basic education

Department:
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REPUBLIC OF SOUTH AFRICA

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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 substituente (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)

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)

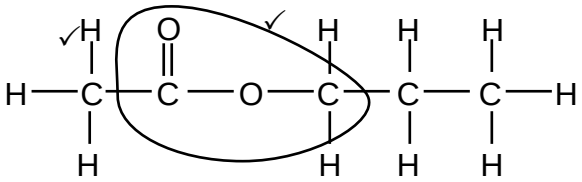
2.3.2 A and/*en* C ✓ (1)

2.4

2.4.1 H_2SO_4/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:	***Nasienkriteria:***
• Correct chain length and functional group, i.e Propanol. ✓ • Everything else correct: IUPAC name completely correct including numbering. ✓	• *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/A*anvaar*:
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/A*anvaar*:
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/pentaan en B/2-metielbutaan
- ***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 vebindings 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/A*anvaar*:
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-dipookragtel (en London-kragte) tussen die molekules.*
- *Intermolekulere 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

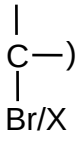
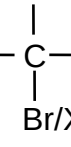
Marking criteria/*Nasienkriteria*
If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./*Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*
The underlined phrases must be in the correct context./*Die onderstreepte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

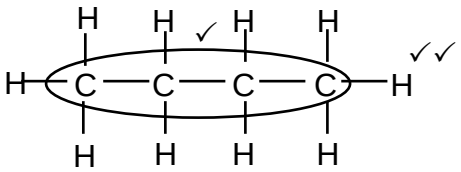
4.2 Primary/*Primêre* ✓

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 premêre C-atoom.

OR/*OF*
The functional group () is bonded to one other C atom.
Die funksionele groep () is gebind aan een ander C-atoom.

Accept/A*anvaar*:
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/Dehidrobrominering (1)

4.6

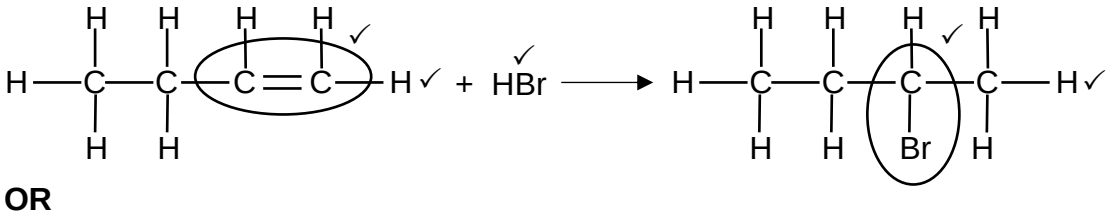
4.6.1

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). ✓

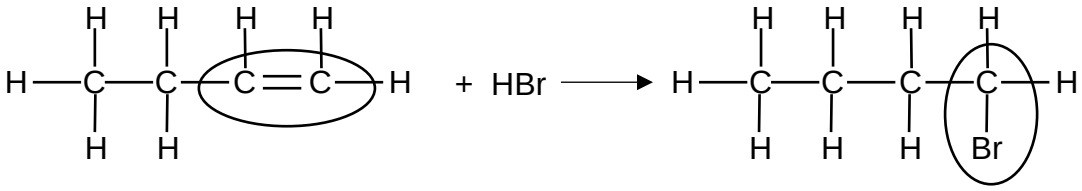
Nasienkriteria:
- *Funksionele groep van alkeen op die eerste C-atoom.* ✓
- *Hele struktuurformule van alkeen korrek.* ✓
- *HBr.* ✓
- *Funksionele groep van haloalkaan korrek.* ✓
- *Hele struktuurformule van haloalkaan korrek (halogeen op die tweede/eerste C-atoom).* ✓

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)

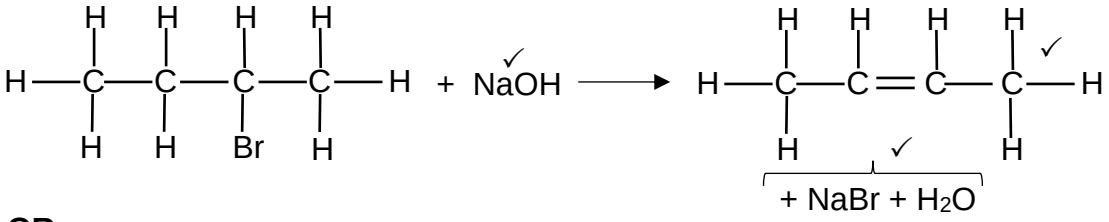
4.6.2

Marking criteria*:*
- NaOH. ✓
- Whole structural formula of alkene correct (functional group on second/ first C atom). ✓
- NaBr + H_2O ✓

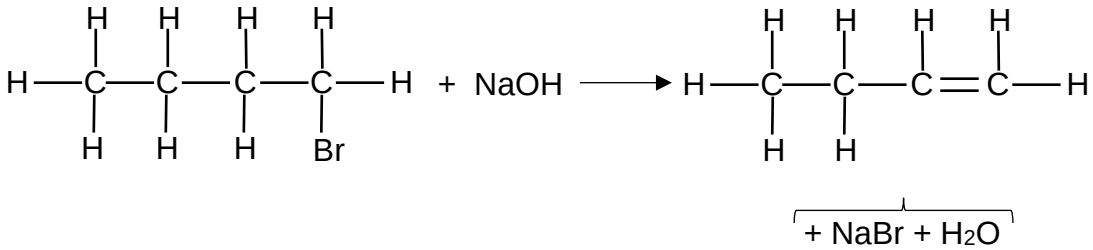
Nasienkriteria:
- *NaOH.* ✓
- *Hele struktuurformule van van alkeen korrek (funksionele groep op de tweede/ eerste C-atoom).* ✓
- *NaBr + H_2O* ✓

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 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	***Nasienkriteria:***
(a) Substitute 0,033 and 5 in rate formula. ✓ (b) Substitute 24,5 in $\frac{V}{V_m}$ ✓ (c) USE mol ratio: $n(A\ell) : n(H_2) = 2 : 3$ ✓ (d) Substitute 27 g·mol^{-1} in $\frac{m}{M}$ ✓ (e) Subtract $m(A\ell)_{t=5}$ from $m(A\ell)_{ini}$ / $n(A\ell)_{t=5}$ from $n(A\ell)_{ini}$ ✓ (f) Final correct answer: 0,38 g ✓ (0,379) Range: 0,365 – 0,42 g	(a) *Vervang* 0,033 en 5 in tempoformule ✓ (b) Vervang 24,5 in $\frac{V}{V_m}$ ✓ (c) *GEBRUIK molverhouding:* $n(A\ell) : n(H_2) = 2 : 3$ ✓ (d) *Vervang* 27 g in $\frac{m}{M}$ ✓ (e) *Trek* $m(A\ell)_{t=5}$ *van* $m(A\ell)_{begin}$ / $n(A\ell)_{t=5}$ *van* $n(A\ell)_{begin}$ ✓ (f) *Finale korrekte antwoord: 0,38 g* (0,379 g) ✓ *Gebied:* 0,365 – 0,42 g

$$\text{Rate/T}empo = \frac{\Delta V(H_2)}{\Delta t}$$

$$0{,}033 = \frac{\Delta V(H_2)}{5} \checkmark\textbf{(a)}$$

$$V(H_2) = 0{,}165\ dm^3$$

$$n(H_2) = \frac{V}{V_m}$$

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

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

$$n(A\ell) = \frac{2}{3} n(H_2)$$

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

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

OPTION 1/*OPSIE 1*:

$$n(A\ell) = \frac{m}{M}$$

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

$$m(A\ell) = 0{,}12\ g\ (0{,}121)$$

$$\Delta m(A\ell) = 0{,}5 - 0{,}12 \checkmark\textbf{(e)}$$

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

OPTION 2/*OPSIE 2*:

$$n(A\ell) = \frac{m}{M}$$

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

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

$$\Delta n(A\ell) = 0{,}0185 - 4{,}49 \times 10^{-3} \checkmark\textbf{(e)}$$

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

$$n(A\ell) = \frac{m}{M}$$

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

$$m(A\ell) = 0{,}38\ g \checkmark\textbf{(f)}$$

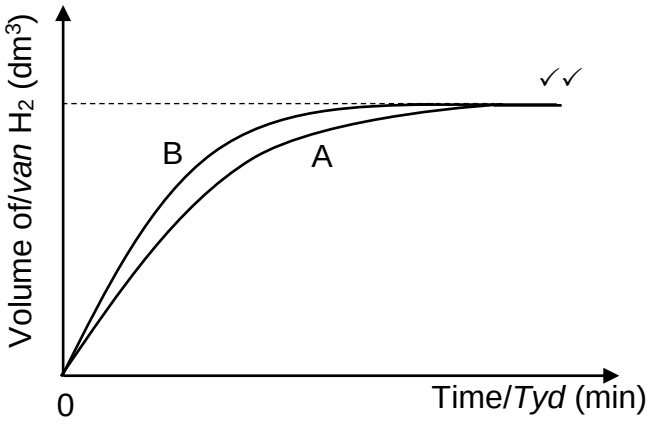
(6)

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

Marking criteria:	***Nasienkriteria:***
• 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. $^1/_2$	• *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.* $^1/_2$



(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 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
6.1.1 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 kosentrasies 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 (O_2). ✓
OR
The concentration of Z (CO) increased with an increase in the concentration of X (O_2).
OR
Z (CO) behaves like X (O_2)/Follows the same trend as X (O_2).
OR
Z (CO) and X(O_2) are both reactants/ Y(CO_2) 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 (O_2).
OF
Die konsentrasie van Z (CO) *neem toe met 'n toename in die konsentrasie van* X (O_2).
OF
Z (CO) tree dieselfde op as X (O_2)/volg dieselfde neiging as X (O_2).
OF
Z(CO) en X(O_2) is beide reaktanse/ Y(CO_2) 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/CO_2 increases. ✓

OR

Concentration of reactant/Z/X/CO/O_2 decreases.

OR

The forward reaction is favoured.

- The forward reaction is exothermic. ✓
- A decrease in temperature favours the exothermic reaction. ✓

- *Konsentrasie van produkte/Y/CO_2 neem toe.* ✓

OF

Konsentrasie van reaktanse/Z/X/CO/O_2 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: $n(H_2O) : n(CO) : n(H_2) : n(CO_2) = 1 : 1 : 1 : 1$ ✓
(b) $n(CO)_{eq} = n(CO)_{initial} - \Delta n(CO)$, $n(H_2O)_{eqm} = n(H_2O)_{initial} - \Delta n(H_2O)$, $n(CO_2)_{eq} = n(CO_2)_{initial} + \Delta n(CO_2)$ AND $n(H_2)_{eqm} = n(H_2)_{initial} + \Delta n(H_2)$ ✓
(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 values of x in $n(CO)_{initial} - \Delta n(CO)_{change}$ ✓
(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: $n(H_2O) : n(CO) : n(H_2) : n(CO_2) = 1 : 1 : 1 : 1$* ✓
(b) $n(CO)_{ewe} = n(CO)_{begin} - \Delta n(CO)$, $n(H_2O)_{ewe} = n(H_2O)_{begin} - \Delta n(H_2O)$, $n(CO_2)_{ewe} = n(CO_2)_{begin} + \Delta n(CO_2)$ EN $n(H_2)_{ewe} = n(H_2)_{begin} + \Delta n(H_2)$ ✓
(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 $n(CO)_{begin} - \Delta n(CO)$ ✓
(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_2O	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 ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*	$\frac{0,6 - x}{2}$	$\frac{0,6 - x}{2}$	$\frac{0,1 + x}{2}$	$\frac{0,1 + x}{2}$

✓ **(c)**

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

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

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. $^6/_9$

x = 0,37

$n(CO)_{eq} = 0,6 - 0,37$ ✓ **(g)**

$= 0,23$ mol

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

$$0,23 = \frac{m}{28}$$ ✓ **(h)**

$m(CO)_{eq} = 6,44$ g ✓ **(i)**

$$[CO]_{eq} = \frac{0,6 - x}{2}$$

$$= \frac{0,6 - 0,37}{2}$$ ✓ **(g)**

$= 0,115 \ mol \cdot dm^{-3}$

$n = cV$

$= (0,115)(2)$

$= 0,23$ mol

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

$$0,23 = \frac{m}{28}$$ ✓ **(h)**

$m(CO)_{eq} = 6,44$ g ✓ **(i)**

(x equilibrium amount/ *ewewigshoeveelheid.)*	CO	H_2O	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 ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie (mol·dm^{-3})*	$\frac{x}{2}$	$\frac{x}{2}$	$\frac{07 - x}{2}$	$\frac{0,7 - x}{2}$

✓ **(a)**

✓ **(c)**

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

4 ✓ **(e)** $= \frac{\left(\frac{0,7 - x}{2}\right)\left(\frac{0,7 - x}{2}\right)}{\left(\frac{x}{2}\right)\left(\frac{x}{2}\right)}$ ✓ **(f)**

$x = 0,23$

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

✓ **(g)** $0,23 = \frac{m}{28}$ ✓ **(h)**

$m(CO)_{eq} = 6,44$ g ✓ **(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 g. ✓
Range: 6,44 – 6,72 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 $[CO_2]_{eq} = [CO_2]_{begin} + \Delta[CO_2]$ and $[H_2]_{ewe} = [H_2]_{initial} + \Delta[H_2]$* ✓
(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 concentration/ *ewewigskonsentrasie.)*	CO	H_2O	H_2	CO_2
Initial concentration ($mol \cdot dm^{-3}$) Aanvanklike konsentrasie ($mol \cdot dm^{-3}$)	0,3	0,3	0,05	0,05 ✓ **(b)**
Change ($mol \cdot dm^{-3}$) *Verandering ($mol \cdot dm^{-3}$)*	x	x	x	x ✓ **(a)**
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)	0,3 - x	0,3 - x	0,05 + x	0,05 + x ✓ **(c)**

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

✓ **(e)**

$$4 = \frac{(0,05 + x)(0,05 + x)}{(0,3 - x)(0,3 - x)}$$ ✓ **(f)**

$x = 0,18$ (0,183)

$[CO] = 0,3 - 0,18$ ✓ **(g)**

$= 0,12\ mol \cdot dm^{-3}$

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

$= (0,12)(2)$

$= 0,24\ mol$

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

$$0,24 = \frac{m}{28}$$ ✓ **(h)**

$m(CO)_{eqm} = 6,72\ g$ ✓ **(i)**

(x equilibrium concentration/ ewewigkonsentrasie*)*	CO	H_2O	H_2	CO_2
Initial concentration ($mol \cdot dm^{-3}$) Aanvanklike konsentrasie ($mol \cdot dm^{-3}$)	0,3	0,3	0,05	0,05 ✓ **(b)**
Change ($mol \cdot dm^{-3}$) *Verandering ($mol \cdot dm^{-3}$)*	-x + 0,3	-x + 0,3	-x + 0,3	-x + 0,3 ✓ **(a)**
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)	x	x	0,35 - x	0,35 - x ✓ **(c)**

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

✓ **(e)**

$$4 = \frac{(0,35 - x)(0,35 - x)}{(x)(x)}$$ ✓ **(f)**

$x = 0,12\ mol \cdot dm^{-3}$

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

$= (0,12)(2)$ ✓ **(g)**

$= 0,24\ mol$

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

$$0,24 = \frac{m}{28}$$ ✓ **(h)**

$m(CO)_{eqm} = 6,72\ g$ ✓ **(i)**

PRODUCTS ARE USED/*PRODUKTE WORD GEBRUIK*

CALCULATIONS USING MOLES
BEREKENINGE WAT GETAL MOL GEBRUIK
Marking criteria:

(a) USING ratio: $n(H_2O) : n(CO) : n(H_2) : n(CO_2) = 1 : 1 : 1 : 1$ ✓
(b) $n(CO)_{eq} = n(CO)_{initial} + \Delta n(CO)$, $n(H_2O)_{eqm} = n(H_2O)_{initial} + \Delta n(H_2O)$, $n(CO_2)_{eq} = n(CO_2)_{initial} - \Delta n(CO_2)$ AND $n(H_2)_{eqm} = n(H_2)_{initial} - \Delta n(H_2)$ ✓
(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 $n(CO)_{initial} + \Delta n(CO)_{change}$ ✓
(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: $n(H_2O) : n(CO) : n(H_2) : n(CO_2) = 1 : 1 : 1 : 1$* ✓
(b) $n(CO)_{ewe} = n(CO)_{begin} + \Delta n(CO)$, $n(H_2O)_{ewe} = n(H_2O)_{begin} + \Delta n(H_2O)$, $n(CO_2)_{ewe} = n(CO_2)_{begin} - \Delta n(CO_2)$ EN $n(H_2)_{ewe} = n(H_2)_{begin} - \Delta n(H_2)$ ✓
(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 $n(CO)_{begin} + \Delta n(CO)$ ✓
(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_2O	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 ($mol \cdot dm^{-3}$) *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)**

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

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

$x = - 0,37$

$n(CO)_{eq} = 0,6 + (– 0,37)$ ✓ **(g)**

$= 0,23$ mol

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

$0,23 = \frac{m}{28}$ ✓ **(h)**

$m(CO)_{eq} = 6,44$ g ✓ **(i)**

(x equilibrium amount / *ewewigshoeveelheid.)*	CO	H_2O	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 ✓ **(a)**
Equilibrium amount (moles) *Ewewigshoeveelheid (*mol) ✓ **(b)**	x	x	0,7 - x	0,7 - x
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie (mol·dm^{-3})*	$\frac{x}{2}$	$\frac{x}{2}$	$\frac{0,7 - x}{2}$	$\frac{0,7 - x}{2}$

✓ **(c)**

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

4 ✓ **(e)** $= \frac{\left(\frac{0,7 - x}{2}\right)\left(\frac{0,7 - x}{2}\right)}{\left(\frac{x}{2}\right)\left(\frac{x}{2}\right)}$ ✓ **(f)**

$x = 0,23$

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

✓ **(g)** $0,23 = \frac{m}{28}$ ✓ **(h)**

$m(CO)_{eq} = 6,44$ g ✓ **(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 Kc 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

***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* $[H_2]_{ewe} = [H_2]_{initial} - \Delta[H_2]$ ✓
(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_2O	H_2	CO_2 ✓ **(b)**
Initial concentration ($mol \cdot dm^{-3}$) Aanvanklike konsentrasie ($mol \cdot dm^{-3}$)	0,3	0,3	0,05	0,05 ✓ **(a)**
Change ($mol \cdot dm^{-3}$) *Verandering* ($mol \cdot dm^{-3}$)	X	x	x	x
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)	0,3 + x	0,3 + x	0,05 - x	0,05 - x ✓ **(c)**

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

✓ **(e)**

$$4 = \frac{(0,05 - x)(0,05 - x)}{(0,3 + x)(0,3 + x)}$$ ✓ **(f)**

x = - 0,18 (0,183)

[CO] = 0,3 +(– 0,18) ✓ **(g)**
= 0,12 $mol \cdot dm^{-3}$

$n(CO)_{eq} = cV$
= (0,12)(2)
= 0,24 mol

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

$$0,24 = \frac{m}{28}$$ ✓ **(h)**

$m(CO)_{eq}$ = 6,72 g ✓ **(i)**

(x equilibrium concentration/ ewewigkonsentrasie)	CO	H_2O	H_2	CO_2	
Initial concentration ($mol \cdot dm^{-3}$) Aanvanklike konsentrasie ($mol \cdot dm^{-3}$)	0,3	0,3	0,05	0,05	✓ **(b)**
Change ($mol \cdot dm^{-3}$) *Verandering ($mol \cdot dm^{-3}$)*	-0,3 +x	-0,3 +x	-0,3 +x	-0,3 +x	✓ **(a)**
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)	X	x	0,35 - x	0,35 - x	

✓ **(c)**

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

✓ **(e)**
$$4 = \frac{(0,35 - x)(0,35 - x)}{(x)(x)}$$ ✓ **(f)**

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

$n(CO)_{eq} = cV$
$= (0,117)(2)$ ✓ **(g)**
$= 0,233 \ mol$

$$n(CO) = \frac{m}{M}$$
$$0,233 = \frac{m}{28}$$ ✓ **(h)**

$m(CO)_{eq} = 6,53 \ g$ ✓ **(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 $HCO_3^-(aq)$ ✓ (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 endpunt 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	***Nasienkriteria:***
(a) Any formula: $\frac{V_a \times c_a}{V_b \times c_b} = \frac{n_a}{n_b}$ **OR** n = cV ✓	*(a) Enige formule:* $\frac{V_a \times c_a}{V_b \times c_b} = \frac{n_a}{n_b}$ ***OF*** *n = cV* ✓
(b) Substitute: 0,1 mol·dm^{-3} & 25 x 10^{-3} dm^3 (25 cm^3) ✓	*(b) Vervang:* 0,1 mol·dm^{-3} & 25 x 10^{-3} dm^3 (25 cm^3) ✓
(c) Substitute average volume 20,1 x 10^{-3} dm^3 (20,1 cm^3)✓	*(c) Vervang gemiddelde volume* 20,1 x 10^{-3} dm^3 (20,1 cm^3) ✓
(d) Use ratio: $n(K_2CO_3) = \frac{1}{2}n(HC\ell)$ ✓	*(d) Gebruik verhouding:* $n(K_2CO_3) = \frac{1}{2}n(HC\ell)$ ✓
(e) Final answer: 0,0625 mol·dm^{-3} ✓	*(e) Finale antwoord:* 0,0625 mol·dm^{-3} ✓
Range: 0,06 to 0,0625 mol·dm^{-3}	*Gebied: 0,06 tot 0,0625 mol·dm^{-3}*
Note: If 20,05 or 20,15 is used: deduct 1 mark	***Aantekening:*** *Indien 20,05 of 20,15 gebruik word: trek een punt af*

OPTION 1/*OPSIE 1*:

$$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \quad ✓ \textbf{(a)}$$

✓ **(b)** $\frac{\boxed{0,1 \times 25}}{c_b \times \boxed{20,1}} = \frac{2}{1}$ ✓ **(d)** ✓ **(c)**

$[K_2CO_3]$ = 0,0622 mol·dm^{-3} (0,06) ✓ **(e)**

OPTION 2/*OPSIE 2*:

$n(HC\ell) = cV$ ✓ **(a)**

$= \boxed{(0,1)(25 \times 10^{-3})}$ ✓ **(b)**

$= 2,5 \times 10^{-3}$ mol

$n(K_2CO_3) = \frac{1}{2} n(HC\ell)$ ✓ **(d)**

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

$= 1,25 \times 10^{-3}$ mol

$n(K_2CO_3) = cV$

$1,25 \times 10^{-3} = c\boxed{(20,1 \times 10^{-3})}$ ✓ **(c)**

c (K_2CO_3) = 0,0622 mol·dm^{-3} (0,06) ✓ **(e)** (5)

7.6 **POSITIVE MARKING FROM QUESTION 7.5/**
POSITIEWE NASIEN VANAF VRAAG 7.5

Marking criteria	***Nasienkriteria:***
(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 dm^3 in $n = cV$ ✓	*(b) Vervang: 600* cm^3 ***OF*** *0,6* 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* ✓

OPTION 1/*OPSIE 1*:

$$c = \frac{m}{MV} \quad \checkmark \textbf{(a)}$$

$$0{,}0622 = \frac{6{,}525}{M(0{,}6)} \quad \checkmark \textbf{(c)} \checkmark \textbf{(b)}$$

$$M = 174{,}84 \text{ g·mol}^{-1}$$

$K_2CO_3 \cdot xH_2O = 174{,}84$

$2(39) + 12 + (3)(16) + x(18)$ ✓ **(d)** $= 174{,}84$

$x = 2$ ✓ **(e)**

OPTION 2/*OPSIE 2:*

$n(K_2CO_3)$ in 600 cm^3 = (0,0622)(0,6) ✓ **(b)**
= 0,0373 mol

$n(K_2CO_3 \cdot xH_2O) = \frac{m}{M}$ ✓ **(a)**

$0,0373 = \frac{6,525}{138+18x}$ ✓**(c)** ✓**(d)**

x = 2 ✓**(e)**

OR

OPTION 3/*OPSIE 3:*

$n(HC\ell) = cV$ ✓ **(a)**
$= (0,1)(2,5 \times 10^{-2})$
$= 2,5 \times 10^{-3}$ mol

$n(K_2CO_3) = \frac{1}{2} n(HC\ell)$
$= \frac{2,5 \times 10^{-3}}{2}$
$= 1,25 \times 10^{-3}$ mol

$n(K_2CO_3)$ in 20 cm^3 = $1,25 \times 10^{-3}$ mol
$n(K_2CO_3)$ in 600 cm^3
$= \frac{(1,250 \times 10^{-2})\ (600)}{20}$ ✓**(b)**
= 0,0375 mol

$n(K_2CO_3) = \frac{m}{M}$

$0,0373 = \frac{m}{138}$

m = 5,147 g ✓**(c)**

$m(H_2O)$ = 6,525 – 5,147
= 1,378 g

$n(H_2O) = \frac{m}{M}$
$= \frac{1,378}{18}$
= 0,0766 mol

$n(K_2CO_3):n(H_2O)$
0,0373 : 0,0766
x = 2 ✓**(e)**

✓**(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
$Mg^0 \rightarrow Mg^{2+}$ 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 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:*
- Reactants ✓ Products ✓ Balancing ✓
  Reaktanse ✓ Produkte ✓ Balansering ✓
- Ignore/*Ignoreer* ⇌ and phases/*en fases*
- Marking rule 6.3.10/*Nasienreël 6.3.10*

8.2.1 $Pb(s) + 2Fe^{3+}(aq)$ ✓ → $Pb^{2+}(aq) + 2Fe^{2+}(aq)$ ✓ Bal. ✓
OR/*OF:*
$Pb + 2Fe^{3+} \rightarrow Pb^{2+} + 2Fe^{2+}$ 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. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions:/*Enige ander formule wat onkonvensionele afkortings gebruik, bv.* $E°_{sel} = E°_{OM} - E°_{RM}$ *gevolg deur korrekte vervangings*: $^{3}/_{4}$

9.1

OPTION 1/*OPSIE 1*

$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ ✓

= -0,13 ✓ – (0,80) ✓

= -0,93 V ✓

∴ non-spontaneous/*nie-spontaan* ✓

OPTION 2/*OPSIE 2*

$Pb^{2+} + 2e^- \rightarrow Pb$ ✓ E^{θ} = -0,13 V ✓

$2Ag \rightarrow 2Ag^+ + 2e^-$ ✓ E^{θ} = -0,80 V ✓

$Pb^{2+} + 2Ag \rightarrow Pb + 2Ag^+$ E^{θ} = -0,93 V ✓

∴ non-spontaneous/*nie-spontaan* ✓ (5)

9.2.1 **ANY ONE*:* (2 or 0)**
- A substance of which the (aqueous) solution contains ions. ✓✓
- 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)

9.2.2 $2C\ell^- \rightarrow C\ell_2 + 2e^-$ ✓✓

Note/*Aantekening:*
- $C\ell_2 + 2e^- \leftarrow 2C\ell^-$ $(^2/_2)$
  $2C\ell^- \rightleftharpoons C\ell_2 + 2e^-$ $(^1/_2)$
  $C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$ $(^0/_2)$
  $2C\ell^- \leftarrow C\ell_2 + 2e^-$ $(^0/_2)$
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (-) omitted on $C\ell^-$/*Indien lading (-) weggelaat op* $C\ell^-$:
  Example/*Voorbeeld:* $2C\ell \rightarrow C\ell_2 + 2e^-$ Max/*Maks:* $^1/_2$

(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