Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIORSERTIFIKAAT*

GRADE/*GRAAD 12*

JUNE/*JUNIE* 2023

PHYSICAL SCIENCES: CHEMISTRY P2
MARKING GUIDELINE/
FISIESE WETENSKAPPE: CHEMIE V2
NASIENRIGLYN

MARKS/*PUNTE*: 150

This marking guideline consists of 17 pages./
Hierdie nasienriglyn bestaan uit 17 bladsye.

QUESTION 1/*VRAAG 1*

1.1 C ✓✓ (2)

1.2 B ✓✓ (2)

1.3 B ✓✓ (2)

1.4 B ✓✓ (2)

1.5 A ✓✓ (2)

1.6 C ✓✓ (2)

1.7 D ✓✓ (2)

1.8 C ✓✓ (2)

1.9 B ✓✓ (2)

1.10 B ✓✓ (2)

[20]

QUESTION 2/*VRAAG 2*

2.1 2.1.1 H ✓ (1)

2.1.2 D ✓ (1)

2.1.3 A ✓ (1)

2.1.4 F ✓ (1)

2.1.5 F ✓ (1)

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.
*Indien enige van die sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase.*

2.2 2.2.1 Compounds that have the same molecular formula but different structural formulae. ✓✓

Verbindings wat dieselfde molekulêre formule maar verskillende struktuurformules het. (2)

2.2.2 POSITIONAL / *POSISIONEEL* ✓ (1)

2.2.3 SECONDARY / *SEKONDÊR* ✓

The C bonded to OH is bonded to two other carbons/ C of functional group bonded to two other carbons / C bonded to OH has 1 hydrogen/ C of functional group has one hydrogen ✓✓

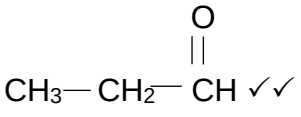
Die C wat verbind is aan die OH is verbind aan twee ander koolstowwe / C van die funksionele groep is verbind aan twee ander koolstowwe / C wat verbind is aan die OH het 1 waterstof / C van die funksionele groep het 1 waterstof. (3)

2.3.1 3,4-dimethylhept-3-ene / 3,4-dimethylhept-3-ene
3,4-dimetielhept-3-een / 3,4-dimetiel-3-hepteen

Marking criteria/*Nasienkriteria*:
- Heptene / *Hept-een* ✓
- Dimethyl / *dimetiel* ✓
- Whole name correct / *hele naam korrek* ✓

(3)

2.3.2



Marking criteria/*Nasienkriteria*:
- Whole structure correct/*Hele struktuur korrek: 2/2*
- Only functional group correct
  Slegs funksionele groep korrek Max./*Maks. 1/2*

OR / *OF*

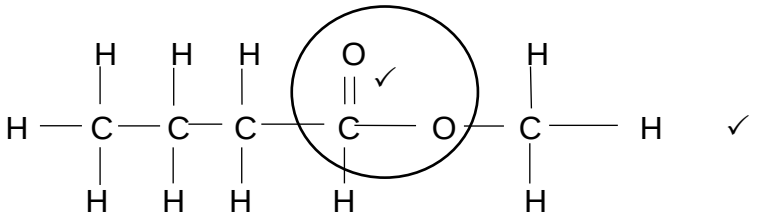
CH_3CH_2CHO ✓✓ (2)

2.4.1 C_2H_4O ✓ (1)

2.4.2 Carboxyl (group) / *Karboksiel (groep)* ✓ (1)

2.5.1 Ester ✓ (1)

2.5.2 Methyl ✓butanoate ✓ / *Metiel butanoaat*



Marking criteria/Nasienkriteria
- Functional group/*Funksionele groep* ✓ 1/2
- Whole structure correct/
  Hele struktuur korrek ✓ *2/2*

(4)
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QUESTION 3/*VRAAG 3*

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted:
- 1 mark per word/phrase.
*Indien enige van die sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase.*

3.1 Melting point is the temperature at which the solid and liquid substances are at equilibrium. ✓✓

Smeltpunt is die temperatuur waarby die vastof- en vloeistoffases van 'n stof in ewewig is. (2)

3.2

Marking criteria
- Increase in molecular size from **A** to **C**
- Increase in molecular size leads to increase in the strength of the London forces/Dispersion forces/Induced dipole forces
- Relate the strength of London forces /dispersion forces/induced dipole to energy involved.

Nasienkriteria
- *Toename in molekulêre grootte vanaf **A** na **C***
- *Toename in molekulêre grootte lei na 'n toename in die sterkte van die Londonkragte/verspreidingskragte/geïnduseerde dipoolkragte*
- *Verwys die sterktes van Londonkragte/Verspreidingskragte/ Geïnduseerde dipoolkragte met energie betrokke.*

From **A** to **C** / *Vanaf **A** na **C***
- Surface area/molecular size/chain length increases ✓
- Strength of London forces/dispersion forces/induced dipole forces increases ✓
- More energy is needed to overcome intermolecular forces ✓

- *Oppervlakte/molekulêre grootte/kettinglengte neem toe*
- *Sterkte van die Londonkragte/verspreidingskragte/geïnduseerde dipoolkragte neem toe*
- *Meer energie word benodig om die intermolekulêrekragte te oorkom*

OR/*OF*

Marking criteria
- Decrease in molecular size from ***C** to **A***
- Decrease in molecular size leads to decrease in the strength of the London forces/dispersion forces/induced dipole forces
- Relate the strength of London forces to energy involved.

Nasienkriteria
- *Afname in molekulêre grootte vanaf **C** na **A***
- *Afname in molekulêre grootte lei na 'n afname in die sterkte van die Londonkragte/verspreidingskragte/geïnduseerde dipoolkragte*
- Verwys die sterktes van *Londonkragte/verspreidingskragte/ geïnduseerde dipoolkragte met energie betrokke*

From **C** to **A** / *Vanaf **C** na **A***

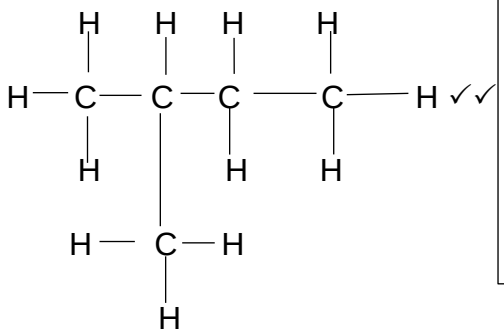
- Surface area/molecular size/chain length decreases ✓
- Strength of London forces/Dispersion forces/Induced dipole forces decreases ✓
- Less energy needed to overcome intermolecular forces ✓

- *Oppervlakte/ molekulêre grootte/ kettinglengte neem af*
- *Sterkte van Londonkragte/verspreidingskragte/geïnduseerde dipoolkragte neem af*
- *Minder energie word benodig om die intermolekulêrekragte te oorkom* (3)

3.3 **A** / Propane / *Propaan* ✓

Lowest melting point / *Laagste smeltpunt* ✓ (2)

3.4 3.4.1



Marking criteria/Nasienriglyne
- 4 Carbons in longest chain ✓ ½
  4 koolstowwe in die langste ketting ½
- Whole structure correct *2/2* ✓
  Hele struktuur korrek 2/2

(2)

3.4.2 LESS THAN / *MINDER AS* - 129 °C ✓ (1)

3.4.3 Yes / *Ja* ✓

Compounds **C** and **D** have the same molecular mass/chain isomers ✓
*Verbindings **C** en **D** het dieselfde molekulêremassa/ketting-isomere.* (2)

3.5

Marking criteria
- **E** has dipole-dipole forces
- **F** has hydrogen bonds
- Correctly compare the strength of hydrogen bonds to dipole-dipole forces
- Relate the strength of the intermolecular forces to energy involved.

Nasienkriteria
- ***E** het dipool-dipoolkragte*
- ***F** het waterstofbindings*
- *Vergelyk die sterkte van die waterstofbindings korrek aan die dipool-dipoolkragte*
- *Verwys die sterktes van intermolekulêrekragte met energie betrokke*

- **F** has hydrogen bonds ✓ (and London forces)
- **E** has dipole-dipole forces ✓ (and London forces)
- Hydrogen bonds are stronger than dipole-dipole forces ✓
- More energy is needed to overcome intermolecular forces in **E** ✓

- ***F** het waterstofbindings (en Londonkragte)*
- ***E** het dipool-dipoolkragte (en Londonkragte)*
- *Waterstofbinding is sterker as dipool-dipoolkragte*
- *Meer energie word benodig om die intermolekulêrekragte te oorkom*

OR/*OF*

Marking criteria
- **E** has dipole-dipole forces
- **F** has hydrogen bonds
- Correctly compare the strength of hydrogen bonds to dipole-dipole forces
- Relate the strength of the intermolecular forces to energy involved

Nasienkriteria
- ***E** het dipool-dipoolkragte*
- ***F** het waterstofbindings*
- *Vergelyk die sterkte van die waterstofbindings korrek aan die dipool-dipoolkragte*
- *Verwys die sterktes van intermolekulêrekragte met energie betrokke*

- **F** has hydrogen bonds ✓ (and London forces)
- **E** has dipole-dipole forces ✓ (and London forces)
- Dipole-dipole forces are weaker than hydrogen bonds ✓
- Less energy is needed to overcome intermolecular forces in **F** ✓

- ***F** het waterstofbindings (en Londonkragte)*
- ***E** het dipool-dipoolkragte (en Londonkragte)*
- *Dipool-dipoolkragte is swakker as waterstofbinding*
- *Minder energie word benodig om die intermolekulêrekragte in **F** te oorkom* (4)

[16]

QUESTION 4/*VRAAG 4*

4.1 4.1.1 Alcohol / *Alkohol* ✓ (1)

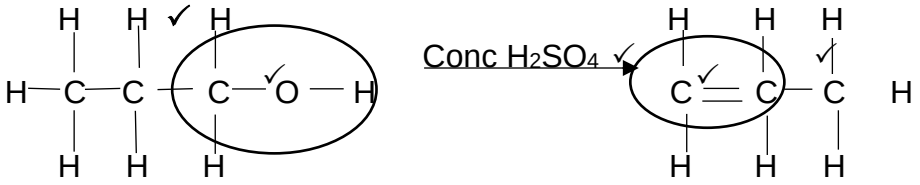
4.1.2 (Mild) heat / dilute base / *(Matige) hitte / verdunde basis* ✓ (1)

4.1.3 H_2O/KOH/NaOH/LiOH ✓ (1)

4.1.4 Dehydration/*Dehidrasie / dehidratering/dehidrerend* ✓ (1)

4.1.5

Marking criteria/Nasienkriteria: Organic compounds only
- Functional group/*Funksionele groep.* ✓ 1/2
- Whole structure correct/ *Hele struktuur korrek* ✓ *2/2*



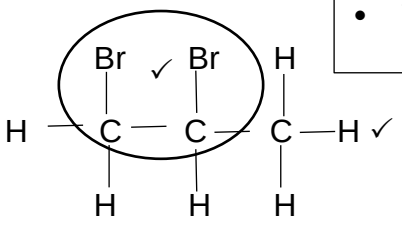
+ H_2O ✓ (6)

4.1.6 Addition ✓ or <u>halogenation and hydrohalogenation</u> ✓
Addisie of <u>halogenering en hidrohalogenering</u> (1)

4.1.7 HBr ✓ (1)

4.1.8 1,2-dibromopropane ✓✓
1,2-dibromopropaan

Marking criteria/Nasienkriteria
- Functional group (2 Br atoms)/*Funksionele groep.* ✓ 1/2
- Whole structure correct/ *Hele struktuur korrek* ✓ *2/2*



(4)

4.2 4.2.1 Breaking down of long chain hydrocarbon molecules into more useful shorter chains ✓✓ **(2 or 0)**

*Afbreek van langer koolwaterstof-molekules in korter meer gebruikbare molekules **(2 of 0)*** (2)

4.2.2 **Marking criteria/*Nasienkriteria*:**

- Identifying compound **Q** / *Identifisering van verbinding **Q***
- Identifying C_xH_6 / *Identifisering van C_xH_6*
- Identifying compound **P** / *Identifisering van verbinding **P***
- Reactants / *Reaktanse*
- Products / *Produkte*
- Balancing / *Balansering*

Q = C_2H_4 ✓
C_xH_6 = C_3H_6 ✓
P = C_8H_{18} ✓

$2\ \underline{C_8H_{18}} + 25\ \underline{O_2}$ ✓ ⟶ $16\ \underline{CO_2} + 18\underline{H_2O}$ ✓ ✓ **Bal.** (6)

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QUESTION 5/*VRAAG 5*

5.1

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted:
- 1 mark per word/phrase.
*Indien enige van die sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase*

ANY ONE
Change in concentration ✓of reactant or product per (unit) time. ✓

Change in amount/number of moles/volume/mass ✓of products or reactants per (unit) time. ✓

Change in amount/number of moles/volume/mass ✓ of products formed or reactants used reactants per (unit) time. ✓

ENIGE EEN
Verandering in konsentrasie van reaktanse of produkte per (eenheid) tyd.

Verandering in hoeveelheid/getal mol/volume/massa van reaktanse of produkte per (eenheid) tyd.

Verandering in hoeveelheid/getal mol/volume/massa van produkte gevorm/reaktanse gebruik per (eenheid) tyd.

OR/*OF*

The rate of change in concentration/amount of moles/number of moles / volume / mass. ✓✓ **(2 or 0)**

*Die tempo van verandering in konsentrasie/hoeveelheid mol/getal mol/volume/massa ✓✓ **(2 of 0)*** (2)

5.2

Marking criteria /*Nasienkriteria*
Both variables correctly identified/ *Beide veranderlike korrek geïdentifiseer* (1/2)
Question relates dependent and independent variables/ *Vraag toon die verband tussen die afhanklike en onafhanklike veranderlike* (1/2)

What is the relationship between concentration and reaction rate? ✓✓
OR How does concentration affect reaction rate?

*Wat is die verhouding tussen konsentrasie en reaksietempo? **OF***
Hoe affekteer konsentrasie die reaksietempo? (2)

5.3 Sulphur / *Swawel* ✓ (1)

5.4 There must be ONE independent variable ✓/ The size of the cross is a control variable
Daar moet slegs EEN onafhanklike veranderlike wees. / Die grootte van die kruis is 'n beheerde veranderlike. (1)

5.5 **Higher concentration**

- More particles per unit volume ✓
- More particles collide with correct orientation ✓
- Frequency of effective collisions increases ✓/More effective collisions per unit time ✓

Hoër konsentrasie

- *Meer deeltjies per eenheid volume*
- *Meer deeltjies bots teen die korrekte oriëntasie*
- *Frekwensie vir effektiewe botsings neem toe/Meer effektiewe botsings per eenheid tyd*

OR/ *OF*

Lower concentration

- Fewer particles per unit volume ✓
- Fewer particles collide with correct orientation ✓
- Frequency of effective collisions decreases/Fewer effective collisions per unit time ✓

Lae konsentrasie

- *Minder deeltjies per eenheid volume*
- *Minder deeltjies bots teen die korrekte oriëntasie*
- *Frekwensie vir effektiewe botsings neem af/Minder effektiewe botsings per eenheid tyd* (3)

5.6

Marking criteria/*Nasienkriteria*

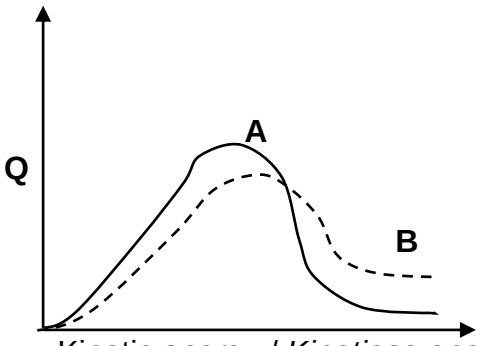
- Reading the correct concentration of $Na_2S_2O_3$/*Korrekte lesing van die konsentrasie van* $Na_2S_2O_3$
- Subst. into/*Vervanging in* n = cV
- Using the mol ratio/*Gebruik van mol verhouding* $Na_2S_2O_3$: S
- Formula/*Formule* m = nM
- Subst. into/*Vervanging* m = nM
- Final answer/*Finale antwoord*

$c\ (Na_2S_2O_3) = 0,125\ mol{\cdot}dm^{-3}$ ✓

$n(Na_2S_2O_3) = cV$
$= 0,125 \times 50/1000$ ✓
$= 6,25 \times 10^{-3}$ mol
$n(Na_2S_2O_3) = n(S) = 6,25 \times 10^{-3}$ mol ✓
$m = nM$ ✓
$= 6,25 \times 10^{-3} \times 32$ ✓
$= 0,2$ g ✓ (6)

5.7 5.7.1 Number of particles/molecules / *Aantal deeltjies/molekules* ✓ (1)

5.7.2



Marking criteria / *Nasienkriteria*

- Shape of / Vorm van B
- Peak of *B* lower / Piek van B laer ✓

NOTE: A or B must be indicated

LET WEL: A of B moet aangedui word

(2)

[18]

QUESTION 6/*VRAAG 6*

6.1

Marking criteria/ *Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted:
- 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per woord/frase

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, sal die sisteem 'n nuwe ewewig instel deur die reaksie te bevoordeel wat die versteuring teenwerk. (2)

6.2 Closed system / container ✓/ *Geslote sisteem/houer* (1)

6.3 6.3.1 **OPTION 1: MOLE CALCULATIONS/**

a. Substitute into n = m/M ✓
b. Determine Δn = 2x ✓
c. Correct ratio $PC\ell_5$: $PC\ell_3$: $C\ell_2$ ✓
d. Divide the equilibrium md by 2 dm^3 ✓
e. Correct K_C expression (formulae in square brackets) ✓
f. Substitution into the correct equilibrium expressions (K_C) ✓

OPSIE 1: MOL BEREKENINGE

a. *Vervanging* n = *m/M* ✓
b. *Bepaal Δn = 2x* ✓
c. *Korrekte verhouding* $PC\ell_5$: $PC\ell_3$: $C\ell_2$ ✓
d. *Deel deur* 2 dm^3 ✓
e. *Korrekte Kc uitdrukking (formule met viekant hakkies)* ✓
f. *Vervanging in korrekte Kc uitdrukking* ✓

$$n = \frac{m}{M}$$

$$n = \frac{83,4}{208,5} \text{ (a) } ✓$$

$$n = 0,4 \text{ mol}$$

$\Delta n\ (PC\ell_5) = (x)(2) = 2x$ ✓ (b)

	$PC\ell_5$	$PC\ell_3$	$C\ell_2$
Initial mol	0,4		-
Change in mol	-2x	+2x	2x ✓ (c)
Equilibrium mol	0,4-2x	2x	2x
Concentration	0,4-2x / 2 0,2 – x	2x / 2 x	2x / 2 ✓ (d) x

$K_c = \frac{[PC\ell_3][\ C\ell_2]}{[PC\ell_5]}$ (e) ✓

$K_c = \frac{(x)(x)}{(0,2 - x)}$ (f) ✓

$K_c = \frac{x^2}{0,2 - x}$ (6)

6.3.1 **OPTION/OPSIE 2: CONCENTRATION CALCULATIONS/KONSENTRASIE BEREKENINGE**

a. Substitute into n = m/M ✓
b. Substitute into c = n/V ✓
c. Correct ratio $PC\ell_5 : PC\ell_3 : C\ell_2$ ✓
d. Equilibrium conc correct ✓
e. Correct K_C expression (formulae in square brackets) ✓
f. Substitution into the correct equilibrium expressions (K_C) ✓

n = m/M
= 83,4/208,5 (a) ✓
= 0,4 mol
$c_i\ (PC\ell_5)$ = n/V
= 0,4/2 (b) ✓
=0,2 mol.dm^{-3}

	$PC\ell_5$	$PC\ell_3$	$C\ell_2$
Initial concentration	0,2		-
Change in concentration	-x	+x	x ✓ (c)
Equilibrium concentration	0,2-x	x	x ✓ (d)

$K_c = \frac{[PC\ell_3][\ C\ell_2]}{[PC\ell_5]}$ (e) ✓

$K_c = \frac{(x)(x)}{(0,2 - x)}$ (f) ✓

$K_c = \frac{x^2}{0,2 - x}$

6.3.2 **Marking criteria/*Nasienkriteria***
- Determine the value of x / *Bepaal die waarde van* x
- Subst. into K_c expression / *Vervanging in* K_c *uitdrukking*

$0,2 - x = 0,001$ ✓

$x = 0,1999$

$K_c = x^2/(0,2 - x)$

$= 0,199^2/(0,001)$ ✓

$= 39,601$ (2)

6.3.3 HIGH YIELD / *HOË OPBRENGS* ✓

$K_c > 1$/ Kc is large / *groot* ✓ (2)

6.4 6.4.1 NO EFFECT/ *GEEN EFFEK* ✓ (1)

6.4.2 DECREASES / *VERLAAG* ✓ (1)

6.5 6.5.1 Equilibrium/ Stage where rate of forward reaction equals rate of reverse reaction ✓

Ewewig / die plek waar die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reakse. (1)

6.5.2 HEATED / *VERHIT* ✓ (1)

6.5.3
- Increase in temperature favours the endothermic reaction. ✓
- Concentration of $PC\ell_5$ decreases while concentration of $C\ell_2$ increases ✓
- The forward reaction was favoured/ equilibrium position shifted towards the right ✓

- *Toename in temperatuur bevoordeel die endotermiese reaksie.*
- *Konsentrasie* $PC\ell_5$ *neem af terwyl die konsentrasie van* $C\ell_2$ *toe neem*
- *Die voorwaartse reaksie word bevoordeel/ ewewigsposisie verksuif regs.* (3)

[20]

QUESTION 7/*VRAAG 7*

7.1 7.1.1 A substance that forms hydrogen ions (H^+)/ hydronium ions (H_3O^+) in water ✓✓
'n Stof wat waterstofione (H^+)/hydroniumione (H_3O^+) in water vorm (2)

7.1.2 Good electrical conductor / Inert ✓
Goeie elektriese geleidingsvermoë / Inert (1)

7.1.3 CH_3COOH ✓
Higher ammeter reading / *Hoër ammeterlesing*
Undergoes higher degree of ionisation / *Ondergaan 'n hoër graad van ionisasie* ✓
Higher concentration of ions in solution / *Hoër konsentrasie van ione in die oplossing* ✓ (3)

7.1.4 H_2O ✓and/ *en* HCO_3^- ✓ (2)

7.1.5 CO_3^{2-} ✓ (1)

7.2 7.2.1 Reaction of a salt with water ✓✓ **(2 or 0)**
*Reaksie van 'n sout met water **(2 of 0)*** (2)

7.2.2 ACIDIC / *SUUR* ✓

$NH_4^+ + H_2O$ ✓ ⟶ $NH_3 + H_3O^+$ ✓

(reactants and products) / *(reaktanse en produkte)*

Excess H_3O^+ are formed / *Oormaat H_3O^+ vorm* ✓ (4)

7.3 7.3.1 pH = - log $[H_3O^+]$ ✓
= - log 1 ✓
= 0 ✓ (3)

7.3.2 n = cV ✓
= 1 x 250/1000 ✓
= 0,25 mol ✓ (3)

7.3.3 **Positive marking from 7.3.2/ *Positiewe nasien vanaf* 7.3.2**
Marking criteria/*Nasienkriteria*

- Formula / *Formule* n = cV
- Subst. of NaOH conc. and vol. into/ *Vervanging van NaOH kons. En vol. in* n = cV
- Mol ratio / *Mol verhouding* NaOH : HCℓ
- Subtract initial mol (from 7.3.2) from mol reacting with NaOH / *Aftrek van aanvanklike mole (vanaf 7.3.2) van regerende mol NaOH*
- Mol ratio / *Mol verhouding* $CaCO_3$: HCℓ
- Subst. into / *Vervanging in* m = nM for $CaCO_3$
- Multiply mass of/ *Vermenigvuldig massa van* $CaCO_3$ by/*met* 100/99,3
- Final answer/ *Finale antwoord*

n(NaOH) = cV ✓
= 0,5x 103/1000 ✓
= 0,0515 mol

n (HCℓ reacting with / *reageer met* NaOH) = 0,0515 mol ✓

n (HCℓ reacting with / *reageer met* $CaCO_3$) = 0,25 – 0,0515 ✓

n (HCℓ reacting with / *reageer met* $CaCO_3$) = 0,1985 mol

$n(CaCO_3)$ = ½ (0,1985) ✓

$n(CaCO_3)$ = 0,09925 mol

m(CaCO3)= nM
= 0,0925 x 100 ✓
= 9,925 g

m = 9,925 x 100/99,3 ✓

m = 9,99 g ✓
(RANGE / *GEBIED*: 9,99 to 10,07 g) (8)
[29]

TOTAL/*TOTAAL*: 150