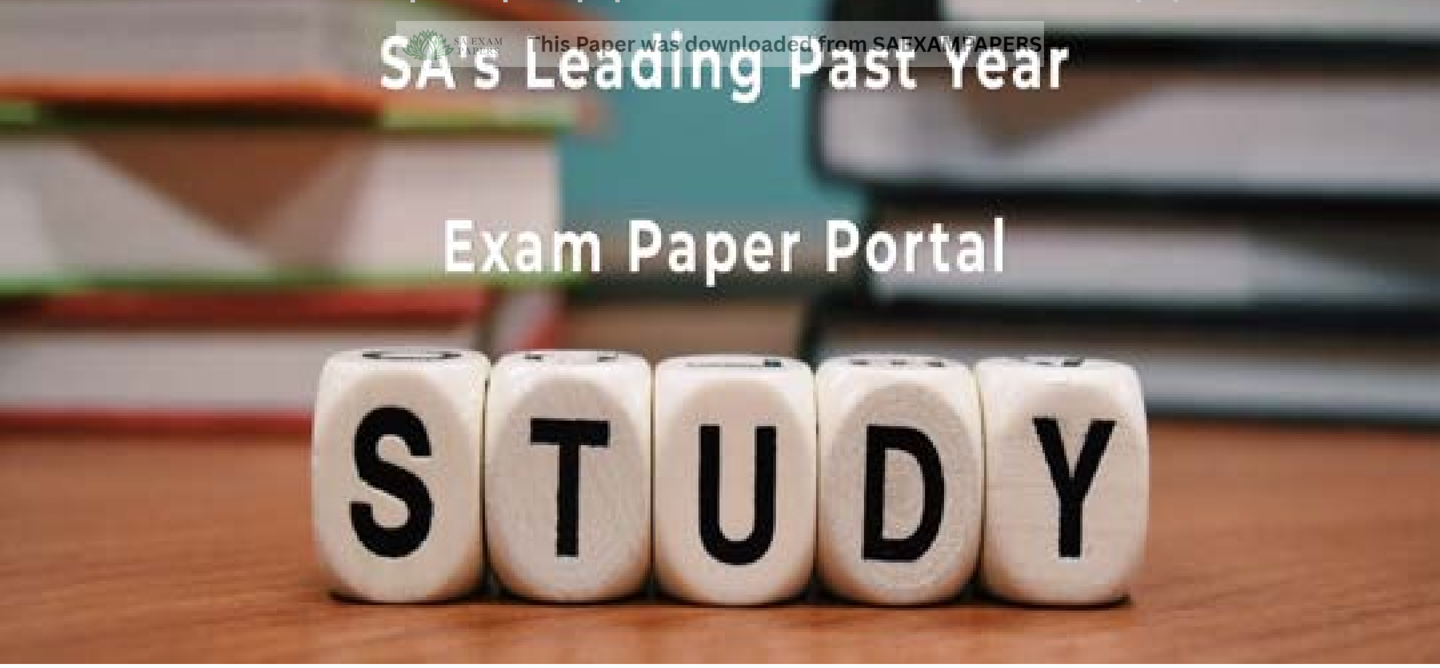

SA's Leading Past Year
Exam Paper Portal
STUDY

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN

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

MAY/JUNE 2025/*MEI/JUNIE 2025*

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 22 pages.
Hierdie nasienriglyne bestaan uit 22 bladsye.

QUESTION 1/*VRAAG 1*

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

QUESTION 2/*VRAAG 2*

2.1 Compounds with one or more <u>multiple bonds between C atoms</u> in the hydrocarbon chain. ✓✓ (2 or 0)
Verbindings met een of meer <u>meervoudige bindings tussen C-atome</u> in die koolwaterstofkettings. (2 of 0)

OR/*OF*
A hydrocarbon with <u>two or more bonds between the C-atoms</u>.
'n Koolwaterstof met <u>twee of meer bindings tussen die C-atome.</u>

OR/*OF*
Hydrocarbons containing not only single bonds between C atoms.
Koolwaterstowwe wat nie slegs enkelbindings tussen die C-atome bevat nie.

<u>ACCEPT/*AANVAAR:*</u>
Compounds with one or more <u>double/triple bonds between C atoms</u> in the hydrocarbon chain.
Verbindings met een of meer <u>dubbel/trippelbindings tussen C-atome</u> in die koolwaterstofkettings. (2)

2.2

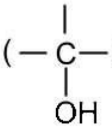
2.2.1 E ✓ (1)

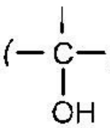
2.2.2 C and/*en* F ✓ (1)

2.3 Ketones/*Ketone* ✓
Aldehydes/*Aldehiede* ✓ (2)

2.4 Tertiary/*Tersiêre* ✓

The hydroxyl group/functional group (-OH) is bonded to a C atom that is bonded to three other C atoms. ✓
Die hidroksiel/funksionele groep (-OH) is gebind aan 'n C-atoom wat aan drie ander C-atome gebind is.

OR/*OF*
The functional group () is bonded to three other C atoms.

Die funksionele groep ( *) is gebind aan drie ander C-atome.* (2)

2.5
2.5.1

Marking criteria: • Correct stem, i.e. hexane. ✓ • All substituents (ethyl and iodo) correctly identified. ✓ • IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓ ***Nasienkriteria:*** • *Korrekte stam, d.i. heksaan.* ✓ • *Substituente (etiel en jodo) korrek geïdentifiseer.* ✓ • *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.* ✓

3-ethyl-4-iodohexane/3-etiel-4-jodoheksaan ✓✓✓ (3)

2.5.2

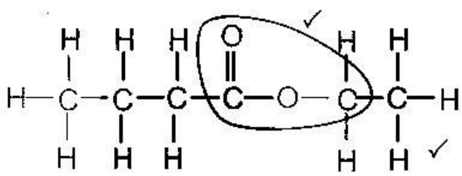
Marking criteria/*Nasienkriteria:* • Correct stem and substituents: methyl and propanol ✓ *Korrekte stam en substituente: metiel en propanol* • IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓ *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.*

2-methylpropan-1-ol/ 2-methyl-1-propanol/ methylpropan-1-ol/ methyl-1-propanol ✓✓
2-metielpropan-1-ol/ 2-metiel-1-propanol / metielpropan-1-ol/ metiel-1-propanol (2)

2.6

2.6.1 Esterification/Condensation/*Verestering/Esterifikasie/Kondensasie* ✓ (1)

2.6.2



Marking criteria/*Nasienkriteria:*

- Functional group correct. ✓
  Funksionele groep korrek.
- Whole structure correct. ✓
  Hele struktuur korrek.

IF/*INDIEN*

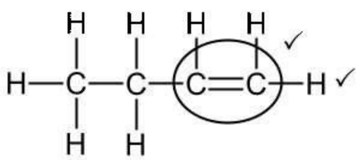
- More than one functional group/wrong functional group:
  Meer as een funksionele groep/foutiewe funksionele groep: $^0/_2$
- If condensed structural formulae used/*Indien gekondenseerde struktuurformules gebruik:* Max./*Maks.* $^1/_2$

(2)

2.7

2.7.1 C_2H_4O ✓ (1)

2.7.2



Marking criteria/*Nasienkriteria*:

- Correct functional group. ✓
  Korrekte funksionele groep.
- Whole structure correct. ✓
  Hele struktuur korrek.

IF/*INDIEN*

- More than one functional group/wrong functional group:
  Meer as een funksionele groep/foutiewe funksionele groep: $^0/_2$
- If condensed structural formulae used/*Indien gekondenseerde struktuurformules gebruik:* Max./*Maks.* $^1/_2$

(2)

[19]

QUESTION 3/*VRAAG 3*

3.1.1

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.*

A series of organic compounds that can be described by the same general formula and that have the same functional group. ✓✓
OR
A series of organic compounds in which one member differs from the next by a CH_2 group.

'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan worden wat dieselfde funksionele groep het.
OF
n Reeks organiese verbindings waarin die een lid van die volgende verskil met 'n CH_2-groep (2)

3.1.2
(a) Formyl (group)/*Formiel(groep)* ✓ (1)

(b)

Marking criteria*:*	***Nasienkriteria:***
• Correct chain length, i.e. Meth. ✓ • Everything else correct: IUPAC name completely correct including numbering. ✓	• *Korrekte kettinglengte d.i. Met.* ✓ • *Alles verder reg: IUPAC-naam heeltemal korrek insluitende nommering.* ✓

Methanal/*Metanaal* ✓✓ (2)

3.1.3
(a) Homologous series/Functional group ✓
Homoloë reeks/Funksionele groep (1)

(b) The boiling points of the carboxylic acids increase with an increase in the chain length/the number of carbon atoms./The boiling points of the carboxylic acids decrease with a decrease in the chain length/number of carbon atoms. ✓

Die kookpunte van die karboksielsure neem toe met 'n toename in die kettinglengte/aantal koolstofatome./Die kookpunte van die karboksielsure neem af met 'n afname in die kettinglengte/aantal koolstofatome. (1)

(c)

Marking criteria:
For increasing or decreasing number of C atoms
- Compare the strength of intermolecular forces. ✓
- Compare the energy required to overcome intermolecular forces. ✓

Nasienkriteria:
Vir toename of afname in aantal C-atome
- *Vergelyk die sterkte van intermolekulêre kragte.* ✓
- *Vergelyk die energie benodig om intermolekulêre kragte te oorkom.* ✓

As the number of C atoms/chain length/surface area/contact area increases
- The strength of intermolecular/London/dispersion forces increases. ✓
- More energy is needed to overcome intermolecular forces London/ dispersion forces. ✓

OR

As the number of C atoms/chain length/surface area/contact area decreases
- The strength of intermolecular/London/dispersion forces decreases. ✓
- Less energy is needed to overcome intermolecular forces London/ dispersion forces. ✓

Met toename in aantal C-atome/kettinglengte/oppervlakarea/kontakarea.
- *Die sterkte van die die intermolekulêre kragte/Londonkragte/ dispersiekragte neem toe.*
- *Meer energie word benodig om die intermolekulêre kragte/Londonkragte/ dispersiekragte te oorkom/breek.*

OF

Met afname in aantal C-atome/kettinglengte/oppervlakarea/kontakarea.
- *Die sterkte van die die intermolekulêre kragte/Londonkragte/ dispersiekragte neem af.*
- *Minder energie word benodig om die intermolekulêre kragte/ Londonkragte/dispersiekragte te oorkom/breek* (2)

3.1.4 75 °C ✓✓ (2)

3.2

<table>
<tr><td>

Marking criteria:

- Higher ✓
- State that carboxylic acids have more than one (three) site for hydrogen bonding and alcohols have one site for hydrogen bonding. ✓
- Comparing the strength of IMFs. ✓
- Comparing the number of molecules at a given temperature/energy needed to overcome IMFs. ✓

Nasienkriteria:

- *Hoër* ✓
- *Stel dat karboksielsure het meer as een (drie) plekke vir waterstofbindings en dat alkohole een plek het vir waterstofbinding.* ✓
- *Vergelyk die sterkte van die IMK's/energie benodig om IMK's te oorkom.* ✓
- *Vergelyk die hoeveelheid molekules by 'n gegewe temperatuur/energie nodig om die IMK te oorkom.* ✓

</td></tr>
<tr><td>

- Higher ✓
- Compound B/$CH_3CH_2CH_2COOH$/Carboxylic acid/Butanoic acid has (in addition to London forces and dipole-dipole forces), more than one site (three) for hydrogen bonding between molecules and compound A/$CH_3CH_2CH_2CH_2CH_2OH$/Alcohol/Pentan-1-ol has (in addition to London forces and dipole-dipole forces) one site for hydrogen bonding between molecules. ✓
- Intermolecular forces in compound B/$CH_3CH_2CH_2COOH$/Carboxylic acids/Butanoic acid are stronger. ✓
- At a given temperature there will be fewer molecules of compound B/$CH_3CH_2CH_2COOH$/Carboxylic acids/Butanoic acid in the vapour phase. ✓

OR

More energy needed to overcome/break intermolecular forces in compound B/ $CH_3CH_2CH_2COOH$/Carboxylic acid/Butanoic acid.

</td></tr>
<tr><td>

- Higher ✓
- Compound A/$CH_3CH_2CH_2CH_2CH_2OH$/Alcohol/Pentan-1-ol has (in addition to London forces and dipole-dipole forces) one site for hydrogen bonding between molecules and compound B/$CH_3CH_2CH_2COOH$/ Carboxylic acid/Butanoic acid has, (in addition to London forces and dipole-dipole forces), more than one site (three) for hydrogen bonding between molecules. ✓
- Intermolecular forces in compound A/$CH_3CH_2CH_2CH_2CH_2OH$/Alcohol/ Pentan-1-ol are weaker. ✓
- At a given temperature there will be more molecules of compound A/$CH_3CH_2CH_2CH_2CH_2OH$/Alcohol/ Pentan-1-ol in the vapour phase. ✓

OR

Less energy needed to overcome/break intermolecular forces in compound A/$CH_3CH_2CH_2CH_2CH_2OH$/Pentan-1-ol/Alcohol.

</td></tr>
</table>

• *Hoër* • *Verbinding B/$CH_3CH_2CH_2COOH$/Karboksielsure/Butanoësuur het, (in toevoeging tot Londonkragte en dipool-dipoolkragte), meer as een punt (drie) vir waterstofbinding tussen molekule en verbinding A/ $CH_3CH_2CH_2CH_2CH_2OH$/Alkohol/Pentan-1-ol het, (in toevoeging tot Londonkragte en dipool-dipoolkragte), een punt vir waterstofbinding tussen molekule.* • *Intermolekulêre kragte in verbinding B/$CH_3CH_2CH_2COOH$/Karboksielsure/ Butanoësuur is sterker.* • *By 'n gegewe temperatuur sal daar minder molekules van verbinding B/$CH_3CH_2CH_2COOH$/Karboksielsure/Butanoësuur in die dampfase wees.* ***OF*** • *Meer energie word benodig om intermolekulêre kragte in verbinding B/$CH_3CH_2CH_2COOH$/Karboksielsure/Butanoësuur te oorkom/breek.*
• *Hoër* • *Verbinding A/$CH_3CH_2CH_2CH_2CH_2OH$/Alkohol/Pentan-1-ol het, (in toevoeging tot Londonkragte en dipool-dipoolkragte), een punt vir waterstofbinding tussen molekule en verbinding B/$CH_3CH_2CH_2COOH$/ Karboksielsure/Butanoësuur het, (in toevoeging tot Londonkragte en dipool-dipoolkragte), meer as een punt (drie) vir waterstofbinding tussen molekule.* • *Intermolekulêre kragte in verbinding A/ $CH_3CH_2CH_2CH_2CH_2OH$/Alkohol/ Pentan-1-ol is swakker.* • *By 'n gegewe temperatuur sal daar meer molekules van verbinding A/ $CH_3CH_2CH_2CH_2CH_2OH$/Alkohol/Pentan-1-ol in die dampfase wees.* ***OF*** *Minder energie word benodig om intermolekulêre kragte in A/ $CH_3CH_2CH_2CH_2CH_2OH$/Alkohol/Pentan-1-ol te oorkom/breek.*

(4)
[15]

QUESTION 4/*VRAAG 4*

4.1

4.1.1 Hydrogenation/*Hidrogenering/Hidrogenasie* ✓ (1)

4.1.2 Dehydration/*Dehidrasie/Dehidratering* ✓ (1)

4.2

Marking criteria:	***Nasienkriteria:***
• Correct chain length, i.e. But. ✓ • Everything else correct: IUPAC name completely correct including numbering. ✓	• *Korrekte kettinglengte d.i. But.* ✓ • *Alles verder reg: IUPAC-naam heeltemal korrek insluitende nommering.* ✓

Butan-1-ol/1-butanol ✓✓ (2)

4.3

4.3.1

Marking criteria/*Nasienkriteria:*
• Whole condensed structural formula of alkene correct. ✓ *Hele gekondenseerde struktuurformule van die alkeen korrek.* • H_2O. ✓ • Hydroxyl group/OH on second C atom of alcohol. ✓ *Hidroksielgroep/OH op die tweede C-atoom van die alcohol.* • Whole condensed structural formula of alcohol correct (OH on second C-atom). ✓ Hele gekondenseerde struktuurformule van alcohol korrek. **IF/*INDIEN*** • Any additional reactants or products /*Enige addisionele reaktanse of produkte:* Deduct 1 mark/Trek 1 punt af. • Structural formulae used/*Struktuurformule gebruik.* Max./*Maks.* $^3/_4$ • Molecular formulae used/*Molekulêre formule gebruik.* Max./*Maks.* $^1/_4$ Marking rule 6.3.10/*Nasienreël 6.3.10*

$CH_2CHCH_2CH_3$ ✓ + H_2O ✓ → $CH_3CHOHCH_2CH_3$ ✓✓

OR/*OF*

$CH_2{=}CHCH_2CH_3$ ✓ + H_2O ✓ → $CH_3CH(OH)CH_2CH_3$ ✓✓ (4)

4.3.2 Sulphuric acid/H_2SO_4/Phosphoric acid/H_3PO_4/*Swaelsuur/Fosforsuur* ✓ (1)

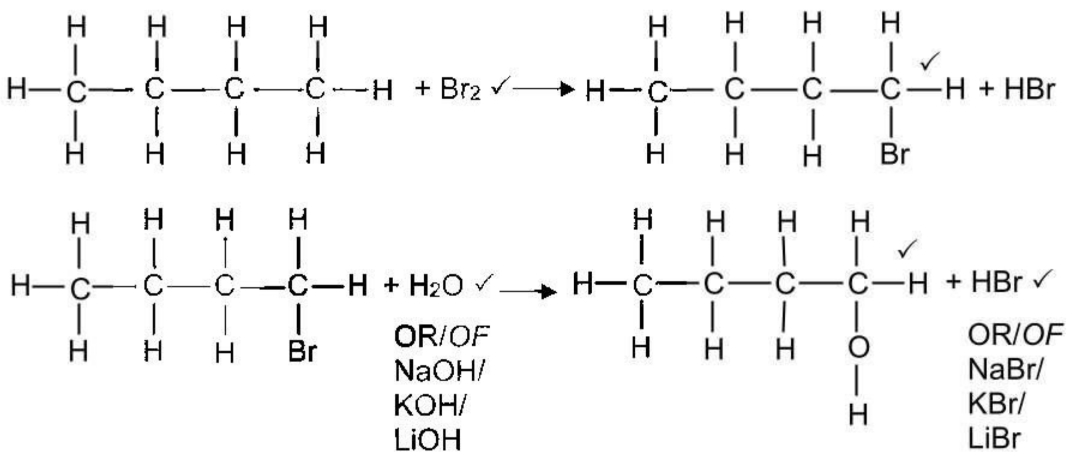
4.4

Marking criteria/*Nasienkriteria:*

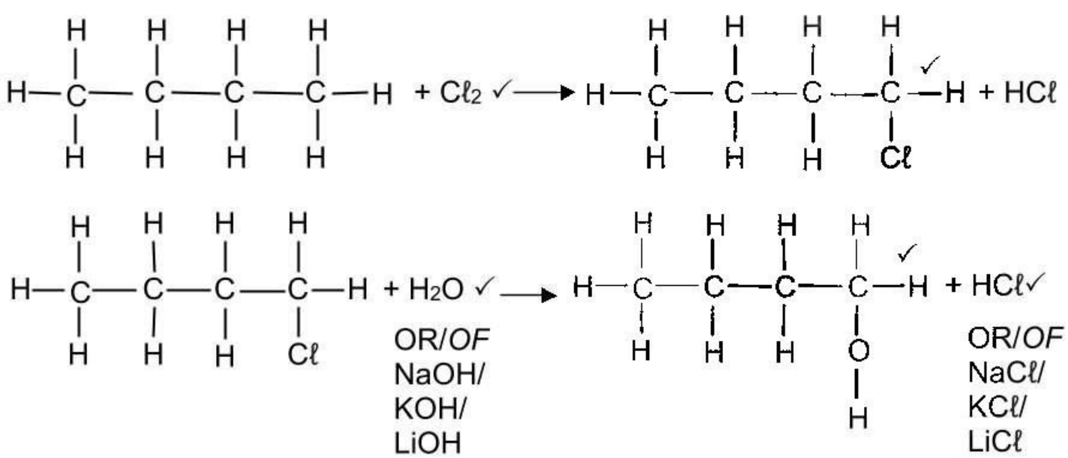
- Br_2/$C\ell_2$. ✓
- Whole structural formula of haloalkane. ✓
  Hele struktuurformule van haloalkaan korrek.
- H_2O/NaOH/KOH/LiOH. ✓
- Whole structural formula of alcohol. ✓
  Hele struktuurformule van alkohol korrek.
- HBr/NaBr/KBr/LiBr/HCℓ/NaCℓ/KCℓ/LiCℓ. ✓

IF/*INDIEN*

- Any additional reactants or products /*Enige addisionele reaktanse of produkte:* Max./*Maks.* $^4/_5$
- Condensed structural formulae used: deduct 1 mark/trek 1 punt af.
- If inorganic product does not correspond with inorganic reactant: no mark for inorganic product./*Indien anorganiese produk nie met die anorganiese reaktans ooreenstem nie, geen punt vir anorganiese produk.*
- Molecular formulae used:/*Molekulêre formule gebruik:* Max./*Maks.* $^3/_5$
- Marking rule 6.3.10/*Nasienreël 6.3.10*



OR/*OF*



(5)

4.5 $2C_4H_{10} + 13O_2$ ✓ $\rightarrow 8CO_2 + 10H_2O$ ✓ Bal. ✓

Ignore phases./*Ignoreer fases.*

Marking criteria/*Nasienkriteria:*
• Reactants ✓ *Reaktanse* Products ✓ *Produkte* Balancing: ✓ *Balansering*
• Ignore double arrows./*Ignoreer dubbelpyle.*
• Marking rule 6.3.10/*Nasienreël 6.3.10.*
IF/*INDIEN*:
• Structural formulae C_4H_{10} used:/*Struktuurformule C_4H_{10} gebruik:* Max./*Maks.* $^2/_3$

(3)
[17]

QUESTION 5/VRAAG 5

5.1

NOTE/*LET WEL*
Give the mark for per unit time only if in context of reaction rate.
Gee die punt vir per eenheidtyd slegs indien in konteks van 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)

5.2 **ANY 1/ENIGE 1:**

Temperature/*Temperatuur* ✓
(Initial) amount/mass of magnesium carbonate
(Aanvanklike) hoeveelheid/massa van magnesiumkarbonaat (1)

5.3 CO_2/gas escapes from the reaction flask. ✓
CO_2 is 'n gas/diffundeer/ontsnap die reaksiefles. (1)

5.4

Marking criteria	***Nasienkriteria***:
(a) Mass subtraction ✓	**(a)** *Aftrek van massas.* ✓
(b) Formula: $n = \frac{m}{M}$ or $V = nV_m$ ✓	**(b)** *Formula:* $n = \frac{m}{M}$ *or* $V = nV_m$ ✓
(c) Substitute $M = 44\ g{\cdot}mol^{-1}$ in $n(CO_2) = \frac{m}{M}$ ✓	**(c)** *Vervang* $M = 44\ g{\cdot}mol^{-1}$ *in* $n(CO_2) = \frac{m}{M}$ ✓
(d) Substitute $24,5\ dm^3$ in $V = nV_m$ ✓	**(d)** *Vervang* $24,5\ dm^3$ *in* $V = nV_m$ ✓
(e) Substitute V_{CO_2} and 120 in rate formula. ✓	**(e)** *Vervang* V_{CO_2} *en 120 in tempo-formule.* ✓
(f) Final correct answer: $2,92 \times 10^{-3}\ (dm^3{\cdot}s^{-1})$ ✓ Range: $2,08 \times 10^{-3}$ to $2,92 \times 10^{-3}$	**(f)** *Finale korrekte antwoord:* $2,92 \times 10^{-3}\ (dm^3{\cdot}s^{-1})$ ✓ *Gebied:* $2,08 \times 10^{-3}$ *tot* $2,92 \times 10^{-3}$

$m(CO_2) = 144,5 - 143,87$ ✓ **(a)**
$= 0,63\ g$

$n(CO_2) = \frac{m}{M}$ ✓ **(b)**
$= \frac{0,63}{44}$ ✓ **(c)**
$= 1,43 \times 10^{-2}\ mol$

$V(CO_2) = nV_m$
$= (1,43 \times 10^{-2})(24,5)$ ✓ **(d)**
$= 0,35\ dm^3$

Ave rate/*gem tempo* $= \frac{\Delta V(CO_2)}{\Delta t}$
$= \frac{0,35-(0)}{120-(0)}$ ✓ **(e)**
$= 2,92 \times 10^{-3}\ (dm^3{\cdot}s^{-1})$ ✓ **(f)** (6)

5.5 A ✓

- Gradient is least steep/lowest reaction rate/least amount of gas produced in 120 s. ✓
- Lowest concentration of HCℓ(aq). ✓
- Least/Less particles per unit volume. ✓
- Least/Less effective collisions per unit time/second. ✓
  OR
  Lowest/Lower frequency of effective collisions.

- *Gradient is die laagste/laagste reaksietempo/minste hoeveelheid gas geproduseer in 120 s.* ✓
- *Laagste konsentrasie van HCℓ(aq).* ✓
- *Minste/Minder deeltjies per eenheidsvolume.* ✓
- *Minste/Minder effektiewe botsings per eenheidstyd/sekonde.* ✓
  OF
  Laagste/Laer frekwensie van effektiewe botsings. (5)

5.6 The same/ *Dieselfde* ✓
$MgCO_3$ is the limiting reactant and the same amount is used in each experiment. ✓
$MgCO_3$ is die beperkte reaktans en dieselfde hoeveelheid is gebruik in elke eksperiment. (2)
[17]

QUESTION 6/*VRAAG 6*

6.1

6.1.1 Remains the same/*Bly dieselfde* ✓ (1)

6.1.2 Decreases/*Neem af* ✓ (1)

6.1.3 Remains the same/*Bly dieselfde* ✓ (1)

6.2
- Decrease in pressure favours the reaction that produces a greater number of moles/amount of gas. ✓
  'n Verlaging in druk bevoordeel die reaksie wat 'n groter aantal mol/hoeveelheid gas produseer.
- Forward reaction is favoured. ✓
  Voorwaartse reaksie word bevoordeel. (2)

6.3

Marking criteria:

(a) Substitute 44 in $n = \frac{m}{M}$ ✓
(b) Change in mass of carbon: $m(C_i) - m(C_f)$ ✓
(c) Substitute 12 in $n = \frac{m}{M}$ ✓
(d) Use mole ratio 1:1 ✓
(e) $n(CO_2)_{equilibrium} = n(CO_2)_{initial} - n(CO_2)_{used}$ OR $m(CO_2)_{equilibrium} = m(CO_2)_{initial} - m(CO_2)_{used}$ ✓
(f) Final answer: 6,16 g ✓
RANGE: 6 to 6,16 g

Nasienkriteria:

(a) *Vervang 44 in* $n = \frac{m}{M}$ ✓
(b) *Verandering in massa:* $m(C_i) - m(C_f)$ ✓
(c) *Vervang 12 in* $n = \frac{m}{M}$ ✓
(d) *Gebruik molverhouding 1:1* ✓
(e) $n(CO_2)_{ewewig} = n(CO_2)_{begin} - n(CO_2)_{gebruik}$ OF
(f) $m(CO_2)_{ewewig} = m(CO_2)_{begin} - m(CO_2)_{gebruik}$ ✓
(g) *Finale anwtoord: 6,16 g* ✓
GEBIED: 6 tot 6,16 g

OPTION 1/*OPSIE 1:*

$n(CO_2)_{initially} = \frac{m}{M}$
$= \frac{41,2}{44}$ ✓ **(a)**
$= 0,94$ mol (0,936)

$\Delta m(C) = 14 - 4,44$ ✓ **(b)**
$= 9,56$ g

$n(C)_{used} = \frac{m}{M}$
$n(C)_{used} = \frac{9,56}{12}$ ✓ **(c)**
$= 0,80$ mol (0,797)

$n(CO_2)_{used} = n(C)$
$= 0,80$ mol (0,797) ✓ **(d)**

$n(CO_2)_{eq} = n(CO_2)_{initially} - n(CO_2)_{used}$
$= 0,94 – 0,80$ ✓ **(e)**
$= 0,14$ mol

$n(CO_2) = \frac{m}{M}$
$0,14 = \frac{m}{44}$
$m(CO_2) = 6,16$ g ✓ **(f)**

OPTION 2/*OPSIE 2:*

$\Delta m(C) = 14 - 4,44$ ✓ **(b)**
$= 9,56$ g

$n(C)_{used} = \frac{m}{M}$
$n(C)_{used} = \frac{9,56}{12}$ ✓ **(c)**
$= 0,80$ mol (0,797)

$n(CO_2)_{used} = n(C)$
$= 0,80$ mol (0,797) ✓ **(d)**

$n(CO_2) = \frac{m}{M}$
$0,80 = \frac{m}{44}$ ✓ **(a)**
$m(CO_2) = 35,05$ g

$m(CO_2)_{eq} = m(CO_2)_{initially} - m(CO_2)_{used}$
$= 41,2 – 35,05$ ✓ **(e)**
$= 6,15$ g ✓ **(f)**

(6)

6.4

POSITIVE MARKING FROM QUESTION 6.3:
POSITIEWE NASIEN VANAF VRAAG 6.3:

Marking criteria

(a) Use of ratio $n(CO_2) : n(CO) = 1: 2$. ✓
(b) Divide by 3 dm^3 ✓
(c) Correct Kc expression (formulae in square brackets). ✓
(d) Substitute of concentration into K_C expression. ✓
(e) Final answer: 5,98 ✓
RANGE: 5,98 – 7,29

Nasienkriteria:

(a) Gebruik verhouding $n(CO_2) : n(CO) = 1: 2$. ✓
(b) Deel deur 3 dm^3 ✓
(c) Korrekte K_c uitdrukking (formules in vierkantige hakies). ✓
(d) Vervang konsentrasies in korrekte K_c uitdrukking. ✓
(e) Finale antwoord: 5,98 ✓
GEBIED: 5,98 – 7,29

CALCULATIONS USING NUMBER OF MOLES
BEREKENINGE WAT GETAL MOL GEBRUIK
OPTION 1/*OPSIE 1:*

$$n(CO_2)_{initial} = \frac{m}{M}$$
$$= \frac{41,2}{44}$$
$$= 0,936 \text{ mol}$$

	CO_2	CO	
Ratio/*Verhouding*	1	2	
Initial quantity (mol) Aanvangshoeveelheid (mol)	0,936	0	
Change (mol) *Verandering (mol)*	0,8	1,6	✓ **(a)**
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	0,14	1,6	
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)	0,047	0,53	Divide by 3 ✓ **(b)**

$$K_c = \frac{[CO]^2}{CO_2} \checkmark \textbf{(c)}$$
$$= \frac{(0,53)^2}{0,047} \checkmark \textbf{(d)}$$
$$= 5,98 \checkmark \textbf{(e)}$$

Wrong K_c expression
Verkeerde K_c-uitdrukking: Max./*Maks.* $^2/_5$
No K_c expression/*Geen K_c- uitdrukking*: $^4/_5$

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK

OPTION 2/*OPTION 2*

$C(CO_2) = \frac{m}{MV}$

$= \frac{41,2}{(44)(3)}$

$= 0,31\ mol\cdot dm^{-3}$

Divide by 3 ✓ **(b)**

$c = \frac{n}{V}$

$= \frac{0,8}{3}$

$= 0,27\ mol\cdot dm^{-3}$ (0,267)

	CO_2	CO	
Ratio/*Verhouding*	1	2	
Initial concentration ($mol\cdot dm^{-3}$) *Aanvangskonsentrasie ($mol\cdot dm^{-3}$)*	0,31	0	
Change in concentration ($mol\cdot dm^{-3}$) *Verandering in konsentrasie ($mol\cdot dm^{-3}$)*	0,27	0,54	✓ **(a)**
Equilibrium concentration ($mol\cdot dm^{-3}$) Ewewigskonsentrasie ($mol\cdot dm^{-3}$)	0,04	0,54	

$K_c = \frac{[CO]^2}{CO_2}$ ✓ **(c)**

$= \frac{(0,54)^2}{0,04}$ ✓ **(d)**

$= 7,29$ ✓ **(e)**

Wrong K_c expression
Verkeerde K_c-uitdrukking: Max./Maks. $^2/_5$
No K_c expression/*Geen K_c- uitdrukking*: $^4/_5$

OPTION 3/OPSIE 3:

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

$= \frac{41,2}{44}$

$= 0,936$ mol

$\Delta n(CO_2) = 0,8$ mol

$n(CO_2)_{equi} = n(CO_2)_{initial} - \Delta n(CO_2)$

$= 0,936 - 0,8$

$= 0,136$ mol

$n(CO)_{formed} = 2\Delta n(CO)_{used} = 1,6$ mol ✓ (a)

$n(CO)_{equil} = \Delta n(CO)_{formed} = 1,6$ mol

$[CO_2]_{eqm} = \frac{0,136}{3} = 4,53 \times 10^{-2}$ mol·dm^{-3}

$[CO]_{eqm} = \frac{1,6}{3} = 0,53$ mol·dm^{-3} ✓ (b)

$K_c = \frac{[CO]^2}{CO_2}$ ✓ (c)

$= \frac{(0,53)^2}{4,53 \times 10^{-2}}$ ✓ (d)

$= 6,2$ ✓ (e)

Wrong K_c expression *Verkeerde K_c-uitdrukking*: Max./Maks. $^2/_5$ No K_c expression/*Geen K_c- uitdrukking*: $^4/_5$

(5)

6.5

6.5.1 Y ✓✓ (2)

6.5.2 Remains the same ✓ (1)

[19]

QUESTION 7/*VRAAG 7*

7.1 Acids produce <u>hydrogen ions</u> (H^+)/H_3O^+ /hydronium ions) in <u>aqueous solution</u>. ✓✓ **(2 or 0)**
'n Suur is 'n stof wat <u>waterstofione</u> (H^+)/hidroniumione (H_3O^+) vorm wanneer dit in <u>water oplos</u>. (2)

7.2

7.2.1 $(COOH)_2$ ✓ (1)

7.2.2 NaCℓ ✓ (1)

7.2.3 HCO_3^- / NH_3 ✓ (1)

7.2.4 NaOH/ $Mg(OH)_2$ ✓✓ (2)

7.3

Marking criteria:	***Nasienkriteria:***
• Calculate $n(H_xY)$ ✓ • Calculate n(NaOH) ✓ • Final answer: x = 2 ✓ • Reactants ✓ Products ✓ Balancing ✓ • Ignore ⇌ and phases • Marking rule 6.3.10	• Bereken $n(H_xY)$ ✓ • Bereken n(NaOH) ✓ • Finale antwoord: x = 2 ✓ • *Reaktanse* ✓ *Produkte* ✓ Balansering ✓ • *Ignoreer* ⇌ *en fases* • *Nasienreël 6.3.10*
OPTION 1/*OPSIE 1:* n = cV $n_{acid} = (0,11)(0,02364)$ ✓ $= 2,60 \times 10^{-3}$ $n_{base} = (0,26)(0,02)$ ✓ $= 5,2 \times 10^{-3}$ (0,0052) $\frac{n(H_xY)}{n(NaOH)} = \frac{n_a}{n_b}$ $\frac{2,6 \times 10^{-3}}{5,2 \times 10^{-3}} = \frac{1}{2}$ x = 2 ✓	**OPTION 2/*OPSIE 2:*** $\frac{V_a \times C_a}{V_b \times C_b} = \frac{n_a}{n_b}$ $\frac{(20)(0,26) ✓}{(23,64)(0,11) ✓} = \frac{1}{2}$ x = 2 ✓

<u>$H_2Y(aq) + 2NaOH(aq)$</u> ✓ → <u>$Na_2Y(aq) + 2H_2O(\ell)$</u> ✓ Bal ✓ (6)

7.4

Marking criteria:

(a) Any formula: $pH = -\log[H_3O^+]$/$pH = -\log[H^+]$/$pOH = -\log[OH^-]$/ $[H_3O^+][OH^-] = 10^{-14}$ /$pH + pOH = 14$ ✓
(b) Substitute 1,61 in $pH = -\log[H_3O^+]$/$pH + pOH = 14$ ✓
(c) Calculate $n(HC\ell)_{unused}$ using $n = \frac{n}{V}$ ✓
(d) Calculate $n(HC\ell)_{initial}$ using $n = \frac{n}{V}$ ✓
(e) Calculate $n(HC\ell)_{used} = n(HC\ell)_{initial} - n(HC\ell)_{unused}$ ✓
(f) Using ratio 1:2 to calculate $n(CaCO_3)$ ✓
(g) Substitute 100 and n in $n = \frac{m}{M}$ ✓
(h) Mass of impurity = $m_{sample} - m(CaCO_3)$ ✓
(i) Final answer: 0,25g ✓ (Range: 0,20 g to 0,30 g)

Nasienkriteria:

(a) *Enige formule: $pH = -\log[H_3O^+]$/$pH = -\log[H^+]$/$pOH = -\log[OH^-]$/ $[H_3O^+][OH^-] = 10^{-14}$/$pH + pOH = 14$* ✓
(b) *Vervang 1,61 in $pH = -\log[H_3O^+]$/$pH + pOH = 14$* ✓
(c) *Bereken $n(HC\ell)_{ongebruik}$ using $n = \frac{n}{V}$* ✓
(d) *Bereken $n(HC\ell)_{begin}$ using $n = \frac{n}{V}$* ✓
(e) *Bereken $n(HC\ell)_{gebruik} = n(HC\ell)_{begin} - n(HC\ell)_{ongebruik}$* ✓
(f) *Gebruik ratio 1:2 om $n(CaCO_3)$ te bereken* ✓
(g) *Vervang 100 en n in $n = \frac{m}{M}$* ✓
(h) *Massa of onsuiwerheid = $m_{monster} - m(CaCO_3)$* ✓
(i) *Finale antwoord: 0,25g* ✓ (Gebied: 0,20 g to 0,30 g)

$pH = -\log[H_3O^+]$ ✓ **(a)**
$1,61 = -\log[H_3O^+]$ ✓ **(b)**
$[H_3O^+] = 10^{-1,61}$
$= 2,45 \times 10^{-2}\ mol\cdot dm^{-3}$ (0,0245)

$n(HC\ell)_{unused} = n(H_3O^+) = cV$
$= (2,45 \times 10^{-2})(0,2)$ ✓ **(c)**
$= 4,90 \times 10^{-3}$ mol (0,0049)

$n(HC\ell)_{initial} = cV$
$= (0,15)(0,2)$ ✓ **(d)**
$= 3 \times 10^{-2}$ mol (0,03)

$n(HC\ell)_{used} = 3 \times 10^{-2} - 4,90 \times 10^{-3}$ ✓ **(e)**
$= 2,51 \times 10^{-2}$ mol (0,0251)

Reaction ratio $nCaCO_3 : nHC\ell = 1:2$

$n(CaCO_3) = ½(2,51 \times 10^{-2})$ ✓ **(f)** $= 1,25 \times 10^{-2}$ mol

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

$1,25 \times 10^{-2} = \frac{m}{100}$ ✓ **(g)**

$m(CaCO_3) = 1,25$ g

m of impurity in the sample = 1,50 – 1,25 ✓ **(h)**
= 0,25 g ✓ **(i)**

(9)
[22]

QUESTION 8/*VRAAG 8*

8.1 H^+/H_3O^+ ions/hydrogen ions/hydronium ions ✓
Waterstofione/hidrononiumione (1)

8.2 0,77 V ✓ (1)

8.3 A ✓ (1)

8.4 H_2 is a stronger reducing agent ✓ than Fe^{2+}/Fe(II) ions ✓ and will reduce Fe^{3+}/Fe(III) ions ✓ (to Fe^{2+}/Fe(II) ions).

H_2 is 'n sterker reduseermiddel as Fe^{2+}/Fe(II)-ione en sal Fe^{3+}/Fe(III)-ione reduseer (na Fe^{2+}/Fe(II)-ione).

OR/*OF*

Fe^{2+}-ion is a weaker reducing agent ✓ than H_2 ✓ and therefore Fe^{3+}/Fe(III) ions (to Fe^{2+}/Fe(II) ions) will be reduced. ✓

Fe^{2+}-ioon is 'n sterker reduseermiddel as H_2 en sal Fe^{3+}/Fe(III)-ione reduseer (na Fe^{2+}/Fe(II)-ione). (3)

8.5

8.5.1 Pt/Platinum ✓ (1)

8.5.2 $H_2 \rightarrow 2H^+ + 2e^-$ ✓✓

<u>NOTE/*AANTEKENING:*</u>

- $2H^+ + 2e^- \leftarrow H_2$ ($\frac{2}{2}$)
  $H_2 \rightleftharpoons 2H^+ + 2e^-$ ($\frac{1}{2}$)
  $2H^+ + 2e^- \rightleftharpoons H_2$ ($\frac{0}{2}$)
  $2H^+ + 2e^- \rightarrow H_2$ ($\frac{0}{2}$)
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on H^+/*Indien lading (+) weggelaat op* H^+:
  Example/*Voorbeeld:* $H_2 \rightarrow 2H + 2e^-$ Max/*Maks:* $\frac{1}{2}$

(2)

8.5.3 Pt(s) | H_2(g) | H^+(aq) ✓ || ✓ Fe^{3+}(aq), Fe^{2+}(aq) | Pt(s) ✓

OR/*OF*

Pt(s) | H_2(g) | H^+(1 mol·dm^{-3}) || Fe^{3+}(1 mol·dm^{-3}), Fe^{2+}(1 mol·dm^{-3}) | Pt(s)

<u>ACCEPT/*AANVAAR*:</u>

Pt | H_2 | H^+ || Fe^{3+}, Fe^{2+} | Pt (3)

8.6 The reaction reaches equilibrium/no charges/electrons flow. ✓
Die reaksie bereik ewewig/geen ladings/elektrone vloei. (1)

[13]

QUESTION 9/*VRAAG 9*

9.1 **ANY ONE/*ENIGE EEN:***

- The chemical process in which electrical energy is converted to chemical energy. ✓✓ (2 or 0)
- The use of electrical energy to produce a chemical change.
- Decomposition of an ionic compound by means of electrical energy.
- The process during which an electric current passes through a solution/ionic liquid/molten ionic compound.

- Die *chemiese proses waarin elektriese energie omgeskakel word na chemiese energie.* ✓✓ (2 *of* 0)
- *Die gebruik van elektriese energie om 'n chemiese verandering te weeg te bring.*
- *Ontbinding van 'n ioniese verbinding met behulp van elektriese energie.* *Die proses waardeur 'n elektriese stroom deur 'n oplossing/ioniese vloeistof/gesmelte ioniese* verbinding beweeg. (2)

9.2 $2H_2O(\ell) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ ✓✓

NOTE/AANTEKENING:

- $H_2(g) + 2OH^-(aq) \leftarrow 2H_2O(\ell) + 2e^-$ ($\frac{2}{2}$) $2H_2O(\ell) + 2e^- \rightleftharpoons H_2(g) + 2OH^-(aq)$ ($\frac{1}{2}$)
  $H_2(g) + 2OH^-(aq) \rightleftharpoons 2H_2O(\ell) + 2e^-$ ($\frac{0}{2}$) $2H_2O(\ell) + 2e^- \leftarrow H_2(g) + 2OH^-(aq)$ ($\frac{0}{2}$)
- 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:* $\frac{1}{2}$
- Ignore phases/*Ignoreer fases* (2)

9.3 X to/*tot* Y ✓ (1)

9.4

Marking criteria:	***Nasienkriteria:***
(a) Substitute 300×10^{-3} and 24 dm^3 into $n = \frac{V}{V_m}$ ✓ **(b)** Using ratio 1:2 to calculate $n(e^-)$ ✓ **(c)** Substitute $6,02 \times 10^{23}$ mol^{-1} in $n = \frac{N}{N_A}$ ✓ **(d)** Final correct answer: $1,505 \times 10^{22}$ electrons ✓ Range: $1,505 \times 10^{22}$ to $2,41 \times 10^{22}$ electrons	**(a)** *Vervang 300×10^{-3} en 24 dm^3 int $n = \frac{V}{V_m}$* ✓ **(b)** *Gebruik verhouding 1:2 om $n(e^-)$ te bereken* ✓ **(c)** *Vervang $6,02 \times 10^{23}$ mol^{-1} in $n = \frac{N}{N_A}$* ✓ **(d)** *Finale korrekte antwoord: $1,505 \times 10^{22}$ elektrone* ✓ *Gebied: $1,505 \times 10^{22}$ tot $2,41 \times 10^{22}$ elektrone*
OPTION 1/*OPSIE 1*: $n(C\ell_2) = \frac{V}{V_m}$ $= \frac{300 \times 10^{-3}}{24}$ ✓(a) $= 0,0125$ mol (0,01) $n(e^-) = 2n(C\ell_2)$ $= 2 \times 0,0125$ ✓(b) $= 0,025$ mol $n(e^-) = \frac{N}{N_A}$ $0,025 = \frac{N}{6,02 \times 10^{23}}$ ✓(c) $N = 1,505 \times 10^{22}$ electrons ✓(d)	**OPTION 2/*OPSIE 2*:** $n(C\ell_2) = \frac{V}{V_m}$ $= \frac{300 \times 10^{-3}}{24}$ ✓(a) $= 0,0125$ mol (0,01) $n(C\ell_2) = \frac{N}{N_A}$ $0,0125 = \frac{N}{6,02 \times 10^{23}}$ ✓(c) $N = 7,525 \times 10^{21}$ $C\ell_2$ $N(e^-) = 2n(C\ell_2)$ $= 2 \times 7,525 \times 10^{21}$ ✓(b) $= 7,525 \times 10^{21}0,025$ electrons ✓(d)

(4)
[9]

TOTAL/*TOTAAL*: 150