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)

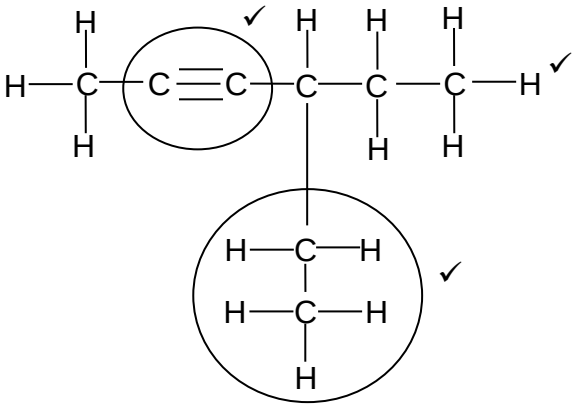
2.1.2 A and C ✓
A en C (1)

2.2
2.2.1 Propanone ✓✓ ACCEPT: Propan-2-one; 2-propanone
Propanoon *AANVAAR: Propan-2-oon; 2-propanoon* (2)

2.2.2 Ethyl✓ propanoate✓
Etielpropanoaat (2)

2.2.3 Methanoic acid✓
Metanoësuur (1)

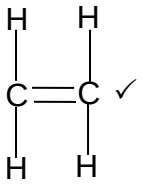
2.3



Marking Criteria/*Nasien kriteria*
Functional group✓
Funksionelegroep
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✓
Addissie (1)

2.5

$C_nH_{2n} + (\frac{3n}{2})O_2$✓ $\rightarrow$ $nCO_2 + nH_2O$✓

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

$\frac{3n}{2} = 6$ ✓

$n = 4$

$\therefore C_nH_{2n} = C_4H_8$✓

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.

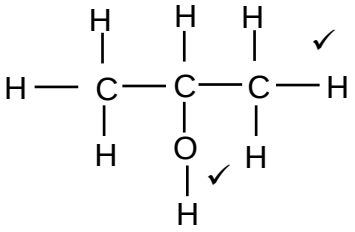
(3)
[8]

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

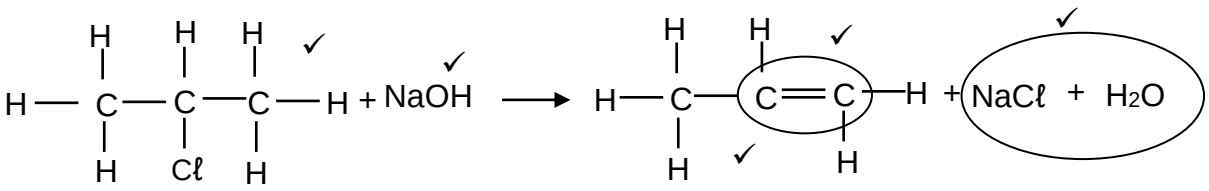
Propan-2-ol/2- propanol✓ (3)

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-een
Whole structure of prop-1-ene correct ✓
Totale struktuur van prop-1-een korrek
$NaC\ell + H_2O$✓
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 ✓ (2)
Matige hitte **[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/CO_2 ✓
Koolstofdioksied/CO_2 (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 CO_2 formed/*Massa CO_2 gevorm* = 150 -145,60 ✓
= 4,4 g

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

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

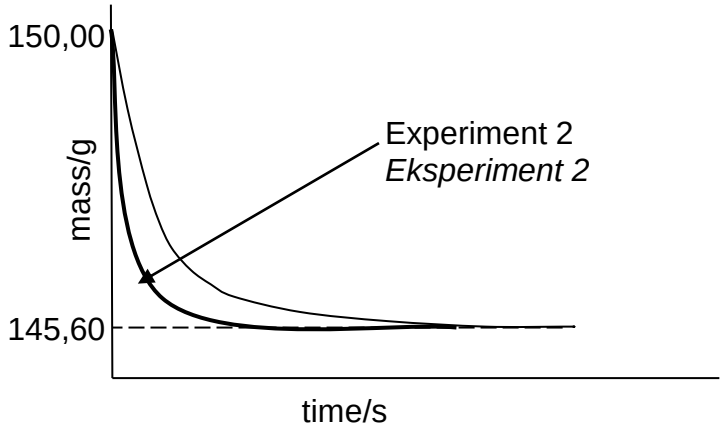
$$n = 0,1 \text{ moles/}mol$$

$$n(CO_2) : n(Na_2CO_3) = 1:1 \checkmark$$

$$m(Na_2CO_3) = n \times M$$
$$= (0,1)(106) \checkmark$$
$$= 10,6 \text{ g} \checkmark$$

(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 konsentrase/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 $n(H_2)$ ✓
  Verandering $n(H_2)$
- Ratio to determine n(CO) reacted and $n(CH_3OH)$ formed = 1 : 1 ✓
  Verhouding om te bepaal n(CO) gereageer en n (CH_3OH) gevorm=1:1
- n(CO) & $n(CH_3OH)$ at equilibrium ✓
  n(CO) & $n(CH_3OH)$ 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 mol ✓
  Antwoord: X= 0,8 mol
- Substitution into m = n x M✓
  Vervanging in m= n x M
- Final answer m = 22,4 g✓

Finale antwoord m = 22,4 g

OPTION 1/*OPSIE 1:*

	$CO(g)$ +	$2\,H_2(g)$ →	$CH_3OH(g)$
	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 Concentration $c = \frac{n}{V}$ ($mol \cdot dm^{-3}$)	$\frac{X - 0,375}{2}$	$\frac{0,75}{2}$ =0,375	$\frac{0,375}{2}$ ✓ =0,1875

$$K_c = \frac{[CH_3OH]}{[H_2]^2[CO]}$$ ✓

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

x = 0,8 mol✓

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

m = (0,8)(28)✓

m = 22,4 g ✓

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

	$CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$		
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

$$K_c = \frac{[CH_3OH]}{[H_2]^2[CO]}$$ ✓

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

x = 0,8 mol✓

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

m = (0,8)(28)✓

m = 22,4g ✓

(9)

6.3 K_c(reverse reaction/*terugwaartse reaksie*) $= \frac{1}{Kc \text{ (forward reaction)}}$ ✓

K_c(reverse reaction/*terugwaartse reaksie*) $= \frac{1}{6,27}$ ✓

K_c(reverse reaction/*terugwaartse reaksie*) $= 0,16$ ✓

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 $NaOH \rightarrow Na^+ + OH^-$

0,75 mol·dm^{-3} (NaOH) gives/*gee* 0,75 mol·dm^{-3} OH^- (Ratio/*Verhouding* 1:1) ✓

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
pOH = - log [OH^-] ✓	$[H^+][OH^-] = 10^{-14}$
pOH = - log[0,75] ✓	$[H^+][0,75] = 10^{-14}$ ✓
pOH = 0,1249	$[H^+] = 1,3333 \times 10^{-14}$ mol·dm^{-3}
pH + pOH = 14	pH = - log $[H^+]$ ✓
pH + 0,1249 = 14✓	pH = - log $[1,3333 \times 10^{-14}]$✓
pH = 13,88✓	pH = 13,88✓

(5)

7.3 $n_{initial/aanvanklik}$ (HCℓ)

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

$n_{initial/aanvanklik} = cV$
$= (0,5)(0,075)$✓
$= 0,0375$ moles

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

n(NaOH) reacted/*gereageer* n = cV
n = 0,75X 0,022✓
n = 0,0165 moles

n(NaOH) : n(HCℓ) = 1:1

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

$n_{reacted/gereageer}$ (HCℓ) with/*met* $CaCO_3$
n= 0,0375-0,0165✓
n=0,021moles/*mol*

$$n_{reacted/gereageer}(CaCO_3) = \frac{1}{2} \times 0,021 = 0,0105 \text{ moles/}mol$$

m = n x M
m = (0,0105)(100)✓
m =1,05 g

$$\% CaCO_3 = \frac{1,05}{5} \times 100 \checkmark$$
$$= 21\% \checkmark$$

(8)
[15]

QUESTION 8/*VRAAG 8*

8.1 Salt bridge.✓
Soutbrug. (1)

8.2 Standard hydrogen electrode.✓ (1)
Standaard waterstofelektrode.

8.3 Provides a surface for the transfer of electrons/Allows conduction.✓ (1)
Voorsien 'n oppervlakte vir die oordrag van elektrone/Laat geleiding toe.

8.4 $Mg\ (s) \mid Mg^{2+}\ (aq)$ ✓ ||✓ $I_2\ (g) \mid I^-\ (aq) \mid Pt$✓ (3)

8.5 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓
$E^0_{sel} = E^0_{katode} - E^0_{anode}$
$E^{\theta}_{cell/sel} = 0,54$✓$- (-2,36)$✓
$E^{\theta}_{cel/sel} = 2,90$ 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. $2O^{2-}(\ell)$✓$\rightarrow O_2(g) + 4e^-$✓ **OR/*OF*** $2O^{2-}(\ell) + C(s) \rightarrow O_2(g) + 4e$ (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 kweekhuisgas 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/$(NH_4)_2SO_4$ ✓
Ammoniumsulfaat/$(NH_4)_2SO_4$ (1)

10.1.4 Nitrogen dioxide/NO_2✓
Stikstofdioksied/NO_2 (1)

10.2 $3NO_2 + H_2O$ ✓ $\rightarrow 2HNO_3 + NO$ ✓ (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 kg
m(N) = $\frac{7}{1} \times 1,2$
Any One✓
m (N) =8,4 kg

m (fertiliser/*kunsmis*) = 1,2 + 2,4 +8,4
= 12 kg✓

% fertiliser/*kunsmis* = $\frac{12}{50} \times 100$ ✓
% fertiliser = 24%: X = 24✓

OPTION 2/*OPSIE 2*

Using NPK ratios
Gebruik NPK verhoudings
NP: K = 9:1

m (NP)= $\frac{9}{1} \times 1,2$ ✓
m (NP) =10,8 kg
m (NPK) =10,8 + 1,2
m (fertiliser/*kunsmis*) = 12 kg✓

% *fertiliser/kunsmis* = $\frac{12}{50} \times 100$ ✓

% fertiliser/*kunsmis* = 24%

X = 24✓

OPTION 3/*OPSIE 3*

If 100% fertiliser/*Indien 100% kunsmis*

m (K)= $\frac{1}{10} \times 50$ ✓

m (K) =5 kg✓

m (K)= $\frac{1,2}{5} \times 100$ ✓
X = 24%✓

(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