education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIORSERTIFIKAAT

GRADE/GRAAD 12

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

SEPTEMBER 2025

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/PUNTE: 150

This marking guidelines consists of 14 pages.
Hierdie nasienryglyne bestaan uit 14 bladsye.

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QUESTION 1 / VRAAG 1

1.1 C ✓✓ (2)

1.2 B ✓✓ (2)

1.3 D ✓✓ (2)

1.4 B ✓✓ (2)

1.5 C ✓✓ (2)

1.6 D ✓✓ (2)

1.7 B ✓✓ (2)

1.8 A ✓✓ (2)

1.9 A ✓✓ (2)

1.10 B ✓✓ (2)

[20]

QUESTION 2 / VRAAG 2

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.*

A series of organic compounds that can be described by the same general formula OR in which one member differs from the next with a CH_2 group.✓✓
'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word OF waarin die een lid van die volgende verskil met 'n CH_2-groep (2)

2.2.1 A ✓ (1)

2.2.2 C ✓ (1)

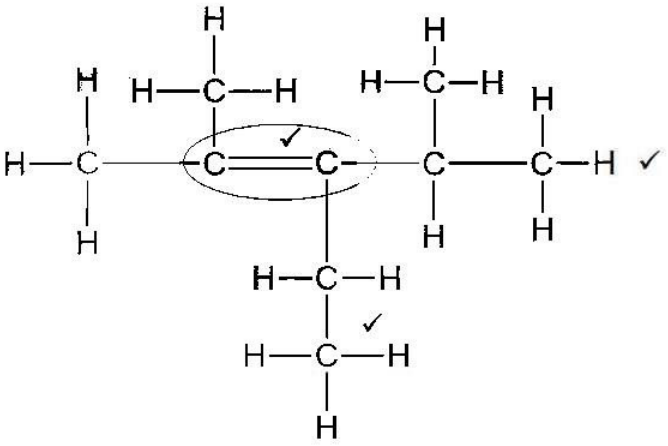
2.3.1 4-bromo-2,2-dimethylpentane / *4-bromo-2,2-dimetielpentaan*

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

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

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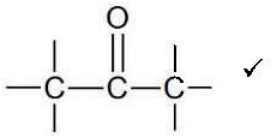
2.3.2



Marking criteria:
- Double bond on C2. ✓
- Methyl groups on C2 and C4 and ethyl group on C3 ✓
- Rest of the chain correct. ✓

Nasienkriteria:
- *Dubbelbinding op C2.*
- *Metielgroepe op C2 en C4 asook etielgroep op C3* ✓
- *Res van die ketting korrek.* ✓ (3)

2.3.3



(1)

2.3.4 Pentanal/*Pentanaal* OR 2,2-dimethylpropanal/*2,2-dimitielpropanaal* ✓✓ (2)

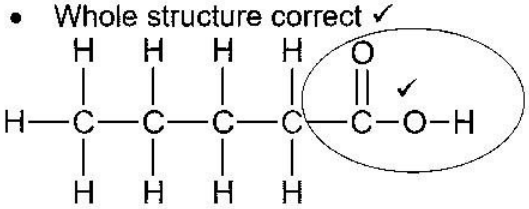
2.4 Tertiary (alcohol)/*Tersiêre (alkohol)* ✓ (1)

2.5.1 Ethyl ✓propanoate ✓/*Etiel propanoaat* (2)

2.5.2

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

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



ACCEPT: Branched carboxylic acid

(2)
[18]

QUESTION 3 / VRAAG 3

3.1.1 14,5 (kPa) ✓ (1)

3.1.2 2-methyl✓butane✓/*2-metielbutaan*

Marking criteria:
- Correct stem i.e. butane. ✓
- One methyl group on Carbon 2. ✓

Nasienkriteria:
- *Korrekte stam d.i. butaan.* ✓
- *Een metielgroep op koolstof 2.* ✓ (2)

3.1.3 A ✓ (1)

3.1.4 **Marking criteria:**
- Compare the structures of the compounds A, B and C
- Compare the strength of intermolecular forces
- Compare the energy required to overcome intermolecular forces

Nasienkriteria:
- *Vergelyk die struktuur van die verbindings A, B en C*
- Vergelyk die sterkte van intermolekulêre kragte
- *Vergelyk die energie benodig om intermolekulêre kragte te oorkom*

From A to C/*Van A na C*:

- **Structure/*Struktuur*:**
  More branched / more compact / more spherical/shorter chain length / smaller surface area (over which intermolecular forces act).✓
  Meer vertak / meer kompak / meer sferies / korter kettinglengte / kleiner oppervlak (waaroor intermolekulêre kragte werk).
- **Intermolecular forces/*Intermolekulêre kragte:***
  Weaker / less intermolecular forces / Van der Waals forces / London forces / dispersion forces.
  Swakker / minder intermolekulêre kragte / Van der Waalskragte / London-kragte / dispersiekragte. ✓
- **Energy/*Energie*:**
  Less energy needed to overcome or break intermolecular forces / Van der Waals forces. ✓
  Minder energie benodig om intermolekulêre kragte / Van der Waalskragte/ dispersiekragte / London-kragte te oorkom.

OR/*OF*

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From C to A/*Van C na A*

- **Structure/*Struktuur*:**
  Less branched / less compact / less spherical /longer chain length /larger surface area (over which intermolecular forces act).✓
  Minder vertak / minder kompak / minder sferies / langer kettinglengte / groter oppervlak (waaroor intermolekulêre kragte werk).
- **Intermolecular forces/*Intermolekulêre kragte:***
  Stronger / more intermolecular forces / Van der Waals forces / London forces / dispersion forces. ✓
  Sterker /meer intermolekulêre kragte / Van der Waalskragte / Londonkragte / dispersiekragte.
- **Energy/*Energie*:**
  More energy needed to overcome or break intermolecular forces / Van der Waals forces. ✓
- *Meer energie benodig om intermolekulêre kragte / Van der Waalskragte/ dispersiekragte / Londonkragte te oorkom.* (3)

3.2.1

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 solid and liquid phases are in equilibrium. ✓✓
Die temperatuur waarby die vastestof- en vloeistoffases van 'n stof in ewewig is. (2)

3.2.2 E ✓ (1)

3.2.3 -113,8 (°C) ✓ (1)

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3.2.4

Marking criteria:
- Identify the type of intermolecular forces for D and E ✓
- Compare the strength of intermolecular forces✓
- Compare the energy required to overcome intermolecular forces ✓

Nasienkriteria:
- *Identifiseer die tiepe intermolekulêre kragte vir D en E*
- Vergelyk die sterkte van intermolekulêre kragte
- *Vergelyk die energie benodig om intermolekulêre kragte te oorkom*

- Compounds **E**/ethanoic acid/carboxylic acid has (in addition to London forces and dipole-dipole forces) hydrogen bonding. Compound **D**/propanal/aldehyde has (in addition to London forces) dipole-dipole forces. ✓
  *Verbinding **E**/etanoësuur/karboksielsuur het waterstofbindings (behalwe Londonkragte en dipool-dipoolkragte). Verbinding **D** / propanaal/aldehied het dipool-dipoolkragte (behalwe Londonkragte).*
- Intermolecular forces in compound **E**/ethanoic acid/carboxylic acid are stronger than intermolecular forces in compound **D**/ propanal/aldehyde. *Intermolekulêre kragte in verbinding **D**/etanoësuur/karboksielsuur is sterker as die intermolekulêre kragte in verbinding **E**/ propanaal/aldehied.* ✓
  OR/*OF*
  Intermolecular forces in compound **D**/ propanal/aldehyde are weaker than intermolecular forces in compound E/ethanoic acid/carboxylic acid.
  *Intermolekulêre kragte in verbinding **D**/propanaal/aldehied is swakker as intermolekulêre kragte in verbinding **E**/etanoësuur/karboksielsuur.*
- More energy is needed to overcome/break intermolecular forces in compound E/ethanoic acid/carboxylic acid than in compound **D**/ propanaal/aldehyde. ✓
  *Meer energie word benodig om intermolekulêre kragte in verbinding **E**/etanoësuur as in verbinding **D**/ propanaal/aldehied te oorkom/breek.*
  OR/*OF*
  Less energy is needed to overcome/break intermolecular forces in compound **D**/propanal/aldehyde than in compound **E**/ethanoic acid/carboxylic acid.
  Minder energie word benodig om intermolekulêre kragte in verbinding **E**/ propanaal/aldehied te oorkom/breek as in verbinding **E**/ etanoësuur/ karboksielsuur.

(3)
[14]

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QUESTION 4/ *VRAAG 4*

4.1.1 Substitution/Halogenation / *Substitusie/Halogenering/Halogenasie* ✓ (1)

4.1.2 Addition/hydrohalogenation/*Adissie/hidrohalogenering/hidrohalogenasie* ✓ (1)

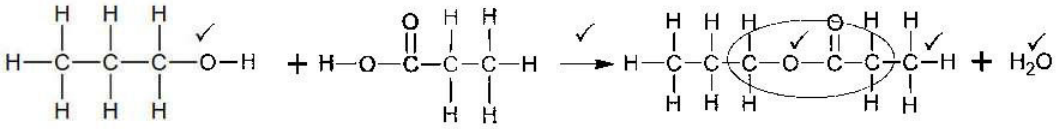
4.2.1 CH_3 ✓ (1)

4.2.2 Ethane/*Etaan* ✓ (1)

4.3.1 Concentrated strong bases/*Gekonsentreerde sterk basis/NaOH(c)/KOH(c)/ LiOH(c)* ✓
Strongly heated/*Sterk verhit* ✓ (2)

4.3.2 Prop-1-ene ✓✓ ACCEPT:Propene (2)

4.4 HCℓ /NaCℓ /KCℓ/LiCℓ✓ (1)

4.5.1 

Marking Criteria/*Nasienriglyne*

- Whole structural formula of the alcohol is correct ✓
  Hele struktuurformule vir vir die alkohol korrek
- Whole structure of carboxylic acid is correct✓
  Hele struktuur van karboksielsuur is korrek
- Correct functional group of the product (ester)✓
  Korrekte funksionele groep van die produk (ester)
- Whole structure of the ester correct✓
  Hele struktuur van die ester is korrek.
- Water(H_2O) as part of the products✓
  Water (H_2O) as deel van die produkte

(5)

4.5.2 Catalyst/Dehydrating agent/Removes the H_2O / Speeds up the reaction✓
Katalisator/Dehidreermiddel/Verwyder water/Maak die reaksie vinniger (1)

[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 Released/*Vrygestel* ✓
ΔH < 0/Energy of products is less than the energy of reactants/ Reaction exothermic✓
ΔH < 0/ Energie van produkte is minder as die energie van die reaktante/ Reaksie is eksotermies (2)

5.3 Lower/l*aer* ✓ (1)

5.4

- At a lower temperature, particles move slower/have a lower (average) 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

- *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 verhoog. (3)

5.5.1 Q✓ (1)

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5.5.2 $\text{rate/tempo} = \frac{\Delta V}{\Delta t}$

$= \frac{300 \times 10^{-3} - 0\checkmark}{120 - 0\checkmark}$

$= 2{,}5 \times 10^{-3}\ (dm^3 \cdot s^{-1})\checkmark$

ACCEPT: any volume between 240 and 300.

(3)

5.5.3

Marking criteria / Nasienkriteria:

a) Substitute 0,3 and 24 in $n = \frac{V}{V_m}$ ✓
b) Use mol ratio n(HCl) : $n(H_2)$ 1:2 ✓
c) Substitute (0,75 x 0,05) in c=nV or m=cMV
d) $n/m_{excess} = n/m_{initial}$ (HCl) – $n/m_{reacted}$ (HCl) ✓
e) Substitude 36,5 $g \cdot mol^{-1}$ in m =nM ✓
f) Final answer ✓

$n(H_2) = \frac{V}{V_m}$

$= \frac{0{,}3}{24}\checkmark$ (a)

$= 0{,}0125$ mol

Afrikaans: Division by 24,3

$n(HCl) = 2n(H_2)$

$= 2(0{,}0125)\checkmark$ (b)

$= 0{,}025$ mol HCl

OPTION 1

$n(HCl)_{initial} = cV$

$= (0{,}75)(0{,}05)\checkmark$ (c)

$= 0{,}0375$ mol

$n(HCl)_{excess} = 0{,}0375 - 0{,}025\ \checkmark$ (d)

$= 0{,}0125$ mol

$m(HCl) = nM$

$= (0{,}0125)(36{,}5)\checkmark$ (e)

$= 0{,}46$ g ✓(0,456) (f)

OPTION 2

$m(HCl)_{reacted} = nM$

$= (0{,}025)(36{,}5)\checkmark$(e)

$= 0{,}9125$ g

$m(HCl)_{initial} = cMV$

$= (0{,}75)(36{,}5)(0{,}05)\checkmark$ (c)

$= 1{,}36875$ g

$m(HCl)_{excess} = 1{,}36875 - 0{,}9125\ \checkmark$ (d)

$= 0{,}46$ g✓ (0,456) (f)

(6)

[18]

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QUESTION 6 / *VRAAG 6*

6.1 When the rate of the forward reaction equals the rate of the reverse reaction. **(2/0)** ✓✓*Die tempo van die voorwaartse reaksie is gelyk aan die tempo van die terugwaartse reaksie.* (2)

6.2 2 (min)✓ (1)

6.3.1 2 ✓ (**ACCEPT**: Multiples if ALL are correct) (1)

6.3.2 1 ✓ (1)

6.3.3 3 ✓ (1)

6.4 **POSITIVE MARKING FROM QUESTION 6.3 (FOR X,Y,Z)**
POSITIEWE NASIEN VANAF VRAAG 6.3 (VIR X,Y.Z)

Marking criteria/*Nasienriglyne*:

a) Substitute/Vervang 3 mol in $c = \frac{n}{v}$ ✓
b) Substitute/Vervang 2,5 mol in $c = \frac{n}{v}$ ✓
c) Substitute/Vervang 1 mol in V n $c = \frac{n}{v}$ ✓
d) Substitute V = 4 dm^3 in the above THREE formulae. ✓ *Vervang V = 4 dm^3 in die bostaande DRIE formules.*
e) Kc expression/Kc-uitdrukking ✓
f) Substitution of concentrations into Kc expression ✓ *Vervanging van konsentrasies in Kc-uitdrukking.*
g) Final answer/*Finale antwoord*: 0,15 ✓

OPTION/*OPSIE* 1

$[A] = \frac{3}{4}$ ✓ (a)
$= 0{,}75 \text{ mol} \cdot \text{dm}^{-3}$
$[B] = \frac{2{,}5}{4}$ ✓ (b)
$= 0{,}625 \text{ mol} \cdot \text{dm}^{-3}$
$[C] = \frac{1{,}5}{4}$ ✓ (c)
$= 0{,}375 \text{ mol} \cdot \text{dm}^{-3}$

Divide by / Deel deur 4 dm^3 ✓ (d)

$K_c = \frac{[C]^3}{[A]^2[B]}$ ✓ (e)
$= \frac{(0{,}375)^3}{(0{,}75)^2(0{,}625)}$ ✓ (f)
$= 0{,}15$ ✓ (g)

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OPTION/*OPSIE* 2

	A	B	C
Initial quantity/Aanvanklike hoeveelheid (mol)	4	3	0
Change/Verandering (mol)	-1	-0,5	+1,5
Quantity at equilibrium/ Hoeveelheid by ewewig (mol)	3✓ (a)	2,5✓(b)	1,5✓(c)
Equilibrium concentration/ Ewewigskonsentrasie ($mol \cdot dm^{-3}$)	0,75	0,625	0,375

(d)

Divide by 4 ✓

$$K_c = \frac{[C]^3}{[A]^2[B]} \checkmark \quad (e)$$

$$= \frac{(0,375)^3}{(0,75)^2(0,625)} \checkmark \quad (f)$$

$$= 0,15 \checkmark (g)$$

(7)

6.5 Concentration of A increases/ *Konsentrasie van A verhoog* ✓ (1)

6.6
- When the concentration is increased the reaction that decreases the concentration is favoured. ✓
- The forward reaction is favoured. ✓
- Concentration of C will increase/the concentration of A and B will decrease ✓

- *Wanneer die konsentrasie verhoog gaan die reaksie wat die konsentrasie verlaag bevoordeel word.*
- *Die voorwaartse reaksie word bevoordeel.*
- *Konsentrasie van C sal toeneem/die konsentrasie van A en B sal afneem* (3)

6.7 Exothermic / Eksotermies ✓
- An increase in temperature favours the endothermic reaction ✓
  'n Verhoging in temperatuur bevoordeel die endotermiese reaksie
- (The K_c value increases), the forward reaction was favoured ✓
  (Die K_c waarde verhoog), die voorwaartse reaksie is bevoordeel. (3)

[20]

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QUESTION 7 / VRAAG 7

7.1.1 Strong bases dissociate completely in water to form a high concentration of OH^- ions. *Sterk basis dissosieer volledig in water om 'n hoë konsentrasie OH^--ione te vorm* ✓✓ (2)

7.1.2 $c(OH^-) = 2c(Ba(OH)_2)$
$= (2)(0,1)$✓

$K_w = [H_3O^+][OH^-]$
$1 \times 10^{-14} = [H_3O^+](0,2)$✓
$[H_3O^+] = 5 \times 10^{-14}\ mol \cdot dm^{-3}$

Any one✓

$pH = -\log[H_3O^+]$
$= -\log(5 \times 10^{-14})$✓
$= 13,3$✓ (5)

7.2

OPTION/*OPSIE* 1

$c = \frac{m}{MV}$✓

$0,2 = \frac{m}{(0,25)(126)}$ ✓✓

$m = 6,30$ g✓

OPTION/*OPSIE* 2

$n = cV$
$= (0,2)(0,25)$✓
$= 0,05$ mol

Any one✓

$m = nM$
$= (0,05)(126)$✓
$= 6,30$ g✓ (4)

NOTE: Award full marks if 90 g.mol^{-1} was used

7.3.1 Burette ✓ (1)

7.3.2

Marking criteria / Nasienkriteria:
a. Division by volume / Deel deur volume
b. Use mol ratio / Gebruik mol verhouding
c. Substitute 233 in formula / Vervang 233 in formule
d. Answer / Antwoord 1,165 g

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

$0,1 = \frac{n}{0,05}$✓

$n = 0,005$ mol

$nBaSO_4 = nBa(OH)_2$
$= 0,005$ mol✓

$m = nM$
$= (0,005)(233)$✓
$= 1,165$ g✓

$c = \frac{m}{MV}$✓

$0,1$✓ $= \frac{m}{(233)(0,05)}$✓

$m = 1,165$ g✓ (4)

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7.4 CH_3COO^- + H_2O ✓ → OH^- + CH_3COOH ✓ ✓ (Bal)

(3)
[19]

QUESTION 8 / VRAAG 8

8.1.1 Pressure is 1 atm / *Druk is 1 atm*✓ (1)

8.1.2 Negative / Negatief ✓ **ACCEPT**: Positive/Positief (1)

8.1.3

	ACCEPT
$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$✓ $= -0,27$✓ $- (0,0)$✓ $= -0,27$ V ✓	$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$✓ $= 0$✓ $- (-0,27)$✓ $= 0,27$ V ✓

(4)

8.2.1

$Ni^{2+} + 2e^- \rightarrow Ni$ ✓✓	$2H^+ + 2e^- \rightarrow H_2$ ✓✓

(2)

8.2.2

Marking criteria / Nasienkriteria:
a) Formula /*Formule* Q = It ✓
b) Substitution of in (2,25)(4 × 3 600) formula / *Vervang (2,25)(4 × 3 600) in formule* ✓
c) Devide answer by 1,6 x 10^{-19} / *Deel antwoord deur 1,6 x 10^{-19}* ✓
d) Mol ratio / *mol verhouding* n(Ni) : n (e^-) (1:2) ✓
e) Substitute 6,023 × 10^{23} in $n = \frac{N}{N_A}$ ✓
f) Substitute 59 in formula / *Vervang 59 in formule* ✓
g) Final answer / *Finale antwoord* 9,918 g (9,91 – 9,93)✓

$Q = It$✓
$= (2,25)(4 \times 3600$✓$)$
$= 32400$ C✓

$n = \frac{Q}{q_e}$
$= \frac{32400}{1,6 \times 10^{-19}}$
$= 2,025 \times 10^{23}$ electrons

$n = \frac{N}{N_A}$
$= \frac{2,025 \times 10^{23}}{6,023 \times 10^{23}}$✓
$= 0,3362$ mol

$n(Ni) = \frac{1}{2}n(e^-)$
$= (0,5)(0,3362)$✓
$= 0,1681$ mol

$m = nM$
$= (0,1681)(59)$✓
$= 9,918$ g✓

NOTE: Mark only the charge calculation (3 marks).

SCALING	
1	2
2	5
3	7

(7)
[15]

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QUESTION 9 / VRAAG 9

9.1.1 Copper (II) ions/*Koper(II)ione*✓ (1)

9.1.2 Stays the same / *Bly dieselfde* ✓ (1)

9.2.1 $Cu^{2+} + 2e^- \rightarrow Cu$ ✓✓ (2)

9.2.2 Decreases / Af neem ✓ (1)

9.3.1 $2H_2O + 2e^-$ ✓→ $H_2 + 2OH^-$✓ (2)

9.3.2 H_2O/Water ✓ (1)

9.3.3 H_2O is a stronger oxidising agent ✓ than Na^+ ✓ and will be reduced ✓ (to H_2).
H_2O is 'n sterker oksideermiddel✓ as Na^+ ✓en sal gereduseer word (na H_2).
OR/OF
Na^+ is a weaker oxidizing agent✓than H_2O ✓ and therefore H_2O will be reduced ✓ (to H_2 and OH^-)
Na^+ is 'n swakker oksideermiddel ✓as H_2O ✓en daarom sal H_2O gereduseer word✓ (na H_2 en OH^-) (3)

[11]

GRAND TOTAL/*GROOTTOTAAL* [150]

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