✓ (c)

$c_1 = 1{,}06\ mol\cdot dm^{-3}$

$m = cVM$ (f)

$= (1{,}06)(1)(17✓)$

$= 18{,}06$ g ✓ (g)

OPTION 4/*OPSIE 4*

$n(HC\ell) = cV$

$= \underline{(0{,}1)(18{,}7 \times 10^{-3})}$ ✓ (a)

$= 1{,}87 \times 10^{-3}$ mol

$(NH_3)_{reacted/reageer} = n(HC\ell)_{reacted/reageer}$

$= 1{,}87 \times 10^{-3}$ mol ✓(b)

$n(NH_3)$ in 22 cm^3 = $1{,}87 \times 10^{-3}$ mol

✓ (c)

$n(NH_3)$ in 250 cm^3 = $\frac{(1{,}87 \times 10^{-3})(250)}{22}$ ✓(d)

$= 0{,}021$ mol

$c(20\ cm^3) = c(1\ dm^3)$

$\frac{n_1}{V_1} = \frac{n_2}{V_2}$

$n(NH_3)$ in 1 000 cm^3 = $\frac{0{,}021 \times 1000}{20}$ ✓ (e)

$= 1{,}06$ mol

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

$1{,}06 = \frac{m}{17}$ ✓(f)

$m(NH_3) = 18{,}06$ g ✓(g)

7.2.5 Less than 7/*Minder as 7* ✓

$NH_4^+(aq) + H_2O(\ell)$ ✓ $\rightleftharpoons NH_3(aq) + H_3O^+(aq)$ ✓

Notes/*Aantekeninge*:

- Ignore single arrow/*Ignoreer* enkelpyl: →

(3)

[21]

Question 8

8.1 Reducing agent is the substance that loses electrons. √ (1)

8.2 Aluminium / Al √ (1)

8.3

8.3.1 chemical to electrical energy √ (1)

8.3.2 temperature 25˚C √

electrolyte concentration 1 $mol.dm^{-3}$ √ (2)

8.4

8.4.1 KNO_3 / KCl / etc √ (1)

8.4.2 M √ (1)

8.5 0,65 $mol.dm^{-3}$ √√ (2)

8.6 DECREASES √ (1)

8.7

OPTION 1/*OPTION 1*	**NOTE/*LET WEL***
$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ ✓ 2 ✓ = $E^{\theta}_{cathode}$ − (-1,66) ✓ $E^{\theta}_{cathode}$ = 0,34 (V) ✓ M is copper/Cu/*koper* ✓	• 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* 5/6

OPTION 2/*OPSIE 2*

✓ $M^{2+}(aq) + 2e^- \rightarrow M(aq)$ E = +x V

$A\ell(s) \rightarrow A\ell^{3+}(aq) + 3e^-$ E = +1,66 V ✓

$2A\ell(s) + 3M^{2+}(aq) \rightarrow 2A\ell^{3+}(aq) + 3M(s)$ E = 2,00 (V) ✓

x = 0,34 (V) ✓

M is copper/Cu/*koper* ✓

(5)
~~(6)~~

8.8

8.8.1 Calcium, Ca √ (1)

8.8.2 $A\ell^{3+}$ is a stronger oxidising agent than Ca^{2+}✓, therefore, Ca will be oxidised ✓ (to Ca^{2+})./

Ca^{2+} is a weaker oxidising agent than $A\ell^{3+}$✓, therefore, Ca will be oxidised ✓ (to Ca^{2+}).

(2)

[19]

Question 9

9.1 ENDOTHERMIC √ (1)

9.2 **Q** √ (1)

9.3 $Ag^+_{(aq)} + e^- \rightarrow Ag_{(s)}$ ✓✓ (2)

9.4 REMAIN THE SAME. √

The rate of reduction at the cathode is the same as the rate of oxidation at the anode. √ (2)

9.5

OPTION 1/*OPSIE 1:*

$n(Ag) = \frac{m}{M}$

$= \frac{5}{108}$ ✓(a)

$= 0,0346$ mol

$n(e^-) = \frac{N}{N_A}$

(c) $0,0346 = \frac{N}{6,02 \times 10^{23}}$ ✓(b)

$N e^- = 2,79 \times 10^{22}$

$N e^- = \frac{Q}{e}$ **OF/OR** $\frac{Q}{q_e}$

$2,79 \times 10^{22} = \frac{Q}{1,6 \times 10^{-19}}$ ✓

$Q = 4459,26C$

$I = \frac{Q}{\Delta t}$ ✓

$= \frac{4459,26}{60(60)}$ ✓(d)

$= 1,24$ A ✓(e)

(6)

[12]

Total 150