GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

VOORBEREIDENDE EKSAMEN

2017

MARKING GUIDELINES /

NASIEN RIGLYNE

PHYSICAL SCIENCES: CHEMISTRY (SECOND PAPER) (10842)

FISIESE WETENSKAPPE: CHEMIE (TWEEDE VRAESTEL) (10842)

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GAUTENG DEPARTMENT OF EDUCATION

GAUTENGSE DEPARTEMENT VAN ONDERWYS

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PROOFREAD ☐	DATE _____
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PHYSICAL SCIENCES: CHEMISTRY /
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(Second Paper)(*Tweede Vraestel)*

MEMORANDUM

QUESTION 1: MULTIPLE-CHOICE QUESTIONS
VRAAG 1: MEERVOUDIGEKEUSE VRAE

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

[20]

QUESTION / *VRAAG* 2

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

2.2 2.2.1 B: Esters ✓ (1)

2.2.2 C: Aldehydes ✓ *Aldehiede* (1)

2.3 C_nH_{2n} ✓ (1)

2.4 Penta✓noic acid ✓ *Pentanoësuur* (2)

2.5 2.5.1 HIGHER THAN ✓ *HOëR AS* (1)

2.5.2 Negative marking from Q2.5.1 to Q 2.5.2 / *Negatiewe nasien vanaf V2.5.1 tot 2.5.2*
(Next member is hexanoic acid.)/ (*Volgende lid is heksanoësuur.)*

Structure / *Struktuur*
Because hexanoic acid has a larger surface area / longer chain length / increasing molecular mass than pentanoic acid, this causes more intermolecular forces ✓
Aangesien heksanoësuur 'n groter kontakoppervlakte het / langer ketting / toename in molekulêre massa as pentanoësuur, sal dit tot meer intermolekulêre kragte lei.

Intermolecular forces / *Intermolekulêre kragte*
More intermolecular forces / induced dipole forces / London forces / dispersion forces / and hydrogen bond between the hydroxyl group of neighbouring molecules in hexanoic acid ✓
Meer intermolekulêre kragte / geïnduseerde dipoolkragte / Londonkragte / dispersiekragte / en waterstofbinding tussen die hidroksielgroepe of naburige molekule in heksanoësuur

Energy: / *Energie*
More energy needed to overcome / break intermolecular forces in hexanoic acid. ✓ (Therefore a higher boiling point in next member of homologous series.)
Meer energie benodig om intermolekulêre kragte te oorkom / breek in heksanoësuur. (Daarom 'n hoër kookpunt in die volgende homoloë reeks.)

OR / *OF*

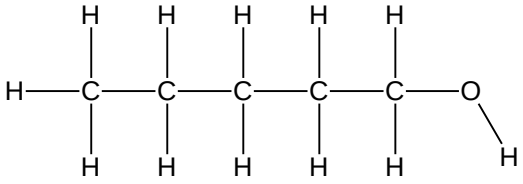
Structure / ***Struktuur***
Because pentanoic acid has a smaller surface area / shorter chain length / lower molecular mass than hexanoic acid, this causes less intermolecular forces ✓
Omdat pentanoësuur 'n kleiner oppervlakarea het / korter kettinglengte / laer molekulêre massa as heksanoësuur, veroorsaak dit minder intermolekulêre kragte.

Intermolecular forces / *Intermolekulêre kragte*
Lower intermolecular forces / induced dipole forces / London forces / dispersion forces / and hydrogen bond between the hydroxyl group of neighbouring molecules in pentanoic acid✓
Minder intermolekulêre kragte / geïnduseerde dipoolkragte / Londonkragte / dispersiekragte / en waterstofbinding tussen die hidroksielgroep van naburige molekule in pentanoësuur.

Energy / *Energie*
Less energy needed to overcome/break intermolecular forces in pentanoic acid than in hexanoic acid. ✓
Minder energie word benodig om die intermolekulêre kragte te oorkom / breek in pentanoësuur as in heksanoësuur. (3)

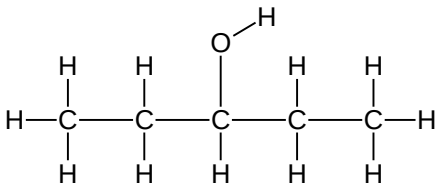
2.6 2.6.1 Same molecular formula, but different positions of the side chain, substituents or functional groups on the parent chain. ✓✓
Dieselfde molekulêre formule maar veerskillende posisies van die syketting, substituente of funksionele groepe op die moederketting. (2)

2.6.2



pentan-1-ol

OR / *OF*



pentan-3-ol

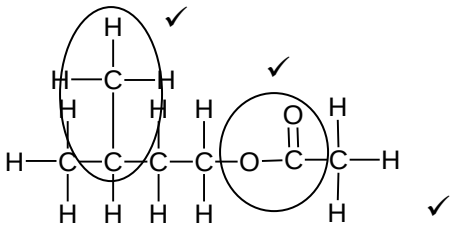
Marking guideline / Nasienriglyne:
- Structure correct 2 / 2
- *Struktuur korrek 2/2*

(2)

2.6.3 (Positive marking from 2.6.2) / *(Positiewe nasien vanaf 2.6.2)*
Pentan-1-ol ✓✓
OR / *OF*
Pentan-3-ol ✓✓ (2)
[17]

QUESTION / *VRAAG* 3

3.1 3.1.1



(3-methylbutyl ethanoate and H_2O)
(*3-metielbutieletanoaat en water)* (3)

Marking guideline / *Nasienriglyne*:
- Water molecule not required / *watermolekule nie nodig nie*
- Ester functional group correct ✓ / *korrekte funksionele groep vir ester*
- Methyl side chain correct ✓ */metielketting korrek*
- Whole structure correct / *hele struktuur korrek 3/3*

3.1.2 To smell the ester ✓ / *Om die ester te ruik*

(The smell of the ester is masked by the smell of the carboxylic acid. Esters are fairly insoluble in water and form a thin layer on the water surface. Esters are volatile. The excess acid and alcohol both dissolve in water and are less volatile and the smell is less pronounced.)
(Die reuk van die ester word gemasker deur die reuk van die karboksielsuur. Esters is redelik oplosbaar in water en vorm 'n dun lag op die water oppervlakte. Esters is vlugtig. Die oormaat suur en alcohol los beide op in water en is minder vlugtig en die reuk is minder opvallend.) (1)

3.1.3 Any TWO safety precautions: / *Enige TWEE veiligheidsmaatreëls:*

- Sulphuric acid is corrosive. Use safety equipment e.g. goggles, gloves, glass ware. ✓
  Swawelsuur is vretend. Gebruik veiligheidsklere, bv. Veiligheidsbrille, handskoene, glassware.
- Do not use a pipette to suck up the acid. ✓
  Moet nie 'n pipet gebruik om die suur op te suig nie.
- Because heat is involved and alcohols are flammable, a water bath is needed in which to place the test tube. ✓
  Omdat hitte betrokke is en alkohole is vlambaar, word 'n waterbad benodig om die proefbuis in te plaas. (2)

3.2 3.2.1 hexan-2-ol ✓✓ *heksan-2-ol* (2)

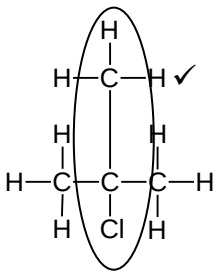
3.2.2 Addition reaction/hydration ✓ / *addissiereaksie / hidrasie* (1)

3.2.3 Any TWO: / *Enige TWEE:*

Excess water / Small amount of acid as catalyst (sulphuric or phosphoric) / Mild heat ✓ mark each

Oormaat water / klein hoeveelheid van die suur as katalisator (swawelsuur of fosforsuur) / matige hitte ✓ *een punt elk.* (2)

3.3 3.3.1



✓ whole structure / *hele struktuur* (2)

3.3.2 2-chloro-2-methyl✓propane ✓ and water ✓
2-chloro-2-metielpropaan en water (3)

3.4 3.4.1 High temperature ✓ / *Hoë temperatuur*
High pressure ✓ / *Hoë druk* (2)

3.4.2 Ethene ✓ / *eteen* (1)

3.4.3 Dehydration ✓ / *dehidrasie* (1)

3.4.4 A polymer formed when monomers (usually containing a double bond) combine through an addition reaction. ✓✓
'n Polimeer vorm wanneer monomere (gewoonlik met 'n dubbelbinding) kombineer deur 'n addissiereaksie. (2)

3.4.5 Polythene ✓ */ politeen of polietileen* (1)
[23]

QUESTION / *VRAAG* 4

4.1 4.1.1 10 kJ ✓ (1)

4.1.2 -20 kJ ✓ (1)

4.2 4.2.1 The particles with sufficient kinetic energy for a reaction to take place. ✓
Die deeltjies met genoegsame kinetiese energie vir 'n reaksie om plaas te vind. (1)

4.2.2 B ✓ (1)

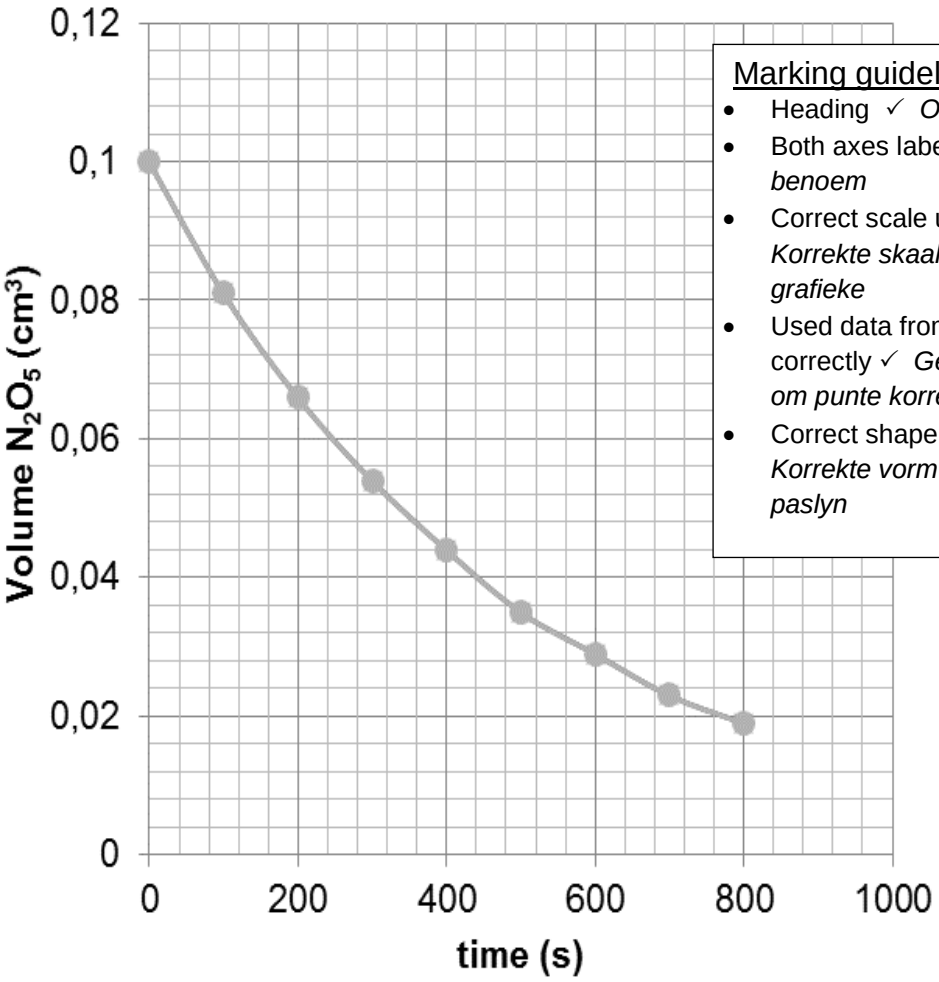
4.2.3 Increasing temperature increases the rate of reaction. ✓ Molecules must collide with sufficient energy for bonds to break ✓ and a reaction to occur (activation energy). When the temperature is increased, more particles have enough energy for more effective collisions to take place ✓ and more particles have energy greater than the activation energy. ✓
Vermeerdering van die temperatuur verhoog die tempo van die reaksie. Molecule moet bots met genoegsame energie vir die bindings om te breek en 'n reaksie om plaas te vind (aktiveringsenergie). Wanneer die temperatuur verhoog, het meer deeltjies genoeg energie vir meer effektiewe botsings om plaas te vind en meer deeltjies het energie groter as die aktiveringsenergie.

OR / *OF*

(4)

Increase in energy increases kinetic energy. As the kinetic energy of the particles increase, more particles have sufficient activation energy, the chances of colliding with correct orientation increases, more effective collisions per unit time takes place.
Toename in energie verhoog die kinetiese energie. Indien die kinetiese energie van die deeltjies verhoog, is daar meer deeltjies met genoegsame aktiveringsenergie, die kanse vir botsings met korrekte oriëntasie verhoog, meer effektiewe botsings per eenheid tyd vind plaas.

4.3 4.3.1 Graph of time of reaction taking place vs Volume of N_2O_5
Grafiek van tyd van reaksie wat plaasvind teenoor Volume van N_2O_5 (5)



Marking guideline / *Nasienriglyne*:
- Heading ✓ *Opskrif*
- Both axes labeled ✓ *Beide asse benoem*
- Correct scale used for both graphs ✓ *Korrekte skaal gebruik vir beide grafieke*
- Used data from table to plot points correctly ✓ *Gebruik data vanaf table om punte korrek te plot.*
- Correct shape of graph/line of best fit ✓ *Korrekte vorm van grafiek / beste paslyn*

4.3.2 The change in concentration of reactants or products per unit time. ✓ ✓
Die verandering in konsentrasie van reaktante of produkte per eenheid tyd. (2)

4.3.3 Rate of reaction *(Reaksietempo)* = $\frac{\text{volume } N_2O_5 \text{ used}}{\Delta t}$ ✓

$= \frac{0,06}{240}$ ✓ $= 2,5 \times 10^{-4}$ mol·dm^{-3}·s^{-1} ✓

(Allow for a range 2,4 – 2,6 x 10^{-4} – see learner's graphs)
(Laat toe vir 'n reeks van 2,4 – 2,6 x 10^{-4} -sien leerder se grafiek) (3)
[18]

QUESTION / *VRAAG* 5

5.1 When the rate of the forward reaction is equal to the rate of the reverse reaction. ✓✓

Or

When both reactants and products continue to form at the same time.

Wanneer die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie

Of

Wanneer beide reaktante en produkte aanhou vorm op dieselfde tyd. (2)

5.2

	$4AO_{2(g)}$ ⇌	$2A_2O_{3(g)}$ +	$O_{2(g)}$
Molar ratio *Molêre verhouding*	**4**	**2**	**1**
Initial concentration *Aanvanklike konsentrasie* ($mol \cdot dm^{-3}$)	**0** **(given)**	**2,0** **(given)**	**1,0** **(given)**
Change in concentration *Verandering in konsentrasie* ($mol \cdot dm^{-3}$)	+4x	-2x	-x
Equilibrium concentration *Konsentrasie by ewewig* ($mol \cdot dm^{-3}$)	4x	2,0-2x	1,0-x

Use ratio 4:2:1 ✓
Gebruik verhouding

n at equilibrium ✓
n by ewewig

At equilibrium, AO_2 is 10% decomposed. */ By ewewig, AO_2 word 10% ontbind.*

$\therefore [A_2O_3]_{eq}$ = 10 % of 2,0 ✓ Use 10 % decomposition / *Gebruik 10% ontbinding*

$\therefore$ 2,0 – 2x ✓= $\frac{10}{100}$ x 2,0

x = 0,9 $mol \cdot dm^{-3}$

OR / *OF*

$[O_2]$ = 10% of 1

$\therefore 1 - x = \frac{10}{100} \times 1$

x = 0,9 $mol \cdot dm^{-3}$

Marking criteria /*Nasienriglyne*:

- Use ratio 4:2:1 ✓
- $n(O_2)_{eq} = n(O_2)_{ini} - n(O_2)_{change} = 1,0 - x$
- $n(A_2O_3)_{eq} = n(A_2O_3)_{ini} - n(A_2O_3)change$
  $= 2,0 - 2x$
- $n(AO_2)_{eq} = n(AO_2)_{ini} + n(AO_2)_{change}$
  $= 0 + 4x$

✓

- Use 10% of decomposition ✓
- Equilibrium concentrations of all substances ✓✓✓

Therefore at equilibrium: / *Dus by ewewig:*

$[AO_2] = 4(0,9) = 3,6\ mol \cdot dm^{-3}$ ✓

$[A_2O_3] = 2,0 - 2(0,9) = 0,20\ mol \cdot dm^{-3}$ ✓

$[O_2] = 1,0 - 0,9 = 0,10\ mol \cdot dm^{-3}$ ✓

Positive marking from **x**
*Positiewe nasien vanaf **x***

(6)

5.3 5.3.1 COLOURLESS ✓ *KLEURLOOS* (1)

5.3.2 (Negative marking from 5.3.1) / *(Negatiewe nasien vanaf 5.3.1)*

Decreasing the volume will increase the pressure.
Reaction will reduce the stress on the system by favouring the reaction that will reduce the pressure, i.e. less number of moles ✓

Reaction will favour the forward reaction / production of $A_2O_{3(g)} + O_{2(g)}$ / decomposition of $AO_{2(g)}$ ✓
More product / colourless gases will reduce the intensity of the mixture's reddish-brown colour ✓

Vermindering van volume sal die druk verhoog.
Reaksie sal die versteuring teenwerk om die sisteem deur die reaksie te bevoordeel wat die druk sal verminder, dit is minder aantal mol.

Die reaksie sal die voorwaartse reaksie bevoordeel / produksie van $A_2O_3(g) + O_2(g)$ / ontbinding van $AO_2(g)$
Meer produkte / kleurlose gasses al die intensiteit van diemengsel se rooi-bruin kleur verminder. (3)
[12]

QUESTION / *VRAAG* 6

6.1 An acid is a substance that donates a proton. ✓✓
Or
An acid is a proton donor.
'n Suur is 'n stof wat 'n proton skenk.
Of
'n Suur is 'n protonskenker. (2)

6.2 HPO_4^{2-} ✓ (1)

6.3 6.3.1 Bromothymol blue. ✓ / *broomtimolblou* (1)

6.3.2 Strong acid + strong base ✓ pH range is between 6 and 7,6 ✓
Sterk suur + sterk basis *pH reeks is tussen 6 en 7,6* (2)

6.3.3

OPTION / *OPSIE* 1

$$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}\checkmark$$

$$\frac{(0,1)(15)\checkmark}{c_b(20)\checkmark} = \frac{1}{2}\checkmark$$

$$c_b = 0,15 \text{ mol}\cdot\text{dm}^{-3}\checkmark$$

OPTION / *OPSIE* 2

$$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}\checkmark$$

$$\frac{(0,1)(\frac{15}{1000})\checkmark}{c_b(\frac{20}{1000})\checkmark} = \frac{1}{2}\checkmark$$

$$c_b = 0,15 \text{ mol}\cdot\text{dm}^{-3}\checkmark$$

(5)

6.3.4

Option / *Opsie* 1

$pOH = - \log [OH^-]$ ✓

$pOH = - \log (0,15)$ ✓

$pOH = -(-0,82)$

$pOH = 0,82$

$pH + pOH = 14$ ✓

$pH = 14 - pOH$

$pH = 14 - 0,82$ ✓

$pH = 13,18$ ✓

The pH of a 0,15 M solution of potassium hydroxide is 13,18.
Die pH van 'n 0,15 M oplossing van kaliumhidroksies is 13,18.

Option / *Opsie* 2

$KOH = 0,15 \text{ mol·dm}^{-3}$

$[OH^-][H_3O^+] = 10^{-14} = K_w$ ✓

$[H_3O^+] = \frac{10^{-14}}{0,15}$ ✓

$= 6,67 \times 10^{-14} \text{ mol·dm}^{-3}$

$pH = -\log[H_3O^+]$ ✓

$= - \log (6,67 \times 10^{-14})$ ✓

$= 13,18$ ✓

(5)

6.4 6.4.1 Hydrolysis ✓ *Hidroliese* (1)

6.4.2 SMALLER THAN 7 ✓ *KLEINER AS 7* (1)

6.4.3 Hydrolysis of the salt of <u>a strong acid and a weak base</u> ✓ results in an acidic solution.
Hidroliese van die sout van 'n sterk suur en 'n swak basis eindig in 'n suur oplossing. (1)

[19]

QUESTION / *VRAAG* 7

7.1 Copper ✓ / *Koper* (1)

7.2 The negative terminal ✓ / *Die negatiewe terminal* (1)

7.3 Reduced ✓ / *gereduseer* (1)

7.4 $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ ✓ (1)

7.5 <u>Electrons must be constantly supplied</u> <u>by the</u> <u>negative terminal</u> ✓ of the battery/power source and <u>cannot alternate between terminals</u>. ✓ If <u>AC is used no plating</u> will occur ✓ / Plating will continuously occur on both.
Elektrone moet constant toegevoeg word tot die negatiewe terminaal van die battery / kragbron en kan nie wissel tussen terminale nie. Indien WS gebruik word sal geen platering plaasvind nie / platering sal plaasvind op beide gelyktydig. (3)

[7]

QUESTION / *VRAAG* 8

8.1 8.1.1 $Ag_{(s)} \mid Ag^{+}_{(aq)}(1\ mol{\cdot}dm^{-3})$ ✓||✓ $Co^{3+}_{(aq)}(1\ mol{\cdot}dm^{-3})|Co^{2+}_{(aq)}$ ✓$(1\ mol{\cdot}dm^{-3})$
(Do not penalise if phases and standard conditions are omitted.)
(Moet nie penaliseer indien fases en standaardtoestande uitgelaat is nie) (3)

8.1.2 $Co^{3+}_{(aq)}$ ✓ (1)

8.1.3 $Co^{3+}_{(aq)} + e^{-} \rightarrow Co^{2+}_{(aq)}$ ✓ (1)

Marking guidelines */Nasienriglyne*:
$Co^{2+}_{(aq)} \leftarrow Co^{3+}_{(aq)} + e^{-}$ 1/1

If double arrow, no marks
Indien dubbel pyle, geen punte.

8.2 8.2.1 To determine the standard electrode potential of another half-cell. ✓
Om die standard electrode potensiaal van 'n ander halfsel te bereken. (1)

8.2.2 Platinum (Pt) ✓ (1)

8.2.3 Complete the circuit / allow ions to move / maintain electrical neutrality / keep the electrolytes separate. ✓
Voltooi die stroombaan / laat ione toe om te vloei / handhaaf elektriese neutraliteit / hou die elektroliete appart. (1)

8.2.4 Metal M is chromium (Cr). ✓✓ *Metaal M is chroom (Cr)* (2)

8.2.5 $2Cr + 6H^{+} \rightarrow 2Cr^{3+} + 6H_2$ ✓ reactants; ✓ products; ✓ balancing
Reaktante produkte balansering (3)

8.2.6 DECREASE ✓ / *VERMINDER*

An increase in $[Cr^{3+}]$ will <u>affect the equilibrium to the left</u>, decreasing the concentration of products and increasing the concentration of reactants. This <u>will result in a decrease</u> in V_{cell}. ✓

'n Toename in $[Cr^{3+}]$ sal die ewewig na links affekteer, vermindering van die konsentrasie van produkte en vermeerdering van die konsentrasie van die reaktante. Dit veroorsaak 'n afname in V_{sel}. (2)

8.2.7 0 V ✓ (1)

8.2.8 H_2 is flammable ✓, H^{+} (or H_3O^{+}) is an acid which is corrosive. ✓
H_2 is vlambaar, H^{+} (of H_3O^{+}) is 'n suur wat vretend is. (2)

[18]

QUESTION 9 / *VRAAG 9*

9.1 9.1.1 $2NO + O_2 \rightarrow 2NO_2$
✓ reactants ✓ products ✓ balancing
Reaktante produkte balansering (3)

9.1.2 Catalytic Oxidation of Ammonia ✓ / *Katalitiese oksidasie van ammoniak* (1)

9.1.3 HNO_3 ✓ (1)

9.2 9.2.1 $(NH_4)_2SO_4$ / ammoniumsulphate ✓ / *ammoniumsulfaat* (1)

9.2.2 NH_4NO_3 / ammoniumnitrate ✓ / *ammoniumnitraat* (1)

9.3 Any TWO. ONE ✓ each: *Enige TWEE. EEN punt elk:*

- Nitrogen saturation of soil leads to washing away of other nutrients needed in the soil, into the rivers and dams.
- Washing of top soil into lakes / rivers / dams causes it to become acidic.
- Build up of nitrates in rivers (eutrophication) causes algae bloom that depletes oxygen causing aqueous life to die.
- Build up of nitrates in drinking water can cause death of infants due to hemoglobin deficiency.
- Ground water can become acidic.
- Promotes growth of alien plants in dams and rivers.
- Water poisoning / blue baby syndrome / nitrates potentially carcinogenic
- *stikstof versadiging van grond lei tot die weg wassery van ander nutrient benodig in die grond na die riviere en damme.*
- *was van bo-grond na die mere / riviere / damme veroorsaak dat dit suur word.*
- *opbou van nitrate in riviere (eutrifikasie) veroorsaak dat alge groei wat suurstof neem uit die water en diere en plante in water laat sterf.*
- *grondwater word suur.*
- *bevorder groei van uitheemse plante in damme en riviere.*
- *water vergiftiging / blou baba sindroom / nitrate potensiaal karsinogenies* (2)

9.4 9.4.1 The N : P : K gives the proportion / ratio of nitrogen, phosphorus and potassium in a fertilizer. ✓
Die N : P : K verhouding gee die verhouding van stikstof, fosfor en kalium in die kunsmis. (1)

9.4.2 4 : 5 : 8 ✓ (1)

9.4.3 Lower N. ✓ This is to prevent too much leaf growth, at the cost of fruit growth. ✓
Laer N. Dit is om te voorkom dat te veel blare groei ten koste van vrugte. (2)

9.4.4 Fertilizer D (*Kunsmis D)* 8/17 x 25 = 11,77% ✓
Fertilizer E *(Kunsmis E)* 9/27 x 20 = 6,67% ✓
Thus Fertilizer D ✓ (If only fertilizer D given as answer 1/3)
Dus Kunsmis D (Indien slegs kunsmis D gegee as antwoord 1/3) (3)

[16]

TOTAL / *TOTAAL*: 150