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 2023

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 23 pages.
Hierdie nasienriglyne bestaan uit 23 bladsye.

Please turn the page/*Blaai om asseblief*

QUESTION 1/*VRAAG 1*

1.1 D ✓✓ (2)

1.2 D ✓✓ (2)

1.3 A ✓✓ (2)

1.4 B ✓✓ (2)

1.5 D ✓✓ (2)

1.6 C ✓✓ (2)

1.7 C ✓✓ (2)

1.8 A ✓✓ (2)

1.9 B ✓✓ (2)

1.10 D ✓✓ (2)
[20]

QUESTION 2/*VRAAG 2*

2.1 Molecules/compounds <u>containing carbon</u> (atoms). ✓
M*olekule/verbinding wat <u>koolstof</u>(atome) <u>bevat.</u>* (1)

2.2

2.2.1 2,3-dimethyl✓but-1-ene✓/2,3-dimethyl-1-butene
2,3-dimetielbut-1-een/2,3-dimetiel-1-buteen

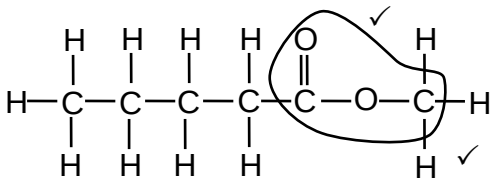
<u>Marking criteria</u>*:*	***<u>Nasie</u>***
• Correct stem i.e. <u>but-1-ene</u>. ✓ • IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓	• *Ko sta <u>but</u> ✓* • *IUI na he ko ins no vo ko s e ko*

2.2.2 Butan-2-one/2-butanone/butanone ✓✓
Butan-2-oon/2-butanoon/butanoon

Marking criteria*:*	***Nasien***
• Correct chain length, i.e But. ✓ • Everything else correct: IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓	• *Kor ketti d.i.* • *Alle reg: naa hee kor insl nom volg kop en k* ✓

2.3

2.3. 1

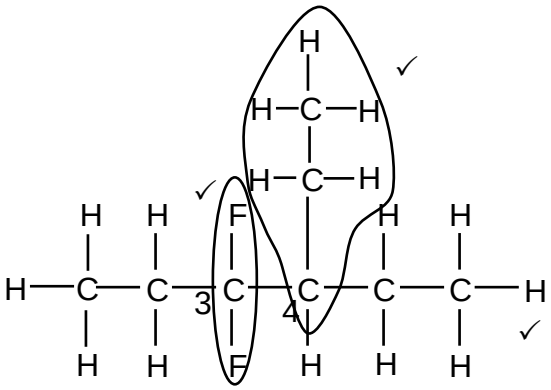


Marking criteria/*Nasienkriteria:*
- Functional group correct✓ *Funksionele groep korrek*.
- Whole structure correct. ✓ *Hele struktuur korrek.*

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)

2.3.2



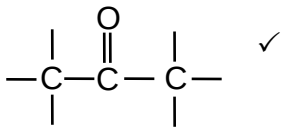
Marking criteria/*Nasienkriteria:*
- Six C atoms in longest chain. ✓ *Ses C-atome in langste ketting.*
- Two F atoms on third C atom. ✓ Twee F-atome op die derde C-atoom.
- Ethyl substituent on fourth C atom. ✓ Etielsubstituent op die vierde C-atoom.

IF/*INDIEN*
H-atom or bond omitted/*H-atoom of binding uitgelaat* Max/Maks: $^2/_3$

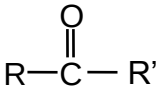
(3)

2.3.3 C_nH_{2n} ✓ (1)

2.3.4



ACCEPT/*AANVAAR*:



(1)

2.3.5 Methanol/*Metanol* ✓✓

NOTE/*NOTA*:
1-methanol/methan-1-ol/*1-metanol/metan-1-ol* Max./*Maks.* $^1/_2$

(2)

2.4

2.4.1 B ✓ (1)

2.4.2 D and/*en* G ✓ (1)

[16]

QUESTION 3/*VRAAG 3*

3.1

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

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

Die temperatuur waarby die dampdruk van die stof gelyk is aan atmosferiese druk. (2)

OPTION 1 FOR 3.2 AND 3.3/*OPSIE 1 VIR 3.2 EN 3.3*

3.2

Marking criteria/*Nasienkriteria:*
- Dependent and independent variables correctly identified. ✓
  Afhanklike en onafhanklike veranderlikes korrek geïdentifiseer.
- Correct relationship between dependent and independent variables stated. ✓
  Korrekte verwantskap tussen die afhanklike en onafhanklike veranderlikes gestel

IF/*INDIEN:*
Directly proportional/*Direk eweredig* Max/*Maks:* $^1/_2$

The higher the molecular mass the higher the boiling point. ✓✓
OR
As the molecular mass increases the boiling point increases.
OR
The longer the C-chain the higher boiling point
OR
The boiling point and the molecular mass are proportional.

Hoe hoër die molekulêre massa hoe hoër die kookpunt.
OF
Soos die molekulêre massa toeneem, neem die kookpunt ook toe.
OF
Hoe langer die C-ketting hoe hoër is die kookpunt.
OF
Die kookpunt en die molekulêre massa is eweredig. (2)

3.3

Marking criteria:
- Strength of intermolecular forces. ✓
- Energy required to overcome intermolecular forces. ✓

Nasienkriteria:
- *Sterkte van intermolekulêre kragte.* ✓
- *Energie benodig om intermolekulêre kragte te oorkom.* ✓

- Strength of the intermolecular forces increases / More sites for London forces with increase of molar mass/chain length/surface area. ✓
- More energy is needed to overcome/break intermolecular forces. ✓

- *Sterkte van die intermolekulêre kragte neem toe. / Meer punte vir Londonkragte met toename in molêre massa/kettinglengte/kontakoppervlak.*
- *Meer energie benodig om intermolekulêre kragte te oorkom/breek.*

(2)

OPTION 2 FOR 3.2 AND 3.3/*OPSIE 2 VIR 3.2 EN 3.3*

3.2 Curve P represents carboxylic acids. ✓✓
Kurwe P verteenwoordig karboksielsure.
OR/*OF*
For every molar mass, P has the highest boiling point.
Vir elke molêre massa, het P die hoogste kookpunt. (2)

3.3 **Marking criteria:**
- Strength of intermolecular forces. ✓
- Energy required to overcome intermolecular forces. ✓

Nasienkriteria:
- *Sterkte van intermolekulêre kragte.* ✓
- *Energie benodig om intermolekulêre kragte te oorkom.* ✓

- Curve P/carboxylic acids has strongest intermolecular forces.✓
- Most energy is needed to overcome/break intermolecular forces. ✓

- *Kurwe P/karboksielsure het die sterkste intermolekulêre kragte.*
- *Meeste energie word benodig om intermolekulêre kragte te oorkom/breek.* (2)

3.4
3.4.1 Aldehyde / *Aldehiede* ✓ (1)

3.4.2

Marking criteria:
- Comparing the strength of intermolecular forces of aldehydes/S with alcohols/R and/or carboxylic acids/P. ✓
- Linking the intermolecular forces to boiling point/energy needed. ✓

Nasienkriteria:
- *Vergelyk die sterkte van die intermolekulêre kragte van aldehyde/S met alkohole/*R *en/of karboksielsure/*P. ✓
- *Trek die verband tussen die intermolekulêre kragte en die kookpunte/energie benodig.* ✓

- Aldehydes/S have the weakest/weaker intermolecular forces. ✓
- Therefore, aldehydes/S have the lowest/lower boiling points / least/lower energy needed to overcome/break intermolecular forces. ✓

OR
- The strength of the intermolecular forces in aldehydes/S is weaker than in alcohols/R / carboxylic acids/P.
- Therefore, aldehydes/S have lower boiling points / need less energy than alcohols/carboxylic acids to overcome/break intermolecular forces

OR
- Carboxylic acids/P have the strongest intermolecular forces.
- Therefore, carboxylic acids/P have the highest boiling points / need most energy to overcome/break intermolecular forces.

OR
- Carboxylic acids/P and alcohols/R have stronger intermolecular forces than aldehydes/S.
- Therefore, carboxylic acids/P and/or alcohols/R have higher boiling points/ need more energy than aldehydes to overcome/break intermolecular forces.

- *Aldehiede/*S *het die swakste/swakker intermolekulêre kragte.* ✓
- *Dus het aldehiede/*S *die laagste/laer kookpunt / die minste/minder energie nodig om die intermolekulêre kragte te oorkom/breek.* ✓

OF
- *Die sterkte van intermolekulêre kragte tussen aldehiede is swakker as tussen alkohole/R / karboksielsure/P.*
- *Dus het aldehiede/*S *'n laer kookpunt as alkohole/*R*/ karboksielsure/*P*/ minder energie nodig om die intermolekulêre kragte te oorkom/breek.*

OF
- *Karboksielsure/P het die sterkste intermolekulêre kragte.*
- *Dus het karboksielsure/P die hoogste kookpunt / die meeste energie nodig om die intermolekulêre kragte te oorkom/breek.*

OF
- *Karboksielsure/P en alkohole/R het sterker intermolekulêre kragte as aldehiede/S.*
- *Dus het karboksielsure/P/alkohole/R 'n hoër kookpunt as aldehiede / meer energie nodig om die intermolekulêre kragte te oorkom/breek.* (2)

3.5

3.5.1 60 ($g \cdot mol^{-1}$) ✓
Range/*Gebied*: 58 – 62 $g \cdot mol^{-1}$ (1)

3.5.2 Propan-1-ol/1-propanol ✓✓

Marking criteria*:*	***Nasienkriteria:***
• Correct stem of alcohol, i.e Propanol. ✓ • Correct position of functional group and everything else correct: IUPAC name completely correct including numbering and hyphens. ✓	• *Korrekte stam vir alkohol d.i. Propanol.* ✓ • *Korrekte posisie van die funksionele groep en alles verder reg: IUPAC-naam heeltemal korrek insluitende nommering en koppeltekens.* ✓

(2)

3.6

Marking criteria:
- State that carboxylic acids have two sites for hydrogen bonding. ✓
- State that alcohols have one site for hydrogen bonding. ✓
- Comparing the strength of IMFs / the energy needed to overcome IMFs. ✓

Nasienkriteria:
- *Stel dat karboksielsure twee plekke het vir waterstofbindings.*
- *Stel dat alkohole een plek het vir waterstofbinding.*
- *Vergelyk die sterkte van die IMKs / energie benodig om IMKs te oorkom.*

- Carboxylic acids/B/Propanoic acid have, (in addition to London forces and dipole-dipole forces), two sites for hydrogen bonding between molecules. ✓

OR

Carboxylic acid/B/Propanoic acid can form dimers due to strong hydrogen bonding between molecules.

- Alcohols/A/Butan-1-ol have, (in addition to London forces and dipole-dipole forces), one site for hydrogen bonding between molecules. ✓

- Intermolecular forces in carboxylic acids are stronger. ✓

OR

More energy needed to overcome/break intermolecular forces in carboxylic acid/B/propanoic acid.

- *Karboksielsure/B/Propanoësuur het, (in toevoeging tot Londonkragte en dipool-dipoolkragte), twee punte vir waterstofbinding tussen molekule.*

OF

Karboksielsure/B/Propanoësuur kan dimere vorm as gevolg van sterk waterstofbindings tussen molekule.

- *Alkohole/A/Butan-1-ol het, (in toevoeging tot Londonkragte en dipool-dipoolkragte), een punt vir waterstofbinding tussen molekule.*

- *Intermolekulêre kragte in karboksielsure is sterker.*

OF

Meer energie word benodig om intermolekulêre kragte in karboksielsure/ B/Propanoësuur te oorkom/breek. (3)

[15]

QUESTION 4/*VRAAG 4*

4.1

4.1.1

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.*
The underlined phrases must be in the correct context. / *Die onderstreepte frases moet in die korrekte konteks wees.*

The chemical process/reaction in which longer chain hydrocarbon/alkane molecules/ are broken down to shorter (more useful) molecules. ✓✓

Die chemiese proses/reaksie waarin langer kettingkoolwaterstof/alkaan-molekule afgebreek word in korter (meer bruikbare) molekules. (2)

4.1.2 X = 12 ✓
Y = 2 ✓
Z = 4 ✓

ACCEPT/*AANVAAR*:

$C_{16}H_{34} \rightarrow C_6H_{14} + C_6H_{12} + 2C_2H_4$ (3)

4.1.3

Marking criteria/*Nasienkriteria*
- O_2 ✓
- Products ✓ / *Produkte*
- Balancing ✓/*Balansering*

$2C_6H_{14} + 19O_2$ ✓ $\rightarrow 12CO_2 + 14H_2O$ ✓ Bal ✓

Notes/*Aantekeninge:*
- Ignore double arrows and phases./*Ignoreer dubbelpyle en fases.*
- Marking rule 6.3.10/*Nasienreël 6.3.10.*
- If condensed structural formulae used:/*Indien gekondenseerde struktuurformules gebruik:* Max/*Maks.* $\frac{2}{3}$

(3)

4.2

4.2.1

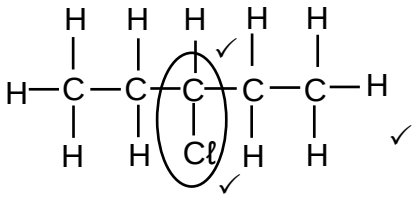
Marking criteria/*Nasienkriteria*
If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./*Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*
The underlined phrases must be in the correct context. / *Die onderstreepte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

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)

4.2.2 Addition/hydrohalogenation/hydrochlorination ✓
Addisie/hidrohalogenering/hidrochlorinering (1)

4.2.3



✓ ✓ ✓

Marking criteria/*Nasienkriteria*:
- Chlorine atom bonded to any C-atom. ✓
  Chlooratoom gebind aan enige C-atoom.
- Correct functional group on third C-atom. ✓
  Korrekte funksionele groep op derde C-atoom.
- Whole structure correct. ✓
  Hele struktuur korrek.

(3)

4.2.4 HCℓ ✓ (1)

4.2.5 (Concentrated/ conc.) H_2SO_4 / sulphuric acid / H_3PO_4 / phosphoric acid ✓
(Gekonsentreerde/ gek.) H_2SO_4 / swawelsuur / H_3PO_4 / fosforsuur
IF/*INDIEN:*
Dilute/*Verdun*: $^0/_1$ (1)

4.2.6 Concentrated strong base ✓
OR
Concentrated NaOH / KOH / LiOH / sodium hydroxide/ potassium hydroxide/ lithium hydroxide
OR
Strong base/NaOH/KOH/LiOH/sodium hydroxide/ potassium hydroxide/lithium hydroxide in ethanol.

Gekonsentreerde sterk basis
OF
Gekonsentreerde NaOH /KOH/ LiOH /natriumhidroksied/ kaliumhidroksied/ litiumhidroksied
OF
Sterk basis/NaOH /KOH/ LiOH / natriumhidroksied/kaliumhidroksied/litium-hidroksied in etanol (1)

4.2.7
- Elimination ✓
- Dehydrohalogenation/dehydrochlorination ✓

- *Eliminasie*
- *Dehidrohalogenering/dehidrohalogenasie/dehidrochlorinasie/ dehidrochlonering*

(2)
[19]

QUESTION 5/*VRAAG 5*

5.1 **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 Concentration (of $Na_2S_2O_3$) ✓
Konsentrasie (*van* $Na_2S_2O_3$) (1)

5.3

Marking criteria/*Nasienkriteria*:

- Substitute/*Vervang* 0,03 and/en 0,13 OR/OF30 and/*en* 0,13. ✓
- Substitute/*Vervang* 0,05 OR/*OF* 50. ✓
- Final correct answer/*Finale korrekte antwoord*: 0,078 mol·dm^{-3}. ✓
  Range 0,075 to/tot 0,08 mol·dm^{-3}

OPTION 1/*OPSIE 1*

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

$0,13 = \frac{n}{0,03}$ ✓

$n = 3,9 \times 10^{-3}$ moles/*mol*

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

$c = \frac{3,9 \times 10^{-3}}{0,05}$ ✓

$= 0,078$ (mol·dm^{-3}) ✓

OPTION 2/*OPSIE 2*

$c_1V_1 = c_2V_2$

(0,13)(0,030) ✓ = c_2 (0,050) ✓

$c_2 = 0,078$ (mol·dm^{-3}) ✓

OPTION 3/*OPSIE 3*

Marking criteria/*Nasienkriteria*:

- Substitute/*Vervang* 0,05 and/*en* 0,13 OR/*OF* 50 and/*en* 0,13 OR/*OF* 0,05 and/*en* 0,10. ✓
- Substitute/*Vervang* 0,05 OR/*OF* 0,0550. ✓
- Final correct answer/*Finale korrekte antwoord*: 0,078 mol·dm^{-3}. ✓
  Range: 0,075 to/tot 0,08 mol·dm^{-3}

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

$0,13 = \frac{n}{0,05}$ ✓

$n = 6,5 \times 10^{-3}$ moles/*mol*

$V_2 : V_1$

3 : 5

$3,9 \times 10^{-3} : 6,5 \times 10^{-3}$

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

$c = \frac{3,9 \times 10^{-3}}{0,05}$ ✓

$= 0,078$ (mol·dm^{-3}) ✓

OR/*OF*

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

$0,10 = \frac{n}{0,05}$ ✓

$n = 5 \times 10^{-3}$ moles/*mol*

$V_2 : V_1$

3 : 4

$3,75 \times 10^{-3} : 5 \times 10^{-3}$

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

$c = \frac{3,75 \times 10^{-3}}{0,05}$ ✓

$= 0,075$ (mol·dm^{-3}) ✓

OPTION 4/*OPSIE 4*

$\frac{3}{5}$ ✓ (0,13) ✓ = 0,078 (mol·dm^{-3}) ✓ **OR/*OF*** $\frac{3}{4}$ ✓ (0,10) ✓ = 0,075 (mol·dm^{-3}) ✓

(3)

5.4

Marking criteria:	***Nasienkriteria***:
• Substitute M = 32 g·mol^{-1} in formula $n(S) = \frac{m}{M}$ ✓ • Use mol/M ratio: $n(S) = n(Na_2S_2O_3)$ ✓ • Substitute M = 158 g·mol^{-1} in formula $n(Na_2S_2O_3) = \frac{m}{M}$ ✓ • Divide by 20,4 s. ✓ • Final correct answer: 0,051 (g·s^{-1}) ✓ Range: 0,048 to 0,080 (g·s^{-1})	• *Vervang* M = 32 g·mol^{-1} in formule $n(S) = \frac{m}{M}$ ✓ • *Gebruik mol/M-verhouding:* $n(S) = n(Na_2S_2O_3)$ ✓ • *Vervang* M = 158 g·mol^{-1} in formula $n(Na_2S_2O_3) = \frac{m}{M}$ ✓ • *Deel deur 20,4 s.* ✓ • *Finale korrekte antwoord*: 0,051 (g·s^{-1})✓ *Gebied: 0,048 tot 0,080* (g·s^{-1})

OPTION 1/*OPSIE 1*

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

$= \frac{0,21}{32}$ ✓

= 0,00656 moles/*mol* ($6,56 \times 10^{-3}$)

$n(S) = n(Na_2S_2O_3)$

= 0,00656 moles/*mol* ✓

$n(Na_2S_2O_3) = \frac{m}{M}$

$0,00656 = \frac{m}{158}$ ✓

$m(Na_2S_2O_3)$ = 1,04 g

OPTION 2/*OPSIE 2*

158 g $Na_2S_2O_3$ ✓ ⟶ 32 g S ✓

x g ⟶ 0,21 g ✓

x = 1,04 g

Rate/*Tempo* $= \frac{\Delta m}{\Delta t}$

$= \frac{1,04}{20,4}$ ✓

= 0,051 (g·s^{-1}) ✓

ACCEPT/*AANVAAR:*

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

$0,13 = \frac{n}{0,05}$

= 0,00656

$n(Na_2S_2O_3) = \frac{m}{M}$

$0,00656 = \frac{m}{158}$ ✓

= 1,03 g (1,027)

Rate/*Tempo* $= \frac{\Delta m}{\Delta t}$

$= \frac{1,03}{20,4}$ ✓

= 0,05 (g·s^{-1}) ✓

Max/*Maks.* $^3/_5$

ACCEPT/*AANVAAR:*

$c = \frac{m}{MV}$

$0,13 = \frac{m}{(158)(0,05)}$ ✓

m = 1,03 g

Rate/*Tempo* $= \frac{\Delta m}{\Delta t}$

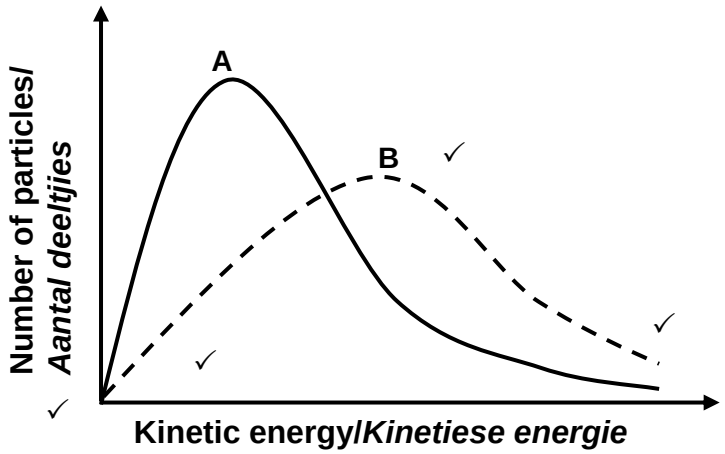
$= \frac{1,03}{20,4}$ ✓

= 0,05 (g·s^{-1}) ✓

Max/*Maks.* $^3/_5$

(5)

5.5



Marking criteria:
- Both axis labelled correctly. ✓
- Both curves start at origin and have correct shape. ✓
- Peak of curve B must be lower than curve A. ✓
- Curve B must have higher kinetic energy than curve A from the peak up to end of curve B. ✓

Nasienkriteria:
- *Beide asse korrek benoem.*
- *Beide kurwes begin by die oorsprong en het dieselfde vorm.*
- *Maksimum van kurwe B moet laer wees as kurwe A.*
- *Maksimum van kurwe B moet hoër kinetiese energie as kurwe A vanaf die piek van B tot by einde van die kurwe B.*

IF/*INDIEN:*
Both curves end on the x-axis then B has to end to the right of A.
Altwee kurwes op die x-as eindig, moet B regs van A eindig. $^{4}/_{4}$

Curves not labelled. Max/*Maks.* $^{2}/_{4}$
Kurwes nie benoem nie.

(4)

5.6 **OPTION 1**

- At a higher temperature particles move faster/have higher kinetic energy. ✓
- More molecules have enough/sufficient kinetic energy for an effective collision. ✓

OR

More molecules have kinetic energy/E_k equal to or greater than the activation energy.

- More effective collisions per unit time/second. ✓

OR

Frequency of effective collisions increases.

- Reaction rate increases. ✓

OPTION 2

- At a lower temperature particles move slower/have lower kinetic energy.
- Less molecules have enough/sufficient kinetic energy for an effective collision.

OR

Less molecules have kinetic energy/E_k equal to or greater than the activation energy.

- Less effective collisions per unit time/second.

OR

Frequency of effective collisions decreases.

- Reaction rate decreases. ✓

OPSIE 1:

- *By 'n hoër temperatuur beweeg die deeltjies vinniger/het die deeltjies hoër kinetiese energie.* ✓

- *Meer molekule het genoeg/voldoende kinetiese energie/E_k vir 'n effektiewe botsing.* ✓

OF

Meer molekule het kinetiese energie gelyk aan of groter as die aktiveringsenergie.

- *Meer effektiewe botsings per eenheidtyd/sekonde.* ✓

OF

Frekwensie van effektiewe botsings verhoog.

- *Reaksietempo neem toe.* ✓

OPSIE 2:

- *By 'n laer temperatuur beweeg die deeltjies stadiger/het die deeltjies laer kinetiese energie.* ✓

- *Minder molekule het genoeg/voldoende kinetiese energie/E_k vir 'n effektiewe botsing.* ✓

OF

Minder molekule het kinetiese energie gelyk aan of groter as die aktiveringsenergie.

- *Minder effektiewe botsings per eenheidtyd/sekonde.* ✓

OF

Frekwensie van effektiewe botsings verlaag.

Reaksietempo neem af. ✓ (4)

[19]

QUESTION 6/*VRAAG 6*

6.1 A reaction where products can be converted back to reactants ✓ (and vice versa).
OR
Both forward and reverse reactions can take place.
OR
A reaction which can take place in both directions.
OR
Products can be converted back to reactants.

'n Reaksie waarin produkte terug na reaktanse, en (omgekeerd), omgeskakel kan word.
OF
Beide voor-en terugwaartse reaksies kan plaasvind.
OF
'n Reaksie wat in beide rigtings kan plaasvind.
OF
Produkte kan omgeskakel word na reaktanse. (1)

6.2

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

When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will cancel/oppose the disturbance. ✓✓

Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n nuwe ewewig instel deur die reaksie te bevoordeel wat die versteuring kanselleer/teenwerk. (2)

6.3
6.3.1 The amount/concentration of $A_2(g)$ was increased./A_2 was added to the container.✓
Die hoeveelheid/konsentrasie $A_2(g)$ is verhoog./A_2 is bygevoeg tot die houer. (1)

6.3.2
- Increase in A_2 /concentration favours the reaction that uses or decreases the amount/concentration of A_2. ✓
- The reverse reaction is favoured. ✓

OR

Amount or concentration of products decreases

OR

Amount or concentration of reactants increases.

- *'n Toename in A_2 /konsentrasie bevoordeel die reaksie wat die hoeveelheid/konsentrasie van A_2 verlaag*
- *Die terugwaartse reaksie is bevoordeel*

OF

Hoeveelheid of konsentrasie van die produkte neem af

OF

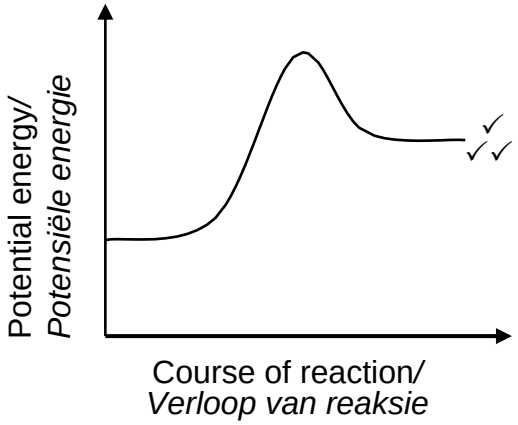
Die hoeveelheid of konsentrasie van die reaktante neem toe. (2)

6.4

OPTION 1/*OPSIE 1:*	**OPTION 2/*OPSIE 2:***
$K_c = \frac{[A_2][B_2]}{[AB]^2}$ ✓ $= \frac{\left(\frac{8}{4}\right)\left(\frac{2}{4}\right)}{\left(\frac{10}{4}\right)^2}$ ✓ ✓ = 0,16 ✓	$K_c = \frac{[A_2][B_2]}{[AB]^2}$ ✓ $= \frac{(2)(0,5)}{(2,5)^2}$ ✓ ✓ = 0,16 ✓
OPTION 3/*OPSIE 3:*	**OPTION 4/ *OPSIE 4:***
$K_c = \frac{[A_2][B_2]}{[AB]^2}$ ✓ $= \frac{\left(\frac{4}{4}\right)\left(\frac{4}{4}\right)}{\left(\frac{6}{4}\right)^2}$ ✓ ✓ = 0,44 ✓	$K_c = \frac{[A_2][B_2]}{[AB]^2}$ ✓ $= \frac{(1)(1)}{(1,5)^2}$ ✓ ✓ = 0,44 ✓
IF/INDIEN: Wrong K_c expression: *Verkeerde K_c-uitdrukking*: *Max./Maks*. $^2/_4$ No K_c expression: *Geen K_c-uitdrukking Max./Maks*. $^3/_4$	

(4)

6.5
6.5.1



✓
✓✓

Marking criteria/*Nasienkriteria:*
- Both axes correctly labelled and shape of Ep curve. ✓
  Asse korrek benoem en vorm van Ep-kurwe
- Shape of Ep curve for endothermic reaction as shown. ✓✓
  Vorm van kurwe vir endotermiese reaksie soos getoon.

ACCEPT/*AANVAAR:*
Time(s)/*Tyd(s)*

(3)

6.5.2 • Less than ✓

• Amount/concentration of products/B_2/A_2 decreases. ✓✓
OR
Amount/concentration of reactants/AB increases.
OR
The reverse reaction is favoured. / Equilibrium (position) shifts to the left.

• *Kleiner as*

• *Hoeveelheid/konsentrasie van produkte/B_2/A_2 neem af.*
OF
Hoeveelheid/konsentrasie van reaktanse/AB neem toe.
OF
Die terugwaartse reaksie word bevoordeel./Die ewewigs(posisie) skuif na links. (3)

6.6 Gradients (of all three curves) will be steeper ✓✓ and reach the same equilibrium ✓ values.
OR
Gradients of curve become zero ✓ at same equilibrium ✓ values before 40 s. ✓
OR
The curves are horizontal at same equilibrium values before 40 s / reaches same equilibrium sooner/less than 40 s.

Gradiënte (van al drie kurwes) is steiler en bereik dieselfde ewewig-waardes.
OF
Gradiënte van die kurwes word nul by dieselfde ewewig-waardes voor 40 s.
OF
Kurwes is horisontaal by dieselfde ewewig-waardes voor 40 s/ bereik dieselfde ewewig gouer/minder as 40 s.

IF/*INDIEN:*
Curves are identified all three must be named.
Kurwes geïndentifiseer word, moet al drie genoem word. (3)
[19]

QUESTION 7/VRAAG 7

7.1 A strong base (ionises) dissociates completely ✓ in water to form a high concentration of OH^- ions. ✓
'n Sterk basis ioniseer/dissosieer volledig in water om 'n hoë konsentrasie OH^--ione te vorm.

ACCEPT/*AANVAAR:*
A strong base (ionises) dissociates completely ✓ in water. ✓
'n Sterk basis ioniseer/dissosieer volledig in water. (2)

7.2.1 $n(Ba(OH)_2) = cV$ ✓
$= (0,15)(0,02)$ ✓
$= 0,003$ mol ✓ (3)

7.2.2 **POSITIVE MARKING FROM QUESTION 7.2.1/**
POSITIEWE NASIEN VAN VRAAG 7.2.1

Marking citeria:	**Nasienkriteria:**
(a) Use ratio: $2nBa(OH)_2$ (7.2.1) = $nHNO_3$ ✓ **(b)** Substitute nH_3O^+ or $nHNO_3$ and 0,025 dm^3 in $c = \frac{n}{V}$ ✓ **(c)** Formula: $pH = -\log[H_3O^+]$ ✓ **(d)** Substitute $[H_3O^+]$ in pH formula ✓ **(e)** Final correct answer: 0,62✓	***(a)*** *Gebruik verhouding:* $2nBa(OH)_2$ *(7.2.1)* = $nHNO_3$ ✓ ***(b)*** *Vervang* nH_3O^+ *of* $nHNO_3$ *en 0,025* dm^3 *in* $c = \frac{n}{V}$ ✓ ***(c)*** *Formule:* $pH = -\log[H_3O^+]$ ✓ ***(d)*** *Vervang* $[H_3O^+]$ *in pH formule* ✓ ***(e)*** *Finale korrekte antwoord: 0,62* ✓

$nHNO_{3\ reacted} = 2nBa(OH)_2$
$= 2(0,003)$ ✓**(a)**
$= 0,006$ mol

OPTION 1/ *OPSIE 1*

$n(H_3O^+) = n(HNO_3)$
$= 0,006$ mol

$[H_3O^+] = \frac{n}{V}$
$= \frac{0,006}{0,025}$ ✓**(b)**
$= 0,24$ mol·dm^{-3}

OPTION 2/*OPSIE 2*

$[HNO_3] = \frac{n}{V}$
$= \frac{0,006}{0,025}$ ✓**(b)**
$= 0,24$ mol·dm^{-3}

$[H_3O^+] = [HNO_3]$
$= 0,24$ mol·dm^{-3}

$pH = -\log[H_3O^+]$ ✓**(c)**
$= -\log(0,24)$ ✓**(d)**
$= 0,62$ ✓**(e)**

(5)

7.3 **POSITIVE MARKING FROM QUESTION 7.2.2/**
POSITIEWE NASIEN VAN VRAAG 7.2.2

Marking criteria:

(a) Substitute $[HNO_3]$ = 0,4 mol·dm^{-3} and 0,025 dm^3 ✓
(b) Subtract:
$n(HNO_3)_{ini} - n(HNO_3)_{excess}$ (7.2.2)/
$[HNO_3]_{ini} - [HNO_3]_{excess}$ (7.2.2) ✓✓
(c) Use of ratio
$n(MCO_3) = ½n(HNO_3)$ ✓
(d) Calculate the pure mass $m(MCO_3)$ ✓
(e) Substitute $n(MCO_3)$ and $m(MCO_3)$ in $n = \frac{m}{M}$ ✓
(f) Subtraction of 60 g·mol^{-1} from molar mass. ✓
(g) Correct answer: Mg ✓

Nasienkriteria:

(a) *Vervang:* $[HNO_3]$ = 0,4 mol·dm^{-3} *en 0,025 dm^3* ✓
(b) *Trek af:*
$n(HNO_3)_{aanv} - n(HNO_3)_{oormaat}$ (7.2.2)/
$[HNO_3]_{aanv} - [HNO_3]_{oormaat}$ (7.2.2) ✓✓
(c) *Gebruik verhouding:*
$n(MCO_3) = ½n(HNO_3)$ ✓
(d) *Bereken suiwer massa* $m(MCO_3)$ ✓
(e) *Vervang* $n(MCO_3)$ *en* $m(MCO_3)$ *in* $n = \frac{m}{M}$ ✓
(f) *Afrek van* 60 g·mol^{-1} vanaf molêre massa. ✓
(g) *Korrekte antwoord: Mg* ✓

OPTION 1/ *OPSIE 1*

$n(HNO_3)_{ini} = cV$
$= (0,4)(0,025)$ ✓ **(a)**
$= 0,01$ mol

$n(HNO_3)_{react} = n(HNO_3)_{ini} - n(HNO_3)_{excess}$
$= 0,01 - 0,006$ ✓✓ **(b)**
$= 0,004$ mol

$n(MCO_3) = ½n(HNO_3)$
$= ½(0,004)$ ✓**(c)**
$= 0,002$ mol

$m(MCO_3) = \frac{85}{100} \times 0,198$ ✓**(d)**
$= 0,168$ g

$n(MCO_3) = \frac{m}{M}$
$0,002 = \frac{0,168}{M}$ ✓**(e)**
$M(MCO_3) = 84$ g·mol^{-1}

Molar mass (M) = 84 - 60 ✓**(f)**
= 24 g·mol^{-1}
Therefore metal M is Mg ✓**(g)**

OPTION 2/ *OPSIE 2*

$[HNO_3]_{reacted} = [HNO_3]_{initial} - [HNO_3]_{excess}$
$= 0,4 - 0,24$ ✓✓ **(b)**
$= 0,16$ mol·dm^{-3}

In 1 dm^3 : 0,16 mol
In 0,025 dm^3 : 0,004 mol ✓ **(a)**

$n(MCO_3) = ½n(HNO_3)$
$= ½(0,004)$ ✓**(c)**
$= 0,002$ mol

$m(MCO_3) = \frac{85}{100} \times 0,198$ ✓**(d)**
$= 0,168$ g

$n(MCO_3) = \frac{m}{M}$
$0,002 = \frac{0,168}{M}$ ✓**(e)**
$M(MCO_3) = 84$ g·mol^{-1}

Molar mass (M) = 84 - 60 ✓**(f)**
= 24 g·mol^{-1}
Therefore, metal M is Mg ✓**(g)**

(8)
[18]

QUESTION 8/*VRAAG 8*

8.1.1 Copper strip becomes thinner/corrodes/decreases in mass/solid/silver coloured particles in solution/the copper becomes plated with silver. ✓
Koper plaatjie word dunner/korrodeer/massa neem af/vaste stof/silwer-kleurige deeltjies in oplossing.
IF/*INDIEN*:
Rust/Roes. $^{0}/_{1}$ (1)

8.1.2 Ag^+ (ion/-*ioon)* / Silver ion/ $AgNO_3$/silver nitrate ✓
Silwernitraat/Silwer-ioon (1)

8.2 Ag^+ (ion) is a stronger oxidising agent✓ than Cu^{2+} ion ✓ and will oxidise Cu ✓ to Cu^{2+} ion.
OR
Cu^{2+} (ion) is a weaker oxidising agent ✓ than Ag^+ ion ✓and Cu will be oxidised✓ to Cu^{2+} ion.
OR
Cu/Copper is a stronger reducing agent ✓than Ag/Silver ✓and will reduce silver ✓ ions to silver. ✓

Ag^+ (-ioon) is 'n sterker oksideermiddel as Cu^{2+} -ioon en sal Cu na Cu^{2+} - ioon oksideer.
OF
Cu^{2+} (-ioon) is 'n swakker oksideermiddel as Ag^+ -ioon en daarom sal Cu na Cu^{2+} -ioon geoksideer word.
OF
Cu/Koper is 'n sterker reduseermiddel as Ag/Silwer en sal silwer-ione na silwer reduseer. (3)

8.3
8.3.1 Silver/Ag/*Silwer* ✓ (1)

8.3.2 $CuSO_4$/Cu^{2+} /Copper (II) ions/copper(II) sulphate ✓
Koper(II)-ione/ koper(II)sulfaat (1)

ACCEPT/*AANVAAR*:
Any soluble copper(II) salt e.g. $Cu(NO_3)_2$
Enige oplosbare koper(II)sout bv. $Cu(NO_3)_2$

8.3.3 $2Ag^+(aq) + Cu(s)$ ✓ $\rightarrow 2Ag(s) + Cu^{2+}(aq)$ ✓ Bal ✓

Marking criteria/*Nasienkriteria:*
- Reactants ✓ Products ✓ Balancing: ✓
  Reaktanse *Produkte* *Balansering*
- Ignore double arrows./*Ignoreer dubbelpyle.*
- Ignore phases./*Ignoreer fases.*
- Marking rule 6.3.10./*Nasienreël 6.3.10.* (3)

8.4 

$[Ag^+]$ decreases. ✓
OR
In silver half-cell concentration of positive ions decreases.
OR
The silver half-cell becomes negative.

ACCEPT:
Maintain the ion balance/electrical neutrality.

$[Ag^+]$ neem af.
OF
In die silwerhalfsel neem die konsentrasie van die positiewe ione af.
OF
Die silwerhalfsel word negatief.

AANVAAR:
Handhaaf die ioonbalans/elektriese neutraliteit. (2)
[12]

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 $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ ✓✓

ACCEPT/*AANVAAR*:
Reduction (reaction) / *Reduksie (reaksie)* $^2/_2$

Marking criteria/*Nasienkriteria:*
- $Cu(s) \leftarrow Cu^{2+}(aq) + 2e^-$ $(^2/_2)$ $Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$ $(^1/_2)$
  $Cu^{2+}(aq) + 2e^- \leftarrow Cu(s)$ $(^0/_2)$ $Cu(s) \rightleftharpoons Cu^{2+}(aq) + 2e^-$ $(^0/_2)$
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on Cu^{2+}/*Indien lading (+) weggelaat op* Cu^{2+}:
  Example/*Voorbeeld:* $Cu^2(aq) + 2e^- \rightarrow Cu(s)$ Max./*Maks:* $^1/_2$
- Ignore phases/*Ignoreer fases.* (2)

9.3 R to/*na* Q ✓ (1)

9.4

Marking criteria:

(a) Substitution of 63,5 into $n = \frac{m}{M}$ ✓
(b) Substitute $6,02 \times 10^{23}$ mol^{-1} ✓
(c) n(electrons) = N(Cu atoms) x 2 OR
n(electrons) = N(Cu atoms) x 1 ✓
(d) Calculate t = (5)(60)(60) ✓
(e) Final correct answer: 2,68 A ✓
Range: 1,34 *to 2,70* A

Nasienkriteria:

(a) *Vervang 63,5 in* $n = \frac{m}{M}$ ✓
(b) *Vervang* $6,02 \times 10^{23}$ mol^{-1} ✓
(c) n(elektrone) = N(Cu-atome) x 2 OF
n(elektrone) = N(Cu-atome) x 1 ✓
(d) *Bereken t = (5)(60)(60)* ✓
(e) *Finale korrekte antwoord: 2,68 A* ✓
Gebied: 1,34 tot 2,70 A

USING/*GEBRUIK* Cu^{2+}

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

$n(Cu) = \frac{16}{63,5}$ ✓**(a)**

$= 0,25$ mol

$n \text{ atoms}(Cu) = \frac{N}{N_A}$

$0,25 = \frac{N}{6,02 \times 10^{23}}$ ✓**(b)**

$N = 1,5 \times 10^{23}$ atoms

$n(\text{electrons}) = (1,5 \times 10^{23})(2)$ ✓**(c)**

$= 3 \times 10^{23}$ electrons

$n(\text{electrons}) = \frac{Q}{e}$ **OR/*OF*** $\frac{Q}{q_e}$

$3 \times 10^{23} = \frac{Q}{1,6 \times 10^{-19}}$

$= 48\,160$ C

$I = \frac{Q}{\Delta t}$

$= \frac{48\,160}{(5)(60)(60)}$ ✓**(d)** 18 000 (s)

$= 2,68$ A ✓**(e)**

USING/*GEBRUIK* Cu^{+}

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

$n(Cu) = \frac{16}{63,5}$ ✓**(a)**

$= 0,25$ mol

$n \text{ atoms}(Cu) = \frac{N}{N_A}$

$0,25 = \frac{N}{6,02 \times 10^{23}}$ ✓**(b)**

$N = 1,5 \times 10^{23}$ atoms

$n(\text{electrons}) = (1,5 \times 10^{23})(1)$ ✓**(c)**

$= 1,5 \times 10^{23}$ electrons

$n(\text{electrons}) = \frac{Q}{e}$ **OR/*OF*** $\frac{Q}{q_e}$

$1,5 \times 10^{23} = \frac{Q}{1,6 \times 10^{-19}}$

$= 24\,080$ C

$I = \frac{Q}{\Delta t}$

$= \frac{24\,080}{(5)(60)(60)}$ ✓**(d)** 18 000 (s)

$= 1,34$ A ✓**(e)**

(5)

9.5

Ag/silver is a weaker reducing agent ✓ than Cu/coper or Zn/zinc ✓ and will not be oxidised.

OR

Cu/coper or Zn/zinc is a stronger reducing agent ✓ than Ag/silver ✓ and Ag will not be oxidised.

OR

Voltage of power source is not effective enough (to oxidise Ag/silver). ✓✓

Ag/silwer is 'n swakker reduseermiddel as Cu/koper of Zn/sink en sal nie geoksideer word nie.

OF

Cu/Koper of Zn/sink is 'n sterker reduseermiddel as Ag/silwer en Ag sal nie geoksideer word nie.

OF

Die potensiaalverskil van die energiebron is nie effektief genoeg om die Ag/silwer te oksideer nie. (2)

[12]

TOTAL/*TOTAAL*: 150