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DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS
LEFAPHA LA THUTO
ISEBE LEZEMFUNDO

**PROVINCIAL PREPARATORY EXAMINATION
PROVINSIALE VOORBEREIDINGSEKSAMEN/**

GRADE/GRAAD 12

**PHYSICAL SCIENCES P2: CHEMISTRY
FISIESE WETENSKAPPE V2: CHEMIE
MARKING GUIDELINES/NASIENRIGLYNE
SEPTEMBER 2019**

**MARKS/PUNTE: 150
TIME/TYD: 3 hours/uur**

**This memorandum consists of 17 pages./
Hierdie memorandum bestaan uit 17 bladsye.**

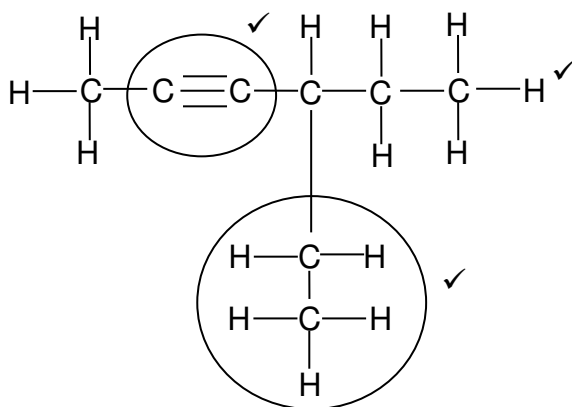
QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

- | | | |
|-------|---------------------------------------|--|
| 2.1 | | |
| 2.1.1 | E ✓ | (1) |
| 2.1.2 | A and C ✓
A en C | (1) |
| 2.2 | | |
| 2.2.1 | Propanone ✓✓
Propanoon | ACCEPT: Propan-2-one; 2-propanone
AANVAAR: Propan-2-oon; 2-propanoon
(2) |
| 2.2.2 | Ethyl✓ propanoate✓
Etielpropanoaat | (2) |
| 2.2.3 | Methanoic acid✓
Metanoësuur | (1) |

2.3



Marking Criteria/Nasien kriteria

Functional group ✓

Funksionele groep

Ethyl substituent on the fourth carbon ✓

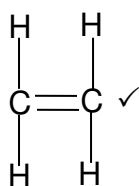
Etielsytak op die vierde koolstof

Whole structure correct ✓

Totale struktuur korrek

(3)

2.4.1



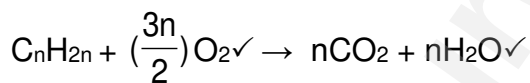
(1)

2.4.2

Addition ✓
 Addisie

(1)

2.5



$$n(O_2) = \frac{m}{M} = \frac{192}{32} = 6$$

$$\frac{3n}{2} = 6$$

$$n = 4$$

$$\therefore C_nH_{2n} = C_4H_8$$

Marking Criteria/Nasien kriteria:

Balancing reactants ✓

Balansering reaktante

Balancing Products ✓

Balansering produkte

Dividing by 32 ✓

Deel deur 32

Equating/Gelykstelling $\frac{3n}{2} = 6$ ✓

Final answer ✓

Finale antwoord

(5)

[17]

QUESTION 3/VRAAG 3

- 3.1 Boiling point increases with an increase in the number of carbons. ✓✓
Kookpunt neem toe met 'n toename in die aantal koolstof atome.
OR/OF
As the number of carbons increases, the boiling point also increases. ✓✓
Indien die aantal koolstofatome toeneem, sal die kookpunt ook toeneem. (2)
- 3.2
- 3.2.1 Higher than ✓
Hoër as (1)
- 3.2.2 ANY TWO:
ENIGE TWEE:
Hydrogen bond ✓
Waterstofbinding
Dipole-dipole force ✓
Dipool-dipool krag
London force/induced dipole-induced dipole force/dispersion force.
Londonkrag/geïnduseerde dipool-geïnduseerde dipool krag/dispersiekrag (2)
- 3.2.3
- Butan-1-ol has strong hydrogen bonds ✓ in addition to the weak london forces.
Butan-1-ol het sterk waterstofbindings saam met swak Londonkragte.
 - Butane has weak London forces. ✓
Butaan het swak Londonkragte
 - More energy needed to overcome/break the hydrogen bonds/ IMF in butan-1-ol than the London forces in butane. ✓
Meer energie is nodig om die waterstofbindings te oorkom/te breek/IMK in butan-1-ol te breek/te oorkom as die Londonkragte in butaan.
OR/OF
 - Butane has London forces/induced dipole- induced dipole forces/ dispersion forces ✓
Butaan het Londonkragte/geïnduseerde dipool-geïnduseerde dipool krag/dispersiekrag
 - Butan-1-ol has strong hydrogen bonds ✓ in addition to the weak london forces.
Butan-1-ol het sterk waterstofbindings saam met swak Londonkragte.
 - Less energy needed to overcome/break the London forces/ IMF in butane than the hydrogen bonds in butan-1-ol. ✓
Minder energie is nodig om die Londonkragte te oorkom/te breek/IMK in butaan te oorkom/te breek as die waterstofbindings in butan-1-ol.

(3)
[8]

QUESTION 4/VRAAG 4

4.1

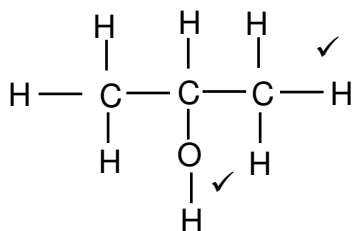
4.1.1 Hydrogenation✓
Hidrogenasie

(1)

4.1.2 Platinum, nickel/*nikkel* or/of palladium/*Pt, Ni, Pd*✓

(1)

4.2



Marking Criteria/Nasien kriteria:

Functional group on second C-2 ✓
Funksionele groep op die tweede C
Whole structure correct ✓
Totale struktuur korrek

Propan-2-ol/2- propanol✓

(3)

4.3 Secondary ✓
Sekondêre

The carbon atom bonded with -OH (hydroxyl) group is bonded to two other carbon atoms. ✓

Die koolstofatoom gebind aan die -OH (hidroksiel) groep is gebind aan twee ander koolstofatome.

(2)

4.4

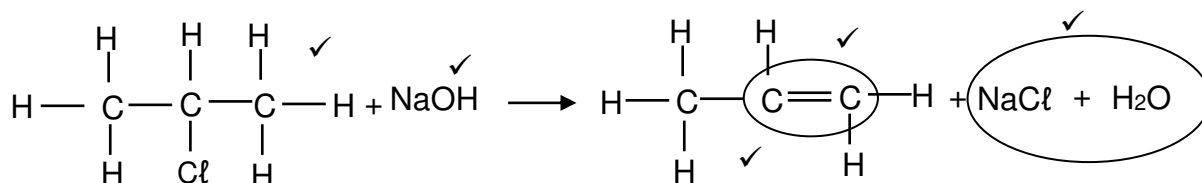
4.4.1 Concentrated sulphuric acid/ H_2SO_4 /phosphoric acid/ H_3PO_4 /heat ✓
Gekonsentreerde swawelsuur/ H_2SO_4 /fosforsuur/ H_3PO_4 /hitte

(1)

4.4.2 Prop-1-ene/Propene✓
Prop-1-een/Propeen

(1)

4.5



Marking Criteria/Nasien kriteria:

Reactants/Reaktante: 2-chloropropane ✓
 2-chloropropaan
 NaOH ✓

Products/Produkte:

Double bond on prop-1-ene ✓
 Dubbelbinding op prop-1-ene ✓
 Whole structure of prop-1-ene correct ✓
 Totale struktuur van prop-1-ene korrek ✓
 NaCl + H₂O ✓

Any additional reactants and/or products/Addisionele reaktante en/produkte: **Max. 4/5**

Molecular/condensed formulae/

Molekulêre/gekondenseerde formules: **Max. 4/5**

Missing arrow/Sonder pyl: **Max. 4/5**

Reactants only /Slegs reaktante: **Max. 2/5**

Products only /Slegs produkte: **Max. 3/5**

(5)

4.6

4.6.1 Substitution/hydrolysis ✓
 Substitusie/hidrolise

(1)

4.6.2 Dilute strong base ✓
 Verdunde sterk basis
 Mild heat ✓
 Matige hitte

(2)

[17]

QUESTION 5/VRAAG 5

5.1 ANY ONE/ ENIGE EEN

- Change in concentration of reactant/product per (unit) time. ✓✓
Verandering in konsentrasie van reaktant/produk per (eenheid) tyd.
- Rate of change in concentration.
Tempo van verandering in konsentrasie
- Change in amount/number of moles/volume/mass of products or reactants per (unit) time
Verandering in hoeveelheid/aantal mol/volume/massa van produkte of reaktante per (eenheid) tyd
- Amount/number of moles/volume/mass of products formed or reactants used per (unit) time.
Hoeveelheid/aantal mol/volume/massa van produkte gevorm of reaktante opgebruik per (eenheid) tyd. (2)

5.2

- 5.2.1 Surface area/state of division ✓
Oppervlak area/toestand van verdeling (1)

5.2.2 ANY ONE/ ENIGE EEN

- Concentration of the acid ✓
Konsentrasie van die suur
Temperature of the acid
Temperatuur van die suur
Mass of the sodium carbonate
Massa van die natriumkarbonaat (1)

- 5.3 Carbon dioxide/CO₂ ✓
Koolstofdioksied/CO₂ (1)

- 5.4 90 seconds ✓
90 sekondes (1)

5.5 Greater than ✓
Groter as

- In experiment 2, the sodium carbonate has a greater surface area which means more reaction sites. ✓
In eksperiment 2 het die natriumkarbonaat 'n groter oppervlak wat meer plekke waar reaksies kan plaasvind beteken.

OR/OF

More particles with correct orientation/more contact points
Meer deeltjies met die regte oriëntering/meer kontakpunte.

- There will be more effective collisions per unit time in experiment 2 than in experiment 1. ✓
Daar sal meer effektiewe botsings per tydseenheid wees in eksperiment 2 as in eksperiment 1.

(3)

5.6

5.6.1 Mass of CO₂ formed/Massa CO₂ gevorm = 150 -145,60 ✓
= 4,4 g

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

$$n = \frac{4,4}{44} \checkmark$$

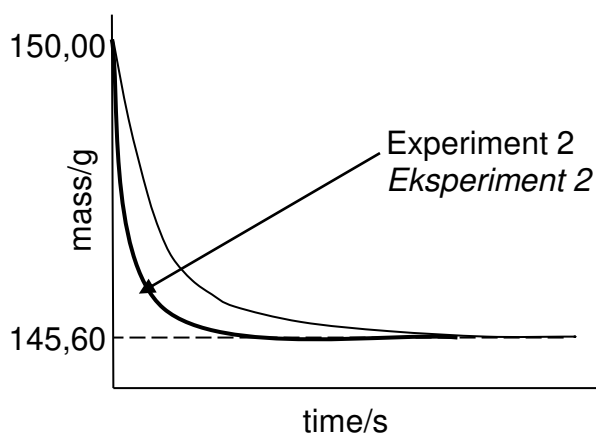
$$n = 0,1 \text{ moles/mol}$$

$$n(\text{CO}_2) : n(\text{Na}_2\text{CO}_3) = 1:1 \checkmark$$

$$\begin{aligned} m(\text{Na}_2\text{CO}_3) &= n \times M \\ &= (0,1)(106) \checkmark \\ &= 10,6 \text{ g} \checkmark \end{aligned}$$

(5)

5.6.2



Marking Criteria/Nasien kriteria:

- Graph for experiment 2 should have a steeper gradient than experiment 1. ✓

Grafiek vir eksperiment 2 moet 'n steiler helling hê as eksperiment 1.

- Time for reaction to come to completion must be shorter. ✓

Tyd vir reaksie om te voltooi moet korter wees.

(2)
[16]

QUESTION 6/VRAAG 6

- 6.1 A stage in a reversible reaction where the rate of the forward reaction equals the rate of the reverse reaction. ✓✓

'n Tydstip tydens 'n omkeerbare reaksie waar die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie.

OR/OF

The stage in a chemical reaction when the concentration/amounts of reactants and products remain constant.

Die tydstip in 'n chemiese reaksie wanneer die konsentrasie/hoeveelheid van die reaktante en produkte onveranderd bly.

(2)

- 6.2 **CALCULATIONS USING NUMBER OF MOLES**
BEREKENINGE WAT AANTAL MOL GEBRUIK

Mark allocation/Punte toekenning:

- Change $n(\text{H}_2)$ ✓
Verandering $n(\text{H}_2)$
- Ratio to determine $n(\text{CO})$ reacted and $n(\text{CH}_3\text{OH})$ formed = 1 : 1 ✓
Verhouding om te bepaal $n(\text{CO})$ gereageer en $n(\text{CH}_3\text{OH})$ gevorm = 1:1
- $n(\text{CO})$ & $n(\text{CH}_3\text{OH})$ at equilibrium ✓
 $n(\text{CO})$ & $n(\text{CH}_3\text{OH})$ tydens ewewig
- Divide three equilibrium amounts by 2 (calculation of concentration) ✓
Verdeel drie ewewighoeveelhede deur 2 (berekening van konsentrasie)
- K_c expression ✓
 K_c uitdrukking
- Substitution into K_c expression ✓
Vervanging in K_c uitdrukking
- Answer : $X = 0,8 \text{ mol}$ ✓
Antwoord: $X = 0,8 \text{ mol}$
- Substitution into $m = n \times M$ ✓
Vervanging in $m = n \times M$
- Final answer $m = 22,4 \text{ g}$ ✓
Finale antwoord $m = 22,4 \text{ g}$

OPTION 1/OPSIE 1:

	CO (g)	+	2 H ₂ (g)	→	CH ₃ OH(g)
	1 mole/mol		2 moles/mol		1 mole/mol
Start/begin (mol)	X		1,5		0
Reacted (mol)	0,375		0,75 ✓		0,375 ratio ✓
Equilibrium (mol)	X-0,375		0,75		0,375 ✓
Equilibrium	$\frac{X-0,375}{2}$		$\frac{0,75}{2}$		$\frac{0,375}{2}$ ✓
Concentration $c = \frac{n}{V}$ (mol·dm ⁻³)			=0,375		=0,1875

$$K_c = \frac{[\text{CH}_3\text{OH}]}{[\text{H}_2]^2[\text{CO}]} \checkmark$$

$$6,27 = \frac{0,1875}{[0,375]^2 \left[\frac{X - 0,375}{2} \right]} \checkmark$$

$$x = 0,8 \text{ mol} \checkmark$$

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

$$m = (0,8)(28) \checkmark$$

$$m = 22,4 \text{ g} \checkmark$$

OPTION 2 (USING CONCENTRATIONS)/OPSIE 2 (GEBRUIK VAN KONSENTRASIES)

	CO (g)	+	2 H ₂ (g)	→
	CH ₃ OH(g)			
Ratio/Verhouding	1		2	1
Initial concentration/Aanvanklike konsentrasie (mol·dm ⁻³)	$\frac{X}{2} = 0,5X$		$\frac{1,5}{2} = 0,75$	0 ✓
Change in concentration/Verandering in konsentrasie (mol·dm ⁻³)	0,1875		0,375 ✓	0,1875 ratio ✓
Equilibrium Concentration/Ewewigskonsentrasie (mol·dm ⁻³)	0,5X - 0,1875		$\frac{0,75}{2} = 0,375$	0,1875

$$K_c = \frac{[\text{CH}_3\text{OH}]}{[\text{H}_2]^2[\text{CO}]} \checkmark$$

$$K_c = \frac{[0,1875]}{[0,375]^2 [0,5X - 0,1875]} \checkmark$$

$$x = 0,8 \text{ mol} \checkmark$$

Initial mass of CO injected in the container/Aanvanklike massa CO toegevoeg tot houer (m) = nxM

$$m = (0,8)(28) \checkmark$$

$$m = 22,4 \text{ g} \checkmark$$

(9)

6.3

$$\left. \begin{aligned} K_c(\text{ reverse reaction/terugwaartse reaksie}) &= \frac{1}{K_c(\text{ forward reaction})} \\ K_c(\text{ reverse reaction/terugwaartse reaksie}) &= \frac{1}{6,27} \\ K_c(\text{reverse reaction/terugwaartse reaksie}) &= 0,16 \end{aligned} \right\} \checkmark$$

NOTE Give 2 marks if the learners write only the correct answer.

NB Gee 2 punte as die leerders slegs die korrekte antwoord gegee het. (2)

6.4

6.4.1 Remains the same ✓

Bly dieselfde

The temperature is constant, K_c value is only affected by a change in temperature. ✓

Die temperatuur is konstant, K_c se waarde word slegs beïnvloed deur 'n verandering in temperatuur. (2)

6.4.2 Decreases ✓

Neem af.

A larger volume (results in a lower pressure which) will favour the reaction producing a larger number of moles ✓ / reverse reaction is favoured.

'n Groter volume (het tot gevolg 'n verlaagde druk) sal die reaksie bevoordeel wat 'n groter aantal mol sal produseer/terugwaartse reaksie word bevoordeel. (2)

6.5 Decreases ✓

Neem af

A decrease in temperature favours the exothermic reaction. ✓ The reverse reaction will be favoured. ✓

'n Afname in temperatuur bevoordeel die eksotermiese reaksie. Die terugwaartse reaksie word bevoordeel. (3)

[20]

QUESTION 7/VRAAG 7

7.1 An acid is a proton donor. ✓✓

'n Suur is 'n protonskenker.

(2)

7.2 $\text{NaOH} \rightarrow \text{Na}^+ + \text{OH}^-$

0,75 mol·dm⁻³ (NaOH) gives/gee 0,75 mol·dm⁻³ OH⁻ (Ratio/Verhouding 1:1) ✓

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
pOH = - log [OH ⁻] ✓	[H ⁺][OH ⁻] = 10 ⁻¹⁴
pOH = - log[0,75] ✓	[H ⁺][0,75] = 10 ⁻¹⁴ ✓
pOH = 0,1249	[H ⁺] = 1,3333x10 ⁻¹⁴ mol·dm ⁻³
pH + pOH = 14	pH = - log [H ⁺] ✓
pH + 0,1249 = 14 ✓	pH = - log [1,3333x10 ⁻¹⁴] ✓
pH = 13,88 ✓	pH = 13,88 ✓

(5)

7.3 n_{initial/aanvanklik} (HCl)

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

n_{initial/aanvanklik} = cV

$$= (0,5) (0,075) \checkmark$$

$$= 0,0375 \text{ moles}$$

For the reaction between HCl (excess) and NaOH/Vir die reaksie tussen HCl (oormaat) en NaOH

n(NaOH) reacted/gereageer n = cV

$$n = 0,75 \times 0,022 \checkmark$$

$$n = 0,0165 \text{ moles}$$

$$n(\text{NaOH}) : n(\text{HCl}) = 1:1$$

n_{excess/oormaat} (HCl) = 0,0165 moles ✓ (ratio/verhouding)

n_{reacted/gereageer} (HCl) with/met CaCO₃

$$n = 0,0375 - 0,0165 \checkmark$$

$$n = 0,021 \text{ moles/mol}$$

$$n_{\text{reacted/gereageer}}(\text{CaCO}_3) = \frac{1}{2} \times 0,021 = 0,0105 \text{ moles/mol}$$

$$m = n \times M$$

$$m = (0,0105)(100) \checkmark$$

$$m = 1,05 \text{ g}$$

$$\% \text{ CaCO}_3 = \frac{1,05}{5} \times 100 \checkmark$$

$$= 21 \% \checkmark$$

(8)

[15]

QUESTION 8/VRAAG 8

- 8.1 Salt bridge.✓
Soutbrug. (1)
- 8.2 Standard hydrogen electrode.✓
Standaard waterstofelektrode. (1)
- 8.3 Provides a surface for the transfer of electrons/Allows conduction.✓
Voorsien 'n oppervlakte vir die oordrag van elektrone/Laat geleiding toe. (1)
- 8.4 $\text{Mg (s)} \mid \text{Mg}^{2+} \text{ (aq)} \parallel \text{I}_2 \text{ (g)} \mid \text{I}^- \text{ (aq)} \mid \text{Pt}$ ✓ (3)
- 8.5 $E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}}$ ✓
 $E^\theta_{\text{sel}} = E^\theta_{\text{katode}} - E^\theta_{\text{anode}}$
 $E^\theta_{\text{cell/sel}} = 0,54 - (-2,36)$ ✓
 $E^\theta_{\text{cel/sel}} = 2,90 \text{ V}$ ✓
 E^θ_{cell} is less than 3 V so the bulb will not glow to its maximum brightness. ✓
 E^θ_{sel} is minder as 3 V en die gloeilamp sal nie gloei teen sy maksimum helderheid nie. (5)
- 8.6 The bulb will switch off/it will no longer glow at all.✓
Die gloeilamp sal afskakel/dit sal nie langer brand nie.
The cell potential will be 0 V.✓
Die selpotensiaal sal 0 V wees. (2)

[13]

QUESTION 9/VRAAG 9

- 9.1 Electrical energy to chemical energy. ✓ (1)
Elektriese energie na chemiese energie.
- 9.2. $2\text{O}^{2-}(\text{l}) \rightarrow \text{O}_2(\text{g}) + 4\text{e}^-$ ✓ **OR/OF** $2\text{O}^{2-}(\text{l}) + \text{C}(\text{s}) \rightarrow \text{O}_2(\text{g}) + 4\text{e}^-$ (2)
- 9.3 They undergo a combustion reaction and get used up. ✓✓
Hulle ondergaan 'n verbrandingsreaksie en word opgebruik.
ACCEPT/AANVAAR:
They get burnt. ✓✓ (since they react with oxygen at a high temperature)
Hulle verbrand. (aangesien hulle met suurstof reageer by hoë temperatuur) (2)
- 9.4 To reduce the working temperature ✓ and hence save on extraction cost.
Om die werkende temperatuur te verlaag en om sodoende ekstraksiekoste te bespaar. (1)
- 9.5 ANY TWO/ENIGE TWEE (Consider any other reasonable answers from learners/Oorweeg enige ander redelike antwoord van die leerders.)
- Excessive CO_2 (which is a green house gas) is formed during the extraction process and this causes global warming. ✓
Oormaat CO_2 (wat 'n kweekhuysgas is) word gevorm gedurende die ekstraksieproses en dit veroorsaak Aardverwarming.
 - The CO_2 formed can also react with water when it rains and this causes acid rain which corrodes buildings and damages plants. ✓
Die gevormde CO_2 kan ook met water reageer wanneer dit reën en dit veroorsaak suurreën wat geboue verweer en plante beskadig.
 - The electricity used in the extraction process is generated from the burning of coal which pollutes the environment and depletes a non renewable energy source.
Die elektrisiteit wat gebruik word gedurende die ekstraksieproses word opgewek deur die verbranding van steenkool wat besoedeling van die omgewing veroorsaak en 'n nie-hernubare energiebron uitput.
 - The plant requires a very large landscape so people might be moved from their places of origin **OR** massive deforestation can occur in order to accommodate the plant.
*Die aanleg benodig 'n baie groot gebied en mense word sodoende verskuif van hulle oorspronklike blyplekke **OF** grootskaalse ontbossing kan gebeur om die aanleg te akkomodeer.*
 - Red mud used in the extraction process can contaminate underground water reserves.
Rooi modder wat gebruik word gedurende die ekstraksie kan die ondergrondse waterreserwes besoedel. (2)

[8]

QUESTION 10/VRAAG 10

- 10.1.1 Nitrogen (gas) ✓
 Stikstof (gas) (1)
- 10.1.2 Haber process ✓
 Haberproses (1)
- 10.1.3 Ammonium sulphate/(NH₄)₂SO₄ ✓
 Ammoniumsulfaat/(NH₄)₂SO₄ (1)
- 10.1.4 Nitrogen dioxide/NO₂ ✓
 Stikstofdoksied/NO₂ (1)
- 10.2 3NO₂ + H₂O ✓ → 2HNO₃ + NO ✓ (balancing/balansering) ✓ (3)

10.3

10.3.1

OPTION 1/OPSIE 1

Using NPK ratios: P:K = 2:1
 Gebruik NPK verhoudings

$$m(P) = \frac{2}{1} \times 1,2$$

$$m(P) = 2,4 \text{ kg}$$

$$m(N) = \frac{7}{1} \times 1,2$$

$$m(N) = 8,4 \text{ kg}$$

$$m(\text{fertiliser/kunsmis}) = 1,2 + 2,4 + 8,4 = 12 \text{ kg} \checkmark$$

$$\% \text{ fertiliser/kunsmis} = \frac{12}{50} \times 100 \checkmark$$

$$\% \text{ fertiliser} = 24\%: X = 24 \checkmark$$

Any One ✓

OPTION 2/OPSIE 2

Using NPK ratios
 Gebruik NPK verhoudings

NP: K = 9:1

$$m(NP) = \frac{9}{1} \times 1,2 \checkmark$$

$$m(NP) = 10,8 \text{ kg}$$

$$m(NPK) = 10,8 + 1,2$$

$$m(\text{fertiliser/kunsmis}) = 12 \text{ kg} \checkmark$$

$$\% \text{ fertiliser/kunsmis} = \frac{12}{50} \times 100 \checkmark$$

$$\% \text{ fertiliser/kunsmis} = 24\%$$

$$X = 24 \checkmark$$

OPTION 3/OPSIE 3

If 100% fertiliser/Indien 100% kunsmis

$$m(K) = \frac{1}{10} \times 50 \checkmark$$

$$m(K) = 5 \text{ kg} \checkmark$$

$$m(K) = \frac{1,2}{5} \times 100 \checkmark$$

$$X = 24\% \checkmark$$

(4)

10.3.2 No.✓

Nee

The chosen fertilizer contains too much nitrogen.✓

Die gekose kunsmis bevat te veel stikstof.

This will make the leaves of the maize plant grow big and green and not promote the actual growth of the maize crop.✓

Dit sal veroorsaak dat die blare van die mielieplant groot en groen groei en sal nie die eintlike groei van die mielie-oes bevoordeel nie.

(3)

10.4 Use organic fertilisers like manure in place of inorganic fertilisers. ✓

Gebruik organiese misstowwe soos beesmis in plaas van kunsmis.

Avoid putting too much or excessive inorganic fertilisers. ✓

Moet nie te veel anorganiese kunsmisstowwe gebruik nie.

(2)

[16]

GRAND TOTAL/GROOTTOTAAL: 150