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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)**

2021

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 19 pages./
Hierdie nasienriglyne bestaan uit 19 bladsye.**

QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

2.1

2.1.1 F ✓ (1)

2.1.2 B & F ✓ (1)

2.1.3 C ✓ (1)

2.2

2.2.1 Haloalkane / alkyl halide ✓
Haloalkaan/alkielhalied (1)

2.2.2 3,5-dibromooctane ✓✓✓
3,5-dibroomoktaan

Marking criteria/Nasienkriteria:

- Octane/Oktaan ✓
- Dibromo/Dibroom ✓
- Substituents (dibromo) correctly numbered, hyphens, commas correctly used./
Substituente (dibroom) korrek genommer, koppeltekens en kommas korrek gebruik. ✓

(3)

2.3

2.3.1 Pentan-3-one ✓✓
Pentan-3-oon
OR/OF
3-pentanone ✓✓
3-pentanoon

Marking criteria/Nasienkriteria:

- Pentanone/pentanoon ✓
- Correct position of functional group. ✓
Korrekte posisie van funksionele groep.

(2)

2.3.2 3-methyl✓butan-2-one✓/3-metielbutan-2-oon

OR/OF

3-methyl✓butanone✓/3-metielbutanoon

OR/OF

methyl✓butanone✓/metielbutanoon

OR/OF

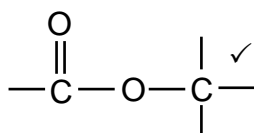
3-methyl✓-2-butanone✓/3-metiel-2-butanoon

(2)

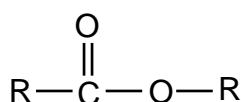
2.4

2.4.1 Hexyl✓methanoate ✓
Heksielmetanoaat (2)

2.4.2



OR/OF



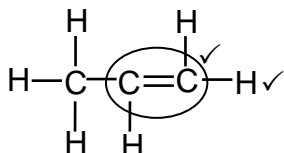
(1)

2.5

2.5.1 Cracking/Elimination ✓
Kraking/eliminatie (1)

2.5.2 C₇H₁₆ ✓✓ (2)

2.5.3

**Notes/Aantekeninge**

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

(2)
[19]**QUESTION 3/VRAAG 3**

3.1

Marking guidelines/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 pressure exerted by a vapour at equilibrium with its liquid in a closed system. ✓✓

Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistoffase in 'n geslote sisteem.

(2)

3.2

Functional group/Type of intermolecular forces/Homologous series ✓

Funksionele groep/Tipe intermolekulêre kragte/Homoloë reeks

(1)

3.3

B ✓

(1)

3.4

Marking criteria/Nasienkriteria

- State hydrogen bonding in **A**./Noem waterstofbinding in **A**. ✓
- State dipole-dipole forces in **B**./Noem dipool-dipoolkragte in **B**. ✓
- Compare strengths of IMFs./Vergelyk sterktes van IMKe. ✓
- Compare energies required./Vergelyk energieë benodig. ✓

- Compound A/butan-1-ol has hydrogen bonding (dipole-dipole and London forces) between molecules. ✓

- Compound B/butan-2-one has dipole-dipole forces (and London forces) between molecules. ✓

- Intermolecular forces in compound A/butan-1-ol are stronger than intermolecular forces in compound B/butan-2-one. ✓

OR

Intermolecular forces in compound B/butan-2-one are weaker than intermolecular forces in compound A/butan-1-ol. ✓

- More energy is needed to overcome/break intermolecular forces in compound A/butan-ol than in compound B/butan-2-one. ✓

- Verbinding A/butan-1-ol het waterstofbindings (dipool-dipoolkragte en Londonkragte) tussen molekule.

- Verbinding B/butan-2-oon het dipool-dipoolkragte (en London kragte) tussen molekule. ✓

- Intermolekulêre kragte in verbinding A/butan-1-ol is sterker as intermolekulêre kragte in verbinding B/butan-2-oon.

OF

Intermolekulêre kragte in verbinding B/butan-2-oon is swakker as intermolekulêre kragte in verbinding A/butan-1-ol.

- Meer energie is nodig om intermolekulêre kragte te oorkom/breek in verbinding A/butan-1-ol as in verbinding B/butan-2-oon.

(4)

3.5

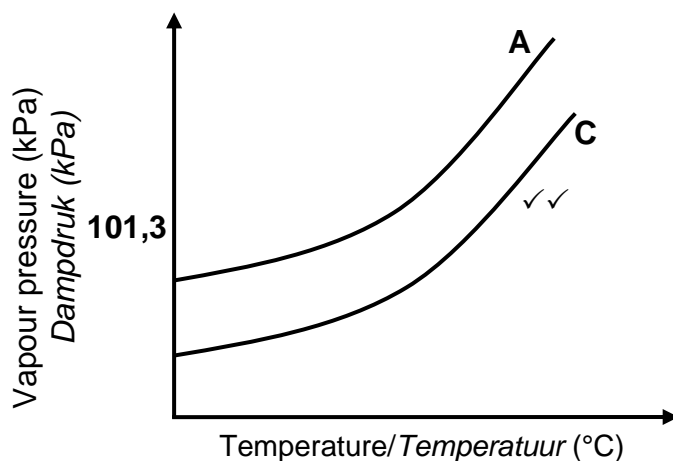
3.5.1 Boiling point (of compound **A**/butan-1-ol) ✓
Kookpunt (van verbinding **A**/butan-1-ol)

(1)

3.5.2 Gas ✓

(1)

3.5.3



Marking criteria/Nasienkriteria:

- Curve **C** starts below curve **A**/Kurwe **C** begin onder kurwe **A**. ✓
- Curve **C** remains below curve **A**/ Kurwe **C** bly onder kurwe **A**. ✓

Accept/Aanvaar

- If **C** is labelled as **B** / Indien **C** as **B** benoem is
- If graph below graph **A** is unlabelled /Indien grafiek onder grafiek **A** nie benoemis nie

Note/Let Wel

If both graphs unlabelled / Indien beide grafiek nie benoem is nie:
0 marks / 0 punte

(2)

[12]

QUESTION 4/VRAAG 4

4.1

4.1.1 Heat/sunlight/ultraviolet light/radiation/light ✓
Hitte/sonlig/ultravioletlig/straling/lig

(1)

4.1.2 HBr/hydrogen bromide/waterstofbromied ✓

(1)

4.1.3 Hydrolysis/hidrolise ✓

(1)

4.1.4 H₂O/water ✓**Accept/Aanvaar**

hydrogen oxide/waterstofoksied

OR/OF

NaOH/KOH/LiOH/sodium hydroxide/potassium hydroxide/lithium hydroxide

NaOH/KOH/LiOH/Natriumhidroksied/kaliumhidroksied/litiumhidroksied

(1)

4.1.5 2-bromo✓propane ✓

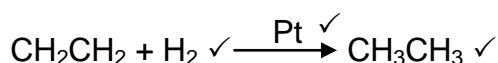
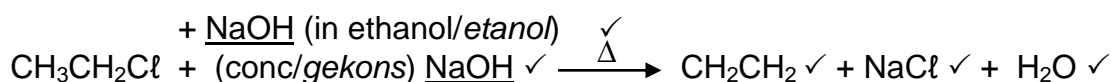
2-bromopropaan

(2)

4.2

Marking criteria/Nasienkriteria:**(Mark bullets independently. / Sien kolpunte onafhanklik na.)**

- React chloroethane with (conc) NaOH or NaOH in ethanol. ✓
- Indicate heat/Δ (on the arrow) or as a reactant in the reaction of chloroethane. ✓
- Correct condensed formula for ethene as product. ✓
- Product NaCl in the reaction of chloroethane. ✓
- Product H₂O in the reaction of chloroethane. ✓
- React ethene with H₂. ✓
- Indicate Pt on the arrow of / at the reaction of ethene with H₂. ✓
- Correct condensed formula of ethane as product. ✓
- Reageer chloroetaan met (gekons) NaOH of NaOH in etanol. ✓
- Dui hitte/Δ (op die pyl) of as 'n reaktant in die reaksie van chloroetaan. ✓
- Korrekte gekondenseerde formule vir eteen as produk. ✓
- Produk NaCl in die reaksie van chloroetaan. ✓
- Produk H₂O in die reaksie van chloroetaan. ✓
- Reageer eteen met H₂. ✓
- Dui Pt aan op die pyl / by die reaksie van eteen met H₂. ✓
- Korrekte gekondenseerde formule vir etaan as produk. ✓

**Note/Let wel**

Any additional reactants or products: Deduct one mark per reaction

Enige addisionele reaktanse of produkte: Trek een punt af per reaksie

(8)

[14]

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

- Time/tyd ✓
- Volume of gas/CO₂/carbon dioxide (in gas syringe) ✓
Volume gas/CO₂/koolstofdioksied (in gasspuit)

OR/OF

- Time taken for Al₂(CO₃)₃ to be used up. ✓✓
Tyd geneem vir die Al₂(CO₃)₃ om opgebruik te word.

Accept/AanvaarMeasure volume of gas/CO₂ at regular time intervals. ✓✓Meet volume van gas/CO₂ met gereelde tydintervalle.

(2)

5.3

Experiment II/Eksperiment II:

- More (HCl) particles per unit volume./More particles with correct orientation. ✓
- More effective collisions per unit time./Higher frequency of effective collisions. ✓
- Higher reaction rate. ✓
- Meer (HCl)-deeltjies per eenheid volume./Meer deeltjies met korrekte oriëntasie.
- Meer effektiewe botsings per eenheid tyd./Hoër frekwensie van effektiewe botsings.
- Hoër reaksietempo.

(3)

OR/OF**Experiment I/Eksperiment I:**

- Less (HCl) particles per unit volume. ✓
- Less effective collisions per unit time./Lower frequency of effective collisions. ✓
- Lower reaction rate. ✓
- Minder (HCl) deeltjies per eenheidvolume.
- Minder effektiewe botsings per eenheidtyd./ Laer frekwensie van effektiewe botsings.
- Laer reaksietempo.

5.4

<u>OPTION 1/OPSIE 1</u> $\text{ave rate/gem tempo} = -\frac{\Delta n}{\Delta t}$ $4,4 \times 10^{-3} = -\frac{n_f - 0,016}{2,5(-0)} \checkmark$ $n[\text{Al}_2(\text{CO}_3)_3] = 0,005 \text{ (mol)} \checkmark$	<u>Marking criteria/Nasienkriteria</u> <ul style="list-style-type: none"> • Substitute average rate and Δt. / Vervang gemiddelde tempo en Δt. ✓ • Substitute/Vervang Δn. ✓ • Final answer/Finale antwoord: 0,005 (mol) ✓
<u>OPTION 2/OPSIE 2</u> $\text{ave rate/gem tempo} = \frac{\Delta n}{\Delta t}$ $4,4 \times 10^{-3} = \frac{\Delta n}{2,5} \checkmark$ $\Delta n[\text{Al}_2(\text{CO}_3)_3] = 0,016 - 0,011 \checkmark$ $= 0,005 \text{ mol} \checkmark$	<u>NOTE/LET WEL</u> <ul style="list-style-type: none"> • Accept negative answers when the negative sign in front of the formula is omitted. / Aanvaar negatiewe antwoord wanneer die negatiewe teken voor die formule uitgelaat is. • Do not penalise if initial and final mole values or time values are swapped. / Moenie penaliseer indien aanvanklike en finale molwaardes omgeruil is nie.
<u>OPTION 3/OPSIE 3</u> <u>With reference to CO₂/Met verwysing na CO₂</u> $\text{ave. rate/gem tempo} = \frac{\Delta n}{\Delta t}$ $4,4 \times 10^{-3} = \frac{\Delta n}{2,5} \checkmark$ $\Delta n(\text{CO}_2) = 0,011 \text{ mol}$ $\begin{array}{ccc} n(\text{CO}_2) & : & n(\text{Al}_2(\text{CO}_3)_3) \\ 3 & : & 1 \\ 0,011 & : & 3,67 \times 10^{-3} \text{ mol} \checkmark \end{array}$ $n(\text{Al}_2(\text{CO}_3)_3 \text{ left/oor}) = 0,016 - 3,67 \times 10^{-3} = 1,23 \times 10^{-2} \text{ mol} \checkmark$	

OPTION 4/OPSIE 4

With reference to HCl/Met verwysing na HCl

$$\text{ave. rate/gem tempo} = \frac{\Delta n}{\Delta t}$$

$$4,4 \times 10^{-3} = \frac{\Delta n}{2,5}$$

$$\Delta n(\text{HCl}) = 0,011 \text{ mol}$$

$$n[\text{Al}_2(\text{CO}_3)_3] = \frac{0,011}{6} = 0,0018 \text{ mol} \checkmark$$

$$n[\text{Al}_2(\text{CO}_3)_3] \text{ left/oor} = 0,016 - 0,0018 = 0,0142 \text{ mol} \checkmark$$

OPTION 5/OPSIE 5

With reference to AlCl₃/Met verwysing na AlCl₃

$$\text{ave. rate/gem tempo} = \frac{\Delta n}{\Delta t}$$

$$4,4 \times 10^{-3} = \frac{\Delta n}{2,5}$$

$$\Delta n(\text{AlCl}_3) = 0,011 \text{ mol}$$

$$n[\text{Al}_2(\text{CO}_3)_3] = 0,0055 \text{ mol} \checkmark$$

$$n[\text{Al}_2(\text{CO}_3)_3] \text{ left/oor} = 0,016 - 0,0055 = 0,0105 \text{ mol} \checkmark$$

(3)

5.5

Marking criteria/Nasienkriteria:

- Use mol ratio/Gebruik molverhouding: $n(\text{CO}_2) : n[\text{Al}_2(\text{CO}_3)_3] = 3 : 1 \checkmark$

- Substitute $24\,000 \text{ cm}^3 \cdot \text{mol}^{-1} / 24 \text{ dm}^3 \cdot \text{mol}^{-1}$ in $n = \frac{V}{V_M}$ or in ratio. \checkmark

Vervang $24\,000 \text{ cm}^3 \cdot \text{mol}^{-1} / 24 \text{ dm}^3 \cdot \text{mol}^{-1}$ in $n = \frac{V}{V_M}$ of in verhouding.

- Final answer/Finale antwoord: $1\,152 \text{ cm}^3 / 1,152 \text{ dm}^3 \checkmark$

OPTION 1/OPSIE 1

$$\begin{aligned} n(\text{CO}_2) &= 3n[\text{Al}_2(\text{CO}_3)_3] \\ &= 3(0,016) \checkmark \\ &= 0,048 \text{ mol} \end{aligned}$$

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

$$\therefore 0,048 = \frac{V}{24000} \checkmark$$

$$V(\text{CO}_2) = 1\,152 \text{ cm}^3 (1,152 \text{ dm}^3) \checkmark$$

OPTION 2/OPSIE 2

$$\begin{aligned} n(\text{CO}_2) &= 3n[\text{Al}_2(\text{CO}_3)_3] \\ &= 3(0,016) \checkmark \\ &= 0,048 \text{ mol} \end{aligned}$$

$$1 \text{ mol} \dots\dots\dots 24\,000 \text{ cm}^3$$

$$0,048 \text{ mol} \dots\dots\dots V$$

$$V(\text{CO}_2) = \frac{0,048 \times 24000}{1} \checkmark$$

$$= 1\,152 \text{ cm}^3 (1,152 \text{ dm}^3) \checkmark$$

(3)

[13]

QUESTION 6/VRAAG 6

- 6.1 (The stage in a chemical reaction when the) rate of forward reaction equals the rate of reverse reaction. ✓✓
 (Die stadium in 'n chemiese reaksie wanneer die) tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie. **(2 or/of 0)**

OR/OF

(The stage in a chemical reaction when the) concentrations of reactants and products remain constant.

(Die stadium in 'n chemiese reaksie wanneer die) konsentrasies van reaktanse en produkte konstant bly. **(2 or/of 0)**

(2)

6.2

6.2.1 X ✓

**ANY ONE/ENIGE EEN**

- The concentration of products increases (from 0 – 6 min.).
Die konsentrasie van die produkte neem toe (van 0 - 6 min.).
- The concentration of reactants decreases (from 0 – 6 min.).
Die konsentrasie van die reaktanse neem af (van 0 – 6 min.).
- No products were present initially. ✓
Geen produkte was aanvanklik teenwoordig nie.
- The curve begins at zero./Die kurwe begin by nul.

(2)

6.2.2 Higher than/Hoër as ✓

(1)

6.3

CALCULATIONS USING NUMBER OF MOLES
BEREKENINGE WAT AANTAL MOL GEBRUIK

Marking criteria/Nasienkriteria

- Calculate/Bereken mol HI: $n(\text{HI})_{\text{ini/aanv.}} = 1(0,5)$. ✓
- Use mol ratio/Gebruik molverhouding: 2:1:1 / $n(\text{HI}) = 2n(\text{H}_2) = 2n(\text{I}_2)$. ✓
- $$\left. \begin{array}{l} n(\text{H}_2)_{\text{equilibrium/ewewig}} = n(\text{H}_2)_{\text{formed/gevorm}} \\ n(\text{I}_2)_{\text{equilibrium/ewewig}} = n(\text{I}_2)_{\text{formed/gevorm}} \end{array} \right\} \checkmark$$
- Note:** If Δn not shown award mark for equal $n_{\text{equilibrium}}$
Let wel: Indien Δn nie aangedui is nie, ken punt toe vir gelyke n_{ewewig}
- $n((\text{HI})_{\text{equilibrium/ewewig}} = n(\text{HI})_{\text{initial/aanvanklik}} - n(\text{HI})_{\text{change/verandering}}$. ✓
- Divide $n(\text{HI})_{\text{equil}}$ & $n(\text{H}_2)_{\text{equil}}$ & $n(\text{H}_2)_{\text{equil}}$ by $0,5 \text{ dm}^3$. ✓
 Deel $n(\text{HI})_{\text{ewewig}}$ & $n(\text{H}_2)_{\text{ewewig}}$ & $n(\text{H}_2)_{\text{ewewig}}$ deur $0,5 \text{ dm}^3$.
- Correct K_c expression (formulae in square brackets). ✓
 Korrekte K_c -uitdrukking (formules in vierkanthakies).
- Substitute 0,04 into K_c expression. ✓
 Vervang 0,04 in K_c -uitdrukking.
- Substitute equilibrium concentrations in K_c expression. ✓
 Vervang ewewigskonsentrasies in K_c -uitdrukking.
- Final answer/Finale antwoord: 0,07 mol ✓
 Range/Gebied: 0,07 – 0,072 mol

OPTION 1/OPSIE 1

$$n(\text{HI}) = 1(0,5) = 0,5 \text{ mol}$$

	HI	H ₂	I ₂
Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i>	0,5 ✓	0	0
Change (mol) <i>Verandering (mol)</i>	2x	x	x
Quantity at equilibrium (mol)/ <i>Hoeveelheid by ewewig (mol)</i>	0,5-2x ✓	x	x ✓
Equilibrium concentration (mol·dm ⁻³) <i>Ewewigskonsentrasie (mol·dm⁻³)</i>	$\frac{0,5-2x}{0,5}$	$\frac{x}{0,5}$	$\frac{x}{0,5}$

ratio ✓
verhoudingdivide by 0,5 ✓
deel deur 0,5

$$K_c = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2} \checkmark$$

$$0,04 = \frac{\left(\frac{x}{0,5}\right)\left(\frac{x}{0,5}\right)}{\left(\frac{0,5-2x}{0,5}\right)^2} \checkmark$$

$$x = 0,071 \text{ mol} \checkmark$$

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. $\frac{6}{9}$ **CALCULATIONS USING CONCENTRATION****BEREKENINGE WAT KONSENTRASIE GEBRUIK****Marking criteria/Nasienkriteria:**

- Use initial/Gebruik aanvanklike $c(\text{HI}) = 1 \text{ mol} \cdot \text{dm}^{-3}$. ✓
- Use mol ratio/Gebruik molverhouding: 2 : 1 : 1 / $n(\text{HI}) = 2n(\text{H}_2) = 2n(\text{I}_2)$. ✓
- $c(\text{H}_2)_{\text{equilibrium/ewewig}} = c(\text{H}_2)_{\text{formed/gevorm}}$ } ✓
 $c(\text{I}_2)_{\text{equilibrium/ewewig}} = c(\text{I}_2)_{\text{formed/gevorm}}$
- **Note:** If Δc not shown award mark for equal $c_{\text{equilibrium}}$
Let wel: Indien Δc nie aangedui is nie, ken punt toe vir gelyke c_{ewewig}
- $c(\text{HI})_{\text{equilibrium/ewewig}} = c(\text{HI})_{\text{initial}} - c(\text{HI})_{\text{change}}$. ✓
- Correct K_c expression (formulae in square brackets). ✓
 Korrekte K_c-uitdrukking (formules in vierkanthakies).
- Substitution of 0,04 into K_c expression. ✓
 Vervang 0,04 in K_c-uitdrukking.
- Substitution of equilibrium concentrations into K_c expression. ✓
 Vervanging van ewewigskonsentrasies in K_c-uitdrukking.
- Multiply concentration by 0,5 dm³. ✓
 Vermenigvuldig konsentrasie met 0,5 dm³.
- Final answer/Finale antwoord: 0,07 mol ✓
 Range/Gebied: 0,07 to/tot 0,072 mol

OPTION 2/OPSIE 2

	HI	H ₂	I ₂
Initial concentration (mol·dm ⁻³) <i>Aanvangskonsentrasie (mol·dm⁻³)</i>	1 ✓	0	0
Change (mol·dm ⁻³) <i>Verandering (mol·dm⁻³)</i>	2x	x	x
Equilibrium concentration (mol·dm ⁻³) <i>Ewewigskonsentrasie (mol·dm⁻³)</i>	1-2x ✓	x	x ✓

$$K_c = \frac{[H_2][I_2]}{[HI]^2} \quad \checkmark$$

$$0,04 = \frac{(x)(x)}{(1-2x)^2} \quad \checkmark$$

$$x = 0,143 \text{ mol·dm}^{-3}$$

$$n(I_2) = cV$$

$$= 0,143 \times 0,5 \quad \checkmark$$

$$= 0,072 \text{ mol} \quad \checkmark$$

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. $\frac{6}{9}$

(9)

6.4

6.4.1 Both forward and reverse/*Beide voorwaartse en terugwaartse* ✓

(1)

6.4.2 Positive/*Positief* ✓

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

(4)

[19]

QUESTION 7/VRAAG 7

7.1 Standard solution/Standaardoplossing ✓

(1)

7.2

7.2.1

Marking criteria/Nasienkriteria:

- Any one of the formulae/*Enige een van die formules*: $c = \frac{m}{MV}$ / $n = \frac{m}{M}$ / $c = \frac{n}{V}$ ✓
- Substitution of $40 \text{ g} \cdot \text{mol}^{-1}$ into correct formula. ✓
Vervanging van $40 \text{ g} \cdot \text{mol}^{-1}$ in korrekte formule.
- Substitution of $0,25 \text{ dm}^3$ into correct formula. ✓
Vervanging van $0,25 \text{ dm}^3$ in korrekte formule.
- Final answer/*Finale antwoord*: $0,2 \text{ mol} \cdot \text{dm}^{-3}$ ✓

OPTION 1/OPSIE 1

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

$$= \frac{2}{\sqrt{40 \times 0,25}} \checkmark$$

$$= 0,20 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

OPTION 2/OPSIE 2

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

$$= \frac{2}{40} \checkmark$$

$$= 0,05 \text{ mol}$$

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

$$= \frac{0,05}{0,25} \checkmark$$

$$= 0,20 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

Any one formula/
enige formule ✓

(4)

7.2.2 POSITIVE MARKING FROM 7.2.1./POSITIEWE NASIEN VAN 7.2.1.

OPTION 1/OPSIE 1

$$[\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14}$$

$$\frac{[\text{H}_3\text{O}^+](0,2)}{[\text{H}_3\text{O}^+]} = \frac{1 \times 10^{-14}}{0,2} \checkmark$$

$$[\text{H}_3\text{O}^+] = 5 \times 10^{-14} \text{ mol} \cdot \text{dm}^{-3}$$

$$\downarrow$$

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

$$= -\log(5 \times 10^{-14}) \checkmark$$

$$= 13,30 \checkmark$$

OPTION 2/OPSIE 2

$$\text{pOH} = -\log[\text{OH}^-] \checkmark$$

$$= -\log(0,2) \checkmark$$

$$= 0,6989 \quad (0,7)$$

$$\downarrow$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} = 14 - 0,6989 \checkmark$$

$$= 13,30 \checkmark$$

(4)

7.3

POSITIVE MARKING FROM QUESTION 7.2.**POSITIEWE NASIEN VANAF VRAAG 7.2.****Marking criteria/Nasienkriteria:**

- Substitution to calculate $n(\text{NaOH})$. / Vervanging om $n(\text{NaOH})$ te bereken. ✓
- Use mol ratio / Gebruik molverhouding: $n(\text{HCl})_{\text{excess/oormaat}} : n(\text{NaOH}) = 1 : 1$. ✓
- Substitute / Vervang $100 \text{ g} \cdot \text{mol}^{-1}$ in $n = \frac{m}{M}$ ✓
- Use mol ratio / Gebruik molverhouding: $n(\text{HCl})_{\text{reacted/oormaat}} : n(\text{CaCO}_3) = 2 : 1$. ✓
- $n(\text{HCl})_{\text{initial/aanvanklik}} = n(\text{HCl})_{\text{excess/oormaat}} + n(\text{HCl})_{\text{reacted/reageer}}$ ✓✓
- Substitute $0,05 \text{ dm}^3$ to calculate either $c(\text{HCl})_{\text{initial}}$ or $c(\text{HCl})_{\text{reacted}}$ ✓
Vervang $0,05 \text{ dm}^3$ om $c(\text{HCl})_{\text{aanvanklik}}$ of $c(\text{HCl})_{\text{reageer}}$ te bereken.
- Final answer / Finale antwoord: $0,7 \text{ mol} \cdot \text{dm}^{-3}$ ✓
Range / Gebied: $0,70$ to / tot $0,90 \text{ mol} \cdot \text{dm}^{-3}$

OPTION 1/OPSIE 1

$$\begin{aligned}
 n(\text{NaOH})_{\text{used/gebruik}} &= c_b V_b \\
 &= 0,2 \times 0,025 \quad \checkmark \\
 &= 5 \times 10^{-3} \text{ mol}
 \end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}
 n(\text{NaOH})_{\text{used/gebruik}} &= \frac{25}{250} \times \frac{2}{40} \quad \checkmark \\
 &= 5 \times 10^{-3} \text{ mol}
 \end{aligned}$$

$$n(\text{HCl})_{\text{excess/oormaat}} = n(\text{NaOH}) = 5 \times 10^{-3} \text{ mol} \quad \checkmark$$

$$\begin{aligned}
 n(\text{CaCO}_3) &= \frac{m}{M} \\
 &= \frac{1,5}{100} \quad \checkmark \\
 &= 0,015 \text{ mol} \quad (0,02 \text{ mol})
 \end{aligned}$$

$$n(\text{HCl})_{\text{reacted/reageer}} = 2n(\text{CaCO}_3) = 0,03 \text{ mol} \quad \checkmark \quad (0,04 \text{ mol})$$

$$\begin{aligned}
 n(\text{HCl})_{\text{ini/aanv.}} &= 5 \times 10^{-3} + 0,03 \quad \checkmark \checkmark \\
 &= 0,035 \text{ mol} \quad (0,045 \text{ mol})
 \end{aligned}$$

$$\begin{aligned}
 c(\text{HCl})_{\text{ini/aanv.}} &= \frac{n}{V} \\
 &= \frac{0,035}{0,05} \quad \checkmark \\
 &= 0,70 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark \quad (0,90 \text{ mol} \cdot \text{dm}^{-3})
 \end{aligned}$$

OPTION 3/OPSIE 3	OPTION/OPSIE 4
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$ $\frac{c_a (0,05)}{(0,2)(0,025)} = \frac{1}{1} \checkmark$ $c_a = c(\text{HCl})_{\text{excess/oormaat}}$ $= 0,1 \text{ mol} \cdot \text{dm}^{-3}$ $n(\text{CaCO}_3) = \frac{m}{M}$ $= \frac{1,5}{100} \checkmark$ $= 0,015 \text{ mol}$ $n(\text{CaCO}_3) : n(\text{HCl}) = 1 : 2$ $n(\text{HCl})_{\text{reacted/reageer}} = 2(0,015) \checkmark$ $= 0,03 \text{ mol}$ $c(\text{HCl})_{\text{reacted/reageer}} = \frac{n}{V}$ $= \frac{0,03}{0,05} \checkmark$ $= 0,6 \text{ mol} \cdot \text{dm}^{-3}$ $c(\text{HCl})_{\text{initial/aanvanklik}} = c(\text{HCl})_{\text{reacted/reageer}} + c(\text{HCl})_{\text{excess/oormaat}}$ $= 0,6 + 0,1 \checkmark \checkmark$ $= 0,7 \text{ mol} \cdot \text{dm}^{-3} \checkmark$	$(\text{NaOH})_{\text{used/gebruik}} = c_b V_b$ $= (0,2)(0,025) \checkmark$ $= 0,005 \text{ mol}$ $n(\text{HCl})_{\text{excess/oormaat}} = n(\text{NaOH}) \checkmark$ $= 0,005 \text{ mol}$ $c(\text{HCl})_{\text{excess/oormaat}} = \frac{0,005}{0,05}$ $= 0,1 \text{ mol} \cdot \text{dm}^{-3}$

(8)
[17]

QUESTION 8/VRAAG 8

8.1

8.1.1 Gain of electrons./Opneem van elektrone. ✓✓ (2 or/of 0) (2)

8.1.2 $2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$ ✓✓

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: $2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}(\text{aq})$ ✓ Max./Maks: $\frac{1}{2}$

(2)

8.1.3 $2\text{Na}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \checkmark \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq}) + 2\text{Na}^+(\text{aq}) \checkmark$ Bal ✓

OR/OF

$2\text{Na}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \checkmark \rightarrow \text{H}_2(\text{g}) + 2\text{NaOH}(\text{aq}) \checkmark$ Bal ✓

Ignore phases./Ignoreer fases.

Marking criteria/Nasienkriteria:

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

(3)

8.1.4 Formation of hydroxide ions / OH^- / sodium hydroxide/base/ alkaline/ $\text{pH} > 7$ ✓
 Vorming van hidroksied / OH^- / natriumhidroksied / basis / alkalies / $\text{pH} > 7$ (1)

8.1.5 Cu is a weaker reducing agent ✓ than H_2 (and OH^-) ✓ and H_2O will not be reduced ✓ (to H_2 and OH^-).
 Cu is 'n swakker reduseermiddel as H_2 (and OH^-) en H_2O sal nie gereduseer word nie na H_2 (en OH^-).

OR/OF

H_2 (and OH^-) are stronger reducing agent ✓ than Cu and H_2O ✓ will not be reduced ✓ (to H_2 and OH^-).
 H_2 (en OH^-) is 'n sterker reduseermiddel as Cu en H_2O sal nie gereduseer word (na H_2 en OH^-).

(3)

8.2

8.2.1 Phase separator/boundary/difference ✓
Fase skeiding/grens/verskil

(1)

8.2.2 Chemical (energy) to electrical (energy) ✓
Chemiese (energie) na elektriese (energie)

(1)

8.2.3

OPTION/OPSIE 1 $E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} \checkmark$ $= 0,77 \checkmark - (-0,13) \checkmark$ $E_{\text{cell}}^{\theta} = 0,90 \text{ V} \checkmark$	Notes/Aantekeninge <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: Max/Maks: $\frac{3}{4}$
OPTION/OPSIE 2 $\checkmark \left\{ \begin{array}{l} \text{Pb(s)} \rightarrow \text{Pb}^{2+}(\text{aq}) + 2\text{e}^{-} \quad 0,13 \text{ (V)} \checkmark \\ 2\text{Fe}^{3+}(\text{aq}) + 2\text{e}^{-} \rightarrow 2\text{Fe}^{2+}(\text{aq}) \quad 0,77 \text{ (V)} \checkmark \\ \text{Pb}^{2+}(\text{aq}) + 2\text{Fe}^{3+}(\text{aq}) \rightarrow \text{Pb(s)} + 2\text{Fe}^{2+}(\text{aq}) \quad 0,90 \text{ V} \checkmark \end{array} \right.$	

(4)

[17]

QUESTION 9/VRAAG 9

9.1 Electrolytic (cell)/Elektrolitiese (sel) ✓



Cells have a battery/DC power source/ Electrical energy is converted to chemical energy. ✓

Selle het batterye/GS kragbron/ Elektriese energie is omgeskakel na chemiese energie.

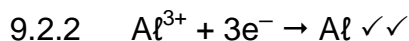
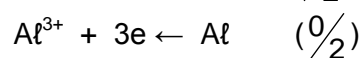
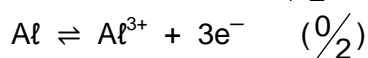
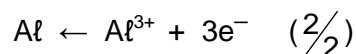
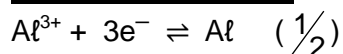
(2)

9.2

9.2.1 $2\text{Cl}^{-} \rightarrow \text{Cl}_2 + 2\text{e}^{-} \checkmark \checkmark$

Notes/Aantekeninge $2\text{Cl}^{-} \rightleftharpoons \text{Cl}_2 + 2\text{e}^{-} \quad (\frac{1}{2})$ $\text{Cl}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{Cl}^{-} \quad (\frac{0}{2})$ $\text{Cl}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{Cl}^{-} \quad (\frac{0}{2})$ <ul style="list-style-type: none"> Ignore if charge omitted on electron./Ignoreer indien lading weggelaat op elektron. If charge (-) omitted on Cl^{-}/Indien lading (-) weggelaat op Cl^{-}: Example/Voorbeeld: $2\text{Cl}(\text{aq}) \rightarrow \text{Cl}_2(\text{g}) + 2\text{e}^{-}$ Max./Maks: $\frac{1}{2}$ 	
---	--

(2)

**Notes/Aantekeninge**

- Ignore if charge omitted on electron./Ignoreer indien lading weggelaat op elektron.
- If charge (+) omitted on Al^{3+} /Indien lading (+) weggelaat op Al^{3+} :

Example/Voorbeeld: $\text{Al}^3(\text{aq}) + 3\text{e}^- \rightarrow \text{Al}(\text{s})$ Max./Maks: $1/2$

(2)



(1)

9.3 **ANY ONE/ENIGE EEN**

- The electrode/carbon/C reacts with oxygen. ✓
Die elektrode/koolstof/C reageer met suurstof.
- $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- Oxidation takes place./Electrons are lost.
Oksidasie vind plaas./Elektrone word verloor.
- Oxygen corrodes the carbon electrode.
Suurstof roes die koolstof elektrode.

(1)

[8]**QUESTION 10/VRAAG 10**

10.1



(1)



(1)

*Vanadiumpentoksied/Vanadium(V) oksied*

(1)

**Marking guidelines/Nasienkriteria:**

- Reactants ✓ Products ✓ Balancing ✓
Reaktanse ✓ Produkte ✓ Balansering ✓
- Ignore/Ignoreer → and phases / en fases
- Marking rule 6.3.10/Nasienreël 6.3.10

(3)

10.2

10.2.1 The ratio of nitrogen (N), phosphorous (P) and potassium (K) in a fertiliser./The ratio of the primary nutrients ✓*Die verhouding van stikstof (N), fosfor (P) en kalium (K) in die kunsmis. / Die verhouding van primêre nutriënte.*

(1)

10.2.2

OPTION 1/OPSIE 1Mass N in 4 kg NH_4NO_3 / Massa N in 4 kg NH_4NO_3

$$m(\text{N}) = \frac{28}{80} \times 4 \checkmark$$

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

$$m(\text{K}) = 2m(\text{N}) \checkmark$$

$$= 2,8 \text{ kg}$$

$$m(\text{P}) = 3m(\text{N}) \checkmark$$

$$= 4,2 \text{ kg}$$

$$m(\text{fertiliser/kunsmis}) = 1,4 + 2,8 + 4,2 \\ = 8,4 \text{ kg} \checkmark$$

OPTION 2/OPSIE 2Mass N in 4 kg NH_4NO_3 / Massa N in 4 kg NH_4NO_3 :

$$m(\text{N}) = \frac{28}{80} \times 4 \checkmark$$

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

N : P : K

1 : 3 : 2

$$\therefore m(\text{fertiliser/kunsmis}) = (6) \checkmark (1,4) \checkmark \\ = 8,4 \text{ kg} \checkmark$$

OPTION 3/OPSIE 3

$$\% \text{ N} = \frac{(2)(14)}{80} \times 100 = 35\%$$

$$\text{Nitrogen in 4 kg} = 35\% \text{ of/van } 4 = 1,4 \text{ kg} \checkmark$$

N : P : K

1 : 3 : 2

1,4 : 4,2 \checkmark : 2,8 \checkmark

$$\text{Total mass of fertiliser / Totale massa kunsmis} = 1,4 + 4,2 + 2,8 \\ = 8,4 \text{ kg} \checkmark$$

(4)
[11]**TOTAL/TOTAAL:****150**