



# 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 2016**

**MEMORANDUM**

**MARKS/PUNTE: 150**

**This memorandum consists of 22 pages.  
*Hierdie memorandum bestaan uit 22 bladsye.***

**QUESTION 1/VRAAG 1**

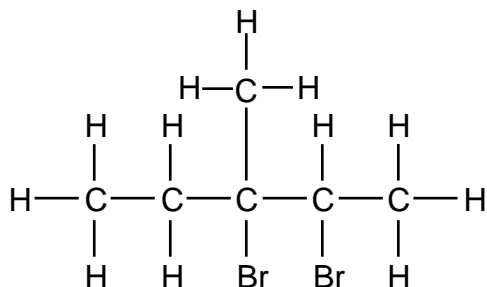
- 1.1 D ✓✓ (2)
- 1.2 C ✓✓ (2)
- 1.3 C ✓✓ (2)
- 1.4 D ✓✓ (2)
- 1.5 B ✓✓ (2)
- 1.6 D ✓✓ (2)
- 1.7 A ✓✓ (2)
- 1.8 A ✓✓ (2)
- 1.9 B ✓✓ (2)
- 1.10 B ✓✓ (2)
- [20]**

**QUESTION 2/VRAAG 2**

- 2.1
- 2.1.1 A **OR/OF** D ✓ (1)
- 2.1.2 B ✓ (1)
- 2.1.3 E ✓ (1)
- 2.1.4 D ✓ (1)

2.2

2.2.1

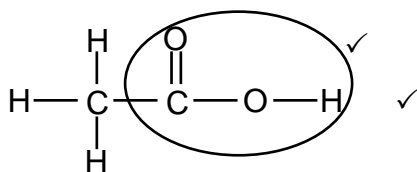


**Marking criteria/Nasienriglyne:**

- Five C atoms in longest chain. ✓  
*Vyf C-atome in langste ketting.*
- Two Br and one methyl substituents. ✓  
*Twee Br- en een metielsubstituente.*
- Whole structure correct. ✓  
*Hele struktuur korrek.* ✓

(3)

2.2.2



**Marking criteria/Nasienriglyne:**

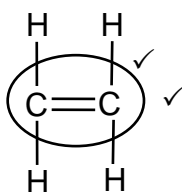
- Whole structure correct:  
*Hele struktuur korrek:*  $\frac{2}{2}$
- Only functional group correct:/Slegs funksionele groep korrek: Max/Maks.:  $\frac{1}{2}$
- Accept -OH as condensed.  
*Aanvaar -OH as gekondenseerd.*

**IF/INDIEN:**

More than one functional group/Meer as een funksionele groep  $\frac{0}{2}$

(2)

2.2.3



**Marking criteria/Nasienriglyne:**

- Whole structure correct:/Hele struktuur korrek:  $\frac{2}{2}$
- Only functional group correct/Slegs funksionele groep korrek Max:  $\frac{1}{2}$

**IF/INDIEN:**

More than one functional group/Meer as een funksionele groep  $\frac{0}{2}$

(2)

2.3

2.3.1 Hydrogen (gas)/Waterstof(gas) ✓

(1)

2.3.2 Addition / Hydrogenation ✓  
*Addisie / Hidrogenasie / Hidrogenering*

(1)

[13]

**QUESTION 3/VRAAG 3**

3.1 Compounds with the same molecular formula ✓ but different structural formulae. ✓ / *Verbindings met dieselfde molekulêre formule maar verskillende struktuurformules.*

(2)

3.2 Chain/Ketting ✓

(1)

3.3 **From A to C/Van A na C:**

• **Structure/Struktuur:**

Less branched / less compact / less spherical/longer chain length / larger surface area (over which intermolecular forces act). ✓

*Minder vertak / minder kompak / minder sferies / langer kettinglengte / groter oppervlak (waaroor intermolekulêre kragte werk).*

• **Intermolecular forces/Intermolekulêre kragte:**

Stronger / more intermolecular forces / Van der Waals forces / London forces / dispersion forces.

*Sterker / meer intermolekulêre kragte / Van der Waalskragte / London-kragte / dispersiekragte. ✓*

• **Energy/Energie:**

More energy needed to overcome or break intermolecular forces / Van der Waals forces. ✓

*Meer energie benodig om intermolekulêre kragte / Van der Waalskragte / dispersiekragte / London-kragte te oorkom.*

**OR/OF**

**From C to A/Van C na A:**

• **Structure/Struktuur:**

More branched / more compact / more spherical / smaller surface area (over which intermolecular forces act). ✓

Meer vertak / meer kompak / meer sferies / kleiner oppervlak (waaroor intermolekulêre kragte werk).

• **Intermolecular forces/Intermolekulêre kragte:**

Weaker / less intermolecular forces / Van der Waals forces / London forces / dispersion forces. ✓

Swakker/minder intermolekulêre kragte / Van der Waalskragte / Londonkragte / dispersiekragte.

**Energy/Energie:**

Less energy needed to overcome or break intermolecular forces / Van der Waals forces. ✓

Minder energie benodig om intermolekulêre kragte / Van der Waalskragte/ dispersiekragte / Londonkragte te oorkom.

(3)

3.4 A / 2,2-dimethylpropane / 2,2-dimetiëlpropaan ✓



Lowest boiling point. / Laagste kookpunt. ✓

(2)

3.5  $C_5H_{12} + 8O_2 \checkmark \rightarrow 5CO_2 + 6H_2O \checkmark$  Bal ✓

**Notes/Aantekeninge:**

- Reactants ✓      Products ✓      Balancing ✓  
*Reaktanse      Produkte      Balansering*
- Ignore double arrows and phases. / *Ignoreer dubbelpyle en fases.*
- Marking rule 6.3.10 / *Nasienreël 6.3.10.*
- If condensed structural formulae used: / *Indien gekondenseerde struktuurformules gebruik:*      Max/Maks.  $\frac{2}{3}$

(3)

[11]

**QUESTION 4/VRAAG 4**

4.1

4.1.1 High temperature / heat / high energy / high pressure ✓  
*Hoë temperatuur / hitte / hoë energie / hoë druk* (1)

4.1.2  $C_6H_{12}$  ✓

**Accept/Aanvaar:**

Condensed structural formula and structural formula.

*Gekondenseerde struktuurformule en struktuurformule.*

E.g./Bv:  $CH_3CH_2CH_2CH_2CHCH_2$

(1)

4.1.3 Alkenes/Alkene ✓ (1)

4.2 X /  $C_6H_{12}$  / Alkene / Alkeen / Hexene / Hekseen ✓

**OPTION 1/OPSIE 1**

- X is an alkene / has a double bond / unsaturated. ✓  
*X is 'n alkeen / het 'n dubbelbinding / onversadig.*
- X can undergo addition. ✓  
*X ondergaan addisie.*
- X will react without light / heat / is more reactive. ✓  
*X sal sonder lig / hitte reageer / is meer reaktief.*

**OPTION 2/OPSIE 2**

- Butane is an alkane **OR** butane is saturated. ✓  
*Butaan is 'n alkaan **OF** butaan is versadig.*
- Butane can only undergo substitution. ✓  
*Butaan kan slegs substitusie ondergaan.*
- Butane will only react in the presence of light / heat **OR** butane is less reactive. ✓  
*Butaan sal slegs in die teenwoordigheid van lig / hitte reageer **OF** butaan is minder reaktief.*

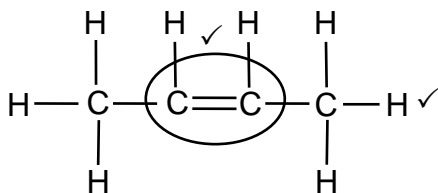
(4)

4.3

4.3.1 2-chloro✓butane ✓  
*2-chlorobutaan* (2)

4.3.2 Substitution / Hydrolysis ✓  
*Substitusie / Hidrolise* (1)

4.3.3



**Marking criteria/Nasienriglyne:**

- Whole structure correct/*Hele struktuur korrek*:  $\frac{2}{2}$
- Only functional group correct/*Slegs funksionele groep korrek*:  $\frac{1}{2}$

**IF/INDIEN:**

More than one functional group/*Meer as een funksionele groep*

$\frac{0}{2}$

4.3.4 Hydration / *Hidrasie / Hidratering* ✓

(1)  
[13]

**QUESTION 5/VRAAG 5**

5.1

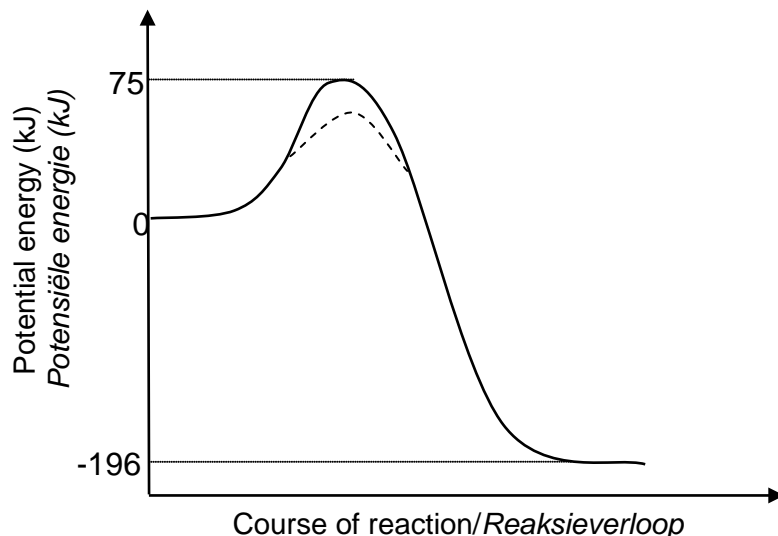
5.1.1 The minimum energy needed for a reaction to take place. ✓✓  
*Die minimum energie benodig vir 'n reaksie om plaas te vind.*

**OR/OF**

Minimum energy needed to form the activated complex./ *Minimum energie nodig om die geaktiveerde kompleks te vorm.*

(2)

5.1.2



<b>Marking criteria/Nasienriglyne:</b>	
Shape of curve for exothermic reaction as shown. <i>Vorme van kurwe vir eksotermiese reaksie soos getoon.</i>	✓
Energy of activated complex shown as 75 kJ in line with the peak. <i>Energie van geaktiveerde kompleks aangetoon as 75 kJ in lyn met die piek.</i>	✓
Energy of products shown as - 196 kJ below the zero. <i>Energie van produkte getoon as - 196 kJ onderkant die nulpunt.</i>	✓
<b>IF/INDIEN:</b> Wrong shape, e.g. straight line./ <i>Verkeerde vorm bv. reguitlyn.</i>	$\frac{0}{3}$

(3)

5.1.3 **Marking criteria/Nasienriglyne**

- Dotted line (---) on graph in QUESTION 5.1.2 showing lower energy for activated complex. ✓  
*Stippellyn (---) op grafiek in VRAAG 5.1.2 wat laer energie vir geaktiveerde kompleks toon.*
- Dotted curve starts at/above energy of reactants and ends at/above energy of products on the inside of the original curve. ✓  
*Stippellyn kurwe begin by/bokant energie van reaktanse en eindig by/bokant energie van produkte aan die binnekant van die oorspronklike kurwe.*

**Note/Aantekening:**

Allocate marks only if curve for either exothermic or endothermic reaction drawn in QUESTION 5.1.2.

*Ken punte slegs toe indien kurwe vir endotermiese of eksotermiese reaksie in VRAAG 5.1.2 geteken is.*

(2)

- 5.1.4
- A catalyst provides an alternative pathway of lower activation energy. ✓  
*'n Katalisator voorsien 'n alternatiewe pad van laer aktiveringsenergie.*

- More molecules have sufficient / enough (kinetic) energy. ✓  
*Meer molekule het voldoende / genoeg (kinetiese) energie.*

**OR/OF**

More molecules have kinetic energy equal to or greater than the activation energy.

*Meer molekule het kinetiese energie gelyk aan of groter as die aktiveringsenergie.*

- More effective collisions per unit time / second. ✓

*Meer effektiewe botsings per eenheidstyd / sekonde.*

**OR/OF**

Rate / frequency of effective collisions increases.

*Tempo / frekwensie van effektiewe botsings neem toe.*

(3)

5.2

5.2.1

$$\begin{aligned} \text{Ave rate/Gem. tempo} &= \frac{\Delta V}{\Delta t} \\ &= \frac{52 - 16}{40 - 10} \checkmark \\ &= 1,2 \text{ (dm}^3 \cdot \text{s}^{-1}) \checkmark \end{aligned}$$

**Accept/Aanvaar:**

- Volume range/gebied:  
16 to/tot 17 cm<sup>3</sup>
- Answer range/Antwoordgebied:  
1,167 to 1,2 dm<sup>3</sup>·s<sup>-1</sup>

(3)

5.2.2

**Marking criteria/Nasienriglyne:**

- $V(\text{O}_2) = 60 \text{ dm}^3$  AND/EN divide volume by 24./deel volume deur 24 ✓
- Use ratio/Gebruik verhouding:  $n(\text{H}_2\text{O}_2) = 2n(\text{O}_2) = 1:2$  ✓
- Use  $34 \text{ g}\cdot\text{mol}^{-1}$  in  $n = \frac{m}{M}$  or in ratio calculation. ✓

*Gebruik  $34 \text{ g}\cdot\text{mol}^{-1}$  in  $n = \frac{m}{M}$  of in verhoudingsberekening.*

- Final answer/Finale antwoord: 170 g ✓

**OPTION 1/OPSIE 1**

$$n(\text{O}_2) = \frac{V}{V_M}$$

$$= \frac{60}{24} \checkmark$$

$$= 2,5 \text{ mol}$$

$$n(\text{H}_2\text{O}_2) = 2n(\text{O}_2)$$

$$= 2(2,5) \checkmark$$

$$= 5 \text{ mol}$$

$$n(\text{H}_2\text{O}_2) = \frac{m}{M}$$

$$\therefore 5 = \frac{m}{34} \checkmark$$

$$\therefore m = 170 \text{ g} \checkmark$$

**OPTION 2/OPSIE 2**

$$24 \text{ dm}^3 : 1 \text{ mol}$$

$$60 \text{ dm}^3 : 2,5 \text{ mol} \checkmark$$

$$n(\text{H}_2\text{O}_2) = 2n(\text{O}_2)$$

$$= 2(2,5) \checkmark$$

$$= 5 \text{ mol}$$

$$34 \text{ g} \checkmark : 1 \text{ mol}$$

$$x : 5 \text{ mol}$$

$$x = 170 \text{ g} \checkmark$$

**OPTION 3/OPSIE 3**

$$n(\text{O}_2) = \frac{V}{V_M}$$

$$= \frac{60}{24} \checkmark$$

$$= 2,5 \text{ mol}$$

$$n(\text{O}_2) = \frac{m}{M}$$

$$\therefore 2,5 = \frac{m}{32}$$

$$\therefore m = 80 \text{ g}$$

$$\checkmark$$

$2(34) \text{ g} \checkmark \text{ H}_2\text{O}_2$	$\dots\dots\dots$	$32 \text{ g O}_2$
$x \text{ g H}_2\text{O}_2$	$\dots\dots\dots$	$80 \text{ g O}_2$

$$m(\text{H}_2\text{O}_2) = 170 \text{ g} \checkmark$$

(4)

5.2.3 Equal to / Gelyk aan ✓

(1)

5.3

5.3.1 Q ✓

(1)

5.3.2 P ✓

(1)

**[20]**



**QUESTION 6/VRAAG 6**

- 6.1 The stage in a chemical reaction when the rate of forward reaction equals the rate of reverse reaction. ✓✓ (2 marks or no marks)

*Die stadium in 'n chemiese reaksie wanneer die tempo van die voorwaartse reaksie is gelyk aan die tempo van die terugwaartse reaksie.* ✓✓  
(2 punte of geen punte nie)

**OR/OF**

The state where the concentrations / quantities of reactants and products remain constant.

*Die toestand wanneer die konsentrasies / hoeveelhede van reaktanse en produkte konstant bly.*

(2)

6.2

- 6.2.1 Remains the same / Bly dieselfde ✓

(1)

- 6.2.2 Decreases / Verlaag ✓



- When the temperature is increased the reaction that will oppose this increase / decrease the temperature will be favoured. ✓

*Wanneer die temperatuur toeneem, sal die reaksie wat hierdie toename teenwerk / die temperatuur laat afneem bevoordeel word.*

**OR/OF**

*The forward reaction is exothermic. / Die voorwaartse reaksie is eksotermies.*

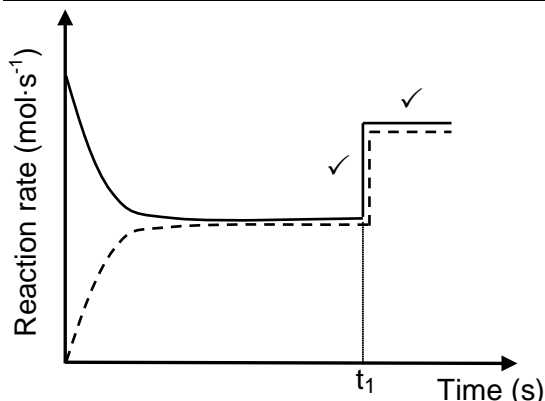
- An increase in temperature favours the endothermic reaction. ✓  
*'n Toename in temperatuur bevoordeel die endotermiese reaksie.*
- The reverse reaction is favoured. ✓  
*Die terugwaartse reaksie word bevoordeel.*

(4)

6.3

**Marking criteria/Nasienriglyne:**

- Vertical parallel lines show a sudden increase in rate of both forward and reverse reactions. / Vertikale parallelle lyne wys 'n skielike toename in reaksietempo van beide voorwaartse en terugwaartse reaksies. ✓
- Horizontal parallel lines showing a constant higher rate for both forward and reverse catalysed reactions after time  $t_1$ . / Horisontale parallelle lyne wat 'n konstante hoër tempo aantoon vir beide voorwaartse en terugwaartse gekataliseerde reaksies na  $t_1$ . ✓



(2)

6.4 **CALCULATIONS USING NUMBER OF MOLES**  
**BEREKENINGE WAT AANTAL MOL GEBRUIK**

**Marking criteria/Nasinriglyne:**

- Use/*Gebruik*  $M(\text{PbS}) = 239 \text{ g} \cdot \text{mol}^{-1}$  in  $n = \frac{m}{M}$  or in ratio calculation/ *of in verhoudingsberekening*. ✓
- Use ratio/*Gebruik verhouding*:  $n(\text{H}_2\text{S})_{\text{equil/ewewig}} = n(\text{PbS})$  ✓
- $n(\text{H}_2\text{S})_{\text{formed/gevorm}} = n(\text{H}_2\text{S})_{\text{equilibrium/ewewig}}$  ✓
- **USING** ratio/**GEBRUIK** *verhouding*:  $\text{H}_2 : \text{H}_2\text{S} = 1 : 1$  ✓
- $n(\text{H}_2)_{\text{equilibrium/ewewig}} = n(\text{H}_2)_{\text{initial/aanvanklik}} - n(\text{H}_2)_{\text{formed/gevorm}}$  ✓
- Divide equilibrium  $n(\text{H}_2\text{S})$  &  $n(\text{H}_2)$  by  $2 \text{ dm}^3$ . ✓  
*Deel  $n(\text{H}_2\text{S})$  &  $n(\text{H}_2)$  deur  $2 \text{ dm}^3$*
- Correct  $K_c$  expression ✓  
*Korrekte  $K_c$  uitdrukking.*
- Substitution of concentrations into  $K_c$  expression. ✓  
*Vervanging van konsentrasies in  $K_c$ -uitdrukking.*
- Final answer/*Finale antwoord*: 0,07 ✓  
**NB/L.W.:** If not rounded/*Indien nie afgerond nie*: 0,067

**OPTION 1/OPSIE 1**

$$n(\text{PbS}) = \frac{m}{M} = \frac{2,39}{239} = 0,01 \text{ mol}$$

$$n(\text{H}_2\text{S})_{\text{equilibrium/by ewewig}} = n(\text{PbS}) \checkmark = 0,01 \text{ mol}$$

	H <sub>2</sub>	H <sub>2</sub> S	
Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i>	0,16	0	
Change (mol) <i>Verandering (mol)</i>	0,01	0,01 ✓	ratio ✓ <i>verhouding</i>
Quantity at equilibrium (mol)/ <i>Hoeveelheid by ewewig (mol)</i>	0,15 ✓	0,01	
Equilibrium concentration (mol·dm <sup>-3</sup> ) <i>Ewewigkonsentrasie (mol·dm<sup>-3</sup>)</i>	0,075	0,005	divide by 2 ✓ <i>deel deur 2</i>

$$K_c = \frac{[\text{H}_2\text{S}]}{[\text{H}_2]} \checkmark$$

$$= \frac{0,005}{0,075} \checkmark$$

$$= 0,067 \approx 0,07 \checkmark$$

No  $K_c$  expression, correct substitution/*Geen  $K_c$ -uitdrukking, korrekte substitusie*: Max./Maks.  $\frac{8}{9}$

Wrong  $K_c$  expression /*Verkeerde  $K_c$ -uitdrukking*:  
Max./Maks.  $\frac{6}{9}$

**IF/INDIEN:**  $[\text{S}] = 1$  in  $K_c = \frac{[\text{H}_2\text{S}]}{[\text{H}_2][\text{S}]}$

No mark for  $K_c$  expression, but continue marking substitution and answer./*Geen punt vir  $K_c$ -uitdrukking, maar gaan voort om substitusie en antwoord na te sien.*

**OPTION 2/OPSIE 2**

$$\begin{aligned} n(\text{PbS}) &= \frac{m}{M} \\ &= \frac{2,39}{239} \checkmark \\ &= 0,01 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{H}_2\text{S})_{\text{reacted/gereageer}} &= n(\text{PbS}) \checkmark = 0,01 \text{ mol} \\ &= n(\text{H}_2\text{S})_{\text{equilibrium/ewewig}} \end{aligned}$$

$$\begin{aligned} n(\text{H}_2\text{S})_{\text{formed/gevorm}} &= n(\text{H}_2\text{S})_{\text{equilibrium/ewewig}} - n(\text{H}_2\text{S})_{\text{initial/aanvanklik}} \\ &= 0,01 - 0 \checkmark \\ &= 0,01 \text{ mol} \end{aligned}$$

$$n(\text{H}_2)_{\text{reacted/gereageer}} = n(\text{H}_2\text{S})_{\text{formed/gevorm}} \checkmark = 0,01 \text{ mol}$$

$$\begin{aligned} n(\text{H}_2)_{\text{equilibrium/ewewig}} &= n(\text{H}_2)_{\text{initial/aanvanklik}} - n(\text{H}_2)_{\text{reacted/gereageer}} \\ &= 0,16 - 0,01 \checkmark \\ &= 0,15 \text{ mol} \end{aligned}$$

$$\begin{aligned} c(\text{H}_2) &= \frac{n}{V} \\ &= \frac{0,15}{2} \\ &= 0,075 \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} c(\text{H}_2\text{S}) &= \frac{n}{V} \\ &= \frac{0,01}{2} \checkmark \\ &= 0,005 \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} K_c &= \frac{[\text{H}_2\text{S}]}{[\text{H}_2]} \checkmark \\ &= \frac{0,005}{0,075} \checkmark \\ &= 0,067 \approx 0,07 \checkmark \end{aligned}$$

No  $K_c$  expression, correct substitution/Geen  $K_c$ -uitdrukking, korrekte substitusie: Max./Maks.  $\frac{8}{9}$

Wrong  $K_c$  expression / Verkeerde  $K_c$ -uitdrukking: Max./Maks.  $\frac{6}{9}$

**IF/INDIEN:**  $[\text{S}] = 1$  in  $K_c = \frac{[\text{H}_2\text{S}]}{[\text{H}_2][\text{S}]}$

No mark for  $K_c$  expression, but continue marking substitution and answer./Geen punt vir  $K_c$ -uitdrukking, maar gaan voort om substitusie en antwoord na te sien.

**OPTION 3/OPSIE 3**

	H <sub>2</sub>	H <sub>2</sub> S	
Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i>	0,16	0	
Change (mol) <i>Verandering (mol)</i>	x	x ✓	ratio ✓ verhouding
Quantity at equilibrium (mol)/ <i>Hoeveelheid by ewewig (mol)</i>	0,16 - x ✓	x	
Equilibrium concentration (mol·dm <sup>-3</sup> ) <i>Ewewigskonsentrasie (mol·dm<sup>-3</sup>)</i>	$\frac{0,16 - x}{2}$	$\frac{x}{2}$	divide by 2 ✓ deel deur 2

$$n(\text{PbS}) = \frac{m}{M}$$

$$= \frac{2,39}{239} \checkmark$$

$$= 0,01 \text{ mol}$$

$$n(\text{H}_2\text{S})_{\text{equilibrium/by ewewig}} = n(\text{PbS}) \checkmark \therefore x = 0,01 \text{ mol}$$

$$[\text{H}_2]_{\text{equilibrium/by ewewig}} = \frac{0,16 - 0,01}{2} = 0,075 \text{ mol}\cdot\text{dm}^{-3}$$

$$[\text{H}_2\text{S}]_{\text{equilibrium/by ewewig}} = \frac{0,01}{2} = 0,005 \text{ mol}\cdot\text{dm}^{-3}$$

$$K_c = \frac{[\text{H}_2\text{S}]}{[\text{H}_2]} \checkmark$$

$$= \frac{0,005}{0,075} \checkmark$$

$$= 0,067 \approx 0,07 \checkmark$$

No K<sub>c</sub> expression, correct substitution/Geen K<sub>c</sub>-uitdrukking, korrekte substitusie: Max./Maks.  $\frac{8}{9}$

Wrong K<sub>c</sub> expression / Verkeerde K<sub>c</sub>-uitdrukking: Max./Maks.  $\frac{6}{9}$

**IF/INDIEN:** [S] = 1 in  $K_c = \frac{[\text{H}_2\text{S}]}{[\text{H}_2][\text{S}]}$

No mark for K<sub>c</sub> expression, but continue marking substitution and answer./Geen punt vir K<sub>c</sub>-uitdrukking, maar gaan voort om substitusie en antwoord na te sien.

**CALCULATIONS USING CONCENTRATION**  
**BEREKENINGE WAT KONSENTRASIE GEBRUIK**

**Marking criteria/Nasinriglyne:**

- Use/Gebruik  $M(\text{PbS}) = 239 \text{ g}\cdot\text{mol}^{-1}$  in  $n = \frac{m}{M}$  or in ratio calculation/ of in verhoudingsberekening. ✓
- Use ratio/Gebruik verhouding:  $n(\text{H}_2\text{S})_{\text{equil/ewewig}} = n(\text{PbS})$  ✓
- Divide equilibrium  $n(\text{H}_2\text{S})_{\text{equil}}$  &  $n(\text{H}_2)_{\text{initial}}$  by  $2 \text{ dm}^3$ . ✓  
Deel  $n(\text{H}_2\text{S})_{\text{ewewig}}$  &  $n(\text{H}_2)_{\text{aanvanklik}}$  deur  $2 \text{ dm}^3$
- $[\text{H}_2\text{S}]_{\text{formed/gevorm}} = [\text{H}_2\text{S}]_{\text{equilibrium/ewewig}}$  ✓
- **USING** ratio/**GEBRUIK** verhouding:  $\text{H}_2 : \text{H}_2\text{S} = 1 : 1$  ✓
- $[\text{H}_2]_{\text{equilibrium/ewewig}} = [\text{H}_2]_{\text{initial/aanvanklik}} - [\text{H}_2]_{\text{formed/gevorm}}$  ✓
- Correct  $K_c$  expression ✓  
Korrekte  $K_c$  uitdrukking.
- Substitution of concentrations into  $K_c$  expression. ✓  
Vervanging van konsentrasies in  $K_c$ -uitdrukking.
- Final answer/Finale antwoord: 0,07 ✓  
**Note/Let Wel:** If not rounded/Indien nie afgerond nie: 0,067

**OPTION 4/OPSIE 4**

$$n(\text{PbS}) = \frac{m}{M} = \frac{2,39}{239} = 0,01 \text{ mol}$$

$$n(\text{H}_2\text{S})_{\text{equilibrium/by ewewig}} = n(\text{PbS}) \checkmark = 0,01 \text{ mol}$$

	$\text{H}_2$	$\text{H}_2\text{S}$
Initial concentration/Aanvangskonsentrasie ( $\text{mol}\cdot\text{dm}^{-3}$ )	$\frac{0,16}{2} = 0,08$	0
Change in concentration/Verandering in konsentrasie ( $\text{mol}\cdot\text{dm}^{-3}$ )	0,005	0,005 ✓
Equilibrium concentration/Ewewigskonsentrasie ( $\text{mol}\cdot\text{dm}^{-3}$ )	0,075	$\frac{0,01}{2} = 0,005$

$$K_c = \frac{[\text{H}_2\text{S}]}{[\text{H}_2]}$$

$$= \frac{0,005}{0,075}$$

$$= 0,067 \approx 0,07$$

No  $K_c$  expression, correct substitution/Geen  $K_c$ -uitdrukking, korrekte substitusie: Max./Maks.  $\frac{8}{9}$

Wrong  $K_c$  expression / Verkeerde  $K_c$ -uitdrukking: Max./Maks.  $\frac{6}{9}$

**IF/INDIEN:**  $[\text{S}] = 1$  in  $K_c = \frac{[\text{H}_2\text{S}]}{[\text{H}_2][\text{S}]}$

No mark for  $K_c$  expression, but continue marking substitution and answer./Geen punt vir  $K_c$ -uitdrukking, maar gaan voort om substitusie en antwoord na te sien.

**OPTION 5/OPSIE 5**

$$\begin{aligned} n(\text{PbS}) &= \frac{m}{M} \\ &= \frac{2,39}{239} \\ &= 0,01 \text{ mol} \end{aligned}$$

$$n(\text{H}_2\text{S})_{\text{equilibrium/by ewewig}} = n(\text{PbS}) \checkmark = 0,01 \text{ mol}$$

$$\begin{aligned} [\text{H}_2\text{S}]_{\text{equilibrium/by ewewig}} &= \frac{n}{V} \\ &= \frac{0,01}{2} \\ &= 0,005 \text{ mol}\cdot\text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} [\text{H}_2]_{\text{initial/aanvanklik}} &= \frac{n}{V} \\ &= \frac{0,16}{2} \\ &= 0,08 \text{ mol}\cdot\text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} [\text{H}_2\text{S}]_{\text{formed/gevorm}} &= [\text{H}_2\text{S}]_{\text{equilibrium/by ewewig}} - [\text{H}_2\text{S}]_{\text{initial/aanvanklik}} \\ &= 0,005 - 0 \checkmark \\ &= 0,005 \text{ mol}\cdot\text{dm}^{-3} \end{aligned}$$

$$[\text{H}_2]_{\text{reacted/gereageer}} = [\text{H}_2\text{S}]_{\text{formed/gevorm}} \checkmark = 0,005 \text{ mol}$$

$$\begin{aligned} [\text{H}_2]_{\text{equilibrium/ewewig}} &= [\text{H}_2]_{\text{initial/aanvanklik}} - [\text{H}_2]_{\text{reacted/gereageer}} \\ &= 0,08 - 0,005 \checkmark \\ &= 0,075 \text{ mol} \end{aligned}$$

$$\begin{aligned} K_c &= \frac{[\text{H}_2\text{S}]}{[\text{H}_2]} \\ &= \frac{0,005}{0,075} \\ &= 0,067 \approx 0,07 \end{aligned}$$

No  $K_c$  expression, correct substitution/Geen  $K_c$ -uitdrukking, korrekte substitusie: Max./Maks.  $\frac{8}{9}$

Wrong  $K_c$  expression / Verkeerde  $K_c$ -uitdrukking: Max./Maks.  $\frac{6}{9}$

**IF/INDIEN:**  $[\text{S}] = 1$  in  $K_c = \frac{[\text{H}_2\text{S}]}{[\text{H}_2][\text{S}]}$

No mark for  $K_c$  expression, but continue marking substitution and answer./Geen punt vir  $K_c$ -uitdrukking, maar gaan voort om substitusie en antwoord na te sien.

(9)  
[18]

**QUESTION 7/VRAAG 7**

7.1

7.1.1 Hydrolysis is the reaction (of a salt) with water. ✓✓  
*Hidrolise is die reaksie (van 'n sout) met water.*

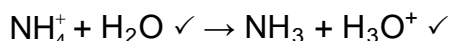
**(2 or/of 0)**

**Accept/Aanvaar:**

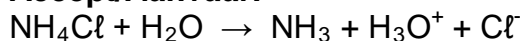
A chemical reaction in which water is a reactant.  
*'n Chemiese reaksie waarin water 'n reaktans is.*

(2)

7.1.2 Smaller than (7)/Kleiner as (7) ✓



**Accept/Aanvaar:**



**Note/Aantekening:**

- Mark equation independently of first answer./Sien vergelyking onafhanklik van eerste antwoord na.

- If incorrect balancing/Indien verkeerde balansering: Max/Maks.  $\frac{2}{3}$

**Marking criteria for equation/Nasienriglyne vir vergelyking:**

- Reactants ✓ Products ✓  
*Reaktanse Produkte*
- Ignore double arrows and phases./Ignoreer dubbelpyle en fases.
- Marking rule 6.3.10/Nasienreël 6.3.10.

(3)

7.2

7.2.1

**Marking guidelines/Nasienriglyne:**

- Substitution of/Substitusie van  $98 \text{ g} \cdot \text{mol}^{-1}$ . ✓
- Final answer/Finale antwoord:  $0,08 \text{ mol}$  ✓

**Note/Let wel:**

If not rounded/Indien nie afgerond nie:  $(0,075 \text{ mol})$

**OPTION 1/OPSIE 1**

$$\begin{aligned} n &= \frac{m}{M} \\ &= \frac{7,35}{98} \\ &= 0,08 \text{ mol } \checkmark \quad (0,075 \text{ mol}) \end{aligned}$$

**OPTION 2/OPSIE 2**

$$\begin{aligned} 98 \text{ g } \checkmark &: 1 \text{ mol} \\ 7,35 &: 0,08 \text{ mol } \checkmark \end{aligned}$$

**OPTION 3/OPSIE 3**

$$\begin{aligned} c &= \frac{m}{MV} \\ &= \frac{7,35}{98 \times 0,5} \\ &= 0,15 \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} n &= cV \\ &= 0,15 \times 0,5 \\ &= 0,08 \text{ mol } \checkmark \end{aligned}$$

(2)

7.2.2 **POSITIVE MARKING FROM QUESTION 7.2.1.**  
**POSITIEWE NASIEN VAN VRAAG 7.2.1.**

<b>OPTION 1/OPSIE 1</b>	<b>Marking guidelines/Nasienriglyne:</b>
<p> <math>\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark</math>  <math>1,3 \checkmark = -\log[\text{H}_3\text{O}^+]</math>  <math>[\text{H}_3\text{O}^+] = 0,05 \text{ mol}\cdot\text{dm}^{-3}</math>  <math>\downarrow</math>  <math>[\text{H}_2\text{SO}_4] = \frac{1}{2}[\text{H}_3\text{O}^+]</math>  <math>= \frac{1}{2} \times 0,05 \checkmark</math>  <math>= 0,025 \text{ mol}\cdot\text{dm}^{-3} \quad (0,03)</math>  <math>\downarrow</math>  <math>n(\text{H}_2\text{SO}_4)_{\text{ex/or}} = cV \checkmark</math>  <math>= 0,025 \times 0,5 \checkmark</math>  <math>= 0,0125 \text{ mol} \quad (0,02)</math>  <math>\downarrow</math>  <math>n(\text{H}_2\text{SO}_4)_{\text{react/rea}} = 0,075 - 0,0125 \checkmark</math>  <math>= 0,0625 \text{ mol} \quad (0,06)</math>  <math>\downarrow</math>  <math>n(\text{NaOH}) = 2n(\text{H}_2\text{SO}_4)</math>  <math>= 2 \times 0,0625 \checkmark</math>  <math>= 0,125 \text{ mol} \quad (0,12)</math> </p>	<ul style="list-style-type: none"> <li>Formula/Formule: <math>\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark</math></li> <li>Substitution of/Substitusie van 1,3 <math>\checkmark</math></li> <li>Use <math>[\text{H}_2\text{SO}_4] : [\text{H}_3\text{O}^+] = 1 : 2 \checkmark</math> Gebruik <math>[\text{H}_2\text{SO}_4] : [\text{H}_3\text{O}^+] = 1 : 2</math></li> <li>Formula/Formule: <math>c = \frac{n}{V} \checkmark</math></li> <li>Multiply by <math>0,5 \text{ dm}^3</math> Vermenigvuldig met <math>0,5 \text{ dm}^3 \checkmark</math></li> <li>Subtract <math>n_{\text{initial}} - n_{\text{excess}} \checkmark</math> Aftrek: <math>n_{\text{begin}} - n_{\text{oormaat}}</math></li> <li>Use <math>n(\text{NaOH}) : n(\text{H}_2\text{SO}_4) = 2:1 \checkmark</math> Gebruik <math>n(\text{NaOH}) : n(\text{H}_2\text{SO}_4) = 2:1</math></li> <li>Substitution of <math>40 \text{ g}\cdot\text{mol}^{-1} \checkmark</math> Vervanging van <math>40 \text{ g}\cdot\text{mol}^{-1}</math></li> <li>Final answer: <math>m = 5 \text{ g} \checkmark</math> Finale antwoord: <math>m = 5 \text{ g}</math></li> </ul> <p>Range/Gebied: 4,8 – 5,6 g</p>
<b>OR/OF</b>	
<p> <math>n(\text{NaOH}) = \frac{m}{M}</math>  <math>0,125 = \frac{m}{40} \checkmark</math>  <math>m = 5 \text{ g} \checkmark \quad (4,8 \text{ g})</math> </p>	<p> <math>1 \text{ mol} \quad : \quad 40 \text{ g} \checkmark</math>  <math>0,125 \text{ mol} \quad : \quad 5 \text{ g} \checkmark</math> </p>



<b>OPTION 2/OPSIE 2</b>	<b>Marking guidelines/Nasienriglyne:</b>
<p> <math>\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark</math>  <math>1,3 \checkmark = -\log[\text{H}_3\text{O}^+]</math>  <math>[\text{H}_3\text{O}^+] = 0,05 \text{ mol}\cdot\text{dm}^{-3}</math>  <math>n(\text{H}_3\text{O}^+)_{\text{ex/oor}} = cV \checkmark</math>  <math>= (0,05)(0,5) \checkmark</math>  <math>= 0,025 \text{ mol} \quad (0,03)</math>  <math>n(\text{H}_3\text{O}^+)_{\text{in/aanv}} = 2n(\text{H}_2\text{SO}_4) \checkmark</math>  <math>= 0,075 \times 2 \checkmark</math>  <math>= 0,15 \text{ mol} \quad (0,16)</math>  <math>n(\text{H}_3\text{O}^+)_{\text{react/reageer}} = 0,15 - 0,025 \checkmark</math>  <math>= 0,125 \text{ mol} \quad (0,13)</math>  <math>n(\text{NaOH}) = n(\text{H}_3\text{O}^+) \checkmark</math>  <math>= 0,125 \text{ mol} \quad (0,13)</math> </p>	<ul style="list-style-type: none"> <li>• Formula/Formule: <math>\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark</math></li> <li>• Substitution of/Substitusie van 1,3 <math>\checkmark</math></li> <li>• Formula/Formule: <math>c = \frac{n}{V} \checkmark</math></li> <li>• Multiply by <math>0,5 \text{ dm}^3</math> Vermenigvuldig met <math>0,5 \text{ dm}^3 \checkmark</math></li> <li>• Use <math>n(\text{H}_2\text{SO}_4) : n(\text{H}_3\text{O}^+) = 1 : 2 \checkmark</math> Gebruik <math>n(\text{H}_2\text{SO}_4) : n(\text{H}_3\text{O}^+) = 1 : 2</math></li> <li>• Subtract <math>n_{\text{initial}} - n_{\text{excess}} \checkmark</math> Aftrek: <math>n_{\text{begin}} - n_{\text{oormaat}}</math></li> <li>• Use <math>n(\text{H}_3\text{O}^+) : n(\text{NaOH}) = 1 : 1 \checkmark</math> Gebruik <math>n(\text{H}_3\text{O}^+) : n(\text{NaOH}) = 1 : 1</math></li> <li>• Substitution of <math>40 \text{ g}\cdot\text{mol}^{-1} \checkmark</math> Vervanging van <math>40 \text{ g}\cdot\text{mol}^{-1}</math></li> <li>• Final answer: <math>m = 5 \text{ g} \checkmark</math> Finale antwoord: <math>m = 5 \text{ g}</math></li> </ul> <p>Range/Gebied: 4,8 – 5,6 g</p>
<p> <math>n(\text{NaOH}) = \frac{m}{M}</math>  <math>0,125 = \frac{m}{40} \checkmark</math>  <math>m = 5 \text{ g} \checkmark \quad (5,2 \text{ g})</math> </p>	<p style="text-align: center;"><b>OR/OF</b></p> <p> <math>1 \text{ mol} \quad : 40 \text{ g} \checkmark</math>  <math>0,125 \text{ mol} : 5 \text{ g} \checkmark</math> </p>

**OPTION 3/OPSIE 3**

$$[\text{H}_2\text{SO}_4]_{\text{in/aanv}} = \frac{n}{V} \checkmark$$

Q7.2.1

$$= \frac{0,075}{0,5} \checkmark$$

$$= 0,15 \text{ mol} \cdot \text{dm}^{-3} \quad (0,16)$$

$$[\text{H}_3\text{O}^+]_{\text{in/aanv}} = 2[\text{H}_2\text{SO}_4]$$

$$= 2 \times 0,15 \checkmark$$

$$= 0,3 \text{ mol} \cdot \text{dm}^{-3} \quad (0,32)$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark$$

$$1,3 \checkmark = -\log[\text{H}_3\text{O}^+] \checkmark$$

$$[\text{H}_3\text{O}^+] = 0,05 \text{ mol} \cdot \text{dm}^{-3}$$

$$[\text{H}_3\text{O}^+]_{\text{react/rea}} = 0,3 - 0,05 \checkmark$$

$$= 0,25 \text{ mol} \cdot \text{dm}^{-3} \quad (0,27)$$

$$[\text{H}_2\text{SO}_4]_{\text{react/rea}} = \frac{1}{2}[\text{H}_3\text{O}^+] \checkmark$$

$$= \frac{1}{2} \times 0,25 \checkmark$$

$$= 0,125 \text{ mol} \cdot \text{dm}^{-3} \quad (0,14)$$

**Marking guidelines/Nasienriglyne:**

- Formula/Formule:  $c = \frac{n}{V} \checkmark$
- Divide by  $0,5 \text{ dm}^3$   
Deel deur  $0,5 \text{ dm}^3 \checkmark$
- Use  $[\text{H}_3\text{O}^+] : [\text{H}_2\text{SO}_4] = 2:1 \checkmark$   
Gebruik  $[\text{H}_3\text{O}^+] : [\text{H}_2\text{SO}_4] = 2:1$
- Formula/Formule:  $\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark$
- Substitution of/Substitusie van  $1,3 \checkmark$
- Subtract  $[\text{H}_3\text{O}^+]_{\text{initial}} - [\text{H}_3\text{O}^+]_{\text{excess}} \checkmark$   
Aftrek:  $[\text{H}_3\text{O}^+]_{\text{begin}} - [\text{H}_3\text{O}^+]_{\text{oormaat}}$
- Use  $n(\text{NaOH}) : n(\text{H}_2\text{SO}_4) = 2:1 \checkmark$   
Gebruik  $n(\text{NaOH}) : n(\text{H}_2\text{SO}_4) = 2:1$
- OR/OF**
- Use  $[\text{H}_2\text{SO}_4] : [\text{NaOH}] = 1 : 2 \checkmark$   
Gebruik  $[\text{H}_2\text{SO}_4] : [\text{NaOH}] = 1 : 2$
- Substitution of  $40 \text{ g} \cdot \text{mol}^{-1} \checkmark$   
Vervanging van  $40 \text{ g} \cdot \text{mol}^{-1}$
- Final answer:  $m = 5 \text{ g} \checkmark$   
Finale antwoord:  $m = 5 \text{ g}$

Range/Gebied:  $4,8 - 5,6 \text{ g}$

**OR/OF**

$$n(\text{H}_2\text{SO}_4)_{\text{react/reageer}} = cV$$

$$= (0,125)(0,5)$$

$$= 0,0625 \text{ mol} \quad (0,07)$$

$$n(\text{NaOH}) = 2n(\text{H}_2\text{SO}_4)$$

$$= 2 \times 0,0625 \checkmark$$

$$= 0,125 \text{ mol} \quad (0,14)$$

$$n(\text{NaOH}) = \frac{m}{M}$$

$$0,125 = \frac{m}{40} \checkmark$$

$$m = 5 \text{ g} \checkmark \quad (5,6 \text{ g})$$

$$[\text{H}_2\text{SO}_4] : [\text{NaOH}]$$

$$1 : 2$$

$$0,125 : 0,25 \checkmark \quad (0,28)$$

$$m = cMV$$

$$= 0,25 \times 40 \checkmark \times 0,5$$

$$= 5 \text{ g} \checkmark \quad (5,6 \text{ g})$$

(9)  
[16]

**QUESTION 8/VRAAG 8**

8.1

8.1.1  $\text{AgNO}_3$  / Silver nitrate ✓  
 $\text{AgNO}_3$  / Silwernittraat

(1)

8.1.2  $\text{Ni} \rightarrow \text{Ni}^{2+} + 2\text{e}^-$  ✓✓

**Marking guidelines/Nasienriglyne:**

- $\text{Ni} \rightleftharpoons \text{Ni}^{2+} + 2\text{e}^-$   $\frac{1}{2}$        $\text{Ni}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ni}$   $\frac{0}{2}$
  - $\text{Ni}^{2+} + 2\text{e}^- \leftarrow \text{Ni}$   $\frac{2}{2}$        $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$   $\frac{0}{2}$
  - Ignore if charge omitted on electron. / Ignoreer indien lading weggelaat op elektron.
  - If charge (+) omitted on  $\text{Ni}^{2+}$  / Indien lading (+) weggelaat op  $\text{Ni}^{2+}$ : Max./Maks:  $\frac{1}{2}$
- Example/Voorbeeld:  $\text{Ni} \rightarrow \text{Ni}^{2+} + 2\text{e}^-$  ✓

(2)

8.1.3  $\text{Ni} + 2\text{Ag}^+ \rightarrow \text{Ni}^{2+} + 2\text{Ag}$  ✓      Bal ✓

**OR/OF**

$\text{Ni} + 2\text{AgNO}_3 \rightarrow \text{Ni}(\text{NO}_3)_2 + 2\text{Ag}$

**Notes/Aantekeninge:**

- Reactants ✓      Products ✓      Balancing: ✓  
*Reaktanse      Produkte      Balansering*
- Ignore double arrows. / Ignoreer dubbelpyle.
- Marking rule 6.3.10 / Nasienreël 6.3.10.

(3)

8.2

8.2.1  Ni ✓

Ni is a stronger reducing agent. / Ni has a higher reducing ability. / Ni is the anode. / Ni loses electrons. / Ni is oxidised. ✓  
*Ni is die sterker reduseermiddel. / Ni het sterker reduseer vermoë. / Ni is die anode. / Ni verloor elektrone. / Ni word geoksideer.*

(2)

8.2.2  $\text{Ni}(\text{s}) \mid \text{Ni}^{2+}(\text{aq}) \parallel \text{Ag}^+(\text{aq}) \mid \text{Ag}(\text{s})$

**OR/OF**

$\text{Ni}(\text{s}) \mid \text{Ni}^{2+}(1 \text{ mol} \cdot \text{dm}^{-3}) \parallel \text{Ag}^+(1 \text{ mol} \cdot \text{dm}^{-3}) \mid \text{Ag}(\text{s})$

**Accept/Aanvaar:**

$\text{Ni} \mid \text{Ni}^{2+} \parallel \text{Ag}^+ \mid \text{Ag}$

(3)

8.2.3

<p><b>OPTION 1/OPSIE 1</b></p> $E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} \checkmark$ $= 0,80 \checkmark - (-0,27) \checkmark$ $= 1,07 \text{ V} \checkmark$	<p><b>Notes/Aantekeninge</b></p> <ul style="list-style-type: none"> <li>Accept any other correct formula from the data sheet./Aanvaar enige ander korrekte formule vanaf gegewensblad.</li> <li>Any other formula using unconventional abbreviations, e.g. <math>E^{\circ}_{\text{cell}} = E^{\circ}_{\text{OA}} - E^{\circ}_{\text{RA}}</math> followed by correct substitutions./Enige ander formule wat onkonvensionele afkortings gebruik bv. <math>E^{\circ}_{\text{sel}} = E^{\circ}_{\text{OM}} - E^{\circ}_{\text{RM}}</math> gevolg deur korrekte vervangings. <math>\frac{3}{4}</math></li> </ul>
<p><b>OPTION 2/OPSIE 2</b></p> $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag} \quad \checkmark$ $\text{Ni} \rightarrow \text{Ni}^{2+} + 2\text{e}^- \quad \checkmark$ <hr/> $\text{Ag}^+ + \text{Ni} \rightarrow \text{Ag} + \text{Ni}^{2+} \quad \checkmark$	$E^{\theta} = 0,80 \text{ V} \checkmark$ $E^{\theta} = +0,27 \text{ V} \checkmark$ $E^{\theta} = +1,07 \text{ V} \checkmark$

(4)

8.2.4 Increases / Verhoog  $\checkmark$

(1)

[16]

**QUESTION 9/VRAAG 9**

9.1 Endothermic / Endotermies  $\checkmark$

(1)

9.2 Anode  $\checkmark$



Connected to the positive terminal of the battery.  $\checkmark$   
Geskakel aan positiewe terminaal van battery.

(2)

9.3

9.3.1 Chlorine (gas) /  $\text{Cl}_2$  / Chloor(gas)  $\checkmark$

(1)

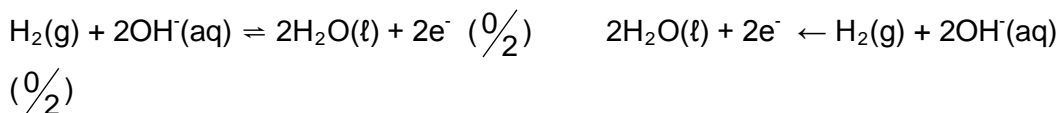
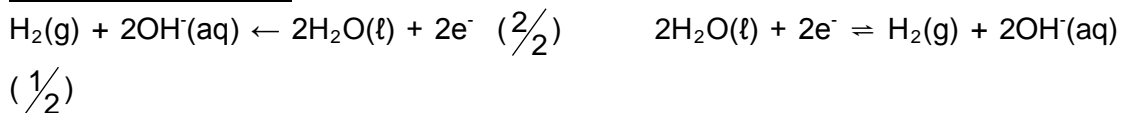
9.3.2 Hydrogen (gas) /  $\text{H}_2$  / Waterstof(gas)  $\checkmark$

(1)

9.3.3  $2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq}) \checkmark \checkmark$

Ignore phases/Ignoreer fases

**Notes/Aantekeninge**



(2)

9.4 Basic / Basies  $\checkmark$



**OR/OF** Alkaline / Alkalies

$\text{OH}^-$  (ions) / NaOH / Strong base forms.  $\checkmark$   
 $\text{OH}^-$  (-ione) / NaOH / Sterk basis vorm.

(2)



**QUESTION 10/VRAAG 10**

10.1

10.1.1 Haber (process) / *Haberproses* ✓ (1)

10.1.2 Contact process / Catalytic oxidation of  $\text{SO}_2$  ✓  
*Kontakproses / Katalitiese oksidasie van  $\text{SO}_2$*  (1)

10.1.3 Sulphur trioxide /  $\text{SO}_3$  / *Swaweltrioksied* ✓ (1)

10.1.4  $\text{SO}_3 + \text{H}_2\text{SO}_4 \checkmark \rightarrow \text{H}_2\text{S}_2\text{O}_7 \checkmark$  Bal. ✓

**Notes/Aantekeninge**

- Reactants ✓ Products ✓ Balancing ✓  
*Reaktanse Produkte Balansering*
- Ignore/*Ignoreer*  $\rightleftharpoons$  and phases/*en fases*.
- Marking rule 6.3.10/*Nasienreël 6.3.10*

(3)

10.1.5  $\text{H}_2\text{SO}_4 \checkmark + 2\text{NH}_3 \checkmark \rightarrow (\text{NH}_4)_2\text{SO}_4 \checkmark$  Bal. ✓

**Notes/Aantekeninge**

- Reactants ✓✓ Products ✓ Balancing ✓  
*Reaktanse Produkte Balansering*
- Ignore/*Ignoreer*  $\rightleftharpoons$  and phases/*en fases*.
- Marking rule 6.3.10/*Nasienreël 6.3.10*

(4)

10.2

**Marking guidelines/Nasienriglyne:**

- Calculate the mass of fertiliser./Bereken die massa kunsmis.
- Add %N and %P OR/OF mass N and mass P.  
Tel %N en %P OR/OF massa N en massa P bymekaar.
- Subtraction/Aftrekking:  $100 - (\%N + \%P)$   
OR/OF  $m(\text{fertiliser/kunsmis}) - [m(N) + m(P)]$   
OR/OF  $\% \text{fertiliser/kunsmis} - [\%N + \%P]$
- Final answer/Finale antwoord: 8:1:5

**OPTION 1/OPSIE 1**

$$m(\text{fertiliser/kunsmis}) = \frac{36}{100} \times 20 \checkmark$$

$$= 7,2 \text{ kg}$$

$$\%N = \frac{4,11}{7,2} \times 100$$

$$= 57,08\%$$

$$\%P = \frac{0,51}{7,2} \times 100$$

$$= 7,08\%$$

$$\%K = \frac{100 - \checkmark}{\checkmark} (57,08 + 7,08) \checkmark$$

$$= 35,84\%$$

$$57,08 : 7,08 : 35,84$$

$$8 : 1 : 5 \checkmark$$

**OPTION 2/OPSIE 2**

$$m(\text{fertiliser/kunsmis}) = \frac{36}{100} \times 20 \checkmark$$

$$= 7,2 \text{ kg}$$

$$m(K) = \frac{7,2 - \checkmark}{\checkmark} (4,11 + 0,51) \checkmark$$

$$= 2,58 \text{ kg}$$

$$4,11 : 0,51 : 2,58$$

$$8 : 1 : 5 \checkmark$$

**OPTION 3/OPSIE 3**

$$\%N = \frac{4,11}{20} \times 100 = 20,55\%$$

$$\%P = \frac{0,51}{20} \times 100 = 2,55\%$$

$$\%K = \frac{36 - \checkmark}{\checkmark} (20,55 + 2,55) \checkmark = 12,9\%$$

$$20,55 : 2,55 : 12,9$$

$$8 : 1 : 5 \checkmark$$

(4)  
[14]

**TOTAL/TOTAAL: 150**