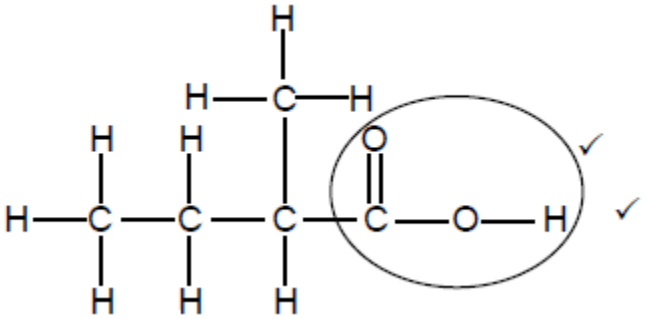
MEMORANDUM

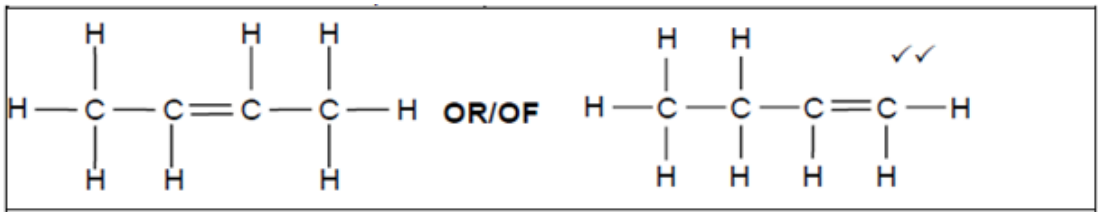
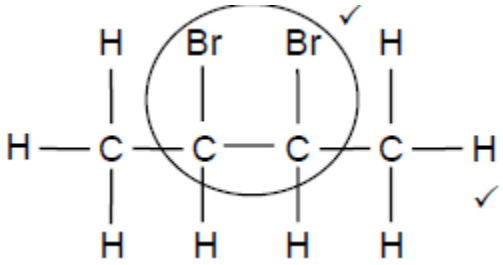
PHYSICAL SCIENCE **SEPTEMBER 2018**

CW PLC COMMON PAPER 2 **TOTAL: 150**

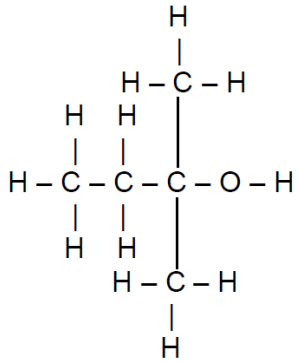
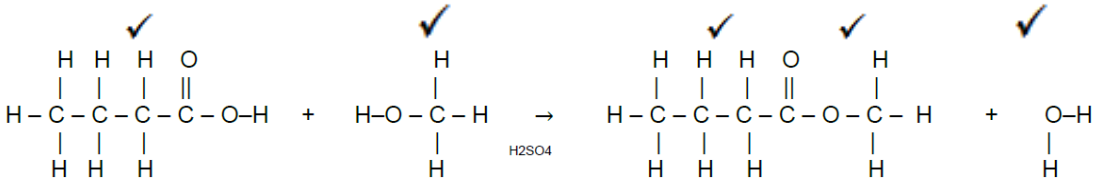
QUESTION 1			
1.1	B		(2)
1.2	A		(2)
1.3	B		(2)
1.4	B		(2)
1.5	A		(2)
1.6	A		(2)
1.7	C		(2)
1.8	A		(2)
1.9	D		(2)
1.10	C		(2) **[20]**

QUESTION 2			
2.1	2.1.1	Carboxyl (group)/*Karboksiel(groep)* ✓	(1)
	2.1.2	Ketones/*Ketone* ✓	(1)
	2.1.3	Addition/*Addisie* ✓	(1)
2.2	2.2.1	Ethene/*Eteen* ✓	(1)
	2.2.2	4-methyl ✓hexan-3-one ✓ (no space/geen spasie)	
		4-metielheksan-3-oon	
		OR/*OF*	
		4-methyl ✓-3-hexanone✓	
		4-metiel-3-heksanoon	(2)
		Notes/*Aantekeninge*: **IF/*INDIEN*:** Correct IUPAC name, but one or more of the following errors: omitting hyphens and/or commas; including extra spaces and/or hyphens *Korrekte IUPAC-naam, maar een of meer van die volgende foute: weglating van koppeltekens en/of kommas; insluiting van ekstra spasies en/of koppeltekens* Max./*Maks.* ½ 4 methyl hexan 3 one ✓ *4 metiel 3 heksanoon* ✓	
	2.2.3	4-ethyl-2,2-dimethyl✓hexane ✓ (no space/geen spasie)	
		4-etiel-2,2-dimetielheksaan	(2)

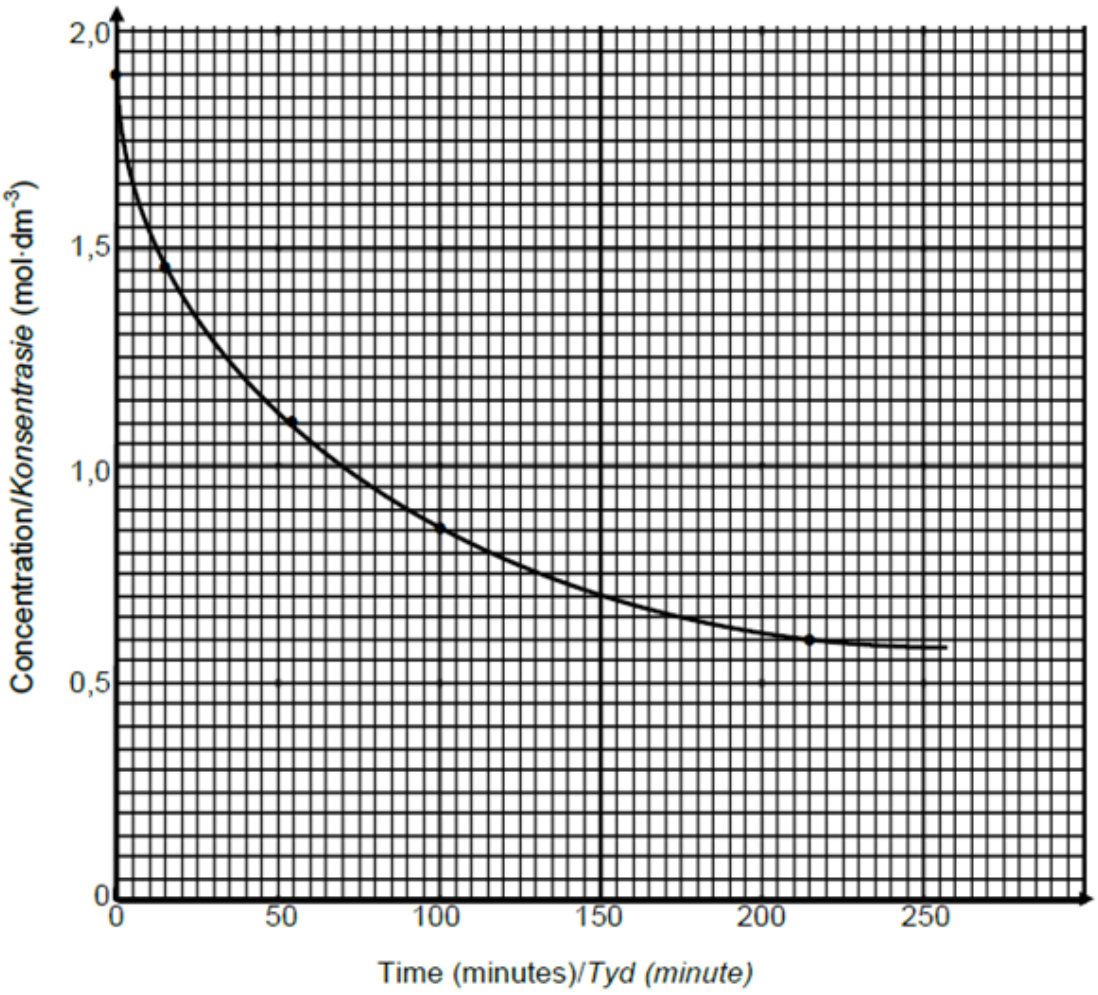
		Notes/*Aantekeninge*: **IF/*INDIEN*:** Correct IUPAC name, but one or more of the following errors: omitting hyphens and/or commas; including extra spaces and/or hyphens *Korrekte IUPAC-naam, maar een of meer van die volgende foute: weglating van koppeltekens en/of kommas; insluiting van ekstra spasies en/of koppeltekens* Max./*Maks.* ½ 4 methyl hexan 3 one ✓ *4 metiel 3 heksanoon* ✓	
	2.2.4	But-2-ene/*But-2-een* **OR/*OF*** 2-Methyl prop-1-ene/*2-Metielprop-1-een* ✓	(1)
2.3		Carbon dioxide/CO_2/*Koolstofdioksied* ✓	
		Water/H_2O ✓	(2)
2.4	2.4.1	 ✓ ✓	(2)
		Notes/*Aantekeninge*: • Condensed or semi-structural formula: ½ *Gekondenseerde of semistruktuurformule*: ½ • Molecular formula/*Molekulêre formule*: 0/2 **Notes/*Aantekeninge*** Whole structure correct/*Hele struktuur korrek*: 2/2 Only functional group correct/*Slegs funksionele groep korrek*: ½	
	2.4.2	**ANY ONE/*ENIGE EEN*:** Two marks or zero./*Twee punte of nul.*	(2)

			
	Notes/*Aantekeninge:* • Condensed or semi-structural formula: Max. ½ *Gekondenseerde of semistruktuurformule: Maks.* ½ • Molecular formula/*Molekulêre formule*: 0/2		
2.5	2.5.1	E ✓	(1)
	2.5.2	Substitution/halogenation/bromination ✓ *Substitusie/halogenering/brominering*	(1)
	2.5.3		(2)
	Notes/*Aantekeninge:* • Condensed or semi-structural formula: Max. ½ *Gekondenseerde of semistruktuurformule: Maks.* ½ • Molecular formula/*Molekulêre formule*: 0/2 **Notes/*Aantekeninge*** Whole structure correct/*Hele struktuur korrek*: ½ Only functional group correct/*Slegs funksionele groep korrek*: ½		
			[19]

QUESTION 3		
3.1.1	Boiling point/*kookpunt*✓	(1)
3.1.2	Chain length/*kettinglengte* or molecular mass/*molekulêre massa*✓	(1)
3.1.3	Boiling point increases as the chain length / molecular mass of alkane increases✓	(1)
3.1.4	As the molecular mass and chain length of the alkanes increases/*Soos die molekulêre mass en kettinglengte van die alkane toeneem* the area for the London force to establish becomes greater/*neem die area waarin die Londonkragte ingestel word, groter.*✓ So, the London forces between alkane molecules increases/*dus neem die sterkte van die Londonkragte tussen die alkaanmolekule toe*.✓ More energy is therefore needed to overcome the London forces/*meer energie is nodig om die Londonkragte te oorkom*.✓	(3)
3.2.1	Degree of branching/*mate van vertakking* or all the molecules are straight chain/not branched/*al die molekule is reguitketting/nie-vertak*✓	(1)
3.2.2	The intermolecular forces in alkanes are <u>weak London forces</u>/die intermolekulêre kragte in alkane is <u>swak Londonkragte</u>, ✓ And the intermolecular forces in alcohols are <u>strong hydrogen bond</u>/*die intermolekulêre kragte in alkohole is <u>sterk waterstofbinding</u>*.✓ More energy is needed to overcome the intermolecular forces in the alcohols/*meer energie is nodig om die intermolekulêre kragte in die alkohole te oorkom*.✓	(3)
3.3.1	ethanol/*ethanol*✓	(1)
3.3.2	Propan-1-ol ✓	(1)
		[12]

QUESTION 4		
4.4.1	✓ ✓ 2-methylbut-1-ene / *2-metielbut-1-een*	(2)
4.1.2	ethanol/*etanol*	(1)
4.1.3		(2)
4.1.4	H_2O / water	(1)
4.2.1		(5)
4.2.2	Functional/*funksionele*	(1)
		[12]

QUESTION 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 TWO OF/SLEGS ENIGE TWEE 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	Average rate / 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** • Substitution/Instelling ✓✓ • Final Answer/Finale Antwoord ✓ **Accept/Aanvaar:** 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 decrease. ✓ 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 $g \cdot mol^{-1}$ in $n = \frac{m}{M}$.
- Final answer/*Finale antwoord:* 3,54–4,0 g.

OPTION 1/*OPSIE 1*

Mol initially/*begin*:

$n(HC\ell) = cV$ ✓

$= (1,9)(60 \times 10^{-3})$ ✓

$= 0,11$ mol (0,114)

Mol final/*finaal*:

$n(HC\ell) = cV$

$= (0,6)(60 \times 10^{-3})$

$= 0,04$ mol (0,036)

$\Delta n(HC\ell) = 0,04 - 0,011$ ✓

$= -0,07$ mol (0,078 mol)

$\Delta n(HC\ell) = 0,07$ mol (0,078)

n(formed/*gevorm*) =n(reacted/*reageer)*

$n(CH_3C\ell) = n(HC\ell)$ ✓

$= 0,07$ 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*

$\Delta c(HC\ell) = 0,6 - 1,9$ ✓

$= -1,3$

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

$\Delta n(HC\ell) = \Delta cV$

$= (1,3)(60 \times 10^{-3})$ ✓

$= 0,08$ mol (0,078)

n(formed/*gevorm*) = n(reacted/*reageer)*

$n(CH_3C\ell) = n(HC\ell)$ ✓

$= 0,08$ mol

$m(CH_3C\ell) = nM$

$= (0,08)(50,5)$ ✓

$= 4$ g ✓

Accept range/*Aanvaar gebied:*

3,54 – 4,0 g

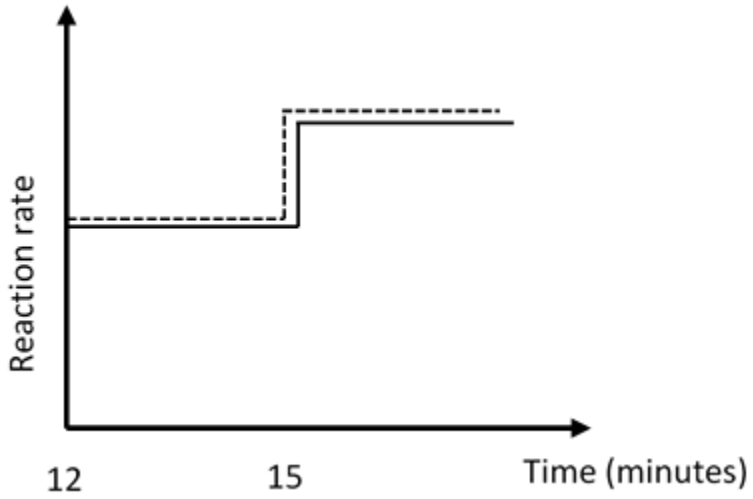
(5)
[19]

<table>
<tr><td colspan="2">QUESTION 6</td><td></td></tr>
<tr><td>6.1</td><td>When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium ✓by favouring a reaction that opposes the disturbance.✓
Wanneer die ewewig in 'n geslote sisteem versteur word, stel die sisteem 'n nuwe ewewig in deur die reaksie wat die versteuring teenwerk, te bevoordeel.</td><td>(2)</td></tr>
<tr><td>6.2.1</td><td>INCREASES ✓
• Increase in pressure favours the reaction that leads to smaller number of moles / volume of gas. ✓
• Forward reaction is favoured. ✓

TOENEEM ✓
• Toename in druk bevoordeel die reaksie wat tot die kleiner getal mol / volume gas lei.✓
• Voorwaartse reaksie word bevoordeel. ✓</td><td>(3)</td></tr>
<tr><td>6.2.2</td><td>DECREASES ✓
• An increase in temperature favours the endothermic reaction. ✓
• The reverse reaction is favoured. ✓

AFNEEM ✓
• Die voorwaarste reaksie is eksotermies. 'n Toename in temperatuur bevoordeel die endotermiese reaksie.✓
• Die terugwaartse reaksie word bevoordeel. ✓</td><td>(3)</td></tr>
<tr><td>6.3.1</td><td>Marking criteria:
1. Values from graph / Waardes op grafiek
2. Calculation of n(O_2) / Berekening van n(O_2)
3. Calculation of n(O_2) reacted / Berekening van n(O_2) gereageer
4. Ratio / verhouding
5. Equation of Kc / Vergelyking van K_c
6. Substitution / Substitusie van waardes
7. Answer / Antwoord

<table>
<tr><td></td><td>SO_2</td><td>O_2</td><td>SO_3</td></tr>
<tr><td>Ratio: / Verhouding</td><td>2</td><td>1</td><td>2</td></tr>
<tr><td>n start:/ aanvanklik</td><td>5</td><td>3</td><td>0</td></tr>
<tr><td>n change / veranderd</td><td>-2,4</td><td>-1,2</td><td>+2,4</td></tr>
<tr><td>n equilibrium / ewewig</td><td>2,6</td><td>1,8</td><td>2,4</td></tr>
<tr><td>c =n/V</td><td>1,3</td><td>0,9</td><td>1,2</td></tr>
</table>
</td><td></td></tr>
</table>

	✓6 subst $K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{(1,2)^2}{(1,3)^2(0,9)} = 0,95$ ✓7	(7)
6.3.2	More oxygen added (conc of O_2 increased) ✓ / *Suurstof word by die sisteem gevoeg(konsentrasie van* O_2 neem toe)	(1)
6.3.3	NO CHANGE. ✓ / *geen verandering*	(1)
6.3.4	• Vertical parallel lines show a sudden increase in rate of both forward and reverse reactions at 15 minutes ✓ • Horisontal parallel lines showing a constant higher rate for both forward and reverse catalysed reactions after time 15 minutes. ✓ / • *Paralelle vertikale wat 'n toename in beide voorwaartse en terugwaartse reaksies toon by 15 minute* • *Horisontale paralelle lyne van beide voorwaartse en terugwaartse reaksie wat .n verhoogde reaksietempo toon na 15 minute*  	(2)
		[19]

QUESTION 7		
7.1.1	Sulphuric acid is a strong acid OR ionizes completely *Swawelsuur is 'n sterk suur OF ioniseer volledig*	(1)
7.1.2	Proton acceptor/*protonakseptor*	(1)
7.1.3	HSO_4^-	(1)
7.1.4	Sulphate / *sulfaat*	(1)
7.2.1	endpoint/*endpunt/omslagpunt*	(1)
7.2.2	burette/*buret*	(1)
7.2.3	decreases/*neem af*	(1)
7.2.4	Reaction is between a weak acid and a strong base. ✓ Therefore the salt that is formed is basic and undergoes hydrolysis (OH^- forms). ✓ /*Die reaksie is tussen 'n swak suur en 'n sterk basis. Daarom is die sout wat vorm basies en dit ondergaan hidrolise (*OH^- vorm).	(2)
7.3	n = cV ✓ = 0,01 x 6 ✓ = 0,06 mol ✓	(3)
7.3.2	n(NaOH) = m/M = 44/40 = 0,11 mol $n(H_2SO_4)$ = 0,11 x ½ = 0,055 mol	(3)
7.3.3	$n(H_2SO_4)$ left = 0,06 - 0,055 ✓ = 0,005 mol $n(H_3O^+)$ = 0,005 x 2 ✓ = 0,01 mol $[H_3O^+]$ = n/V = 0,01 / 6 ✓ = 0,00166… $mol.dm^{-3}$ pH = -log $[H_3O^+]$ ✓ = - log (0,00166..) ✓ = 2,78 ✓	(6) **[21]**

QUESTION 8			
8.1	8.1.1	$C\ell_2(g)$ / chlorine gas ✓ *chloorgas*	(1)
	8.1.2	$Fe \longrightarrow Fe^{3+} + 3e^-$ ✓✓	(2)
	8.1.3	✓ ✓ ✓ $Fe \mid Fe^{3+} \parallel Cl_2 \mid Cl^-$; Pt(s)	(3)
8.2		$E_{cell} = E_{cathode} - E_{anode}$ ✓ = 1,36 – (- 0,06) ✓ = 1,42 V ✓	(3)
8.3		smaller than ✓, work done in moving the ions through the electrolyte ✓ / internal resistance in cell / loss in voltage *Kleiner as* ✓ – *werk verrig deur die ione, deur die elektroliet / interne weerstand in sel / potensiaalverskil wat verlore gaan* ✓	(2)
			[11]

QUESTION 9			
9.1	Number of moles of electrons transferred = 0,8 mol Therefore, number of moles of copper atoms formed = 0,4 mol (ratio 2:1) m = n x M ✓ = 0,4 ✓ x 63,5 ✓ = 25,4 g ✓		(4)
9.2	25,4 g copper was oxidized ✓ % copper in impure sample = 25,4/28 x 100 = 90,71% ✓ ✓ The copper is not suitable. ✓		(4)
9.3	Silver and platinum both are much weaker reducing agents than copper. ✓		(1)
			[9]

<table>
<tr><td colspan="3">QUESTION 10</td><td></td></tr>
<tr><td>10.1</td><td>10.1.1</td><td>$SO_3 + H_2SO_4$ ✓→ $H_2S_2O_7$ ✓ Bal. ✓

<u>Notes/Aantekeninge</u>
• Reactants ✓ Reaktanse Products ✓ Produkte Balancing ✓ Balansering
• Ignore/Ignoreer ⇌
• Marking rule 3.9/Nasienreël 3.9</td><td>(3)</td></tr>
<tr><td></td><td>10.1.2</td><td>The reaction is (highly) exothermic/ produces toxic fumes / mist. ✓
Die reaksie is (hoogs) eksotermies / vorm giftige dampe /mis.</td><td>(1)</td></tr>
<tr><td>10.2</td><td>10.2.1</td><td>Ammonium phosphate / Ammoniumfosfaat ✓
Highest percentage phosphorous. / Hoogste persentasie fosfor. ✓</td><td>(2)</td></tr>
<tr><td></td><td>10.2.2</td><td>• Excess fertiliser runs into water resources causing contamination of water resources/ eutrophication / higher concentration of nitrates in water / dead zones ✓
that can result in poor water quality / dying of fish / changing of habitats. ✓
Oormaat kunsmis loop af in waterbronne en veroorsaak kontaminasie van waterbronne / eutrofikasie / hoër nitraatkonsentrasies in water / dooie sones
wat tot swak waterkwaliteit / visvrektes / veranderde habitatte kan lei.
• Excess fertiliser in soil leads to eutrophication / change in acidity of soil / dead zones ✓
that can result in changing of natural growth / habitats. ✓
Oormaat kunsmis in grond lei tot eutrofikasie / verandering in suurgehalte van grond / dooie sones
wat tot verandering in natuurlike groei/habitatte kan lei.
<u>Marking guidelines/Nasienriglyne:</u>
• Immediate effect of excess fertiliser runoff in water. ✓
Onmiddellike invloed van oormaat kunsmis wat in water afloop.
• Effect of contaminated water on environment. ✓
Invloed van besmette water op omgewing.
• Immediate effect if excess fertiliser in soil. ✓
Onmiddellike invloed van oormaat kunsmis in grond.
• Effect of contaminated soil on environment. ✓
Invloed van besmette grond op omgewing.</td><td>(2)</td></tr>
<tr><td></td><td></td><td></td><td>[8]</td></tr>
</table>