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**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

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

NOVEMBER 2024

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 28 pages.
*Hierdie nasienriglyne bestaan uit 28 bladsye.***

QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

- | | | |
|-------|-----|-----|
| 2.1 | | |
| 2.1.1 | D ✓ | (1) |
| 2.1.2 | A ✓ | (1) |
| 2.1.3 | E ✓ | (1) |
| 2.2 | | |
| 2.2.1 | | |

Marking criteria:

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

Nasienkriteria:

- *Korrekte stam d.i. heksaan.* ✓
- *Korrekte substituenten (bromo en metiel) geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.* ✓

3,3-dibromo-4,4-dimethylhexane/3,3-dibromo-4,4-dimietielheksaan ✓✓✓ (3)

2.2.2

Marking criteria:

- Correct stem, i.e. pentyne. ✓
- Substituent (dimethyl) correctly identified. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:

- *Korrekte stam, d.i. pentyn.* ✓
- *Substituente (dimetiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.* ✓

4,4-dimethylpent-2-yne/4,4-dimethyl-2-pentyne ✓✓✓

4,4-dimetielpent-2-yn/4,4-dimetiel-2-pentyn

(3)

2.3

2.3.1

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.*

Compounds with the same molecular formula, ✓ but different functional groups/homologous series. ✓

Verbindings met dieselfde molekulêre formule, maar verskillende funksionele groepe/homoloë reekse.

(2)

2.3.2

A and/en C ✓

(1)

2.4

2.4.1

 H₂SO₄/Sulphuric acid/Swaelsuur ✓

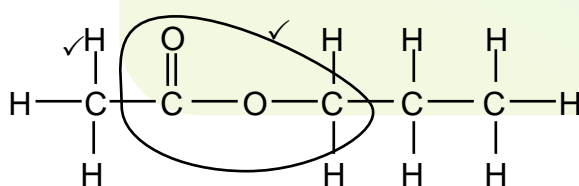
(1)

2.4.2

Esterification/Condensation/Verestering/Esterifikasie/Kondensasie ✓

(1)

2.4.3


Marking criteria:

- Functional group correct. ✓
- Whole structural formula correct. ✓

Nasienkriteria:

- *Funksionele groep korrek.* ✓
- *Hele struktuurformule korrek.* ✓

(2)

2.4.4

Marking criteria:

- Correct chain length and functional group, i.e. Propanol. ✓
- Everything else correct: IUPAC name completely correct including numbering. ✓

Nasienkriteria:

- *Korrekte kettinglengte en funksionele groep, d.i. Propanol.* ✓
- *Alles verder reg: IUPAC-naam heeltemal korrek nommering ingesluit.* ✓

Propan-1-ol/1-propanol ✓✓

NOTE/AANTEKENING:

Propanol ✓

(2)

[18]

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

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

(2)

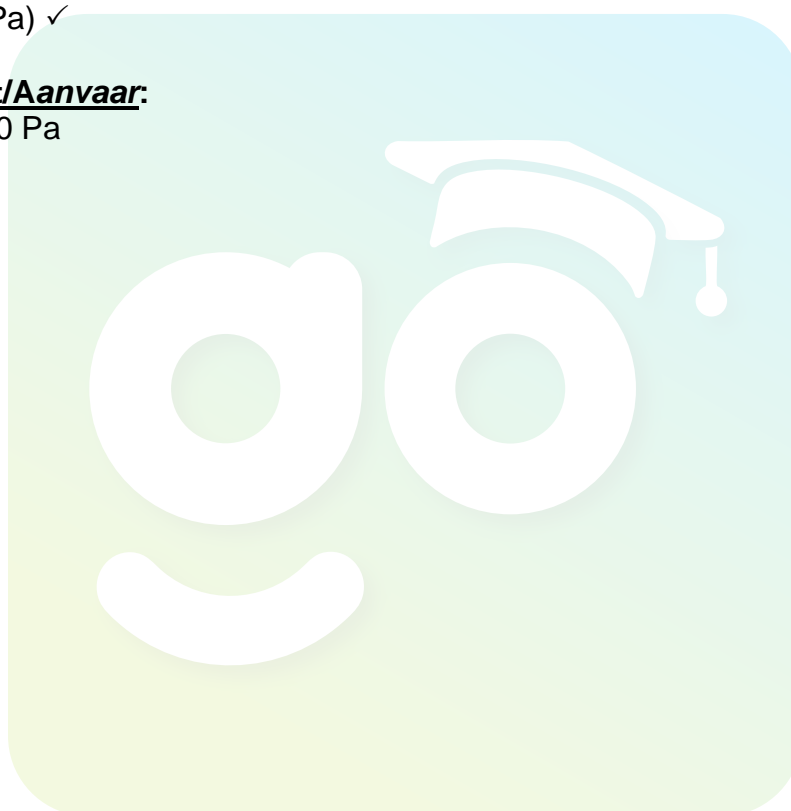
3.2

3.2.1 146 (kPa) ✓

Accept/Aanvaar:

146 000 Pa

(1)



3.2.2

Marking criteria:

- Compare structures. ✓
- Compare the strength of intermolecular forces. ✓
- Compare the energy required to overcome intermolecular forces. ✓

Nasienkriteria:

- *Vergelyk strukture.* ✓
- *Vergelyk die sterkte van intermolekulêre kragte.* ✓
- *Vergelyk die energie benodig om intermolekulêre kragte te oorkom.* ✓

Accept/Aanvaar:

Abbreviation IMF in explanations./Afkorting IMK in verduidelikings.

Comparing compound C/2,2-dimethylpropane with compounds A/pentane and B/2-methylbutane

- **Structure:**
Compound C is more branched than compounds A and B/Shorter chain length/most compact most spherical/smallest surface area (over which intermolecular forces act). ✓
- **Intermolecular forces:**
Compound C has weaker/less intermolecular forces/Van der Waals forces/London forces than A and B. ✓
- **Energy:**
Lesser energy needed to overcome or break intermolecular forces/Van der Waals force in compound C than A and B. ✓

Vergelyk verbinding C/2,2-dimetielpropaan met verbindings A/pentaa en B/2-metielputaan

- **Struktuur:**
Verbinding C is meer vertak as verbindings A en B/Korter kettinglengte/meer kompak/meer sferies/kleiner oppervlak (waaroor intermolekulêre kragte werk).
- **Intermolekulêre kragte:**
Verbinding C het swakker/minder intermolekulêre kragte/Van der Waals-kragte/London-kragte as verbindings A en B.
- **Energie:**
Minder energie benodig om intermolekulêre kragte/Van der Waals-kragte/London-kragte van verbinding C te oorkom/breek as in verbinding A en B.

(3)

3.3

3.3.1 E/butanal/butanaal ✓

(1)

3.3.2

Marking criteria:

- Strongest intermolecular forces in compound D: Hydrogen bond. ✓
- Strongest intermolecular forces in compound E: Dipole-dipole forces. ✓
- Compare the strength of intermolecular forces. ✓
- Compare the energy required to overcome intermolecular forces. ✓

Nasienkriteria:

- *Sterkste intermolekulêre kragte in verbinding D: Waterstofbinding.* ✓
- *Sterkste intermolekulêre kragte in verbinding E: Dipool-dipoolkragte.* ✓
- *Vergelyk die sterkte van die intermolekulêre kragte.* ✓
- *Vergelyk die energie benodig om intermolekulêre kragte te oorkom.* ✓

Accept/Aanvaar:

Abbreviation IMF in explanations./Afkorting IMK in verduidelikings.

- Compound D/Propanoic acid has hydrogen bonding (dipole-dipole and London forces) between molecules. ✓
- Compound E/Butanal has dipole-dipole forces (and London forces) between molecules. ✓
- Intermolecular forces between molecules of compound D/propanoic acid are stronger than intermolecular forces between molecules of compound E/butanal. ✓
- More energy is needed to overcome/break intermolecular forces between molecules of compound D/propanoic acid than in compound E/butanal. ✓

OR

- Compound D/Propanoic acid has hydrogen bonding (dipole-dipole and London forces) between molecules.
- Compound E/Butanal has dipole-dipole forces (and London forces) between molecules.
- Intermolecular forces between molecules of compound E/butanal are weaker than intermolecular forces between compound D/propanoic acid
- Lesser energy is needed to overcome/break intermolecular forces between molecules of compound E/butanal than in compound D/propanoic acid

- *Verbinding D/propanoësuur het watertofbinding (dipool-dipool en London-kragte) tussen die molekules.*
- *Verbinding E/butanaal het dipool-dipoolkragte (en London-kragte) tussen die molekules.*
- *Intermolekulêre kragte tussen die molekules van verbinding D/propanoësuur is sterker as die intermolekulêre kragte tussen molekules van verbinding E/butanaal.*
- *Meer energie word benodig om die intermolekulêre kragte tussen die molekules van verbinding D/propanoësuur te oorkom/breek.*

OF

- *Verbinding D/propanoësuur het watertofbinding (dipool-dipool en London-kragte) tussen die molekules.*
- *Verbinding E/butanaal het dipool-dipoolkragte (en London-kragte) tussen die molekules.*
- *Intermolekulêre kragte tussen die molekules van verbinding E/butanaal is swakker as die intermolekulêre kragte tussen verbinding D/propanoësuur.*
- *Minder energie word benodig om die intermolekulêre kragte tussen die molekules van verbinding D/butanaal te oorkom/breek.*

(4)

[11]

QUESTION 4/VRAAG 4

4.1

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 underlined phrases must be in the correct context./Die onderstreepte frases moet in die korrekte konteks wees.

The chemical process/reaction in which longer chain hydrocarbon/alkane molecules/are broken down to shorter (more useful) molecules. ✓✓

Die chemiese proses/reaksie waarin langer kettingkoolwaterstof/alkaan- molekule afgebreek word in korter (meer bruikbare) molekules. (2)

4.2

Primary/Primêre ✓

The halogen/bromine/functional group (-X) is bonded to a C atom that is bonded to one other C atom. ✓

Die halogeen/broom/funksionele groep (-X) is gebind aan 'n C-atoom wat aan een ander C-atoom gebind is/ 'n primêre C-atoom.

OR/OF

The functional group ($\begin{array}{c} | \\ -\text{C}- \\ | \\ \text{Br/X} \end{array}$) is bonded to one other C atom.

Die funksionele groep ($\begin{array}{c} | \\ -\text{C}- \\ | \\ \text{Br/X} \end{array}$) is gebind aan een ander C-atoom.

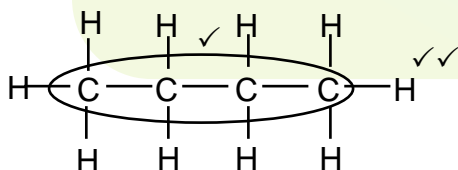
Accept/Aanvaar:

The Br/bromine (atom)/X/halogen is bonded to first /last/ terminal C-atom.

Die Br/broom (atoom)/X/halogeen is gebind/verbind aan die eerste/laaste C-atoom. (2)

4.3

4.3.1

**Marking criteria:**

- Correct stem, i.e. 4 C atoms. ✓
- Whole structural formula correct. ✓✓

Nasienkriteria:

- Korrekte stam, d.w.s. 4 C-atome. ✓
- Hele struktuur korrek. ✓✓

(3)

POSITIVE MARKING FROM QUESTION 4.3.1**POSITIEWE NASIEN VAN VRAAG 4.3.1**

4.3.2

 C_8H_{18} ✓ (1)

4.4

4.4.1

 Br_2 /Bromine/Broom ✓ (1)

4.4.2

Substitution / Substitusie ✓ (1)

4.4.3

UV/(Sun)light/Heat/(Son)lig/Hitte ✓ (1)

- 4.5 Dehydrohalogenation/Dehydrobromination ✓
 Dehidrohalogenering/Dehidrohalogenasie/Dehidrobrominerig

(1)

4.6

4.6.1

Marking criteria:Reaction IV

- Functional group of alkene on first C atom. ✓
- Whole structural formula of alkene correct. ✓
- HBr. ✓
- Functional group of haloalkane correct. ✓
- Whole structural formula of haloalkane correct (halogen on second/first C-atom). ✓

Nasienkriteria:

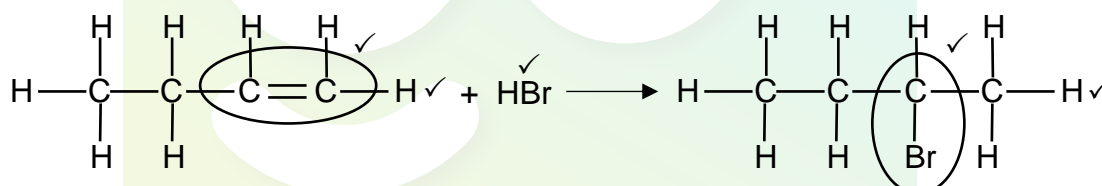
- *Funksionele groep van alkeen op die eerste C-atoom.* ✓
- *Hele struktuurformule van alkeen korrek.* ✓
- *HBr.* ✓
- *Funksionele groep van haloalkaan korrek.* ✓
- *Hele struktuurformule van haloalkaan korrek (halogeen op die tweede/eerste C-atoom).* ✓

IF/INDIEN

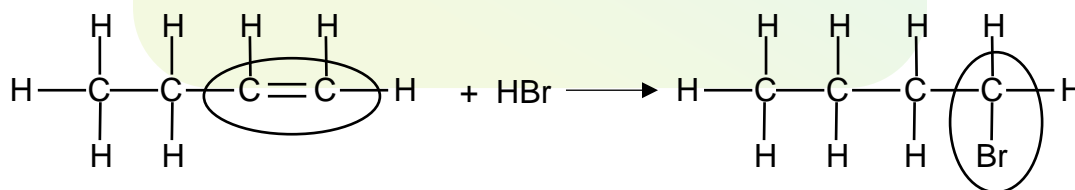
- Condensed, semi structural or molecular formula
Gekondenseerde, semi-struktuurformule of molekulêre formule: Max/Mak: 1/5
- Marking rule 6.3.10/Nasienreël 6.3.10

Note/Aantekening:

For extra product or reactant, deduct 1 mark.

Vir ekstra produk of reaktans, trek 1 punt af.

OR



(5)

4.6.2

Marking criteria:

- NaOH. ✓
- Whole structural formula of alkene correct (functional group on second/first C atom). ✓
- NaBr + H₂O ✓

Nasienkriteria:

- NaOH. ✓
- Hele struktuurformule van van alkeen korrek (funksionele groep op de tweede/ eerste C-atoom). ✓
- NaBr + H₂O ✓

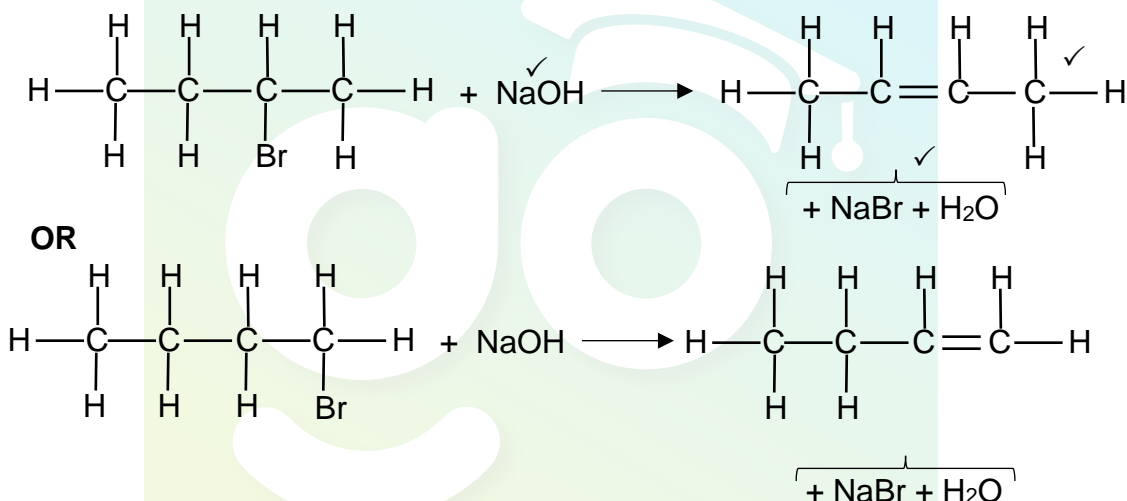
IF/INDIEN

- Condensed, semi structural or molecular formula.
Gekondenseerde, semi-struktuurformule of molekulêre formule. Max/Maks: 1/5
- Marking rule 6.3.10/Nasienreël 6.3.10

Note/Aantekening:

For extra product or reactant, deduct 1 mark.

Vir ekstra produk of reaktans, trek 1 punt af.



(3)

4.6.3 But-2-ene/2-butene/but-1-ene/1-butene/But-2-een/2-buteen/but-1-een/1-buteen ✓✓

Butene/Buteen: deduct 1 mark/trek een punt af.

(2)

[22]

QUESTION 5/VRAAG 5

5.1
5.1.1

NOTE/LET WEL

Give the mark for per unit time only if in context of reaction rate.

Gee die punt vir per eenheid tyd 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)

5.1.2

Marking criteria

- (a) Substitute 0,033 and 5 in rate formula. ✓
 (b) Substitute 24,5 in $\frac{V}{V_m}$ ✓
 (c) USE mol ratio:
 $n(\text{Al}) : n(\text{H}_2) = 2 : 3$ ✓
 (d) Substitute $27 \text{ g} \cdot \text{mol}^{-1}$ in $\frac{m}{M}$ ✓
 (e) Subtract $m(\text{Al})_{t=5}$ from $m(\text{Al})_{\text{ini}}$ /
 $n(\text{Al})_{t=5}$ from $n(\text{Al})_{\text{ini}}$ ✓
 (f) Final correct answer: 0,38 g ✓
 (0,379)
 Range: 0,365 – 0,42 g

Nasienkriteria:

- (a) Vervang 0,033 en 5 in tempoformule ✓
 (b) Vervang 24,5 in $\frac{V}{V_m}$ ✓
 (c) **GEBRUIK** molverhouding:
 $n(\text{Al}) : n(\text{H}_2) = 2 : 3$ ✓
 (d) Vervang 27 g in $\frac{m}{M}$ ✓
 (e) Trek $m(\text{Al})_{t=5}$ van $m(\text{Al})_{\text{begin}}$ /
 $n(\text{Al})_{t=5}$ van $n(\text{Al})_{\text{begin}}$ ✓
 (f) Finale korrekte antwoord: 0,38 g
 (0,379 g) ✓
 Gebied: 0,365 – 0,42 g

$$\text{Rate/Tempo} = \frac{\Delta V(\text{H}_2)}{\Delta t}$$

$$0,033 = \frac{\Delta V(\text{H}_2)}{5} \quad \checkmark \text{ (a)}$$

$$V(\text{H}_2) = 0,165 \text{ dm}^3$$

$$\begin{aligned} n(\text{H}_2) &= \frac{V}{V_m} \\ &= \frac{0,165}{24,5} \quad \checkmark \text{ (b)} \\ &= 6,74 \times 10^{-3} \text{ mol (0,0067)} \end{aligned}$$

$$\begin{aligned} n(\text{Al}) &= \frac{2}{3} n(\text{H}_2) \\ &= \frac{2}{3} (6,74 \times 10^{-3}) \quad \checkmark \text{ (c)} \\ &= 4,49 \times 10^{-3} \text{ mol (0,00449)} \end{aligned}$$

OPTION 1/OPSIE 1:

$$\begin{aligned} n(\text{Al}) &= \frac{m}{M} \\ 4,49 \times 10^{-3} &= \frac{m(\text{Al})}{27} \quad \checkmark \text{ (d)} \end{aligned}$$

$$m(\text{Al}) = 0,12 \text{ g (0,121)}$$

$$\begin{aligned} \Delta m(\text{Al}) &= 0,5 - 0,12 \quad \checkmark \text{ (e)} \\ &= 0,38 \text{ g} \quad \checkmark \text{ (f)} \end{aligned}$$

OPTION 2/OPSIE 2:

$$\begin{aligned} n(\text{Al}) &= \frac{m}{M} \\ &= \frac{0,5}{27} \\ &= 0,0185 \text{ mol} \end{aligned}$$

$$\begin{aligned} \Delta n(\text{Al}) &= 0,0185 - 4,49 \times 10^{-3} \quad \checkmark \text{ (e)} \\ &= 0,014 \text{ mol} \end{aligned}$$

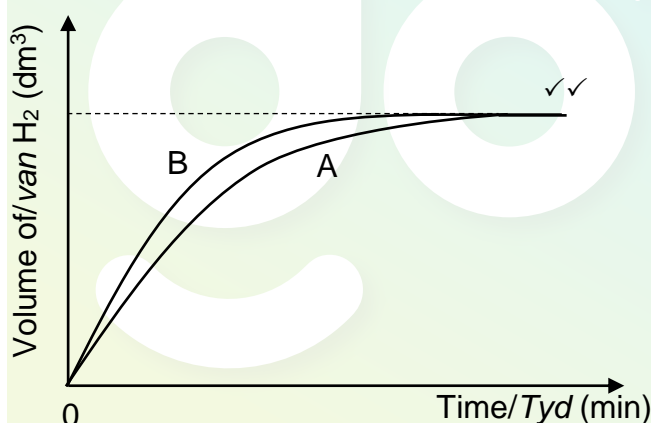
$$\begin{aligned} n(\text{Al}) &= \frac{m}{M} \\ 0,014 &= \frac{m(\text{Al})}{27} \quad \checkmark \text{ (d)} \\ m(\text{Al}) &= 0,38 \text{ g} \quad \checkmark \text{ (f)} \end{aligned}$$

(6)

- 5.1.3
- The surface area/contact area/mass/size of aluminium decreases. ✓
 - Less particles exposed. ✓
 - Less effective collisions per unit time/second. ✓
- OR**
- Lower frequency of effective collisions.
- Reaction rate decreases./Lower reaction rate./Reaction slows down. ✓
- *Die reaksieoppervlak/kontakoppervlak/massa/grootte van aluminium neem af.*
- *Minder deeltjies blootgestel.*
- Minder effektiewe botsings per eenheid tyd/sekonde.
- OF**
- Laer frekwensie van effektiewe botsings.
- *Reaksietempo neem af./Laer reaksietempo./ Reaksie is stadiger .* (4)

5.1.4

<p><u>Marking criteria:</u></p> <ul style="list-style-type: none"> • Curve B starts at the origin and ends at the same point as curve A. ✓ • Gradient of curve B steeper for the whole duration. ✓ <p>Note: Graph not labelled: Max. $\frac{1}{2}$</p>	<p><u>Nasienkriteria:</u></p> <ul style="list-style-type: none"> • <i>Kurwe B begin by oorsprong en eindig by dieselfde punt as kurwe A.</i> ✓ • <i>Gradiënt van kurwe B steiler vir die volle duur.</i> ✓ <p>Aantekening: Grafiek nie benoem nie: Maks. $\frac{1}{2}$</p>
---	---



(2)

- 5.1.5 Equal to./Gelyk aan. ✓

(1)

5.2

- 5.2.1 An increase in temperature./'n Toename in temperatuur. ✓

(1)

- 5.2.2 Curve Y has a peak/maximum at a higher kinetic energy./Peak shifted to the right.

OR

The (average) kinetic energy (of the particles) increases./More particles with higher kinetic energy./Larger area with higher kinetic energy. ✓

Kurwe Y het 'n piek/maksimum by 'n hoër kinetiese energie./Piek het regs geskuif.

OF

Die (gemiddelde) kinetiese energie van die deeltjies het toegeneem./Meer deeltjies met 'n hoer kinetiese energie./Groter oppervlak met hoër kinetiese energie

(1)

[17]

QUESTION 6/VRAAG 6

- 6.1 (The dynamic equilibrium when) the rate of the forward reaction equals the rate of the reverse reaction. ✓✓ (2 or 0)
 6.1.1 (Die dinamiese ewewig wanneer) die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie.

OR/OF

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

Die stadium in 'n chemiese reaksie waar die konsentrasie van die reaktanse en produkte konstant bly.

(2)

- 6.1.2 X ✓

(1)

- 6.1.3 Decreased/Verlaag ✓

(1)

- 6.1.4 The concentrations of (all) the gases decreased./The reverse reaction was favoured. ✓
Die konsentrasies van die (al) die gasse verminder./Die terugwaartse reaksie is bevoordeel.

Accept/Aanvaar:

All concentrations decreased./Al die konsentrasies het verminder.

(1)

- 6.1.5 CO(g)/carbon monoxide/koolstofmonoksied. ✓

(1)

- 6.1.6 The concentration of Z (CO) decreased with a decrease in the concentration of X (O₂). ✓

OR

The concentration of Z (CO) increased with an increase in the concentration of X (O₂).

OR

Z (CO) behaves like X (O₂)/Follows the same trend as X (O₂).

OR

Z (CO) and X(O₂) are both reactants/ Y(CO₂) is the product.

OR

The reverse reaction is favoured to increase the number of moles.

Die konsentrasie van Z (CO) neem af met 'n afname in die konsentrasie van X (O₂).

OF

Die konsentrasie van Z (CO) neem toe met 'n toename in die konsentrasie van X (O₂).

OF

Z (CO) tree dieselfde op as X (O₂)/volg dieselfde neiging as X (O₂).

OF

Z(CO) en X(O₂) is beide reaktanse/ Y(CO₂) is die produk.

OF

Die terugwaartse reaksie word bevoordeel om die hoeveelheid mol te verhoog.

(1)

6.1.7 Decreased/Verlaag ✓

(1)

6.1.8 • Concentration of products/Y/CO₂ increases. ✓

OR

Concentration of reactant/Z/X/CO/O₂ decreases.

OR

The forward reaction is favoured.

• The forward reaction is exothermic. ✓

• A decrease in temperature favours the exothermic reaction. ✓

• Konsentrasie van produkte/Y/CO₂ neem toe. ✓

OF

Konsentrasie van reaktanse/Z/X/CO/O₂ neem af.

OF

Die voorwaartse reaksie word bevoordeel.

• Die voorwaartse reaksie is eksotermies. ✓

• Afname in temperatuur bevoordeel die eksotermiese reaksie. ✓

(3)

6.2

REACTANTS ARE USED/REAKTANSE WORD GEBRUIK

CALCULATIONS USING MOLES

BEREKENINGE WAT GETAL MOL GEBRUIK

Marking criteria:

(a) USING ratio: $n(\text{H}_2\text{O}) : n(\text{CO}) : n(\text{H}_2) : n(\text{CO}_2) = 1 : 1 : 1 : 1$ ✓

(b) $n(\text{CO})_{\text{eq}} = n(\text{CO})_{\text{initial}} - \Delta n(\text{CO})$, $n(\text{H}_2\text{O})_{\text{eqm}} = n(\text{H}_2\text{O})_{\text{initial}} - \Delta n(\text{H}_2\text{O})$,
 $n(\text{CO}_2)_{\text{eq}} = n(\text{CO}_2)_{\text{initial}} + \Delta n(\text{CO}_2)$ AND $n(\text{H}_2)_{\text{eqm}} = n(\text{H}_2)_{\text{initial}} + \Delta n(\text{H}_2)$ ✓

(c) Divide n_{eq} by the volume 2 dm³ ✓

(d) Correct K_c expression. ✓

(e) Substitute K_c value 4. ✓

(f) Substitute concentrations in K_c expression. ✓

(g) Substitute numerical values of x in $n(\text{CO})_{\text{initial}} - \Delta n(\text{CO})_{\text{change}}$ ✓

(h) Substitute of 28 in $n = \frac{m}{M}$ ✓

(i) Final answer: 6,44 g ✓

Range: 6,44 – 6,72 g

Nasienkriteria:

(a) GEBRUIK verhouding: $n(\text{H}_2\text{O}) : n(\text{CO}) : n(\text{H}_2) : n(\text{CO}_2) = 1 : 1 : 1 : 1$ ✓

(b) $n(\text{CO})_{\text{ewe}} = n(\text{CO})_{\text{begin}} - \Delta n(\text{CO})$, $n(\text{H}_2\text{O})_{\text{ewe}} = n(\text{H}_2\text{O})_{\text{begin}} - \Delta n(\text{H}_2\text{O})$,
 $n(\text{CO}_2)_{\text{ewe}} = n(\text{CO}_2)_{\text{begin}} + \Delta n(\text{CO}_2)$ EN $n(\text{H}_2)_{\text{ewe}} = n(\text{H}_2)_{\text{begin}} + \Delta n(\text{H}_2)$ ✓

(c) Deel n_{ewe} deur 2 dm³ ✓

(d) Korrekte K_c -uitdrukking. ✓

(e) Vervang K_c -waarde 4. ✓

(f) Vervanging van konsentrasies in K_c -uitdrukking. ✓

(g) Vervanging van nomeriese waarde van x in $n(\text{CO})_{\text{begin}} - \Delta n(\text{CO})$ ✓

(h) Vervanging van 28 in $n = \frac{m}{M}$ ✓

(i) Finale answer: 6,44 g ✓

Gebied: 6,44 – 6,72 g

IF/INDIEN:

No table/calculation giving table values – do not award marks for criteria (a) and (b)

Geen tabel/berekening waarin tabelwaardes gegee is – geen punt vir riglyn (a) en (b).

(x change in amount/ verandering in hoeveelheid.)	CO	H ₂ O	CO ₂	H ₂
Initial amount (moles) Aanvanklike hoeveelheid (mol)	0,6	0,6	0,1	0,1
Change in amount (moles) Verandering in hoeveelheid (mol)	x	x	x	x ✓ (a)
Equilibrium amount (moles) Ewewigshoeveelheid (mol) ✓ (b)	0,6 - x	0,6 - x	0,1 + x	0,1 + x
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	$\frac{0,6 - x}{2}$	$\frac{0,6 - x}{2}$	$\frac{0,1 + x}{2}$	$\frac{0,1 + x}{2}$

✓ (c)

$$K_c = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]} \quad \checkmark \text{ (d)}$$

$$4 \checkmark \text{ (e)} = \frac{\left(\frac{0,1 + x}{2}\right)\left(\frac{0,1 + x}{2}\right)}{\left(\frac{0,6 - x}{2}\right)\left(\frac{0,6 - x}{2}\right)} \quad \checkmark \text{ (f)}$$

$x = 0,37$

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./Maks. 6/9

$n(\text{CO})_{\text{eq}} = 0,6 - 0,37 \quad \checkmark \text{ (g)}$ $= 0,23 \text{ mol}$ $n(\text{CO})_{\text{eq}} = \frac{m}{M}$ $0,23 = \frac{m}{28} \quad \checkmark \text{ (h)}$ $m(\text{CO})_{\text{eq}} = 6,44 \text{ g} \quad \checkmark \text{ (i)}$	$[\text{CO}]_{\text{eq}} = \frac{0,6 - x}{2}$ $= \frac{0,6 - 0,37}{2} \quad \checkmark \text{ (g)}$ $= 0,115 \text{ mol} \cdot \text{dm}^{-3}$ $n = cV$ $= (0,115)(2)$ $= 0,23 \text{ mol}$ $n(\text{CO})_{\text{eq}} = \frac{m}{M}$ $0,23 = \frac{m}{28} \quad \checkmark \text{ (h)}$ $m(\text{CO})_{\text{eq}} = 6,44 \text{ g} \quad \checkmark \text{ (i)}$
--	--

(x equilibrium amount/ ewewigshoeveelheid.)	CO	H ₂ O	CO ₂	H ₂
Initial amount (moles) Aanvanklike hoeveelheid (mol)	0,6	0,6	0,1	0,1
Change in amount (moles) Verandering in hoeveelheid (mol)	-x + 0,6	-x + 0,6	-x + 0,6	-x + 0,6
Equilibrium amount (moles) Ewewigshoeveelheid (mol) ✓ (b)	x	x	0,7 - x	0,7 - x
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	$\frac{x}{2}$	$\frac{x}{2}$	$\frac{0,7 - x}{2}$	$\frac{0,7 - x}{2}$

✓ (a)

✓ (c)

$$K_c = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]} \quad \checkmark \text{ (d)}$$

$$4 \quad \checkmark \text{ (e)} = \frac{\left(\frac{0,7 - x}{2}\right)\left(\frac{0,7 - x}{2}\right)}{\left(\frac{x}{2}\right)\left(\frac{x}{2}\right)} \quad \checkmark \text{ (f)}$$

$$x = 0,23$$

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

$$\checkmark \text{ (g)} \quad 0,23 = \frac{m}{28} \quad \checkmark \text{ (h)}$$

$$m(\text{CO})_{\text{eq}} = 6,44 \text{ g} \quad \checkmark \text{ (i)}$$

CALCULATIONS USING CONCENTRATION

BEREKENINGE WAT KONSENTRASIE GEBRUIK

Marking criteria:

- (a) **USING RATIO:** [H₂O] : [CO] : [H₂] : [CO₂] = 1 : 1 : 1 : 1 ✓
- (b) Calculate [CO]_{initial}, [H₂O]_{initial}, [CO₂]_{initial} AND [H₂]_{initial} (divide initial moles by the volume of 2 dm³) ✓
- (c) [CO]_{eq} = [CO]_{initial} - Δ[CO] and [H₂O]_{eq} = [H₂O]_{initial} - Δ[H₂O] and [CO₂]_{eq} = [CO₂]_{initial} + Δ[CO₂] and [H₂]_{eq} = [H₂]_{initial} + Δ[H₂] ✓
- (d) Correct K_c expression ✓
- (e) Substitute K_c = 4 ✓
- (f) Substitute K_c expression ✓
- (g) Substitute numerical value of x in c(CO)_{initial} - Δc(CO) ✓
- (h) Substitute 28 in $n = \frac{m}{M}$ ✓
- (i) **CORRECT** final answer; x = 6,72 g. ✓
Range: 6,44 – 6,72 g

Nasienkriteria:

- (a) **GEBRUIK** verhouding: [H₂O] : [CO] : [H₂] : [CO₂] = 1 : 1 : 1 : 1 ✓
- (b) Bereken [CO]_{begin}, [H₂O]_{begin}, [CO₂]_{begin} AND [H₂]_{begin} (divide initial moles by the volume of 2 dm³) ✓
- (c) [CO]_{ewe} = [CO]_{begin} - Δ[CO] en [H₂O]_{ewe} = [H₂O]_{begin} - Δ[H₂O] en [CO₂]_{eq} = [CO₂]_{begin} + Δ[CO₂] and [H₂]_{ewe} = [H₂]_{initial} + Δ[H₂] ✓
- (d) Korrekte K_c uitdrukking (formules in vierkanthakies). ✓
- (e) Vervang K_c = 4 ✓
- (f) Vervanging van konsentrasies in K_c-uitdrukking.
- (g) Vervanging van nomeriese waarde van x in c(CO)_{begin} - Δc(CO) ✓
- (h) Vervang 28 in $n = \frac{m}{M}$ ✓
- (i) **Korrekte** final answer; x = 6,72 g. ✓
Gebied: 6,44 – 6,72 g

(x change concentration/ ewewigskonsentrasie.)	CO	H ₂ O	H ₂	CO ₂
Initial concentration (mol·dm ⁻³) Aanvanklike konsentrasie (mol·dm ⁻³)	0,3	0,3	0,05	0,05 ✓ (b)
Change (mol·dm ⁻³) Verandering (mol·dm ⁻³)	x	x	x	x ✓ (a)
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	0,3 - x	0,3 - x	0,05 + x	0,05 + x ✓ (c)

$$K_c = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]} \quad \checkmark \text{ (d)}$$

$$4 = \frac{(0,05 + x)(0,05 + x)}{(0,3 - x)(0,3 - x)} \quad \checkmark \text{ (e)} \quad \checkmark \text{ (f)}$$

$$x = 0,18 \text{ (0,183)}$$

$$[\text{CO}] = 0,3 - 0,18 \quad \checkmark \text{ (g)}$$

$$= 0,12 \text{ mol·dm}^{-3}$$

$$n(\text{CO})_{\text{eq}} = cV$$

$$= (0,12)(2)$$

$$= 0,24 \text{ mol}$$

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

$$0,24 = \frac{m}{28} \quad \checkmark \text{ (h)}$$

$$m(\text{CO})_{\text{eqm}} = 6,72 \text{ g} \quad \checkmark \text{ (i)}$$

(x equilibrium concentration/ ewewigskonsentrasie)	CO	H ₂ O	H ₂	CO ₂
Initial concentration (mol·dm ⁻³) Aanvanklike konsentrasie (mol·dm ⁻³)	0,3	0,3	0,05	0,05 ✓ (b)
Change (mol·dm ⁻³) Verandering (mol·dm ⁻³)	-x + 0,3	-x + 0,3	-x + 0,3	-x + 0,3 ✓ (a)
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	x	x	0,35 - x	0,35 - x ✓ (c)

$$K_c = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]} \quad \checkmark \text{ (d)}$$

$$4 = \frac{(0,35 - x)(0,35 - x)}{(x)(x)} \quad \checkmark \text{ (e)} \quad \checkmark \text{ (f)}$$

$$x = 0,12 \text{ mol·dm}^{-3}$$

$$n(\text{CO})_{\text{eq}} = cV$$

$$= (0,12)(2) \quad \checkmark \text{ (g)}$$

$$= 0,24 \text{ mol}$$

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

$$0,24 = \frac{m}{28} \quad \checkmark \text{ (h)}$$

$$m(\text{CO})_{\text{eqm}} = 6,72 \text{ g} \quad \checkmark \text{ (i)}$$

PRODUCTS ARE USED/PRODUKTE WORD GEBRUIK**CALCULATIONS USING MOLES****BEREKENINGE WAT GETAL MOL GEBRUIK****Marking criteria:**

- (a) USING ratio: $n(\text{H}_2\text{O}) : n(\text{CO}) : n(\text{H}_2) : n(\text{CO}_2) = 1 : 1 : 1 : 1$ ✓
- (b) $n(\text{CO})_{\text{eq}} = n(\text{CO})_{\text{initial}} + \Delta n(\text{CO})$, $n(\text{H}_2\text{O})_{\text{eqm}} = n(\text{H}_2\text{O})_{\text{initial}} + \Delta n(\text{H}_2\text{O})$,
 $n(\text{CO}_2)_{\text{eq}} = n(\text{CO}_2)_{\text{initial}} - \Delta n(\text{CO}_2)$ AND $n(\text{H}_2)_{\text{eqm}} = n(\text{H}_2)_{\text{initial}} - \Delta n(\text{H}_2)$ ✓
- (c) Divide n_{eq} by the volume 2 dm^3 ✓
- (d) Correct K_c expression. ✓
- (e) Substitute K_c value 4. ✓
- (f) Substitute concentrations in K_c expression. ✓
- (g) Substitute numerical value of x in $n(\text{CO})_{\text{initial}} + \Delta n(\text{CO})_{\text{change}}$ ✓
- (h) Substitute of 28 in $n = \frac{m}{M}$ ✓
- (i) Finale answer: 6,44 g ✓
 Range: 6,44 – 6,72 g

Nasienkriteria:

- (a) GEBRUIK verhouding: $n(\text{H}_2\text{O}) : n(\text{CO}) : n(\text{H}_2) : n(\text{CO}_2) = 1 : 1 : 1 : 1$ ✓
- (b) $n(\text{CO})_{\text{ewe}} = n(\text{CO})_{\text{begin}} + \Delta n(\text{CO})$, $n(\text{H}_2\text{O})_{\text{ewe}} = n(\text{H}_2\text{O})_{\text{begin}} + \Delta n(\text{H}_2\text{O})$,
 $n(\text{CO}_2)_{\text{ewe}} = n(\text{CO}_2)_{\text{begin}} - \Delta n(\text{CO}_2)$ EN $n(\text{H}_2)_{\text{ewe}} = n(\text{H}_2)_{\text{begin}} - \Delta n(\text{H}_2)$ ✓
- (c) Deel n_{ewe} deur 2 dm^3 ✓
- (d) Korrekte K_c -uitdrukking. ✓
- (e) Vervang K_c -waarde 4. ✓
- (f) Vervanging van konsentrasies in K_c -uitdrukking. ✓
- (g) Vervanging van nomeriese waarde van x in $n(\text{CO})_{\text{begin}} + \Delta n(\text{CO})$ ✓
- (h) Vervanging van 28 in $n = \frac{m}{M}$ ✓
- (i) Finale answer: 6,44 g ✓
 Gebied: 6,44 – 6,72 g

(x change in amount/ verandering in hoeveelheid.)	CO	H ₂ O	CO ₂	H ₂
Initial amount (moles) Aanvanklike hoeveelheid (mol)	0,6	0,6	0,1	0,1 ✓ (a)
Change in amount (moles) Verandering in hoeveelheid (mol)	x	x	x	x
Equilibrium amount (moles) Ewewigshoeveelheid (mol) ✓ (b)	0,6 + x	0,6 + x	0,1 - x	0,1 - x
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	$\frac{0,6+x}{2}$	$\frac{0,6+x}{2}$	$\frac{0,1-x}{2}$	$\frac{0,1-x}{2}$

✓ (c)

$$K_c = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]} \quad \checkmark \text{ (d)}$$

$$4 \quad \checkmark \text{ (e)} = \frac{\left(\frac{0,1-x}{2}\right)\left(\frac{0,1-x}{2}\right)}{\left(\frac{0,6+x}{2}\right)\left(\frac{0,6+x}{2}\right)} \quad \checkmark \text{ (f)}$$

$$x = -0,37$$

$$n(\text{CO})_{\text{eq}} = 0,6 + (-0,37) \quad \checkmark \text{ (g)}$$

$$= 0,23 \text{ mol}$$

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

$$0,23 = \frac{m}{28} \quad \checkmark \text{ (h)}$$

$$m(\text{CO})_{\text{eq}} = 6,44 \text{ g} \quad \checkmark \text{ (i)}$$

(x equilibrium amount / ewewigshoeveelheid.)	CO	H ₂ O	CO ₂	H ₂
Initial amount (moles) Aanvanklike hoeveelheid (mol)	0,6	0,6	0,1	0,1
Change in amount (moles) Verandering in hoeveelheid (mol)	-0,6 + x	-0,6 + x	-0,6 + x	-0,6 + x
Equilibrium amount (moles) Ewewigshoeveelheid (mol) ✓ (b)	x	x	0,7 - x	0,7 - x
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	$\frac{x}{2}$	$\frac{x}{2}$	$\frac{0,7-x}{2}$	$\frac{0,7-x}{2}$

✓ (c)

$$K_c = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]} \quad \checkmark \text{ (d)}$$

$$4 \quad \checkmark \text{ (e)} = \frac{\left(\frac{0,7-x}{2}\right)\left(\frac{0,7-x}{2}\right)}{\left(\frac{x}{2}\right)\left(\frac{x}{2}\right)} \quad \checkmark \text{ (f)}$$

$$x = 0,23$$

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

$$\checkmark \text{ (g)} \quad 0,23 = \frac{m}{28} \quad \checkmark \text{ (h)}$$

$$m(\text{CO})_{\text{eq}} = 6,44 \text{ g} \quad \checkmark \text{ (i)}$$

CALCULATIONS USING CONCENTRATION**BEREKENINGE WAT KONSENTRASIE GEBRUIK****Marking criteria:**

- (a) **USING RATIO:** $[H_2O] : [CO] : [H_2] : [CO_2] = 1 : 1 : 1 : 1$ ✓
 (b) Calculate $[CO]_{initial}$, $[H_2O]_{initial}$, $[CO_2]_{initial}$ AND $[H_2]_{initial}$ (divide initial moles by the volume of 2 dm^3) ✓
 (c) $[CO]_{eq} = [CO]_{initial} + \Delta[CO]$ and $[H_2O]_{eq} = [H_2O]_{initial} + \Delta[H_2O]$ and $[CO_2]_{eq} = [CO_2]_{initial} - \Delta[CO_2]$ and $[H_2]_{eq} = [H_2]_{initial} - \Delta[H_2]$ ✓
 (d) Correct K_c expression ✓
 (e) Substitute $K_c = 4$ ✓
 (f) Substitute K_c expression ✓
 (g) Substitute numerical value of x in $c(CO)_{initial} + \Delta c(CO)$ ✓
 (h) Substitute 28 in $n = \frac{m}{M}$ ✓
 (i) **CORRECT** final answer; $x = 6,72 \text{ g}$. ✓
 Range: $6,44 - 6,72 \text{ g}$

Nasienkriteria:

- (a) **GEBRUIK** verhouding: $[H_2O] : [CO] : [H_2] : [CO_2] = 1 : 1 : 1 : 1$ ✓
 (b) Bereken $[CO]_{begin}$, $[H_2O]_{begin}$, $[CO_2]_{begin}$ AND $[H_2]_{begin}$ (divide initial moles by the volume of 2 dm^3) ✓
 (c) $[CO]_{ewe} = [CO]_{begin} + \Delta[CO]$ en $[H_2O]_{ewe} = [H_2O]_{begin} + \Delta[H_2O]$ en $[CO_2]_{ewe} = [CO_2]_{begin} - \Delta[CO_2]$ and $[H_2]_{ewe} = [H_2]_{begin} - \Delta[H_2]$ ✓
 (d) Korrekte K_c uitdrukking (*formules in vierkanthakies*). ✓
 (e) Vervang $K_c = 4$ ✓
 (f) Vervanging van konsentrasies in K_c -uitdrukking. ✓
 (g) Vervanging van nomeriese waarde van x in $c(CO)_{begin} - \Delta c(CO)$ ✓
 (h) Vervang 28 in $n = \frac{m}{M}$ ✓
 (i) **Korrekte** final answer; $x = 6,72 \text{ g}$. ✓
 Gebied: $6,44 - 6,72 \text{ g}$

(x change in concentration/ verandering in konsentrasie.)	CO	H ₂ O	H ₂	CO ₂ ✓ (b)
Initial concentration (mol·dm ⁻³) Aanvanklike konsentrasie (mol·dm ⁻³)	0,3	0,3	0,05	0,05
Change (mol·dm ⁻³) Verandering (mol·dm ⁻³)	X	x	x	x ✓ (a)
Equilibrium concentration (mol·dm ⁻³) Ewigigskonsentrasie (mol·dm ⁻³)	0,3 + x	0,3 + x	0,05 - x	0,05 - x ✓ (c)

$$K_c = \frac{[CO_2][H_2]}{[CO][H_2O]} \quad \checkmark \text{ (d)}$$

$$4 = \frac{(0,05 - x)(0,05 - x)}{(0,3 + x)(0,3 + x)} \quad \checkmark \text{ (e) (f)}$$

$$x = -0,18 \text{ (0,183)}$$

$$[CO] = 0,3 + (-0,18) \quad \checkmark \text{ (g)}$$

$$= 0,12 \text{ mol·dm}^{-3}$$

$$n(CO)_{eq} = cV$$

$$= (0,12)(2)$$

$$= 0,24 \text{ mol}$$

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

$$0,24 = \frac{m}{28} \quad \checkmark \text{ (h)}$$

$$m(CO)_{eq} = 6,72 \text{ g} \quad \checkmark \text{ (i)}$$

(x equilibrium concentration/ ewewigkonsentrasie)	CO	H ₂ O	H ₂	CO ₂	
Initial concentration (mol·dm ⁻³) Aanvanklike konsentrasie (mol·dm ⁻³)	0,3	0,3	0,05	0,05	✓ (b)
Change (mol·dm ⁻³) Verandering (mol·dm ⁻³)	-0,3 + x	-0,3 + x	-0,3 + x	-0,3 + x	✓ (a)
Equilibrium concentration (mol·dm ⁻³) Ewewigkonsentrasie (mol·dm ⁻³)	X	x	0,35 - x	0,35 - x	✓ (c)

$$K_c = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]} \quad \checkmark \text{ (d)}$$

$$\checkmark \text{ (e)} \quad \frac{(0,35 - x)(0,35 - x)}{4} = \frac{(x)(x)}{4} \quad \checkmark \text{ (f)}$$

$$x = 0,117 \text{ mol·dm}^{-3}$$

$$n(\text{CO})_{\text{eq}} = cV = (0,117)(2) \quad \checkmark \text{ (g)} = 0,233 \text{ mol}$$

$$n(\text{CO}) = \frac{m}{M} \quad \checkmark \text{ (h)} \quad 0,233 = \frac{m}{28}$$

$$m(\text{CO})_{\text{eq}} = 6,53 \text{ g} \quad \checkmark \text{ (i)}$$

(9)
[20]

QUESTION 7/VRAAG 7

- 7.1 Weak bases dissociate/ionise incompletely/partially in water ✓ to form a low concentration of hydroxide/ OH^- ions ✓
Swak basisse dissosieer/ioniseer onvolledig/gedeeltelik in water om 'n lae konsentrasie hidroksied/ OH^- -ione te vorm. (2)
- 7.2 $\text{HCO}_3^-(\text{aq})$ ✓ (1)
- 7.3
- 7.3.1 26,55 (cm^3) ✓ (1)
- 7.3.2 28,15 (cm^3) ✓ (1)
- 7.4
- The titration's equivalence point/colour change is in pH range less than 7./ Solution is acidic/ The reaction of strong acid and weak base has equivalence point at pH less than 7. ✓
Die titrasie se ekwivalente punte/kleurverandering is in pH gebied minder as 7./ Oplossing is suur/ Die reaksie van 'n sterk suur met 'n swak basis het 'n ekwivalente punt laer as pH 7.
 - The end point of this titration is within the pH range in which methyl orange/indicator changes colour./Methyl orange changes colour at a pH less than 7. ✓
Die endpoint van hierdie titrasie is binne die pH-gebied waarin metieloranje/indicator kleur verander./ Metieloranje verander van kleur by 'n pH minder as 7. (2)

7.5

<p>Marking criteria</p> <p>(a) Any formula: $\frac{V_a \times c_a}{V_b \times c_b} = \frac{n_a}{n_b}$ ✓</p> <p>OR $n = cV$ ✓</p> <p>(b) Substitute: $0,1 \text{ mol} \cdot \text{dm}^{-3}$ & $25 \times 10^{-3} \text{ dm}^3$ (25 cm^3) ✓</p> <p>(c) Substitute average volume $20,1 \times 10^{-3} \text{ dm}^3$ ($20,1 \text{ cm}^3$) ✓</p> <p>(d) Use ratio: $n(\text{K}_2\text{CO}_3) = \frac{1}{2}n(\text{HCl})$ ✓</p> <p>(e) Final answer: $0,0625 \text{ mol} \cdot \text{dm}^{-3}$ ✓ Range: $0,06$ to $0,0625 \text{ mol} \cdot \text{dm}^{-3}$</p> <p>Note: If $20,05$ or $20,15$ is used: deduct 1 mark</p>	<p>Nasienkriteria:</p> <p>(a) Enige formule: $\frac{V_a \times c_a}{V_b \times c_b} = \frac{n_a}{n_b}$ ✓</p> <p>OF $n = cV$ ✓</p> <p>(b) Vervang: $0,1 \text{ mol} \cdot \text{dm}^{-3}$ & $25 \times 10^{-3} \text{ dm}^3$ (25 cm^3) ✓</p> <p>(c) Vervang gemiddelde volume $20,1 \times 10^{-3} \text{ dm}^3$ ($20,1 \text{ cm}^3$) ✓</p> <p>(d) Gebruik verhouding: $n(\text{K}_2\text{CO}_3) = \frac{1}{2}n(\text{HCl})$ ✓</p> <p>(e) Finale antwoord: $0,0625 \text{ mol} \cdot \text{dm}^{-3}$ ✓ Gebied: $0,06$ tot $0,0625 \text{ mol} \cdot \text{dm}^{-3}$</p> <p>Aantekening: Indien $20,05$ of $20,15$ gebruik word: trek een punt af</p>
<p>OPTION 1/OPSIE 1:</p> $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \quad \checkmark \text{ (a)}$ $\checkmark \text{ (b)} \quad \frac{0,1 \times 25}{c_b \times 20,1} = \frac{2}{1} \quad \checkmark \text{ (d)}$ $\checkmark \text{ (c)}$ $[\text{K}_2\text{CO}_3] = 0,0622 \text{ mol} \cdot \text{dm}^{-3} \text{ (0,06)} \quad \checkmark \text{ (e)}$	<p>OPTION 2/OPSIE 2:</p> $n(\text{HCl}) = cV \quad \checkmark \text{ (a)}$ $= (0,1)(25 \times 10^{-3}) \quad \checkmark \text{ (b)}$ $= 2,5 \times 10^{-3} \text{ mol}$ $n(\text{K}_2\text{CO}_3) = \frac{1}{2} n(\text{HCl}) \quad \checkmark \text{ (d)}$ $= \frac{2,5 \times 10^{-3}}{2}$ $= 1,25 \times 10^{-3} \text{ mol}$ $n(\text{K}_2\text{CO}_3) = cV$ $1,25 \times 10^{-3} = c(20,1 \times 10^{-3}) \quad \checkmark \text{ (c)}$ $c(\text{K}_2\text{CO}_3) = 0,0622 \text{ mol} \cdot \text{dm}^{-3} \text{ (0,06)} \quad \checkmark \text{ (e)} \quad (5)$

7.6

POSITIVE MARKING FROM QUESTION 7.5/
POSITIEWE NASIEN VANAF VRAAG 7.5

<u>Marking criteria</u>	<u>Nasienkriteria:</u>
(a) Any formula: $n = \frac{m}{M}$ OR $c = \frac{m}{MV}$ OR $n = cV$ ✓	(a) Enige formule: $n = \frac{m}{M}$ OF $c = \frac{m}{MV}$ OF $n = cV$ ✓
(b) Substitute: 600 cm^3 OR $0,6 \text{ dm}^3$ in $n = cV$ ✓	(b) Vervang: 600 cm^3 OF $0,6 \text{ dm}^3$ in $n = cV$ ✓
(c) Substitute: 6,525 in formula $n = \frac{m}{M}$ OR $c = \frac{m}{MV}$ ✓	(c) Vervang: 6,525 in formule $n = \frac{m}{M}$ OF $c = \frac{m}{MV}$ ✓
(d) Substitute: 138 & 18 in $n = \frac{m}{M}$ ✓	(d) Vervang: 138 & 18 in $n = \frac{m}{M}$ ✓
(e) Final answer: $x = 2$ ✓	(e) Finale antwoord: $x = 2$ ✓
<u>OPTION 1/OPSIE 1:</u> $c = \frac{m}{MV} \quad \checkmark \text{ (a)}$ $0,0622 = \frac{6,525}{M(0,6)} \quad \checkmark \text{ (c)}$ $M = 174,84 \text{ g} \cdot \text{mol}^{-1}$ $\frac{K_2CO_3 \cdot xH_2O}{2(39) + 12 + (3)(16) + x(18)} = 174,84 \quad \checkmark \text{ (d)}$ $x = 2 \quad \checkmark \text{ (e)}$	

<u>OPTION 2/OPSIE 2:</u>	<u>OPTION 3/OPSIE 3:</u>
$n(\text{K}_2\text{CO}_3) \text{ in } 600 \text{ cm}^3 = (0,0622)(0,6) \quad \checkmark \text{ (b)}$ $= 0,0373 \text{ mol}$	$n(\text{HCl}) = cV \quad \checkmark \text{ (a)}$ $= (0,1)(2,5 \times 10^{-2})$ $= 2,5 \times 10^{-3} \text{ mol}$ $n(\text{K}_2\text{CO}_3) = \frac{1}{2} n(\text{HCl})$ $= \frac{2,5 \times 10^{-3}}{2}$ $= 1,25 \times 10^{-3} \text{ mol}$ $n(\text{K}_2\text{CO}_3) \text{ in } 20 \text{ cm}^3 = 1,25 \times 10^{-3} \text{ mol}$ $n(\text{K}_2\text{CO}_3) \text{ in } 600 \text{ cm}^3 \quad \checkmark \text{ (b)}$ $= \frac{(1,250 \times 10^{-2})(600)}{20}$ $= 0,0375 \text{ mol}$
$n(\text{K}_2\text{CO}_3 \cdot x\text{H}_2\text{O}) = \frac{m}{M} \quad \checkmark \text{ (a)}$ $0,0373 = \frac{6,525}{138+18x} \quad \checkmark \text{ (c)}$ $\quad \checkmark \text{ (d)}$ $x = 2 \quad \checkmark \text{ (e)}$	<p style="text-align: center;">OR</p> $n(\text{K}_2\text{CO}_3) = \frac{m}{M}$ $0,0373 = \frac{m}{138}$ $m = 5,147 \text{ g}$ $m(\text{H}_2\text{O}) = 6,525 - 5,147 \quad \checkmark \text{ (c)}$ $= 1,378 \text{ g}$ $n(\text{H}_2\text{O}) = \frac{m}{M}$ $= \frac{1,378}{18}$ $= 0,0766 \text{ mol}$ $n(\text{K}_2\text{CO}_3):n(\text{H}_2\text{O})$ $0,0373 : 0,0766$ $x = 2 \quad \checkmark \text{ (e)}$ <div style="position: absolute; right: 0; top: 50%; transform: translateY(-50%);"> $\checkmark \text{ (d)}$ Both/ Beide </div>

(5)
[17]

QUESTION 8/VRAAG 8

8.1

8.1.1 The oxidation number of H changes from +1 to 0 ✓ **AND** the oxidation number of Mg changes from 0 to +2. ✓

*Die oksidasiegetal van H verander van +1 na 0 **EN** Die oksidasiegetal van Mg verander van 0 na +2.*

OR/OF

$Mg^0 \rightarrow Mg^{2+}$ Oxidation number increases./Oksidasiegetal neem toe.

$H^+ \rightarrow H_2^0$ Oxidation number decreases./Oksidasiegetal neem af.

(2)

8.1.2 H^+/HCl ✓

(1)

8.1.3 Cu/copper is a weaker reducing agent ✓ than hydrogen/ H_2 ✓ (and will not reduce H^+ /hydrogen ion to H_2).

OR

Cu/copper is too weak a reducing agent ✓ to reduce H^+ /hydrogen ion (to H_2). ✓

Cu/koper is 'n swakker reduseermiddel as H_2 (en sal nie H^+ /waterstofione na H_2 te reduseer).

OF

Cu/koper is te 'n swak reduseermiddel om H^+ /waterstofione (na H_2) te reduseer.

(2)

8.1.4 Yes/Ja ✓

NO_3^- /Nitrate ion/Nitric acid is a stronger oxidising agent ✓ than Cu^{2+} /copper (II) ion ✓ (therefore Cu/copper will be oxidised to Cu^{2+} /copper (II) ion).

NO_3^- /Nitrate ion/Salpetersuur is 'n sterker oksideermiddel as Cu^{2+} /koper(II)ioon (daarom sal Cu/koper geoksideer word na Cu^{2+} /koper(II)ion).

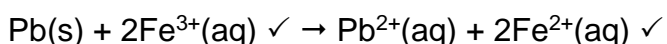
(3)

8.2

8.2.1

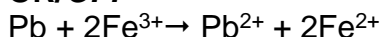
Marking criteria/Nasienkriteria:

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



Bal. ✓

OR/OF:



Bal.

(3)

8.2.2 Increases/Toeneem ✓

(1)

[12]

QUESTION 9/VRAAG 9

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. $E^{\circ}_{\text{cell}} = E^{\circ}_{\text{OA}} - E^{\circ}_{\text{RA}}$ followed by correct substitutions:/Enige ander formule wat onkonvensionele afkortings gebruik, bv. $E^{\circ}_{\text{sel}} = E^{\circ}_{\text{OM}} - E^{\circ}_{\text{RM}}$ gevolg deur korrekte vervangings: $\frac{3}{4}$

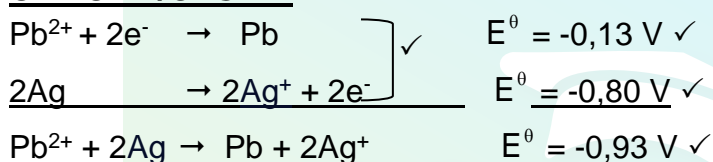
9.1

OPTION 1/OPSIE 1

$$\begin{aligned} E^{\circ}_{\text{cell}} &= E^{\circ}_{\text{reduction}} - E^{\circ}_{\text{oxidation}} \checkmark \\ &= -0,13 \checkmark - (0,80) \checkmark \\ &= -0,93 \text{ V} \checkmark \end{aligned}$$

\therefore non-spontaneous/nie-spontaan \checkmark

OPTION 2/OPSIE 2



\therefore non-spontaneous/nie-spontaan \checkmark

(5)

9.2.1

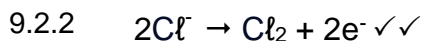
ANY ONE: (2 of 0)

- A substance of which the (aqueous) solution contains ions. $\checkmark\checkmark$
- A substance that dissolves in water to give a solution that conducts electricity.
- A substance that forms ions in water / when melted.
- A solution/substance that conducts electricity through the movement of ions.

ENIGE EEN: (2 of 0)

- 'n Stof waarvan die oplossing in water ione bevat.
- 'n Stof wat in water oplos om 'n oplossing te vorm wat elektrisiteit gelei.
- 'n Stof wat ione in water vorm/ wanneer dit gesmelt word.
- 'n Oplossing/stof wat elektrisiteit gelei deur die beweging van ione.

(2)



Note/Aantekening:

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

(2)

9.2.3 Hydroxide ions/ OH^- /Sodium hydroxide/ NaOH ✓
Hidroksiedione/Natriumhidroksied

Hydrogen/ H_2 ✓
Waterstof

(2)

9.2.4 Water/ H_2O is a stronger oxidising agent ✓ (than Na^+ /sodium ion) and water/ H_2O will be reduced. ✓
Water/ H_2O is 'n sterker oksideermiddel (as Na^+ /natrium-ioon) en water/ H_2O sal gereduseer word.

OR/OF

Na^+ /sodium ion is a weaker oxidising agent than water/ H_2O and water/ H_2O will be reduced.

Na^+ /natrium-ioon is 'n swakker oksideermiddel as water/ H_2O en water/ H_2O sal gereduseer word.

(2)
[13]

TOTAL/TOTAAL: 150