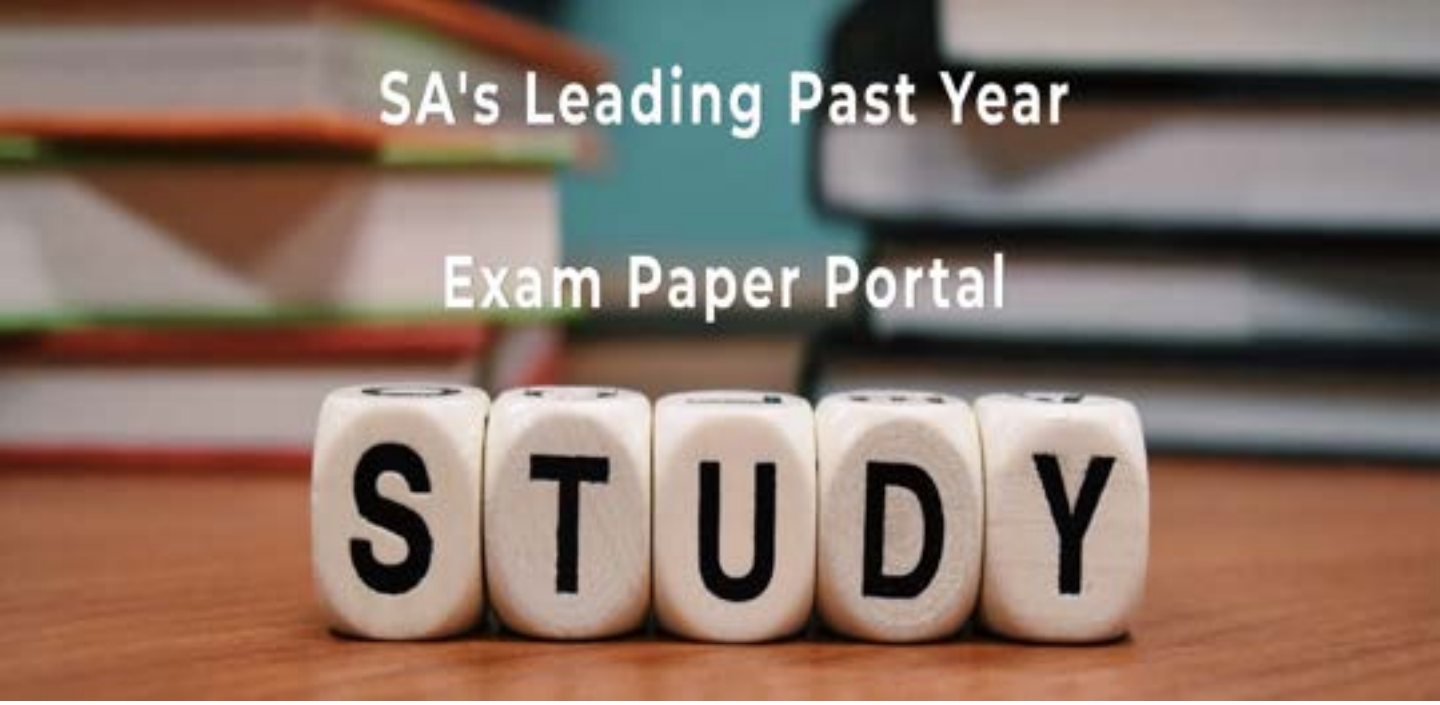


education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

NATIONAL SENIOR CERTIFICATE EXAMINATION

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P2)

June 2021

MARKING GUIDELINE

MARKS/PUNTE: 150

This memorandum consists of 11 pages

Hierdie memorandum bestaan uit 11 bladsye

QUESTION 1 / VRAAG 1

1.1 D ✓✓

1.2 B ✓✓

1.3 C ✓✓

1.4 B ✓✓

1.5 C ✓✓

1.6 C ✓✓

1.7 D ✓✓

1.8 A ✓✓

1.9 C ✓✓

1.10 B ✓✓

[20]

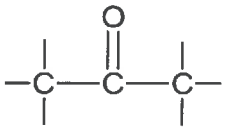
QUESTION 2 / VRAAG 2

2.1.1 F✓ (1)

2.1.2 G✓ (1)

2.1.3 C✓ (1)

2.2.1



✓✓

(2)

2.2.2 Carboxylic acid / *Karboksielsuur* ✓ (1)

2.2.3 Propyl ✓ propanoate ✓ / *Propielpropanoaat* (2)

2.2.4 3-bromo-2-chloro-3,4-dimethylpentane / *3-broom-2-chloor-3,4-dimetielpentaan*

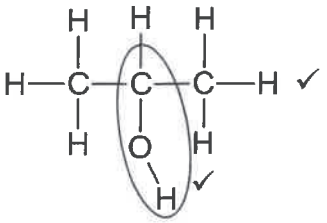
Marking criteria / *Nasienriglyne*

- 3-bromo-2-chloro / *3-broom-2-chloor*✓
- 3,4-dimethyl / *3,4-dimetiel*✓
- Pentane / *pentaan*✓
- Any error e.g. hyphens omitted and/or incorrect sequence Max / *Maks* $^{2}/_{3}$

(3)

2.3.1 The C atom bonded to the functional group / hydroxyl (group) / -OH ✓is bonded to one other C atom. ✓
Die C-atoom gebind aan die funksionele groep/hidroksiel (groep)/-OH is gebind aan slegs een ander C-atoom (2)

2.3.2



Marking criteria / *Nasienriglyne*
- Only functional group correct / *Slegs funksionele groep korrek* ✓
- Whole structure correct / *Hele struktuur korrek* ✓

(2)

2.4.1 Compound B is an alkene and it has one or more multiple bonds between C atoms in its hydrocarbon chains. ✓
Verbinding B is 'n alkeen waarin een of meer meervoudige bindings voorkom tussen C-atome in hul koolwaterstofkettings. (1)

2.4.2 Bromine water/*Broomwater*✓ (1)

2.4.3 The orange brown colour of bromine water will disappear immediately/decolourises immediately✓✓
Die oranjebruin kleur van die broom water gaan dadelik verdwyn/ ontkleur dadelik (2)

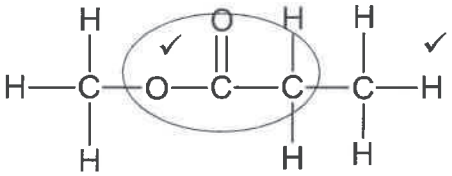
2.4.4 Chloroethane / *Chloor etaan*✓✓ (2)

[21]

QUESTION 3 / VRAAG 3

3.1.1 Type of compound/homologous series/ *Tipe verbinding / homoloëreeks* ✓ (1)

3.1.2



Marking criteria / *Nasienriglyne*
- Only functional group correct / *Slegs funksionele groep korrek* ✓
- Whole structure correct / *Hele struktuur korrek* ✓

(2)

3.1.3 79,8 °C✓ (1)

3.1.4 138,5°C ✓ (1)

3.2
- In **R**/Methyl propanoate/Ester: dipole-dipole forces✓ (in addition to London forces/dispersion forces/induced dipole forces.
- In **S**/ Pentan-1-ol: Hydrogen bonding✓ (in addition to London forces/dispersion forces/induced dipole forces.
- Intermolecular forces in **R**/ methyl propanoate are weaker✓ than in **S**/pentan-1-ol.
  OR intermolecular forces in **T**/pentan-1-ol are stronger than methyl propanoate/ ester **OR** dipole-dipole forces are weaker than hydrogen bonds in **S**

- More energy needed to overcome/break intermolecular forces in **S**.✓
- *In **R** /metielpropanoaat/Ester: dipool-dipoolkragte (tesame met Londonkragte / dispersiekragte/geïnduseerde dipoolkragte).*
- *In **S** / pentan-1-ol: Waterstofbindings (tesame met Londonkragte / dispersiekragte / geïnduseerde dipoolkragte).*
- *Intermolekulêre kragte in **R** swakker as in **S** / pentan-1-ol **OF** intermolekulêre kragte in **S**/ pentan-1-ol is sterker as in **P**/ metielpropanoaat/ester. **OR** dipool-dipoolkragte is swakker as waterstofbindings*
- *Meer energie benodig om intermolekulêre kragte te oorkom / breek in **S**.* (4)

3.3.1 The pressure exerted by a vapour ✓at equilibrium with its liquid in a closed system.✓

Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem (2)

3.3.2 $2C_6H_{14} + 19O_2$ ✓ $\rightarrow 12\ CO_2 + 14H_2O$✓ bal✓

Notes/ *Aantekeninge*		
• Reactants ✓	Products ✓	Balancing ✓
• *Reaktante*	*Produkte*	*Balansering*
• Marking rule */Nasienreël 3.9*		

(3)

3.3.3 P✓ (1)

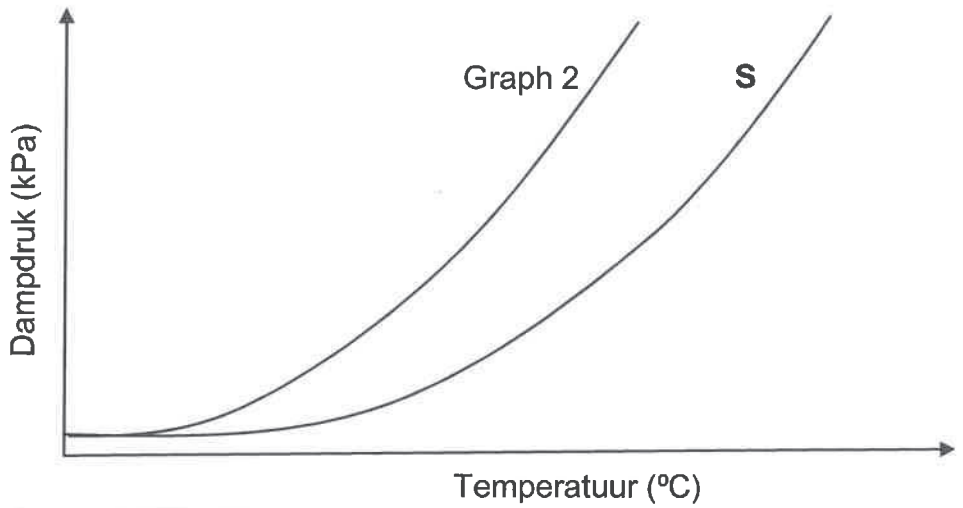
3.3.4
- **P** is less branched / less compact / less spherical/longer chain length / larger surface area (over which intermolecular forces act).✓
  ***P** is minder vertak / minder kompak / minder sferies / langer kettinglengte / groter oppervlak (waaroor intermolekulêre kragte werk).*
- Stronger / more intermolecular forces / Van der Waals forces / London forces / dispersion forces. ✓
  Sterker / meer intermolekulêre kragte / Van der Waalskragte / Londonkragte / dispersiekragte.
- More energy needed to overcome or break intermolecular forces / Van der Waals forces. ✓
  More energie benodig om intermolekulêre kragte / Van der Waalskragte/ dispersiekragte / London-kragte te oorkom.

OR

- **Q** is more branched / more compact / more spherical/shorter chain length / smaller surface area (over which intermolecular forces act).✓
  ***Q** is meer vertak / meer kompak / meer sferies / korter kettinglengte / kleiner oppervlak (waaroor intermolekulêre kragte werk).*
- Weaker / less intermolecular forces / Van der Waals forces / London forces / dispersion forces. ✓
  Swakker / minder intermolekulêre kragte / Van der Waalskragte / Londonkragte / dispersiekragte.
- Less energy needed to overcome or break intermolecular forces / Van der Waals forces. ✓
  Minder energie benodig om intermolekulêre kragte / Van der Waalskragte/ (3)

dispersiekragte / London-kragte te oorkom.

3.3.5



Marking guidelines/ *Nasienriglyne*

- Starting at the same pressure / Begin by dieselfde druk ✓
- Graph **S** must be below Graph 2 / *Grafiek S moet onder Grafiek 2 wees*✓

(2)
[20]

QUESTION 4/ *VRAAG 4*

4.1.1 Organic compounds that consist of hydrogen and carbon only.✓✓
Organiese verbindings wat slegs uit waterstof en koolstof bestaan. (2)

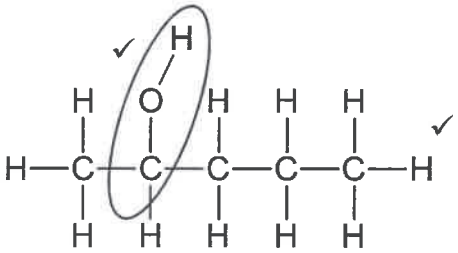
4.1.2 Pentane /*Pentaan* ✓ (1)

4.2.1 Halogenation / Substitution /*Halogenering / Substitusie* ✓ (1)

4.2.2 Hydration /Addition / *Hidrasie / Hidratering /Addisie*✓ (1)

4.2.3 Hydrolysis/Substitution / *Hidrolise/Substitusie*✓ (1)

4.3



Marking criteria / *Nasienriglyne*

- Only functional group correct / *Slegs funksionele groep korrek* ✓
- Whole structure correct / *Hele struktuur korrek* ✓

Notes / *Aantekeninge*

- Accept -OH as condensed. / *Aanvaar -OH as gekondenseer* ✓
- Condensed structural formula / *Gekondenseerde struktuurformule*✓ Maks: $^1/_2$

Propan-2-ol / 2-Propanol ✓

Notes / *Aantekeninge*
- Whole name correct / *Hele naam korrek* ✓

(3)

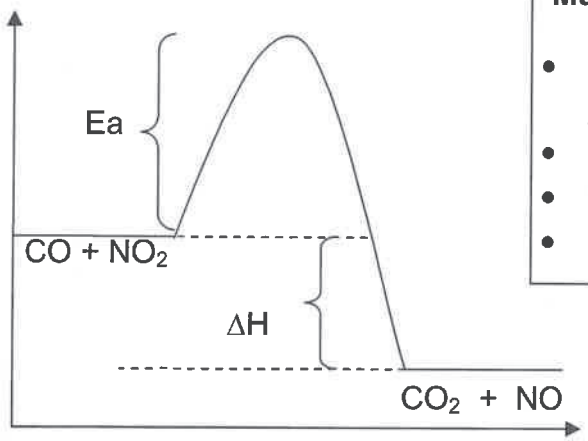
4.4 Hydrohalogenation / *Hidrohalogenasie / Hidrohalogenering* ✓ (1)

4.5 Reaction 2 / *Reaksie 2* ✓ (1)

[11]

QUESTION 5/ *VRAAG 5*

5.1



Marking criteria / Nasienriglyne
- reactants and products / *reaktante en produkte* ✓
- activation energy / *aktieveringsenergie* ✓
- heat of reaction / *reaksiewarmte* ✓
- shape / *vorm van grafiek* ✓

(4)

5.2 A catalyst is a substance that increase the rate of the chemical reaction without undergo a permanent change itself. /A substance that increases the rate of a reaction by providing an alternative path of lower activation energy. ✓✓
'n Katalisator is 'n stof wat die tempo van 'n chemiese reaksie verhoog sonder om self 'n pernamente verandering te ondergaan. Is 'n stoft wat die tempo van 'n reaksie verhoog deur 'n alternatiewe roete van laer aktiveringsenergie te verskaf (2)

5.3 Platinium. ✓
- A catalyst decreases the activation energy by providing an alternative route for the reaction to take place. ✓
  'n Katalisator verlaag die aktiveringsenergie en versakaf 'n alternatiewe roete vir die reaksie om plaas te vind.
- The lower the activation energy the higher the rate of reaction. ✓
  Hoe laer die aktieverings energie hoe hoër die tempo van die reaksie.
- More particles have $E_K \geq E_A$ / More particles have a E_K that is eaual or greater than E_A✓
  Meer deeltjies het 'n $E_K \geq E_A$ /Meer deeltjie het 'n groter E_K om die Ea te oorkom.

(4)

[10]

QUESTION 6 / *VRAAG 6*

6.1

Criteria for investigative question / *Riglyne vir ondersoekende vraag*	
The dependent and independent variables are stated. *Die afhanklike en onafhanklike veranderlikes is genoem.*	✓
Ask a question about the relationship between the independent and dependent variables. *Vra 'n vraag oor die verwantskap tussen die onafhanklike en afhanklike veranderlikes.*	✓

Example / *Voorbeeld*
What is the relationship between the concentration of sulphuric acid and the rate of the reaction? / *Wat is die verhouding tussen die konsentrasie van swawelsuur en die tempo van die reaksie?* ✓ ✓ (2)

6.2 temperature/mass of Mg/surface area of Mg/ *temperatuur/ massa van Mg/ reaksieoppervlak van Mg* ✓ (1)

6.3 Decrease / *Afneem* ✓ (1)

6.4 Less particles are available for collisions to take place /Fewer particles are exposed ✓
Less particles collide with correct orientation✓
Less effective collisions per unit time/per second✓
Minder deeltjies is besikbaar vir botsings om plaas te vind.
Minder deeltjies bots met die regte oriëntasie
Minder effektiewe botsings per eenheids tyd/per sekonde. (3)

6.5 Increase / *Toeneem* ✓ (1)

6.6 $c=\frac{n}{V}$ ✓
$0,3=\frac{n}{0,2}$ ✓
n=0,06 mol

$n(HC\ell) = \frac{1}{2} n(CO_2)$
$n(CO_2)$= 0,03mol✓

$n=\frac{V}{V_m}$
$0,03=\frac{V}{22,4}$
$V=0,672\ dm^3$ ✓ (4)

Marking criteria / Nasienriglyne

- Any formula/*Enige formule:* $c = \frac{n}{V}$ / $n = \frac{V}{Vm}$ ✓
- Substitution of / Vervanging van 0,3 and 0,2✓
- Use mol ratio / Gebruik molverhouding: 2:1
  $n(HC\ell) = \frac{1}{2} n(CO_2)$✓ ✓
- Final answer / Finale antwoord: 0,672 dm^3✓

6.8 rate/tempo$=\frac{\Delta V}{\Delta t}$ (3)

$= \frac{0,672-(0)✓}{20-(0)✓}$

$V=0,03\ (dm^3 \cdot s^{-1})$✓

6.9 Equal to / *Gelyk aan* ✓ (1)

[16]

QUESTION 7 / *VRAAG 7*

7.1 (The stage in a chemical reaction when the) rate of the forward reaction equals the rate of reverse reaction. ✓✓
(*Die stadium in 'n chemiese reaksie wanneer die) tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie.* (2)

7.2.1 The pressure of both reactions increases/ the volume decreased, and the concentration of both the reactants and products increases. ✓ Both reaction rates increase. ✓
Die druk vir beide reaksie is verhoog /die volume verminder wat veroorsaak dat die konsentrasie van beide die reaktante en produkte verhoog. Beide reaksie tempo's word verhoog. (2)

7.2.2 Reverse / Terugwaars ✓ (1)

7.2.3 When pressure is increased the reaction that leads to the smaller amount of mole of gas is favoured. ✓
The reverse reaction is favoured, more A_2B is formed/more reactants are formed.✓
Wanneer die druk verhoog word die reaksie wat tot die kleiner hoeveelheid mol bevoordeel.
Die terugwaartse reaksie word bevoordeel, meer A_2B word gevorm/meer reaktante word gevorm. (2)

7.3 Endothermic / Endotermies ✓
Decrease in temperature favours the exothermic reaction✓
The reverse reaction is favoured /The number of moles of A_2B increases /The concentration of A_2B increases / The amount of product decreases. ✓
Afname in temperatuur bevoordeel die eksotermiese reaksie
Terugwaartse reaksie word bevoordeel./ Die getal mol A_2B neem toe/ Die konsentrasie van A_2B verhoog / Die hoeveelheid produkte verlaag (3)

7.4 A catalyst was added. / 'n Katalisator is bygevoeg. (1)

7.5 Remains the same.✓
A catalyst was added to the reaction✓ both the rate of the forward and reverse reaction increased. ✓
Bly dieselfde.
'n Katalisator is by die reaksie gevoeg. die tempo van beide die voorwaartse en terugwaartse reaksies verhoog. (3)

7.6.1 No effect / Geen effek. ✓ (1)

7.6.2 Decrease✓ (1)

7.7 **CALCULATIONS USING NUMBER OF MOLES BEREKENINGE WAT GETAL MOL GEBRUIK**

Marking guidelines / *Nasienriglyne*

- $n(A_2 \text{ and } B_2)_{change/verandering} = n(A_2 \text{ and } B_2)_{initial/begin} - n(A_2 \text{ and } B_2)_{final/finaal}$ ✓
- Use mole ratio / *Gebruik molverhouding*: 2:2:1✓
- Calculation of volume / *Berekening van volume* ($3dm^3$) ✓
- Divide moles at equibrium with calculated volume / *Deel mol by ewewig deur berekende volume.* ✓
- Correct K_c expression / *Korrekte K_c-uitdrukking* ✓
- Substitution of concentration into K_c expression / *Vervanging van konsentrasies in K_c-uitdrukking.* ✓
- Final answer / *Finale antwoord.* (3,456) ✓

	$2A_2B$	$2A_2$	B_2
Initial quantity (mol) Aanvangs hoeveelheid (mol)	5,1	0	0
Change (mol) Verandering (mol)	-3,6	+3,6	+1,8
Quantity at equilibrium (mol) Hoeveelheid by ewewig (mol)	1,5	3,6	1,8
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)	0,5	1,2	0,6

Ratio ✓

Change in A_2B and B_2 ✓

Divide by volume ✓

✓

$$Kc = \frac{[A_2]^2[B_2]}{[A_2B]^2} \quad ✓$$

$$= \frac{(1,2)^2(0,6)}{(0,5)^2} \quad ✓$$

$$= 3,456 ✓$$

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

$$1,2 = \frac{3,6}{V}$$

$$V = 3\ dm^3$$

CALCULATIONS USING CONCENTRATION / *BEREKENINGE WAT KONSENTRASIE GEBRUIK*

Marking guidelines / *Nasienriglyne*

- Calculation of volume / *Berekening van volume* ($3\ dm^3$) ✓
- Initial $n(A_2B)$ divide by $3\ dm^3$. / *Aanvanklike $n(A_2B)$ gedeel deur $3\ dm^3$.* ✓
- $c(A_2 \text{ and } B_2)_{change/verandering} = c(A_2 \text{ and } B_2)_{initial/begin} - c(A_2 \text{ and } B_2)_{final/finaal}$ ✓
- Use mole ratio / *Gebruik molverhouding*: 2:2:1✓
- Correct K_c expression / *Korrekte K_c-uitdrukking* ✓
- Substitution of concentration into K_c expression / *Vervanging van konsentrasies in K_c-uitdrukking.* ✓
- Final answer / *Finale antwoord.* (3,456) ✓

	$2A_2B$	$2A_2$	B_2
Initial concentration ($mol \cdot dm^{-3}$) Aanvangs konsentrasie ($mol \cdot dm^{-3}$)	1,7✓	0	0
Change ($mol \cdot dm^{-3}$) Verandering ($mol \cdot dm^{-3}$)	1,2	1,2	0,6
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)	0,5	1,2	0,6

Ratio ✓

Change in A_2B and B_2 ✓

$$Kc = \frac{[A_2]^2[B_2]}{[A_2B]^2} \checkmark$$

$$= \frac{(1,2)^2(0,6)}{(0,5)^2} \checkmark$$

$$= 3,456 \checkmark$$

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

$$1,2 = \frac{3,6}{V}$$

$$V = 3\ dm^3 \checkmark$$

(7)
[23]

QUESTION 8 / *VRAAG 8*

8.1.1 It can donate two protons per molecule. ✓✓
Dit kan twee protone skenk per molekule. (2)

8.1.2 $pH = -\log [H_3O^+]$ ✓
$= -\log (0,5)$ ✓
$= 0,3$ ✓
$c[H_3O^+] = 2(0,25) = 0,5\ mol \cdot dm^{-3}$✓ (4)

8.1.3 $c_1V_1 = c_2V_2$ ✓
$(0,25)(20) = (0,1)\ V_2$ ✓
$V_2 = 50\ cm^3 / 0,05\ dm^3$✓
Add 30 cm^3 /0,03 dm^3 water / *Voeg 30 cm^3 / 0,03 dm^3 water by*✓ (4)

8.2 $NH_4^+ + H_2O$ ✓ $\rightleftharpoons NH_3 + H_3O^+$ ✓
The H_3O^+ ions formed is a strong acid. / *Die H_3O^+ ione gevorm is 'n sterk suur.* ✓ (3)

8.3.1 Ampholyte/*Amfoliet* ✓ (1)

8.3.2 H_2O✓ and/*en* SO_4^{2-} ✓ (2)

8.4.1 No change/ *Geen verandering* ✓ (1)

8.4.2 Decreases/ *Afneem* ✓ (1)

8.5.1 $n = c \times V$ ✓ (3)

= 0,8 x 0,05 ✓
= 0,04 mol ✓

8.5.2

Marking criteria / Nasienriglyne

- Calculate the number of moles of NaOH✓
  Bereken die getal mol van NaOH
- Use of ratio (NaOH: HCℓ) - /1:1✓
  Gebruik die verhouding (NaOH: HCℓ) -1:1
- Calculate the number of moles of HCℓ that reacted✓
  Bereken die getal mol HCℓ wat gereageer het
- Use of ratio (HCℓ: MgO) - 2:1✓
  Gebruik van verhouding (HCℓ: MgO) - 2:1
- Use of formula m = n x M✓
  Gebruik formule m = n x M
- Use of molar mass 40✓
- Final answer / *Finale antwoord*✓

n(NaOH) = c x V
= 0,5 x 0,02
= 0,01 mol ✓

n(HCℓ) = n(NaOH)) = 0,01 mol ✓

0,01 mol HCℓ was in excess

0,04 – 0,01✓ = 0,03 mol HCℓ reacted

n(MgO) = ½ n(HCℓ)= 0,015 mol✓

0,015 mol MgO reacted ✓

m = n x M ✓
= 0,015 x 40✓
= 0,6g

% MgO = $\frac{0,6}{0,96}$ x 100 = 62,5% ✓

(8)
[29]

TOTAL 150