



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 2017

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

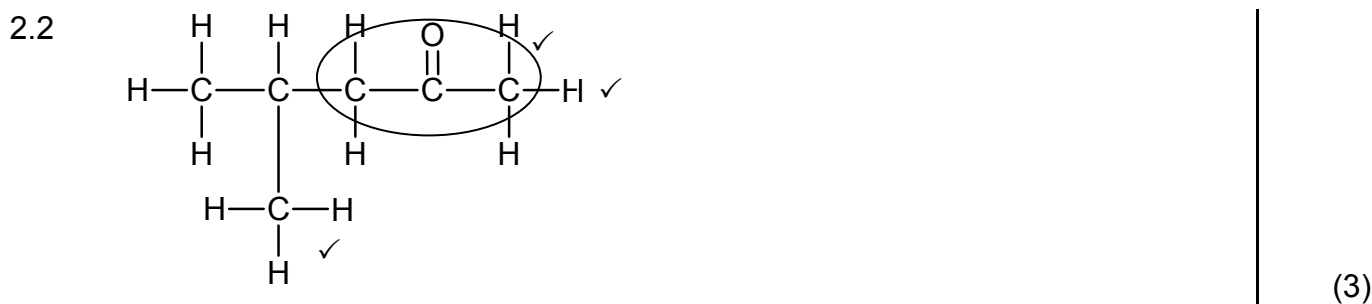
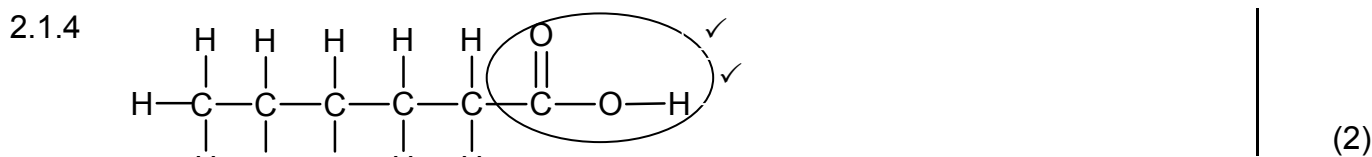
**These marking guidelines consist of 11 pages.
*Hierdie nasienriglyne bestaan uit 11 bladsye.***

QUESTION/VRAAG 1

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

QUESTION/VRAAG 2

- 2.1
- 2.1.1 Esters ✓ (1)
- 2.1.2 Ethyl ✓ butanoate ✓ / *Etielbutanoaat* (2)
- 2.1.3 Butanoic acid / *Butanoësuur* ✓ (1)



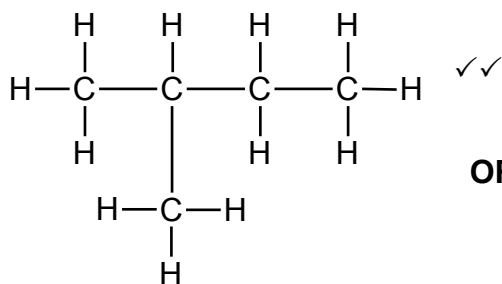
- 2.3
2.3.1 C_nH_{2n-2} ✓ (1)
- 2.3.2 5-ethyl-2,6-dimethylhept-3-yne/5-ethyl-2,6-dimethyl-3-heptyne
5-etiël-2,6-dimetiëlhept-3-yn/5-etiël-2,6-dimetiël-3-heptyn (3)

[13]

QUESTION/VRAAG 3

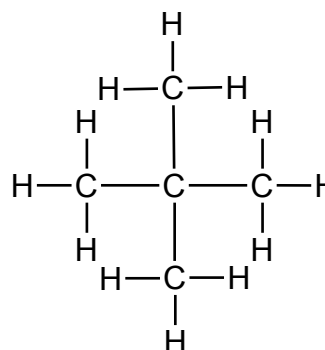
- 3.1 **ANY ONE/ENIGE EEN:**
- They have ONLY single bonds. ✓
Hulle het SLEGS enkelbindings.
 - They have single bonds between C atoms.
Hulle het enkelbindings tussen C-atome.
 - They have no double OR triple bonds OR multiple bonds.
Hulle het geen dubbel- OF trippelbindings OF meervoudige bindings nie.
 - They contain the maximum number of H atoms bonded to C atoms.
Hulle bevat die maksimum getal H-atome gebind aan C-atome.
 - Each C atom is bonded to four other atoms.
Elke C-atoom is gebind aan vier ander atome. (1)
- 3.2 The pressure exerted by a vapour in equilibrium with its liquid ✓ in a closed system. ✓
Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem. (2)
-
- 3.3
3.3.1 Increases/Verhoog ✓ (1)
- 3.3.2 Q ✓
It is the temperature where the graph intercepts the dotted line. ✓
Dit is die temperatuur waar die grafiek die stippellyn sny.
- OR/OF**
It is the temperature where the vapour pressure of compound **Q** equals atmospheric pressure/is equal to 760 mmHg.
*Dit is die temperatuur waar die dampdruk van verbinding **Q** gelyk is aan atmosferiese druk/gelyk is aan 760 mmHg.* (2)
- 3.3.3 S ✓
- At a given temperature, **S** has the lowest vapour pressure/highest boiling point. ✓
*By 'n gegewe temperatuur het **S** die laagste dampdruk/hoogste kookpunt.*
 - Strongest intermolecular forces/London forces/dispersion forces/induced dipole forces. ✓
Sterkste intermolekulêre kragte/London-kragte/dispersiekragte/geïnduseerde dipoolkragte.
 - Highest energy needed to overcome/break the intermolecular forces. ✓
Hoogste energie benodig om intermolekulêre kragte te oorkom/breek. (4)

3.4
3.4.1



2-methylbutane ✓
2-metielbutaan

OR/OF



2,2-dimethylpropane ✓
2,2-dimetielpropaan

(3)

3.4.2 Higher than/Hoër as ✓

(1)

[14]

QUESTION/VRAAG 4

4.1 Secondary/Sekondêre ✓

The C atom bonded to the –OH group is bonded to TWO other C atoms. ✓
Die C-atoom gebind aan die –OH-groep is aan TWEE ander C-atome gebind.

(2)

4.2

4.2.1 Dehydration ✓

Dehidrasie/dehidratering

(1)

4.2.2 Hydration ✓

Hidrasie/hidratering

(1)

4.2.3 Dehydrohalogenation/dehydrobromination ✓

Dehidrohalogenasie/dehidrohalogenering/dehidrobrominasie/
dehidrobrominerig

(1)

4.3

4.3.1 Substitution/Hydrolysis ✓

Substitusie/Hidrolise

(1)

4.3.2 • Dilute base/sodium hydroxide/NaOH ✓

Verdunde basis/natriumhidroksied/NaOH

• Moderate temperature/(mild) heat ✓

Matige temperatuur/(matige) hitte

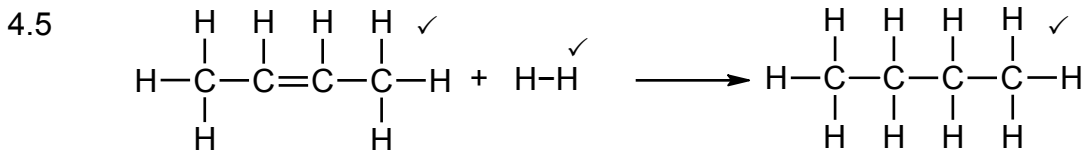
(2)

4.3.3 2-✓bromobutane ✓/2-bromobutaan

(2)

4.4 NaOH/KOH ✓

(1)



(3)

4.6 Butane/Butaan

(1)

[15]

QUESTION/VRAAG 5

5.1 **ANY ONE/ENIGE EEN:**

- Change in concentration of products/reactants per (unit) time. ✓✓
Verandering in konsentrasie van produkte/reaktanse per (eenheid) 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 (eenheid) 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 (eenheid) tyd.

(2)

5.2

Marking criteria/Nasienriglyne:	
Dependent and independent variables correctly identified. <i>Afhanklike en onafhanklike veranderlikes korrek geïdentifiseer.</i>	✓
Ask a question about the relationship between the independent and dependent variables./Vra 'n vraag oor die verwantskap tussen die afhanklike en onafhanklike veranderlikes.	✓

Examples/Voorbeelde:

- What is the relationship between concentration and reaction rate?
Wat is die verwantskap tussen konsentrasie en reaksietempo?
- How does the reaction rate change when the concentration changes/increases/decreases?
Hoe sal die reaksietempo verander wanneer die konsentrasie verander/verhoog/verlaag?

(2)

5.3 Q ✓

- Smaller gradient./Less steep. ✓
Kleiner gradiënt./Minder steil.
- Reaction **I** has the lowest HCl concentration and will take longer to reach completion/for the maximum volume of gas to be formed. ✓
*Reaksie **I** het die laagste HCl-konsentrasie en neem langer om voltooi te word/die maksimum volume gas te vorm.*

(3)

5.4

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
$\text{Ave rate/Gem. tempo} = \frac{\Delta V}{\Delta t}$ $15 = \frac{\Delta V}{30 - 0} \quad \checkmark$ $V(\text{H}_2)_{\text{produced/berei}} = 450 \text{ cm}^3$ $n(\text{H}_2)_{\text{produced/berei}} = \frac{V}{V_m}$ $= \frac{450}{24\,000} \quad \checkmark$ $= 0,0188 \text{ mol}$ $n(\text{Zn}) = n(\text{H}_2) = 0,0188 \text{ mol} \quad \checkmark$ $n(\text{Zn})_{\text{used/gebruik}} = \frac{m}{M}$ $\therefore 0,0188 = \frac{m}{65} \quad \checkmark$ $\therefore m(\text{Zn}) = 1,22 \text{ g} \quad \checkmark$	$\text{Ave rate/Gem. tempo} = \frac{15}{24\,000} \quad \checkmark$ $= 6,25 \times 10^{-4} \text{ mol}\cdot\text{s}^{-1}$ $V(\text{H}_2)_{\text{produced/berei}} = 6,25 \times 30 \quad \checkmark$ $= 0,0188 \text{ mol}$ $n(\text{Zn}) = n(\text{H}_2) = 0,0188 \text{ mol} \quad \checkmark$ $n(\text{Zn})_{\text{used}} = \frac{m}{M}$ $0,0188 = \frac{m}{65} \quad \checkmark$ $\therefore m(\text{Zn}) = 1,22 \text{ g} \quad \checkmark$
	<u>OPTION 3/OPSIE 3</u> $\text{Ave rate/Gem. tempo} = \frac{\Delta V}{\Delta t}$ $15 = \frac{\Delta V}{30 - 0} \quad \checkmark$ $V(\text{H}_2)_{\text{produced/berei}} = 450 \text{ cm}^3$ $65 \text{ g} \quad \checkmark \text{ Zn} \dots\dots\dots 24\,000 \text{ cm}^3 \quad \checkmark$ $x \text{ g Zn} \dots\dots\dots 450 \text{ cm}^3 \quad \checkmark$ $x = 1,22 \text{ g} \quad \checkmark$

(5)

5.5

5.5.1 Equal to/Gelyk aan \checkmark

(1)

5.5.2 Equal to/Gelyk aan \checkmark

(1)

5.6

- At higher temperature the average kinetic energy of particles is higher. \checkmark
By hoër temperatuur is die gemiddelde kinetiese energie van deeltjies hoër.
- More molecules gain sufficient/enough kinetic energy OR more molecules have kinetic energy equal to or greater than the activation energy. \checkmark
Meer molekule het voldoende/genoeg kinetiese energie OF meer molekule het kinetiese energie gelyk aan of groter as die aktiveringsenergie.
- More effective collisions per unit time./Frequency of effective collisions increases. \checkmark
Meer effektiewe botsings per eenheidtyd./Frekwensie van effektiewe botsings neem toe.

(3)

[17]

QUESTION/VRAAG 6

6.1 The stage in a chemical reaction when the rate of forward reaction equals the rate of reverse reaction. ✓✓

Die stadium in 'n chemiese reaksie wanneer die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie.

OR/OF

The stage in a chemical reaction when the concentrations of reactants and products remain constant. ✓✓

Die stadium in 'n chemiese reaksie wanneer die konsentrasies van reaktanse en produkte konstant bly.

(2)

6.2

6.2.1

OPTION 1/OPSIE 1

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

$$= \frac{1,12}{28} \checkmark$$

$$= 0,04 \text{ mol}$$

	COBr ₂	CO	Br ₂
Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i>		0	0
Change (mol) <i>Verandering (mol)</i>	0,04	0,04	0,04
Quantity at equilibrium (mol)/ <i>Hoeveelheid by ewewig (mol)</i>		0,04	0,04 ✓
Equilibrium concentration/ <i>Ewewigskonsentrasie (mol·dm⁻³)</i>		0,02	0,02

Divide by 2 ✓
Deel deur 2

$$K_c = \frac{[\text{CO}][\text{Br}_2]}{[\text{COBr}_2]} \checkmark$$

$$0,19 \checkmark = \frac{(0,02)^2}{[\text{COBr}_2]} \checkmark$$

$$[\text{COBr}_2] = 2,11 \times 10^{-3} \text{ mol·dm}^{-3} \checkmark$$

OPTION 2/OPSIE 2

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

$$= \frac{1,2}{28} \checkmark$$

$$= 0,04 \text{ mol}$$

$$n(\text{CO})_{\text{formed/gevorm}} = n(\text{Br}_2)_{\text{formed/gevorm}} \checkmark$$

$$= 0,04 \text{ mol}$$

$$c(\text{CO})_{\text{eq/ewe}} = c(\text{Br}_2)_{\text{eq/ewe}}$$

$$= \frac{n}{V}$$

$$= \frac{0,04}{2} \checkmark$$

$$= 0,02 \text{ mol} \cdot \text{dm}^{-3}$$

$$K_c = \frac{[\text{CO}][\text{Br}_2]}{[\text{COBr}_2]} \checkmark$$

$$0,19 \checkmark = \frac{(0,2)^2}{[\text{COBr}_2]} \checkmark$$

$$[\text{COBr}_2] = 2,11 \times 10^{-3} \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

(7)

6.2.2

OPTION 1/OPSIE 1

$$n(\text{COBr}_2)_{\text{eq/ewewig}} = cV$$

$$= 2,11 \times 10^{-3} \times 2 \checkmark$$

$$= 4,22 \times 10^{-3} \text{ mol}$$

$$n(\text{COBr}_2)_{\text{initial/begin}} \swarrow$$

$$= 0,04 + 4,22 \times 10^{-3} \checkmark$$

$$= 0,044 \text{ mol}$$

$$\% \text{ decomposed} = \frac{0,04 \checkmark}{0,044} \times 100$$

$$= 90,46\% \checkmark$$

Range/Gebied: 90,46 – 90,9%

OPTION 2/OPSIE 2

$$n(\text{COBr}_2)_{\text{eq/ewewig}} = cV$$

$$= 2,11 \times 10^{-3} \times 2 \checkmark$$

$$= 4,22 \times 10^{-3} \text{ mol}$$

$$n(\text{COBr}_2)_{\text{initial/begin}} \swarrow$$

$$= 0,04 + 4,22 \times 10^{-3} \checkmark$$

$$= 0,044 \text{ mol}$$

$$m(\text{COBr}_2)_{\text{initial/begin}} = nM$$

$$= 0,044 \times 188$$

$$= 8,27 \text{ g}$$

$$m(\text{COBr}_2)_{\text{reacted/reageer}} = 0,04 \times 188$$

$$= 7,52 \text{ g}$$

$$\% \text{ decomposed/ontbind} = \frac{7,52 \checkmark}{8,27} \times 100$$

$$= 90,9\% \checkmark$$

(4)

6.3 $K_c < 0,19$

(1)

6.4 Decreases/*Verminder* ✓

A decreases in pressure favours the reaction that produces the larger number of moles of gas. / *n Afname in druk bevoordeel die reaksie wat die groter aantal mol gas lewer.* ✓

The forward reaction will be favoured. / *Die voorwaartse reaksie sal bevoordeel word.* ✓

(3)

[17]

QUESTION/VRAAG 7

7.1

7.1.1 Weak/Swak ✓
 Dissociates/Ionises incompletely (in water) ✓
 Dissosieer/Ioniseer onvolledig (in water) (2)

7.1.2 NH₄⁺ ✓ (1)

7.1.3 H₂O/water **OR/OF** NH₃ ✓ (1)

7.2

7.2.1 Acidic/Suur ✓
 pH < 7 ✓ (2)

7.2.2	<p>OPTION 1/OPSIE 1</p> <p>pH = -log[H₃O⁺] ✓ 6 ✓ = -log[H₃O⁺] [H₃O⁺] = 1 × 10⁻⁶ mol·dm⁻³</p> <p>[H₃O⁺][OH⁻] = 10⁻¹⁴ ✓ [OH⁻] = 1 × 10⁻⁸ mol·dm⁻³ ✓</p>	<p>OPTION 2/OPSIE 2</p> <p>pH + pOH = 14 ✓ 6 ✓ + pOH = 14</p> <p>pOH = -log[OH⁻] ✓ 8 = -log[OH⁻] [OH⁻] = 1 × 10⁻⁸ mol·dm⁻³ ✓</p>	(4)
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7.3

	<p>OPTION 1/OPSIE 1</p> <p>$n(\text{Na}_2\text{CO}_3) = \frac{m}{M}$ ✓ $= \frac{0,29}{106}$ ✓ $= 2,74 \times 10^{-3} \text{ mol}$</p> <p>$n(\text{HCl}) = 2n(\text{Na}_2\text{CO}_3)$ ✓ $= 5,47 \times 10^{-3} \text{ mol}$</p> <p>$c(\text{HCl})_{\text{dilute/verduun}} = \frac{n}{V}$ $= \frac{5,47 \times 10^{-3}}{0,05}$ ✓ $= 0,1094 \text{ mol} \cdot \text{dm}^{-3}$</p> <p>$cV(\text{HCl})_{\text{dilute/verduun}} = cV(\text{HCl})_{\text{concl/gekons}}$ $0,1094 \times 500$ ✓ = (HCl)_{concl/gekons} × 5 ✓ $\therefore c(\text{HCl})_{\text{concl/gekons}} = 10,94 \text{ mol} \cdot \text{dm}^{-3}$ ✓</p>	<p>OPTION 2/OPSIE 2</p> <p>$n(\text{Na}_2\text{CO}_3) = \frac{m}{M}$ ✓ $= \frac{0,29}{106}$ ✓ $= 2,74 \times 10^{-3} \text{ mol}$</p> <p>$n(\text{HCl}) = 2n(\text{Na}_2\text{CO}_3)$ ✓ $= 5,47 \times 10^{-3} \text{ mol}$</p> <p>In 50 cm³: $n(\text{HCl}) = 5,47 \times 10^{-3} \text{ mol}$ In 500 cm³: $n(\text{HCl}) = \frac{500}{50} (5,47 \times 10^{-3})$ ✓ $= 0,547 \text{ mol}$</p> <p>$c(\text{HCl})_{\text{concl/gekons}} = 0,547 \times \frac{1000}{5}$ ✓ $= 10,94 \text{ mol} \cdot \text{dm}^{-3}$ ✓</p>	(7)
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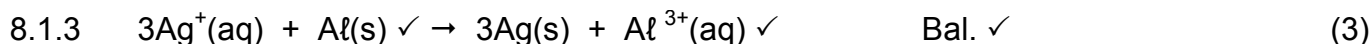
[17]

QUESTION/VRAAG 8

8.

8.1.1 Voltmeter/Multimeter ✓ (1)

8.1.2 Anode ✓ (1)



8.1.4

<p>OPTION 1/OPSIE 1</p> $E_{\text{cell}}^{\ominus} = E_{\text{reduction}}^{\ominus} - E_{\text{oxidation}}^{\ominus} \checkmark$ $= +0,80 \checkmark - (-1,66) \checkmark$ $= 2,46 \text{ V} \checkmark$						
<p>OPTION 2/OPSIE 2</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding: 5px;">$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$</td> <td style="padding: 5px; text-align: right;">0,80 V \checkmark</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">$\text{Al}(\text{s}) \rightarrow \text{Al}^{3+}(\text{aq}) + 3\text{e}^-$</td> <td style="padding: 5px; text-align: right;">1,66 V \checkmark</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">$3\text{Ag}^+(\text{aq}) + \text{Al}(\text{s}) \rightarrow 3\text{Ag}(\text{s}) + \text{Al}^{3+}(\text{aq})$</td> <td style="padding: 5px; text-align: right;">2,46 V \checkmark</td> </tr> </table>	$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$	0,80 V \checkmark	$\text{Al}(\text{s}) \rightarrow \text{Al}^{3+}(\text{aq}) + 3\text{e}^-$	1,66 V \checkmark	$3\text{Ag}^+(\text{aq}) + \text{Al}(\text{s}) \rightarrow 3\text{Ag}(\text{s}) + \text{Al}^{3+}(\text{aq})$	2,46 V \checkmark
$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$	0,80 V \checkmark					
$\text{Al}(\text{s}) \rightarrow \text{Al}^{3+}(\text{aq}) + 3\text{e}^-$	1,66 V \checkmark					
$3\text{Ag}^+(\text{aq}) + \text{Al}(\text{s}) \rightarrow 3\text{Ag}(\text{s}) + \text{Al}^{3+}(\text{aq})$	2,46 V \checkmark					

(4)

8.2
 8.2.1 Platinum/Pt/Carbon/C/Koolstof \checkmark (1)

8.2.2 **ANY TWO/ENIGE TWEE:**
 Concentration/Konsentrasie: $1 \text{ mol}\cdot\text{dm}^{-3} \checkmark$
 Temperature/Temperatuur: $25 \text{ }^{\circ}\text{C}/298 \text{ K} \checkmark$
 Pressure/Druk: $101,3 \text{ kPa}/1,01 \times 10^5 \text{ Pa}/1 \text{ atm}$ (2)

8.2.3 Zinc/Zn/sink \checkmark (1)

8.2.4 PQ \checkmark (1)
[14]

QUESTION/VRAAG 9

9.1 DC \checkmark (1)

9.2 Cathode/Katode \checkmark
 $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu} \checkmark\checkmark$

9.3 Cu^{2+} is a stronger oxidising agent \checkmark than Zn^{2+} ions \checkmark and therefore Zn^{2+} ions will not be reduced (to Zn). \checkmark
 Cu^{2+} is 'n sterker oksideermiddel as Zn^{2+} -ione en dus sal Zn^{2+} -ione nie gereduseer word nie (na Zn). (3)

9.4
 9.4.1 (Chlorine) gas/bubbles is/are formed. \checkmark
 (Chloor)gas/borrels vorm. (1)

9.4.2 Decreases/Verlaag \checkmark (1)
[9]

QUESTION 10/VRAAG 10

10.1

10.1.1 Ammonia/Ammoniak ✓ (1)

10.1.2 NO₂ ✓ (1)

10.1.3 Catalytic oxidation of ammonia ✓
Katalitiese oksidasie van ammoniak (1)

10.1.4 Platinum/Pt ✓ (1)

10.1.5 Ostwald (process)/Ostwald(proses)✓ (1)

10.1.6 Haber (process)/Haber(proses)✓ (1)

10.1.7 NH₃ + HNO₃ ✓ → NH₄NO₃ ✓ Bal. ✓ (3)

10.2

10.2.1	<u>OPTION 1/OPSIE 1</u> N : P : K 10 : 5 : 15 $m(\text{fertiliser/kunsmis}) = \frac{30}{100} \times 15$ $= 4,5 \text{ kg}$ $m(\text{P}) = \frac{5}{30} \times 4,5 \checkmark$ $= 0,75 \text{ kg} \checkmark$	<u>OPTION 2/OPSIE 2</u> $m(\text{fertiliser/kunsmis}) = \frac{5}{100} \times 15 \checkmark$ $= 0,75 \text{ kg} \checkmark$	(2)
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10.2.2 %fertiliser/kunsmis = 10 + 5 + 15 = 30%

%filler/bindstof = 100 – 30 = 70%

$m(\text{filler/bindstof}) = \frac{70}{100} \checkmark \times 15 \checkmark$
 $= 10,5 \text{ kg} \checkmark$ (3)

[14]

TOTAL/TOTAAL: 150