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)

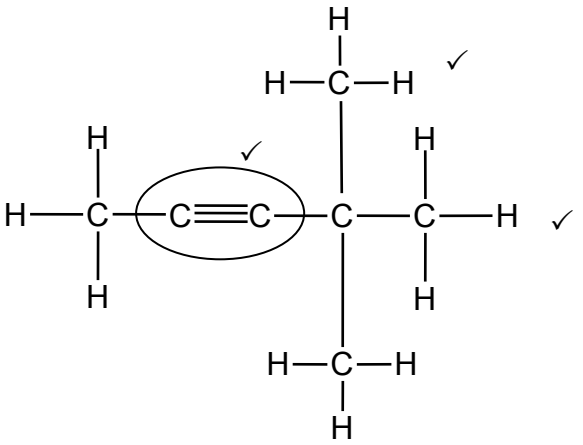
[20]

QUESTION 2/*VRAAG 2*

2.1

2.1.1 C_nH_{2n-2} ✓ (1)

2.1.2



Marking criteria/*Nasienriglyne*
- Functional group correct. ✓
  Funksionele groep korrek.
- 2 methyl substituents. ✓
  2 metielsubstituente.
- Whole structure correct:/*Hele struktuur korrek:* $^{3}/_{3}$

(3)

2.2

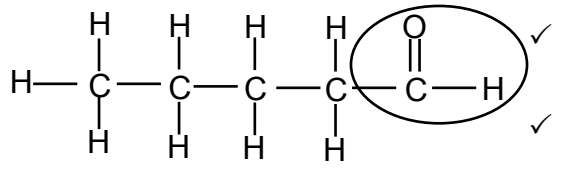
2.2.1 Compounds with the same molecular formula, ✓ but different positions of the side chain/substituents/functional groups ✓on the parent chain.
Verbindings met dieselfde molekulêre formule, maar verskillende posisies van die syketting/substituente/funksionele groepe op die stamketting. (2)

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

Marking criteria/*Nasienriglyne*
- Functional group and correct position i.e. 3 /*Funksionele groep en korrekte posisie nl. 3.* ✓
- Whole name correct/*Hele naam korrek.* ✓

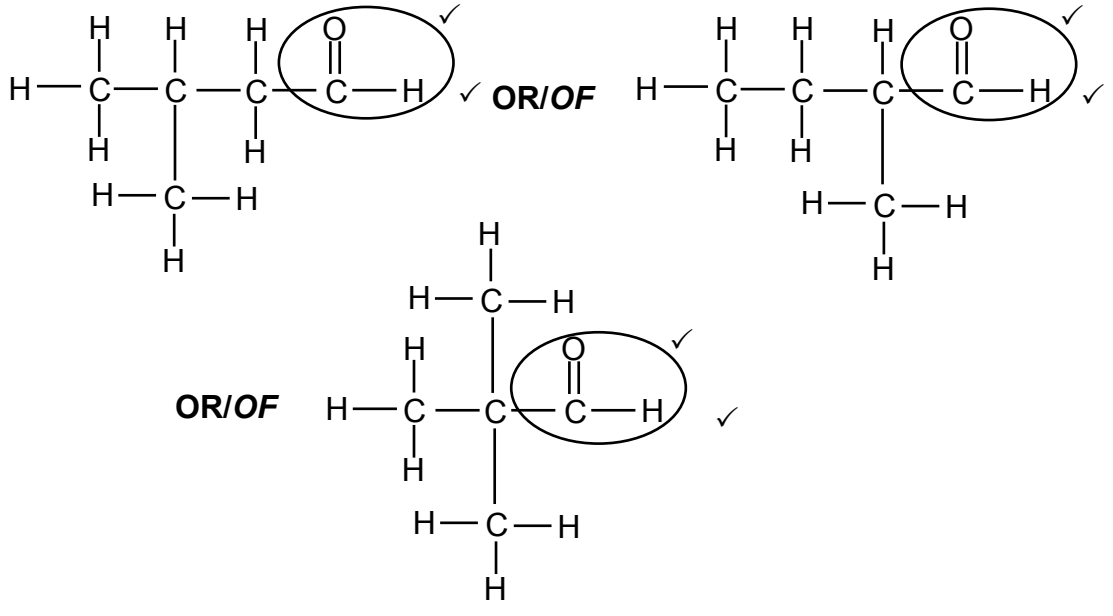
Accept for ONE mark/Aanvaar vir EEN punt
Pentanone with the 3 in incorrect place, e.g. penta-3-none.
Pentanoon met die 3 in foutiewe plek, bv. penta-3-noon. (2)

2.2.3



Marking criteria/*Nasienriglyne*
- Whole structure correct:/*Hele struktuur korrek:* 2/2
- Only functional group correct/*Slegs funksionele groep korrek* Max: 1/2

OR: Any correct structure of an aldehyde with five carbon atoms.
OF:Enige korrekte struktuur van 'n aldehied met vyf koolstofatome.



(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*: ½

(2)

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

Marking criteria/*Nasienriglyne*
- 2-methyl/*2-metiel* ✓
- But-2-ene/2-butene/*But-2-een/2-buteen* ✓
- Any error e.g. hyphens omitted and/or incorrect sequence:
  Enige fout, bv. koppeltekens weggelaat en/of verkeerde volgorde: Max./*Maks*: ½

(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 branced/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.
- *In*termolekulêre kragte in v*erbinding **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/aldehiede: 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)

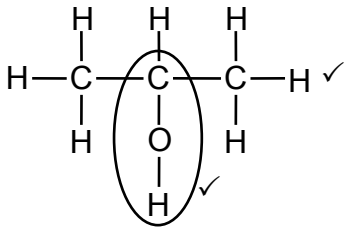
4.3

4.3.1
- (Mild) heat/Heating/*(matige) hitte/ verhitting* ✓
- Dilute (strong base)/*Verdunde (sterk basis)*/(NaOH/KOH/LiOH) ✓
  OR/*OR*
  Add water/H_2O/*Voeg water/H_2O by* (2)

4.3.2 Propan-1-ol/1-propanol ✓✓

Marking criteria/*Nasienriglyne:*
- 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



✓

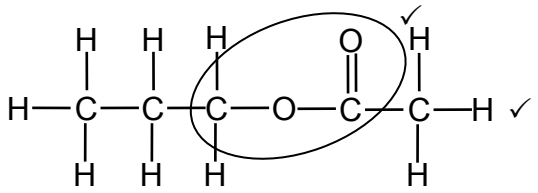
Marking criteria/*Nasienriglyne*
- Whole structure correct:/*Hele struktuur korrek:* $^2/_2$
- Only functional group correct/*Slegs funksionele groep korrek:* $^1/_2$

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



✓ ✓

Marking criteria/*Nasienriglyne*
- Whole structure correct:/*Hele struktuur korrek:* $^{2}/_{2}$
- Only functional group correct/*Slegs funksionele groep korrek:* $^{1}/_{2}$

Notes/*Aantekeninge*
- Condensed or semi-structural formula:
  Gekondenseerde of semistruktuurformule: Max./*Maks.* $^{1}/_{2}$
- Molecular formula/*Molekulêre formule*: $^{0}/_{2}$
- If functional group is incorrect/*Indien funksionele groep verkeerd is*: $^{0}/_{2}$

(2)

4.5.2 (Concentrated) sulphuric acid/*(Gekonsentreerde) swawelsuur*/H_2SO_4 ✓ (1)

[13]

QUESTION 5/*VRAAG 5*

5.1 Exothermic/*Eksotermies* ✓

(-)

$\triangle H$ < 0/Energy is released/*Energie word vrygestel* ✓ (2)

5.2

rate/*tempo* = $-\frac{\Delta m}{\Delta t}$ = $-\frac{0,25-2}{30}$ ✓ ✓ = 0,06 (g· s^{-1}) ✓ (0,0583 g· s^{-1})	**OR/*OF*** rate/*tempo* = $-\frac{\Delta m}{\Delta t}$ = $-\frac{-1,75}{30}$ ✓ = 0,06 (g· s^{-1}) ✓ (0,0583 g· s^{-1})

(3)

Notes/*Aantekeninge*
Accept negative answer i.e./***Aanvaar*** *negatiewe antwoord d.i.* - 0,06 g· s^{-1}.

5.3

Marking guidelines

- Calculate/*Bereken*: m($CaCO_3$) reacted/*reageer* or / *of* V(CO_2) produced/*gevorm.* ✓
- Substitute/*Vervang*: 100 g·mol^{-1}. ✓
- USE mol ratio/*GEBRUIK molverhouding*: n(CO_2) : n($CaCO_3$) = 1 : 1 ✓
- Use of/ /*Gebruik van* 22,4 dm^{-3}·mol^{-1}.✓
- Final answer/*Finale antwoord*: 0,18 dm^3 (0,1792 dm^3) ✓

OPTION 1/*OPSIE 1*

$m(CaCO_3) = \frac{40}{100} \times 2$ ✓

$= 0,8$ g

$n(CaCO_3)_{reacted} = \frac{m}{M}$

$= \frac{0,8}{100}$ ✓

$= 8 \times 10^{-3}$ mol

$n(CO_2) = n(CaCO_3)$ ✓

$= 8 \times 10^{-3}$ mol

$V(CO_2) = 8 \times 10^{-3} \times 22,4$ ✓

$= 0,18$ dm^3 ✓

OPTION 2/*OPSIE 2*

For 2 g antacid/*teensuurtablet*:

100 g ✓$CaCO_3$ .....22,4 dm^3 ✓ CO_2

2 g $CaCO_3$ .....0,448 dm^3 ✓

100% CO_2 ..... 0,448 dm^3 ✓

40% CO_2 ..... 0,18 dm^3 ✓

OPTION 3/*OPSIE 3*

100% $CaCO_3$ .....2 g

40% .....0,8 g ✓

100 g ✓……. 1 mol

0,8 g ..... 8×10^{-3} mol ✓

1 mol .....22,4 dm^3 ✓

8×10^{-3} mol .....0,18 dm^3 ✓ (5)

5.4 **ANY ONE/*ENIGE EEN*:**

- Concentration (of acid)/*Konsenterasie (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

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

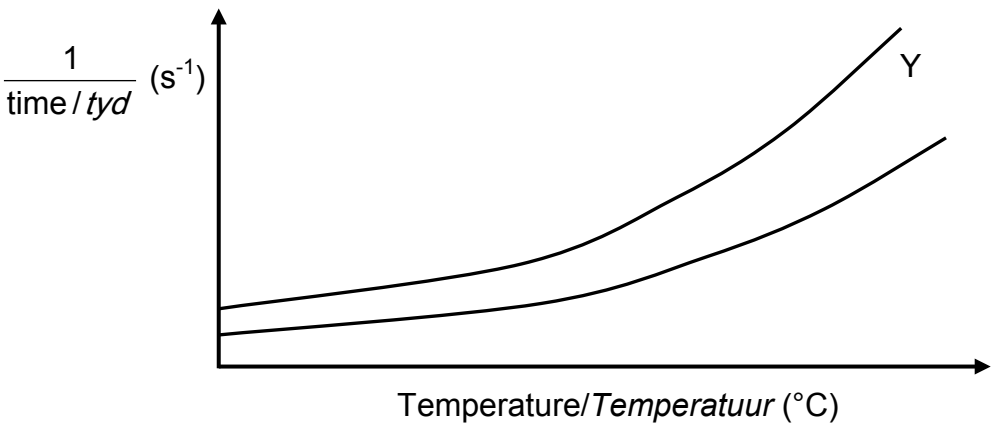
Examples/*Voorbeelde*:

- Reaction rate ($\frac{1}{\text{time}}$) increases with increase in temperature.
  Reaksietempo ($\frac{1}{\text{time}}$) *neem toe met toename in temperatuur.*
- Reaction rate ($\frac{1}{\text{time}}$) decreases with decrease in temperature.
  Reaksietempo ($\frac{1}{\text{time}}$) *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. $\frac{1}{2}$
Reaksietempo 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 g·mol^{-1}. ✓
- Equilibrium concentration of CO_2 multiply by 3 dm^3 / *Ewewigskonsentrasie van* CO_2 *vermenigvuldig met 3 dm*^{3} **AND/*EN*** $n(CO)_{eq}$ divide by /*deel* deur 3 dm^3 ✓
- Use mole ratio/*Gebruik molverhouding:* 1:2 / $n(CO) = 2n(CO_2)$. ✓
- $n(CO_2)_{change} = n(CO_2)_{initial} - n(CO_2)_{final}$ / $n(CO)_{eq/ewe} = n(CO)_{initial/begin} + \Delta n(CO)$ ✓
- 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*

$n(CO_2) = \frac{m}{M}$

$= \frac{60,8}{44}$ ✓

$= 1,382$ mol

	CO_2	CO
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	1,382	0
Change (mol) ✓ *Verandering (mol)*	1,22	2,44
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	0,162	2,44
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*	0,054	0,813

Use ratio/*Gebruik verhouding* ✓

Divide/multiply by 3/*Deel/ vermenigvuldig met 3* ✓

$K_c = \frac{[CO]^2}{[CO_2]}$ ✓

$= \frac{(0,813)^2}{0,054}$ ✓

$= 12,24$ ✓

No K_c expression, correct substitution/*Geen K_c- uitdrukking, korrekte substitusie:* Max./*Maks.* $\frac{6}{7}$

Wrong K_c expression/*Verkeerde K_c- uitdrukking*: Max./*Maks.* $\frac{4}{7}$

OPTION 2/*OPSIE 2*

$n(CO_2) = \frac{m}{M}$

$= \frac{60,8}{44}$ ✓

$= 1,382$ mol

$n(CO_2)_{change} = n(CO_2)_{initial/begin} - n(CO_2)_{final/finaal}$

$= 1,382 - 0,162$

$= 1,22$ mol

$n(CO)_{change} = 2(CO_2)$ ✓

$= 2(1,22)$ ✓

$= 2,44$ mol

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

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

$= \frac{2.44}{3}$ ✓

$= 0,813\ mol \cdot dm^{-3}$

$K_c = \frac{[CO]^2}{[CO_2]}$ ✓

$= \frac{(0,813)^2}{0,054}$ ✓

$= 12,24$ ✓ (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(CO_2)divide by 3 dm^3. ✓
  Aanvanklike n(CO_2) gedeel deur 3 dm^3.
- **USE** ratio/***GEBRUIK*** *verhouding:* c(CO_2) : c(CO) = 1 : 2 ✓
- $\Delta c(CO_2) = c(CO_2)_{initial/begin} - c(CO_2)_{eq/ewe}$ ✓
  $c(CO)_{eq/ewe} = c(CO)_{initial/begin} + \Delta c(CO)$.
- 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*

$$n(CO_2) = \frac{m}{M}$$
$$= \frac{60,8}{44} \checkmark$$
$$= 1,382 \text{ mol}$$

	CO_2	CO
Initial concentration (mol·dm^{-3}) *Aanvanklike konsentrasie (mol·dm^{-3})*	0,4607 ✓	0
Change (mol·dm^{-3}) *Verandering (mol·dm^{-3})*	0,4067	0,813
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	0,054	0,813

Divide by /*Deel deur* 3 dm^3 ✓

ratio ✓ *verhouding*

$$K_c = \frac{[CO]^2}{[CO_2]} \checkmark$$
$$= \frac{(0,813)^2}{0,054} \checkmark$$
$$= 12,15 \checkmark$$

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***

$n(C)_{reacted/reageer} = n(CO_2)_{reacted/reageer}$
$= 1,22$ mol ✓

$m(C) = nM$ ✓
$= 1,22(12)$
$= 14,64$ g ✓

Marking guidelines

- **USE** mol ratio/ ***GEBRUIK*** *molverhouding*: n(C) = n(CO_2). ✓
- 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 CO_2 is formed. ✓
  Die terugwaartse reaksie word bevoordeel./ meer CO_2 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 dm^3 /mol ✓
  OR/*OF*
  Calculate the total concentration at equilibrium/*Bereken die totale konsentrasie by ewewig*: 0,054 + 0,813 = 0,867 $mol \cdot dm^{-3}$
- Calculate percentage of ANY one gas/*Bereken persentasie van ENIGE een gas* (CO_2 or/*of* CO). ✓
- Final answer/*Finale antwoord*: T = 827 °C ✓

OPTION 1/*OPSIE 1*

$V_{total\ eq}$ = 0,162 + 2,44 ✓
= 2,606 dm^3

$\%\ CO_2 = \frac{0,162}{2,606} \times 100$ ✓
= 6,225 %

OR/*OF*

$\%\ CO = \frac{2,44}{2,606} \times 100$ ✓
= 93,63 %

OPTION 2/*OPSIE 2*

$c_{total\ eq}$ = 0,054 + 0,813
= 0,867 $mol \cdot dm^{-3}$

$\%\ CO_2 = \frac{0,054}{0,867} \times 100$ ✓
= 6,228 %

OR/*OF* $\%\ CO = \frac{0,813}{0,867} \times 100$ ✓
= 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 dm^3 /90 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*

$n(NaOH)_{reacted/reageer}$ = cV ✓
= 0,5(0,0165) ✓
= 0,00825 mol

$n(HBr)_{excess/oormaat}$ = n(NaOH) = 0,00825 mol ✓

$c(H_3O^+) = \frac{n}{V}$
$= \frac{0,00825}{0,09}$ ✓
= 0,092 mol·dm^{-3}

pH = -log[H_3O^+] ✓
= -log(0,092) ✓
= 1,04 ✓

OPTION 2/*OPSIE 2*

$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$ ✓

$\frac{c_a (90)}{(0,5)(16,5)} = \frac{1}{1}$ ✓

c_a = 0,092 mol·dm^{-3}

pH = -log[H_3O^+] ✓
= -log(0,092) ✓
= 1,04 ✓

(7)

7.3.2

Marking guidelines/*Nasienriglyne*

- Calculate/*Bereken* $n(HBr)_{initial/aanvanklik}$: substitute/*vervang* (0,45)(0,09) in n = cV ✓
- Subtraction/*Aftrekking:*
  $n(HBr)_{reacted/reageer} = n(HBr)_{initial/aanvanklik} - n(HBr)_{reacted\ with/reageer\ met\ NaOH}$. ✓✓
  OR/*OF*: $c(HBr)_{reacted/reageer} = c(HBr)_{initial/aanvanklik} - c(H_3O^+)_{excess/oormaat}$
- Use mol ratio/*Gebruik molverhouding:* $n(Zn(OH)_2) : n(HBr) = 1 : 2$ ✓
- Substitution of/*Vervanging van:* 99 g·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*

$n(HBr)_{initial/begin}$ = cV
= (0,45)(0,09) ✓
= 0,0405 mol

n(HBr reacted with/*reageer met* $Zn(OH)_2$) = 0,0405 – 0,00825 ✓✓
= 0,03224 mol

$n(Zn(OH)_2)$ = ½n(HBr) = ½(0,03224) ✓= 0,016125 mol

$m(Zn(OH)_2)$ = nM
= (0,016125)(99) ✓
= 1,596 g ✓

OPTION 2/*OPSIE 2*

c(HBr) = 0,45 – 0,092 ✓✓
= 0,358 mol·dm^{-3}
n(HBr reacted/*reageer*) = cV
= 0,358 x 0,09 ✓
= 0,0322 mol

$n(Zn(OH)_2)$ = ½n(HBr) = ½(0,0322) ✓= 0,01611 mol

$m(Zn(OH)_2)$ = nM
= 0,01611 x 99 ✓
= 1,595 g ✓ (1,60 g)

(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***

$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓

$1{,}49 = 1{,}36 - E^{\theta}_{anode}$ ✓ ✓

$E^{\theta}_{anode} = 1{,}36 - 1{,}49$

$= -0{,}13$ (V) ✓

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. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions:/*Enige ander formule wat onkonvensionele afkortings gebruik, bv.* $E°_{sel} = E°_{OM} - E°_{RM}$ *gevolg deur korrekte vervangings*: 4/5

OPTION 2/*OPSIE 2*

✓ $C\ell_2 + 2e^- \rightarrow 2C\ell^-$ E^{θ} = 1,36 V ✓

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

$C\ell_2 + X \rightarrow X^{2+} + 2C\ell^-$ E^{θ} = 1,49 V ✓

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 t*empo 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
- $[C\ell^-]$ 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

9.2.1 $2H_2O(\ell) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ ✓✓
Ignore phases/*Ignoreer fases*

Marking guidelines/*Nasienriglyne*
- $H_2(g) + 2OH^-(aq) \leftarrow 2H_2O(\ell) + 2e^-$ $(^2/_2)$ $2H_2O(\ell) + 2e^- \rightleftharpoons H_2(g) + 2OH^-(aq)$ $(^1/_2)$
  $H_2(g) + 2OH^-(aq) \rightleftharpoons 2H_2O(\ell) + 2e^-$ $(^0/_2)$ $2H_2O(\ell) + 2e^- \leftarrow H_2(g) + 2OH^-(aq)$ $(^0/_2)$
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (-) omitted on OH^- /*Indien lading (-) weggelaat op* OH^-:
  Example/*Voorbeeld:* $2H_2O(\ell) + 2e^- \rightarrow H_2(g) + 2OH(aq)$ ✓ 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 $H_2(g)$ 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 $H_2(g)$ *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*/H_2 ✓ (1)

10.1.2 Nitrogen monoxide/*Stikstofmonoksied*/NO ✓ (1)

10.1.3 Nitric acid/*Salpetersuur*/HNO_3 ✓ (1)

10.2

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

10.2.2 NH_3 + HNO_3 ✓ → NH_4NO_3 ✓ 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

Marking guidelines/*Nasienriglyne*

- 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. ✓

OPTION 1/*OPSIE 1*

Mass fertiliser in A:
Massa kunsmis in A:

$m = \frac{21}{100} \times 50$ ✓ = 10,5 kg

Mass fertiliser in B:
/*Massa kunsmis in B*:

$m = \frac{27}{100} \times 40$ ✓ = 10,8 kg

Mass phosphorous in A/
Massa fosfor in A:

$\frac{3}{8} \times 10{,}5$ = 3,94 kg

Mass phosphorous in B/
Massa fosfor in B:

$\frac{3}{8} \times 10{,}8$ = 4,05 kg

✓

Fertiliser B has more phosphorous than fertiliser A. ✓

OPTION 2/*OPSIE 2*

Mass phosphorous in A/
Massa fosfor in A:

$m = \frac{3}{8} \times \frac{21}{100} \times 50$ ✓ = 3,94 kg

Mass(P) in B
Massa (P) in B:

$m = \frac{3}{8} \times \frac{27}{100} \times 40$ ✓ = 4,05 kg

✓

Fertiliser B has more phosphorous than fertiliser A. /*Kunsmis B het meer fosfor as kunsmis A.*✓

OPTION 3/*OPSIE 3*

Mass phosphorous in A/
Massa fosfor in A:

$\%P = \frac{3}{8} \times 21 = 7{,}88\%$

$m(P) = \frac{7{,}88}{100} \times 50$ ✓ = 3,94 kg

Mass(P) in B
Massa (P) in B:

$\%(P) = \frac{3}{8} \times 27 = 10{,}13\%$

$m = \frac{10{,}13}{100} \times 40$ ✓ = 4,05 kg

✓

Fertiliser B has more phosphorous than fertiliser A. /*Kunsmis B het meer fosfor as kunsmis A* ✓

OPTION 4/*OPSIE 4*

Mass fertiliser in A:
Massa kunsmis in A:

$m = \frac{21}{100} \times 50$ ✓ = 10,5 kg

Mass fertiliser in B:
/*Massa kunsmis in B*:

$m = \frac{27}{100} \times 40$ ✓ = 10,8 kg

For the same NPK ratio ✓
the bag with more fertiliser will have more phosphorous ∴ bag B✓
Vir dieselfde NPK verhouding, die sak met meer kunsmis sal meer fosfor het ∴ sak B

(4)
[12]

TOTAL/*TOTAAL*: 150