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)

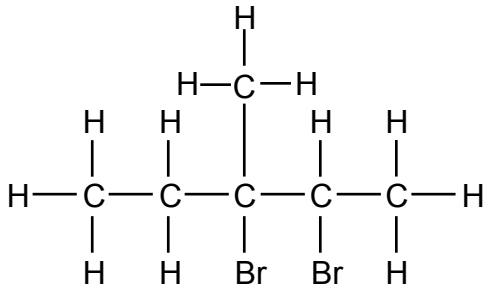
2.1.2 B ✓ (1)

2.1.3 E ✓ (1)

2.1.4 D ✓ (1)

2.2

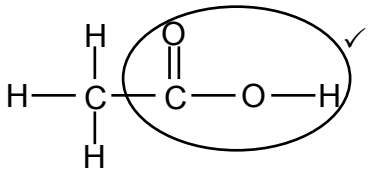
2.2.1



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



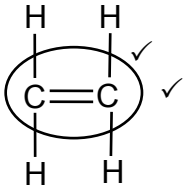
✓ ✓

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-dimetielpropaan* ✓

Lowest boiling point. */ Laagste kookpunt*.✓ (2)

3.5 $C_5H_{12} + 8O_2$ ✓ → $5CO_2 + 6H_2O$ ✓ 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.*

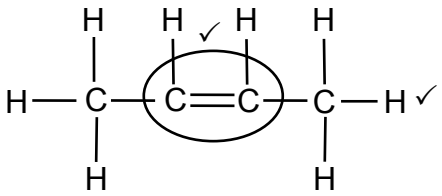
(4)

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* $\frac{0}{2}$

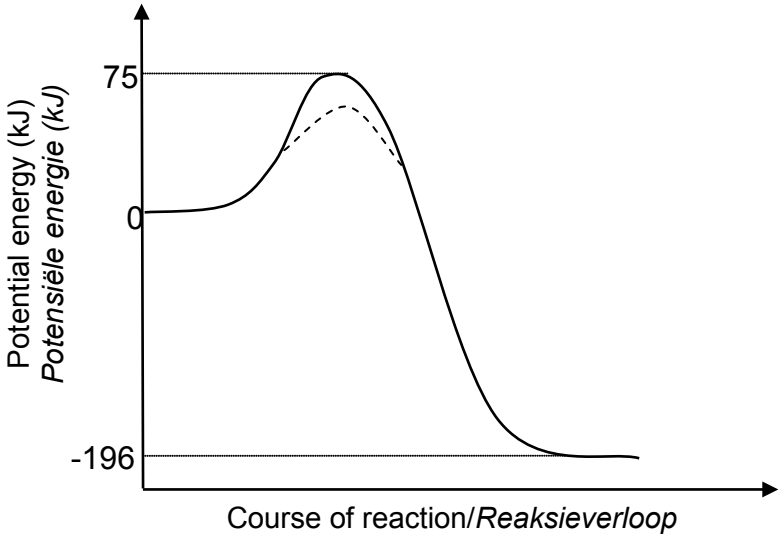
4.3.4 Hydration / *Hidrasie / Hidratering* ✓ (1)
[13]

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



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

(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

Ave rate/*Gem. tempo* = $\frac{\Delta V}{\Delta t}$

= $\frac{52 - 16}{40 - 10}$ ✓ ✓

= 1,2 ($dm^3 \cdot s^{-1}$) ✓

Accept/*Aanvaar*:
- Volume range/*gebied*: 16 to/*tot* 17 cm^3
- Answer range/*Antwoordgebied:* 1,167 to 1,2 $dm^3 \cdot s^{-1}$

(3)

5.2.2

Marking criteria/*Nasienriglyne:*

- $V(O_2)$ = 60 dm^3 AND/*EN* divide volume by 24./*deel volume deur* 24 ✓
- Use ratio/Gebruik v*erhouding*: $n(H_2O_2) = 2n(O_2) = 1:2$ ✓
- Use 34 $g \cdot mol^{-1}$ in $n = \frac{m}{M}$ or in ratio calculation. ✓

  Gebruik 34 $g \cdot mol^{-1}$ *in* $n = \frac{m}{M}$ *of in verhoudingsberekening*.
- Final answer/*Finale antwoord:* 170 g ✓

OPTION 1/*OPSIE 1*

$n(O_2) = \frac{V}{V_M}$

$= \frac{60}{24}$ ✓

$= 2,5$ mol

$n(H_2O_2) = 2n(O_2)$

$= 2(2,5)$ ✓

$= 5$ mol

$n(H_2O_2) = \frac{m}{M}$

$\therefore 5 = \frac{m}{34}$ ✓

$\therefore m = 170$ g ✓

OPTION 2/*OPSIE 2*

24 dm^3 : 1 mol

60 dm^3 : 2,5 mol ✓

$n(H_2O_2) = 2n(O_2)$

$= 2(2,5)$ ✓

$= 5$ mol

34 g ✓: 1 mol

x : 5 mol

x = 170 g ✓

OPTION 3/*OPSIE 3*

$n(O_2) = \frac{V}{V_M}$

$= \frac{60}{24}$ ✓

$= 2,5$ mol

$n(O_2) = \frac{m}{M}$

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

$\therefore m = 80$ g ✓

2(34) g ✓ H_2O_2 .....32 g O_2

x g H_2O_2 ..... 80 g O_2

$m(H_2O_2) = 170$ g ✓ (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 terugwaarste 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* ✓

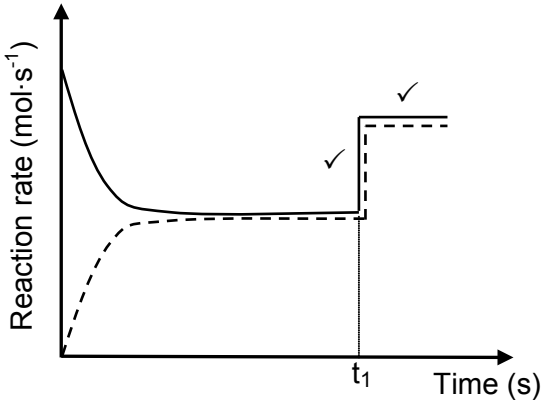
-

- 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 voorwaarste 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.* ✓
- Horisontal 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(PbS) = 239 g·mol^{-1} in $n = \frac{m}{M}$ or in ratio calculation/ *of in verhoudingsberekening*. ✓
- Use ratio/*Gebruik verhouding*: $n(H_2S)_{equil/ewewig} = n(PbS)$ ✓
- $n(H_2S)_{formed/gevorm} = n(H_2S)_{equilibrium/ewewig}$ ✓
- **USING** ratio/***GEBRUIK*** *verhouding:* $H_2 : H_2S = 1 : 1$ ✓
- $n(H_2)_{equilibrium/ewewig} = n(H_2)_{initial/aanvanklik} - n(H_2)_{formed/gevorm}$ ✓
- Divide equilibrium $n(H_2S)$ & $n(H_2)$ by 2 dm^3. ✓
  Deel $n(H_2S)$ & $n(H_2)$ deur 2 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*

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

$n(H_2S)_{equilibrium/by\ ewewig}$ = n(PbS) ✓ = 0,01 mol

	H_2	H_2S	
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	0,16	0	
Change (mol) *Verandering (mol)*	0,01	0,01 ✓	ratio ✓ *verhouding*
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	0,15 ✓	0,01	
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	0,075	0,005	divide by 2 ✓ *deel deur 2*

$K_c = \frac{[H_2S]}{[H_2]}\checkmark$

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

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

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./M*aks.* $\frac{6}{9}$

IF/*INDIEN:* [S] = 1 in $K_c = \frac{[H_2S]}{[H_2][S]}$

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*

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

$n(H_2S)_{reacted/gereageer} = n(PbS)\checkmark = 0,01$ mol
$= n(H_2S)_{equilibrium/ewewig}$

$n(H_2S)_{formed/gevorm} = n(H_2S)_{equilibrium/ewewig} - n(H_2S)_{initial/aanvanklik}$
$= 0,01 - 0\checkmark$
$= 0,01$ mol

$n(H_2)_{reacted/gereageer} = n(H_2S)_{formed/gevorm}\checkmark = 0,01$ mol

$n(H_2)_{equilibrium/ewewig} = n(H_2)_{initial/aanvanklik} - n(H_2)_{reacted/gereageer}$
$= 0,16 - 0,01\checkmark$
$= 0,15$ mol

$$c(H_2) = \frac{n}{V} = \frac{0,15}{2} = 0,075\ mol \cdot dm^{-3}$$

$$c(H_2S) = \frac{n}{V} = \frac{0,01}{2}\checkmark = 0,005\ mol \cdot dm^{-3}$$

$$K_c = \frac{[H_2S]}{[H_2]}\checkmark = \frac{0,005}{0,075}\checkmark = 0,067 \approx 0,07\checkmark$$

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

Wrong K_C expression /*Verkeerde K_c-uitdrukking*: Max./M*aks.* $^{6}/_{9}$

IF/*INDIEN:* [S] = 1 in $K_c = \frac{[H_2S]}{[H_2][S]}$

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_2	H_2S
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	0,16	0
Change (mol) *Verandering (mol)*	x	x ✓
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	0,16 - x ✓	x
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*	$\frac{0,16 - x}{2}$	$\frac{x}{2}$

ratio ✓
verhouding

divide by 2 ✓
deel deur 2

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

$n(H_2S)_{equilibrium/by\ ewewig} = n(PbS)$ ✓ ∴ x = 0,01 mol

$$[H_2]_{equilibrium/by\ ewewig} = \frac{0,16 - 0,01}{2} = 0,075\ mol \cdot dm^{-3}$$

$$[H_2S]_{equilibrium/by\ ewewig} = \frac{0,01}{2} = 0,005\ mol \cdot dm^{-3}$$

$$K_c = \frac{[H_2S]}{[H_2]} \checkmark$$
$$= \frac{0,005}{0,075} \checkmark$$
$$= 0,067 \approx 0,07 \checkmark$$

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./M*aks.* $\frac{6}{9}$

IF/*INDIEN*: [S] = 1 in $K_c = \frac{[H_2S]}{[H_2][S]}$

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.*

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK

Marking criteria/Nasinriglyne*:*

- Use/*Gebruik* M(PbS) = 239 g·mol^{-1} in $n = \frac{m}{M}$ or in ratio calculation/ *of in verhoudingsberekening*. ✓
- Use ratio/*Gebruik verhouding*: $n(H_2S)_{equil/ewewig} = n(PbS)$ ✓
- Divide equilibrium $n(H_2S)_{equil}$ & $n(H_2)_{initial}$ by 2 dm^3. ✓
  Deel $n(H_2S)_{ewewig}$ & $n(H_2)_{aanvanklik}$ *deur 2 dm^3*
- $[H_2S]_{formed/gevorm} = [H_2S])_{equilibrium/ewewig}$ ✓
- **USING** ratio/***GEBRUIK*** *verhouding:* $H_2 : H_2S = 1 : 1$ ✓
- $[H_2]_{equilibrium/ewewig} = [H_2]_{initial/aanvanklik} - [H_2]_{formed/gevorm}$ ✓
- 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*

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

$n(H_2S)_{equilibrium/by\ ewewig} = n(PbS)$ ✓ = 0,01 mol

	H_2	H_2S
Initial concentration/Aanvangs-konsentrasie (mol·dm^{-3})	$\frac{0,16}{2}$ = 0,08	0
Change in concentration/ V*erandering* in konsentrasie (mol·dm^{-3})	0,005	0,005 ✓
Equilibrium concentration Ewewigskonsentrasie (mol·dm^{-3})	0,075	$\frac{0,01}{2}$ = 0,005

$$K_c = \frac{[H_2S]}{[H_2]} = \frac{0,005}{0,075} = 0,067 \approx 0,07$$

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./M*aks.* $\frac{6}{9}$

IF/*INDIEN*: [S] = 1 in $K_c = \frac{[H_2S]}{[H_2][S]}$

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*

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

$n(H_2S)_{equilibrium/by\ ewewig}$ = n(PbS) ✓= 0,01 mol

$$[H_2S]_{equilibrium/by\ ewewig} = \frac{n}{V}$$
$$= \frac{0,01}{2}$$
$$= 0,005\ mol\cdot dm^{-3}$$

$$[H_2]_{initial/aanvanklik} = \frac{n}{V}$$
$$= \frac{0,16}{2}$$
$$= 0,08\ mol\cdot dm^{-3}$$

$[H_2S]_{formed/gevorm} = [H_2S]_{equilibrium/by\ ewewig} - [H_2S]_{initial/aanvanklik}$
= 0,005 – 0 ✓
= 0,005 mol·dm^{-3}

$[H_2]_{reacted/gereageer} = [H_2S]_{formed/gevorm}$ ✓ = 0,005 mol

$[H_2]_{equilibrium/ewewig} = [H_2]_{initial/aanvanklik} - [H_2]_{reacted/gereageer}$
= 0,08 - 0,005 ✓
= 0,075 mol

$$K_c = \frac{[H_2S]}{[H_2]}$$
$$= \frac{0,005}{0,075}$$
$$= 0,067 \approx 0,07$$

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./M*aks.* $\frac{6}{9}$

IF/*INDIEN*: [S] = 1 in $K_c = \frac{[H_2S]}{[H_2][S]}$

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)* ✓

$NH_4^+ + H_2O$ ✓ $\rightarrow NH_3 + H_3O^+$ ✓

Accept/*Aanvaar*:
$NH_4C\ell + H_2O \rightarrow NH_3 + H_3O^+ + C\ell^-$

$NH_4^+ \rightarrow NH_3 + H^+$

Note/*Aantekening*:
- Mark equation independently of first answer./*Sien vergelyking onafhanklik van eerste antwoord na.*
- If incorrect balancing/*Indien verkeerde balansering:* Max/*Maks.* $^2/_3$

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 g·mol^{-1}. ✓
- Final answer/*Finale antwoord:* 0,08 mol ✓

Note/Let wel:
If not rounded/*Indien nie afgerond nie*: (0,075 mol)

OPTION 1/*OPSIE 1*

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

$= \frac{7,35}{98}$

= 0,08 mol ✓ (0,075 mol)

OPTION 2/*OPSIE 2*

98 g ✓: 1 mol
7,35 :0,08 mol ✓

OPTION 3/*OPSIE 3*

$c = \frac{m}{MV}$

$= \frac{7,35}{98 \times 0,5}$

= 0,15 mol·dm^{-3}

n = cV
= 0,15 x 0,5
= 0,08 mol ✓ (2)

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

OPTION 1/*OPSIE 1*

$pH = -\log[H_3O^+]$ ✓
1,3 ✓ $= -\log[H_3O^+]$
$[H_3O^+] = 0,05 \text{ mol·dm}^{-3}$

$[H_2SO_4] = ½[H_3O^+]$
$= ½ \times 0,05$ ✓
$= 0,025 \text{ mol·dm}^{-3}$ (0,03)

$n(H_2SO_4)_{ex/oor} = cV$ ✓
$= 0,025 \times 0,5$ ✓
$= 0,0125 \text{ mol}$ (0,02)

Q7.2.1

$n(H_2SO_4)_{react/rea} = 0,075 - 0,0125$ ✓
$= 0,0625 \text{ mol}$ (0,06)

$n(NaOH) = 2n(H_2SO_4)$
$= 2 \times 0,0625$ ✓
$= 0,125 \text{ mol}$ (0,12)

OR/*OF*

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

$0,125 = \frac{m}{40}$ ✓

$m = 5 \text{ g}$ ✓ (4,8 g)

Marking guidelines/*Nasienriglyne:*

- Formula/*Formule:* $pH = -\log[H_3O^+]$ ✓
- Substitution of/*Substitusie van* 1,3 ✓
- Use $[H_2SO_4] : [H_3O^+] = 1 : 2$ ✓
  Gebruik $[H_2SO_4] : [H_3O^+] =$ *1 : 2*
- Formula/*Formule:* $c = \frac{n}{V}$ ✓
- Multiply by 0,5 dm^3
  Vermenigvuldig met 0,5 dm^3 ✓
- Subtract $n_{initial} - n_{excess}$ ✓
  Aftrek: $n_{begin} - n_{oormaat}$
- Use $n(NaOH) : n(H_2SO_4) = 2:1$ ✓
  Gebruik $n(NaOH) : n(H_2SO_4) = 2:1$
- Substitution of 40 $g \cdot mol^{-1}$ ✓
  Vervanging van 40 $g \cdot mol^{-1}$
- Final answer: m = 5 g ✓
  Finale antwoord: m = 5 g

  Range/Gebied: 4,8 – 5,6 g

1 mol : 40 g ✓
0,125 mol : 5 g ✓

OPTION 2/*OPSIE 2*

Q7.2.1

$pH = -\log[H_3O^+]$ ✓
1,3 ✓ $= -\log[H_3O^+]$
$[H_3O^+] = 0,05 \text{ mol·dm}^{-3}$

$n(H_3O^+)_{ex/oor} = cV$ ✓
$= (0,05)(0,5)$ ✓
$= 0,025 \text{ mol}$ (0,03)

$n(H_3O^+)_{in/aanv} = 2n(H_2SO_4)$
$= 0,075 \times 2$ ✓
$= 0,15 \text{ mol}$ (0,16)

$n(H_3O^+)_{react/reageer} = 0,15 - 0,025$ ✓
$= 0,125 \text{ mol}$ (0,13)

$n(NaOH) = n(H_3O^+)$ ✓
$= 0,125 \text{ mol}$ (0,13)

OR/*OF*

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

$0,125 = \frac{m}{40}$ ✓

$m = 5 \text{ g}$ ✓ (5,2 g)

1 mol : 40 g ✓
0,125 mol : 5 g ✓

Marking guidelines/*Nasienriglyne:*

- Formula/*Formule:* $pH = -\log[H_3O^+]$ ✓
- Substitution of/*Substitusie van* 1,3 ✓
- Formula/*Formule:* $c = \frac{n}{V}$ ✓
- Multiply by 0,5 dm^3
  Vermenigvuldig met 0,5 dm^3 ✓
- Use $n(H_2SO_4) : n(H_3O^+) = 1 : 2$ ✓
  Gebruik $n(H_2SO_4) : n(H_3O^+) = 1 : 2$
- Subtract $n_{initial} - n_{excess}$ ✓
  Aftrek: $n_{begin} - n_{oormaat}$
- Use $n(H_3O^+) : n(NaOH) = 1 : 1$ ✓
  Gebruik $n(H_3O^+) : n(NaOH) = 1 : 1$
- Substitution of 40 $g \cdot mol^{-1}$ ✓
  Vervanging van 40 $g \cdot mol^{-1}$
- Final answer: m = 5 g ✓
  Finale antwoord: m = 5 g

Range/Gebied: 4,8 – 5,6 g

OPTION 3/*OPSIE 3*

Q7.2.1

$[H_2SO_4]_{in/aanv} = \frac{n}{V}$ ✓

$= \frac{0,075}{0,5}$ ✓

$= 0,15 \text{ mol·dm}^{-3}$ (0,16)

$[H_3O^+]_{in/aanv} = 2[H_2SO_4]$

$= 2 \times 0,15$ ✓

$= 0,3 \text{ mol·dm}^{-3}$ (0,32)

$pH = -\log[H_3O^+]$ ✓

1,3 ✓ = $-\log[H_3O^+]$

$[H_3O^+] = 0,05 \text{ mol·dm}^{-3}$

$[H_3O^+]_{react/rea} = 0,3 - 0,05$ ✓

$= 0,25 \text{ mol·dm}^{-3}$ (0,27)

$[H_2SO_4]_{react/rea} = ½[H_3O^+]$

$= ½ \times 0,25$

$= 0,125 \text{ mol·dm}^{-3}$ (0,14)

Marking guidelines/*Nasienriglyne:*

- Formula/*Formule:* $c = \frac{n}{V}$ ✓
- Divide by 0,5 dm^3
  Deel deur 0,5 dm^3 ✓
- Use $[H_3O^+] : [H_2SO_4] = 2:1$ ✓
  Gebruik $[H_3O^+] : [H_2SO_4] = 2:1$
- Formula/*Formule:* $pH = -\log[H_3O^+]$ ✓
- Substitution of/*Substitusie van* 1,3 ✓
- Subtract $[H_3O^+]_{initial} - [H_3O^+]_{excess}$ ✓
  Aftrek: $[H_3O^+]_{begin} - [H_3O^+]_{oormaat}$
- Use $n(NaOH) : n(H_2SO_4) = 2:1$ ✓
  Gebruik $n(NaOH) : n(H_2SO_4) = 2:1$
  OR/*OF*
  Use $[H_2SO_4] : [NaOH] = 1 : 2$ ✓
  Gebruik $[H_2SO_4] : [NaOH] = 1 : 2$
- Substitution of 40 $g \cdot mol^{-1}$ ✓
  Vervanging van 40 $g \cdot mol^{-1}$
- Final answer: m = 5 g ✓
  Finale antwoord: m = 5 g

  Range/Gebied: 4,8 – 5,6 g

OR/*OF*

$n(H_2SO_4)_{react/reageer} = cV$

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

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

$n(NaOH) = 2n(H_2SO_4)$

$= 2 \times 0,0625$ ✓

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

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

$0,125 = \frac{m}{40}$ ✓

m = 5 g ✓ (5,6 g)

$[H_2SO_4] : [NaOH]$

1 : 2

0,125 : 0,25 ✓ (0,28)

m = cMV

= 0,25 x 40 ✓x 0,5

= 5 g ✓ (5,6 g)

(9)
[16]

QUESTION 8/*VRAAG 8*

8.1

8.1.1 $AgNO_3$ / Silver nitrate ✓
$AgNO_3$ / Silwernitraat (1)

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

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

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

OR/*OF*
$Ni + 2\ AgNO_3 \rightarrow Ni(NO_3)_2 + 2Ag$

Notes/*Aantekeninge:*
- Reactants ✓ Products ✓ Balancing: ✓
  Reaktanse *Produkte* *Balansering*
- Ignore double arrows./*IDgnoreer 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 Ni (s) ✓ | Ni^{2+} (aq) ✓ || Ag^+(aq) ✓ | Ag(s)

OR/*OF*
Ni (s) | Ni^{2+} (1 mol·dm^{-3}) || Ag^+(1 mol·dm^{-3}) | Ag(s)

Accept/*Aanvaar:*
Ni | Ni^{2+} || Ag^+ | Ag (3)

8.2.3

OPTION 1/*OPSIE 1*	**Notes/*Aantekeninge***
$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ ✓ = 0,80 ✓ – (-0,27) ✓ = 1,07 V ✓	• Accept any other correct formula from the data sheet./*Aanvaar enige ander korrekte formule vanaf gegewensblad.* • Any other formula using unconventional abbreviations, e.g. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions:/*Enige ander formule wat onkonvensionele afkortings gebruik bv.* $E°_{sel} = E°_{OM} - E°_{RM}$ *gevolg deur korrekte vervangings*: $^{3}/_{4}$

OPTION 2/*OPSIE 2*

$Ag^{+} + e^{-} \rightarrow Ag$ ✓ E^{θ} = 0,80 V ✓

$Ni \rightarrow Ni^{2+} + 2e^{-}$ E^{θ} = +0,27 V ✓

$Ag^{+} + Ni \rightarrow Ag + Ni^{2+}$ E^{θ} = +1,07 V ✓ (4)

8.2.4 Increases / *Verhoog* ✓ (1)
[16]

QUESTION 9/*VRAAG 9*

9.1 Endothermic / *Endotermies* ✓ (1)

9.2 Anode ✓

Connected to the positive terminal of the battery. ✓
Geskakel aan positiewe terminaal van battery. (2)

9.3

9.3.1 Chlorine (gas) / $C\ell_2$ / *Chloor(gas)* ✓ (1)

9.3.2 Hydrogen (gas) /H_2 / *Waterstof(gas*) ✓ (1)

9.3.3 $2H_2O(\ell) + 2e^{-} \rightarrow H_2(g) + 2OH^{-}(aq)$ ✓✓

Ignore phases/*Ignoreer fases*

Notes/*Aantekeninge*
$H_2(g) + 2OH^{-}(aq) \leftarrow 2H_2O(\ell) + 2e^{-}$ ($^{2}/_{2}$) $2H_2O(\ell) + 2e^{-} \rightleftharpoons H_2(g) + 2OH^{-}(aq)$ ($^{1}/_{2}$)
$H_2(g) + 2OH^{-}(aq) \rightleftharpoons 2H_2O(\ell) + 2e^{-}$ ($^{0}/_{2}$) $2H_2O(\ell) + 2e^{-} \leftarrow H_2(g) + 2OH^{-}(aq)$ ($^{0}/_{2}$)

(2)

9.4 Basic / *Basies* ✓

OR/*OF* Alkaline / *Alkalies*

OH^{-} (ions) / NaOH / Strong base forms.✓
OH^{-}(-ione) / NaOH / Sterk basis vorm. (2)

[9]

QUESTION 10/*VRAAG 10*

10.1

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

10.1.2 Contact process / Catalytic oxidation of SO_2 ✓
Kontakproses / Katalitiese oksidasie van SO_2 (1)

10.1.3 Sulphur trioxide / SO_3 / *Swaweltrioksied* ✓ (1)

10.1.4 $SO_3 + H_2SO_4$ ✓ → $H_2S_2O_7$ ✓ Bal. ✓

Notes/*Aantekeninge*
- Reactants ✓ Products ✓ Balancing ✓
  Reaktanse *Produkte* *Balansering*
- Ignore/*Ignoreer* ⇌ and phases/*en fases*.
- Marking rule 6.3.10/*Nasienreël 6.3.10* (3)

10.1.5 H_2SO_4 ✓ + $2NH_3$ ✓ → $(NH_4)_2SO_4$ ✓ Bal. ✓

Notes/*Aantekeninge*
- Reactants ✓✓ Products ✓ Balancing ✓
  Reaktanse *Produkte* *Balansering*
- Ignore/*Ignoreer* ⇌ 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(fertiliser/*kunsmis*) – [m(N) + m(P)]
  OR/*OF* %fertiliser/*kunsmis* – [%N + %P]
- Final answer/*Finale antwoord:* 8:1:5

OPTION 1/*OPSIE 1*

m(fertiliser/*kunsmis*) = $\frac{36}{100}$ x 20 ✓
= 7,2 kg

%N = $\frac{4,11}{7,2}$ x 100
= 57,08%

%P = $\frac{0,51}{7,2}$ x 100
= 7,08%

%K = 100 – ✓ (57,08 + 7,08) ✓
= 35,84%

57,08 : 7,08 : 35,84
8 : 1 : 5 ✓

OPTION 2/*OPSIE 2*

m(fertiliser/*kunsmis*) = $\frac{36}{100}$ x 20 ✓
= 7,2 kg

m(K) = 7,2 – ✓ (4,11 + 0,51) ✓
= 2,58 kg

4,11 : 0,51 : 2,58
8 : 1 : 5 ✓

OPTION 3/*OPSIE 3*

%N = $\frac{4,11}{20}$ x 100 = 20,55%
%P = $\frac{0,51}{20}$ x 100 = 2,55% } ✓

%K = 36 – ✓ (20,55 + 2,55) ✓ = 12,9%

20,55 : 2,55 : 12,9
8 : 1 : 5 ✓

(4)
[14]

TOTAL/*TOTAAL*: 150