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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.**



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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-dimetielheksaan ✓✓✓ (3)



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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-dimetieipent-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

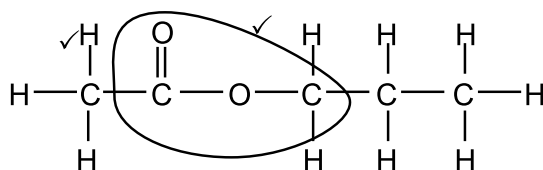
2.4.1 H₂SO₄/Sulphuric acid/Swaelsuur ✓

(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. ✓

Nasiënriteria:

- 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.

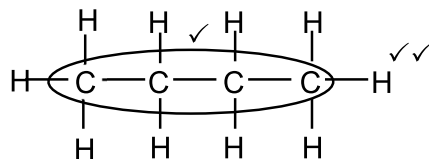
Accept/Aanvaar:

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:

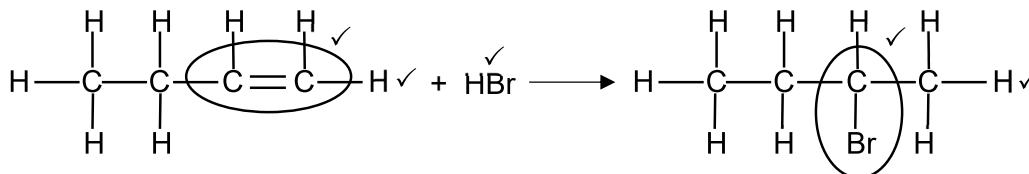
- *Funksionele groep van alkeen op die eerste C-atoom.* ✓
- *Hele struktuurformule van alkeen korrek.* ✓
- *HBr.* ✓
- *Funksionele groep van haloalkaan korrek.* ✓
- *Hele struktuurformule van haloalkaan korrek (haloogen op die tweede/eerste C-atoom).* ✓

IF/INDIEN

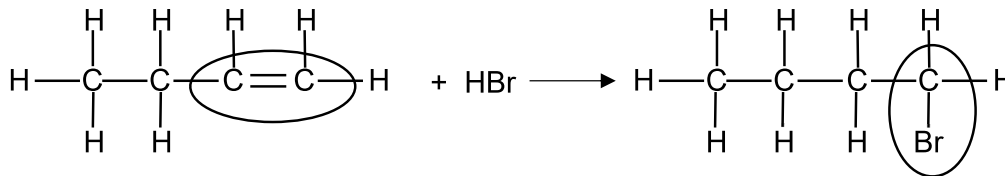
- Condensed, semi structural or molecular formula
Gekondenseerde, semi-struktuurformule of molekulêre formule: Max/Mak: 1/5
- Marking rule 6.3.10/Nasienreël 6.3.10

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 ✓

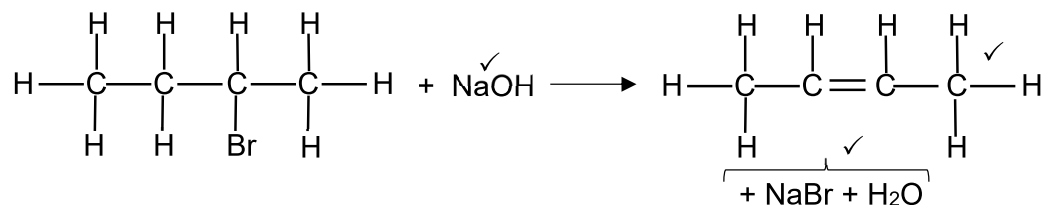
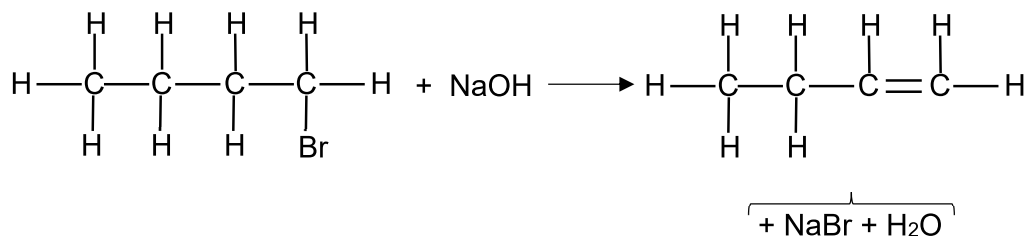
IF/INDIEN

- 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.

**OR**

(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 55.1
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

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

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

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

$$n(\text{H}_2) = \frac{V}{V_m}$$

$$= \frac{0,165}{24,5} \quad \checkmark \text{ (b)}$$

$$= 6,74 \times 10^{-3} \text{ mol (0,0067)}$$

$$n(\text{Al}) = \frac{2}{3} n(\text{H}_2)$$

$$= \frac{2}{3} (6,74 \times 10^{-3}) \quad \checkmark \text{ (c)}$$

$$= 4,49 \times 10^{-3} \text{ mol (0,00449)}$$

OPTION 1/OPSIE 1:

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

$$4,49 \times 10^{-3} = \frac{m(\text{Al})}{27} \quad \checkmark \text{ (d)}$$

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

$$\Delta m(\text{Al}) = 0,5 - 0,12 \quad \checkmark \text{ (e)}$$

$$= 0,38 \text{ g} \quad \checkmark \text{ (f)}$$

OPTION 2/OPSIE 2:

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

$$= \frac{0,5}{27}$$

$$= 0,0185 \text{ mol}$$

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

$$= 0,014 \text{ mol}$$

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

$$0,014 = \frac{m(\text{Al})}{27} \quad \checkmark \text{ (d)}$$

$$m(\text{Al}) = 0,38 \text{ g} \quad \checkmark \text{ (f)}$$

(6)



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- 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)

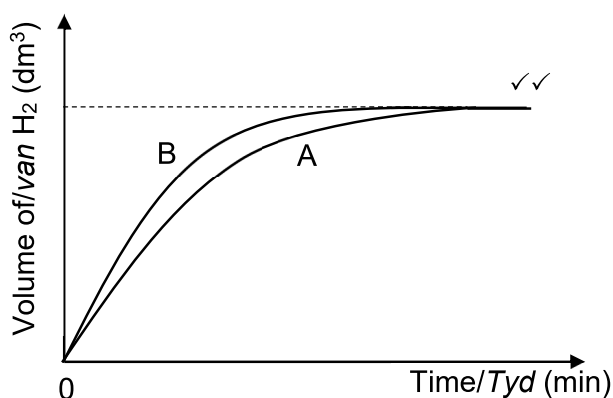
5.1.4

Marking criteria:

- Curve B starts at the origin and ends at the same point as curve A. ✓
- Gradient of curve B steeper for the whole duration. ✓

Note:Graph not labelled: Max. $\frac{1}{2}$ **Nasienkriteria:**

- *Kurwe B begin by oorsprong en eindig by dieselfde punt as kurwe A.* ✓
- *Gradiënt van kurwe B steiler vir die volle duur.* ✓

Aantekening:*Grafiek nie benoem nie: Maks. $\frac{1}{2}$* 

(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 hoër 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)

(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)

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

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

$x = 0,37$

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

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



(x equilibrium amount/ ewewigshoeveelheid.)	CO	H ₂ O	CO ₂	H ₂	✓ (a)
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)	$\frac{x}{2}$	$\frac{x}{2}$	$\frac{0,7 - x}{2}$	$\frac{0,7 - x}{2}$	

✓ (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

Nasiennkriteria:

- (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/ 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)	x	x	x	x	✓ (a)
Equilibrium concentration (mol·dm ⁻³) Ewewigkonsentrasie (mol·dm ⁻³)	0,3 - x	0,3 - x	0,05 + x	0,05 + x	✓ (c)

$K_c = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]}$ ✓ (d)
 ✓ (e) $4 = \frac{(0,05 + x)(0,05 + x)}{(0,3 - x)(0,3 - x)}$ ✓ (f)
 $x = 0,18 \text{ (0,183)}$
 $[\text{CO}] = 0,3 - 0,18$ ✓ (g)
 $= 0,12 \text{ mol·dm}^{-3}$
 $n(\text{CO})_{\text{eq}} = cV$
 $= (0,12)(2)$
 $= 0,24 \text{ mol}$

$n(\text{CO}) = \frac{m}{M}$
 $0,24 = \frac{m}{28}$ ✓ (h)
 $m(\text{CO})_{\text{eqm}} = 6,72 \text{ g}$ ✓ (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)	-x + 0,3	-x + 0,3	-x + 0,3	-x + 0,3	✓ (a)
Equilibrium concentration (mol·dm ⁻³) Ewewigkonsentrasie (mol·dm ⁻³)	x	x	0,35 - x	0,35 - x	✓ (c)

$K_c = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]}$ ✓ (d)
 ✓ (e) $4 = \frac{(0,35 - x)(0,35 - x)}{(x)(x)}$ ✓ (f)
 $x = 0,12 \text{ mol·dm}^{-3}$
 $n(\text{CO})_{\text{eq}} = cV$
 $= (0,12)(2)$ ✓ (g)
 $= 0,24 \text{ mol}$

$n(\text{CO}) = \frac{m}{M}$
 $0,24 = \frac{m}{28}$ ✓ (h)
 $m(\text{CO})_{\text{eqm}} = 6,72 \text{ g}$ ✓ (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) GBRUIK 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) <i>Aanvanklike hoeveelheid (mol)</i>	0,6	0,6	0,1	0,1 ✓ (a)
Change in amount (moles) <i>Verandering in hoeveelheid (mol)</i>	x	x	x	x
Equilibrium amount (moles) <i>Ewewigshoeveelheid (mol)</i> ✓ (b)	0,6 + x	0,6 + x	0,1 - x	0,1 - x
Equilibrium concentration (mol·dm ⁻³) <i>Ewewigskonsentrasie (mol·dm⁻³)</i>	$\frac{0,6 + x}{2}$	$\frac{0,6 + x}{2}$	$\frac{0,1 - x}{2}$	$\frac{0,1 - x}{2}$

✓ (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) <i>Aanvanklike hoeveelheid (mol)</i>	0,6	0,6	0,1	0,1
Change in amount (moles) <i>Verandering in hoeveelheid (mol)</i>	-0,6 + x	-0,6 + x	-0,6 + x	-0,6 + x
Equilibrium amount (moles) <i>Ewewigshoeveelheid (mol)</i> ✓ (b)	x	x	0,7 - x	0,7 - x
Equilibrium concentration (mol·dm ⁻³) <i>Ewewigskonsentrasie (mol·dm⁻³)</i>	$\frac{x}{2}$	$\frac{x}{2}$	$\frac{0,7 - x}{2}$	$\frac{0,7 - x}{2}$

✓ (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 dm³) ✓
 (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 g. ✓
 Range: 6,44 – 6,72 g

Nasiennkriteria:

- (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 dm³) ✓
 (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 g. ✓
 Gebied: 6,44 – 6,72 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) Ewewigskonsentrasie (mol·dm ⁻³)	0,3 + x	0,3 + x	0,05 - x	0,05 - x ✓ (c)

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

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

$$x = -0,18 \quad (0,183)$$

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

$$= 0,12 \text{ mol·dm}^{-3}$$

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

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

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

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

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

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

(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)

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

$$\checkmark \text{ (e)} \quad \frac{(0,35 - x)(0,35 - x)}{4} = \frac{(x)(x)}{1} \quad \checkmark \text{ (f)}$$

$$x = 0,117 \text{ mol} \cdot \text{dm}^{-3}$$

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

$$= (0,117)(2) \quad \checkmark \text{ (g)}$$

$$= 0,233 \text{ mol}$$

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

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

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

(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

Marking criteria (a) Any formula: $\frac{V_a \times c_a}{V_b \times c_b} = \frac{n_a}{n_b}$ OR $n = cV$ ✓ (b) Substitute: $0,1 \text{ mol} \cdot \text{dm}^{-3}$ & $25 \times 10^{-3} \text{ dm}^3$ (25 cm^3) ✓ (c) Substitute average volume $20,1 \times 10^{-3} \text{ dm}^3$ ($20,1 \text{ cm}^3$) ✓ (d) Use ratio: $n(\text{K}_2\text{CO}_3) = \frac{1}{2}n(\text{HCl})$ ✓ (e) Final answer: $0,0625 \text{ mol} \cdot \text{dm}^{-3}$ ✓ Range: $0,06$ to $0,0625 \text{ mol} \cdot \text{dm}^{-3}$ Note: If $20,05$ or $20,15$ is used: deduct 1 mark	Nasienkriteria: (a) Enige formule: $\frac{V_a \times c_a}{V_b \times c_b} = \frac{n_a}{n_b}$ OF $n = cV$ ✓ (b) Vervang: $0,1 \text{ mol} \cdot \text{dm}^{-3}$ & $25 \times 10^{-3} \text{ dm}^3$ (25 cm^3) ✓ (c) Vervang gemiddelde volume $20,1 \times 10^{-3} \text{ dm}^3$ ($20,1 \text{ cm}^3$) ✓ (d) Gebruik verhouding: $n(\text{K}_2\text{CO}_3) = \frac{1}{2}n(\text{HCl})$ ✓ (e) Finale antwoord: $0,0625 \text{ mol} \cdot \text{dm}^{-3}$ ✓ Gebied: $0,06$ tot $0,0625 \text{ mol} \cdot \text{dm}^{-3}$ Aantekening: Indien $20,05$ of $20,15$ gebruik word: trek een punt af
OPTION 1/OPSIE 1: $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \quad \checkmark \text{ (a)}$ $\checkmark \text{ (b)} \quad \frac{0,1 \times 25}{c_b \times 20,1} = \frac{2}{1} \quad \checkmark \text{ (d)}$ $\checkmark \text{ (c)}$ $[\text{K}_2\text{CO}_3] = 0,0622 \text{ mol} \cdot \text{dm}^{-3}$ ($0,06$) ✓ (e)	OPTION 2/OPSIE 2: $n(\text{HCl}) = cV \quad \checkmark \text{ (a)}$ $= (0,1)(25 \times 10^{-3}) \quad \checkmark \text{ (b)}$ $= 2,5 \times 10^{-3} \text{ mol}$ $n(\text{K}_2\text{CO}_3) = \frac{1}{2} n(\text{HCl}) \quad \checkmark \text{ (d)}$ $= \frac{2,5 \times 10^{-3}}{2}$ $= 1,25 \times 10^{-3} \text{ mol}$ $n(\text{K}_2\text{CO}_3) = cV$ $1,25 \times 10^{-3} = c(20,1 \times 10^{-3}) \quad \checkmark \text{ (c)}$ $c(\text{K}_2\text{CO}_3) = 0,0622 \text{ mol} \cdot \text{dm}^{-3}$ ($0,06$) ✓ (e) (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> $c = \frac{m}{MV} \quad \checkmark \text{ (a)}$ $0,0622 = \frac{6,525}{M(0,6)} \quad \checkmark \text{ (c)}$ $M = 174,84 \text{ g} \cdot \text{mol}^{-1}$ $\text{K}_2\text{CO}_3 \cdot x\text{H}_2\text{O} = 174,84$ $\boxed{2(39) + 12 + (3)(16) + x(18)} \quad \checkmark \text{ (d)} = 174,84$ $x = 2 \quad \checkmark \text{ (e)}$	



OPTION 2/OPSIE 2: $n(\text{K}_2\text{CO}_3) \text{ in } 600 \text{ cm}^3 = (0,0622)(0,6) \quad \checkmark \text{ (b)}$ $= 0,0373 \text{ mol}$	OPTION 3/OPSIE 3: $n(\text{HCl}) = cV \quad \checkmark \text{ (a)}$ $= (0,1)(2,5 \times 10^{-2})$ $= 2,5 \times 10^{-3} \text{ mol}$ $n(\text{K}_2\text{CO}_3) = \frac{1}{2} n(\text{HCl})$ $= \frac{2,5 \times 10^{-3}}{2}$ $= 1,25 \times 10^{-3} \text{ mol}$ $n(\text{K}_2\text{CO}_3) \text{ in } 20 \text{ cm}^3 = 1,25 \times 10^{-3} \text{ mol}$ $n(\text{K}_2\text{CO}_3) \text{ in } 600 \text{ cm}^3 \quad \checkmark \text{ (b)}$ $= \frac{(1,250 \times 10^{-2}) (600)}{20}$ $= 0,0375 \text{ mol}$
$n(\text{K}_2\text{CO}_3 \cdot x\text{H}_2\text{O}) = \frac{m}{M} \quad \checkmark \text{ (a)}$ $0,0373 = \frac{6,525}{138+18x} \quad \checkmark \text{ (c)}$ $x = 2 \quad \checkmark \text{ (e)}$	OR $n(\text{K}_2\text{CO}_3) = \frac{m}{M}$ $0,0373 = \frac{m}{138}$ $m = 5,147 \text{ g}$ $m(\text{H}_2\text{O}) = 6,525 - 5,147 \quad \checkmark \text{ (c)}$ $= 1,378 \text{ g}$ $n(\text{H}_2\text{O}) = \frac{m}{M}$ $= \frac{1,378}{18}$ $= 0,0766 \text{ mol}$ $n(\text{K}_2\text{CO}_3):n(\text{H}_2\text{O})$ $0,0373 : 0,0766$ $x = 2 \quad \checkmark \text{ (e)}$ $\checkmark \text{ (d)}$ Both/ Beide

(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

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

$\text{H}^+ \rightarrow \text{H}_2^0$ 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 ioon/Salpetersuur is 'n sterker oksideermiddel as Cu^{2+} /koper(II)ioon (daarom sal Cu/koper geoksideer word na Cu^{2+} /koper(II)ion).

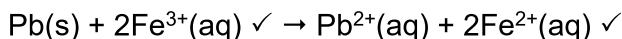
(3)

8.2

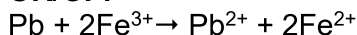
Marking criteria/Nasienkriteria:

8.2.1

- | | | |
|---|------------|---------------|
| • Reactants ✓ | Products ✓ | Balancing ✓ |
| • Reaktanse ✓ | Produkke ✓ | Balansering ✓ |
| • Ignore/Ignoreer ⇌ 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]

SA EXAM PAPERS

QUESTION 9/VRAAG 9

9.1

Notes/Aantekeninge

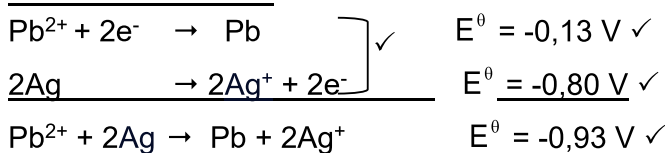
- Accept any other correct formula from the data sheet./Aanvaar enige ander korrekte formule vanaf gegewensblad.
- Any other formula using unconventional abbreviations, e.g. $E^\circ_{\text{cell}} = E^\circ_{\text{OA}} - E^\circ_{\text{RA}}$ followed by correct substitutions:/Enige ander formule wat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

OPTION 1/OPSIE 1

$$E^\circ_{\text{cell}} = E^\circ_{\text{reduction}} - E^\circ_{\text{oxidation}} \checkmark$$

$$= -0,13 \checkmark - (0,80) \checkmark$$

$$= -0,93 \text{ V} \checkmark$$

 $\therefore$ non-spontaneous/nie-spontaan $\checkmark$ **OPTION 2/OPSIE 2** $\therefore$ non-spontaneous/nie-spontaan $\checkmark$

(5)

9.2.1

ANY ONE: (2 or 0)

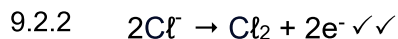
- A substance of which the (aqueous) solution contains ions. $\checkmark\checkmark$
- A substance that dissolves in water to give a solution that conducts electricity.
- A substance that forms ions in water / when melted.
- A solution/substance that conducts electricity through the movement of ions.

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**