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basic education

Department:
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)**

2022

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

QUESTION 2/VRAAG 2

- 2.1
- 2.1.1 E ✓ (1)
- 2.1.2 F ✓ (1)
- 2.1.3 C ✓ (1)
- 2.1.4 H ✓ (1)

2.2

2.2.1 2-bromo-2,4,5-trimethylhexane/2-broom-2,4,5-trimetiëlheksaan

Marking criteria:

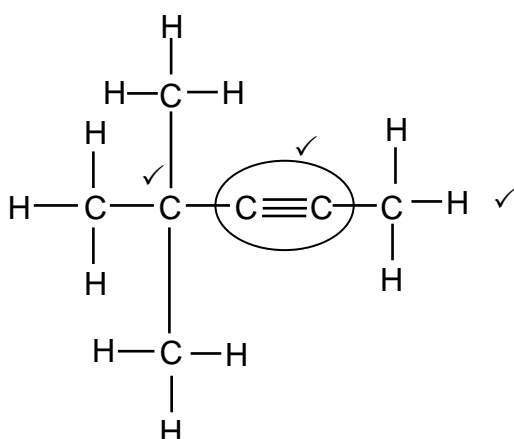
- Correct stem i.e. hexane. ✓
- All substituents (bromo and trimethyl) correctly identified. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:

- Korrekte stam d.i. heksaan. ✓
- Alle substituenten (bromo and trimetiël) korrek geïdentifiseer. ✓
- IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas. ✓

(3)

2.2.2



Marking criteria/Nasienkriteria:

- Five C atoms in longest chain + triple bond. ✓
Vyf C-atome in langste ketting + drievoudige binding.
- Two methyl substituents. ✓
Twee metielsubstituente.
- Whole structure correct. ✓
Hele struktuur korrek.

IF/INDIEN

- More than one functional group/wrong functional group:

Meer as een funksionele groep/foutiewe funksionele groep:

0/3

- If condensed structural formulae used/Indien gekondenseerde struktuurformules gebruik:

Max/Maks.: 2/3

(3)

2.3

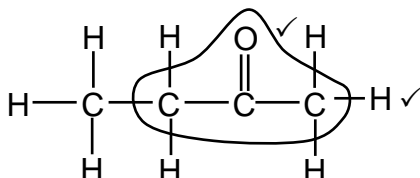
2.3.1 Aldehyde/Aldehyd ✓

(1)

2.3.2 Formyl/Formiel ✓

(1)

2.3.3



Marking criteria/Nasienkriteria:

- Functional group. ✓
Funksionele groep.
- Whole structure correct. ✓
Hele struktuur korrek.

IF/INDIEN

- More than one functional group/wrong functional group:

Meer as een funksionele groep/foutiewe funksionele groep:

0/2

- If condensed structural formulae used/Indien gekondenseerde struktuurformules gebruik:

Max/Maks.: 1/2

(2)

2.4

2.4.1 Methylpropane ✓ / 2-methylpropane / Metielpropaan / 2-metielpropaan

(2)

2.4.2 $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$ ✓ Bal. ✓

Ignore phases./Ignoreer fases.

Marking criteria/Nasienkriteria:

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

IF: Structural formula for C_4H_{10} Max. 2/3

INDIEN: Structural formula for C_4H_{10} Max. 2/3

(3)

[19]

QUESTION 3/VRAAG 3

3.1

Marking criteria/Nasienkriteria

If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The temperature at which the vapour pressure of a substance equals atmospheric/external pressure. ✓✓

Die temperatuur waar die dampdruk van 'n stof gelyk is aan atmosferiese/ eksterne druk. (2)

3.2

3.2.1 Increases/Neem toe ✓ (1)

3.2.2 **From A to C:**

- Increase in molecular mass/size/chain length/surface area/number of C atoms. ✓
- Strength of the intermolecular forces increases/More sites for London forces. ✓
- More energy is needed to overcome/break intermolecular forces. ✓

OR**From C to A:**

- Decrease in molecular mass/size/chain length/surface area/number of C atoms. ✓
- Strength of the intermolecular forces decreases/Less sites for London forces. ✓
- Less energy is needed to overcome/break intermolecular forces. ✓

Van A na C:

- Verhoging in molekulêre massa/molekulêre grootte/kettinglengte/reaksie-oppervlak/aantal C-atome. ✓
- Sterkte van die intermolekulêre kragte verhoog./Meer punte vir Londonkragte. ✓
- Meer energie benodig om intermolekulêre kragte te oorkom/breek. ✓

OF**Van C na A:**

- Verlaging in molekulêre massa/molekulêre grootte/kettinglengte/reaksie-oppervlak/aantal C-atome. ✓
- Sterkte van die intermolekulêre kragte verlaag./Minder punte vir Londonkragte. ✓
- Minder energie benodig om intermolekulêre kragte te oorkom/breek. ✓ (3)

3.3 No / Nee ✓

More than one independent variable./Molar mass and chain length (surface area) are changing. ✓

Meer as een onafhanklike veranderlike./Molêre massa (reaksie-oppervlak) en kettinglengte verander. (2)

3.4

3.4.1 Functional group/homologous series/type of intermolecular forces/type of compound ✓ (1)
Funksionele groep/homoloë reeks/soort intermolekulêre kragte/tipe verbinding

3.4.2 Dipole-dipole forces/Dipool-dipoolkragte ✓ (1)

3.5 D / methylbutane / metielbutaan ✓



Lower boiling point/Weaker intermolecular forces ✓ (2)
Laer kookpunt/Swakker intermolekulêre kragte

[12]

QUESTION 4/VRAAG 4

4.1

4.1.1 Dehydrohalogenation/elimination/dehydrobromination ✓ (1)
Dehidrohalogenering/eliminasi/dehidrobrominerig

4.1.2 2-methylbut-2-ene / 2-methyl-2-butene ✓✓
 2-metielbut-2-ene / 2-metiel-2-buteen ✓✓

Marking criteria/Nasienkriteria

Methylbutene/metielbuteen ✓
 IUPAC name correct/IUPAC-naam korrek ✓

(2)

IF/INDIEN

Any error, e.g. hyphens omitted and/or incorrect sequence/Enige fout, bv. koppeltekens weggelaat en/of verkeerde volgorde: Max/Maks: $\frac{1}{2}$

4.1.3 Water/H₂O ✓ (1)

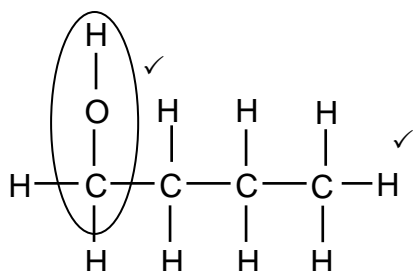
4.1.4 Heat/Hitte ✓
 (Concentrated) sulphuric acid/catalyst ✓
 (Gekonsentreerde) swawelsuur/katalisator

ACCEPT/AANVAAR:

High temperature/
 Hoë temperatuur

(2)

4.1.5



Marking criteria/Nasienkriteria

- 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 $\frac{0}{2}$

(2)

4.2

4.2.1 Catalyst/Lowers the activation energy./Increases the rate of the reaction. ✓ (1)
Katalisator/Verlaag die aktiveringsenergie./Laat reaksietempo toeneem.

- 4.2.2 The bromine water/ Br_2 /solution decolourises. ✓
Die broomwater/ Br_2 /oplossing ontkleur.

OR/OF

Bromine water/ Br_2 /solution changes from brown/reddish to colourless.

Broomwater/ Br_2 /oplossing verander van bruin/rooi na kleurloos.

(1)

- 4.2.3 Addition/halogenation/bromination ✓
Addisie/halogenering/brominering

(1)

- 4.2.4 C_2H_6 ✓✓✓ (3 or/of 0) **OR/OF** C_4H_{10} **OR/OF** C_6H_{14}

IF structural/condensed formulae: (2 or 0)

INDIEN struktuurformules/gekondenseerde formules gebruik: (2 of 0)

(3)

4.2.5

<u>Marking criteria</u>	<u>Nasienkriteria</u>
<ul style="list-style-type: none"> Correct functional group i.e. double bond. ✓ Correct number of C atoms in relation to answer in Q4.2.4. ✓ Whole structure correct. ✓ <p>IF condensed/molecular formulae used: Max. $\frac{2}{3}$</p>	<ul style="list-style-type: none"> Korrekte funksionele groep d.i. dubbelbinding. ✓ Korrekte aantal C-atome na aanleiding van antwoord in V4.2.4. ✓ Hele struktuur korrek. ✓ <p>INDIEN gekondenseerde/molekulêre formules gebruik: Maks. $\frac{2}{3}$</p>
<p>IF C_2H_6 in QUESTION 4.2.4/INDIEN C_2H_6 in VRAAG 4.2.4:</p> <div style="display: flex; align-items: center; justify-content: space-around;"> <div style="text-align: center;"> </div> <div>OR/OF</div> <div style="text-align: center;"> </div> </div>	
<p>IF C_4H_{10} in QUESTION 4.2.4/INDIEN C_4H_{10} in VRAAG 4.2.4:</p> <div style="text-align: center;"> </div>	<p>IF C_6H_{14} in QUESTION 4.2.4:INDIEN C_6H_{14} in VRAAG 4.2.4:</p> <div style="text-align: center;"> </div>

(3)
[17]

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:**

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

ENIGE EEN:

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

(2)

5.2

- Surface area / state of division / particle size (of MgCO_3) ✓
- Concentration (of HCl) ✓
- *Reaksieoppervlak/toestand van verdeeldheid/deeltjie-grootte (van MgCO_3)*
- *Konsentrasie (van HCl)*

(2)

5.3

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

(4)

5.4.1

Marking criteria	Nasienkriteria
<ul style="list-style-type: none"> Formula: $n = \frac{m}{M}$ ✓ Substitution of $84 \text{ g} \cdot \text{mol}^{-1}$ in $n = \frac{m}{M}$ ✓ Use mole ratio: $n(\text{MgCO}_3)_{\text{used}} = n(\text{CO}_2)_{\text{produced}}$ ✓ Substitution of $44 \text{ g} \cdot \text{mol}^{-1}$ in $n = \frac{m}{M}$ or to calculate rate in $\text{mol} \cdot \text{min}^{-1}$. ✓ Correct substitution of 0,5 in rate equation. ✓ Final answer: 5,238 to 5,28 min ✓ 	<ul style="list-style-type: none"> Formule: $n = \frac{m}{M}$ ✓ Vervanging van $84 \text{ g} \cdot \text{mol}^{-1}$ in $n = \frac{m}{M}$ ✓ Gebruik molverhouding: $n(\text{MgCO}_3)_{\text{gebruik}} = n(\text{CO}_2)_{\text{berei}}$ ✓ Vervanging van $44 \text{ g} \cdot \text{mol}^{-1}$ in $n = \frac{m}{M}$ of om tempo te bereken in $\text{mol} \cdot \text{min}^{-1}$. ✓ Korrekte vervanging van 0,5 in tempovergelyking. ✓ Finale antwoord: 5,238 tot 5,28 min ✓

$n(\text{MgCO}_3) = \frac{m}{M}$ ✓

$= \frac{5}{84}$ ✓

$= 0,06 \text{ mol} \quad (0,0595 \text{ mol})$

$n(\text{CO}_2)_{\text{produced/gevorm}} = n(\text{MgCO}_3) \checkmark = 0,06 \text{ mol}$

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

$0,06 = \frac{m}{44}$ ✓

$m(\text{CO}_2) = 2,64 \text{ g}$

Ave rate/gem tempo = $\frac{\Delta m(\text{CO}_2)}{\Delta t}$

$0,5 \checkmark = \frac{2,64}{\Delta t}$

$\Delta t = 5,28 \text{ min} \checkmark$

Ave rate/gem tempo in $\text{mol} \cdot \text{min}^{-1}$:

$\frac{0,5 \checkmark}{44 \checkmark} = 0,0114 \text{ mol} \cdot \text{min}^{-1}$

Ave rate/gem tempo = $\frac{\Delta n(\text{CO}_2)}{\Delta t}$

$0,0114 = \frac{0,06}{\Delta t}$

$\Delta t = 5,28 \text{ min} \checkmark$

(6)

5.4.2

POSITIVE MARKING FROM QUESTION 5.4.1.

POSITIEWE NASIEN VANAF VRAAG 5.4.1.

Marking criteria	Nasienkriteria
<ul style="list-style-type: none"> Substitution of $n(\text{CO}_2)$ AND $1,5 \text{ dm}^3$ in $n = \frac{V}{V_m}$ ✓ Final answer: 25 to $25,21 \text{ dm}^3 \cdot \text{mol}^{-1}$ ✓ 	<ul style="list-style-type: none"> Vervanging van $n(\text{CO}_2)$ EN $1,5 \text{ dm}^3$ in $n = \frac{V}{V_m}$ ✓ Finale antwoord: 25 dm^3 tot $25,21 \text{ dm}^3 \cdot \text{mol}^{-1}$ ✓

$$n = \frac{V}{V_m}$$

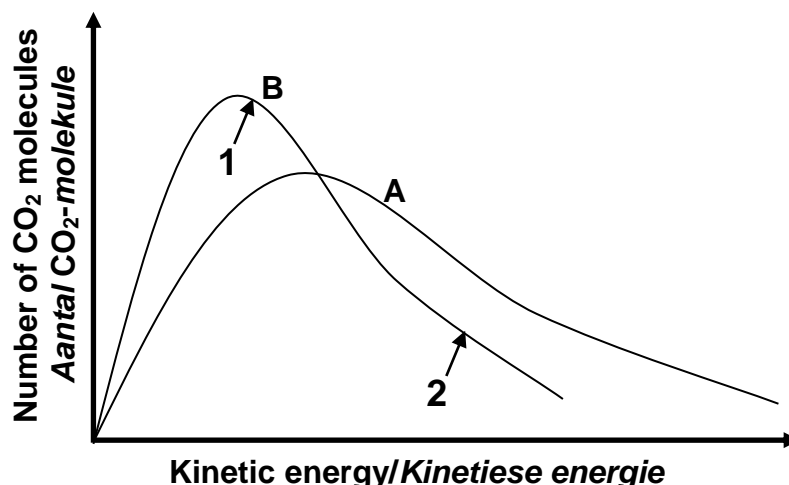
$$0,06 = \frac{1,5}{V_m} \checkmark$$

$$V_m = 25 \text{ dm}^3 \cdot \text{mol}^{-1} \checkmark \quad (25,21 \text{ dm}^3 \cdot \text{mol}^{-1})$$

ACCEPT/AANVAAR: 25 dm^3

(2)

5.5



Marking criteria/Nasienkriteria		
1	Curve B has a higher peak to the left of curve A . <i>Kurwe B het hoër piek aan die linkerkant van kurwe A.</i>	✓
2	Curve B is below curve A beyond the peak of curve A . <i>Kurwe B is onder kurwe A na die piek van kurwe A.</i>	✓
If BOTH graphs not labelled (A and B): no marks <i>Indien BEIDE grafieke nie benoem nie (A en B): geen punte</i>		

(2)
[18]

QUESTION 6/VRAAG 6

6.1.1 2 (mol·dm⁻³) ✓

(1)

6.1.2 **Marking criteria/Nasienkriteria:**

If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

When the equilibrium in a closed system is disturbed, the system will re-instate a (new) equilibrium ✓ by favouring the reaction that will cancel/oppose the disturbance. ✓

Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n (nuwe) ewewig instel deur die reaksie te bevoordeel wat die versteuring kanselleer/teenwerk. ✓

(2)

6.1.3 Cooled/Afgekoel ✓

(1)

- 6.1.4
- A decrease in temperature favours the exothermic reaction./An increase in temperature favours the endothermic reaction. ✓
 - The forward reaction is favoured./HI concentration increases./Equilibrium (position) shifts to the right. ✓
 - The forward reaction is exothermic./Reverse reaction is endothermic. ✓
 - *Afname in temperatuur bevoordeel die eksotermiese reaksie./Toename in temperatuur bevoordeel die endotermiese reaksie. ✓*
 - *Die voorwaartse reaksie word bevoordeel./ HI-konsentrasie neem toe./Die ewewigs(posisie) skuif na regs. ✓*
 - *Voorwaartse reaksie is eksotermies./Die terugwaartse reaksie is endotermies. ✓*

(3)

6.2

6.2.1 Products can be converted back to reactants. ✓

OR

Both forward and reverse reactions can take place.

OR

A reaction which can take place in both directions.

*Produkke kan omgeskakel word na reaktanse. ✓***OF***Beide voor-en terugwaartse reaksies kan plaasvind.***OF***'n Reaksie wat in beide rigtings kan plaasvind.*

(1)

6.2.2

Marking criteria	Nasienkriteria:
a) $\Delta n(\text{N}_2\text{O}_4) = n(\text{N}_2\text{O}_4)_{\text{eq}} - n(\text{N}_2\text{O}_4)_{\text{ini}}$. ✓	(a) $\Delta n(\text{N}_2\text{O}_4) = n(\text{N}_2\text{O}_4)_{\text{ewe}} - n(\text{N}_2\text{O}_4)_{\text{aanv}}$. ✓
b) <u>USING</u> ratio: $n(\text{NO}_2) : n(\text{N}_2\text{O}_4) = 2 : 1$ ✓	(b) <u>GEBRUIK</u> verhouding: $n(\text{NO}_2) : n(\text{N}_2\text{O}_4) = 2 : 1$ ✓
c) $n(\text{NO}_2)_{\text{eq}} = n(\text{NO}_2)_{\text{ini}} - \Delta n(\text{NO}_2)$ ✓	(c) $n(\text{NO}_2)_{\text{ewe}} = n(\text{NO}_2)_{\text{aanv}} - \Delta n(\text{NO}_2)$ ✓
d) Divide BOTH by 1 dm^3 ✓	(d) Deel BEIDE deur 1 dm^3 ✓
e) Correct K_c expression (<u>formulae in square brackets</u>). ✓	(e) Korrekte K_c uitdrukking (<u>formules in vierkantige hakies</u>). ✓

	NO_2	N_2O_4	
Initial amount (moles) <i>Aanvangshoeveelheid (mol)</i>	x	0	
Change in amount (moles) <i>Verandering in hoeveelheid (mol)</i>	1,62	0,81 ^(a) ✓	ratio ✓ verhouding
Equilibrium amount (moles) <i>Ewewigshoeveelheid (mol)</i>	$x - 1,62$ ^(c) ✓	0,81	
Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Ewewigskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i>	$x - 1,62$	0,81	

$$K_c = \frac{[\text{N}_2\text{O}_4]}{[\text{NO}_2]^2} \checkmark \text{ (e)}$$

$$= \frac{(0,81)}{(x - 1,62)^2}$$

Wrong or no K_c expression/ Verkeerde of geen K_c -
 uitdrukking: Max./Maks. $\frac{4}{5}$

(5)

6.2.3 **POSITIVE MARKING FROM QUESTION 6.2.2****POSITIEWE NASIEN VAN VRAAG 6.2.2.**

Marking criteria	Nasienkriteria:
a) Add 0,79 mol to $n(\text{N}_2\text{O}_4)_{\text{ini}}$. ✓	(a) Voeg 0,79 mol by $n(\text{N}_2\text{O}_4)_{\text{aanv.}}$ ✓
b) <u>USING</u> ratio: $n(\text{NO}_2) : n(\text{N}_2\text{O}_4) = 2 : 1$ to calculate $\Delta n(\text{N}_2\text{O}_4)$ <u>as 0,6 mol</u> . ✓	(b) <u>GEBRUIK</u> verhouding: $n(\text{NO}_2) : n(\text{N}_2\text{O}_4) = 2 : 1$ om $\Delta n(\text{N}_2\text{O}_4)$ <u>as 0,6 mol</u> te bereken. ✓
c) $n(\text{NO}_2)_{\text{eq}} = n(\text{NO}_2)_{\text{ini}} + \Delta n(\text{NO}_2)$ $n(\text{N}_2\text{O}_4)_{\text{eq}} = n(\text{N}_2\text{O}_4)_{\text{ini}} - \Delta n(\text{N}_2\text{O}_4)$ } ✓	(c) $n(\text{NO}_2)_{\text{ewe}} = n(\text{NO}_2)_{\text{aanv}} + \Delta n(\text{NO}_2)$ $n(\text{N}_2\text{O}_4)_{\text{ewe}} = n(\text{N}_2\text{O}_4)_{\text{aanv}} - \Delta n(\text{N}_2\text{O}_4)$ } ✓
d) Substitution of concentrations into correct K_c expression. ✓	(d) Vervanging van konsentrasies in korrekte K_c -uitdrukking.
e) Equating K_c expression from Q6.1.3 and Q6.2.3. ✓	(e) Stel K_c -uitdrukking van Q6.1.3 en Q6.2.3 gelyk aan mekaar. ✓
f) Final answer: 12,42 ✓ (Range: 11,27 – 12,42)	(f) Finale antwoord: 12,42 ✓ (Gebied: 11,27 – 12,42)

	NO_2	N_2O_4
Initial amount (moles) <i>Aanvangs hoeveelheid (mol)</i>	$x - 1,62$	$0,81 + 0,79$ ✓ $= 1,6$
Change in amount (moles) <i>Verandering in hoeveelheid (mol)</i>	1,2	0,6 ✓
Equilibrium amount (moles) <i>Ewigshoeveelheid (mol)</i>	$x - 1,62 + 1,2$	1 ✓ (c)
Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Ewigskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i>	$x - 0,42$	1

$$K_c = \frac{[\text{N}_2\text{O}_4]}{[\text{NO}_2]^2}$$

$$\frac{(0,81)}{(x - 1,62)^2} \stackrel{(e)}{=} \frac{1}{(x - 0,42)^2} \stackrel{(d)}{=} \quad \checkmark$$

$$x = 12,42 \text{ (mol)} \quad \checkmark (f)$$

Wrong K_c expression/Verkeerde K_c - uitdrukking:
Max./Maks. $\frac{4}{6}$

No K_c expression/Geen K_c - uitdrukking: $\frac{6}{6}$

(6)
[19]**QUESTION 7/VRAAG 7**

7.1

7.1.1 An acid is a proton (H^+ ion) donor. ✓✓'n Suur is 'n protondonor/skenker of H^+ -ioon donor/skenker.

(2)

7.1.2 HY ✓



For the SAME acid concentration:

Lower pH / higher H^+ or H_3O^+ concentration / more ionised. ✓

Vir DIESELFDE suurkonsentrasie:

Laer pH / hoër H^+ / H_3O^+ konsentrasie / meer geïoniseer.

(2)

7.1.3 Lower than./Laer as ✓

 $K_a < 1$ / HX ionises incompletely. / HX has a small K_a value. / HX is a weak acid. ✓ $K_a < 1$ / HX ioniseer onvolledig. / HX het 'n klein K_a -waarde. / HX is 'n swak suur.

(2)

7.2

7.2.1 $\text{pH} = -\log[\text{H}_3\text{O}^+]$ **OR/OF** $[\text{H}_3\text{O}^+] = 10^{-\text{pH}}$ ✓
 2 ✓ $= -\log[\text{H}_3\text{O}^+]$
 $[\text{H}_3\text{O}^+] = 0,01 \text{ mol} \cdot \text{dm}^{-3}$ ✓ $(1 \times 10^{-2} \text{ mol} \cdot \text{dm}^{-3})$

(3)

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

<p>Marking criteria for OPTION 1:</p> <ul style="list-style-type: none"> Substitute $c(\text{HCl})_{\text{excess}}$ and $0,35 \text{ dm}^3$ to calculate $n(\text{HCl})_{\text{excess}}$. ✓ Substitute to calculate $n(\text{HCl})_{\text{initial}}$. ✓ $n(\text{HCl})_{\text{react}} = n(\text{HCl})_{\text{ini}} - n(\text{HCl})_{\text{excess}}$. ✓✓ Use ratio: $n(\text{NaOH}) = n(\text{HCl})$ ✓ Substitute $0,15 \text{ dm}^3$ in $c = \frac{n}{V}$. ✓ Final answer: $0,02 \text{ mol} \cdot \text{dm}^{-3}$ ✓ or $0,0167 \text{ mol} \cdot \text{dm}^{-3}$ or $0,017 \text{ mol} \cdot \text{dm}^{-3}$ 	<p>Nasienkriteria vir OPSIE 1:</p> <ul style="list-style-type: none"> Vervang $c(\text{HCl})_{\text{oormaat}}$ en $0,35 \text{ dm}^3$ om $n(\text{HCl})_{\text{oormaat}}$ te bereken. ✓ Vervang om $n(\text{HCl})_{\text{aanv}}$ te bereken. ✓ $n(\text{HCl})_{\text{rea}} = n(\text{HCl})_{\text{aanv}} - (\text{HCl})_{\text{oormaat}}$. ✓✓ Gebruik verhouding: $n(\text{NaOH}) = n(\text{HCl})$ ✓ Vervang $0,15 \text{ dm}^3$ in $c = \frac{n}{V}$. ✓ Finale antwoord: $0,02 \text{ mol} \cdot \text{dm}^{-3}$ ✓ of $0,0167 \text{ mol} \cdot \text{dm}^{-3}$ of $0,017 \text{ mol} \cdot \text{dm}^{-3}$
<p>OPTION 1/OPSIE 1</p> <p>$n(\text{HCl})_{\text{excess/oormaat}} = cV$ $= \underline{0,01 \times 0,35}$ ✓ $= 3,5 \times 10^{-3} \text{ mol}$</p> <p>$n(\text{HCl})_{\text{initial/aanv}} = cV$ $= 0,03 \times 0,2$ ✓ $= 0,006 \text{ mol}$</p> <p>$n(\text{HCl})_{\text{reacted/reageer}} = \underline{0,006 - 3,5 \times 10^{-3}}$ ✓✓ $= 0,0025 \text{ mol}$</p> <p>$n(\text{NaOH})_{\text{reacted/reageer}} = n(\text{HCl})_{\text{reacted/reageer}} = 0,0025 \text{ mol}$ ✓</p> <p>$c(\text{NaOH}) = \frac{n}{V}$ $= \frac{0,0025}{0,15}$ ✓ $= 0,02 \text{ mol} \cdot \text{dm}^{-3}$ ✓ <math>(0,0167 \text{ mol} \cdot \text{dm}^{-3} \text{ or/of } 0,017 \text{ mol} \cdot \text{dm}^{-3})</math></p>	

<p>OPTION 2/OPSIE 2</p> <p>Concentration ratio in final solution: <i>Konsentrasie verhouding in finale oplossing:</i> $\text{HCl} : \text{H}_3\text{O}^+ = 1 : 1 \checkmark$</p> <p>Thus/dus $[\text{HCl}] = 0,01 \text{ mol}\cdot\text{dm}^{-3} \checkmark\checkmark$</p> <p> $[\text{HCl}]_{\text{react}} = [\text{HCl}]_{\text{initial}} - [\text{HCl}]_{\text{excess}}$ $= 0,03 - 0,01 \checkmark\checkmark$ $= 0,02 \text{ mol}\cdot\text{dm}^{-3}$ </p> <p>Concentration ratio in final solution: <i>Konsentrasie verhouding in oorspronklike oplossing:</i> $\text{HCl} : \text{NaOH} = 1 : 1 \checkmark$</p> <p>$[\text{NaOH}] = 0,02 \text{ mol}\cdot\text{dm}^{-3} \checkmark$</p>	<p>Marking criteria</p> <ul style="list-style-type: none"> Ratio $\text{HCl} : \text{H}_3\text{O}^+ = 1 : 1 \checkmark$ $c(\text{HCl})_{\text{excess}} = 0,01 \text{ (mol}\cdot\text{dm}^{-3}) \checkmark\checkmark$ $n(\text{HCl})_{\text{react}} = n(\text{HCl})_{\text{ini}} - (\text{HCl})_{\text{excess}} \checkmark\checkmark$ Use ratio: $n(\text{NaOH}) = n(\text{HCl}) \checkmark$ Final answer: $0,02 \text{ mol}\cdot\text{dm}^{-3} \checkmark$ <p>Nasienkriteria</p> <ul style="list-style-type: none"> Verhouding $\text{HCl} : \text{H}_3\text{O}^+ = 1 : 1 \checkmark$ $c(\text{HCl})_{\text{oormaat}} = 0,01 \text{ (mol}\cdot\text{dm}^{-3}) \checkmark\checkmark$ $n(\text{HCl})_{\text{reag}} = n(\text{HCl})_{\text{aanv}} - (\text{HCl})_{\text{oormaat}} \checkmark\checkmark$ Gebruik verhouding: $n(\text{NaOH}) = n(\text{HCl}) \checkmark$ Finale antwoord: $0,02 \text{ mol}\cdot\text{dm}^{-3} \checkmark$
<p>OPTION 3/OPSIE 3</p> <p> $\frac{c_1 V_1}{c_2 V_2} = \frac{n_1}{n_2}$ $\frac{c_1(200)}{(0,01)(350)} = \frac{1}{1} \checkmark$ $c_1 = 0,0175 \text{ mol}\cdot\text{dm}^{-3}$ </p> <p> $c(\text{HCl})_{\text{react}} = c(\text{HCl})_{\text{ini}} - c(\text{HCl})_{\text{excess}}$ $= 0,03 - 0,0175 \checkmark\checkmark$ $= 0,0125 \text{ mol}\cdot\text{dm}^{-3}$ </p> <p> $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$ $\frac{(0,0125)(200)}{c_b(150)} = \frac{1}{1} \checkmark$ </p> <p>$c(\text{NaOH}) = 0,0167 \text{ mol}\cdot\text{dm}^{-3} \checkmark$</p> <p>$(0,0167 \text{ mol}\cdot\text{dm}^{-3})$ or/of $0,017 \text{ mol}\cdot\text{dm}^{-3}$</p>	<p>Marking criteria</p> <ul style="list-style-type: none"> Substitute 350 cm^3 in $\frac{c_1 V_1}{c_2 V_2} = \frac{n_1}{n_2} \checkmark$ Ratio of $\text{HCl} : \text{H}_3\text{O}^+ = 1 : 1 \checkmark$ $n(\text{HCl})_{\text{react}} = n(\text{HCl})_{\text{ini}} - (\text{HCl})_{\text{excess}} \checkmark\checkmark$ Use ratio: $n(\text{NaOH}) = n(\text{HCl}) \checkmark$ Substitute 150 cm^3 in $\frac{c_1 V_1}{c_2 V_2} = \frac{n_1}{n_2} \checkmark$ Final answer: $0,02 \text{ mol}\cdot\text{dm}^{-3} \checkmark$ or $0,0167 \text{ mol}\cdot\text{dm}^{-3}$ or $0,017 \text{ mol}\cdot\text{dm}^{-3}$ <p>Nasienkriteria</p> <ul style="list-style-type: none"> Vervang 350 cm^3 in $\frac{c_1 V_1}{c_2 V_2} = \frac{n_1}{n_2} \checkmark$ Verhouding $\text{HCl} : \text{H}_3\text{O}^+ = 1 : 1 \checkmark$ $n(\text{HCl})_{\text{reag}} = n(\text{HCl})_{\text{aanv}} - (\text{HCl})_{\text{oormaat}} \checkmark\checkmark$ Gebruik verhouding: $n(\text{NaOH}) = n(\text{HCl}) \checkmark$ Vervang 150 cm^3 in $\frac{c_1 V_1}{c_2 V_2} = \frac{n_1}{n_2} \checkmark$ Finale antwoord: $0,02 \text{ mol}\cdot\text{dm}^{-3} \checkmark$ of $0,0167 \text{ mol}\cdot\text{dm}^{-3}$ of $0,017 \text{ mol}\cdot\text{dm}^{-3}$

(7)
[16]

QUESTION 8/VRAAG 8

8.1

- 8.1.1 Temperature/Temperatuur: 25 °C/298 K ✓
 Pressure/Druk: 101,3 kPa/1 atmosphere ✓
 Concentration/Konsentrasie: 1 mol·dm⁻³ ✓

(3)

8.1.2

OPTION 1/OPSIE 1	Notes/Aantekeninge
$E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} \checkmark$ $2,89 \checkmark = E_{\text{reduction}}^{\theta} - (-1,66) \checkmark$ $E_{\text{reduction}}^{\theta} = 1,23 \text{ (V)} \checkmark$ <p>X is O₂/oxygen/suurstof ✓</p> <p>[X marked independently/ X onafhanklik nagesien]</p>	<ul style="list-style-type: none"> 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: $\frac{4}{5}$
OPTION 2/OPSIE 2	
$\left. \begin{array}{l} \text{O}_2(\text{g}) + 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O} \\ \text{Al}(\text{s}) \rightarrow \text{Al}^{3+}(\text{aq}) + 3\text{e}^- \end{array} \right\} \checkmark$ $4\text{Al}(\text{s}) + 3\text{O}_2(\text{g}) + 12\text{H}^+ \rightarrow 4\text{Al}^{3+}(\text{aq}) + 6\text{H}_2\text{O} \quad E^{\theta} = +2,89 \text{ (V)} \checkmark$ <p>X is O₂/oxygen/suurstof ✓</p> <p>[X marked independently/X onafhanklik nagesien]</p>	

(5)

8.1.3 Al ✓

(1)

8.1.4 O₂(g) + 4H⁺ + 4e⁻ → 2H₂O ✓✓

Ignore phases./Ignoreer fases.

Marking criteria/Nasienkriteria:

- 2H₂O ← O₂(g) + 4H⁺ + 4e⁻ ($\frac{2}{2}$) O₂(g) + 4H⁺ + 4e⁻ ⇌ 2H₂O ($\frac{1}{2}$)
 O₂(g) + 4H⁺ + 4e⁻ ← 2H₂O ($\frac{0}{2}$) 2H₂O ⇌ O₂(g) + 4H⁺ + 4e⁻ ($\frac{0}{2}$)
 - Ignore if charge omitted on electron./Ignoreer indien lading weggelaat op elektron.
 - If charge (+) omitted on H⁺/ Indien lading (+) weggelaat op H⁺: Max./Maks: $\frac{1}{2}$
- Example/Voorbeeld: O₂(g) + 4H + 4e⁻ → 2H₂O ✓

(2)

8.1.5 $\underbrace{\text{Al}(\text{s}) | \text{Al}^{3+}(\text{aq})}_{\checkmark} || \underbrace{\text{O}_2(\text{g}) | \text{H}^+(\text{aq}) | \text{H}_2\text{O}(\text{l}) | \text{Pt}(\text{s})}_{\checkmark}$

OR/OFAl(s) | Al³⁺(aq) || O₂(g) | H⁺(aq) | H₂O(l) | C(s)**OR/OF**Al | Al³⁺ || O₂ | H⁺ | H₂O | Pt

(3)

8.2 Copper/Koper ✓

- Cu is a weaker reducing agent than Ni ✓ and will not reduce Ni²⁺ (to Ni). / Cu will not be oxidised (to Cu²⁺). ✓
- Zn is a stronger reducing agent than Ni ✓ and will reduce Ni²⁺ (to Ni). / Zn will be oxidised (to Zn²⁺).
- Cu is 'n swakker reduseermiddel as Ni en sal nie Ni²⁺ (na Ni) reduseer nie. / Cu sal nie geoksideer word nie na (Cu²⁺).
- Zn is 'n sterker reduseermiddel as Ni en sal Ni²⁺ (na Ni) reduseer. / Zn sal geoksideer word (na Zn²⁺).

NOTE/LET WEL:

The mark for 'reduce' can be awarded at any ONE of the two comparisons.
Die punt vir 'reduseer' kan toegeken word by ENIGEEN van die twee vergelykings.

(4)
[18]

QUESTION 9/VRAAG 9

9.1

Marking criteria/Nasienkriteria:

If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

ANY ONE/ENIGE EEN:

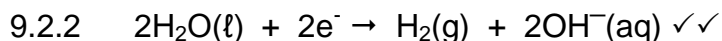
- The chemical process in which electrical energy is converted to chemical energy. ✓✓
- The use of electrical energy to produce a chemical change.
- Decomposition of an ionic compound by means of electrical energy.
- The process during which an electric current passes through a solution/ionic liquid/molten ionic compound.
- Die chemiese proses waarin elektriese energie omgeskakel word na chemiese energie. ✓✓
- Die gebruik van elektriese energie om 'n chemiese verandering te weeg te bring.
- Ontbinding van 'n ioniese verbinding met behulp van elektriese energie.
- Die proses waardeur 'n elektriese stroom deur 'n oplossing/ioniese vloeistof/gesmelte ioniese verbinding beweeg.

(2)

9.2

9.2.1 X ✓

(1)

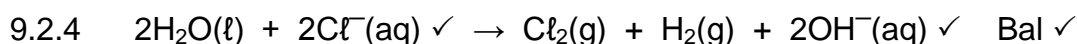
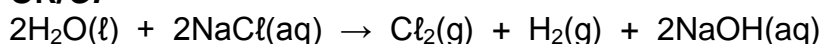
Ignore phases/*Ignoreer fases***Marking criteria/Nasienkriteria:**

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

(2)



(1)

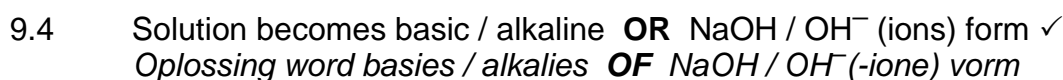
**OR/OF**Ignore phases/*Ignoreer fases***Marking criteria/Nasienkriteria:**

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

(3)



(1)



(1)

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