education

Department of Education
FREE STATE PROVINCE

# PREPARATORY EXAMINATION
# *VOORBEREIDENDE EKSAMEN*

## GRADE/*GRAAD* 12

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


## SEPTEMBER 2023

## MARKS/*PUNTE*: 150

## MARKING GUIDELINES/*NASIENRIGLYNE*

**These marking guidelines consist of 15 pages.**
***Hierdie nasienriglyne bestaan uit 15 bladsye.***

## QUESTION 1/*VRAAG 1*

1.1 D ✓✓ (2)

1.2 D ✓✓ (2)

1.3 C ✓✓ (2)

1.4 C ✓✓ (2)

1.5 A ✓✓ (2)

1.6 B ✓✓ (2)

1.7 D ✓✓ (2)

1.8 C ✓✓ (2)

1.9 C ✓✓ (2)

1.10 A ✓✓ (2)

**[20]**

## QUESTION 2/*VRAAG 2*

2.1.1 B ✓ (1)

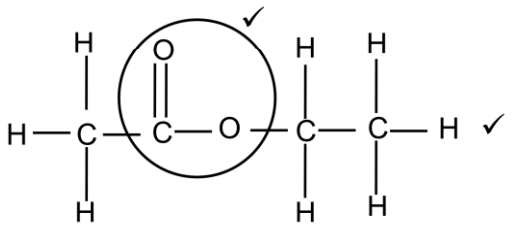
2.1.2 D ✓ (1)

2.1.3 A / B ✓ (1)

2.1.4 B ✓ (1)

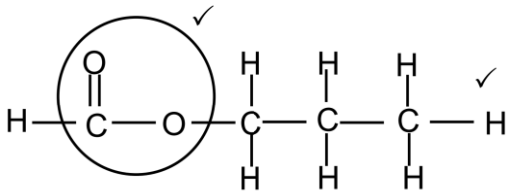
2.2.1 Carboxyl/*Karboksiel* ✓✓ (2)

2.2.2

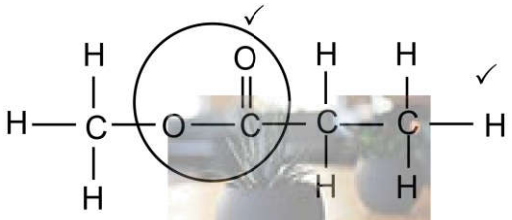



✓ ✓

OR/*OF*



OR/*OF*



**Marking criteria/*Nasienkriteria*:**
- Whole structure correct/*Hele struktuur korrek*: 2/2
- Only functional group correct/single bonds between carbon atoms: ½
  *Slegs funksionele groep korrekte/enkelbindings tussen koolstofatome*: ½

(2)

2.3.1 3,5-dichloro/*dichloor*✓-4-methyl/*metiel* ✓octane/*oktaan* ✓

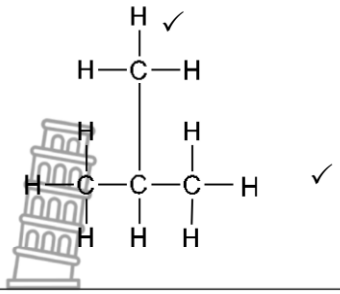
**Marking criteria/*Nasienkriteria*:**
- 3,5-dichloro/*dichloor* ✓
- 4-methyl/*Metiel* ✓
- Octane/*Oktaan* ✓

(3)

2.3.2 Propanone/propan-2-one/*Propanoon/propaan-2-een* ✓✓ (2)

2.4 Propanal/*Propanaal* ✓✓ (2)

2.5.1

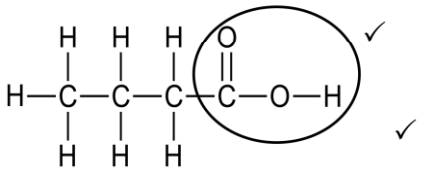


| **Marking criteria/*Nasienkriteria*:** | |
|---|---|
| • Whole structure correct/*Hele struktuur korrek*: | 2/2 |
| • One methyl substituent/*Een metielsubstituent:* | |

| **Notes/*Aantekeninge*:** | |
|---|---|
| Condensed formulae or semi-structural formula: | |
| *Gekondenseerde formules of semi-struktuurformule*: | Max./*Maks.* ½ |
| Molecular formula/*Molekulêre formule*: | 0/2 |

(2)

2.5.2



| **Marking criteria/*Nasienkriteria*:** | |
|---|---|
| • Whole structure correct/*Hele struktuur korrek:* | 2/2 |
| • Only functional group correct/*Slegs funksionele groep korrek*: | ½ |

(2)
**[19]**

## QUESTION 3/*VRAAG 3*

3.1.1 **Marking criteria/*Nasienkriteria*:**

| |
|---|
| If any of the underlined key phrases in the correct context is omitted, deduct 1 mark.<br>*Indien enige van die onderstreepte sleutelfrases in die korrekte konteks weggelaat word, trek 1 punt af.* |

The pressure exerted by vapour at equilibrium with its liquid in a closed system. ✓✓
*Die druk wat uitgeoefen word deur damp by ewewig met sy vloeistof in 'n geslote sisteem.* (2)

3.1.2 B ✓ (1)

3.1.3 **B/methylpropane/*metielpropaan***
- Smaller surface area/*Kleiner oppervlakte* ✓
- Weaker intermolecular forces/*Swakker intermolekulêre kragte* ✓
- Less energy needed to break the intermolecular forces/*Minder energie benodig om die intermolekulêre kragte te breek* ✓

**A/butane/*butaan***
- Larger surface area/*Groter oppervlakte* ✓
- Stronger/more intermolecular forces/*Sterker/meer intermolekulêre kragte* ✓
- More energy needed to break the intermolecular forces/*Meer energie benodig om die intermolekulêre kragte te breek* ✓ (3)

3.1.4 One independent variable/same homologous series and are (chain) isomers/same molecular mass and are (chain) isomers. ✓
*Een onafhanklike veranderlike/dieselfde homoloë reeks en is (ketting) isomere/dieselfde molekulêre massa en is (ketting) isomere.* (1)

3.2
- propan -1-ol ✓
- propan -1-ol has hydrogen bonding, (dipole-dipole and London forces) between molecules propanone has dipole-dipole forces (and London forces). ✓
- Intermolecular forces in propan-1-ol are stronger than intermolecular forces in propanone. ✓

- *propaan -1-ol*
- *propaan -1-ol het waterstofbinding, (dipool-dipool en Londen-kragte) tussen molekules propanoon het dipool-dipool kragte (en Londen-kragte).*
- *Intermolekulêre kragte in propaan-1-ol is sterker as intermolekulêre kragte in propanoon.*

**OR/*OF***

- Intermolecular forces in propanone are weaker than intermolecular forces in propan-1-ol.
- More energy needed to overcome or break intermolecular forces/van der Waals forces in propan-1-ol ✓ than propanone.

**OR**

- Less energy needed to overcome or break intermolecular forces/Van der. Waals forces in compound D than compound C.

- *Intermolekulêre kragte in propanoon is swakker as intermolekulêre kragte in propaan-1-ol.*
- *Meer energie benodig om intermolekulêre kragte/Van der Waals kragte in propaan-1-ol te oorkom of te breek as propanoon.*

***OF***

- *Minder energie benodig om intermolekulêre kragte/Van der Waals kragte in verbinding D te oorkom as in verbinding C.* (4)

3.3.1 Branching/*Vertakking* ✓ (1)

3.3.2

- From **A** to **C**: less branching/greater surface area ✓
- Stronger/more intermolecular forces (London forces) ✓
- More energy needed to break the intermolecular forces (London forces) ✓

- *Vanaf **A** tot **C**: minder vertakking/groter oppervlakte*
- *Sterker/meer intermolekulêre kragte (Londen-kragte)*
- *Meer energie benodig om die intermolekulêre kragte te breek (Londen-kragte)*

(3)
**[15]**

## QUESTION 4/*VRAAG 4*

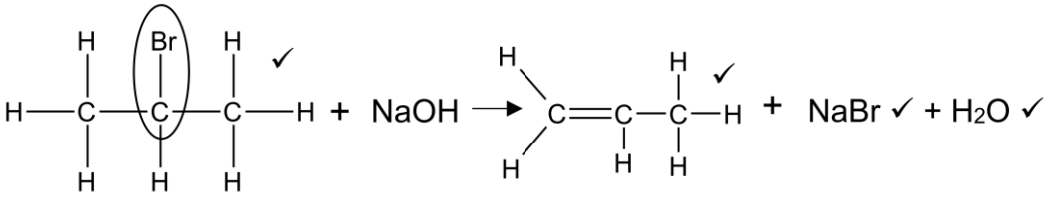
4.1.1 Elimination/dehydrohalogenation/dehydrobromination ✓
*Eliminasie/dehidrohalogenering/dehidrobromering* (1)

4.1.2 Substitution/hydrolysis/*Substitusie/hidrolise* ✓ (1)

4.1.3 Elimination/dehydration/*Eliminasie/dehidrasie* ✓ (1)

4.2.1 2-bromo ✓propane/*propaan* ✓ (2)

4.2.2




**Notes/*Aantekeninge*:**
- Ignore/*Ignoreer* ⇌
- Any additional reactants and/or products./*Enige addisionele reaktanse en/of ander produkte.* Max./*Maks.* $^{3}/_{4}$
- Accept coefficients that are multiples./*Aanvaar koëffisiënte wat veelvoude is.*
- Condensed or semi-structural formulae/*Gekondenseerde of semi-struktuurformules:* Max./*Maks.* $^{2}/_{4}$
- Molecular formulae/*Molekulêre formules*: Max./*Maks.* $^{2}/_{4}$

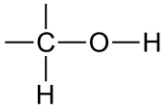
(4)

4.2.3 prope-1-ene/propene/*prope-1-een/propeen* ✓✓ (2)

4.3 X – concentrated strong base, heat/*gekonsentreerde sterk basis, hitte* ✓
Y – dilute strong base, mild heat/*verdunde sterk basis, matige hitte* ✓ (2)

4.4 Alcohol where the C atom bonded to hydroxyl/functional group (-OH) is bonded to two other carbon atoms. ✓✓
*Alkohol waar die C-atoom gebind aan hidroksiel/funksionele groep (-OH) aan twee ander koolstofatome gebind is.*

**OR/*OF***

The functional group (  )is bonded to two other carbon atoms.
*Die funksionele groep* *is aan twee ander koolstofatome gebind.* (2)

**[15]**

## QUESTION 5/*VRAAG 5*

5.1.1 Exothermic/*Eksotermies* ✓
Energy of products is less than that of reactants/energy is given off/
$\Delta H < 0$. ✓
*Energie van produkte is minder as dié van reaktanse/energie wat afgegee word* $\Delta H < 0$. (2)

5.1.2 (a) A ✓ (1)

(b) A – C ✓✓ (2)

(c) C – B ✓✓ (2)

5.2.1 The amount of a substance per volume of water/solution ✓✓
*Die hoeveelheid van 'n stof per volume water/oplossing* (2)

5.2.2 Zinc/Zn ✓ (1)

5.2.3 $n(H_2) = \frac{V}{V_m}$ ✓

$= \frac{0,4144}{22,4}$ ✓
= 0,0185 mol

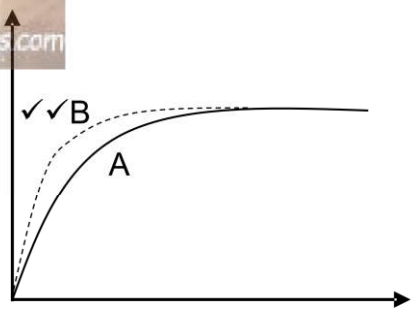
$n(Zn) = n(H_2) = 0,0185$ mol ✓

m(Zn) = n(Zn) x M
= 0,0185 x 65 ✓
=1,2025g ✓
(RANGE/*GEBIED*: 1,19 g to 1,3 g) (5)

5.2.4 (a) DECREASES/*AFNEEM* ✓ (1)

(b)
- Decrease in surface area/*Afname in oppervlakte* ✓
- Fewer particles with correct orientation/*Minder deeltjies met korrekte oriëntasie* ✓
- Fewer effective collisions per unit time/*Minder effektiewe botsings per eenheidstyd* ✓ (3)

5.2.5




**Note: If both graphs are not labelled**
***Let Wel: Indien beide grafiek nie benoem is nie*** $^0/_2$ (2)
**[21]**

## QUESTION 6/ *VRAAG 6*

6.1 A system that is isolated from its surroundings./A system where substances cannot leave/escape the container. ✓✓
*'n Sisteem wat van sy omgewing geïsoleer is./'n Sisteem waar stowwe nie die houer kan verlaat/ontsnap nie.* (2)

6.2 **OPTION/*OPSIE* 1**

**CALCULATIONS USING NUMBER OF MOLES/**
***BEREKENINGE MET GEBRUIK VAN AANTAL MOL***
**Mark allocation/*Puntetoekenning:***
(a) Change n($H_2$) = equilibrium n($H_2$) = 0,02
*Verandering n($H_2$) = ewewig n($H_2$) = 0,02*
(b) **USING** ratio HI:$H_2$:$I_2$ = 2:1:1
***GEBRUIK*** *verhouding HI:$H_2$:$I_2$ = 2:1:1*
(c) Equilibrium mole of $I_2$ = Change mole $I_2$ ✓
*Ewewig mol van $I_2$ = Verander mol $I_2$*
(d) Divide 0,02 by 5 AND multiplying 0,0316 by 5 ✓
*Deel 0,02 deur 5 EN vermenigvuldig 0,0316 met 5*
(e) Correct $K_c$ expression (formulae in square brackets) ✓
*Korrekte $K_c$ uitddrukking (formules tussen vierkantige hakies)*
(f) Substitution of $K_c$ 0,016
*Vervanging van $K_c$ 0,016*
(g) Substitution of concentrations into $K_c$ expression ✓
*Vervanging van konsentrasies in $K_c$ uitdrukking*
(h) Initial mole of HI = Equilibrium + Change = 0,198 mol ✓
Range/*Gebied*: 0,19 – 0,2 mol

| | HI | $H_2$ | $I_2$ | |
|---|---|---|---|---|
| Initial quantity (mol)<br>*Aanvanklike hoeveelheid (mol)* | 0,198✓(h) | | 0 | |
| Change/*Verander* (mol) | 0,04 | 0,02 ✓ (a) | 0,02 | ratio ✓(b)<br>*verhouding* |
| Quantity at equilibrium (mol)<br>n = cv<br>*Hoeveelheid by ewewig (mol)*<br>*n = cv* | 0,158 | 0,02 | 0,02 ✓ | (c) |
| Equilibrium concentration (mol·dm$^{-3}$)<br>*Ewewig konsentrasie (mol·dm$^{-3}$)* | 0,0316 | 0,004 | 0,004 | ✓(d) |

Kc = $\frac{[H_2][I_2]}{[HI]^2}$ ✓ (e)

✓(f) 0,016 = $\frac{(0,004)^2}{[HI]^2}$ ✓(g)

[HI] = 0,0316 mol.dm$^{-3}$

| | |
|---|---|
| Wrong $K_c$ expression/*Verkeerde $K_c$ uitdrukking* | Max/*Maks:* $^5/_8$ |
| No $K_c$ expression followed by correct substitutions/*Geen $K_c$-uitdrukking nie gevolg deur korrekte vervangings* | Max/Maks: $^7/_8$ |

**OPTION/*OPSIE* 2**

**CALCULATIONS USING CONCENTRATIONS/**
***BEREKENINGE MET GEBRUIK VAN KONSENTRASIES***
**Mark allocation/*Puntetoekenning:***
(a) Change $[H_2]$ = equilibrium $[H_2]$ = 0,04
*Verandering $[H_2]$ = ewewig $[H_2]$ = 0,04*
(b) **USING** ratio $HI:H_2:I_2$ = 2:1:1
***GEBRUIK** verhouding $HI:H_2:I_2$ = 2:1:1*
(c) Equilibrium concentration of $I_2$ = Change concentration $I_2$ ✓
*Ewewig konsentrasie van $I_2$ = Verander konsentrasie $I_2$*
(d) Correct $K_c$ expression (formulae in square brackets) ✓
*Korrekte $K_c$ uitddrukking (formules tussen vierkantige hakies)*
(e) Substitution of concentrations into $K_c$ expression ✓
*Vervanging van konsentrasies in $K_c$ uitdrukking*
(f) Substitution of $K_c$ 0,016
*Vervanging van $K_c$ 0,016*
(g) Initial concetration of HI = Equilibrium + Change ✓
*Aanvanklike konsentrasie van HI = Ekwilibrium + Verandering*
(h) Devide 0,2 by 5 AND multiplying ,0396 by 5
*Deel 0,2 deur 5 EN vermenigvuldig ,0396 met 5*
Range/*Gebied*: 0,19 – 0,2 mol

Equilibrium/*Ewewig* $[H_2] = \frac{0,02}{5}$ = 0,004 mol·dm$^{-3}$ (h) ✓

| | HI | $H_2$ | $I_2$ | |
|---|---|---|---|---|
| Initial quantity (concentration) *Aanvanklike hoeveelheid (konsentrasie)* | 0,0396✓(g) | | 0 | |
| Change (concentration) *Verander (konsentrasie)* | 0,008 | 0,004 ✓ (a) | 0,004 | ratio ✓(b) *verhouding* |
| Equilibrium concentration (mol·dm$^{-3}$) *Ewewig konsentrasie (mol·dm$^{-3}$)* | 0,0316 | 0,004 | 0,004 ✓ | (c) |

n(HI)initial/*aanvanklike* = 0,0396 x 5
= 0,198 mol

Kc = $\frac{[H_2][I_2]}{[HI]^2}$ (d) ✓
✓(f) 0,016 = $\frac{(0,004)^2}{[HI]^2}$ ✓ (e)
[HI] = 0,0396 mol.dm$^{-3}$

(8)

| |
|---|
| Wrong $K_c$ expression/*Verkeerde uitdrukking*: Max/*Maks*: $^5/_8$ |
| No $K_c$ expression followed by correct substitutions/Geen Kc-uitdrukking nie gevolg deur korrekte vervangings: Max/*Maks*: $^7/_8$ |

6.3.1 Decreases/*Neem af* ✓ (1)

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

6.4 Endothermic ✓
- $K_c$ decreases with a decrease in temperature ✓
- Reverse reaction is favoured/concentration of reactants increases/ concentration of products decreases/yield decreases ✓
- Decrease in temperature favours an exothermic reaction ✓

*Endotermies*
- *$K_c$ neem af met 'n afname in temperatuur*
- *Omgekeerde reaksie word bevoordeel/konsentrasie van reaktanse neem toe/konsentrasie van produkte neem af/opbrengs neem af*
- *Afname in temperatuur bevoordeel 'n eksotermiese reaksie* (4)

**[16]**

## QUESTION 7/*VRAAG 7*

7.1.1 It dissociates/ionises completely✓ in water. ✓
*Dit dissosieer/ioniseer heeltemalin water.* (2)

7.1.2

**Marking criteria/*Nasienriglyne:***

a) Formula/*Formule* n = $\frac{m}{M}$/ c = $\frac{n}{V}$ ✓
b) Substitute/*Vervang* 58 in n = $\frac{m}{M}$ ✓
*c)* **USING** ratio/*GEBRUIK verhouding* n($H_2SO_4$) : n($Mg(OH)_2$) = 1:1✓
d) Substitute/*Vervang* 1,5 and/*en* 0,03448 in n = cV ✓
e) $n(H_2SO_4)_{final} = n_{initial} - n_{reacted}$ ✓✓
f) Substitute/ *Vervang* $n(H_2SO_4)_{final}$ and/*en* 0,03 in c = $\frac{n}{V}$ ✓
g) Final answer/*Finale antwoord:* 0,5 mol·dm$^{-3}$ ✓
Range/*Gebied*: 0,5 to 0,67 mol·dm$^{-3}$

n(MgOH):

$n = \frac{m}{M}$ ✓(a)

$= \frac{2}{58}$ ✓(b)

= 0,03448 mol

$n_{reacted}(H_2SO_4)$ = n(MgOH)
$n(H_2SO_4)$ = 0,03 mol ✓(c)

$n_{initial}(H_2SO_4)$ = c x V
= 1,5 x 0,03 ✓(d)
= 0,05 mol

$n_{final}(H_2SO_4)$ = 0,05 – 0,03 ✓✓(e)
= 0,02 mol

$[H_2SO_4]$ $c = \frac{n}{V}$

$= \frac{0,02}{0,03}$ ✓(f)

= 0,67 mol·dm$^{-3}$ ✓(g) (8)

7.2.1 Contain a small amount (number of moles) of acid ✓in proportion to the volume of water. ✓
*Bevat 'n klein hoeveelheid (aantal mol) suur in verhouding tot die volume water.* (2)

7.2.2 $pH = -\log[H_3O^+]$ ✓
$pH = -\log(0,15)$ ✓
$pH = 0,82$ ✓ (3)

7.3.1 Basic/*Basis* ✓ (1)

7.3.2

**Marking criteria/*Nasienkriteria*:**
a) Reactants/*Reaktanse* ✓ Products/*Produkte* ✓
Balancing/*Balansering* ✓
b) Ignore single arrows and phases/*Ignoreer enkel pyle en fases*
c) Marking rule/*Nasienreël* 3.10

$CO_3^{2-}(aq) + H_2O(\ell)$ ✓ ⇌ $HCO_3^-(aq) + OH^-(aq)$ ✓ ✓ balancing/*balansering*
OR
$Na_2CO_3(aq) + H_2O(\ell)$ ✓ ⇌ $H_2CO_3(aq) + NaOH(aq)$ ✓ ✓ balancing/*balansering*
(3)
**[19]**

## QUESTION 8/*VRAAG 8*

8.1 Completes the circuit/maintains electrical neutrality/provides path for movement of ions. ✓
*Voltooi die stroombaan/handhaaf elektriese neutraliteit/verskaf pad vir beweging van ione.* (1)

8.2 Cu ✓ (1)

8.3.1 $CuSO_4$/copper(II) sulphate/*koper(II)sulfaat* ✓ (1)

Accept: Salt that contains $Cu^{2+}$ ions/*Aanvaar: Sout wat $Cu^{2+}$ ione bevat*

8.3.2 $AgNO_3$/silver nitrate/*silwernitraat* ✓ (1)

Accept: Salt that contains $Ag^+$ ions/*Aanvaar: Sout wat $Ag^+$ ione bevat*

8.4 $Cu + 2Ag^+$✓ $\rightarrow Cu^{2+} + 2Ag$ ✓ ✓balancing/*balansering* (3)

**Marking criteria/*Nasienkriteria*:**
- Reactant/*Reaktanse* ✓ Products/*Produkte* ✓
  Balancing/Balansering ✓
- Ignore double arrows/*Ignoreer dubbel pyle*
- Marking rule/*Nasienreël* 6.3.10

8.5 **OPTION/*OPSIE* 1**

$E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ ✓
$= 0,8$ ✓ $- 0,34$ ✓
$= 0,46$ V ✓

**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. $E^\theta_{cell} = E^\theta_{OA} E^\theta_R$, followed by correct substitutions: $^3/_4$
*Enige ander formule wat onkonvensionele afkortings gebruik, bv.* $E^\theta_{cell} = E^\theta_{OA} E^\theta_R$ *gevolg deur korrekte vervangings:* $^3/_4$

**OPTION/*OPSIE 2***

✓
$Cu \rightarrow Cu^{2+} + 2e^-$ $E° = -0,34$(V) ✓
$Ag^+ + e^- \rightarrow Ag$ $E° = 0,8$ (V) ✓
$Cu + 2Ag^+ \rightarrow Cu^{2+} + 2Ag$ $E° = 0,46$ V ✓ (4)

8.6 Temperature/*Temperatuur*: 25 °C/ 298 K ✓
Concentration/*Konsentrasie*: 1 mol·dm$^{-3}$ ✓ (2)
**[13]**

## QUESTION 9/*VRAAG 9*

9.1 Electrical to chemical/*Elektries tot chemies* ✓✓ (2)

9.2 A solution that conducts electricity through the movement of ions ✓✓
*'n Oplossing wat elektrisiteit gelei deur die beweging van ione* (2)

9.3 (Electrode/*Elektrode*) A ✓ (1)

9.4 $Cu^{2+} + 2e^- \rightarrow Cu$ ✓✓

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

(2)

9.5 Anode ✓ (1)

9.6.1 A yelow green gas/chlorine / $C\ell_2$ gas will form ✓✓
*'n Geelgroen gas/chloor/* $C\ell_2$ *gas sal vorm* (2)

9.6.2 $2C\ell^- \rightarrow C\ell_2 + 2e^-$ ✓✓

**Marking criteria/*Nasienkriteria:***
- $2C\ell^- \rightleftharpoons C\ell_2 + 2e^-$ $\frac{1}{2}$ $C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$ $\frac{0}{2}$
  $C\ell_2 + 2e^- \rightarrow 2C\ell^-$ $\frac{0}{2}$ $C\ell_2 + 2e^- \leftarrow 2C\ell^-$ $\frac{2}{2}$
- Ignore if charge omitted on electron/*Ignoreer as lading electron op weggelaat is*
- If charge (+) omitted on $C\ell^-$/*Indien lading (+) weggelaat is op* $C\ell^-$: Max./*Maks:* $\frac{1}{2}$
- Example/*Voorbeeld*: $2C\ell \rightarrow C\ell_2 + 2e^-$

(2)
**[12]**

**TOTAL/*TOTAAL*: 150**