Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo
Provinsie van die Oos Kaap: Department van Onderwys
Porafensie Ya Kapa Botjahabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

JUNE/*JUNIE* 2025

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

MARKS/*PUNTE*: 150

This marking guideline consists of 15 pages./
Hierdie nasienriglyn bestaan uit 15 bladsye.

QUESTION/*VRAAG 1*

1.1	B ✓✓	(2)
1.2	D ✓✓	(2)
1.3	D ✓✓	(2)
1.4	B ✓✓	(2)
1.5	C ✓✓	(2)
1.6	C ✓✓	(2)
1.7	B ✓✓	(2)
1.8	D ✓✓	(2)
1.9	C ✓✓	(2)
1.10	B ✓✓	(2)
		[20]

QUESTION/*VRAAG* 2

2.1 A bond or an atom or a group of atoms that determine(s) the physical and chemical properties of a group of organic compounds. ✓✓

'n Binding of 'n atoom of 'n groep atome wat die fisiese en chemiese eienskappe van 'n groep organiese verbindings bepaal. (2)

2.2 2.2.1 A ✓ (1)

2.2.2 C ✓ (1)

2.2.3 B ✓ (1)

2.3 2.3.1 3-methylbutanal ✓✓
3-metielbutanaal

Marking criteria/*Nasienkriteria*:
• Butanal / *butanaal* ✓
• Whole name correct / *Hele naam korrek* ✓

(2)

2.3.2 4-methylpent-2-yne ✓✓
4-metielpent-2-yn

Marking criteria/*Nasienkriteria*:
• Pent-2-yne / *pent-2-yn* ✓
• Whole name correct / *Hele naam korrek* ✓✓

OR/*OF*

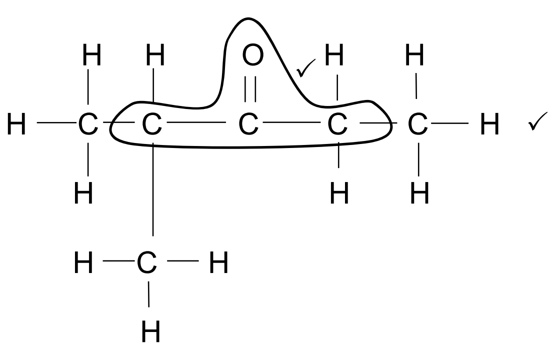
4-methyl-2-pentyne ✓✓
4-metiel-2-pentyn (2)

2.3.3 2,3-dibromo-4-ethylhexane ✓✓✓
2,3-dibromo-4-etielheksaan

Marking criteria/*Nasienkriteria*:
• Hexane / *heksaan* ✓
• dibromo and ethyl / *dibromo en etiel* ✓
• Whole name correct / *Hele naam korrek* ✓

(3)

2.4 2.4.1

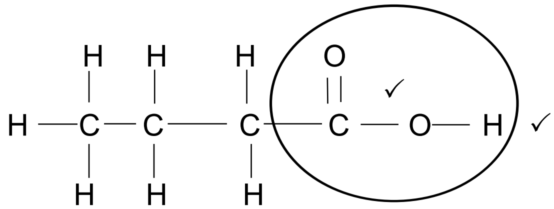


Markingcriteria /*Nasienkriteria*
• Correct functional group / *Funksionele groep korrek* ✓ 1/2
• Whole structure correct/ *Hele struktuur korrek* ✓2/2

(2)

2.4.2 Esterification / Condensation / *Esterifikasie / Kondensasie* ✓ (1)

2.4.3



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

(2)

2.5 2.5.1

$$43{,}24 = \frac{M}{74} \times 100 \checkmark$$

M = 31,9976

M = 32 g·mol^{-1}
M(O) = 16 g·mol^{-1}

$C_xH_yO_2$
Organic compound is either carboxylic acid or ester.
Organiese verbinding is 'n karboksiesuur of 'n ester.

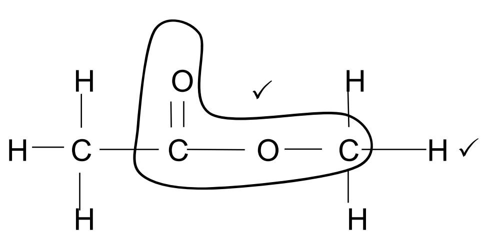
General formula / *Algemene formule*: $C_nH_{2n}O_2$

12 x n + 2 x n + 32 = 74 ✓

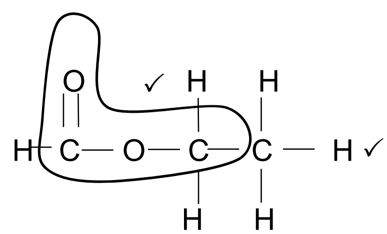
n = 3

$C_3H_6O_2$ ✓ (3)

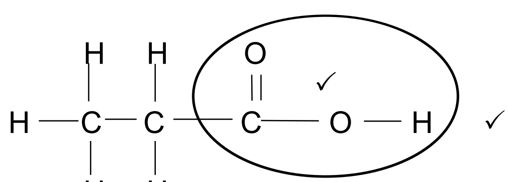
2.5.2



OR/ *OF*



AND/*EN*



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

(4)
[24]

Please turn over/*Blaai om asseblief*

QUESTION/*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 Boiling point is the temperature at which the vapour pressure of a substance /liquid equal the atmospheric pressure ✓✓

Kookpunt is die temperatuur waarteen die dampdruk van 'n stof/vloeistof gelyk aan die atmosferiesedruk is (2)

3.2 Same functional group / Same homologous series ✓
Dieselfde funksionele groep / Dieselfde homoloëreeks
Accept same type of intermolecular forces/*Aanvaar dieselfde tipe van intermolekulêre kragte* (1)

3.3 **Marking criteria**

- The boiling point increases down the table
- Chain length / molecular size increases down the table
- Increase in the strength of the London forces/Dispersion forces/Induced dipole forces / down the table
- Relate the strength of London forces /dispersion forces/induced dipole to energy involved

Nasienkriteria

- *Die kookpunt styg teen die tafel af*
- *Kettinglengte / molekulêre grootte neem teen die tabel af*
- *Toename in die sterkte van die Londonkragte /Dispersiekragte /Geïnduseerde dipoolkragte / teen die tabel af*
- *Verband hou met die sterkte van die Londonkragte/ verspreidingskrag/ geïnduseerde dipoolkragte met die energie betrokke*

- The trend shows an increase in the boiling point down the table ✓
- Increase in the surface area/chain length/molecular size down the table ✓
- Strength of London forces/dispersion forces/induced dipole forces / increases ✓
- More energy is needed to overcome intermolecular forces ✓

- *Die tendens toon 'n toename in die kookpunt teen die tabel af*
- *Toename in die oppervlakte/ketting lengte/molekulêre grootte teen die tabel af*
- *Sterkte van die Londonkragte/verspreidingskragte/geïnduseerde dipoolkragte neem toe*
- *Meer energie word benodig om die intermolekulêre kragte te oorkom* (4)

3.4 Decreases. ✓ The boiling point increases. ✓
Afneem. Die kookpunt neem toe. (2)

3.5 2-methylpropan-1-ol / 2-methyl-1-propanol ✓✓
2-metielpropan-1-ol/ 2-metiel-1-propanol

Marking criteria/*Nasienkriteria*:
- Propan-1-ol ✓
- Whole name correct / *Hele naam korrek* ✓

(2)

3.6 **Marking criteria**
- Compare the boiling point of the alcohol to the alcohol with 3-carbon atom alcohol
- Compare the surface area/chain length/molecular size of the alcohol to the alcohol with 3-carbon atoms
- Compare the boiling point of the alcohol to the alcohol with 4-carbon atoms
- Compare the surface area/chain length of the alcohol to the alcohol with 4-carbon atoms

- ***Nasienkriteria***
- *Vergelyk die kookpunt van die alkohol met die 3-koolstof atoom alkohol*
- *Vergelyk die oppervlakte/kettinglengte/molekulêre grootte van die alkohol met die 3-koolstof atoom alkohol*
- *Vergelyk die kookpunt van die alkohol met die 4-koolstof atoom alkohol*
- *Vergelyk die oppervlakte/kettinglengte van die alkohol met die 4-koolstof atoom alkohol*

- The boiling point of the unknown alcohol (2-methylpropan-1-ol) is higher than that of the alcohol with 3-carbon atoms (propan-1-ol) ✓
- Surface area / chain length / molecular size is greater than the alcohol with 3-carbon atoms (propan-1-ol) ✓
- The boiling point of the unknown alcohol (2-methylpropan-1-ol) is smaller than that of the straight chain alcohol with 4-carbon atoms (butan-1-ol) ✓
- Surface area / chain length is smaller than the straight chain alcohol with 4-carbon atoms (butan-1-ol) ✓

- *Die kookpunt van die onbekende alkohol (2-metielpropan-1-ol) is hoër as dié alkohol met 3-koolstofatome (propan-1-ol)*
- *Oppervlakte / kettinglengte / molekulêre grootte is grootter as die alkohol met 3-koolstof atome (propan-1-ol)*
- *Die kookpunt van die onbekende alkohol (2-metielpropan-1-ol) is laer as die reguitketting alkohol met 4-koolstofatome (butan-1-ol)*
- *Oppervlakte / kettinglengte is kleiner as die reguitketting alkohol met 4-koolstof atome (butan-1-ol)*

(4)
[15]

QUESTION/*VRAAG* 4

4.1 4.1.1 Breaking down of long chain hydrocarbon molecules into more useful shorter chains ✓✓ **(2 or 0)**
*Die afbreek van lang kettingkoolwaterstof-molekules in meer bruikbare, molekule korter kettings **(2 of 0)*** (2)

4.1.2 C_2H_4 ✓✓ (2)

4.1.3 Used as a fuel / *Word as 'n brandstof gebruik* ✓ (1)

4.1.4 $C_5H_{12} + 8\ O_2$ ✓ $\longrightarrow$ $5\ CO_2 + 6\ H_2O$ ✓ (✓ bal.)

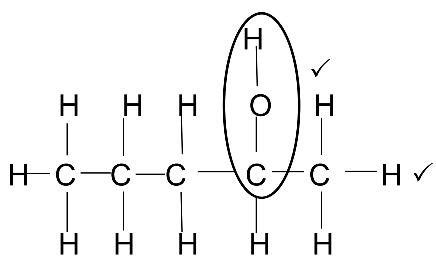
Reactants, ✓ products ✓and balancing ✓
Reaktanse, produkte en balansering (3)

4.2 4.2.1 2-bromopentane / *2-bromopentaan* ✓✓ (2)

4.2.2 Substitution/ Hydrolysis of haloalkanes / *Substitusie / Hydrolise van haloalkane* ✓ (1)

4.2.3 <u>Diluted strong base</u> / diluted NaOH ✓
<u>Verdunde sterk basis</u> / verdunde NaOH (1)

4.2.4

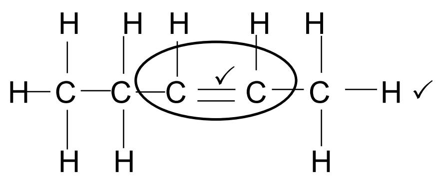


<u>Marking criteria/*Nasienkriteria*</u>
- Correct functional group / *Funksionele groep korrek* ✓ 1/2
- Whole structure correct/ *Hele struktuur korrek* ✓ *2/2*

(2)

4.2.5 Dehydration / *Dehidrasie / Dihidratering* ✓ (1)

4.2.6



<u>Marking criteria/Nasienkriteria</u>
- Correct functional group / *Funksionele groep korrek* ✓ 1/2
- Whole structure correct/ *Hele struktuur korrek* ✓ *2/2*

(2)
[17]

QUESTION/*VRAAG* 5

5.1 EXOTHERMIC / *EKSOTERMIES*. ✓ $\Delta H < 0$ ✓ (2)

5.2 Carbon dioxide (CO_2) gas escapes / *Koolstof dioksied (CO_2) gas ontsnap* ✓✓ (2)

5.3 189 g ✓ Accept/*Anvaar* (188,5 – 189) (1)

5.4 5.4.1 11 (minutes / *minute*) accept/ *aanvaar* 10 (minutes / *minute*) ✓ (1)

5.4.2 EQUAL TO ✓

The amount of $CaCO_3$ consumed is equal to the amount of CO_2 produced / the mol ratio of $CaCO_3$ to CO_2 is 1 : 1. ✓

The time taken for consumption and production is the same. ✓

GELYK AAN

Die hoeveelheid $CaCO_3$ verbruik is gelyk aan die hoeveelheid CO_2 vervaardig / die molverhouding van $CaCO_3$ tot CO_2 is 1 : 1.

Die tyd geneem vir die verbuik en vervaardiging is dieselfde. (3)

5.4.3

Marking criteria / *Nasienkriteria*
(a) Subtract / *Aftrek* 200 – 185
(b) Subst. into / *Vervanging in* n = m/M
(c) Formula / *Formule* $V = nV_m$
(d) Subst. into/ *Vervanging in* $V = nV_m$
(e) Final answer/ *Finale antwoord*

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

$$n = \frac{200 - 185 \checkmark \text{(a)}}{44} \checkmark \text{(b)}$$

$$n = 0{,}34 \text{ mol}$$

$V = nV_m$ ✓ (c)

$V = (0{,}34)(24000)$ ✓ (d)

$V = 8\ 160\ (cm^3)$ ✓ (e)

Range = 8160 – 8181,82 (5)

5.4.4 **<u>Marking criteria/*Nasienkriteria*</u>**

(a) Use of mol ratio / *Gebruik van molverhouding* $CO_2 : CaCO_3$
(b) Subst. into/ *Vervanging in* n = m/M
(c) Subst. into rate equation/ *Vervanging in tempo vergelyking*
(d) Final answer / *Finale antwoord*

<u>Positive marking from/*Positiewe nasien van 5.4.3*</u>

n (CO_2) = n ($CaCO_3$) = 0,34 mol ✓ (a)

m = nM

m = (0,34)(100) ✓ (b)

m = 34 g

$$\text{rate/}\textit{tempo} = -\frac{\Delta m}{\Delta t}$$

$$\text{rate/}\textit{tempo} = -\frac{0 - 34}{11} \checkmark \text{ (c)}$$

m = $3{,}09\ g{\cdot}min^{-1}$ ✓ (d) (4)

5.5 5.5.1

<u>Marking criteria for hypothesis</u>
• Statement regarding the correct <u>independent and dependent variable</u>
• Statement is measurable
<u>Nasienkriteria vir hipotese</u>
• *Stelling om die <u>onafhanklike</u> en <u>afhanklike veranderlike</u> is korrek*
• *Stelling is meetbaar*

A(n) decrease / increase in <u>temperature</u> will decrease / increase the <u>reaction rate</u>.
'n Afname/ toename in <u>temperatuur</u> sal die <u>reaksietempo</u> laat afneem/ toeneem. (2)

5.5.2 INCREASES / *TOENEEM* ✓ (1)

5.5.3
- <u>Higher temperature means the average kinetic energy of the particles increases</u> ✓
- <u>More particles will have sufficient kinetic energy / more particles will have kinetic energy equal to or higher than the activation energy</u> ✓
- <u>More effective collisions per unit time / Frequency of the effective collisions increases</u> ✓

- *Hoër temperatuur beteken die gemiddelde kinetiese energie van die deeltjies neem toe*
- *Meer deeltjies het genoeg kinetiese energie / meer deeltjies het kinetiese energie gelyk of hoër as die aktiveringsenergie*
- *Meer effektiewe botsings per tydseenheid / Frekwensie van die effektiewe botsings neem toe* (3)

[24]

QUESTION/*VRAAG* 6

6.1.1

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/cancel the disturbance. ✓✓

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

6.1.2 (a) NO EFFECT / *GEEN EFFEK* ✓ (1)

(b) INCREASES / *TOENEEM* ✓ (1)

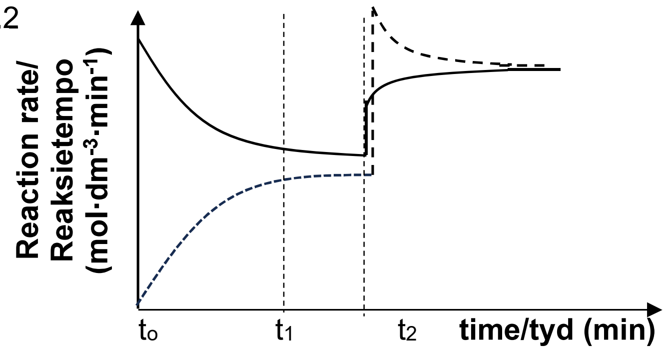
(c) DECREASES / *AFNEEM* ✓

- An increase in pressure favours the reaction that produces the least number of gaseous moles. ✓
- Mole ratio of reactants : products 1 : 2 ✓
- The reverse reaction is favoured / the equilibrium position shifted towards left. ✓

- *'n Toename in druk bevoordeel die reaksie wat die minste gasmol produseer.*
- *Die molverhouding reaktanse : produkte 1 : 2*
- *Die terugwaartse reaksie word bevoordeel / die ewewigsposisie verskuif links.* (4)

6.2 6.2.1 $2\,NO_2(g) \rightarrow N_2O_4(g)$ ✓✓ (2)

6.2.2



Marking criteria/ ***Nasienkriteria***

Both graphs rates increases vertically and reached new equilibrium ✓

Increase in the reverse reaction rate is higher than the forward rate ✓

Beide grafieke se tempo neem vertikaal toe en bereik 'n nuwe ewewig

Toename in die tempo van die terugwaartse reaksie is hoër as die tempo van die voortwaartse reaksie

(2)

6.3 6.3.1

$K_c = \frac{[NO_2]^2}{[N_2O_4]}$ ✓

$K_c = \frac{(0,0457)^2}{(0,448)}$ ✓

$K_c = 4,66 \times 10^{-3}$ ✓ (3)

6.3.2 LOW YIELD. ✓ Kc is less than 1. ✓
LAE OPBRENGS. Kc is kleiner as 1. (2)

6.3.3 **POSITIVE MARKING FROM / *POSITIEWE NASIEN VANAF* 6.3.1**
MARKING CRITERIA

a. Subst. Kc value and correct N_2O_4 concentration into the correct Kc expression ✓
b. Determine the change in concentration of NO_2 ✓
c. Correct ratio N_2O_4 and NO_2 ✓
d. Determine the initial concentration N_2O_4 ✓
e. Subst. change in concentration and initial concentration of N_2O_4 in % change formula ✓
f. Final answer ✓

NASIENKRITERIA

a. *Vervang die Kc-waarde en korrekte N_2O_4 konsentrasie in die korrekte Kc-uitdrukking*
b. *Bepaal die verandering in die konsentrasie van NO_2*
c. *Korrekte verhouding tussen N_2O_4 en NO_2*
d. *Bepaal die aanvanklike konsentrasie van N_2O_4*
e. *Vervanging in verandering in konsentrasie en die aanvanklike konsentrasie van N_2O_4 in die % verandering formule*
f. *Finale antwoord*

$$K_c = \frac{[NO_2]^2}{[N_2O_4]}$$

$$4{,}66 \times 10^{-3} = \frac{[NO_2]^2}{(0{,}491)} \text{ (a) } \checkmark$$

$[NO_2] = 0{,}0478 \text{ mol·dm}^{-3}$

	N_2O_4	$2\ NO_2$ (g)
Initial conc/ *Aanvangskonsentrasie*	0,5 (d) ✓	0,03
Change in conc./ *Verandering in konsentrasie*	$8{,}9 \times 10^{-3}$	0,0178 (b) ✓
Equilibrium conc./ *Ewewigskonsentrasie*	0,491	0,0478

(c) ratio/ verhouding ✓

$$\% [N_2O_4] = \frac{8{,}9 \times 10^{-3}}{0{,}5} \times 100\ \% \text{ (e) } \checkmark$$

$\% [N_2O_4] = 1{,}78\ \%$ (f) ✓ (6)

[23]

QUESTION/*VRAAG* 7

7.1 7.1.1 An acid is a proton (H^+) donor ✓✓ **(2 or 0)**
'n Suur is proton (H^+) skenker ***(2 of 0)*** (2)

7.1.2 $CH_3COOH + H_2O$ ✓ $\rightleftharpoons CH_3COO^- + H_3O^+$ ✓
Ignore phases / *Ignoreer fases* (2)

7.1.3 Weak acid / *Swaksuur* ✓
K_a value is less than 1 / *K_a-waarde is kleiner as 1* ✓ (2)

7.1.4 *Methanoic acid* ✓

It has the larger K_a-value / Ionises to a greater extend / It is the stronger acid. ✓
The higher the concentration of the H_3O^+ the lower the pH-value. ✓

Metanoësuur
Dit is het die groter K_a-waarde / Ioniseer tot 'n groter mate / Dit is die sterker suur.
Hoe hoër die konsentrasie van H_3O^+ hoe kleiner is is die pH-waarde (3)

7.2 7.2.1 Burette / *Buret* ✓ (1)

7.2.2 To ensure reliable results / accurate results ✓
Om betroubare resultate / akkurate resultate te verseker (1)

7.2.3 8,3–10 ✓ (1)

7.2.4 $C_2O_4^{2-} + H_2O$ ✓ $\rightarrow$ $HC_2O_4^- + OH^-$ ✓
(reactants / *reaktanse* and / *en* products / *produkte*)
Excess OH^- is produced / *Oormaat OH^- is geproduseer* ✓ (3)

7.3 7.3.1 $n = cV$ ✓
$n = (0,1)(25 \times 10^{-3})$ ✓
$n = 2,5 \times 10^{-3}$ mol ✓ (3)

7.3.2

OPTION 1	OPTION 2
OPTION 1 **Marking criteria** (a) pH formula (b) Subst. into pH-formula (c) Subst. into $K_w = [H_3O^+][OH^-]$ (d) Final answer	**OPTION 2** **Marking criteria** (a) Formula pH + pOH = 14 (b) Subst. into pH + pOH =14 (c) Subst. into pOH formula (d) Final answer
OPSIE 1 ***Nasienkriteria*** *(a) pH-formule* *(b) Vervang in pH-formule* *(c) Vervang in $K_w = [H_3O^+][OH^-]$* *(d) Finale antwoord*	***OPSIE 2*** ***Nasienkriteria*** (a) *Formule pH +pOH = 14* (b) *Vervang in pH + pOH =14* (c) *Vervang in pOH-formule* (d) *Finale antwoord*
$pH = -\log[H_3O^+]$ ✓ (a) $12,52 = -\log[H_3O^+]$ ✓ (b) $[H_3O^+] = 3,02 \times 10^{-13}$ mol·dm^{-3} $K_w = [H_3O^+][OH^-]$ $1 \times 10^{-14} = (3,02 \times 10^{-13})[OH^-]$ ✓ (c) $[OH^-] = 0,033$ mol·dm^{-3} ✓ (d)	pH + pOH = 14 ✓ (a) 12,52 + pOH = 14 ✓ (b) pOH = 1,48 $pOH = -\log[OH^-]$ $1,48 = -\log[OH^-]$ ✓ (c) $[OH^-] = 0,033$ mol·dm^{-3} ✓ (d)

(4)

7.3.3 **<u>POSITIVE MARKING FROM QUESTION 7.3.1 AND 7.3.2</u>**
<u>POSITIEWE NASIEN VAN VRAAG 7.3.1 EN 7.3.2</u>

<u>Marking criteria</u>
(a) Subst. 0,033 and V into n = cV
(b) Subst. 0,033V, 0,1V and n equivalence point in
$n_{excess} = n_{Totaal} - n_{ep}$
(c) Subst. into V (total volume) = V (volume titrated) + V (acid)
(d) Subst. eq (2) into (1)
(e) Final answer

<u>Nasienkritria</u>
(a) Vervang 0,033 en V in n = cV
(b) Vervang 0,033V , 0,1V en 'n ekwivalente punt in
$n_{oormaat} = n_{totaal} - n_{ekw}$
(c) Vervang in V (totale volume) = V (volume getitreer) + V (suur)
(d) Vervang vergelyking (2) in (1)
(e) Finale antwoord

n (excess) = n (total) – n (equivalence point)
n (oormaat) = n (totaal) – n (ekwivalente punt)

cV (total volume) = cV(volume titrated) – n (equivalence point)
cV (totaal volume) = cV (volume getitreer) – n (ekwivalente punt)

0,033V (total volume) ✓ **(a)** = 0,1V (volume titrated) – $2,5 \times 10^{-3}$ …(1) ✓ **(b)**

V (total volume) = V (volume titrated) + V (acid)
V (totale volume) = V(getitreer) + V (suur)

V (total volume) = V (volume titrated) + 25 x 10^{-3} … (2) **(c)** ✓

Subst. equation (2) into (1) / *Vervang vergelyking (2) in (1)*

0,033 [Volume titrated + 25 x 10^{-3}] ✓ **(d)** = 0,1 Volume titrated – 2,5 x 10^{-3}

Volume titrated / *volume getitreer* = 0,050 dm^3

Volume titrated / *volume getitreer* = 50 cm^3 ✓ **(e)** (5)

[27]

TOTAL/*TOTAAL*: 150