



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

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

NOVEMBER 2019

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 20 pages.
*Hierdie nasienriglyne bestaan uit 20 bladsye.***

QUESTION 1/VRAAG 1

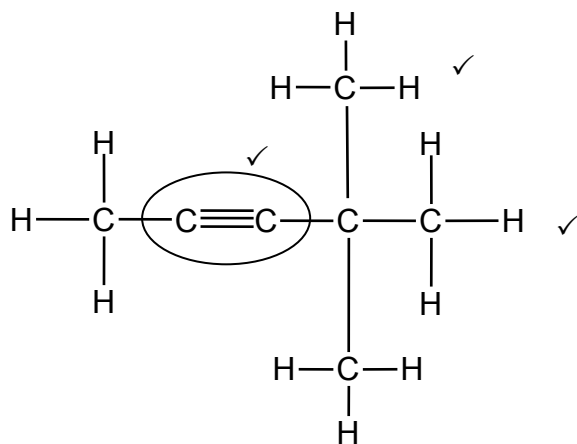
- 1.1 D ✓✓ (2)
- 1.2 C ✓✓ (2)
- 1.3 B ✓✓ (2)
- 1.4 D ✓✓ (2)
- 1.5 C ✓✓ (2)
- 1.6 B ✓✓ (2)
- 1.7 B ✓✓ (2)
- 1.8 A ✓✓ (2)
- 1.9 A ✓✓ (2)
- 1.10 C ✓✓ (2)
- [20]**

QUESTION 2/VRAAG 2

2.1

- 2.1.1 C_nH_{2n-2} ✓ (1)

2.1.2



Marking criteria/Nasiemriglyne

- Functional group correct. ✓
Funksionele groep korrek.
- 2 methyl substituents. ✓
2 metielsubstituente.
- Whole structure correct: /Hele
struktuur korrek: 3/3

(3)

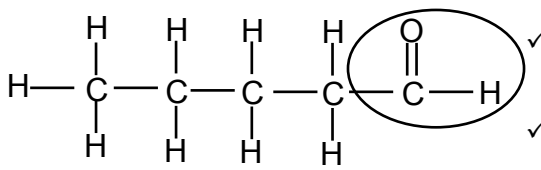
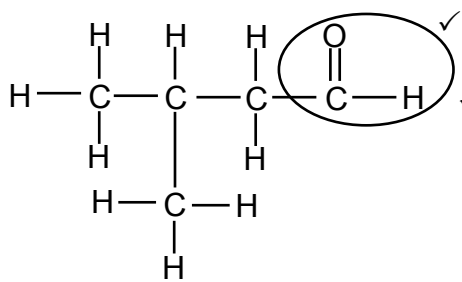
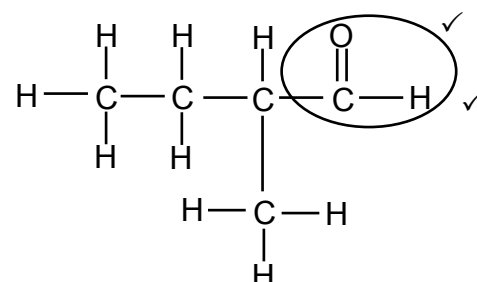
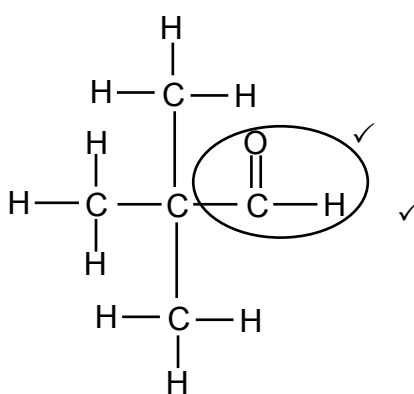
2.2

2.2.1 Compounds with the same molecular formula, ✓ but different positions of the side chain/substituents/functional groups ✓ on the parent chain.
Verbindings met dieselfde molekulêre formule, maar verskillende posisies van die syketting/substituente/funksionele groepe op die stamketting. (2)

2.2.2 Pentan-3-one/3-pentanone ✓✓
 Pentan-3-oon/3-pentanoon

| | |
|--|-----|
| <p>Marking criteria/Nasienriglyne</p> <ul style="list-style-type: none"> • Functional group and correct position i.e. 3 /Funksionele groep en korrekte posisie nl. 3. ✓ • Whole name correct/Hele naam korrek. ✓ <p>Accept for ONE mark/Aanvaar vir EEN punt</p> <p>Pentanone with the 3 in incorrect place, e.g. penta-3-none. Pentanoon met die 3 in foutiewe plek, bv. penta-3-noon.</p> | (2) |
|--|-----|

2.2.3

| | |
|--|---|
|  | <p>Marking criteria/Nasienriglyne</p> <ul style="list-style-type: none"> • Whole structure correct:/Hele struktuur korrek: $\frac{2}{2}$ • Only functional group correct/Slegs funksionele groep korrek Max: $\frac{1}{2}$ |
| <p>OR: Any correct structure of an aldehyde with five carbon atoms. OF: Enige korrekte struktuur van 'n aldehied met vyf koolstofatome.</p> | |
|  | <p>OR/OF</p>  |
| <p>OR/OF</p>  | |

(2)

2.3

2.3.1 Tertiary (alcohol)/Tersiêre (alkohol) ✓

The C atom bonded to the functional group/hydroxyl (group)/-OH is bonded to three other C atoms. /The C-atom bonded to the hydroxyl (group) has no hydrogen atoms. ✓

Die C-atoom gebind aan die funksionele groep/hidroksiel(groep)/-OH is gebind aan drie ander C-atome./ Die C-atoom gebind aan die hidroksiel (groep) het geen waterstofatome nie.

(2)

2.3.2 2-methylbutan-2-ol/2-methyl-2-butanol/2-metielbutan-2-ol/2-metiel-2-butanol

Marking criteria/Nasienriglyne

- 2-methyl/2-metiel ✓
- Butan-2-ol/2-butanol ✓
- Any error e.g. hyphens omitted and/or incorrect sequence:

Enige fout, bv. koppeltekens weggelaat en/of verkeerde volgorde: Max./Maks: 1/2

(2)

2.3.3 2-methylbut-2-ene/2-methyl-2-butene/2-metielbut-2-ene/2-metiel-2-buteen

Marking criteria/Nasienriglyne

- 2-methyl/2-metiel ✓
- But-2-ene/2-butene/But-2-ene/2-buteen ✓
- Any error e.g. hyphens omitted and/or incorrect sequence:

Enige fout, bv. koppeltekens weggelaat en/of verkeerde volgorde: Max./Maks: 1/2

(2)

[16]

QUESTION 3/VRAAG 3

3.1

Marking guidelines/Nasienriglyne

The underlined key phrases must be used in the **CORRECT CONTEXT (pressure/boiling)**. /Die onderstreepte frases moet gebruik word in die **KORREKTE KONTEKS (druk/kook)**.

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

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

(2)

3.2 (Q, R and S) have same molecular mass/formulae/number of carbon and hydrogen atoms/are (chain) isomers. ✓

(Q, R en S) het dieselfde molekulêre massa/formule/aantal koolstof en waterstofatome/ is (ketting)isomere.

OR/OF

The compounds are all alkanes /same homologous series and have the same number of carbon atoms.

Die verbindings is almal alkane /dieselfde homoloë reeks en het die dieselfde aantal koolstofatome.

(1)

Marking guidelines/Nasienriglyne

- 55 (°C) ✓
- Compare all three compounds or Q and S in terms of branches/chain lengths / surface area. ✓
Vergelyk al drie verbindings of Q en S in terme van vertakkings/kettinglengte/ oppervlakarea.
- Compare strengths of all three or Q and S's IMF's / *Vergelyk sterkte van al drie of Q en S se IMK'e.* ✓
- Compare energy of all three / *Vergelyk energie van al drie.* ✓

3.3 55 (°C) ✓

Compare compound R with compounds Q and S:

- Compound **R** is less branched/compact/spherical/surface area than compound **Q** and more branched/compact/spherical/surface area than compound **S**. ✓
OR
Q is the most branched/compact /spherical/surface area and **S** is least branched/compact/spherical/surface area.
- Intermolecular forces in compound R are stronger than in compound Q and weaker than in compound S. ✓
- More energy needed to overcome intermolecular forces in compound R than in compound Q and less energy needed to overcome (break) intermolecular forces in compound R than in compound S. ✓

OR

- Compound **R** has a longer chain length than compound **Q** and a shorter chain length than compound **S**. ✓
OR
S has the longest chain length and **Q** the shortest.
- Intermolecular forces increase with increase in chain length. ✓
- More energy needed to overcome intermolecular forces as chain length increases. ✓

Vergelyk verbinding R met verbindings Q en S:

- Verbinding R is minder vertak/kompak/sferieseoppervlak as verbinding Q en meer vertak as verbinding S.

OF

- Q is die meeste vertak/kompak en S is die minste vertak/kompak/series/oppervlak.
- Intermolekulêre kragte in verbinding R is sterker as in verbinding Q en swakker as in verbinding S.
- Meer energie word benodig om intermolekulêre kragte in verbinding R te oorkom as in verbinding Q, en minder energie word benodig om intermolekulêre kragte in verbinding R te oorkom / breek as in verbinding S.

OF

- Verbinding R het 'n langer kettinglengte as verbinding Q en 'n korter kettinglengte as S.
OF
S het die langste ketting en **Q** die kortste.
- Intermolekulêre kragte neem toe met toename in kettinglengte.
- Meer energie word benodig om intermolekulêre kragte te oorkom wanneer kettinglengte toeneem.

(4)

3.4

3.4.1 P ✓✓

(2)

3.4.2

Marking guidelines/Nasienriglyne

- Name type of IMFs in **P/pentanal**. ✓
Noem tipe IMK'e in P/pentanaal.
 - Name type of IMFs in/*Noem tipe IMK'e in T/pentan-1-ol.* ✓
 - Compare strength of IMFs. /*Vergelyk sterkte van IMK'e.* ✓
- OR/OF**
Compare energy needed to overcome IMFs. /*Vergelyk energie benodig om IMK'e te oorkom.*

- In **P/ pentanal**/aldehydes: dipole-dipole forces ✓ (in addition to London forces/dispersion forces/induced dipole forces).
- In **T/pentan-1-ol**: Hydrogen bonding. ✓ (in addition to London forces/dispersion forces/induced dipole forces).
- Intermolecular forces in P/pentanal are weaker ✓ than in **T/pentan-1-ol**
OR dipole-dipole forces are weaker than hydrogen bonds **OR**
intermolecular forces in **T/pentan-1-ol** are stronger than in **P/pentanal**.
OR
More energy needed to overcome/break intermolecular forces in T.
- In **P/pentanaal**/aldehyede: dipool-dipoolkragte (tesame met Londonkragte/dispersiekragte/geïnduseerde dipoolkragte).
- In **T/pentan-1-ol**: Waterstofbinding. (tesame met Londonkragte/dispersiekragte/geïnduseerde dipoolkragte).
- Intermolekulêre kragte in P swakker as in T/pentan-1-ol **OF**
intermolekulêre kragte in **T/pentan-1-ol** sterker as in **P/pentanaal** **OF**
dipool-dipoolkragte is swakker as waterstofbindings.
OF
Meer energie benodig om intermolekulêre kragte te oorkom/breek in T.

(3)

[12]

QUESTION 4/VRAAG 4

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

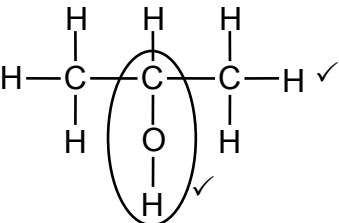
4.2
4.2.1 Elimination/dehydrohalogenation ✓
Eliminasie/dehidrohalogenering (1)

4.2.2 Substitution/hydrolysis ✓
Substitusie/hidrolise (1)

4.2.3 Esterification/condensation ✓
Esterifikasie/kondensasie/verestering (1)

4.3
4.3.1 • (Mild) heat/Heating/(*matige*) *hitte*/ *verhitting* ✓
• Dilute (strong base)/*Verdunde (sterk basis)*/(NaOH/KOH/LiOH) ✓
OR/OR
Add water/H₂O/*Voeg water/H₂O* by (2)

4.3.2 Propan-1-ol/1-propanol ✓✓
Marking criteria/Nasierriglyne:
• Correct stem and functional group i.e. propanol/*Korrekte stam en funksionele groep, d.i. propanol.* ✓
• Whole name correct:/*Hele naam korrek:* propan-1-ol ✓ (2)

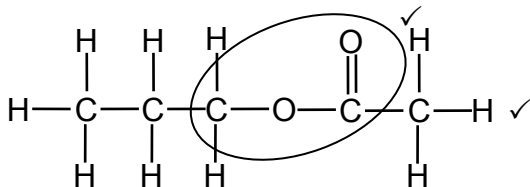
4.4  **Marking criteria/Nasierriglyne**
• Whole structure correct:/*Hele struktuur korrek:* 2/2
• Only functional group correct/*Slegs funksionele groep korrek:* 1/2

Notes/Aantekeninge
• Accept –OH as condensed. /*Aanvaar –OH as gekondenseerd.*
• Condensed or semi-structural formula:
Gekondenseerde of semi-struktuurformule: Max./*Maks.* 1/2
• Molecular formula/*Molekulêre formule:* 0/2
• If functional group is incorrect/*Indien funksionele groep verkeerd is:* 0/2
• If more than one functional group:
Indien meer as een funksionele groep: 0/2 (2)

4.5

POSITIVE MARKING FROM Q4.3.2 ONLY IF THE COMPOUND IN Q4.3.2 IS AN ALCOHOL. /POSITIEWE NASIEN VANAF V4.3.2 SLEGS INDIEN DIE VERBINDING IN Q4.3.2 'N ALKOHOL IS.

4.5.1



| |
|---|
| <p>Marking criteria/Nasienriglyne</p> <ul style="list-style-type: none"> • Whole structure correct:/Hele struktuur korrek: $\frac{2}{2}$ • Only functional group correct/Slegs funksionele groep korrek: $\frac{1}{2}$ |
|---|

| | |
|--|-----|
| <p>Notes/Aantekeninge</p> <ul style="list-style-type: none"> • Condensed or semi-structural formula: Gekondenseerde of semistruktuurformule: Max./Maks. $\frac{1}{2}$ • Molecular formula/Molekulêre formule: $\frac{0}{2}$ • If functional group is incorrect/Indien funksionele groep verkeerd is: $\frac{0}{2}$ | (2) |
|--|-----|

4.5.2 (Concentrated) sulphuric acid/(Gekonsentreerde) swawelsuur/H₂SO₄ ✓

(1)
[13]

QUESTION 5/VRAAG 5

5.1 Exothermic/Eksotermies ✓



ΔH < 0/Energy is released/Energie word vrygestel ✓

(2)

5.2

| | | |
|--|---|-----|
| $\begin{aligned} \text{rate/tempo} &= -\frac{\Delta m}{\Delta t} \\ &= -\frac{0,25 - 2}{30} \checkmark \\ &= 0,06 \text{ (g} \cdot \text{s}^{-1}) \checkmark \\ &\quad (0,0583 \text{ g} \cdot \text{s}^{-1}) \end{aligned}$ | <p>OR/OF</p> $\begin{aligned} \text{rate/tempo} &= -\frac{\Delta m}{\Delta t} \\ &= -\frac{-1,75}{30} \checkmark \\ &= 0,06 \text{ (g} \cdot \text{s}^{-1}) \checkmark \\ &\quad (0,0583 \text{ g} \cdot \text{s}^{-1}) \end{aligned}$ | (3) |
|--|---|-----|

| |
|--|
| <p>Notes/Aantekeninge Accept negative answer i.e./Aanvaar negatiewe antwoord d.i. - 0,06 g · s⁻¹.</p> |
|--|

5.3

| | |
|---|---|
| <p>Marking guidelines</p> <ul style="list-style-type: none"> Calculate/Bereken: $m(\text{CaCO}_3)$ reacted/reageer or / of $V(\text{CO}_2)$ produced/gevorm. ✓ Substitute/Vervang: $100 \text{ g} \cdot \text{mol}^{-1}$. ✓ USE mol ratio/GEBRUIK molverhouding: $n(\text{CO}_2) : n(\text{CaCO}_3) = 1 : 1$ ✓ Use of/ /Gebruik van $22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$. ✓ Final answer/Finale antwoord: $0,18 \text{ dm}^3$ ($0,1792 \text{ dm}^3$) ✓ | |
| <p>OPTION 1/OPSIE 1</p> $m(\text{CaCO}_3) = \frac{40}{100} \times 2 \checkmark$ $= 0,8 \text{ g}$ $n(\text{CaCO}_3)_{\text{reacted}} = \frac{m}{M}$ $= \frac{0,8}{100} \checkmark$ $= 8 \times 10^{-3} \text{ mol}$ $n(\text{CO}_2) = n(\text{CaCO}_3) \checkmark$ $= 8 \times 10^{-3} \text{ mol}$ $V(\text{CO}_2) = 8 \times 10^{-3} \times 22,4 \checkmark$ $= 0,18 \text{ dm}^3 \checkmark$ | <p>OPTION 2/OPSIE 2</p> <p>For 2 g antacid/teensuurtablet:</p> $100 \text{ g} \checkmark \text{CaCO}_3 \dots\dots 22,4 \text{ dm}^3 \checkmark \text{CO}_2$ $2 \text{ g CaCO}_3 \dots\dots 0,448 \text{ dm}^3 \checkmark$ |
| | <p>100% $\text{CO}_2 \dots\dots 0,448 \text{ dm}^3 \checkmark$ 40% $\text{CO}_2 \dots\dots 0,18 \text{ dm}^3 \checkmark$</p> <p>OPTION 3/OPSIE 3</p> $100\% \text{ CaCO}_3 \dots\dots 2 \text{ g}$ $40\% \dots\dots 0,8 \text{ g} \checkmark$ |
| | <p>100 g ✓ 1 mol 0,8 g $8 \times 10^{-3} \text{ mol} \checkmark$ 1 mol $22,4 \text{ dm}^3 \checkmark$ $8 \times 10^{-3} \text{ mol} \dots\dots 0,18 \text{ dm}^3 \checkmark$</p> |

(5)

5.4

ANY ONE/ENIGE EEN:

- Concentration (of acid)/Konsentrasie (van suur) ✓
- Size/mass of tablet/Identical tablet /Type of tablet.
Grootte/massa van tablet/Identiese tablet./Tipe tablet.
- State of division / Surface area / Toestand van verdeeldheid /
reaksieoppervlak.

(1)

5.5

| | |
|--|---|
| <p>Criteria for conclusion/Riglyne vir gevolgtrekking:</p> | |
| <p>Dependent [(reaction) rate/time] and independent (temperature) variables correctly identified. <i>Afhanklike [(reaksie)tempo/tyd] en onafhanklike (temperatuur) veranderlikes korrek geïdentifiseer.</i></p> | ✓ |
| <p>Relationship between the independent and dependent variables correctly stated./<i>Verwantskap tussen die afhanklike en onafhanklike veranderlikes korrek genoem.</i></p> | ✓ |

Examples/Voorbeelde:

- Reaction rate ($\frac{1}{\text{time}}$) increases with increase in temperature.
Reaksietyempo ($\frac{1}{\text{time}}$) neem toe met toename in temperatuur.
- Reaction rate ($\frac{1}{\text{time}}$) decreases with decrease in temperature.
Reaksietyempo ($\frac{1}{\text{time}}$) neem af met afname in temperatuur.
- Time taken for reaction decreases when temperature increases.
Tyd vir die reaksie neem af wanneer temperatuur toeneem.
- Time taken for reaction increases when temperature decreases.
Tyd vir die reaksie neem toe as temperatuur afneem.

IF/INDIEN

Reaction rate is DIRECTLY proportional to temperature: Max. $\frac{1}{2}$
Reaksietyempo is DIREK eweredig aan temperatuur: Maks. $\frac{1}{2}$

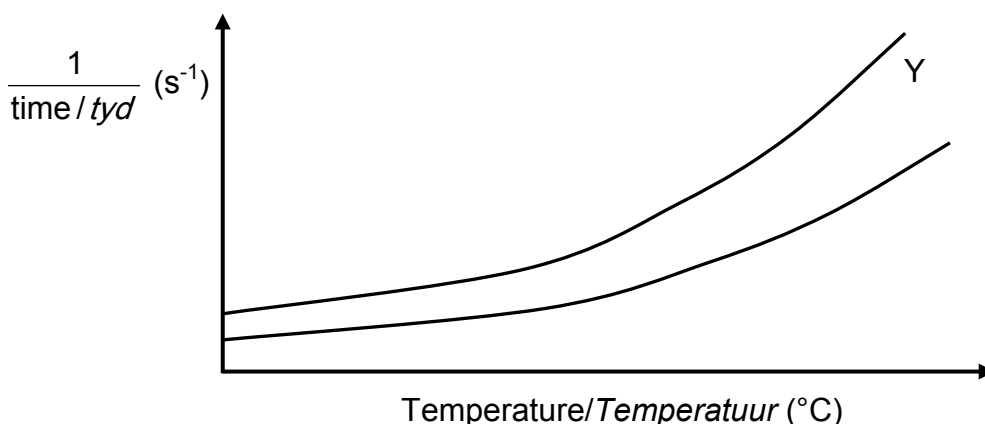
(2)

- 5.6
- Increase in temperature increases the average kinetic energy/molecules move faster. /*Toename in temperatuur verhoog die gemiddelde kinetiese energie/molekule beweeg vinniger.* ✓
 - More molecules have enough/sufficient kinetic energy/More molecules have $E_k > E_a$. ✓
Meer molekule het genoeg/voldoende kinetiese energie/Meer molekule het $E_k > E_a$.
 - More effective collisions per unit time/second. /Frequency of effective collisions increases. ✓
Meer effektiewe botsings per eenheidtyd/sekonde./Frekwensie van effektiewe botsings neem toe.

(3)

5.7 **Marking guidelines/Nasienriglyne**

- For each value of temperature, the CURVE Y must be above the given CURVE. /
Vir elke waarde van temperatuur, moet kurwe Y bo die gegewe kurwe wees. ✓
- CURVE Y must have an increasing rate with an increase in temperature. /
KURWE Y moet 'n toenemende tempo het soos die temperatuur toeneem. ✓



(2)
[18]

QUESTION 6/VRAAG 6

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

OR/OF

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

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

6.2 CALCULATIONS USING NUMBER OF MOLES BEREKENINGE WAT AANTAL MOL GEBRUIK

6.2.1 Marking guidelines/Nasienriglyne

- Substitute/Vervang: $44 \text{ g} \cdot \text{mol}^{-1}$. ✓
- Equilibrium concentration of CO_2 multiply by 3 dm^3
Ewewigskonsentrasie van CO_2 vermenigvuldig met 3 dm^3 } ✓
ANDIEN $n(\text{CO})_{\text{eq}}$ divide by /deel deur 3 dm^3
- Use mole ratio/Gebruik molverhouding: $1:2$ / $n(\text{CO}) = 2n(\text{CO}_2)$. ✓
- $n(\text{CO}_2)_{\text{change}} = n(\text{CO}_2)_{\text{initial}} - n(\text{CO}_2)_{\text{final}}$ } ✓
 $n(\text{CO})_{\text{eq/ewe}} = n(\text{CO})_{\text{initial/begin}} + \Delta n(\text{CO})$ }
- Correct K_c expression (formulae in square brackets). ✓
Korrekte K_c -uitdrukking (formules in vierkanthakies).
- Substitution of concentrations into K_c expression. ✓
Vervanging van konsentrasies in K_c -uitdrukking.
- Final answer/Finale antwoord: 12,24 (range/gebied: 11,85 – 12,66) ✓

OPTION 1/OPSIE 1

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

$$= \frac{60,8}{44} \checkmark$$

$$= 1,382 \text{ mol}$$

| | CO ₂ | CO | |
|--|-----------------|-------|---|
| Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i> | 1,382 | 0 | |
| Change (mol) <i>Verandering (mol)</i> | ✓ 1,22 | 2,44 | Use ratio/Gebruik verhouding ✓ |
| Quantity at equilibrium (mol)/ <i>Hoeveelheid by ewewig (mol)</i> | 0,162 | 2,44 | Divide/multiply by 3/Deel/ vermenigvuldig met 3 ✓ |
| Equilibrium concentration (mol·dm ⁻³) <i>Ewewigkonsentrasie (mol·dm⁻³)</i> | 0,054 | 0,813 | |

$$K_c = \frac{[\text{CO}]^2}{[\text{CO}_2]} \checkmark$$

$$= \frac{(0,813)^2}{0,054} \checkmark$$

$$= 12,24 \checkmark$$

No K_c expression, correct substitution/Geen K_c-uitdrukking, korrekte substitusie: Max./Maks. 6/7

Wrong K_c expression/Verkeerde K_c-uitdrukking: Max./Maks. 4/7

OPTION 2/OPSIE 2

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

$$= \frac{60,8}{44} \checkmark$$

$$= 1,382 \text{ mol}$$

$$n(\text{CO}_2)_{\text{change}} = n(\text{CO}_2)_{\text{initial/begin}} - n(\text{CO}_2)_{\text{final/finaal}}$$

$$= 1,382 - 0,162$$

$$= 1,22 \text{ mol}$$

$$n(\text{CO})_{\text{change}} = 2(\text{CO}_2) \checkmark$$

$$= 2(1,22) \checkmark$$

$$= 2,44 \text{ mol}$$

$$n(\text{CO})_{\text{eq}} = n(\text{CO})_{\text{change}} = 2,44 \text{ mol}$$

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

$$= \frac{2,44}{3} \checkmark$$

$$= 0,813 \text{ mol·dm}^{-3}$$

$$K_c = \frac{[\text{CO}]^2}{[\text{CO}_2]} \checkmark$$

$$= \frac{(0,813)^2}{0,054} \checkmark$$

$$= 12,24 \checkmark \text{ (Accept range/Aanvaar gebied: 11,85 – 12,66).}$$

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK

Marking guidelines/Nasienriglyne

- Substitute 44 g·mol⁻¹. ✓
- Initial n(CO₂) divide by 3 dm³. ✓
Aanvanklike n(CO₂) gedeel deur 3 dm³.
- **USE** ratio/**GEBRUIK** verhouding: c(CO₂) : c(CO) = 1 : 2 ✓
- $\Delta c(\text{CO}_2) = c(\text{CO}_2)_{\text{initial/begin}} - c(\text{CO}_2)_{\text{eq/ewe}}$. ✓
 $c(\text{CO})_{\text{eq/ewe}} = c(\text{CO})_{\text{initial/begin}} + \Delta c(\text{CO})$. ✓
- Correct K_c expression (formulae in square brackets). ✓
Korrekte K_c uitdrukking (formules in vierkanthakies).
- Substitution of concentrations into K_c expression. ✓
Vervanging van konsentrasies in K_c-uitdrukking.
- Final answer/Finale antwoord: 12,15 (range/gebied: 11,85 – 12,66) ✓

OPTION 3/OPSIE 3

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

$$= \frac{60,8}{44} \checkmark$$

$$= 1,382 \text{ mol}$$

| | CO ₂ | CO |
|--|-----------------|-------|
| Initial concentration (mol·dm ⁻³) <i>Aanvanklike konsentrasie (mol·dm⁻³)</i> | 0,4607 | 0 |
| Change (mol·dm ⁻³) <i>Verandering (mol·dm⁻³)</i> | 0,4067 | 0,813 |
| Equilibrium concentration (mol·dm ⁻³) <i>Ewewigskonsentrasie (mol·dm⁻³)</i> | 0,054 | 0,813 |

Divide by /Deel deur 3 dm³ ✓
 ratio ✓
 verhouding

$$K_c = \frac{[\text{CO}]^2}{[\text{CO}_2]} \checkmark$$

$$= \frac{(0,813)^2}{0,054} \checkmark$$

$$= 12,15 \checkmark$$

No K_c expression, correct substitution/Geen K_c-uitdrukking, korrekte substitusie: Max./Maks. 6/7

Wrong K_c expression/Verkeerde K_c-uitdrukking: Max./Maks. 4/7

(7)

6.2.2 POSITIVE MARKING FROM Q6.2.1/POSITIEWE NASIEN VANAF V6.2.1

$$\frac{n(\text{C})_{\text{reacted/reageer}}}{n(\text{CO}_2)_{\text{reacted/reageer}}} =$$

$$= 1,22 \text{ mol} \checkmark$$

$$m(\text{C}) = nM$$

$$= 1,22(12) \checkmark$$

$$= 14,64 \text{ g} \checkmark$$

Marking guidelines

- **USE** mol ratio/ **GEBRUIK** molverhouding: n(C) = n(CO₂). ✓
- Substitute/Vervang: 12 g·mol⁻¹. ✓
- Final answer/Finale antwoord: 14,64 g. ✓

(3)

6.3

6.3.1 Remains the same/*Bly dieselfde* ✓

(1)

6.3.2 Decreases/*Afneem* ✓



- (When pressure is increased) the reaction that leads to the smaller amount/number of moles/volume of gas is favoured. ✓
(Wanneer die druk verhoog word,) word die reaksie wat tot die kleiner hoeveelheid/aantal mol/volume gas lei, bevoordeel.
- The reverse reaction is favoured. / More CO₂ is formed. ✓
Die terugwaartse reaksie word bevoordeel./ meer CO₂ word gevorm.

(3)

6.4

6.4.1 Endothermic/*Endotermies* ✓



- When the temperature increases the mol/percentage CO(g)/product increases/forward reaction is favoured./*Wanneer die temperatuur toeneem, neem die mol/persentasie CO(g)/produk toe/voorwaartse reaksie word bevoordeel.* ✓
- An increase in temperature favours the endothermic reaction/*Toename in temperatuur bevoordeel die endotermiese reaksie.* ✓

(3)

6.4.2

POSITIVE MARKING FROM Q6.2.1./POSITIEWE NASIEN VANAF V6.2.1.

Marking guidelines/Nasienriglyne

- Calculate total volume/mol of gas at equilibrium/*Bereken totale volume/mol gas by ewewig: 0,162 + 2,44 = 2,606 dm³ /mol* ✓
- OR/OF**
 Calculate the total concentration at equilibrium/*Bereken die totale konsentrasie by ewewig: 0,054 + 0,813 = 0,867 mol·dm⁻³*
- Calculate percentage of ANY one gas/*Bereken persentasie van ENIGE een gas (CO₂ or/of CO).* ✓
- Final answer/*Finale antwoord: T = 827 °C* ✓

OPTION 1/OPSIE 1

$$V_{\text{total eq}} = 0,162 + 2,44 \checkmark$$

$$= 2,606 \text{ dm}^3$$

$$\% \text{ CO}_2 = \frac{0,162}{2,606} \times 100 \checkmark$$

$$= 6,225 \%$$

OR/OF

$$\% \text{ CO} = \frac{2,44}{2,606} \times 100 \checkmark$$

$$= 93,63 \%$$

OPTION 2/OPSIE 2

$$C_{\text{total eq}} = 0,054 + 0,813$$

$$= 0,867 \text{ mol·dm}^{-3}$$

$$\% \text{ CO}_2 = \frac{0,054}{0,867} \times 100 \checkmark$$

$$= 6,228 \%$$

OR/OF

$$\% \text{ CO} = \frac{0,813}{0,867} \times 100 \checkmark$$

$$= 93,77 \%$$

∴ T = 827 °C ✓

(3)

[22]

QUESTION 7/VRAAG 7

7.1  Strong (acid)/Sterk (suur) ✓

Large/Groot K_a value/waarde/ $K_a > 1$ / (HBr) ionises completely/ioniseer volledig ✓

(2)

7.2 H_2O ✓

Br^- ✓

(2)

7.3

7.3.1

Marking guidelines/Nasienriglyne

- Formula/Formule: $c = \frac{n}{V} / n = cV / \frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b}$ ✓
- Substitution of/Vervanging van: (0,5)(0,0165)/(0,5)(16,5) ✓
- Use mol ratio/Gebruik molverhouding: 1:1/n(HBr) = n(NaOH) ✓
- Substitute/Vervang: $V = 0,09 \text{ dm}^3 / 90 \text{ cm}^3$ ✓
- Formula/Formule: $pH = -\log[H_3O^+]$ ✓
- Substitute $[H_3O^+]$ in pH formula. ✓
- Final answer/Finale antwoord: $pH = 1,04$ (range/gebied: 1,036 – 1,05) ✓

| OPTION 1/OPSIE 1 | OPTION 2/OPSIE 2 |
|--|--|
| $n(\text{NaOH})_{\text{reacted/reageer}} = cV \checkmark$ $= 0,5(0,0165) \checkmark$ $= 0,00825 \text{ mol}$ $n(\text{HBr})_{\text{excess/oormaat}} = n(\text{NaOH}) = 0,00825 \text{ mol} \checkmark$ $c(\text{H}_3\text{O}^+) = \frac{n}{V}$ $= \frac{0,00825}{0,09} \checkmark$ $= 0,092 \text{ mol} \cdot \text{dm}^{-3}$ $pH = -\log[H_3O^+] \checkmark$ $= -\log(0,092) \checkmark$ $= 1,04 \checkmark$ | $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \checkmark$ $\frac{c_a (90) \checkmark}{(0,5)(16,5) \checkmark} = \frac{1}{1} \checkmark$ $c_a = 0,092 \text{ mol} \cdot \text{dm}^{-3}$ $pH = -\log[H_3O^+] \checkmark$ $= -\log(0,092) \checkmark$ $= 1,04 \checkmark$ |

(7)

7.3.2

Marking guidelines/Nasienriglyne

- Calculate/Bereken $n(\text{HBr})_{\text{initial/aanvanklik}}$: substitute/vervang (0,45)(0,09) in $n = cV$ ✓
- Subtraction/Aftrekking:
 $n(\text{HBr})_{\text{reacted/reageer}} = n(\text{HBr})_{\text{initial/aanvanklik}} - n(\text{HBr})_{\text{reacted with/reageer met NaOH}}$ ✓✓
OR/OF: $c(\text{HBr})_{\text{reacted/reageer}} = c(\text{HBr})_{\text{initial/aanvanklik}} - c(\text{H}_3\text{O}^+)_{\text{excess/oormaat}}$
- Use mol ratio/Gebruik molverhouding: $n(\text{Zn}(\text{OH})_2) : n(\text{HBr}) = 1 : 2$ ✓
- Substitution of/Vervanging van: $99 \text{ g} \cdot \text{mol}^{-1}$ ✓
- Final answer/Finale antwoord: 1,5964 g (range/gebied: 1,58 – 1,68) ✓

POSITIVE MARKING FROM Q7.3.1/POSITIEWE NASIEN VANAF V7.3.1

OPTION 1/OPSIE 1

$$\begin{aligned}
 n(\text{HBr})_{\text{initial/begin}} &= cV \\
 &= (0,45)(0,09) \checkmark \\
 &= 0,0405 \text{ mol} \\
 n(\text{HBr reacted with/reageer met Zn}(\text{OH})_2) &= \frac{0,0405 - 0,00825}{2} \checkmark \checkmark \\
 &= 0,03224 \text{ mol} \\
 n(\text{Zn}(\text{OH})_2) &= \frac{1}{2}n(\text{HBr}) = \frac{1}{2}(0,03224) \checkmark = 0,016125 \text{ mol} \\
 m(\text{Zn}(\text{OH})_2) &= nM \\
 &= (0,016125)(99) \checkmark \\
 &= 1,596 \text{ g} \checkmark
 \end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}
 c(\text{HBr}) &= 0,45 - 0,092 \checkmark \checkmark \\
 &= 0,358 \text{ mol} \cdot \text{dm}^{-3} \\
 n(\text{HBr reacted/reageer}) &= cV \\
 &= 0,358 \times 0,09 \checkmark \\
 &= 0,0322 \text{ mol} \\
 n(\text{Zn}(\text{OH})_2) &= \frac{1}{2}n(\text{HBr}) = \frac{1}{2}(0,0322) \checkmark = 0,01611 \text{ mol} \\
 m(\text{Zn}(\text{OH})_2) &= nM \\
 &= 0,01611 \times 99 \checkmark \\
 &= 1,595 \text{ g} \checkmark \quad (1,60 \text{ g})
 \end{aligned}$$

(6)
 [17]

QUESTION 8/VRAAG 8

8.1 Chemical to electrical/*Chemies na elektries* ✓ (1)

8.2 Provides path for movement of ions./ Completes the circuit./Ensures electrical neutrality in the cell./Restore charge balance. ✓
Verskaf pad vir beweging van ione./Voltooi die stroombaan./Verseker elektriese neutraliteit in die sel./Herstel balans van lading. (1)

8.3 **OPTION 1/OPTION 1**

$$E_{\text{cell}}^{\ominus} = E_{\text{cathode}}^{\ominus} - E_{\text{anode}}^{\ominus} \checkmark$$

$$1,49 = 1,36 - E_{\text{anode}}^{\ominus} \checkmark$$

$$E_{\text{anode}}^{\ominus} = 1,36 - 1,49 \checkmark$$

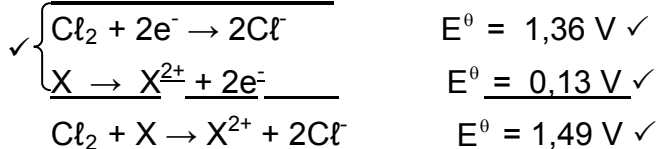
$$= -0,13 \text{ (V)} \checkmark$$

X is Pb/Lead/Lood ✓

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. $E_{\text{cell}}^{\ominus} = E_{\text{OA}}^{\ominus} - E_{\text{RA}}^{\ominus}$ followed by correct substitutions: /Enige ander formule wat onkonvensionele afkortings gebruik, bv. $E_{\text{sel}}^{\ominus} = E_{\text{OM}}^{\ominus} - E_{\text{RM}}^{\ominus}$ gevolg deur korrekte vervangings: $\frac{4}{5}$

OPTION 2/OPSIE 2



X is Pb/Lead/Lood ✓ (5)

POSITIVE MARKING FROM Q8.3/POSITIEWE NASIEN VANAF V8.3

8.4 X/Pb/Lead/Lood ✓ (1)

8.5

8.5.1 Reaction reached equilibrium./ (In each half cell) the rate of oxidation is equal to rate of reduction./Rate of the forward reaction is equal to the rate of the reverse reaction. ✓
Reaksie bereik ewewig./ (In elke halfsel) die tempo van oksidasie is gelyk aan tempo van reduksie./Tempo van die voorwaartse reaksie is gelyk aan die tempo van die terugwaartse reaksie. (1)

8.5.2 Increases/Toeneem ✓ (1)

8.5.3

- $[\text{Cl}^-]$ decreases/neem af. ✓
- Forward reaction is favoured./Voorwaartse reaksie word bevoordeel. ✓

(2)

[12]

QUESTION 9/VRAAG 9

9.1

Marking guidelines/Nasienriglyne
 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 chemical process in which electrical energy is converted to chemical energy. ✓✓

Die chemiese proses waarin elektriese energie omgeskakel word na chemiese energie.

OR/OF

The use of electrical energy to produce a chemical change.

Die gebruik van elektriese energie om 'n chemiese verandering teweeg te bring.

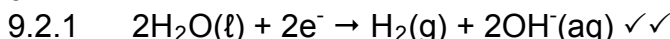
OR/OF

The process during which an electrical current passes through a solution/molten ionic compound.

Die proses waar 'n elektriese stroom deur 'n oplossing/gesmelte ioniese verbinding gestuur word.

(2)

9.2



Ignore phases / Ignoreer fases

Marking guidelines/Nasienriglyne

- $\text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq}) \leftarrow 2\text{H}_2\text{O}(\ell) + 2\text{e}^-$ (2/2) $2\text{H}_2\text{O}(\ell) + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$ (1/2)
- $\text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq}) \rightleftharpoons 2\text{H}_2\text{O}(\ell) + 2\text{e}^-$ (0/2) $2\text{H}_2\text{O}(\ell) + 2\text{e}^- \leftarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$ (0/2)

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

(2)

9.2.2 Water / H_2O ✓

(1)

9.3 H_2O is a stronger oxidising agent ✓ than Na^+ ✓ and will be reduced ✓ (to H_2).
 H_2O is 'n sterker oksideermiddel as Na^+ en sal gereduseer word (na H_2).

OR/OF

Na^+ is a weaker oxidizing agent ✓ than H_2O ✓ and therefore H_2O will be reduced ✓ (to H_2)

Na^+ is 'n swakker oksideermiddel as H_2O en daarom sal H_2O gereduseer word (na H_2)

OR/OF

The half-reaction that produces $\text{H}_2(\text{g})$ has a more positive reduction potential (-0,83 V) ✓ than the half-reaction that produces Na (-2,71 V). ✓

Therefore water/ H_2O will be reduced ✓ to H_2 . / Na^+ will not be reduced to Na.

Die halfreaksie wat $\text{H}_2(\text{g})$ vorm, het 'n meer positiewe reduksiepotensiaal (-0,83 V) as die halfreaksie wat Na vorm (-2,71 V).

Daarom word water/ H_2O na H_2 gereduseer. / Na^+ sal nie gereduseer word na

(3)

Na nie.

[8]

QUESTION 10/VRAAG 10

10.1

10.1.1 Hydrogen/Waterstof/H₂ ✓ (1)

10.1.2 Nitrogen monoxide/Stikstofmonoksied/NO ✓ (1)

10.1.3 Nitric acid/Salpetersuur/HNO₃ ✓ (1)

10.2

10.2.1 (Catalytic) oxidation/Redox/(Katalitiese) oksidasie/Redoks ✓ (1)

10.2.2 NH₃ + HNO₃ ✓ → NH₄NO₃ ✓ Bal ✓

Notes/Aantekeninge

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

(3)

10.3

10.3.1 (Total) percentage of nutrients/fertiliser/N,P,K. ✓
(Totale) persentasie nutriente/ kunsmis/N,P, K. (1)

10.3.2

| |
|--|
| <p>Marking guidelines/Nasienriglyne</p> <ul style="list-style-type: none"> • Calculate mass fertiliser in A./Bereken massa kunsmis in A ✓ • Calculate mass fertiliser in B./ Bereken massa kunsmis in B ✓ • Calculate mass P in A and B ./Bereken massa P in A en B✓ • Final answer/Finale antwoord: B has more phosphorous than/het meer fosfor as A. ✓ |
|--|

| | |
|---|--|
| <p>OPTION 1/OPSIE 1</p> <p>Mass fertiliser in A: <i>Massa kunsmis in A:</i></p> $m = \frac{21}{100} \times 50 \checkmark = 10,5 \text{ kg}$ <p>Mass fertiliser in B: <i>/Massa kunsmis in B:</i></p> $m = \frac{27}{100} \times 40 \checkmark = 10,8 \text{ kg}$ <p>Mass phosphorous in A/ <i>Massa fosfor in A:</i></p> $\frac{3}{8} \times 10,5 = 3,94 \text{ kg}$ <p>Mass phosphorous in B/ <i>Massa fosfor in B:</i></p> $\frac{3}{8} \times 10,8 = 4,05 \text{ kg}$ <p>Fertiliser B has more phosphorous than fertiliser A. ✓</p> | <p>OPTION 3/OPSIE 3</p> <p>Mass phosphorous in A/ <i>Massa fosfor in A:</i></p> $\%P = \frac{3}{8} \times 21 = 7,88\%$ $m(P) = \frac{7,88}{100} \times 50 \checkmark = 3,94 \text{ kg}$ <p>Mass(P) in B <i>Massa (P) in B:</i></p> $\%(P) = \frac{3}{8} \times 27 = 10,13\%$ $m = \frac{10,13}{100} \times 40 \checkmark = 4,05 \text{ kg}$ <p>Fertiliser B has more phosphorous than fertiliser A. <i>/Kunsmis B het meer fosfor as kunsmis A ✓</i></p> |
| <p>OPTION 2/OPSIE 2</p> <p>Mass phosphorous in A/ <i>Massa fosfor in A:</i></p> $m = \frac{3}{8} \times \frac{21}{100} \times 50 \checkmark = 3,94 \text{ kg}$ <p>Mass(P) in B <i>Massa (P) in B:</i></p> $m = \frac{3}{8} \times \frac{27}{100} \times 40 \checkmark = 4,05 \text{ kg}$ <p>Fertiliser B has more phosphorous than fertiliser A. <i>/Kunsmis B het meer fosfor as kunsmis A. ✓</i></p> | <p>OPTION 4/OPSIE 4</p> <p>Mass fertiliser in A: <i>Massa kunsmis in A:</i></p> $m = \frac{21}{100} \times 50 \checkmark = 10,5 \text{ kg}$ <p>Mass fertiliser in B: <i>/Massa kunsmis in B:</i></p> $m = \frac{27}{100} \times 40 \checkmark = 10,8 \text{ kg}$ <p>For the same NPK ratio ✓ the bag with more fertiliser will have more phosphorous ∴ bag B ✓ <i>Vir dieselfde NPK verhouding, die sake met meer kunsmis sal meer fosfor het ∴ sak B</i></p> |

(4)
 [12]

TOTAL/TOTAAL:

150