



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 2025

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 22 pages.
Hierdie nasienriglyne bestaan uit 22 bladsye.**

QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

- 2.1
- 2.1.1 D ✓ (1)
- 2.1.2 A and/en C ✓ (1)
- 2.1.3 E and/en F ✓ (1)

2.2

2.2.1

Marking criteria:

- Correct stem i.e. butanone. ✓
- Substituents (methyl) correctly identified. ✓
- IUPAC name is completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:

- *Korrekte stam, d.i. butanoon.*
- *Substituente (metiel) korrek geïdentifiseer.*
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.*

3-methylbutan-2-one ✓✓✓/3-methylbutanone

3-metielbutan-2-oon/3-metielbutanoon

ACCEPT/AANVAAR

3-methyl-2-butanone/ methylbutanone/3-metiel-2-butanoon/metielbutanoon (3)

2.2.2

Marking criteria:

- Correct stem i.e. heptane. ✓
- Substituents (dichloro and dimethyl) correctly identified. ✓
- IUPAC name is completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:

- *Korrekte stam, d.i. heptaan.*
- *Substituente (dichloro en dimetiel) korrek geïdentifiseer.*
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.*

2,6-dichloro-2,5-dimethylheptane ✓✓✓

2,6-dichloro-2,5-dimetielheptaan

(3)

2.2.3

Marking criteria:

- Correct stem i.e. hexene. ✓
- Substituents (ethyl and methyl) correctly identified. ✓
- IUPAC name is completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:

- *Korrekte stam, d.i. hekseen.*
- *Substituente (etiel en metiel) korrek geïdentifiseer.*
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.*

3-ethyl-2-methylhex-2-ene ✓✓✓/3-ethyl-2-methyl-2-hexene

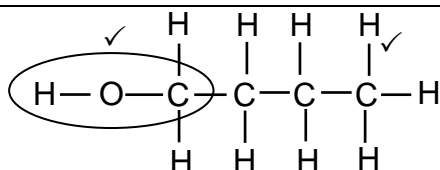
3-etiel-2-metielheks-2-een/3-etiel-2-metiel-2-hekseen

(3)

2.2.4

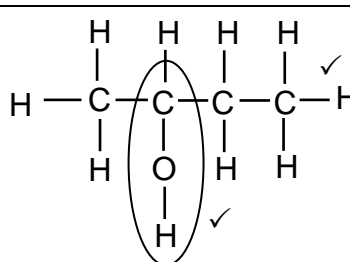
Marking criteria/Nasienkriteria:

- Hydroxyl group on the 1st C-atom. ✓
Hidroksiel groep op 1^{ste} C-atoom.
- Whole structure correct. ✓
Hele struktuur korrek.



Marking criteria/Nasienkriteria:

- Hydroxyl group on the 2nd C-atom. ✓
Hidroksiel groep op 2^{de} C-atoom.
- Whole structure correct. ✓
Hele struktuur korrek.



IF/INDIEN

- More than one functional group/wrong functional group: $0/2$ per molecule/*molekule*
Meer as een funksionele groep/foutiewe funksionele groep:
- Condensed structural formulae used
Gekondenseerde struktuurformules gebruik: Max/Maks. $2/4$
- Bond between O and H not shown, accept.
Binding tussen O en H nie gewys nie, aanvaar.

(4)

ACCEPT/ AANVAAR:Moles calculated using 22,4 dm³ or any other molar gas volume.*Mol bereken deur 22,4 dm³ of ander molêre gasvolume te gebruik.***Marking criteria:**

- (a) V(O₂) and V(C₃H₈)/
n(O₂) and n(C₃H₈) used. ✓
- (b) V(CO₂) and V(H₂O)/
n(CO₂) and n(H₂O) produced. ✓
- (c) V(O₂)/ n(O₂) remaining ✓
- (d) Addition of the three volumes/moles ✓
- (e) Correct final answer 66 cm³
or 0,066 dm³ ✓

Nasienkriteria:

- (a) V(O₂) en V(C₃H₈)/
n(O₂) en n(C₃H₈) gebruik. ✓
- (b) V(CO₂) en V(H₂O)/
n(CO₂) en n(H₂O) gevorm. ✓
- (c) V(O₂)/ n(O₂) wat oorbly ✓
- (d) Optel van drie volumes/moles ✓
- (e) Korrekte finale antwoord 66 cm³
of 0,066 dm³ ✓

$$n(\text{C}_3\text{H}_8) = \frac{V}{V_m} = \frac{0,008}{22,4} = 3,571 \times 10^{-4} \text{ mol}$$

$$n(\text{O}_2)_{\text{change}} = (5)3,571 \times 10^{-4} = 1,7855 \times 10^{-3} \text{ mol}$$

$$n(\text{O}_2)_{\text{change}} = \frac{V}{V_m} = \frac{1,7855 \times 10^{-3}}{22,4}$$

$$V(\text{O}_2)_{\text{change}} = 0,04 \text{ dm}^3$$

$$V(\text{O}_2)_{\text{remaining}} = 0,05 - 0,04 = 0,01 \text{ dm}^3 \quad \checkmark \text{ (a)}$$

$$n(\text{CO}_2) = (3) 3,571 \times 10^{-4} = 1,0713 \times 10^{-3} \text{ mol}$$

$$n(\text{CO}_2) = \frac{V}{V_m} = \frac{1,0713 \times 10^{-3}}{22,4}$$

$$V(\text{CO}_2) = 0,024 \text{ dm}^3$$

$$n(\text{H}_2\text{O}) = (4)3,571 \times 10^{-4} = 1,43 \times 10^{-3} \text{ mol} \quad \checkmark \text{ (b)}$$

$$n(\text{H}_2\text{O}) = \frac{V}{V_m} = \frac{1,43 \times 10^{-3}}{22,4}$$

$$V(\text{H}_2\text{O}) = 0,032 \text{ dm}^3$$

$$V_{\text{Total}} = 0,01 + 0,024 + 0,032 \quad \checkmark \text{ (d)}$$

$$= 0,066 \text{ dm}^3 \quad \checkmark \text{ (e)}$$

$$n(\text{C}_3\text{H}_8) = \frac{V}{V_m} = \frac{0,008}{22,4} = 3,571 \times 10^{-4} \text{ mol}$$

$$n(\text{O}_2)_{\text{change}} = (5)3,571 \times 10^{-4} = 1,7855 \times 10^{-3} \text{ mol} \quad \checkmark \text{ (a)}$$

$$n(\text{O}_2)_{\text{ini}} = \frac{V}{V_m} = \frac{0,05}{22,4} = 2,232 \times 10^{-3} \text{ mol}$$

$$n(\text{O}_2)_{\text{remaining}} = 2,232 \times 10^{-3} - 1,7855 \times 10^{-3} = 4,465 \times 10^{-4} \text{ mol} \quad \checkmark \text{ (c)}$$

$$n(\text{CO}_2) = (3)3,571 \times 10^{-4} = 1,0713 \times 10^{-3} \text{ mol}$$

$$n(\text{H}_2\text{O}) = (4) \times 3,571 \times 10^{-4} = 1,43 \times 10^{-3} \text{ mol} \quad \checkmark \text{ (b)}$$

$$n_{\text{Total}} = 4,465 \times 10^{-4} + 1,0713 \times 10^{-3} + 1,43 \times 10^{-3} \quad \checkmark \text{ (d)}$$

$$= 2,95 \times 10^{-3} \text{ mol}$$

$$n_{\text{Total}} = \frac{V}{V_m} = \frac{2,95 \times 10^{-3}}{22,4}$$

$$V_{\text{Total}} = 0,066 \text{ dm}^3 \quad \checkmark \text{ (e)}$$

(5)
[22]

QUESTION 3/VRAAG 3

- 3.1 A series of organic compounds that can be described by the same general formula. ✓ (1 OR 0)

OR

A series of organic compounds in which one member differs from the next by a CH₂ group.

'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word. (1 OF 0)

OR

'n Reeks organiese verbindings waarin die een lid van die volgende verskil met 'n CH₂-groep

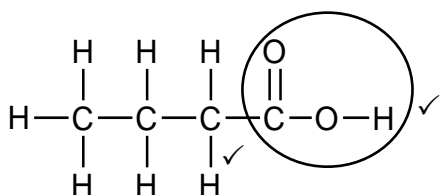
(1)

- 3.2 Ester ✓ and carboxylic acid ✓ / Ester en karboksielsuur

(2)

3.3

3.3.1



Marking criteria/Nasienkriteria:

(a) Functional group correct. ✓

Funksionele groep korrek.

(b) Whole structure correct. ✓

Hele struktuur korrek.

(2)

- 3.3.2 Methyl propanoate/Propyl methanoate/Ethyl ethanoate ✓✓ (2 OR/OF 0)
Metielpropanoaat/Propielmetanoaat/Etieleetanoaat

(2)

- 3.4.1 Hydrogen bonds / Waterstofbindings ✓

(1)

- 3.4.2 Dipole-dipole forces / Dipool-dipoolkragte ✓

(1)

- 3.5 A ✓

The hydrogen bond is stronger than the dipole-dipole force. ✓

OR

The dipole-dipole force is weaker than the hydrogen bonds.

OR

Compound A has stronger intermolecular forces (than B).

OR

Compound B has weaker intermolecular forces (than A).

Die waterstofbinding is sterker as die dipool-dipoolkrag.

OR

Die dipool-dipoolkragte is swakker as die waterstofbinding.

OR

Verbinding A het sterker intermolekulêre kragte (as B).

OR

Verbinding B het swakker intermolekulêre kragte (as A).

(2)

- 3.6 Decreases/Afneem ✓

(1)

[12]

QUESTION 4/VRAAG 4

4.1

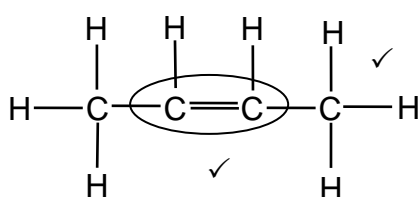
4.1.1 2-bromo✓butane✓/2-bromobutaan (2)

4.1.2 NaBr/Sodium bromide/Natriumbromied ✓ (1)

4.1.3 Addition/Addisie ✓
Hydrohalogenation/Hydrobromination/Hydrohalogenering/Hidrobrominering ✓ (2)

4.1.4 (Concentrated) sulphuric acid/ H₂SO₄/Phosphoric acid/H₃PO₄/
(Gekonsentreerde) swaelsuur/Fosforsuur ✓ (1)

4.1.5



Marking criteria/Nasienkriteria:

(a) Correct functional group. ✓

Funksionele groep korrek.

(b) Whole structure correct. ✓

Hele struktuur korrek.

IF/INDIEN

• More than one functional group/wrong functional group:

• Meer as een funksionele groep/foutiewe funksionele groep: 0/2

• Correct condensed formula:

Korrekte gekondenseerde formule Max: 1/2 (2)

4.1.6 Concentrated strong base/Gekonsentreerde sterk basis ✓
Concentrated/Gekonsentreerde NaOH/KOH/LiOH (1)

4.2

4.2.1

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.

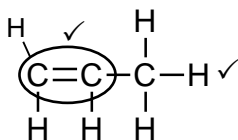
The underlined phrases must be in the correct context. / Die onderstreepte frases moet in die korrekte konteks wees.

The chemical process/reaction in which longer chain hydrocarbon/alkane molecules/ are broken down to shorter (more useful) molecules. ✓✓

Die chemiese proses/reaksie waarin langer kettingkoolwaterstof/alkaan- molekule afgebreek word in korter (meer bruikbare) molekules. (2)

4.2.2 Decolourisation/colour fades/becomes lighter in colour/colourless ✓
Ontkleuring/kleur raak dowwer/word ligter van kleur/kleurloos (1)

4.2.3

**Marking criteria/Nasienkriteria:**

- (a) Correct functional group. ✓
Funksionele groep korrek.
 (b) Whole structure correct. ✓
Hele struktuur korrek.

(2)

4.2.4 **X** / C₃H₆ / Propene / Propeen ✓

- **X** is unsaturated/has a double bond/is an alkene. ✓

ANY ONE

- **X** undergoes addition. ✓

OR

Alkenes are more reactive than alkanes/Unsaturated compounds react faster than saturated compounds.

Addition reaction is faster than substitution

Addition reaction does not need UV/light.

- **X** is onversadig/besit 'n dubbelbinding/is 'n alkeen.

ENIGE EEN

- **X** ondergaan addisie.

OF

Alkene is meer reaktief as alkane./Onversadigde verbindings reageer vinniger as versadigde verbindings.

Addisiereaksie is vinniger as substitusie.

Addisiereaksie benodig nie UV/lig.

(3)

[17]

QUESTION 5/VRAAG 5

5.1

NOTE/LET WEL

Give the mark for per unit time only if in context of reaction rate.

Gee die punt vir per eenheid tyd slegs indien in konteks met reaksietempo.

ANY ONE:

- Change in concentration ✓ of products/reactants per (unit) time. ✓
- Change in amount/number of moles/volume/mass of products or reactants per (unit) time.
- Amount/number of moles/volume/mass of products formed/reactants used per (unit) time.
- Rate of change in concentration/amount/number of moles/volume/mass. ✓✓ **(2 or 0)**

ENIGE EEN:

- Verandering in konsentrasie van produkte/reaktanse per (eenheid) tyd.
- Verandering in hoeveelheid/getal mol/volume/massa van produkte of reaktanse per (eenheid) tyd.
- Hoeveelheid/getal mol/volume/massa van produkte gevorm/reaktanse gebruik per (eenheid) tyd.
- Tempo van verandering in konsentrasie/ hoeveelheid/aantal mol/ volume/massa. **(2 of 0)**

(2)

5.2.1 10 (s) ✓

(1)

5.2.2

<p>Marking criteria</p> <p>(a) Calculate the change: $[O_2]_{\text{final}} - [O_2]_{\text{initial}} /$ $n(O_2)_{\text{final}} - n(O_2)_{\text{initial}} /$ $n(CO_2)_{\text{final}} - n(CO_2)_{\text{initial}}.$ ✓ Accept: 0,265 to 0,27 for $[O_2]_{\text{initial}}$</p> <p>(b) Substitute 10 s in rate formula. ✓</p> <p>(c) Multiply rate / concentration of O_2 by 3 dm^3. ✓</p> <p>(d) USE mol ratio: $n(O_2) : n(CO_2) = 1 : 2$ ✓</p> <p>(e) Final correct answer $= 0,072 \text{ (mol} \cdot \text{s}^{-1})$ ✓</p> <p>RANGE: 0,06 – 0,072</p>	<p>Nasienkriteria:</p> <p>(a) Bereken die verandering: $[O_2]_{\text{finale}} - [O_2]_{\text{aanvank}} /$ $n(O_2)_{\text{finale}} - n(O_2)_{\text{aanvanklik}} /$ $n(CO_2)_{\text{finale}} - n(CO_2)_{\text{aanvanklik}}$ ✓ Aanvaar: 0,265 tot 0,27 vir $[O_2]_{\text{aanvank}}$</p> <p>(b) Vervang 10 s in tempoformule. ✓</p> <p>(f) Vermenigvuldig tempo/konsentrasie O_2 met 3 dm^3. ✓</p> <p>(c) Gebruik molverhouding: $n(O_2) : n(CO_2) = 1 : 2$ ✓</p> <p>(d) Finale korrekte antwoord $= 0,072 \text{ (mol} \cdot \text{s}^{-1})$ ✓</p> <p>GEBIED: 0,06 – 0,072</p>
<p>OPTION 1/OPSIE 1:</p> $\text{Rate/Tempo} = - \frac{\Delta c(O_2)}{\Delta t}$ $= - \left(\frac{0,15 - 0,27}{10 - 0} \right) \text{ (a)}$ $= 0,012 \text{ mol} \cdot \text{dm}^{-3} \cdot \text{s}^{-1} \text{ (b)}$ <p>Rate/Tempo (O_2) in $\text{mol} \cdot \text{s}^{-1}$ $= cV$ $= (0,012)(3) \text{ (c)}$ $= 0,036 \text{ mol} \cdot \text{s}^{-1}$</p> <p>Rate/Tempo ($CO_2$) = 2 x rate ($O_2$) $= 2 \times 0,036 \text{ (d)}$ $= 0,072 \text{ (mol} \cdot \text{s}^{-1}) \text{ (e)}$</p>	<p>OPTION 2/OPSIE 2:</p> $\Delta c(O_2) = 0,27 - 0,15 \text{ (a)}$ $= 0,12 \text{ mol} \cdot \text{dm}^{-3}$ <p>$\Delta n(O_2) = cV$ $= 0,12(3) \text{ (c)}$ $= 0,36 \text{ mol}$</p> <p>$\Delta n(CO_2) = 2n(O_2) \text{ (d)}$ $= 2(0,36)$ $= 0,72 \text{ mol}$</p> <p>Rate(CO_2) = $\frac{\Delta n}{\Delta t}$ $= \frac{0,72}{10 - 0} \text{ (b)}$ $= 0,072 \text{ (mol} \cdot \text{s}^{-1}) \text{ (e)}$</p>
<p>OPTION 3/OPSIE 3:</p> <p>$n(O_2)_{\text{at } 0s} = cV$ $= 0,27 \times 3 \text{ (c)}$ $= 0,81 \text{ mol}$</p> <p>$n(O_2)_{\text{at } 10s} = cV$ $= 0,15 \times 3$ $= 0,45 \text{ mol}$</p> <p>Rate (O_2) = $-\frac{\Delta n}{\Delta t}$ $= - \left(\frac{0,45 - 0,81}{10 - 0} \right) \text{ (a)}$ $= 0,036 \text{ mol} \cdot \text{s}^{-1} \text{ (b)}$</p> <p>Rate ($CO_2$) = 2 x rate ($O_2$) $= 2 \times 0,036 \text{ (d)}$ $= 0,072 \text{ (mol} \cdot \text{s}^{-1}) \text{ (e)}$</p>	

(5)

5.2.3 O₂/Oxygen/Suurstof ✓ (1)

5.2.4 Increases/Neem toe ✓

Higher reaction rate./Concentration of reactants are higher. ✓
Hoër reaksietempo./Konsentrasie van die reaktanse is hoër.

ACCEPT/AANVAAR: pressure increased/*druk verhoog.* (2)

5.3.1 Absorption ✓
Absorpsie (1)

5.3.2 **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.

Unstable (high energy) transition state from reactants to products. ✓✓
Onstabiele (hoë energie) *oorgangs-toestand* van *reaktanse na produkte*

ACCEPT/AANVAAR:

Unstable (high energy) transition state between reactants and products. ✓✓
Onstabiele (hoë energie) *oorgangs-toestand* tussen *reaktanse en produkte*. (2)

5.3.3

- Catalyst provides an alternative path with lower activation energy / lowers the activation energy. ✓
- More particles have sufficient (kinetic) energy / kinetic energy greater (or equal to) activation energy. ✓
- More effective collisions per unit time/second. ✓

OR
Higher frequency of effective collisions.

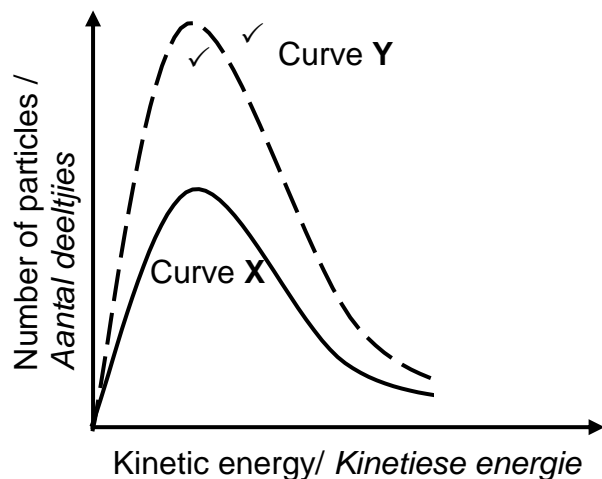
- *Katalisator verskaf 'n alternatiewe roete met 'n laer aktiveringsenergie/ Verlaag die aktiveringsenergie.*
- *Meer deeltjies het genoeg (kinetiese) energie/kinetiese energie groter (of gelyk aan) aktiveringsenergie.*
- *Meer effektiewe botsings per eenheid tyd/seconde.*

OF

Hoër frekwensie van effektiewe botsings. (3)

5.3.4 Remains the same/Bly dieselfde ✓ (1)

5.3.5



Marking criteria:

- Both curves start at origin and have correct shape with peaks at same E_k . ✓
- Peak of curve Y must be higher than curve X with peaks at same E_k . ✓

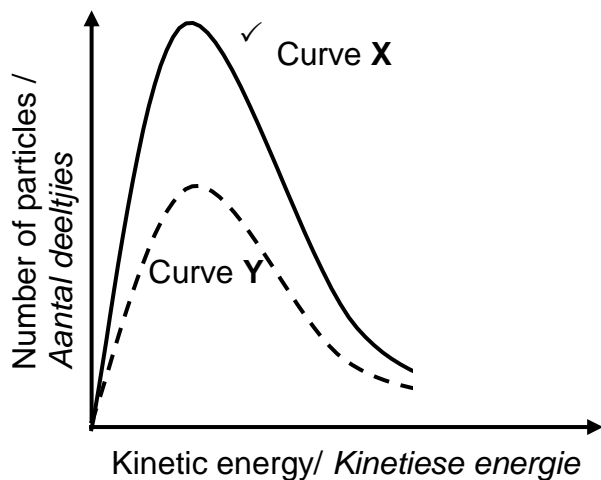
Nasienkriteria:

- Beide kurwes begin by die oorsprong en het dieselfde vorm met maksimums by dieselfde E_k .
- Maksimum van kurwe Y moet hoër wees as kurwe X met maksimums by dieselfde E_k .

IF/INDIEN:

- Both curves not labelled./ Beide kurwes nie benoem 0/2
- Curves intersect at any other point, beside the origin. Kurwes kruis by enige ander punt as oorsprong. Max: 1/2.

IF/INDIEN:



Max/Maks: 1/2

(2)
[20]

QUESTION 6/VRAAG 6

6.1

Marking criteria/Nasienkriteria:

6.1.1

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.

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)

6.1.2

(Mass) decreases./ (Massa) Afneem. ✓ (1)

6.1.3

- Decrease in amount of OH^- ions /concentration of OH^- ions, favours the reaction that increases the amount/concentration of OH^- ions. ✓ **OR**
Acid/ HCl/H^+ reacts with OH^- ions.

- The forward reaction is favoured ✓ **OR**
The amount/concentration of the products increases.

- 'n Afname in hoeveelheid OH^- -ione /konsentrasie OH^- -ione bevoordeel die reaksie wat die hoeveelheid/konsentrasie van OH^- -ione laat toeneem. **OF**
Suur HCl/H^+ reageer met OH^- ione.

- Die voorwaartse reaksie is bevoordeel. **OF**
Die hoeveelheid/konsentrasie van die produkte neem toe. (2)

6.2.1

Endothermic/Endotermies ✓ (1)

6.2.2

- With an increase in the temperature the K_c value increases. ✓
- The concentration of the products increases. **OR** Concentration of reactants decreases. **OR** The forward reaction is favoured. ✓
- (According to Le Chatelier's principle) an increase in temperature favours the endothermic reaction. ✓

- Met 'n toename in temperatuur neem die K_c -waarde toe.
- Die konsentrasie van die produkte neem toe. **OF** Konsentrasie van die reaktante neem af. **OF** Voorwaartse reaksie is bevoordeel.
- (Volgens Le Chatelier se beginsel) sal 'n toename in temperatuur die endotermiese reaksie bevoordeel. (3)

6.2.3

CALCULATIONS USING MOLES

BEREKENINGE WAT MOL GEBRUIK

Marking criteria:

- (a) Calculate number of moles NH_4HS ($\frac{70}{51}$) ✓ **OR** 1,37 moles
(b) **USING RATIO:** $\text{NH}_4\text{HS} : \text{NH}_3 : \text{H}_2\text{S} : = 1 : 1 : 1$ ✓
(c) Calculate $c(\text{NH}_3)$ and $c(\text{H}_2\text{S})$ at equilibrium (divide equilibrium moles by 3) ✓
(d) Correct K_c expression ✓
(e) Substitute $K_c = 18 \times 10^{-2}$ ✓
(f) $n(\text{NH}_4\text{HS})_{\text{eq}} = n(\text{NH}_4\text{HS})_{\text{in}} - n(\text{NH}_4\text{HS})_{\text{change}}$ **OR**
 $m(\text{NH}_4\text{HS})_{\text{eq}} = m(\text{NH}_4\text{HS})_{\text{in}} - m(\text{NH}_4\text{HS})_{\text{change}}$ ✓
(g) Substitute 51 in $n = \frac{m}{M}$ ✓
(h) **CORRECT** final answer: $m = 5,61 \text{ g}$ ✓
Range: 4,96 – 5,74 g

Nasienkriteria:

- (a) Bereken aantal mol NH_4HS ($\frac{70}{51}$) ✓ **OF** 1,37 mol
(b) **GEBRUIK VERHOUDING:** $\text{NH}_4\text{HS} : \text{NH}_3 : \text{H}_2\text{S} : = 1 : 1 : 1$ ✓
(c) Bereken $c(\text{NH}_3)$ en $c(\text{H}_2\text{S})$ by ewewig (deel ewewig mol met 3) ✓
(d) Korrekte K_c uitdrukking ✓
(e) Vervang $K_c = 18 \times 10^{-2}$ ✓
(f) $n(\text{NH}_4\text{HS})_{\text{eq}} = n(\text{NH}_4\text{HS})_{\text{in}} - n(\text{NH}_4\text{HS})_{\text{change}}$ **OF**
 $m(\text{NH}_4\text{HS})_{\text{eq}} = m(\text{NH}_4\text{HS})_{\text{in}} - m(\text{NH}_4\text{HS})_{\text{change}}$ ✓
(g) Vervang 51 in $n = \frac{m}{M}$ ✓
(h) **KORREKTE** finale antwoord: $m = 5,61 \text{ g}$ ✓
Gebied: 4,95 – 5,74 g

OPTION 1/OPSIE 1:

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

$$= \frac{70}{51} \quad \checkmark \text{(a)}$$

	$\text{NH}_4\text{HS}(\text{s})$	$\text{NH}_3(\text{g})$	$\text{H}_2\text{S}(\text{g})$	
Initial amount (mol) Aanvanklike hoeveelheid (mol)	1,37	0	0	
Change (mol) Verandering (mol)	x	x	x	✓(b)
Equilibrium amount (mol) Ewewig hoeveelheid (mol)	1,37 - x	x	x	
Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) Ewewigkonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)		$\frac{x}{3}$	$\frac{x}{3}$	✓(c)

$$K_c = [\text{NH}_3][\text{H}_2\text{S}] \quad \checkmark \text{(d)}$$

$$\checkmark \text{(e)} \quad 18 \times 10^{-2} = \left(\frac{x}{3}\right)^2$$

$$x = 1,27$$

$$n(\text{NH}_4\text{HS})_{\text{eq}} = 1,37 - 1,27 \quad \checkmark \text{(f)}$$

$$= 0,1 \text{ mol}$$

$$m(\text{NH}_4\text{HS})_{\text{eq}} = nM$$

$$= 0,1 \times 51 \quad \checkmark \text{(g)}$$

$$= 5,1 \text{ g} \quad \checkmark \text{(h)}$$

No K_c expression, correct substitution
Geen K_c -uitdrukking, korrekte substitusie:
Max./Maks. 7/8

Wrong K_c expression/
Verkeerde K_c -uitdrukking: Max./Maks. 6/8

OPTION 2/OPSIE 2:

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

$$= \frac{70}{51} \checkmark (a)$$

$$K_c = [\text{NH}_3][\text{H}_2\text{S}] \checkmark (d)$$

$$\checkmark (e) 18 \times 10^{-2} = x^2$$

$$x = 0,42$$

	NH ₄ HS(s)	NH ₃ (g)	H ₂ S(g)	
Initial amount (mol) Aanvanklike hoeveelheid (mol)	1,37	0	0	
Change (mol) Verandering (mol)	1,26	1,26	1,26	$\checkmark (b)$
Equilibrium amount (mol) Ewewig hoeveelheid (mol)	$\checkmark (f) 0,11$	1,26	1,26	
Equilibrium concentration (mol·dm ⁻³) Ewewigkonsentrasie (mol·dm ⁻³)		0,42	0,42	$\checkmark (c)$

$$m(\text{NH}_4\text{HS})_{\text{eq}} = nM$$

$$= 0,11 \times 51 \checkmark (g)$$

$$= 5,61 \text{ g} \checkmark (h)$$

OR/OF

$$m(\text{NH}_4\text{HS})_{\text{change}} = nM$$

$$= 1,26 \times 51 \checkmark (g)$$

$$= 64,26 \text{ g}$$

$$m(\text{NH}_4\text{HS})_{\text{eq}} = 70 - 64,26 \checkmark (f)$$

$$= 5,74 \text{ g} \checkmark (h)$$

No K_c expression, correct substitution
 Geen K_c - uitdrukking, korrekte substitusie:
 Max./Maks. 7/8

Wrong K_c expression/
 Verkeerde K_c -uitdrukking: Max./Maks. 6/8

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK

	NH ₄ HS(s)	NH ₃ (g)	H ₂ S(g)
Initial concentration (mol·dm ⁻³) Aanvanklike konsentrasie (mol·dm ⁻³)		0	0
Change (mol·dm ⁻³) Verandering (mol·dm ⁻³)		✓(b) x	x
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)		x	x

$$\begin{aligned} \checkmark(d) K_c &= [\text{NH}_3][\text{H}_2\text{S}] \\ \checkmark(e) 18 \times 10^{-2} &= x^2 \\ x &= 0,424 \text{ mol}\cdot\text{dm}^{-3} \end{aligned}$$

No K_c expression, correct substitution
Geen K_c-uitdrukking, korrekte substitusie: Max./Maks. 7/8

$$\begin{aligned} n\text{NH}_3(\text{change}) &= cV \\ &= (0,424)(3) \checkmark(c) \\ &= 1,272 \text{ mol} \end{aligned}$$

Wrong K_c expression/
Verkeerde K_c-uitdrukking: Max./Maks. 6/8

$$n(\text{NH}_4\text{HS})_{\text{change}} = n\text{NH}_3(\text{change}) = 1,272 \text{ mol}$$

$$\begin{aligned} \checkmark(a) \\ n(\text{NH}_4\text{HS})_{\text{eq}} &= \frac{70}{51} - 1,272 \checkmark(f) \\ &= 0,098 \text{ mol} \end{aligned}$$

$$\begin{aligned} m(\text{NH}_4\text{HS})_{\text{eq}} &= nM \\ &= 0,098 \times 51 \checkmark(g) \\ &= 4,998 \text{ g} \checkmark(h) \end{aligned}$$

OR/OF

$$\begin{aligned} m(\text{NH}_4\text{HS})_{\text{change}} &= nM \\ &= 1,272 \times 51 \checkmark(g) \\ &= 64,872 \text{ g} \end{aligned}$$

$$\begin{aligned} m(\text{NH}_4\text{HS})_{\text{eq}} &= 70 - 64,872 \checkmark(f) \\ &= 5,128 \text{ g} \checkmark(h) \end{aligned}$$

(8)
[17]

QUESTION 7/VRAAG 7

7.1.1 H_2PO_4^- ✓
 K_a of H_2PO_4^- greater/higher than K_a of HPO_4^{2-} ✓
Accept: K_a of H_2PO_4^- greater (2)

7.1.2 HPO_4^{2-} ✓ (1)

7.1.3 H_2PO_4^- **OR/OF** HPO_4^{2-} ✓ (1)

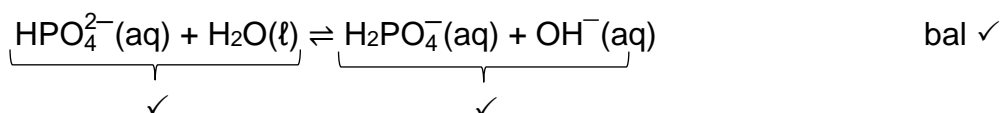
7.1.4 Basic/*Basies* ✓ (1)

7.1.5 **Marking criteria/Nasienkriteria:**

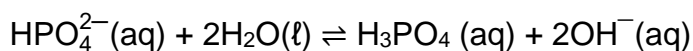
• Reactants ✓	Products ✓	Balancing ✓
Reaktanse ✓	Produkte ✓	Balansering ✓

- Ignore/*Ignoreer* → and phases/*en fases*

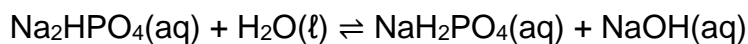
Marking rule 6.3.10/*Nasienreël 6.3.10*



OR/OF



ACCEPT/AANVAAR:



7.2.1

Marking criteria:	Nasienkriteria:
<p>a) Any formula: $\text{pH} = -\log[\text{H}_3\text{O}^+]$ / $\text{pH} = -\log[\text{H}^+] / [\text{H}_3\text{O}^+] = 10^{-\text{pH}}$ / $\text{pOH} = -\log[\text{OH}^-]$ / $[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ / $\text{pH} + \text{pOH} = 14$ ✓</p> <p>b) Substitute 12,62 in $\text{pH} = -\log[\text{H}_3\text{O}^+]$ / $\text{pH} + \text{pOH} = 14$ ✓</p> <p>c) Substitute calculated $[\text{H}_3\text{O}^+]$ in $[\text{H}_3\text{O}^+][\text{OH}^-]$ / 1,38 in $\text{pOH} = -\log[\text{OH}^-]$ ✓</p> <p>d) Final answer: $0,04 \text{ mol} \cdot \text{dm}^{-3}$ ✓ RANGE: $0,04 - 0,042 \text{ mol} \cdot \text{dm}^{-3}$</p>	<p>a) Enige formule: $\text{pH} = -\log[\text{H}_3\text{O}^+]$ / $\text{pH} = -\log[\text{H}^+] / [\text{H}_3\text{O}^+] = 10^{-\text{pH}}$ / $\text{pOH} = -\log[\text{OH}^-]$ / $[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ / $\text{pH} + \text{pOH} = 14$ ✓</p> <p>b) Vervang 12,62 in $\text{pH} = -\log[\text{H}_3\text{O}^+]$ / $\text{pH} + \text{pOH} = 14$ ✓</p> <p>c) Vervang berekende $[\text{H}_3\text{O}^+]$ in $[\text{H}_3\text{O}^+][\text{OH}^-]$ / 1,38 in $\text{pOH} = -\log[\text{OH}^-]$ ✓</p> <p>d) Finale antwoord: $0,04 \text{ mol} \cdot \text{dm}^{-3}$ ✓ GEBIED: $0,04 - 0,042 \text{ mol} \cdot \text{dm}^{-3}$</p>
<p>OPTION 1/OPSIE 1</p> <p>$\text{pH} = -\log[\text{H}_3\text{O}^+]$ 12,62 ✓ (b) $= -\log[\text{H}_3\text{O}^+]$ OR/OF $[\text{H}_3\text{O}^+] = 10^{-12,62}$ Any one/Enige een ✓ (a) $[\text{H}_3\text{O}^+] = 2,4 \times 10^{-13}$</p> <p>$[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ ✓ (c) $(2,4 \times 10^{-13})[\text{OH}^-] = 1 \times 10^{-14}$ $[\text{OH}^-] = 0,0417 \text{ mol} \cdot \text{dm}^{-3}$ ✓ (d) (0,04)</p>	
<p>OPTION 2/OPSIE 2</p> <p>$\text{pH} + \text{pOH} = 14$ ✓ (b) $12,62 + \text{pOH} = 14$ Any one/Enige een ✓ (a) $\text{pOH} = 1,38$</p> <p>$\text{pOH} = -\log[\text{OH}^-]$ 1,38 ✓ (c) $= -\log[\text{OH}^-]$ $[\text{OH}^-] = 0,042 \text{ mol} \cdot \text{dm}^{-3}$ ✓ (d) (0,04)</p>	

(4)

7.2.2

**POSITIVE MARKING FROM QUESTION 7.2.1/
POSITIEWE NASIEN VANAF VRAAG 7.2.1**

<p>Marking criteria</p> <p>(a) Substitute: $0,2 \text{ mol} \cdot \text{dm}^{-3}$ AND $0,015 \text{ dm}^3$ in $n = cV$ ✓</p> <p>(b) USING RATIO: $n(\text{OH}^-) : n\text{HCl} = 1 : 1 / n(\text{Ba}(\text{OH})_2) :$ $n(\text{HCl}) = 1 : 2$ ✓</p> <p>(c) Substitute: $c(\text{OH}^-)$ AND $0,04$ in $n = cV$ ✓</p> <p>(d) Calculate $n(\text{OH}^-)_{\text{ini}}$ $= n(\text{OH}^-)_{\text{reacted with HCl}} + n(\text{OH}^-)_{\text{fin}}$ ✓✓</p> <p>(e) USING RATIO: $n(\text{Ba}(\text{OH})_2) : n(\text{OH}^-) = 1 : 2$ ✓</p> <p>(f) Multiply $n\text{Ba}(\text{OH})_2$ in 25 cm^3 by 4 OR Divide by $0,025 \text{ dm}^3$ AND multiply by $0,1 \text{ dm}^3$ ✓</p> <p>(g) Final correct answer: $9,34 \times 10^{-3} \text{ mol}$ ✓ Range: $9,2 \times 10^{-3} - 9,36 \times 10^{-3}$</p>	<p>Nasienkriteria:</p> <p>(a) Vervang: $0,2 \text{ mol} \cdot \text{dm}^{-3}$ EN $0,015 \text{ dm}^3$ in $n = cV$ ✓</p> <p>(b) GEBRUIK VERHOUDING: $n(\text{OH}^-) : n\text{HCl} = 1 : 1 / n(\text{Ba}(\text{OH})_2) :$ $n(\text{HCl}) = 1 : 2$ ✓</p> <p>(c) Vervang: $c(\text{OH}^-)$ EN $0,04$ in $n = cV$ ✓</p> <p>(d) Bereken $n(\text{OH}^-)_{\text{ini}}$ $= n(\text{OH}^-)_{\text{reageer met HCl}} + n(\text{OH}^-)_{\text{finale}}$ ✓✓</p> <p>(e) GEBRUIK VERHOUDING: $n(\text{Ba}(\text{OH})_2) : n(\text{OH}^-) = 1 : 2$ ✓</p> <p>(f) Vermenigvuldig $n\text{Ba}(\text{OH})_2$ in 25 cm^3 met 4 OF Deel deur $0,025 \text{ dm}^3$ EN vermenigvuldig met $0,1 \text{ dm}^3$</p> <p>(g) Finale korrekte antwoord: $9,34 \times 10^{-3} \text{ mol}$ ✓ Gebied: $9,2 \times 10^{-3} - 9,36 \times 10^{-3}$</p>
<p>OPTION 1/OPSIE 1</p> <p>$n\text{HCl} = cV$ $= (0,2)(0,015)$ ✓(a) $= 3 \times 10^{-3} \text{ mol}$</p> <p>$n\text{OH}^- = n\text{HCl}$ ✓(b) $= 3 \times 10^{-3} \text{ mol}$</p> <p>$n\text{OH}^-_{\text{final}} = cV$ $= (0,0417)(0,04)$ ✓(c) $= 1,67 \times 10^{-3} \text{ mol}$</p> <p>$n\text{OH}^-_{\text{ini}} = 3 \times 10^{-3} + 1,67 \times 10^{-3}$ ✓✓(d) $= 4,67 \times 10^{-3} \text{ mol}$</p> <p>$n\text{Ba}(\text{OH})_2 = \frac{1}{2} n\text{OH}^-_{\text{ini}}$ $= \frac{1}{2} (4,67 \times 10^{-3})$ ✓(e) $= 2,33 \times 10^{-3} \text{ mol in } 25 \text{ cm}^3$</p> <p>In $100 \text{ cm}^3 = (4)(2,33 \times 10^{-3})$ ✓(f) $= 9,34 \times 10^{-3} \text{ mol}$ ✓(g)</p>	<p>OPTION 2/OPSIE 2</p> <p>$n\text{HCl} = cV$ $= (0,2)(0,015)$ ✓(a) $= 3 \times 10^{-3} \text{ mol}$</p> <p>$n\text{Ba}(\text{OH})_2 = \frac{1}{2} n\text{HCl}$ $= \frac{1}{2} (3 \times 10^{-3})$ ✓(b) $= 1,5 \times 10^{-3} \text{ mol}$</p> <p>$n\text{OH}^-_{\text{final}} = cV$ $= (0,0417)(0,04)$ ✓(c) $= 1,67 \times 10^{-3} \text{ mol}$</p> <p>$n\text{Ba}(\text{OH})_2 = \frac{1}{2} n\text{OH}^-_{\text{ini}}$ $= \frac{1}{2} (1,67 \times 10^{-3})$ ✓(e) $= 8,33 \times 10^{-4} \text{ mol}$</p> <p>$n\text{Ba}(\text{OH})_2_{\text{ini}} = 1,5 \times 10^{-3} + 8,33 \times 10^{-4}$ ✓✓(d) $= 2,33 \times 10^{-3} \text{ mol in } 25 \text{ cm}^3$</p> <p>In $100 \text{ cm}^3 = (4)(2,33 \times 10^{-3})$ ✓(f) $= 9,34 \times 10^{-3} \text{ mol}$ ✓(g)</p>

OPTION 3/OPSIE 3:

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

$$= (0,2)(0,015) \checkmark \text{(a)}$$

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

$$n\text{Ba(OH)}_2 = \frac{1}{2} n\text{HCl}$$

$$= \frac{1}{2} (3 \times 10^{-3}) \checkmark \text{(b)}$$

$$= 1,5 \times 10^{-3} \text{ mol}$$

$$c\text{Ba(OH)}_2 = \frac{1}{2} c\text{OH}^-_{\text{final}} \checkmark \text{(e)}$$

$$= \frac{1}{2} (0,0417)$$

$$= 0,02085 \text{ mol} \cdot \text{dm}^{-3}$$

$$n\text{Ba(OH)}_2 = cV$$

$$= (0,02085 \times 0,04) \checkmark \text{(c)}$$

$$= 8,34 \times 10^{-4} \text{ mol}$$

$$n\text{Ba(OH)}_{2 \text{ ini}} = 1,5 \times 10^{-3} + 8,34 \times 10^{-4} \checkmark \checkmark \text{(d)}$$

$$= 2,34 \times 10^{-3} \text{ mol in } 25 \text{ cm}^3$$

$$\text{In } 100 \text{ cm}^3 = (4)(2,34 \times 10^{-3}) \checkmark \text{(f)}$$

$$= 9,36 \times 10^{-3} \text{ mol} \checkmark \text{(g)}$$

$\checkmark \text{(g)}$ in all options/in alle opsies:

$$n\text{Ba(OH)}_2 \text{ in } 25 \text{ cm}^3 = cV$$

$$2,33 \times 10^{-3} \text{ mol} = c(0,025)$$

$$c\text{Ba(OH)}_2 \text{ in } 25 \text{ cm}^3 = 0,0936 \text{ mol} \cdot \text{dm}^{-3}$$

$$n\text{Ba(OH)}_2 \text{ in } 100 \text{ cm}^3 = cV$$

$$= (0,0936)(0,1)$$

$$= 0,0936 \text{ mol}$$

(8)
[20]

QUESTION 8/VRAAG 8

8.1 ANY ONE:

- A substance whose (aqueous) solution contains ions. $\checkmark \checkmark$ (2 OR/OF 0)
- Substance that dissolves in water to give a solution that conducts electricity (through movement of ions).

OR

- A substance that dissociates to form ions in water/in molten state.

ENIGE EEN:

- 'n Stof waarvan die (waterige) oplossing ione bevat.
- 'n Stof wat in water oplos om 'n oplossing te vorm wat elektrisiteit gele (deur die beweging van ione).

OF

- 'n Stof wat dissosieer om ione in water te vorm/in gesmelte toestand

(2)

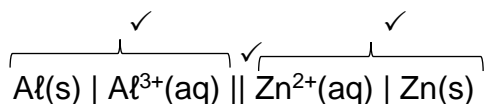
8.2 Al^{3+} /Aluminium ion/ioon \checkmark

Al is oxidised OR Al is a stronger reducing agent. \checkmark

Al is geoksideer OF Al is 'n sterker reduseermiddel.

(2)

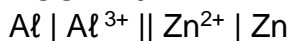
8.3



OR/OF



ACCEPT/AANVAAR



(3)

8.4

<p>Marking criteria</p> <p>(a) Calculate $n(\text{Al}^{3+})$ ✓</p> <p>(b) USE mol ratio: $n\text{Al}_2(\text{SO}_4)_3 : n\text{Al}^{3+} = 1 : 2$ ✓</p> <p>(c) Multiply $n\text{Al}_2(\text{SO}_4)_3$ by $M = 342$ ✓</p> <p>(d) Final correct answer $= 42,75 \text{ g}$ ✓</p>	<p>Nasienkriteria:</p> <p>(a) Bereken $n(\text{Al}^{3+})$ ✓</p> <p>(b) Gebruik molverhouding: $n\text{Al}_2(\text{SO}_4)_3 : n\text{Al}^{3+} = 1 : 2$ ✓</p> <p>(c) Vermenigvuldig $n\text{Al}_2(\text{SO}_4)_3$ met $M = 342$ ✓</p> <p>(d) Finale korrekte antwoord $= 42,75 \text{ g}$ ✓</p>
<p>OPTION 1/OPSIE 1:</p> <p>$n(\text{Al}^{3+}) = cV$ $= (1)(0,25)$ ✓ (a) $= 0,25 \text{ mol}$</p> <p>$n\text{Al}_2(\text{SO}_4)_3 = \frac{1}{2} n(\text{Al}^{3+})$ $= \frac{1}{2} (0,25)$ ✓ (b) $= 0,125 \text{ mol}$</p> <p>$n\text{Al}_2(\text{SO}_4)_3 = \frac{m}{M}$ $0,125 = \frac{m}{342}$ ✓ (c) $m = 42,75 \text{ g}$ ✓ (d)</p>	<p>OPTION 2/OPSIE 2:</p> <p>$c = \frac{m}{VM}$ $1 = \frac{m}{(0,25)(342)}$ ✓ (a) ✓ (c) $m = 85,5 \text{ g}$</p> <p>$\text{Al}_2(\text{SO}_4)_3 \rightarrow 2 \text{ mol} \cdot \text{dm}^{-3} \text{ Al}^{3+}$ $m(\text{Al}_2(\text{SO}_4)_3) = \frac{1}{2} (85,5)$ ✓ (b) $= 42,75 \text{ g}$ ✓ (d)</p>

(4)
[11]

QUESTION 9/VRAAG 9

9.1 Electrolytic/*Elektrolitiese* ✓ (1)

9.2.1 Increases/*Neem toe* ✓ (1)

9.2.2 Decrease ✓

- More copper (II) ions/ Cu^{2+} are reduced than formed./ Only copper (II) ions/ Cu^{2+} are reduced. ✓
- Copper (II) ion/ Cu^{2+} is a stronger oxidising agent than the zinc (II) ion/ Zn^{2+} ✓

OR

Zinc (II) ion/ Zn^{2+} is a weaker oxidising agent than the copper (II) ion/ Cu^{2+}

Afneem

- Meer koper(II)ione/ Cu^{2+} word gereduseer as wat gevorm word./ Slegs koper(II)ione/ Cu^{2+} word gereduseer.
- Koper(II)ioon/ Cu^{2+} is 'n sterker oksideermiddel as die sink(II)ioon/ Zn^{2+}

OF

Sink(II)ioon/ Zn^{2+} is 'n swakker oksideermiddel as die koper(II)ioon/ Cu^{2+}

(3)

9.2.3

Marking criteria	Nasienkriteria:
(a) USING RATIO: $n(\text{Cu}^{2+}) : n(\text{Zn}^{2+}) = 1 : 1$ ✓	(a) GEBRUIK VERHOUDING ✓ $n(\text{Cu}^{2+}) : n(\text{Zn}^{2+}) = 1 : 1$
(b) Formula: $n = \frac{m}{M}$ ✓	(b) Formule: $n = \frac{m}{M}$ ✓
(c) Substitute 65 AND $n(\text{Zn}^{2+})$ in $n = \frac{m}{M}$ ✓	(c) Vervang 65 EN $n(\text{Zn}^{2+})$ in $n = \frac{m}{M}$ ✓
(d) Subtraction of moles ✓	(d) Aftrek van aantal mol ✓
(e) Substitute 63,5 AND $n(\text{Cu})$ in $n = \frac{m}{M}$ ✓	(e) Vervang 63,5 EN $n(\text{Cu})$ in $n = \frac{m}{M}$ ✓
(f) Final correct answer: <u>9,6 g</u> ✓ (NO RANGE)	(f) Finale korrekte antwoord: <u>9,6 g</u> ✓ (GEEN GEBIED)

$$n(\text{Zn}^{2+}) = n(\text{Cu}^{2+}) \\ = 0,05 \text{ mol} \quad \checkmark \text{(a)}$$

$$m(\text{Zn}) = nM \quad \checkmark \text{(b)} \\ = (0,05)(65) \quad \checkmark \text{(c)} \\ = 3,25 \text{ g Zn from R}$$

$$0,15 - 0,05 \quad \checkmark \text{(d)} = 0,1 \text{ mol Cu} \\ m(\text{Cu}) = nM \\ = (0,1)(63,5) \quad \checkmark \text{(e)} \\ = 6,35 \text{ g Cu from R}$$

$$\text{Change in mass} = 6,35 + 3,25 \\ = 9,6 \text{ g} \quad \checkmark \text{(f)} \quad (\text{decrease in mass})$$

(6)
[11]

TOTAL/TOTAAL: 150