

MEMORANDUM

PHYSICAL SCIENCE

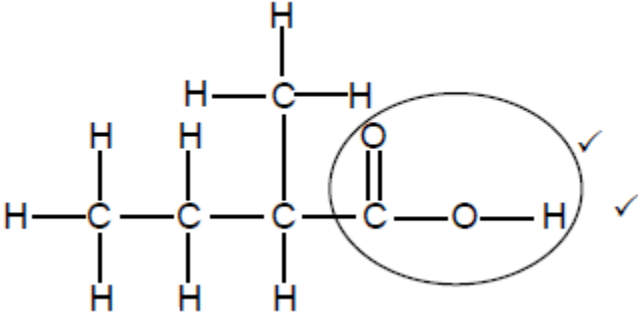
SEPTEMBER 2018

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)
			<b>[20]</b>

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	
		<b>OR/OF</b>	
		4-methyl ✓ -3-hexanone ✓	
		4-metiel-3-heksanoon	(2)
		<p><b><u>Notes/Aantekeninge:</u></b>  <b><u>IF/INDIEN:</u></b>            Correct IUPAC name, but one or more of the following errors: omitting hyphens and/or commas; including extra spaces and/or hyphens  <i>Korrekte IUPAC-naam, maar een of meer van die volgende foute: weglating van koppeltekens en/of kommas; insluiting van ekstra spasies en/of koppeltekens</i>            Max./Maks. <math>\frac{1}{2}</math></p> <p>4 methyl hexan 3 one ✓            4 metiel 3 heksanoon ✓</p>	
	2.2.3	<u>4-ethyl-2,2-dimethyl</u> ✓ hexane ✓ (no space/geen spasie)	
		4-eties-2,2-dimetielheksaan	(2)

		<p><b>Notes/Aantekeninge:</b>  <b>IF/INDIEN:</b>          Correct IUPAC name, but one or more of the following errors: omitting hyphens and/or commas; including extra spaces and/or hyphens  <i>Korrekte IUPAC-naam, maar een of meer van die volgende foute: weglating van koppeltekens en/of kommas; insluiting van ekstra spasies en/of koppeltekens</i>  <u>Max./Maks. 1/2</u>          4 methyl hexan 3 one ✓          4 metiel 3 heksanoon ✓</p>	
	2.2.4	But-2-ene/But-2-een <b>OR/OF</b> 2-Methyl prop-1-ene/2-Metielprop-1-een ✓	(1)
	2.3	Carbon dioxide/CO <sub>2</sub> /Koolstofdioksied ✓	
		Water/H <sub>2</sub> O ✓	(2)
2.4	2.4.1		(2)
		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <p><b>Notes/Aantekeninge:</b>            • Condensed or semi-structural formula: 1/2  <i>Gekondenseerde of semistruktuurformule: 1/2</i>            • Molecular formula/Molekulêre formule: 0/2</p> </div> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-left: 20px;"> <p><b>Notes/Aantekeninge</b>            Whole structure correct/Hele struktuur korrek: 2/2            Only functional group correct/Slegs funksionele groep korrek: 1/2</p> </div>	
	2.4.2	<p><b>ANY ONE/ENIGE EEN:</b>          Two marks or zero./Twee punte of nul.</p>	(2)

	<p><b>Notes/Aantekeninge:</b></p> <ul style="list-style-type: none"> <li>• Condensed or semi-structural formula: Max. <math>\frac{1}{2}</math></li> <li><u>Gekondenseerde of semistruktuurformule: Maks. <math>\frac{1}{2}</math></u></li> <li>• Molecular formula/<u>Molekulêre formule</u>: <math>\frac{0}{2}</math></li> </ul>		
2.5	2.5.1	E ✓	(1)
	2.5.2	Substitution/halogenation/bromination ✓ Substitusie/halogenering/brominerig	(1)
	2.5.3		(2)
	<p><b>Notes/Aantekeninge:</b></p> <ul style="list-style-type: none"> <li>• Condensed or semi-structural formula: Max. <math>\frac{1}{2}</math></li> <li><u>Gekondenseerde of semistruktuurformule: Maks. <math>\frac{1}{2}</math></u></li> <li>• Molecular formula/<u>Molekulêre formule</u>: <math>\frac{0}{2}</math></li> </ul>		<p><b>Notes/Aantekeninge</b></p> <p>Whole structure correct/<u>Hele struktuur korrek</u>: <math>\frac{1}{2}</math></p> <p>Only functional group correct/<u>Slegs funksionele groep korrek</u>: <math>\frac{1}{2}</math></p>
			[19]

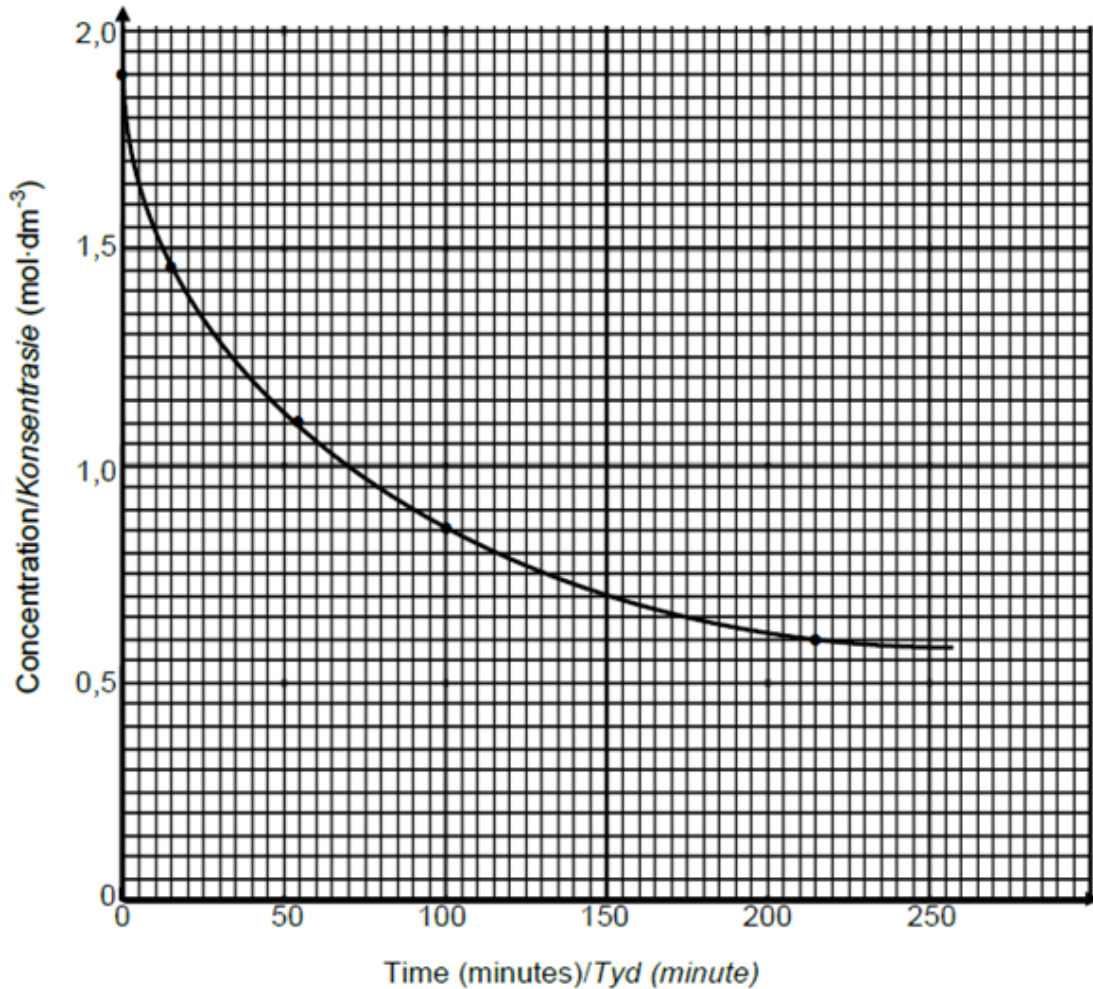
QUESTION 3		
3.1.1	Boiling point/ <i>kookpunt</i> ✓	(1)
3.1.2	Chain length/ <i>kettinglengte</i> or molecular mass/ <i>molekulêre massa</i> ✓	(1)
3.1.3	Boiling point increases as the chain length / molecular mass of alkane increases ✓	(1)
3.1.4	As the molecular mass and chain length of the alkanes increases/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

QUESTION 4		
4.4.1	<p style="text-align: center;">✓      ✓</p> 2-methylbut-1-ene / 2-metielbut-1-een	(2)
4.1.2	ethanol/ <i>etanol</i>	(1)
4.1.3	$  \begin{array}{c}  & & & H & & & \\  & & &   & & & \\  & & & H-C-H & & & \\  & & H &   & & & \\  & H & H &   & & & \\  &   &   &   & & & \\  H-C-C-C-O-H & & & & & & \\  &   &   &   & & & \\  & H & H & H-C-H & & & \\  & & &   & & & \\  & & & H & & &   \end{array}  $	(2)
4.1.4	H <sub>2</sub> O / water	(1)
4.2.1	$  \begin{array}{c}  & & & \checkmark & \\  & H & H & H & O & & H & & H & H & H & O & H & & O-H & & & & & & & & & & & \\  &   &   &   &    & &   & &   &   &   &    &   & &   & & & & & & & & & & & \\  H-C-C-C-C-O-H & + & H-O-C-H & \rightarrow & H-C-C-C-C-O-C-H & + & O-H & \\  &   &   &   & & &   & &   &   &   & &   & &   & & & & & & & & & & & \\  & H & H & H & & & H & & H & H & H & & H & & H & & & & & & & & & & & \\  &   \end{array}  $ <p style="text-align: center; margin-left: 100px;">H<sub>2</sub>SO<sub>4</sub></p>	(5)
4.2.2	Functional/ <i>funksionele</i>	(1)
		<b>[12]</b>

QUESTION 5		
5.1	<p><b><u>ONLY ANY TWO OF/SLEGS ENIGE TWEE VAN:</u></b></p> <ul style="list-style-type: none"> <li>• Increase temperature./Verhoog die temperatuur. ✓</li> <li>• Increase concentration of acid./Verhoog die konsentrasie van die suur. ✓</li> <li>• Add a catalyst./Voeg 'n katalisator by.</li> </ul>	(2)
5.2	<p><b><u>ONLY ANY TWO OF/SLEGS ENIGE TWEE VAN:</u></b></p> <ul style="list-style-type: none"> <li>• Change in concentration of products/reactants ✓ per (unit) time. ✓ <i>Verandering in konsentrasie van produkte/reaktanses per (eenheids)tyd.</i></li> <li>• Rate of change in concentration. ✓✓ <i>Tempo van verandering in konsentrasie.</i></li> <li>• Change in amount/number of moles/volume/mass of products or reactants per (unit) time. <i>Verandering in hoeveelheid/getal mol/volume/massa van produkte of reaktanses Per (eenheids)tyd.</i></li> <li>• Amount/number of moles/volume/mass of products formed or reactants used per (unit) time. <i>Hoeveelheid/getal mol/volume/massa van produkte gevorm of reaktanses gebruik per (eenheids)tyd.</i></li> </ul>	(2)
5.3 5.3.1	<p>Average rate / Gemiddelde tempo = <math>-\frac{\Delta c}{\Delta t}</math></p> $= -\frac{(1,45 - 1,90)}{(15 - 0)}$ $= 0,03 \text{ (mol} \cdot \text{dm}^{-3}) \cdot \text{min}^{-1}$ <div style="border: 1px solid black; padding: 10px; margin-top: 10px;"> <p><b><u>Notes/Aantekeninge</u></b></p> <ul style="list-style-type: none"> <li>• Substitution/Instelling ✓✓</li> <li>• Final Answer/Finale Antwoord ✓</li> </ul> <p><b>Accept/Aanvaar:</b></p> <math display="block">\text{Rate / Tempo} = \frac{\Delta c}{\Delta t}</math> <math display="block">= \frac{1,45 - 1,90}{15 - 0}</math> <math display="block">= -0,03 \text{ (mol} \cdot \text{dm}^{-3}) \cdot \text{min}^{-1}</math> </div>	(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<sup>-3</sup> ✓Accept range/Aanvaar gebied: 1,15 to/tot 1,25 mol·dm<sup>-3</sup>

(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/Nasiennriglyne**

- Use  $n = cV$  to calculate  $\Delta n/n(\text{initial})$  &  $n(\text{final})$ .  
*Gebruik  $n = cV$  om  $\Delta n/n(\text{aanvanklik})$  &  $n(\text{finaal})$  te bereken.*
- $\Delta n(\text{HCl}) = n(\text{final/finaal}) - n(\text{initial/aanvanklik})$ .  
*OR/OF*  
 $\Delta c(\text{HCl}) = c(\text{final/finaal}) - c(\text{initial/aanvanklik})$
- Use ratio/*Gebruik verhouding*  $n(\text{CH}_3\text{Cl}) : n(\text{HCl}) = 1 : 1$
- Substitute/*Vervang*  $50,5 \text{ g} \cdot \text{mol}^{-1}$  in  $n = \frac{m}{M}$ .
- Final answer/*Finale antwoord*: 3,54–4,0 g.

**OPTION 1/OPSIE 1**Mol initially/*begin*:

$$n(\text{HCl}) = cV \checkmark$$

$$= (1,9)(60 \times 10^{-3}) \checkmark$$

$$= 0,11 \text{ mol (0,114)}$$

Mol final/*finaal*:

$$n(\text{HCl}) = cV$$

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

$$= 0,04 \text{ mol (0,036)}$$

$$\Delta n(\text{HCl}) = 0,04 - 0,11 \checkmark$$

$$= -0,07 \text{ mol (0,078 mol)}$$

$$\Delta n(\text{HCl}) = 0,07 \text{ mol (0,078)}$$

$$n(\text{formed/gevorm}) = n(\text{reacted/reageer})$$

$$n(\text{CH}_3\text{Cl}) = n(\text{HCl}) \checkmark$$

$$= 0,07 \text{ mol}$$

$$m(\text{CH}_3\text{Cl}) = nM$$

$$= (0,07)(50,5) \checkmark$$

$$= 3,54 \text{ g} \checkmark$$

Accept range/*Aanvaar gebied*:  
3,54 – 4,0 g**OPTION 2/OPSIE 2**

$$\Delta c(\text{HCl}) = 0,6 - 1,9 \checkmark$$

$$= -1,3$$

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

$$\Delta n(\text{HCl}) = \Delta cV$$

$$= (1,3)(60 \times 10^{-3}) \checkmark$$

$$= 0,08 \text{ mol (0,078)}$$

$$n(\text{formed/gevorm}) = n(\text{reacted/reageer})$$

$$n(\text{CH}_3\text{Cl}) = n(\text{HCl}) \checkmark$$

$$= 0,08 \text{ mol}$$

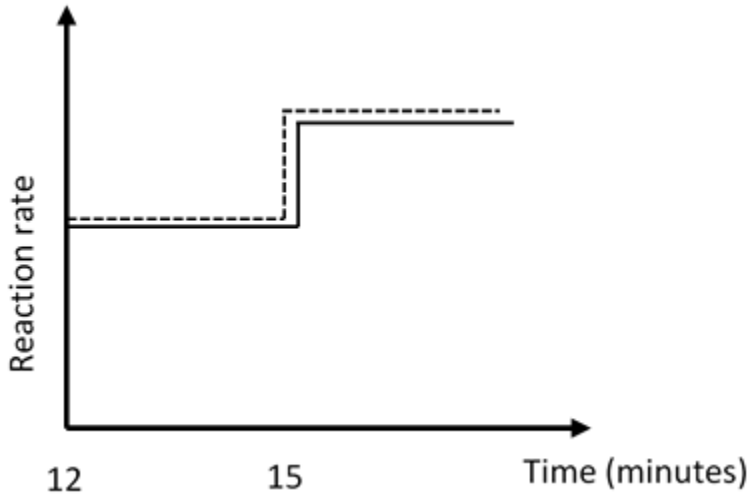
$$m(\text{CH}_3\text{Cl}) = nM$$

$$= (0,08)(50,5) \checkmark$$

$$= 4 \text{ g} \checkmark$$

Accept range/*Aanvaar gebied*:  
3,54 – 4,0 g(5)  
[19]

QUESTION 6																										
6.1	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. ✓ <i>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.</i>	(2)																								
6.2.1	<p>INCREASES ✓</p> <ul style="list-style-type: none"> <li>Increase in pressure favours the reaction that leads to smaller number of moles / volume of gas. ✓</li> <li>Forward reaction is favoured. ✓</li> </ul> <p>TOENEEM ✓</p> <ul style="list-style-type: none"> <li>Toename in druk bevoordeel die reaksie wat tot die kleiner getal mol / volume gas lei. ✓</li> <li>Voorwaartse reaksie word bevoordeel. ✓</li> </ul>	(3)																								
6.2.2	<p>DECREASES ✓</p> <ul style="list-style-type: none"> <li>An increase in temperature favours the endothermic reaction. ✓</li> <li>The reverse reaction is favoured. ✓</li> </ul> <p>AFNEEM ✓</p> <ul style="list-style-type: none"> <li>Die voorwaartse reaksie is eksotermies. 'n Toename in temperatuur bevoordeel die endotermiese reaksie. ✓</li> <li>Die terugwaartse reaksie word bevoordeel. ✓</li> </ul>	(3)																								
6.3.1	<p>Marking criteria:</p> <ol style="list-style-type: none"> <li>Values from graph / <i>Waardes op grafiek</i></li> <li>Calculation of <math>n(\text{O}_2)</math> / <i>Berekening van <math>n(\text{O}_2)</math></i></li> <li>Calculation of <math>n(\text{O}_2)</math> reacted / <i>Berekening van <math>n(\text{O}_2)</math> gereageer</i></li> <li>Ratio / <i>verhouding</i></li> <li>Equation of <math>K_c</math> / <i>Vergelyking van <math>K_c</math></i></li> <li>Substitution / <i>Substitusie van waardes</i></li> <li>Answer / <i>Antwoord</i></li> </ol> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th></th> <th>SO<sub>2</sub></th> <th>O<sub>2</sub></th> <th>SO<sub>3</sub></th> </tr> </thead> <tbody> <tr> <td>Ratio: / <i>Verhouding</i></td> <td>2</td> <td>1</td> <td>2</td> </tr> <tr> <td>n start: / <i>aanvanklik</i></td> <td>5</td> <td>3</td> <td>0</td> </tr> <tr> <td>n change / <i>veranderd</i></td> <td>-2,4</td> <td>-1,2</td> <td>+2,4</td> </tr> <tr> <td>n equilibrium / <i>ewewig</i></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> </tbody> </table>		SO <sub>2</sub>	O <sub>2</sub>	SO <sub>3</sub>	Ratio: / <i>Verhouding</i>	2	1	2	n start: / <i>aanvanklik</i>	5	3	0	n change / <i>veranderd</i>	-2,4	-1,2	+2,4	n equilibrium / <i>ewewig</i>	2,6	1,8	2,4	c = n/V	1,3	0,9	1,2	
	SO <sub>2</sub>	O <sub>2</sub>	SO <sub>3</sub>																							
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c = n/V	1,3	0,9	1,2																							

	$K_c = \frac{[SO_3]^2}{[SO_2]^2 [O_2]} = \frac{(1,2)^2}{(1,3)^2 (0,9)} = 0,95$	(7)
6.3.2	More oxygen added (conc of O <sub>2</sub> increased) ✓ / <i>Suurstof word by die sisteem gevoeg(konsentrasie van O<sub>2</sub> neem toe)</i>	(1)
6.3.3	NO CHANGE. ✓ / <i>geen verandering</i>	(1)
6.3.4	<ul style="list-style-type: none"> <li>Vertical parallel lines show a sudden increase in rate of both forward and reverse reactions at 15 minutes ✓</li> <li>Horizontal parallel lines showing a constant higher rate for both forward and reverse catalysed reactions after time 15 minutes. ✓ /</li> <li><i>Parallele vertikale wat 'n toename in beide voorwaartse en terugwaartse reaksies toon by 15 minute</i></li> <li><i>Horisontale paralelle lyne van beide voorwaartse en terugwaartse reaksie wat .n verhoogde reaksietempo toon na 15 minute</i></li> </ul> 	(2)
		[19]

QUESTION 7		
7.1.1	Sulphuric acid is a strong acid OR ionizes completely <i>Swawelsuur is 'n sterk suur OF ioniseer volledig</i>	(1)
7.1.2	Proton acceptor/protonakseptor	(1)
7.1.3	$\text{HSO}_4^-$	(1)
7.1.4	Sulphate / <i>sulfaat</i>	(1)
7.2.1	endpoint/ <i>endpunt/omslagpunt</i>	(1)
7.2.2	burette/ <i>buret</i>	(1)
7.2.3	decreases/ <i>neem af</i>	(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 ( $\text{OH}^-$ forms). ✓ <i>IDie reaksie is tussen 'n swak suur en 'n sterk basis. Daarom is die sout wat vorm basies en dit ondergaan hidrolise (<math>\text{OH}^-</math> vorm).</i>	(2)
7.3	$n = cV$ ✓ $= 0,01 \times 6$ ✓ $= 0,06 \text{ mol}$ ✓	(3)
7.3.2	$n(\text{NaOH}) = m/M$ $= 44/40$ $= 0,11 \text{ mol}$ $n(\text{H}_2\text{SO}_4) = 0,11 \times \frac{1}{2}$ $= 0,055 \text{ mol}$	(3)
7.3.3	$n(\text{H}_2\text{SO}_4) \text{ left} = 0,06 - 0,055$ ✓ $= 0,005 \text{ mol}$ $n(\text{H}_3\text{O}^+) = 0,005 \times 2$ ✓ $= 0,01 \text{ mol}$ $[\text{H}_3\text{O}^+] = n/V = 0,01 / 6$ ✓ $= 0,00166\dots \text{ mol.dm}^{-3}$ $\text{pH} = -\log [\text{H}_3\text{O}^+]$ ✓ $= -\log (0,00166\dots)$ ✓ $= 2,78$ ✓	(6) [21]

QUESTION 8			
8.1	8.1.1	$\text{Cl}_2(\text{g})$ / chlorine gas ✓ <i>chloorgas</i>	(1)
	8.1.2	$\text{Fe} \rightarrow \text{Fe}^{3+} + 3\text{e}^-$ ✓ ✓	(2)
	8.1.3	$\text{Fe} \mid \text{Fe}^{3+} \parallel \text{Cl}_2 \mid \text{Cl}^- ; \text{Pt}(\text{s})$ ✓ ✓ ✓	(3)
8.2		$E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$ ✓ $= 1,36 - (-0,06)$ ✓ $= 1,42 \text{ V}$ ✓	(3)
8.3		smaller than ✓, work done in moving the ions through the electrolyte ✓ / internal resistance in cell / loss in voltage  <i>Kleiner as ✓ – werk verrig deur die ione, deur die elektroliet / interne weerstand in sel / potensiaalverskil wat verlore gaan ✓</i>	(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) $m = n \times M$ ✓ $= 0,4$ ✓ $\times 63,5$ ✓ $= 25,4 \text{ g}$ ✓		(4)
9.2	25,4 g copper was oxidized ✓ % copper in impure sample = $25,4/28 \times 100 = 90,71\%$ ✓ ✓ The copper is not suitable. ✓		(4)
9.3	Silver and platinum both are much weaker reducing agents than copper. ✓		(1)
			[9]

QUESTION 10			
10.1	10.1.1	$\text{SO}_3 + \text{H}_2\text{SO}_4 \checkmark \rightarrow \text{H}_2\text{S}_2\text{O}_7 \checkmark \quad \text{Bal.} \checkmark$ <div style="border: 1px solid black; padding: 5px;"> <p><b>Notes/Aantekeninge</b></p> <ul style="list-style-type: none"> <li>• Reactants <math>\checkmark</math>      Products <math>\checkmark</math>      Balancing <math>\checkmark</math>  <i>Reaktanse              Produkte              Balansering</i></li> <li>• Ignore/Ignoreer =</li> <li>• Marking rule 3.9/Nasienreël 3.9</li> </ul> </div>	(3)
	10.1.2	<p>The reaction is (highly) exothermic/ produces toxic fumes / mist. <math>\checkmark</math>  <i>Die reaksie is (hoogs) eksotermies / vorm giftige dampe / mis.</i></p>	(1)
10.2	10.2.1	<p>Ammonium phosphate / <i>Ammoniumfosfaat</i> <math>\checkmark</math>  Highest percentage phosphorous. / <i>Hoogste persentasie fosfor.</i> <math>\checkmark</math></p>	(2)
	10.2.2	<ul style="list-style-type: none"> <li>• Excess fertiliser runs into water resources causing contamination of water resources/ eutrophication / higher concentration of nitrates in water / dead zones <math>\checkmark</math>  that can result in poor water quality / dying of fish / changing of habitats. <math>\checkmark</math>  <i>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.</i></li> <li>• Excess fertiliser in soil leads to eutrophication / change in acidity of soil / dead zones <math>\checkmark</math>  that can result in changing of natural growth / habitats. <math>\checkmark</math>  <i>Oormaat kunsmis in grond lei tot eutrofikasie / verandering in suurgehalte van grond / dooie sones wat tot verandering in natuurlike groei/habitatte kan lei.</i></li> </ul> <div style="border: 1px solid black; padding: 5px;"> <p><b>Marking guidelines/Nasienriglyne:</b></p> <ul style="list-style-type: none"> <li>• Immediate effect of excess fertiliser runoff in water. <math>\checkmark</math>  <i>Onmiddellike invloed van oormaat kunsmis wat in water afloop.</i></li> <li>• Effect of contaminated water on environment. <math>\checkmark</math>  <i>Invloed van besmette water op omgewing.</i></li> <li>• Immediate effect if excess fertiliser in soil. <math>\checkmark</math>  <i>Onmiddellike invloed van oormaat kunsmis in grond.</i></li> <li>• Effect of contaminated soil on environment. <math>\checkmark</math>  <i>Invloed van besmette grond op omgewing.</i></li> </ul> </div>	(2)
			[8]