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Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN**

**PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)**

2019

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 16 pages./
Hierdie nasienriglyne bestaan uit 16 bladsye.**

QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

2.1 Unsaturated/Onversadig ✓

**ANY ONE/ENIGE EEN:**

- C/It has a triple/multiple bond. ✓
C/Dit het 'n trippelbinding/meervoudige-binding.
- C/It has a triple/multiple bond between C atoms.
C/Dit het 'n trippelbinding/meervoudige-binding tussen C-atome.
- C/It does NOT contain the maximum number of H atoms bonded to C atoms.
C/Dit bevat NIE die maksimum getal H-atome gebind aan C-atome nie.
- Compound C is an alkyne./Verbinding C is 'n alkyn. (2)

2.2

2.2.1 D ✓ (1)

2.2.2 B ✓ (1)

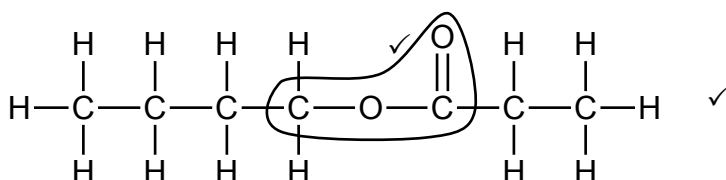
2.2.3 C ✓ (1)

2.2.4 E ✓ (1)

2.3

2.3.1 $\text{—C}\equiv\text{C—}$ ✓ (1)

2.3.2



(2)

Marking criteria/Nasienriglyne:

- Whole structure correct:

Hele struktuur korrek: $\frac{2}{2}$

- Only functional group correct:/Slegs funksionele groep korrek: Max/Maks.: $\frac{1}{2}$

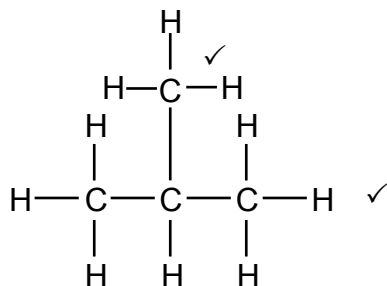
IF/INDIEN:

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

- If condensed or semi structural formula used:/Indien gekondenseerde of semi-struktuurformule gebruik:

Max/Maks. $\frac{1}{2}$

2.3.3

**Marking criteria/Nasienriglyne:**

- Three C atoms in longest chain. ✓
Drie C-atome in langste ketting.
- One methyl substituent on C2. ✓
Een metielsubstituent op C2.

IF/INDIEN

Any error e.g. omission of H atoms, condensed or semi structural formula/*Enige fout bv weglating van H-atome, gekondenseerde of semi-struktuurformule.* Max/Maks.: $\frac{1}{2}$

(2)

2.4

2.4.1 2,3-dibromo-5-methylheptane/2,3-dibromo-5-metielheptaan

Marking criteria/Nasienriglyne:

- Correct stem i.e. heptane./Korrekte stam d.i. heptaan. ✓
- All substituents (bromo and methyl) correctly identified./Alle substituenten (bromo en metiel) korrek geïdentifiseer. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas./IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas. ✓

(3)

2.4.2 $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$ ✓ 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. $\frac{2}{3}$
- Accept coefficients that are multiples./Aanvaar koëffisiënte wat veelvoude is.

(3)

[17]**QUESTION 3/VRAAG 3**

3.1

3.1.1 Yes/Ja ✓

**ANY ONE/ENIGE EEN:**

- Compounds have the same molecular mass. ✓
Verbindings het dieselfde molekulêre massa.
- Only one independent variable./Slegs een onafhanklike veranderlike.

(2)

3.1.2 Functional group/Homologous series/Type of (organic) compound ✓
Funksionele groep/Homoloë reeks/Tipe (organiese) verbinding

(1)

3.2 A/butane/butaan ✓



- Lowest boiling point/weakest intermolecular forces. ✓
Laagste kookpunt/swakste intermolekulêre kragte.

(2)

3.3

Marking guidelines/Nasienriglyne

- Type of IMF in A./Tipe IMK in A.
 - BOTH B and C have hydrogen bonding./BEIDE B en C het waterstofbinding.
 - Compare number of sites for hydrogen bonding in B and C./Vergelyk aantal punte vir waterstofbinding in B en C.
 - Compare strength of IMFs./Vergelyk sterkte van IMKe.
 - Compare energy required./Vergelyk energie benodig.
 - Between molecules of butane/compound A are London forces/dispersion forces/induced dipole forces. ✓
 - Molecules of compound B/propan-1-ol have one site for hydrogen bonding. ✓
 - Molecules of compound C/ethanoic acid have two/more sites for hydrogen bonding. ✓
 - Strength of intermolecular forces increases from compound A/butane to compound B/propan-1-ol to compound C/ethanoic acid. ✓
- OR**
- Intermolecular forces in compound A/butane are the weakest and intermolecular forces in compound C/ethanoic acid are the strongest.
- More energy is needed to overcome/break intermolecular forces in compound C than in the other two compounds. ✓
 - Tussen molekule van butaan/verbinding A is Londonkragte/dispersie-kragte/geïnduseerde dipoolkragte. ✓
 - Molekule van verbinding B/propan-1-ol het een punt vir waterstof-bindings. ✓
 - Molekule van verbinding C/etanoësuur het twee punte vir waterstof-bindings. ✓
 - Sterkte van intermolekulêre kragte neem toe van verbinding A/butaan na verbinding B/propan-1-ol na verbinding C/etanoësuur. ✓
- OF**
- Intermolekulêre kragte tussen propaan is die swakste en intermolekulêre kragte in verbinding C is die sterkste.
- Meer energie word benodig om intermolekulêre kragte in verbinding C as in die ander twee bindings te oorkom/breek. ✓

(5)

3.4

Butan-1-ol ✓

⊖

- Longer chain length./Larger molecule./Larger molecular mass./Larger molecular size./Stronger intermolecular forces./Larger surface area. ✓
- Langer kettinglengte./Groter molekuul./Groter molekulêre massa/Groter molekuul./Sterker intermolekulêre kragte./Groter oppervlakte.

(2)

[12]

QUESTION 4/VRAAG 4

4.1

4.1.1 Addition (polymerisation)/Addisie-(polimerisasie) ✓ (1)

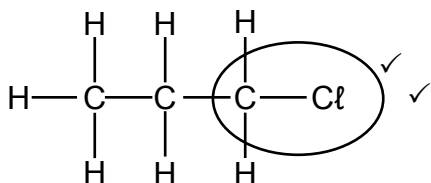
4.1.2 Ethene/eteen ✓ (1)

4.1.3 Polyethene/polythene ✓
Poli-eteen/politeen (1)

4.2

4.2.1 Dehydration/elimination ✓
Dehidrasie/dehidratering/eliminatie (1)4.2.2 Catalyst/dehydrating agent/causes dehydration/removes water molecules ✓
Katalisator/dehidreermiddel/veroorzaak dehidrasie/verwyder watermolekule (1)4.2.3 Prop-1-ene/propene/1-propene ✓✓ (2 or 0)
Prop-1-een/propeen/1-propeen (2 of 0) (2)

4.2.4

**Marking criteria/Nasienriglyne:**

- Whole structure correct:

Hele struktuur korrek: $\frac{2}{2}$

- Only functional group correct:/Slegs funksionele groep korrek: Max/Maks.: $\frac{1}{2}$

IF/INDIEN:

- More than one functional group/Meer as een funksionele groep: $\frac{0}{2}$
- If condensed or semi structural formula used:/Indien gekondenseerde of semi-struktuurformule gebruik:

Max/Maks. $\frac{1}{2}$

4.2.5 Addition/Hydration ✓
Addisie/Hidrasie/Hidratering (1)

4.2.6 Propan-2-ol/2-propanol ✓✓

Marking criteria/Nasienriglyne:

- Correct stem and functional group i.e propanol/Korrekte stam en funksionele groep d.i propanol ✓
- Name completely correct/Naam volledig korrek: Propan-2-ol/2-propanol ✓✓

(2)
[12]

QUESTION 5/VRAAG 5

5. 1

NOTE/LET WELGive the mark for per unit time only if in context of reaction rate.Gee die punt vir per eenheidtyd slegs indien in konteks met reaksietempo.**ANY ONE/ENIGE EEN**

- Change in concentration ✓ of products/reactants per (unit) time. ✓
Verandering in konsentrasie van produkte/reaktanse per (eenheid) tyd.
- Change in amount/number of moles/volume/mass of products or reactants per (unit) time.
Verandering in hoeveelheid/getal mol/volume/massa van produkte of reaktanse per (eenheid) tyd.
- Amount/number of moles/volume/mass of products formed/reactants used per (unit) time.
Hoeveelheid/getal mol/volume/massa van produkte gevorm/reaktanse gebruik per (eenheid) tyd.
- Rate of change in concentration/amount/number of moles/volume/mass.
Tempo van verandering in konsentrasie/ hoeveelheid/getal mol/ volume/massa. ✓✓ (2 or/of 0)

(2)

5.2

5.2.1 Rate of the reaction/Reaksietempo ✓

(1)

5.2.2

Criteria for conclusion/Kriteria vir gevolgtrekking:

Dependent (reaction rate) and independent (concentration) variables correctly identified./Afhanklike(reaksietempo) en onafhanklike (konsentrasie) veranderlikes korrek geïdentifiseer.

✓

Relationship between the independent and dependent variables correctly stated.
Verwantskap tussen die afhanklike en onafhanklike veranderlikes korrek genoem.

✓

Example/Voorbeeld:Reaction rate increases with increase in concentration./Reaction rate is proportional to concentration.Reaksietempo neem toe met toename in konsentrasie./Reaksietempo is eweredig aan konsentrasie.**IF/INDIEN**DIRECTLY proportional/DIREK eweredig: Max/Maks.: $\frac{1}{2}$

(2)

5.3

- 5.3.1 Activation energy/(The boundary line for the) molecules with (adequate) kinetic energy to make effective collisions. ✓
Aktiveringsenergie/(Die grenslyn vir die) molekule met (genoeg) kintiese energie vir effektiewe botsings. (1)

- 5.3.2 B ✓ (1)

- 5.3.3
- At a higher temperature particles move faster/have a higher kinetic energy. ✓
By 'n hoër temperatuur beweeg die deeltjies vinniger/het die deeltjies hoër kinetiese energie.
 - More molecules have enough/sufficient (kinetic) energy. ✓
Meer molekule het genoeg/voldoende (kinetiese) energie.
OR/OF
 More molecules have (kinetic) energy equal to or greater than activation energy.
Meer molekule het (kinetiese) energie gelyk aan of groter as aktiveringsenergie.
 - More effective collisions per unit time/second./Increased frequency of effective collisions.
Meer effektiewe botsings per eenheidtyd/sekonde./Frekwensie van effektiewe botsings neem toe.
 - Reaction rate increases. ✓
Reaksietempo neem toe. (4)

- 5.4 Curve **Y**/it was obtained for the reaction where a catalyst was added. ✓
*Kurwe **Y**/dit is vir die reaksie waar 'n katalisator bygevoeg is, verkry.*

OR/OF

- Curve **X** was obtained for the reaction in the absence of a catalyst.
*Kurwe **X** is verkry vir die reaksie sonder 'n katalisator.* (1)

5.5

Marking guidelines/Nasienriglyne

- Any formula/*Enige formule*: $n = \frac{m}{M}$ or/of $c = \frac{n}{V}$ ✓
- Substitute/*Vervang* 0,1 dm³ in $n = cV$ ✓
- Use mole ratio/*Gebruik molverhouding*:
 $n(S)_{\text{expected/verwag}} = \frac{1}{2}n(\text{HCl})_{\text{used/gebruik}}$ ✓
- Substitution of/*Vervanging van* 32 g·mol⁻¹ in $n = \frac{m}{M}$ ✓
- SUBSTITUTE in/*VERVANG in*:

$$\frac{n(S)_{\text{produced / berei}}}{n(S)_{\text{expected / verwag}}} \times 100 / \frac{m(S)_{\text{produced / berei}}}{m(S)_{\text{expected / verwag}}} \times 100$$
 ✓
- Final answer/*Finale antwoord*: 56,25% to 60% ✓

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$n(\text{HCl})_{\text{used/gebruik}} = cV \checkmark$ $= 0,2 \times 0,1 \checkmark$ $= 0,02 \text{ mol}$ $n(\text{S})_{\text{expected/verwag}} = \frac{1}{2}n(\text{HCl})_{\text{used/gebruik}}$ $= \frac{1}{2}(0,02) \checkmark$ $= 0,01 \text{ mol}$ $n(\text{S})_{\text{produced/berei}} = \frac{m}{M}$ $= \frac{0,18}{32} \checkmark$ $= 0,0056 \text{ mol}$ $\% \text{yield/opbrengs} = \frac{n(\text{S})_{\text{prod/berei}}}{n(\text{S})_{\text{exp/verwag}}} \times 100$ $= \frac{0,0056}{0,01} \times 100 \checkmark$ $= 56,25\% \checkmark$	$n(\text{HCl})_{\text{used/gebruik}} = cV \checkmark$ $= 0,2 \times 0,1 \checkmark$ $= 0,02 \text{ mol}$ $n(\text{S})_{\text{expected/verwag}} = \frac{1}{2}n(\text{HCl})_{\text{used/gebruik}}$ $= \frac{1}{2}(0,02) \checkmark$ $= 0,01 \text{ mol}$ $m(\text{S})_{\text{expected/verwag}} = nM$ $= (0,01)(32) \checkmark$ $= 0,32 \text{ g}$ $\% \text{yield/opbrengs} = \frac{m(\text{S})_{\text{prod/berei}}}{m(\text{S})_{\text{exp/verwag}}} \times 100$ $= \frac{0,18}{0,32} \times 100 \checkmark$ $= 56,25\% \checkmark$

(6)

[18]

QUESTION 6/VRAAG 6

- 6.1 Reversible reaction/Both forward and reverse reactions can take place./Products can be converted back to reactants. \checkmark
Omkeerbare reaksie/Beide voorwaartse en terugwaartse reaksies kan plaasvind./Produkte kan terugverander word na reaktanse. (1)
- 6.2 To favour the forward reaction/production of ammonia./To increase the yield of ammonia./Prevent the decomposition of NH_3 . \checkmark
Om die voorwaartse reaksie/produksie van ammoniak te bevoordeel./Om die ammoniak-opbrengs te verhoog./Voorkom die ontbinding van NH_3 . (1)
- 6.3 20(%) \checkmark (1)

6.4

6.4.1 At 500 °C lower yield of ammonia:

- The (forward) reaction is exothermic./Reverse reaction is endothermic. ✓
Die (voorwaartse) reaksie is eksotermies./Terugwaartse reaksie is endotermies.
- 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.

OR/OF

At 350 °C higher yield of ammonia:

- The (forward) reaction is exothermic./Reverse reaction is endothermic. ✓
Die (voorwaartse) reaksie is eksotermies./Terugwaartse reaksie is endotermies.
- A decrease in temperature favours the exothermic reaction. ✓
'n Afname in temperatuur bevoordeel die eksotermiese reaksie.
- The forward reaction is favoured. ✓
Die voorwaartse reaksie word bevoordeel.

(3)

6.4.2 At 350 atm higher yield of ammonia:

- An increase in pressure favours the reaction that produces the lower number of moles/number of molecules/volume of gas. ✓
'n Toename in druk bevoordeel die reaksie wat die kleiner aantal mol/aantal molekule/volume gas lewer.
- The forward reaction is favoured. ✓
Die voorwaartse reaksie word bevoordeel.

OR/OF

At 150 atm lower yield of ammonia:

- A decrease in pressure favours the reaction that produces the higher number of moles/number of molecules/volume of gas. ✓
'n Afname in druk bevoordeel die reaksie wat die groter aantal mol/aantal molekule/volume gas lewer.
- Reverse reaction is favoured. ✓
Die terugwaartse reaksie word bevoordeel.

(2)

6.5

6.5.1 1 mol N₂ reacts with 3 mol H₂ to produce 2 mol NH₃
 ∴ 2 mol N₂ reacts with 6 mol H₂ to produce 4 (mol) NH₃ ✓✓ (2 or 0)

1 mol N₂ reageer met 3 mol H₂ om 2 mol NH₃ te lewer
 ∴ 2 mol N₂ reageer met 6 mol H₂ om 4 (mol) NH₃ te vorm (2 of 0)

(2)

6.5.2 **POSITIVE MARKING FROM QUESTION 6.5.1.****Marking criteria/Nasienriglyne:**

- Calculate 35% of 4 mol NH_3 (answer from Q6.5.1). ✓
- Use mol ratio/*Gebruik molverhouding* $n(\text{N}_2) : n(\text{H}_2) : n(\text{NH}_3) = 1 : 3 : 2$ ✓
- Equilibrium/*Ewig* $n(\text{N}_2) = \text{initial/aanvanklike } n(\text{N}_2) - \Delta n(\text{N}_2)$ } ✓
Equilibrium/*Ewig* $n(\text{H}_2) = \text{initial/aanvanklike } n(\text{H}_2) - \Delta n(\text{H}_2)$ }
- Divide by/*Deel deur* $0,5 \text{ dm}^3$. ✓
- Correct K_c expression (*formulae in square brackets*). ✓
Korrekte K_c uitdrukking (formules in vierkantige hakies).
- Substitution of concentrations into correct K_c expression. ✓
Vervanging van konsentrasies in korrekte K_c -uitdrukking.
- Final answer/*Finale antwoord*: 0,002 ✓
Range/*Gebied*: 0,00155 to 0,002 ($1,55 \times 10^{-3}$ to 2×10^{-3})

$$n(\text{NH}_3) = \frac{35}{100} \times 4 \checkmark$$

$$= 1,4 \text{ mol}$$

	N_2	H_2	NH_3
Initial amount (moles) <i>Aanvangs hoeveelheid (mol)</i>	6	6	0
Change in amount (moles) <i>Verandering in hoeveelheid (mol)</i>	0,7	2,1	1,4
Equilibrium amount (moles) <i>hoeveelheid (mol)</i>	5,3	3,9 ✓	1,4
Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Ewigskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i>	10,6	7,8	2,8

ratio ✓
verhoudingDivide by
 $0,5 \text{ dm}^3$ ✓

$$K_c = \frac{[\text{NH}_3]^2}{[\text{H}_2]^3 [\text{N}_2]} \checkmark$$

$$= \frac{(2,8)^2}{(7,8)^3 (10,6)} \checkmark$$

$$= 0,002 \checkmark$$

No K_c expression, correct substitution/*Geen K_c -uitdrukking, korrekte substitusie*: Max./Maks. $\frac{6}{7}$ Wrong K_c expression/*Verkeerde K_c -uitdrukking*:
Max./Maks. $\frac{4}{7}$ (7)
[17]

QUESTION 7/VRAAG 7

- 7.1 A base forms hydroxide ions (OH^-) in water/aqueous solution. ✓✓
'n Basis vorm hidroksiedione (OH^-) in water/waterige oplossing.

IF/INDIEN:

A base ionises to form hydroxide ions (OH^-). ✓

'n Basis ioniseer om hidroksiedione (OH^-) te vorm.

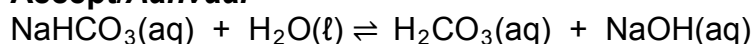
Max./Maks. $\frac{1}{2}$

(2)

- 7.2 A strong base ionises/dissociates completely ✓ and a weak base ionises/dissociates incompletely. ✓
'n Sterk basis ioniseer/dissosieer volledig en 'n swak basis ioniseer/dissosieer onvolledig.

(2)

- 7.3 $\text{HCO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_2\text{CO}_3(\text{aq}) + \text{OH}^-(\text{aq})$ ✓ Bal. ✓

Accept/Aanvaar**Notes/Aantekeninge:**

- Reactants/Reaktanse ✓ Products/Produkte ✓ Balancing/Balansering ✓
- Ignore single arrow./Ignoreer enkel pyl.
- Marking rule 6.3.10./Nasienreël 6.3.10.
- Ignore phases./Ignoreer fases.

(3)

7.4

- 7.4.1 $\text{pH} = -\log[\text{H}_3\text{O}^+]$ ✓
 $= -\log(0,2)$ ✓
 $= 0,70$ ✓ (0,699)

(3)

- 7.4.2 Titration of a weak base and a strong acid. ✓
 Titrasië van 'n swak basis en 'n sterk suur.

OR/OF

The endpoint will be at $\text{pH} < 7$. / Die eindpunt sal by 'n $\text{pH} < 7$.

(1)

7.4.3

Marking guidelines/Nasienriglyne:

- Any formulae/Enige formule: $c = \frac{n}{V} / n = \frac{m}{M} / \frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b} / c = \frac{m}{MV}$ ✓
- Substitute/Vervang $0,2 \text{ mol} \cdot \text{dm}^{-3}$ & $20 \times 10^{-3} / 0,02 \text{ dm}^3$ or 20 cm^3 . ✓
- Use mol ratio/Gebruik molverhouding $n(\text{XHCO}_3) : n(\text{HCl}) = 1 : 1$ ✓
- Substitute/Vervang $n(\text{XHCO}_3)$ or/of $c(\text{XHCO}_3)$ AND/EN $0,4 \text{ g}$. ✓
- $M(\text{X}) = 39 \text{ g} \cdot \text{mol}^{-1}$ ✓
- $\text{X} = \text{K}$ /potassium/kalium. ✓

OPTION 1/OPSIE 1

$$c(\text{HCl}) = \frac{n}{V} \quad \checkmark$$

$$\therefore 0,2 = \frac{n}{20 \times 10^{-3}} \quad \checkmark$$

$$n(\text{HCl}) = 4 \times 10^{-3} \text{ mol}$$

$$n(\text{XHCO}_3) = n(\text{HCl}) \quad \checkmark$$

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

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

$$\therefore 4 \times 10^{-3} = \frac{0,4}{M} \quad \checkmark$$

$$M = 100 \text{ g} \cdot \text{mol}^{-1}$$

$$M(\text{XHCO}_3) = M(\text{X}) + 61$$

$$= 100$$

$$\therefore M(\text{X}) = 39 \text{ g} \cdot \text{mol}^{-1} \quad \checkmark$$

$$\text{X} = \text{K} \quad \checkmark$$

OR/OF

potassium/kalium

$$\begin{array}{l} 1 \text{ mol} \\ M(\text{XHCO}_3) \quad 4 \times 10^{-3} \text{ mol} \rightarrow \\ \rightarrow 0,4 \text{ g} \quad \checkmark \end{array}$$

$$M(\text{XHCO}_3) = 100 \text{ g} \cdot \text{mol}^{-1}$$

$$M(\text{XHCO}_3) = M(\text{X}) + 61$$

$$= 100$$

$$\therefore M(\text{X}) = 39 \text{ g} \cdot \text{mol}^{-1} \quad \checkmark$$

$$\text{X} = \text{K} \quad \checkmark$$

OR/OF

potassium/kalium

OPTION 2/OPSIE 2

$$\frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b} \quad \checkmark$$

$$\frac{0,2 \times 20}{c_b \times 100} = \frac{1}{1} \quad \checkmark$$

$$c_b = 0,04 \text{ mol} \cdot \text{dm}^{-3}$$

$$c(\text{XHCO}_3) = \frac{m}{MV}$$

$$\therefore 0,04 = \frac{0,4}{M(0,1)} \quad \checkmark$$

$$M(\text{XHCO}_3) = 100 \text{ g} \cdot \text{mol}^{-1}$$

$$M(\text{XHCO}_3) = M(\text{X}) + 61$$

$$= 100$$

$$\therefore M(\text{X}) = 39 \text{ g} \cdot \text{mol}^{-1} \quad \checkmark$$

$$\text{X} = \text{K} \quad \checkmark$$

OR/OF

potassium/kalium

(6)
[17]

QUESTION 8/VRAAG 8

- 8.1 It is a conductor of electricity/a solid to connect wires to./Pt is inert or unreactive. ✓
Dit is 'n geleier van elektrisiteit/'n vaste stof waaraan drade geskakel kan word./Pt is inert of onreaktief.

OR/OF

$\text{Cl}^-(\text{aq})$ and chlorine gas are not solids and cannot be used as an electrode.
 $\text{Cl}^-(\text{aq})$ en chloorgas is nie vaste stowwe nie en kan nie as 'n elektrode gebruik word nie.

(1)

8.2

- 8.2.1 Chemical (energy) to electrical (energy) ✓
Chemiese (energie) na elektriese (energie)

(1)

- 8.2.2 $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$ ✓✓

Marking guidelines/Nasienriglyne

- $\text{Cl}_2 + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$ $\frac{1}{2}$ $2\text{Cl}^- \rightleftharpoons \text{Cl}_2 + 2\text{e}^-$ $\frac{0}{2}$
- $2\text{Cl}^- \leftarrow \text{Cl}_2 + 2\text{e}^-$ $\frac{2}{2}$ $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ $\frac{0}{2}$
- Ignore if charge omitted on electron./Ignoreer indien lading weggelaat op elektron.
- If charge (-) omitted on Cl^- /Indien lading (-) weggelaat op 2Cl^- :
Max./Maks: $\frac{1}{2}$ Example/Voorbeeld: $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}$ ✓

(2)

- 8.2.3 $\text{Cr}(\text{s}) | \text{Cr}^{3+}(\text{aq}) \parallel \text{Cl}_2(\text{g}) | \text{Cl}^-(\text{aq}) | \text{Pt}(\text{s})$ ✓✓

OR/OF

$\text{Cr}(\text{s}) | \text{Cr}^{3+}(1 \text{ mol} \cdot \text{dm}^{-3}) \parallel \text{Cl}_2(\text{g}) | \text{Cl}^-(1 \text{ mol} \cdot \text{dm}^{-3}) | \text{Pt}(\text{s})$

Accept/Aanvaar:

$\text{Cr} | \text{Cr}^{3+} \parallel \text{Cl}_2 | \text{Cl}^- | \text{Pt}$

(3)

8.3

OPTION 1/OPSIE 1

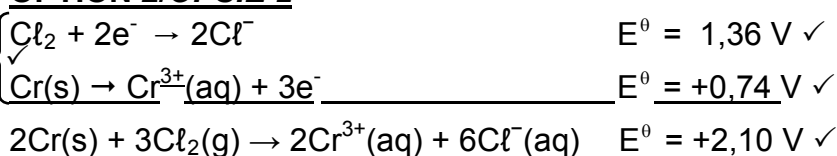
$$E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} \quad \checkmark$$

$$= 1,36 \checkmark - (-0,74) \checkmark$$

$$E_{\text{cell}}^{\theta} = 2,10 \text{ V} \checkmark$$

Notes/Aantekeninge

- Accept any other correct formula from the data sheet./Aanvaar enige ander korrekte formule vanaf gegewensblad.
- Any other formula using unconventional abbreviations, e.g. $E_{\text{cell}}^{\theta} = E_{\text{OA}}^{\theta} - E_{\text{RA}}^{\theta}$ followed by correct substitutions./Enige ander formule wat onkonvensionele afkortings gebruik bv. $E_{\text{sel}}^{\theta} = E_{\text{OM}}^{\theta} - E_{\text{RM}}^{\theta}$ gevolg deur korrekte vervangings: $\frac{3}{4}$

OPTION 2/OPSIE 2

(4)

- 8.4 Increases/Verhoog ✓✓

(2)

[13]

QUESTION 9/VRAAG 99.1 Electrolytic/*Elektrolities* ✓ (1)9.2 $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$ ✓✓**Marking guidelines/Nasienriglyne**

- $2\text{H}_2\text{O} + 2\text{e}^- \rightleftharpoons \text{H}_2 + 2\text{OH}^-$ $\frac{1}{2}$ $\text{H}_2 + 2\text{OH}^- \rightleftharpoons 2\text{H}_2\text{O} + 2\text{e}^-$ $\frac{0}{2}$
 $\text{H}_2 + 2\text{OH}^- \leftarrow 2\text{H}_2\text{O} + 2\text{e}^-$ $\frac{2}{2}$ $\text{H}_2 + 2\text{OH}^- \rightarrow 2\text{H}_2\text{O} + 2\text{e}^-$ $\frac{0}{2}$
- Ignore if charge omitted on electron. / *Ignoreer indien lading weggelaat op elektron.*
- If charge (-) omitted on OH^- / *Indien lading (-) weggelaat op OH^- :*
 Max./Maks: $\frac{1}{2}$ Example/Voorbeeld: $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$
 ✓

(2)

9.3

9.3.1 Chlorine (gas) / Cl_2 / *Chloor(gas)* ✓ (1)

9.3.2 P ✓ & Y ✓ (2)

9.4 Cathode/*Katode* ✓Reduction takes place here. / *Gains electrons.* ✓*Reduksie vind hier plaas. / Wins van elektrone.*

(2)

9.5 $\text{CuCl}_2(\text{aq}) \checkmark \rightarrow \text{Cu}(\text{s}) + \text{Cl}_2(\text{g}) \checkmark$ Bal ✓**OR/OF** $\text{Cu}^{2+}(\text{aq}) + 2\text{Cl}^- \rightarrow \text{Cu}(\text{s}) + \text{Cl}_2(\text{g})$ **Notes/Aantekeninge:**

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

(3)

[11]

QUESTION 10/VRAAG 10

10.1

10.1.1 II – IV – III – I ✓

(1)

10.1.2 $2\text{NH}_3 + \text{H}_2\text{SO}_4 \checkmark \rightarrow (\text{NH}_4)_2\text{SO}_4 \checkmark$ Bal ✓**Notes/Aantekeninge:**

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

(3)

10.1.3 Vanadium pentoxide/*Vanadiumpentoksied* ✓

(1)

10.1.4 $\text{SO}_3(\text{g}) + \text{H}_2\text{SO}_4 \checkmark \rightarrow \text{H}_2\text{S}_2\text{O}_7 \checkmark$ Bal ✓**Notes/Aantekeninge:**

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

(3)

10.1.5 Sulphuric acid will form (white) mists./The reaction is very exothermic/gives off too much heat./Corrosive reaction. ✓
Swawelsuur sal (wit) mis vorm./Die reaksie is té eksotermies/gee te veel warmte af./Vretende reaksie.

(1)

10.2

Marking criteria/Nasienriglyne:

- Calculate $m(\text{fertiliser})$./Bereken $m(\text{kunsmis})$. ✓
- Use ratio/gebruik verhouding: $\frac{2}{X+3} / m(\text{P}) = \frac{1}{2}m(\text{K}) \checkmark$
- Use/Gebruik $m(\text{K}) = 3,33 \text{ kg} \checkmark$
- Final answer/Finale antwoord: 3 ✓

OPTION 1/OPSIE 1

$$m(\text{fertiliser}) = \frac{20}{100} \times 50 \checkmark$$

$$= 10 \text{ kg}$$

$$m(\text{K}) = \frac{2}{X+3} \times 10$$

$$\therefore 3,33 \checkmark = \frac{2 \checkmark}{X+3} \times 10$$

$$\therefore X = 3 \checkmark$$

OPTION 2/OPSIE 2

$$m(\text{K}) = \frac{2 \checkmark}{X+3} \times \frac{20}{100} \times 50 \checkmark = 3,33 \checkmark$$

$$X = 3 \checkmark$$

OPTION 3/OPSIE 3

$$m(\text{fertiliser}) = \frac{20}{100} \times 50 \checkmark$$

$$= 10 \text{ kg}$$

$$m(\text{P}) = \frac{1}{2}m(\text{K}) \checkmark$$

$$= \frac{1}{2}(3,33) = 1,665 \text{ kg}$$

$$m(\text{X}) = 10 - 3,33 \checkmark - 1,665$$

$$= 5,005$$

$$\text{N} : \text{P} : \text{K} = 5,005 : 1,665 : 3,33$$

$$= 3 : 1 : 2$$

$$\therefore X = 3 \checkmark$$

(4)

[13]**TOTAL/TOTAAL:****150**