education

MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

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

SEPTEMBER 2026

MARKING GUIDELINES/*NASIENRIGLYNE*

APPROVED

MARKS/PUNTE: 150

09/09/2026

This memorandum consists of 13 pages.
Hierdie memorandum bestaan uit 13 bladsye.

QUESTION 1 / *VRAAG 1*

1.1 D ✓✓ (2)

1.2 B ✓✓ (2)

1.3 A ✓✓ (2)

1.4 B ✓✓ (2)

1.5 C ✓✓ (2)

1.6 D ✓✓ (2)

1.7 A ✓✓ (2)

1.8 B ✓✓ (2)

1.9 A ✓✓ (2)

1.10 D ✓✓ (2)
[20]

QUESTION 2 / VRAAG 2

2.1.1 E ✓ (1)

2.1.2 B ✓ (1)

2.1.3 A ✓ (1)

2.2.1 3-methylbutan-2-one/ *3-metielbutan-2-oon* ✓✓✓

Marking criteria:
- Correct stem i.e. butanone. ✓
- Substituent (methyl) correctly identified ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:
- *Korrekte stam d.i. pentaan.* ✓
- *Substituent (metiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas.* ✓ (3)

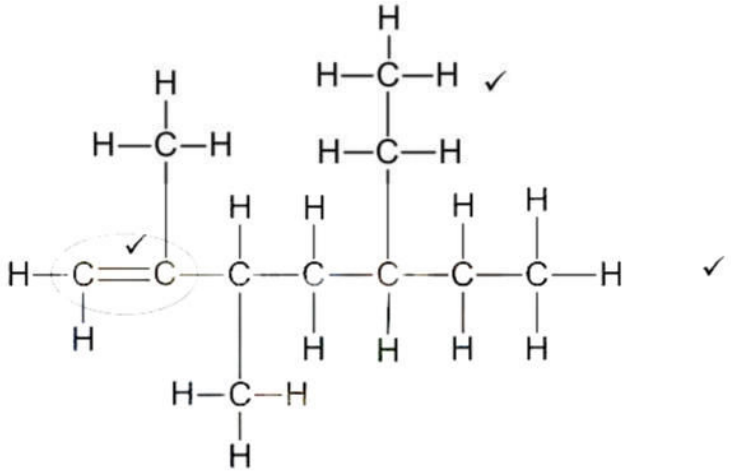
2.2.2 2,4-dichloro-2-methylhexane / *2,4-dichloor-2-metielheksaan* ✓✓✓

Marking criteria:
- Correct stem i.e. hexane ✓
- All substituents (dichloro and methyl) correctly identified ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:
- *Korrekte stam d.i. heksaan.* ✓
- *Alle substituente (dichloro en metiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas.* (3)

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2.3

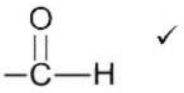


Marking criteria:
- Correct chain length (7Cs). ✓
- Functional group (double bond) on C1 ✓
- Methyl groups on C2 and C3 and ethyl group on C5 ✓

Nasienkriteria:
- *Funksionele groep (dubbelbinding op C1.* ✓
- *Metielgroepe op C2 en C3 asook etielgroep op C5* ✓
- *Res van die ketting korrek.* ✓

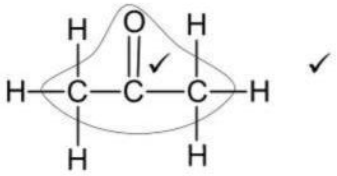
(3)

2.4.1



(1)

2.4.2

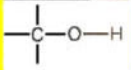


Marking criteria:
- Correct functional group. ✓
- Whole structure correct ✓

Nasienkriteria:
- *Korrekte funksionele groep* ✓
- *Hele struktuur korrek* ✓

(2)

2.5 Secondary (alcohol) / *Sekondêre (alcohol)* ✓

The C-atom bonded to the hydroxyl/-OH is bonded to two other C-atoms/the functional group() is bonded to two other C-atoms. ✓
Die C-atoom wat aan die hidroksiel/-OH gebind is aan twee ander C-atome gebind.

(2)
[17]

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QUESTION 3 / VRAAG 3

3.1.1

Marking criteria/*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 temperature at which the vapour pressure (of a compound) equals atmospheric pressure. ✓✓
Die temperatuur waarby die dampdruk (van 'n verbinding) gelyk is aan die atmosferiese druk. (2)

3.1.2 X ✓ (1)

3.1.3
- X/Pent-2-ene has a longer chain length./is less branched./has a larger surface area/ contact area. ✓
- Strength of the intermolecular forces is greater./There are more sites for London forces. ✓
- More energy is needed to overcome/break intermolecular forces. ✓

- *Het 'n langer kettinglengte./is minder vertak./het 'n groter kontakoppervlak/reaksieoppervlak.* ✓
- *Sterkte van die intermolekulêre kragte verhoog./Daar is meer plekke vir Londonkragte.* ✓
- *Meer energie word benodig om die intermolekulêre kragte te oorkom/breek.* ✓

OR/OF
- Y/2-methylbut-2-ene has a shorter chain length./is more branched./ has a smaller surface area/contact area.
- Strength of the intermolecular forces is weaker./There are fewer sites for London forces.
- Less energy is needed to overcome/break intermolecular forces.

- *2-metielbut-2-een het 'n korter kettinglengte./is meer vertak./het 'n kleiner kontakoppervlak/reaksieoppervlak.*
- *Sterkte van die intermolekulêre kragte is swakker./Daar is minder plekke vir Londonkragte.*
- *Minder energie word benodig om intermolekulêre kragte te oorkom/breek.* (3)

3.2.1 -0,5 (°C) ✓ (1)

3.2.2 B/CH_3CH_2COOH/propanoic acid ✓
B has the highest boiling point/strongest intermolecular forces. ✓
B het die hoogste kookpunt/sterktste intermolekulêre kragte. (2)

3.2.3 Dipole-dipole (intermolecular forces) /*Dipool-dipool (intermolekulêre kragte)* ✓ (1)

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3.2.4

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 IMF's OR the energy needed to overcome IMF's. ✓

Nasienkriteria:

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

- Carboxylic acids/B have, (in addition to London forces and dipole-dipole forces), two sites for hydrogen bonding between molecules. ✓
- Alcohols/C have, (in addition to London forces and dipole-dipole forces), one site for hydrogen bonding between molecules. ✓
- Intermolecular forces in carboxylic acids are stronger./More energy needed to overcome/break intermolecular forces in carboxylic acid/B. OR intermolecular forces in alcohols are weaker/Less energy is required to overcome the forces. ✓

- *Karboksielsure/B het, in toevoeging tot Londonkragte en dipool-dipoolkragte, twee punte vir waterstofbinding tussen molekule.*
- *Alkohole/C het, in toevoeging tot Londonkragte en dipool-dipoolkragte, een punt vir waterstofbinding tussen molekule.*
- *Intermolekulêre kragte in karboksielsure is sterker./Meer energie word benodig om intermolekulêre kragte in karboksielsure te oorkom/breek.*

(3)

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QUESTION 4/ *VRAAG 4*

4.1 Elimination/Dehydration / *Eliminasie/Dehidrasie* ✓ (1)

4.2.1 Saturated/*Versadig* ✓ (1)

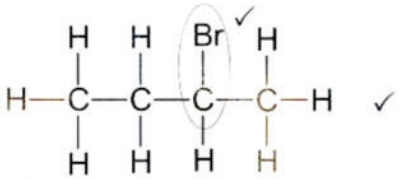
4.2.2 Pt/Ni/Pd ✓ (Do not accept chemical names) (1)

4.3.1 But-1-ene ACCEPT: 1-butene✓✓ **(2 or 0)** (2)

4.3.2 UV(sun) light or heat/hf/*UV(son)-lig en hitte* ✓ (1)

4.4.1 Hydrohalogenation/hydrobromination/*Hidrohalogenering/Hidrohalogenasie* ✓ (1)

4.4.2



✓ ✓

Marking criteria:
- Correct functional group ✓
- Whole structure correct with Br on C2. ✓

Nasienkriteria:
- *Broom atoom op die tweede koolstof atoom.* ✓
- *Hele struktuur korrek* ✓ (2)

4.5.1 Propene/ Prop-1-ene/*Propeen/Prop-1-een* ✓ (1)

4.5.2 H_2O/ water/dihydrogen monoxide ✓ (1)

4.5.3 $2\underline{C_6H_{14}}$✓ + $19O_2$ ✓→ $12CO_2 + 14H_2O$ ✓ (Marking Rule 6.3.10) Bal ✓ (4)
[Reactants (Any alkane + O_2) and products] **[15]**

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QUESTION 5/ *VRAAG 5*

5.1

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.*

ANY ONE

- The change in concentration ✓of reactants or products per unit time✓
- Rate of change in concentration/amount of moles/number of moles/volume/ mass. ✓✓**(2 or 0)**

ENIGE EEN

- *Die verandering in konsentrasie ✓van reaktante of produkte per eenheid tyd.* ✓
- *Tempo van verandering in konsentrasie/ hoeveelheid mol/getal mol/ volume/ massa.* ✓✓ ***(2 of 0)*** (2)

5.2 Exothermic/*Eksotermies*✓
Heat is released during the reaction/Temperature increases/ Reaction vessel becomes warmer✓
Hitte is vrygestel gedurende die reaksie/ Temperatuur verhoog/ Die houer waarin die reaksie plaasvind word warmer (2)

5.3 No,✓ more than one independent variable ✓
Nee, meer as een onafhanklike veranderlike (2)

5.4 Lower than /*Laer as* ✓ (1)

5.5

- In experiment A, the concentration (of the HNO_3) is lower. ✓
- Less particles per unit volume. ✓
- Less effective collisions per unit time will take place./less frequency of effective collisions ✓

OR

- In experiment D, the concentration (of the HNO_3) is higher. ✓
- More particles per unit volume. ✓
- More effective collisions per unit time will take place/ Higher frequency of effective collisions. ✓

- *Die konsentrasie (van die HNO_3) in Eksperiment A is laer*
- *Minder deeltjies per eenheidsvolume.*
- *Minder effektiewe botsings per tydseenheid sal plaasvind* (3)

5.6.1 Q ✓ (1)

5.6.2 Rate of reaction/*Tempo van reaksie* ✓ (1)

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5.6.3 **Marking criteria / Nasienkriteria:**

a) Substitute/*Vervang* 0,0294 $dm^3 \cdot min^{-1}$ and/en 12 min in Tempo $= \frac{\Delta V}{\Delta t}$ ✓
b) Substitute/*Vervang* 22,4 $dm^3 \cdot mol^{-1}$ and V(NO_2) in $n = \frac{V}{V_m}$ ✓
c) Use mol ratio/*Gebruik molverhouding* n(Cu) : n(NO_2) 2:3 ✓
d) Substitute/*Vervang* nCu and/*en* 63,5 $g \cdot mol^{-1}$ in m=nM ✓
e) Final answer/*Finale antwoord* ✓

$$\text{Tempo} = \frac{\Delta V}{\Delta t}$$
$$0{,}0294 = \frac{\Delta V}{12\text{-}(0)} \checkmark(a)$$
$$\Delta V = 0{,}3528\ dm^3$$
$$n = \frac{V}{V_m}$$
$$= \frac{0{,}3528}{22{,}4} \checkmark(b)$$
$$= 0{,}01575\ mol$$
$$n(Cu) = \frac{3}{2} n(NO_2)$$
$$n(Cu) = \frac{3}{2}(0{,}01575)$$
$$= 0{,}02363\ mol \checkmark(c)$$
$$m(Cu) = nM$$
$$= (0{,}02363 \times 63{,}5) \checkmark(d)$$
$$= 1{,}50\ g \checkmark(e)$$

(5)
[17]

QUESTION 6 / *VRAAG 6*

6.1 **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.*

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

Wanneer die ewewig in 'n geslote sisteem versteur word, stel die sisteem 'n nuwe ewewig in deur die reaksie wat die versteuring teenwerk, te bevoordeel (2)

6.2
- Pressure decreased/volume of the container increased ✓
- Decrease in pressure favours the reaction that forms the most amount/number of moles (gas molecules). ✓
- The reverse reaction will be favoured. ✓
- [C_2H_4] and [H_2O] will increase and [O_2] will decrease. ✓ (4)

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- *Wanneer die druk afneem, sal die reaksie met die meeste mol bevoordeel word*
- *Die reaksie met die meeste mol sal bevoordeel*
- *Die terugwaartse reaksie word bevoordeel*
- *[C_2H_2] en [H_2O] sal toeneem en [O_2] sal afneem*

6.3
- ENDOTHERMIC ✓
- If the temperature increased the endothermic reaction will be favoured ✓
- [O_2] increases/[C_2H_4] and [H_2O] decreased ✓
- The forward reaction will be favoured ✓

- *ENDOTERMIES*
- *As die temperatuur verhoog sal die endotermiese reaksie bevoordeel*
- *[O_2] verhoog*
- *Die voorwaartse reaksie word bevoordeel* (4)

6.4 (It is a dynamic equilibrium) when the rate of the forward reaction equals the rate of the reverse reaction. ✓✓

OR

When the amount of products and reactants remains constant. **(2/0)**
Dit is 'n dinamiese ewewig wanneer die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie (2)

6.5 No effect ✓✓ / *geen effek* (2)

6.6 **CALCULATIONS USING NUMBER OF MOLES**
BEREKENINGE WAT AANTAL MOL GEBRUIK

Marking criteria/*Nasienriglyne*:
a) Determine percentage and substitute 0,095x3 in table / *Bereken die persentasie en vervang 0,095x3 in die tabel* ✓
b) Use of ratio/ *Gebruik die verhouding* ✓
c) $n(N_2O_4)eq = n(N_2O_4)initial - \Delta n(N_2O_4)$, $n(NO_2)eq = n(NO_2)initial - \Delta n(NO_2)$ ✓,
d) K_c expression / K_c-uitdrukking ✓
e) Substitution of K_c value / Vervang K_c waarde ✓
Final answer/*Finale antwoord*: 0,0994 (0,1)✓

OPTION 1/*OPSIE 1*

	N_2O_4	$2NO_2$	
Initial quantity/Aanvanklike hoeveelheid (mol)	1,38	0	
Change/Verandering (mol)	-0,285 ✓(a)	0,5712	✓(b)
Quantity at equilibrium/ Hoeveelheid by ewewig (mol)	1,095	0,5713	✓ (c)
Concentration (mol/dm^3)	0,365	0,19044	

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} \checkmark (d)$$

$$K_c = \frac{(0,19044)^2}{(0,365)} \checkmark (e)$$

$$= 0,0994\ (0,1) \checkmark (f)$$

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK

Marking criteria/*Nasienriglyne*:

f) Determine percentage and substitute 0,095 in table / *Bereken die persentasie en vervang 0,095 in die tabel* ✓
g) Use of ratio/ *Gebruik die verhouding* ✓
h) $c(N_2O_4)eq = c(N_2O_4)$ initial $- \Delta\, c(N_2O_4)$, $c(NO_2)eq = c(NO_2)$initial $- \Delta c(NO_2)$✓,
i) K_c expression / K_c-uitdrukking ✓
j) Substitution of K_c value / Vervang K_c waarde ✓
k) Final answer/*Finale antwoord*: 0,0994 (0,1)✓

OPTION 2/*OPSIE 2*

	N_2O_4	$2NO_2$	
Initial quantity/Aanvanklike hoeveelheid (concentration / konsentrasie)	0,46	0	
Change/Verandering (concentration / konsentrasie))	-0,095 ✓(a)	0,19044	✓(b)
Quantity at equilibrium/ Hoeveelheid by ewewig (concentration / konsentrasie)	0,365	0,19044	✓ (c)

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} \checkmark (d)$$

$$K_c = \frac{(0,19044)^2}{(0,365)} \checkmark (e)$$

$$= 0,0994\ (0,1) \checkmark (f)$$

(6)
[20]

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QUESTION 7 / VRAAG 7

7.1.1 Battery acid / Battery suur ✓✓ (2)

7.1.2 $pH = -\log[H_3O^+]$ ✓

$4,12✓ = -\log[H_3O^+]$

$[H_3O^+] = 7,585775 \times 10^{-5}\ mol \cdot dm^{-3}$

$K_w = [H_3O^+][OH^-]$

$1 \times 10^{-14} = (7,585775 \times 10^{-5})[OH^-]✓$

$[OH^-] = 1,318 \times 10^{-10}\ mol \cdot dm^{-3}$ ✓ **Range** ($1,23 \times 10^{-10}$ - $1,32 \times 10^{-10}$) (4)

7.1.3 a) Increases / *toeneem* ✓ (1)

b) Increases / *toeneem* ✓ (1)

7.2.1 $[H_3O^+] = [HCO_3^-] = 0,012\ mol \cdot dm^{-3}$ ✓

$n = cV$
$= (0,012)(0,5)✓$
$= 0,006\ mol$ ✓ (3)

7.2.2 $n(NaOH) = cV$ ✓
$= (0,25)(0,75)$ ✓
$= 0,1875\ mol$

Therefore/ *Dus* $n(OH^-) = 0,1875\ mol$ ✓ (3)

7.2.3

Marking criteria / *Nasienriglyne*:

a. Substituting 0,1 and 0,5 in n=cV✓
b. Using ratio / Gebruik verhouding 1 (OH^-) : 1 (HCO_3^-) correctly / korrek✓ (0,05 mol of acid neutralises 0,05 mol of base)
c. $n(OH^-)$ in excess / in oormaat 0,1875 - 0,05 ✓ = 0,1375mol
d. Substitution / invervanging✓ in c = n/v
e. $[H_3O^+] = 10^{-14}/0,102$ ✓
f. Substitution in formula / Vervang in formula ✓
g. Final answer / Finale antwoord ✓

$n = cV$
$= (0,1)(0,5)✓$ (a)
$= 0,05\ mol$

0,05 mol acid neutralises 0,05 mol of base ✓(b)/
0,05 mol suur neutraliseer 0,05mol basis

$n(OH^-)_{in\ excess/oormaat} = 0,1875 - 0,05$ ✓(c)
$= 0,1375\ mol$

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$$c(OH^-) = \frac{n}{V}$$
$$= \frac{0,1375}{(0,5+0,75)} \checkmark \text{ (d)}$$
$$= 0,11 \text{ mol} \cdot \text{dm}^{-3}$$

$$K_w = [H_3O^+][OH^-]$$
$$1 \times 10^{-14} = [H_3O^+](0,11) \checkmark \text{ (e)}$$
$$[H_3O^+] = 9,0909 \times 10^{-14} \text{ mol} \cdot \text{dm}^{-3}$$

$$pH = -\log[H_3O^+]$$
$$= -\log(9,0909 \times 10^{-14}) \checkmark \text{ (f)}$$
$$= 13,04 \checkmark \text{ (g)}$$

(7)
[21]

QUESTION 8 / VRAAG 8

8.1.1 $Fe / Fe^{2+} \checkmark\checkmark$ (2)

8.1.2 $Fe \rightarrow Fe^{2+} + 2e^- \checkmark\checkmark$ (2)

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

Example/*Voorbeeld:* $Fe \rightarrow Fe^{2} + 2e^- \checkmark$

8.1.3 $2Fe + O_2 + 4H^+ \checkmark \rightarrow 2Fe_2+ + 2H_2O \checkmark$ bal✓ (3)

8.1.4 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode} \checkmark$
$= 1,23 \checkmark - (-0,44) \checkmark$
$= 1,67 \text{ V} \checkmark$ (4)

8.2 Mg is a stronger reducing agent ✓than Fe✓ / *Mg is 'n sterker reduseermiddel as Fe*
OR
Fe is a weaker reducing agent than Mg. (3)

Mg will be oxidised to Mg^{2+}/Fe will not be oxidized to Fe^{2+} ✓ / *Mg sal geoksiedeer word na* Mg^{2+}

8.3 $C\ell_2 + 2e^- \rightarrow 2C\ell^-$ ✓✓ (2)

Marking guidelines/*Nasienriglyne:*

- $C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$ $\frac{1}{2}$ $2C\ell^- \rightleftharpoons C\ell_2 + 2e$ $\frac{0}{2}$
  $C\ell_2 + 2e^- \leftarrow 2C\ell^-$ $\frac{2}{2}$ $2C\ell^- \rightarrow C\ell_2 + 2e$ $\frac{0}{2}$
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on Cu^{2+} / *Indien lading (+) weggelaat op* Cu^{2+}: Max./*Maks:* $\frac{1}{2}$

Example/*Voorbeeld:* $C\ell_2 + 2e \rightarrow 2C\ell^-$ ✓

[16]

QUESTION 9 / VRAAG 9

9.1 Negative / *Negatief*✓ (1)

9.2 Remain the same/*Bly dieselfde* ✓
The rate of oxidation (of Cu) is equal to the rate of reduction (of Cu^{2+})/*Die tempo van oksidasie is gelyk aan die tempo van reduksie.* ✓ (2)

9.3 Decrease / Verlaag ✓
$Cu \rightarrow Cu^{2+} + 2e^-$ ✓✓ (3)

Marking guidelines/*Nasienriglyne:*

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

Example/*Voorbeeld:* $Cu \rightarrow Cu^2 + 2e^-$ ✓

9.4 $n(Cu) = \frac{1}{2}n(e^-)$

$= \frac{2}{2}$

$= 1$ mol ✓

$m(Cu) = nM$

$= (1)(63,5)$✓

$= 63,5$ g

$$\text{mass impure Cu} = \frac{63,5 \times 100\checkmark}{95,7\checkmark}$$

$= 66,35$ g ✓

(5)
[11]

GRAND TOTAL/*GROOTTOTAAL* [150]

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