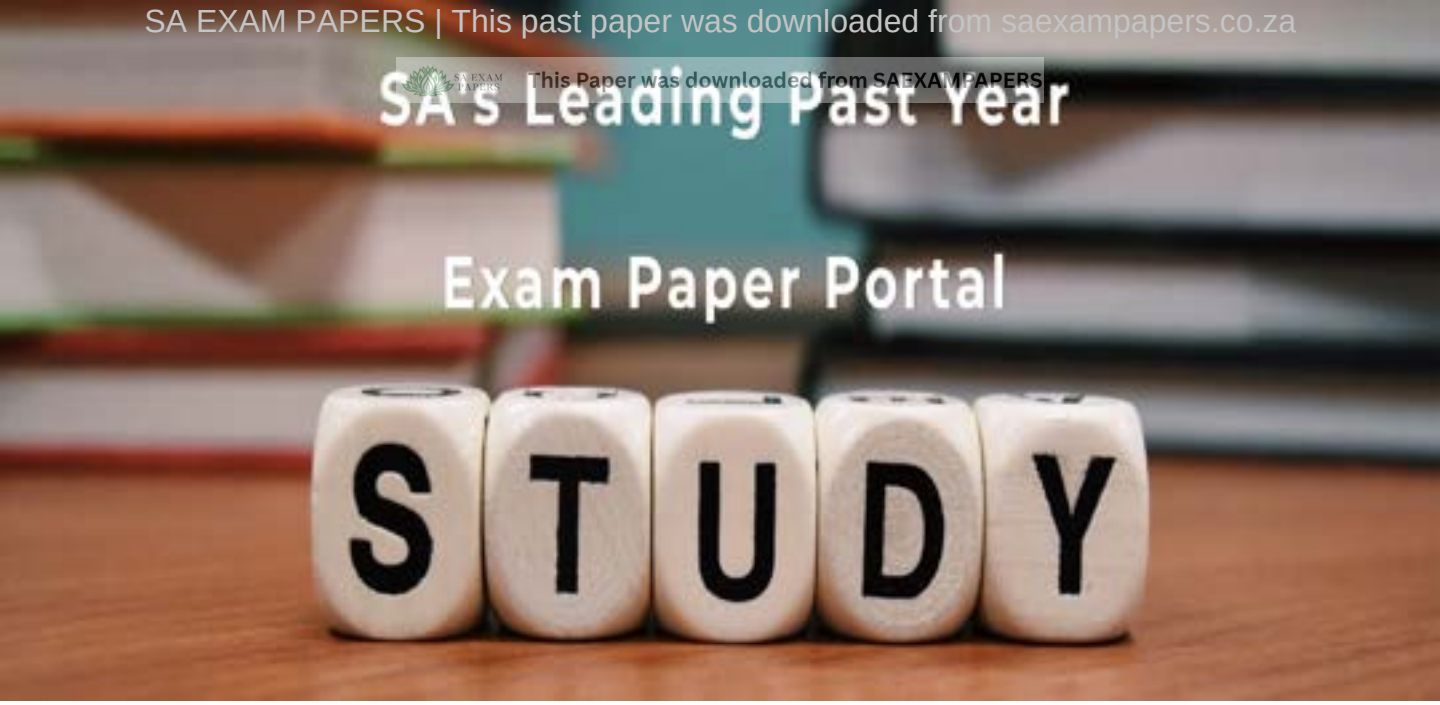


GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION/

2020

MARKING GUIDELINE
NASIENRIGLYNE

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

13 pages/*bladsye*

QUESTION / *VRAAG* 1

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

[20]

QUESTION / *VRAAG* 2

2.1 Homologous series is a series of organic molecules/compounds that can be described by the same general formula, ✓✓
OR one member differs from the next with the CH_2 group. **(2 or 0)**

Homoloë reeks: 'n Reeks organiese verbindings/molekule 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 Carboxyl group / *Karboksielgroep* ✓

Do not accept carboxylic acid / *Moet nie karboksielsuur aanvaar nie* (1)

2.3 2.3.1 F ✓ (1)

2.3.2 C ✓ (1)

2.3.3 H ✓ (1)

2.3.4 G ✓ (1)

2.4 2.4.1 Butyl✓ propanoate ✓/ *Butielpropanoaat* (2)

2.4.2 2-bromo-5-methylhexane / *2-bromo-5-metielheksaan*

Marking criteria/*Nasienkriteria*:
- Correct stem and substituents / *Korrekte stam en substituente* ✓
- Everything correct / *heeltemal korrek* ✓ (2)

2.5 2.5.1 (Concentrated) sulphuric acid / *(gekonsentreerde) swawelsuur* ✓ (1)

2.5.2 Esterification **OR** condensation / *Esterifikasie **OF** kondensasie* ✓ (1)

2.5.3 Water ✓ and/*en* H_2O ✓ (2)

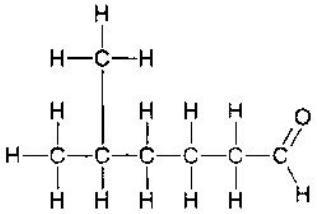
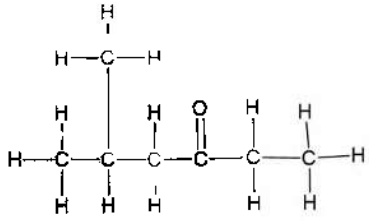
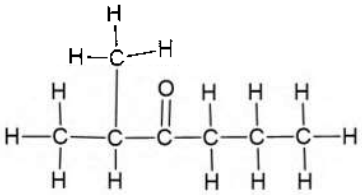
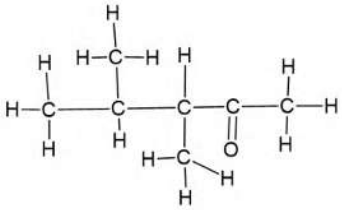
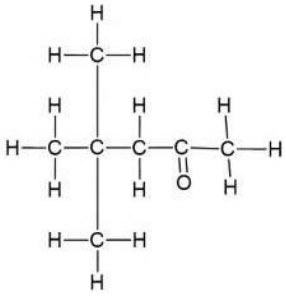
2.6 2.6.1 Organic compounds with the same molecular formula but different structural formulae. ✓✓ **(2 or 0)**

Struktuurisomeer: Organiese molekule met dieselfde molekulêre formule, maar verskillende struktuurformules. (2)

2.6.2 (1)

2.6.3 (2)

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

Functional isomers / *Funksionele isomeer* ✓	
Positional isomer / *Posisionele isomeer*	 OR 
Chain isomer / *Ketting isomeer*	 OR 

2.7 C_3H_7 ✓✓ (2)

2.8 C_nH_{2n} ✓ (1)

2.9 $2C_6H_{14} + \underline{19\ O_2} \rightarrow 12\ CO_2 + 14\ H_2O$ ✓ balancing / *balanseer* ✓ (3)

[26]

QUESTION / *VRAAG* 3

3.1

Marking criteria/*Nasienkriteria:*

If any one of the underlined key phrases in the correct context is omitted, deduct 1 mark.

Indien enige een van die onderstreepte sleutelfrases in die korrekte konteks weggelaat word, trek 1 punt af.

The temperature at which the solid and liquid phases of a substance are at equilibrium. ✓✓

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

3.2 3.2.1 Melting point / *Smeltpunt* ✓ (1)

3.2.2 Straight chain alkane ✓ Accept: Homologous series
Reguitketting alkane *Aanvaar: Homoloë reeks* (1)

3.2.3

Marking Criteria: show the relationship between the dependent and independent variables. If the question has a yes or no answer – deduct one mark.

Example:
What is the relationship between the chain length/molecular mass/number of carbon atoms and the melting points of organic compounds (from the same homologous series)? ✓✓

(2)

Nasienkriteria: *toon die verband tussen die afhanklike en onafhanklike veranderlike. Indien die vraag 'n ja of nee antwoord het – trek een punt af.*

Voorbeeld:
Wat is die verband tussen die kettinglengte/molekulêre massa/ getal koolstofatome en die smeltpunt van die organiese verbinding(van dieselfde homoloëreeks)?

3.2.4

- The melting point of organic compounds increases with an increase in the chain length/molecular mass/number of carbon atoms/longer chain length of organic compounds. ✓
- The intermolecular forces in R are stronger than in P and Q ✓
- More energy is required to overcome the intermolecular forces in R than in P and Q. ✓

- *Die smeltpunt van 'n organiese verbinding verhoog met 'n verhoging in die kettinglente/ molekulêre massa/ getal koolstofatome/langer kettinglengte in die organiese verbinding.*
- *Die intermolekulêrekragte in R is sterker as in P en Q*
- *Meer energie word benodig om die intermolekulêrekragte te oorkom in R as in P en Q.* (3)

3.3 3.3.1 R ✓ (1)

3.3.2 R ✓ (1)

3.3.3
- Compound R has a longer straight chain length/larger surface area as compared to the branched compound S. ✓
- Both have London forces but the intermolecular forces in compound R are stronger than in S. ✓
- More energy is needed to overcome/weaken the intermolecular forces in compound R. ✓

- *Verbinding R het 'n langer reguit kettinglengte/groter oppervlakarea in vergelyking met die vertakte verbinding S.*
- *Albei het London-kragte, maar die intermolekulêre kragte in verbinding R is sterker as in S.*
- *Meer energie is nodig om die intermolekulêre kragte in verbinding R te oorkom/verswak.* (3)

3.4 3.4.1 Alkane / *Alkaan* ✓ (1)

3.4.2 2,2-dimethylpropane / dimethylpropane ✓✓

2,2-dimetielpropaan / dimetielpropaan

Marking criteria/*Nasienkriteria*:
- Correct stem and substituents / *Korrekte stam en substituente* ✓
- Whole name correct / *Hele naam korrek* ✓ (2)

[17]

QUESTION / *VRAAG* 4

4.1 4.1.1 Hydrogenation / *Hydrogenering* ✓ (1)

4.1.2 Hydration / *hidrasie* ✓ (1)

4.1.3 Hydrohalogenation / *hydrohalogenering* ✓ (1)

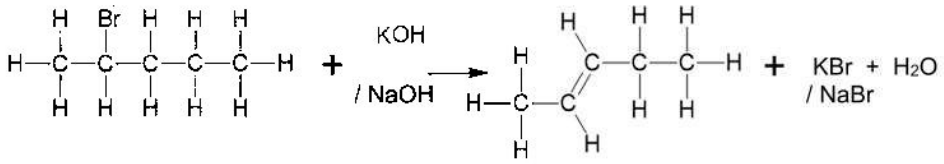
4.2 4.2.1 Elimination / dehydrohalogenation / dehydrobromination

Eliminasie / dehydrohalogenasie / dehydrobrominasie ✓ (1)

4.2.2 Concentrated strong base / NaOH(c) / KOH(c) / LiOH(c) ✓
Heat ✓ (under reflux)

Gekonsentreerde sterk basis / NaOH(c) / KOH(c) / LiOH(c)
Hitte (onder refluks) (2)

4.2.3



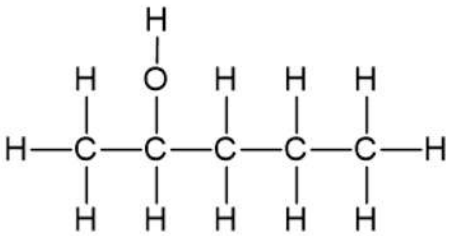
Marking criteria/*Nasienkriteria*:
- Correct structural formula of 2-bromopentane where the Br is on the correct carbon ✓and KOH / NaOH / LiOH ✓
- Functional group of alkene ✓
- Correct structural formula of pent-2-ene ✓ and KBr + H_2O ✓

- *Korrekte struktuurformule vir 2-bromopentaan waar die Br op die regte koolstof is en KOH* / NaOH / LiOH
- *Funskionele groep van alkeen*
- *Korrekte struktuurformule vir pent-2-een en KBr + H_2O*

(5)

4.3 4.3.1 Alcohol / *alkohol* ✓ (1)

4.3.2



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

(2)

4.3.3 pentan-2-ol / *pentan-2-ol* ✓✓ **(2 or 0)** (2)

4.4 $CH_3\overset{\checkmark}{C}HCH\overset{\checkmark}{C}H_2CH_3 + HBr \rightarrow CH_3\overset{\checkmark}{C}HBrCH_2\overset{\checkmark}{C}H_2CH_3$ ✓

Marking criteria for product/*Nasienkriteria vir produk*:
- Functional group / *Funksionele groep* ✓
- Whole formula correct/*Hele formule korrek* ✓

NOTE / *NOTA*
If structural formulae used – max ¾
indien struktuurformule – maks ¾
If molecular formula used – ¼ only for HBr
Indien molekulêre formule gebruik – slegs ¼ vir HBr

(4)

4.5 Substitution / *Substitusie* ✓ (1)

4.6 4.6.1 Hydrolysis / *Hidrolise* ✓ (1)

4.6.2 Diluted Strong base / NaOH(aq) ✓
Verdunde Sterk basis / NaOH(aq) (1)
[23]

QUESTION / *VRAAG* 5

5.1 The change in concentration of reactants or products per unit time. ✓✓ **(2 or 0)**
OR Rate of change in concentration of reactants or products

Die verandering in konsentrasie van reaktante of produkte per eenheid tyd.
OF *Tempo van verandering in konsentrasie van reaktante of produkte* (2)

5.2
- Measure the volume of hydrogen gas using a gas syringe/downward displacement of water. ✓
- Measure the decrease in mass on a scale/the rate of colour change of the solution. ✓
(accept any two reasonable answers – be it collecting gas or measuring the mass).

- *Meet die volume van die waterstofgas met die hulp van 'n gasspuit/afwaarste verplasing van water.*
- *Meet die afname aan massa op 'n skaal/die tempo van kleurverandeing van die oplossing.*
(aanvaar enige twee redelike antwoorde – wat hetsy gasversameling of die meting van die massa). (2)

5.3 5.3.1 $\text{Rate} = \frac{\Delta V}{\Delta t}$ ✓ for the conversion / *vir die omskakeling*

$= \frac{5 - (0) \checkmark}{60 - (0) \checkmark}$

$= 0{,}08$ ✓$(\text{dm}^3.\text{s}^{-1})$

Accept calculation done in cm^3 and then converted.
Aanvaar berekeininge wat in cm^3 gedoen word en dan omgeskakel word. (4)

5.3.2

Marking criteria:	***Nasienkriteria***
(a) Substituting 5 and 22,4 into n $= \frac{V}{V_M}$ ✓	(a) *Vervanging van 5 en 22,4 in* n $= \frac{V}{V_M}$ ✓
(b) Equation n= $\frac{m}{M}$ ✓	(b) *Vergelyking* n= $\frac{m}{M}$ ✓
(c) Substitution ✓	(c) *Vervanging* ✓
(d) Final answer m = 0,45 g (0,4464 g) ✓	(d) *Finale antwoord* m = 0,45 (0,4464) g ✓

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

$= \frac{5}{22,4}$ ✓ **(a)**

= 0,2232 mol

$n(H_2) = \frac{m}{M}$ ✓ **(b)**

$0,2232 = \frac{m}{2}$ ✓ **(c)**

m = 0,45 g ✓ **(d)** (4)

5.3.3

Marking criteria:
(a) n = 0,16673 mol ✓
(b) mole ratio Cr: H_2; 2:3; 0,16673: 0,25 ✓
(c) m = 0,5 g ✓
(d) substitution $\frac{0,45}{0,5}$ × 100 into percentage yield equation ✓
(e) Final answer: 90% ✓ (Range 89,25%-90%)
Nasienkriteria
(a) n = 0,16673 mol ✓
(b) m*olverhouding* Cr: H_2; 2:3; 0,16673: 0,25 ✓
(c) m = 0,5 g ✓
(d) *vervanging* $\frac{0,45}{0,5}$ × 100 *in persentasieopbrengs vergelyking* ✓
(e) *Finale antwoord:* 90% ✓ *(Gebied 89,25%-90%)*

OPTION 1 / *OPSIE 1*

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

$= \frac{8,67}{52}$ ✓ **(a)**

$= 0,16673$ mol

Mole ratio/*Molverhouding*

Cr : H_2

2 : 3 ✓ **(b)**

0,16673 : 0,25

$n(H_2) = \frac{m}{M}$

$0,25 = \frac{m}{2}$ ✓ **(c)**

m = 0,5 g

Percentage Yield / *Persentasie opbrengs*

$= \frac{\text{Actual yield/Werklike opbrengs}}{\text{Theoretical yield/Teoretiese opbrengs}} \times 100$

$= \frac{0,45}{0,5} \times 100$ ✓ **(d)**

= 90% ✓ **(e)** (Accept range/*Aanvaar reeks* 89,25%-90%)

OPTION 2 / *OPSIE 2*

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

$= \frac{8,67}{52}$ ✓ **(a)**

= 0,16673 mol

Mole ratio/*Molverhouding*

Cr : H_2

2 : 3 ✓ **(b)**

0,16673 : 0,25

from / *van* Q5.2.3 = 0,2232 mol✓ **(c)**

Percentage Yield / *Persentasie opbrengs*

$= \frac{\text{Actual yield/Werklike opbrengs}}{\text{Theoretical yield/Teoretiese opbrengs}} \times 100$

$= \frac{0,2232}{0,25} \times 100$ ✓ **(d)**

= 89,28% ✓ **(e)**

(5)

OPTION 3 / *OPSIE 3*

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

$= \frac{8,67}{52}$ ✓ **(a)**

= 0,16673 mol

Mole ratio / *Molverhouding*

Cr : H_2

2 : 3 ✓ **(b)**

0,16673 : 0,25

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

$V = 0,25(22,4)$ ✓ **(c)**

$= 5,6\ dm^3$

Percentage Yield / *Persentasie opbrengs*

$= \frac{\text{Actual yield/Werklike opbrengs}}{\text{Theoretical yield/Teoretiese opbrengs}} \times 100$

$= \frac{5}{5,6} \times 100$ ✓ **(d)**

= 89,29% ✓ **(e)**

5.3.4 DECREASES / *VERLAAG*✓ (1)

5.3.5
- As surface area decreases, the exposed area decreases, ✓ and
- fewer molecules will have sufficient energy ✓, less than or equal to the activation energy, / less particles with Ek ≥ Ea
- leading to less effective collisions per unit time / lower frequency of effective collisions ✓

- *Soos die oppervlak afneem, neem die blootgestelde area af,*
- *en minder molekules sal voldoende energie hê , minder as of gelyk aan die aktiveringsenergie, / minder deeltjies met Ek ≥ Ea*
- *wat lei tot minder effektiewe botsings per eenheid tyd / laer frekwensie van effektiewe botsings* (3)

[21]

QUESTION / *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 een van die onderstreepte sleutelfrases in die korrekte konteks weggelaat word, trek 1 punt af.

When the equilibrium in a closed system is disturbed, the system will reinstate 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 A CLOSED ✓ system is isolated from its surroundings/in a sealed gas syringe.✓

'n GESLOTE system is geïsoleer van die omgewing/ in 'n geseëlde gasspuit (2)

6.3 6.3.1 INCREASES / *VERHOOG*✓ (1)

6.3.2 REMAINS THE SAME / *BLY DIESELFDE*✓ (1)

6.4 6.4.1 EXOTHERMIC / *EKSOTERMIES*✓ (1)

6.4.2
- Placing the syringe in ice cubes will <u>decrease the temperature</u>. ✓
- The system will decrease the effect by <u>favouring an exothermic reaction</u>.✓
- The <u>forward reaction is favoured</u> because the syringe turns colourless.✓

- *As die gasspuit in ysblokkies geplaas word, <u>verlaag die temperatuur</u>.*
- *Die sisteem sal die effek teenwerk deur <u>die eksotermiese reaksie te bevoordeel</u>.*
- *Die <u>voorwaartse reaksie word</u> bevoordeel omdat die spuit kleurloos raak.* (3)

6.5 6.5.1
$$n = \frac{m}{M} \quad ✓$$
$$= \frac{8,28}{92} \quad ✓$$
$$= 0,09 \text{ mol} \quad ✓$$
(3)

6.5.2

Marking criteria:

(a) Initial quantities of all substances ✓
(b) Using the correct mol ratio ✓
(c) Calculating the quantity(mol) at equilibrium of NO_2 and N_2O_4 ✓
(d) Divide the number of moles at equilibrium by 1 dm^3 ✓
(e) Kc expression✓(no or wrong expression 6/7)
(f) Correct substitution of equilibrium concentrations into Kc expression ✓
(g) Final Answer K_c = 0,36 ✓

NOTE: If concentration table was used, the values will be the same, but the labels will differ.

Nasienkriteria:

(a) Aanvanklike hoeveelhede van alle stowwe
(b) Gebruik die korrekte mol verhouding
(c) Bereken die hoeveelheid(mol) by ewewig van NO_2 en N_2O_4
(d) Deel die aantal mol in ewewig deur 1 dm^3
(e) Kc uitdrukking(Verkeerde of geen Kc 6/7)
(f) Vervang ekwilibriumkonsentrasies in die K_c uitdrukking
(g) Finale antwoord K_c = 0,36

NOTA: Indien konsentrasie in tabel gebruik word, sal die waardes dieselfde bly, maar die byskrifte sal verskil.

	$2NO_2(g)$	$N_2O_4(g)$
Initial amount(mol) *Aanvanklike hoeveelheid(mol)*	0,52	0,08 ✓ **(a)**
Change(mol) *Verandering(mol)*	−0,02	+ 0,01 ✓**(b)**
Equilibrium amount(mol) *Ewewigshoeveelheid(mol)*	0,50	0,09 ✓**(c)**
Equilibrium concentration($mol \cdot dm^{-3}$) *Ewewigskonsentrasie*($mol \cdot dm^{-3}$)	$\frac{0,50}{1}$ = 0,50	$\frac{0,09}{1}$ = 0,09 ✓**(d)**

$K_c = \frac{[N_2O_4]}{[NO_2]^2}$ ✓ **(e)**

$= \frac{(0,09)}{(0,50)^2}$ ✓ **(f)**

= 0,36 ✓ **(g)** (7)

[20]

QUESTION /*VRAAG 7*

7.1 Strong acids ionise completely in water to form a high concentration of H_3O^+ ions. ✓✓ **(2 or 0)**

'n Suur is 'n stof wat waterstofione (H^+)/hidroniumione (H_3O^+) vorm wanneer dit in water oplos. (2)

7.2 $HC\ell$; $C\ell^-$ ✓✓ **(2 or 0)**
OR/*OF*
H_2O : H_3O^+ (2)

7.3 Acids that release/donate ONLY ONE PROTON / H^+ ion✓

Sure wat NET EEN PROTON / H^+ ioon vrystel / skenk (1)

7.4 7.4.1 $c(HC\ell) = \frac{n}{V}$ ✓

n = (0,8) (0,15) ✓

n = 0,12 mol ✓ (3)

7.4.2

Marking criteria:

(a) Substituting (0,5)(0,06) into $c_{(NaOH)} = \frac{n}{V}$ ✓

(b) Using the correct mol ratio NaOH : HCℓ 1:1 ✓

(c) Calculating $n(HC\ell)_{reacted} = n_{initial} - n_{excess}$ by substituting ✓

(d) $n(HC\ell)_{reacted}$ = 0,09 mol ✓

(e) Mole Ratio $CaCO_3$: HCℓ 1:2; 0,045 : 0,09 ✓

(f) Substituting 0,045 and 100 into $n = \frac{m}{M}$ ✓

(g) Final answer m = 4,5 g ✓

Nasienkriteria:

(a) Vervang (0,5)(0,06) in $c_{(NaOH)} = \frac{n}{V}$ ✓

(b) Gebruik die korrekte molverhouding NaOH : HCℓ 1:1 ✓

(c) Bereken $n_{(HC\ell)reacted} = n_{initial} - n_{excess}$ *deur vervanging* ✓

(d) $n(HC\ell)_{reacted}$ *= 0,09 mol* ✓

(e) molverhouding $CaCO_3$*: HCℓ 1:2; 0,045 : 0,09*

(f) Vervang 0,045 en 100 in $n = \frac{m}{M}$ ✓

(g) *Finale Antwoord m = 4,5 g* ✓

$c_{(NaOH)} = \frac{n}{V}$

$n_{(NaOH)}$ = (0,5)(0,06) ✓ **(a)**

$n_{(NaOH)}$ = 0,03 mol

Mole Ratio NaOH : HCℓ

1:1

0,03: 0,03 mol (in excess/*in oormaat*) ✓**(b)**

$n(HC\ell)_{reacted/gereageer} = n_{initial/aanvanklik} - n_{excess/oormaat}$

= 0,12 – 0,03 ✓**(c)**

= 0,09 mol

Mole Ratio

$CaCO_3$: HCℓ

1 : 2

0,045 ✓ **(e)** : 0,09 ✓ **(d)**

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

$0,045 = \frac{m}{100}$ ✓ **(f)**

m = 4,5 (g) ✓ **(g)** (7)

7.4.3 NO. ✓ It is a salt of a strong acid and a strong base. ✓

NEE. Dit is 'n sout van 'n sterk suur en 'n sterk basis. (2)

7.4.4
- The <u>equivalence point is at pH of 7</u>. ✓
- <u>Bromothymol blue changes colour at a pH equal to 7.</u> ✓ The endpoint of this titration is within the pH range (of 6 -7,6) in which bromothymol blue / indicator changes colour.

- *Die <u>ekwivalensiepunt is by 'n pH van 7.</u>*
- *<u>Broomtimolblou verander van kleur by 'n pH gelyk aan 7.</u> Die eindpunt van hierdie titrasie is binne die pH-gebied van (6 -7,6) waarin bromotimolblou / indikator van kleur verander.* (2)

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

(a) Using the ratio of the base of KOH:OH^- / *Gebruik die verhouding van die KOH:OH^-* ✓
(b) Substitution/*Vervanging* $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ ✓
(c) Substituting/*Vervanging* $0,4 \times 10^{-7}$ into/*in* pH = -log $[H_3O^+]$ ✓
(d) Final answer/*Finale antwoord* pH = 7,3979 (7,40) ✓

OPTION 1/ *OPSIE 1*

$KOH \rightarrow K^+ + OH^-$
1 : 1 ✓**(a)**

$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$
$1 \times 10^{-14} = [H_3O^+][2,5 \times 10^{-7}]$ ✓ **(b)**
$[H_3O^+] = 0,4 \times 10^{-7}$ mol·dm^{-3}
pH = -log $[H_3O^+]$
= -log $(0,4 \times 10^{-7})$ ✓**(c)**
= 7,3979 (7,40) ✓**(d)**

OPTION 2/ *OPSIE 2*

$KOH \rightarrow K^+ + OH^-$
1 : 1 ✓**(a)**

pOH = - log$[OH^-]$
pOH = - log$(2,5 \times 10^{-7})$ ✓ **(b)**
= 6,60209

pOH + pH = 14
pH = 14 – 6,60209 ✓**(c)**
= 7,3979 ✓**(d)**

(4)

[23]

TOTAL: 150