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.

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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. ✓

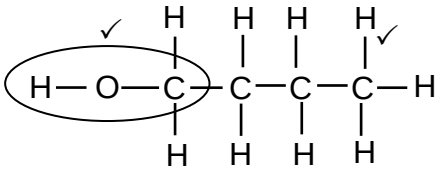
Nasienkriteria:
- *Korrekte stam, d.i. hekseen.*
- *Substituente (etiel en metiel) korrek geïdentifiseer.*
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.*

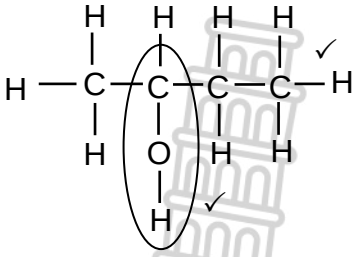
3-ethyl-2-methylhex-2-ene ✓✓✓/3-ethyl-2-methyl-2-hexene

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

2.2.4

Marking criteria/*Nasienkriteria:*	**Marking criteria/*Nasienkriteria:***
• Hydroxyl group on the 1st C-atom. ✓ *Hidroksiel groep op 1ste C-atoom.* • Whole structure correct. ✓ *Hele struktuur korrek.*	• Hydroxyl group on the 2nd C-atom. ✓ *Hidroksiel groep op 2de 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)

2.3.1 Combustion/oxidation/*Verbranding/oksidasie* ✓ (1)

2.3.2

Marking criteria:	***Nasienkriteria:***
(a) Volume O_2 and C_3H_8 used. ✓	*(a) Volume O_2 en C_3H_8 gebruik.* ✓
(b) Volume CO_2 and H_2O produced✓	*(b) Volume CO_2 en H_2O gevorm*✓
(c) Volume O_2 remaining ✓	*(c) Volume O_2 wat oorbly* ✓
(d) Addition of the three volumes ✓	*(d) Optel van drie volumes* ✓
(e) Correct final answer 66 cm^3 or 0,066 dm^3 ✓	*(e) Korrekte finale antwoord 66 cm^3 of 0,066 dm^3* ✓

OPTION 1/*OPSIE 1*:

$V(O_2)_{used/gebruik} = 5V(C_3H_8)$
$= (5)(8)$
$= 40\ cm^3$ ✓ **(a)**

$V(CO_2)_{formed/gevrom} = 3V(C_3H_8)$
$= (3)(8)$
$= 24\ cm^3$

$V(H_2O)_{formed/gevrom} = 4V(C_3H_8)$
$= (4)(8)$
$= 32\ cm^3$
✓ **(b)**

$V(O_2)_{unused} = 50 - 40 = 10\ cm^3$ ✓ **(c)**

Volume gas in the container = 10 + 24 + 32 ✓ **(d)**
Total volume gas in the container = 66 cm^3 ✓ **(e)**

OPTION 2/ *OPSIE 2*:

	C_3H_8	O_2	CO_2	H_2O
Initial volume (cm^3) *Aanvanklike volume (*cm^3*)*	8	50	0	0
Change volume (cm^3) ✓ **(a)** *Verandering in volume (*cm^3*)*	-8	-40	24	32 ✓ **(b)**
Final volume (cm^3) *Finale volume (*cm^3*)*	0	10 ✓ **(c)**	24	32
Total volume of gases in container (cm^3) *Totale volume gas in houer (*cm^3*)*		10 + 24 +32 ✓ **(d)** = 66 cm^3 ✓ **(e)**		

ACCEPT/AANVAAR:
If subtraction not shown, give mark for the 10 *cm^3*/
Indien aftrekking nie getoon, gee punt vir 10 cm^3.

$n(C_3H_8) : n(O_2) : n(CO_2) : n(H_2O)$
1 : 5 : 3 : 4

V = 8 ✓ **(a)** 40 24 ✓ **(b)** 32

✓ **(c)**

Total volume = 10 + 24 + 32 ✓ **(d)**
= 66 cm^3 ✓ **(e)**

ACCEPT/ *AANVAAR*:
Moles calculated using 22,4 dm^3 or any other molar gas volume.
Mol bereken deur 22,4 dm^3 of ander molêre gasvolume te gebruik.

Marking criteria:	***Nasienkriteria:***
(a) $V(O_2)$ and $V(C_3H_8)$/ $n(O_2)$ and $n(C_3H_8)$ used. ✓ (b) $V(CO_2)$ and $V(H_2O)$/ $n(CO_2)$ and $n(H_2O)$ produced. ✓ (c) $V(O_2)$/ $n(O_2)$ remaining ✓ (d) Addition of the three volumes/moles ✓ (e) Correct final answer 66 cm^3 or 0,066 dm^3 ✓	*(a) $V(O_2)$ en $V(C_3H_8)$/ $n(O_2)$ en $n(C_3H_8)$ gebruik.* ✓ *(b)* $V(CO_2)$ en $V(H_2O)$/ $n(CO_2)$ en $n(H_2O)$ gevorm.✓ *(c) $V(O_2)$/ $n(O_2)$ wat oorbly* ✓ *(d) Optel van drie volumes/moles* ✓ *(e) Korrekte finale antwoord 66 cm^3* of 0,066 dm^3 ✓
$n(C_3H_8) = \frac{V}{V_m}$ $= \frac{0,008}{22,4}$ $= 3,571\times10^{-4}$ mol $n(O_2)_{change} = (5)3,571 \times 10^{-4}$ $= 1,7855 \times 10^{-3}$ mol $n(O_2)_{change} = \frac{V}{V_m}$ $1,7855 \times 10^{-3} = \frac{V}{22,4}$ $V(O_2)_{change} = 0,04\ dm^3$ ✓ **(a)** $V(O_2)_{remaining} = 0,05 - 0,04$ $= 0,01\ dm^3$ ✓ **(c)** $n(CO_2) = (3)\ 3,571\times10^{-4}$ $= 1,0713 \times 10^{-3}$ mol $n(CO_2) = \frac{V}{V_m}$ $1,0713 \times 10^{-3} = \frac{V}{22,4}$ $V(CO_2) = 0,024\ dm^3$ $n(H_2O) = (4)3,571\times10^{-4}$ $= 1,43 \times 10^{-3}$ mol $n(H_2O) = \frac{V}{V_m}$ $1,43 \times 10^{-3} = \frac{V}{22,4}$ $V(H_2O) = 0,032\ dm^3$ ✓ **(b)** $V_{Total} = 0,01 + 0,024 + 0,032$ ✓ **(d)** $= 0,066\ dm^3$ ✓ **(e)**	$n(C_3H_8) = \frac{V}{V_m}$ $= \frac{0,008}{22,4}$ $= 3,571\times10^{-4}$ mol $n(O_2)_{change} = (5)3,571 \times 10^{-4}$ $= 1,7855 \times 10^{-3}$ mol ✓ **(a)** $n(O_2)_{ini} = \frac{V}{V_m}$ $= \frac{0,05}{22,4}$ $= 2,232 \times 10^{-3}$ mol $n(O_2)_{remaining}$ $= 2,232 \times 10^{-3} - 1,7855 \times 10^{-3}$ $= 4,465 \times 10^{-4}$ mol ✓ **(c)** $n(CO_2) = (3)3,571\times10^{-4}$ $= 1,0713 \times 10^{-3}$ mol $n(H_2O) = (4)x\ 3,571\times10^{-4}$ $= 1,43 \times 10^{-3}$ mol ✓ **(b)** n_{Total} $= 4,465 \times 10^{-4} + 1,0713 \times 10^{-3} + 1,43 \times 10^{-3}$ ✓ **(d)** $= 2,95 \times 10^{-3}$ mol $n_{Total} = \frac{V}{V_m}$ $2,95 \times 10^{-3} = \frac{V}{22,4}$ $V_{Total} = 0,066\ dm^3$ ✓ **(e)**

(5)
[22]

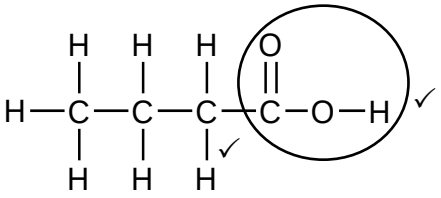
QUESTION 3/*VRAAG 3*

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 CH_2 group.

'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word. **(1 OF 0)**
OF
'n Reeks organiese verbindings waarin die een lid van die volgende verskil met 'n CH_2-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/Etieletanoaat (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.
OF
Die dipool-dipoolkragte is swakker as die waterstofbinding.
OF
Verbinding A het sterker intermolekulêre kragte (as B).
OF
Verbinding B het swakker intermolekulêre kragte (as A). (2)

3.6 Decreases/*Afneem* ✓ (1)
[12]

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QUESTION 4/*VRAAG 4*

4.1

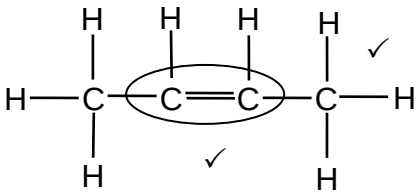
4.1.1 2-bromo✓butane✓/*2-bromobutaan* (2)

4.1.2 NaBr/Sodium bromide/*Natriumbromied* ✓ (1)

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

4.1.4 (Concentrated) sulphuric acid/ H_2SO_4/Phosphoric acid/H_3PO_4/
(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

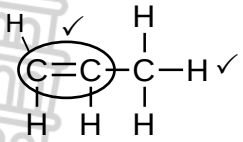
4.2.1

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** / C_3H_6 / 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

Marking criteria	***Nasienkriteria:***
(a) Calculate the change: $[O_2]_{final} - [O_2]_{initial}$ / $n(O_2)_{final} - n(O_2)_{initial}$ / $n(CO_2)_{final} - n(CO_2)_{initial}$. ✓ Accept: 0,265 to 0,27 for $[O_2]_{initial}$ (b) Substitute 10 s in rate formula. ✓ (c) Multiply rate / concentration of O_2 by 3 dm^3. ✓ (d) USE mol ratio: $n(O_2) : n(CO_2) = 1 : 2$ ✓ (e) Final correct answer $= 0,072\ (mol{\cdot}s^{-1})$ ✓ RANGE: 0,06 – 0,072	(a) *Bereken die verandering:* $[O_2]_{finale} - [O_2]_{aanvank}$ / $n(O_2)_{finale} - n(O_2)_{aanvanklik}$ / $n(CO_2)_{finale} - n(CO_2)_{aanvanklik}$ ✓ *Aanvaar: 0,265 tot 0,27 vir* $[O_2]_{aanvank}$ (b) *Vervang 10 s in tempoformule.* ✓ (f) *Vermenigvuldig tempo/konsentrasie O_2 met 3 dm^3.* ✓ (c) *Gebruik molverhouding:* $n(O_2) : n(CO_2) = 1 : 2$ ✓ (d) *Finale korrekte antwoord* $= 0,072\ (mol{\cdot}s^{-1})$ ✓ GEBIED: 0,06 – 0,072

OPTION 1/*OPSIE 1*:

$$\text{Rate/}T\textit{empo} = -\frac{\Delta c(O_2)}{\Delta t}$$

$$= -\left(\frac{0,15 - 0,27}{10 - 0}\right) \checkmark\textbf{(a)} \checkmark\textbf{(b)}$$

$$= 0,012\ mol{\cdot}dm^{-3}{\cdot}s^{-1}$$

Rate/*Tempo* (O_2) in $mol{\cdot}s^{-1}$
$= cV$
$= (0,012)(3)$ ✓**(c)**
$= 0,036\ mol{\cdot}s^{-1}$

Rate/*Tempo* $(CO_2) = 2 \times$ rate (O_2)
$= 2 \times 0,036$ ✓**(d)**
$= 0,072\ (mol{\cdot}s^{-1})$ ✓**(e)**

OPTION 2/*OPSIE 2*:

$\Delta c(O_2) = 0,27 - 0,15$ ✓**(a)**
$= 0,12\ mol{\cdot}dm^{-3}$

$\Delta n(O_2) = cV$
$= 0,12(3)$ ✓**(c)**
$= 0,36\ mol$

$\Delta n(CO_2) = 2n(O_2)$ ✓**(d)**
$= 2(0,36)$
$= 0,72\ mol$

$$\text{Rate}(CO_2) = \frac{\Delta n}{\Delta t}$$

$$= \frac{0,72}{10 - 0} \checkmark\textbf{(b)}$$

$= 0,072\ (mol{\cdot}s^{-1})$ ✓**(e)**

OPTION 3/*OPSIE 3*:

$n(O_2)_{at\ 0s} = cV$
$= 0,27 \times 3$ ✓**(c)**
$= 0,81\ mol$

$n(O_2)_{at\ 10s} = cV$
$= 0,15 \times 3$
$= 0,45\ mol$

$$\text{Rate}\ (O_2) = -\frac{\Delta n}{\Delta t}$$

$$= -\left(\frac{0,45 - 0,81}{10 - 0}\right) \checkmark\textbf{(a)} \checkmark\textbf{(b)}$$

$= 0,036\ mol{\cdot}s^{-1}$

Rate $(CO_2) = 2 \times$ rate (O_2)
$= 2 \times 0,036$ ✓**(d)**
$= 0,072\ (mol{\cdot}s^{-1})$ ✓**(e)**

(5)

5.2.3 O_2/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)

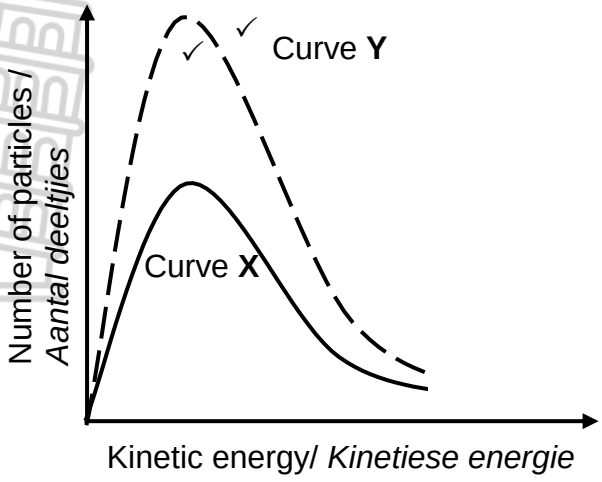
5.3.3
- Catalyst provides an alternative path with lower activation energy / lowers the activation energy. ✓
- More particles have sufficient (kinetic) energy / kinetic energy greater (or equal to) activation energy. ✓
- More effective collisions per unit time/second. ✓
  OR
  Higher frequency of effective 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/sekonde.*
  OF
  Hoër frekwensie van effektiewe botsings. (3)

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

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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. ✓

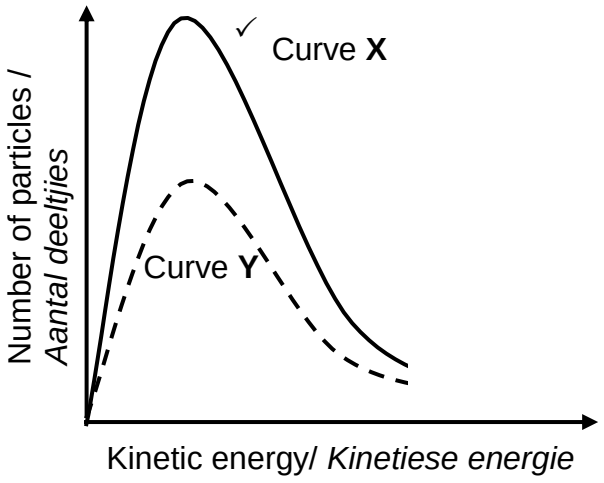
Nasienkriteria:

- *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 6.1.1

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.*

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/ $HC\ell/H^+$ 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 /$HC\ell/H^+$ *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 Kc 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 Kc-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)

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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**: $NH_4HS : NH_3 : H_2S : = 1 : 1 : 1$ ✓
(c) Calculate $c(NH_3)$ and $c(H_2S)$ at equilibrium (divide equilibrium moles by 3) ✓
(d) Correct K_c expression ✓
(e) Substitute $K_c = 18 \times 10^{-2}$ ✓
(f) $n(NH_4HS)_{eq} = n(NH_4HS)_{in} - n(NH_4HS)_{change}$ OR
$m(NH_4HS)_{eq} = m(NH_4HS)_{in} - m(NH_4HS)_{change}$ ✓
(g) Substitute 51 in $n = \frac{m}{M}$ ✓
(h) ***CORRECT*** final answer: m = 5,61 g ✓
Range: 4,96 – 5,74 g

***Nasienkriteria*:**

(a) *Bereken aantal mol NH_4HS ($\frac{70}{51}$)* ✓ ***OF** 1,37 mol*
(b) ***GEBRUIK VERHOUDING**: $NH_4HS : NH_3 : H_2S : = 1 : 1 : 1$* ✓
(c) *Bereken $c(NH_3)$ en $c(H_2S)$ by ewewig (deel ewewig mol met 3)* ✓
(d) *Korrekte K_c uitdrukking* ✓
(e) *Vervang $K_c = 18 \times 10^{-2}$* ✓
(f) *$n(NH_4HS)_{eq} = n(NH_4HS)_{in} - n(NH_4HS)_{change}$ OF*
$m(NH_4HS)_{eq} = m(NH_4HS)_{in} - m(NH_4HS)_{change}$ ✓
(g) *Vervang 51 in $n = \frac{m}{M}$* ✓
(h) ***KORREKTE** finale antwoord: m = 5,61 g* ✓
Gebied: 4,95 – 5,74 g

OPTION 1/*OPSIE 1*:

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

$= \frac{70}{51}$ ✓**(a)**

	$NH_4HS(s)$	$NH_3(g)$	$H_2S(g)$	
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 ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*		$\frac{x}{3}$	$\frac{x}{3}$	✓**(c)**

$K_c = [NH_3][H_2S]$ ✓**(d)**

✓**(e)** $18 \times 10^{-2} = \left(\frac{x}{3}\right)^2$

$x = 1,27$

$n(NH_4HS)_{eq} = 1,37 - 1,27$ ✓**(f)**
$= 0,1$ mol

$m(NH_4HS)_{eq} = nM$
$= 0,1 \times 51$ ✓**(g)**
$= 5,1$ g ✓**(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.* $^6/_8$

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OPTION 2/*OPSIE 2*:

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

$= \frac{70}{51}$ ✓**(a)**

$K_c = [NH_3][H_2S]$ ✓**(d)**

✓**(e)** $18 \times 10^{-2} = x^2$

$x = 0,42$

	$NH_4HS(s)$	$NH_3(g)$	$H_2S(g)$	
Initial amount (mol) Aanvanklike *hoeveelheid* (mol)	1,37	0	0	
Change (mol) *Verandering (mol)*	1,26	1,26	1,26	✓**(b)**
Equilibrium amount (mol) Ewewig hoeveelheid (mol)	✓**(f)** 0,11	1,26	1,26	
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)		0,42	0,42	✓**(c)**

$m(NH_4HS)_{eq} = nM$

$= 0,11 \times 51$ ✓**(g)**

$= 5,61$ g ✓**(h)**

OR/*OF*

$m(NH_4HS)_{change} = nM$

$= 1,26 \times 51$ ✓**(g)**

$= 64,26$ g

$m(NH_4HS)_{eq} = 70 - 64,26$ ✓**(f)**

$= 5,74$ g ✓**(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

	$NH_4HS(s)$	$NH_3(g)$	$H_2S(g)$
Initial concentration ($mol \cdot dm^{-3}$) Aanvanklike konsentrasie ($mol \cdot dm^{-3}$)		0	0
Change ($mol \cdot dm^{-3}$) *Verandering ($mol \cdot dm^{-3}$)*		✓**(b)** x	x
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)		x	x

✓**(d)** $K_c = [NH_3][H_2S]$

✓**(e)** $18 \times 10^{-2} = x^2$

$x = 0,424 \text{ mol} \cdot dm^{-3}$

$nNH_{3(change)} = cV$
$= (0,424)(3)$ ✓**(c)**
$= 1,272 \text{ mol}$

$n(NH_4HS)_{change} = nNH_{3(change)} = 1,272 \text{ mol}$
✓**(a)**

$n(NH_4HS)_{eq} = \frac{70}{51} - 1,272$ ✓**(f)**
$= 0,098 \text{ mol}$

$m(NH_4HS)_{eq} = nM$
$= 0,098 \times 51$ ✓**(g)**
$= 4,998 \text{ g}$ ✓**(h)**

OR/*OF*

$m(NH_4HS)_{change} = nM$
$= 1,272 \times 51$ ✓**(g)**
$= 64,872 \text{ g}$

$m(NH_4HS)_{eq} = 70 - 64,872$ ✓**(f)**
$= 5,128 \text{ g}$ ✓**(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.* $^6/_8$

(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*

$\underbrace{HPO_4^{2-}(aq) + H_2O(\ell)}_{\checkmark} \rightleftharpoons \underbrace{H_2PO_4^-(aq) + OH^-(aq)}_{\checkmark}$ bal ✓

OR/*OF*

$HPO_4^{2-}(aq) + 2H_2O(\ell) \rightleftharpoons H_3PO_4\,(aq) + 2OH^-(aq)$

ACCEPT/AANVAAR:

$Na_2HPO_4(aq) + H_2O(\ell) \rightleftharpoons NaH_2PO_4(aq) + NaOH(aq)$

$Na_2HPO_4(aq) + H_2O(\ell) \rightleftharpoons H_2PO_4^-(aq) + 2Na^+(aq) + OH^-(aq)$

$Na_2HPO_4(aq) + H_2O(\ell) \rightleftharpoons NaH_2PO_4\,(aq) + NaOH(aq)$

$Na_2HPO_4(aq) + 2H_2O(\ell) \rightleftharpoons H_3PO_4(aq) + 2Na^+(aq) + 2OH^-(aq)$

$Na_2HPO_4(aq) + 2H_2O(\ell) \rightleftharpoons H_3PO_4(aq) + 2NaOH\,(aq)$ (3)

7.2.1

Marking criteria:	***Nasienkriteria:***
a) Any formula: pH = -log[H_3O^+] / pH = -log[H^+] / [H_3O^+] = 10^{-pH}/ pOH = -log[OH^-] / [H_3O^+][OH^-] = 10^{-14} / pH + pOH = 14 ✓ **b)** Substitute 12,62 in pH = -log[H_3O^+]/ pH + pOH = 14 ✓ **c)** Substitute calculated [H_3O^+] in [H_3O^+][OH^-] / 1,38 in pOH = -log[OH^-] ✓ **d)** Final answer: 0,04 mol·dm^{-3} ✓ RANGE: 0,04 – 0,042 mol·dm^{-3}	***a)*** Enige formule: pH = - log[H_3O^+] / pH = - log[H^+] /[H_3O^+] = 10^{-pH} / pOH = - log[OH^-] / [H_3O^+][OH^-] = 10^{-14} / pH + pOH = 14 ✓ ***b)*** *Vervang* 12,62 in pH = - log[H_3O^+]/ pH + pOH = 14 ✓ ***c)*** *Vervang berekende* [H_3O^+] in [H_3O^+][OH^-] / 1,38 in pOH = -log[OH^-] ✓ ***d)*** *Finale antwoord: 0,04 mol·dm^{-3}* ✓ GEBIED: 0,04 – 0,042 mol·dm^{-3}

OPTION 1/*OPSIE 1*

pH = - log[H_3O^+]

12,62 ✓**(b)** = - log[H_3O^+] **OR/*OF*** [H_3O^+] = $10^{-12,62}$

Any one/*Enige een* ✓**(a)**

[H_3O^+] = 2,4 x 10^{-13}

[H_3O^+][OH^-] = 10^{-14}

✓**(c)**

(2,4 x 10^{-13})[OH^-] = 1 x 10^{-14}

[OH^-] = 0,0417 mol·dm^{-3} ✓**(d)** (0,04)

OPTION 2/*OPSIE 2*

pH + pOH = 14

✓**(b)** 12,62 + pOH = 14

pOH = 1,38

Any one/*Enige een* ✓**(a)**

pOH = -log[OH^-]

1,38 ✓**(c)** = -log[OH^-]

[OH^-] = 0,042 mol·dm^{-3} ✓**(d)** (0,04)

(4)

7.2.2

POSITIVE MARKING FROM QUESTION 7.2.1/
POSITIEWE NASIEN VANAF VRAAG 7.2.1

Marking criteria	***Nasienkriteria:***
(a) Substitute: 0,2 mol·dm^{-3} **AND** 0,015 dm^3 in n = cV ✓	*(a) Vervang: 0,2 mol·dm^{-3} **EN** 0,015 dm^3 in n = cV* ✓
(b) **USING RATIO**: $n(OH^-) : nHC\ell = 1 : 1$ / $n(Ba(OH)_2) : n(HC\ell) = 1 : 2$ ✓	*(b) **GEBRUIK VERHOUDING**: $n(OH^-) : nHC\ell = 1 : 1$ / $n(Ba(OH)_2) : n(HC\ell) = 1 : 2$* ✓
(c) Substitute: c(OH^-) **AND** 0,04 in n = cV ✓	(c) *Vervang: c(OH^-) **EN** 0,04 in n = cV* ✓
(d) Calculate $n(OH^-)_{ini}$ = $n(OH^-)_{reacted\ with\ HC\ell}$ + $n(OH^-)_{fin}$ ✓✓	*(d) Bereken $n(OH^-)_{ini}$ = $n(OH^-)_{reageer\ met\ HC\ell}$ + $n(OH^-)_{finale}$* ✓✓
(e) **USING RATIO**: $n(Ba(OH)_2) : n(OH^-) = 1 : 2$ ✓	*(e) **GEBRUIK VERHOUDING**: $n(Ba(OH)_2) : n(OH^-) = 1 : 2$* ✓
(f) Multiply $nBa(OH)_2$ in 25 cm^3 by 4 **OR** Divide by 0,025 dm^3 **AND** multiply by 0,1 dm^3 ✓	(f) Vermenigvuldig $nBa(OH)_2$ in 25 cm^3 met 4 ***OF*** Deel deur 0,025 dm^3 **EN** vermenigvuldig met 0,1 dm^3
(g) Final correct answer: 9,34 x 10^{-3} mol ✓ Range: 9,2 x 10^{-3} – 9,36 x 10^{-3}	*(g) Finale korrekte antwoord: 9,34 x 10^{-3} mol* ✓ *Gebied:* 9,2 x 10^{-3} *– 9,36 x 10^{-3}*

OPTION 1/*OPSIE 1*

$nHC\ell = cV$
$= \boxed{(0,2)(0,015)}$ ✓**(a)**
$= 3 \times 10^{-3}$ mol

$nOH^- = nHC\ell$ ✓**(b)**
$= 3 \times 10^{-3}$ mol

$nOH^-_{final} = cV$
$= \boxed{(0,0417)(0,04)}$ ✓**(c)**
$= 1,67 \times 10^{-3}$ mol

$nOH^-_{ini} = 3 \times 10^{-3} + 1,67 \times 10^{-3}$ ✓✓ **(d)**
$= 4,67 \times 10^{-3}$ mol

$nBa(OH)_2 = \frac{1}{2} nOH^-_{ini}$
$= \frac{1}{2}(4,67 \times 10^{-3})$ ✓**(e)**
$= 2,33 \times 10^{-3}$ mol in 25 cm^3

In 100 cm^3 = (4)(2,33 x 10^{-3}) ✓**(f)**
= 9,34 x 10^{-3} mol ✓**(g)**

OPTION 2/*OPSIE 2*

$nHC\ell = cV$
$= \boxed{(0,2)(0,015)}$ ✓**(a)**
$= 3 \times 10^{-3}$ mol

$nBa(OH)_2 = \frac{1}{2} nHC\ell$
$= \frac{1}{2}(3 \times 10^{-3})$ ✓**(b)**
$= 1,5 \times 10^{-3}$ mol

$nOH^-_{final} = cV$
$= \underline{(0,0417)(0,04)}$ ✓**(c)**
$= 1,67 \times 10^{-3}$ mol

$nBa(OH)_2 = \frac{1}{2} nOH^-_{ini}$
$= \frac{1}{2}(1,67 \times 10^{-3})$ ✓**(e)**
$= 8,33 \times 10^{-4}$ mol

$nBa(OH)_{2\ ini} = 1,5 \times 10^{-3} + 8,33 \times 10^{-4}$ ✓✓ **(d)**
$= 2,33 \times 10^{-3}$ mol in 25 cm^3

In 100 cm^3 = (4)(2,33 x 10^{-3}) ✓**(f)**
= 9,34 x 10^{-3} mol ✓**(g)**

OPTION 3/*OPSIE 3:*

$nHC\ell = cV$

$= \boxed{(0,2)(0,015)}$ ✓**(a)**

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

$nBa(OH)_2 = \frac{1}{2} nHC\ell$

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

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

$cBa(OH)_2 = \frac{1}{2} cOH^-_{final}$ ✓**(e)**

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

$= 0,02085$ mol·dm^{-3}

$nBa(OH)_2 = cV$

$= \boxed{0,02085 \times 0,04}$ ✓**(c)**

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

$nBa(OH)_{2\ ini} = 1,5 \times 10^{-3} + 8,34 \times 10^{-4}$ ✓✓ **(d)**

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

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

$= 9,36 \times 10^{-3}$ mol ✓**(g)**

✓**(g) in all options/*in alle opsies*:**

$nBa(OH)_2$ in 25 cm^3 $= cV$

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

$cBa(OH)_2$ in 25 cm^3 $= 0,0936$ mol·dm^{-3}

$nBa(OH)_2$ in 100 cm^3 $= cV$

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

$= 0,0936$ mol

(8)
[20]

QUESTION 8/*VRAAG 8*

8.1 **ANY ONE**/*:*

- A substance whose (aqueous) solution contains ions. ✓✓ (**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 gelei (deur die beweging van ione).*

OF

- *'n Stof wat dissosieer om ione in water te vorm/in gesmelte toestand* (2)

8.2 $A\ell^{3+}$/Aluminium ion/*ioon* ✓

Aℓ is oxidised **OR** Aℓ is a stronger reducing agent. ✓

*Aℓ is geoksideer **OF** Aℓ is 'n sterker reduseermiddel.* (2)

8.3 $A\ell(s) \mid A\ell^{3+}(aq) \parallel Zn^{2+}(aq) \mid Zn(s)$ ✓ ✓ ✓

OR/*OF*

$A\ell(s) \mid A\ell^{3+}\ (1\ mol{\cdot}dm^{-3}) \parallel Zn^{2+}(aq)\ (1\ mol{\cdot}dm^{-3}) \mid Zn(s)$

ACCEPT/*AANVAAR*

$A\ell \mid A\ell^{3+} \parallel Zn^{2+} \mid Zn$ (3)

8.4

Marking criteria	***Nasienkriteria:***
(a) Calculate $n(A\ell^{3+})$ ✓ (b) USE mol ratio: $nA\ell_2(SO_4)_3 : nA\ell^{3+} = 1 : 2$ ✓ (c) Multiply $nA\ell_2(SO_4)_3$ by M = 342 ✓ (d) Final correct answer = 42,75 g ✓	(a) *Bereken* $n(A\ell^{3+})$ ✓ (b) *Gebruik molverhouding:* $nA\ell_2(SO_4)_3 : nA\ell^{3+} = 1 : 2$ ✓ (c) *Vermenigvuldig* $nA\ell_2(SO_4)_3$ *met* *M = 342* ✓ (d) *Finale korrekte antwoord* = *42*,75 g ✓
OPTION 1/*OPSIE 1:*	**OPTION 2/*OPSIE 2:***
$n(A\ell^{3+}) = cV$ $= (1)(0,25)$ ✓**(a)** $= 0,25$ mol $nA\ell_2(SO_4)_3 = \frac{1}{2}\,n(A\ell^{3+})$ $= \frac{1}{2}\,(0,25)$ ✓**(b)** $= 0,125$ mol $nA\ell_2(SO_4)_3 = \frac{m}{M}$ $0,125 = \frac{m}{342}$ ✓**(c)** $m = 42,75$ g ✓**(d)**	$c = \frac{m}{VM}$ ✓**(a)** $1 = \frac{m}{(0,25)(342)}$ ✓**(c)** $m = 85,5$ g $Al_2(SO_4)_3 \rightarrow 2\ mol{\cdot}dm^{-3}\ Al^{3+}$ $m(Al_2(SO_4)_3) = \frac{1}{2}(85,5)$ ✓**(b)** $= 42,75$ g ✓**(d)**

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

$n(Zn^{2+}) = n(Cu^{2+})$
$= 0,05$ mol ✓**(a)**

$m(Zn) = nM$ ✓**(b)**
$= (0,05)(65)$ ✓**(c)**
$= 3,25$ g Zn from R

$0,15 - 0,05$ ✓**(d)** $= 0,1$ mol Cu
$m(Cu) = nM$
$= 0,1(63,5)$ ✓**(e)**
$= 6,35$ g Cu from R

Change in mass $= 6,35 + 3,25$
$= 9,6$ g ✓**(f)** (decrease in mass) (6)

[11]

TOTAL/*TOTAAL*: 150

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