LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

SEPTEMBER 2020

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 10 pages.
Hierdie memorandum bestaan uit 10 bladsye.

QUESTION 1/*VRAAG 1*

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

QUESTION 2/*VRAAG 2*

2.1.1 Tertiary (halo-alkane) ✓ the carbon attached to the halogen/Br is attached to three other carbons✓
Tersiêre (haloalkaan) die koolstof waaraan die halogeen/Br verbind is,is aan drie ander koolstowwe verbind (2)

2.1.2 2-bromo-2-methylbutane
2-bromo-2-metielbutaan / 2-broom-2-metielbutaan

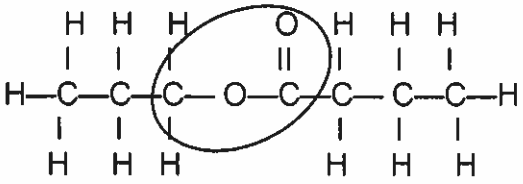
Marking criteria/*Nasienriglyne*
- Butane/butaan ✓
- **Both** substituents correct : bromo **and** methyl /Altwee substituente korrek: bromo en metiel✓
- Everything correct / Alles reg✓
(Any error e.g. hyphens omitted and/or incorrect sequence:
Enige fout, bv. koppeltekens weggelaat en/of verkeerde volgorde: Max./*Maks*: $\frac{2}{3}$) (3)

2.1.3 2-methyl-2-butene/ 2-methyl but-2-ene / *2-metiel-2-buteen / 2-metielbut-2-een*

Marking criteria/*Nasienriglyne*
- But-2-ene/2-butene/*But-2-een/2-buteen* ✓
- 2-methyl/*2-metiel*✓
Any error e.g. hyphens omitted and/or incorrect sequence:
Enige fout, bv. koppeltekens weggelaat en/of verkeerde volgorde: Max./*Maks*: $\frac{1}{2}$ (2)

2.2.1 (A series of) organic compounds which have the same general formula OR which differ from each other by a CH_2 group/unit✓✓ / *'n Homoloë reeks is 'n reeks organiese verbindings wat deur dieselfde algemene formule beskryf word* ***OF*** *waarvan die een lid van die volgende lid verskil met 'n CH_2-groep.* (2)

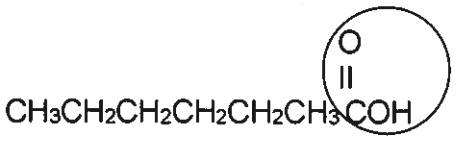
2.2.3 Esters ✓ (1)

2.2.3 

Marking criteria/*nasienriglyne*
Functional group✓
Everything else correct✓
funksionele groep
alles verder korrek (2)

(2)

2.2.4 Propanol✓ and butanoïc acid✓ / *Propanol en butanoësuur*

2.2.5 

$CH_3CH_2CH_2CH_2CH_2CH_3COH$

Marking criteria/*nasienriglyne*
Functional group✓
Everything else correct✓
funksionele groep alles verder korrek

(2)

2.3 $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$ (Reactants ✓Products ✓ Balancing✓)
(reaktante, produkte, balansering) (3)
[19]

QUESTION 3/*VRAAG 3*

3.1.1 Organic molecules with the same molecular formular✓ but different structural formule ✓/ (2)
Organiese molekule met dieselfde molekulêre formule, maar verskillende struktuurformules.

3.1.2 C_nH_{2n+2} ✓ (1)

3.1.3 Chain(isomers)✓ / *ketting(isomere)* (1)

3.2.1 The temperature✓ at which the vapour pressure of a substance equals atmospheric/external pressure✓
Die temperatuur waar die dampdruk van 'n stof gelyk is aan die atmosferiese/eksterne druk (2)

3.2.2 number of branches✓ */aantal vertakkings* (1)

3.2.3 Number of C and H atoms,/ molecular mass ✓
Aantal C en H atome,/ molekulêre massa (1)

3.2.4 **From A to C**
(Structure) Branching decreases/molecules become less compact/surface area increases (over which intermolecular forces acts)✓
(Intermolecular forces) Stronger/more intermolecular forces/Van Der Waals forces/London forces✓
(Energy) More energy needed to overcome intermolecular forces/Van Der Waals forces/ /London forces✓
Van A na C
(Struktuur) *Vertakkings verminder/molekule word minder kompak/oppervlakte (waaroor intermolekulêre kragte werk) word groter*
(Intermolekulêre kragte) *Sterker of meer intermolekulêre kragte /Van Der Waalskragte / Londonkragte*
{Energie} *Meer energie benodig om intermolekulêre kragte /Van Der Waalskragte / Londonkragte te oorkom* (3)

3.2.5 A✓
Lowest boiling point ✓/ *laagste kookpunt* (2)

3.3 Aldehydes✓/ *aldehiede* (1)

3.4 D/butan-1-ol has hydrogen bonding forces between the molecules✓
E/butanal has dipole-dipole forces between the molecules✓
Hydrogen bonds are stronger than dipole-dipole forces✓
D/butan-1-ol het waterstofbindings tussen die molekule
E/butanaal het dipool-dipoolkragte tussen die molekule
Waterstofbindings is sterker as dipool-dipool kragte (3)
[17]

QUESTION 4/*VRAAG 4*

4.1.1 Addition ✓/ hydration
Addisie / hidrasie//hidratering (1)

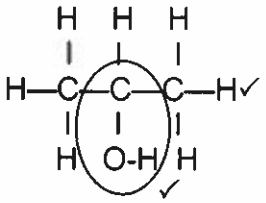
4.1.2 Substitution✓ /halogenation/ chloronation
Substitusie /halogenasie//halogenering//chloronering (1)

4.1.3 Elimination✓/dehydration
Eliminasie//dehidrasie//dehidratering (1)

4.1.4 Substitution✓
Substitusie (1)

4.2.1 H_2SO_4 / H_3PO_4 ✓ (1)

4.2.2



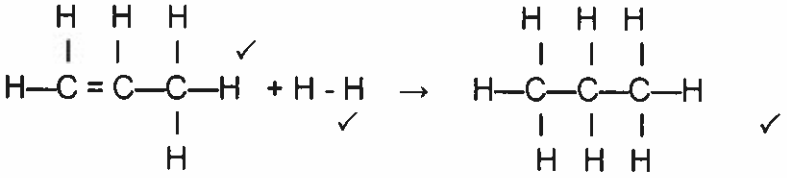
Marking criteria/*nasienriglyne*
Functional group correct✓/
Funksionele groep korrek ✓
Whole molecule correct✓/ *Molekuul korrek*
Note: Accept OH. Line (bond) must be from C to O
Aanvaar OH. Lyn (binding) moet vanaf C na O wees
(2)

4.2.3 2✓-propanol✓ / propan-2-ol

Marking criteria/*nasienriglyne*
propanol✓
Everything correct ✓/ Alles reg
(2)

4.3.1 Hydrogenation ✓/*hidrogenasie/hidrogenering* (1)

4.3.2



Accept/*aanvaar* H_2 (3)

4.4.1 2-chloro✓propane✓ / *2-chloropropaan* (2)

4.4.2 Sodium hydroxide /potassium hydroxide ✓
Natriumhidroksied/ kaliumhidroksied (1)

4.4.3 Dilute base OR adding of water ✓/*verdunde basis OF byvoeging van water*
(Mild) heat✓/(M*atige) hitte* (2)
[18]

QUESTION 5/*VRAAG 5*

5.1.1 Endothermic reaction✓ /*endotermiese reaksie* (1)

5.1.2 Energy is absorbed ✓✓ OR Energy is required for reaction to take place OR Energy is absorbed from the surroundings
Energie is geabsorbeer OF Energie word benodig vir die reaksie om plaas te vind OF Energie word geabsorbeer uit die omgewing. (1)

5.2.1 NO/gas escapes✓ OR it is not a closed system
NO/ gas ontsnap OF dit is nie 'n geslote sisteem nie (1)

5.2.2 Rate/tempo = $-\frac{\Delta m}{\Delta t}$

$= -\frac{6,3-0\checkmark}{0-105\checkmark} = 0,06\ g{\cdot}s^{-1}\ \checkmark$

(accept/*aanvaar* $-0,06\ g{\cdot}s^{-1}$) (3)

5.2.3 Reaction is completed/all Cu(reactant) is used up✓(NOT equilibrium)
Reaksie is voltooi/al die Cu(reaktante) is opgebruik (NIE ewewig nie) (1)

5.2.4 Temperature increased/heat is given off /exothermic reaction✓
Accept: HNO_3 removes CuO from Cu surface/ cleans copper surface
Temperatuur neem toe/ hitte word vrygestel/ eksotermiese reaksie
Aanvaar HNO_3 verwyder CuO vanaf Cu oppervlak/ maak Cu oppervlak skoon (1)

5.2.5 Concentration of HNO_3 decreased/ reactants are being used up✓
Konsentrasie van HNO_3 neem af /reaktanse opgebruik (1)

5.2.6 The number of particles has decreased✓ Thus fewer/less effective collisions occur per second✓
Die aantal deeltjies neem af✓ Minder effektiewe botsings vind per sekonde plaas✓ (2)

5.2.7 NO: $n = \frac{m}{M} = \frac{6,3\ \checkmark}{30} = 0,21$ mol (Accept / Aanvaar 6,2 - 6,4)

$n_{Cu} : n_{NO}$

1 : 4 $\therefore \frac{0,21}{4} = 0,052$ mol ✓(Using ratio / toepassing van verhouding)

Cu: m = nM = 0,052 x 63,5✓ = 3,30 g ✓ (4)

5.2.8 Increase the concentration of HNO_3✓
Increase the temperature of the solution✓
Use Cu powder / smaller pieces of Cu/increase the surface area of Cu ✓
Verhoog die konsentrasie van die HNO_3
Verhoog die temperatuur van die oplossing
Gebruik Cu-poeier kleiner Cu stukkies/ vergroot die reaksie oppervlak van Cu (3)

5.3

Marking guidelines/*Nasienriglyne*

- Substitution of/*vervanging van*: 0,25x0,1 ✓
- Use mol raio/ *gebruik molverhouding:* 1:2 ; 0,025:0,0125 ✓
- Formula/*formule*: $n = \frac{m}{M}$ ✓
- Substitute/*vervang:* 32✓
- Substitute/*vervang*: $\frac{0,0075}{0,0125}$ **OR/*OF*** $\frac{0,24}{0,4}$ ✓
- Final answer/*finale antwoord*: 60 %✓

$n = cV$
$= 0,25x0,1$✓
$= 0,025$ mol

HCℓ : S
2 : 1
0,025 : 0,0125 ✓

Option 1/*opsie 1*

$n = \frac{m}{M}$ ✓$= \frac{0,24}{32}$✓ $= 0,0075$ mol

% opbrengs = $\frac{0,0075}{0,0125}$ ✓x 100

= 60 % ✓

Option 2/*opsie 2*

m = nM✓
= 0,0125 x 32✓
= 0,4 g

% opbrengs = $\frac{0,24}{0,4}$ ✓x 100

= 60 %✓

(6)
[19]

QUESTION 6/*VRAAG 6*

6.1 When an external stress (change in pressure, temperature or concentration) is applied to a closed system in chemical equalibrium,✓ the equilibrium point will change in such a way as to counteract the stress.✓
Wanneer die ewewig in 'n geslote sisteem versteur word (verandering in druk,temperatuur of konsentrasie) stel die sisteem 'n nuwe ewewig in deur die reaksie wat die versteuring teëwerk te bevoordeel. (2)

6.2 Reaction producing fewer moles/ less volume of gas favoured✓
The reverse reaction is favoured✓
The amount of ozone will increase✓
Die reaksie wat minder gas vorm/ kleinervolume gas vorm word bevoordeel
Die terugwaatse reaksie word bevoordeel
Dus sal die hoeveelheid osoon vermeerder (3)

6.3.1 Reverse ✓/*terugwaarts* (1)

6.3.2 Exothermic ✓ /*eksotermies* (1)

6.3.3 Decreases✓/*verlaag* (1)

6.4 A catalyst is a chemical substance which increases the rate of a reaction✓without undergoing a permanent change itself ✓//
'n Katalisator is 'n chemiese stof wat die tempo van 'n chemiese reaksie verhoog sonder om self 'n permanente verandering te ondergaan.
OR/*OF*
A catalyst increases the rate of a reaction✓ by providing an alternative route with lower activation energy.✓ //
'n Katalisator verhoog die tempo van 'n reaksie deur 'n alternatiewe roete van laer aktiveringsenergie te verskaf. (2)

6.5 Amount of oxygen remains the same✓
A catalyst speeds up the rate of the forward and reverse reactions equally✓
Die hoeveelheid van suurstof bly dieselfde.
'n Katalisator verhoog die tempo van die voorwaarte en terugwaartse reaksies ewe vee (2)

6.6 **Mark allocation/*Puntetoekenning***

- Substitution of 0,72 mol NO at equilibrium or 0,36 mol.dm^3 if using concentrations✓/ *vervanging van 0,72 mol by ewewig of 0,36 mol·dm^{-3} as konsentrasie gebruik word.*
- Change in NO (0,54/ 1,08)/*verandering in NO(0,54/ 1,08)* ✓
- USING ratio/*GEBRUIK verhouding:* 1:1:1 ✓
- Divide or multiply by volume/*Gedeel deur of vermenigvuldig met volume* (2 dm^3) ✓
- Correct K_c expression (formulae in square brackets). ✓
  Korrekte K_c -uitdrukking (formules tussen vierkanthakies).
- Substitution of reactant and product concentrations/ *Vervanging van reaktans- en produkkonsentrasies.* ✓ (7)
- **Correct** final answer/***Korrekte*** *finale antwoord: 20,25*✓

Moles/*mol*:

	O_3	NO	O_2	NO_2
Initial moles *Aanvanklik mol*	0,6X2=1,2	0,9X2=1,8	0,73X2=1,46	0,55X2=1,10
Change */verandering*	1,08	(-) **1,08** ✓	(+) 1,08	1,08
Equilibrium *Ewewig* (moles */ mol*)	0,12	0,36X2=**0,72** ✓	2,54	2,18
Concentration *Konsentrasie*	C=n/v =0,12/2=0,06	0,36	1,27	1,09

Ratio ✓

+2✓

$$K_c = \frac{[O_2][NO_2]}{[O_2][NO]} \checkmark = \frac{(1,27)(1,09)}{(0,06)(0,36)} \checkmark = 64,09 \checkmark \quad (64,0\text{-}64,2)$$

Concentration/*konsentrasie*

	O_3	NO	O_2	NO_2
Initial moles *Aanvanklik mol*	0,6	0,9	0,73	0,55
Change *Verandering*	0,54	(-) **0,54** ✓	(+) 0,54	0,54
Concentration *Konsentrasie*	0,06	**0,36** ✓	1,27	1,09

ratio✓

$$K_c = \frac{[O_2][NO_2]}{[O_2][NO]} \checkmark = \frac{(1,27)(1,09)}{(0,06)(0,36)} \checkmark = 64,09 \checkmark \quad (64,0\text{-}64,2)$$

x2✓

(7)

6.7.1 Increases✓/ *neem toe* (1)

6.7.2 Remains the same✓/ *bly dieselfde* (1)

6.7.3 Increases✓/ *neem toe* (1)

6.7.4 Decreases✓/ *neem af* (1)

6.7.5 Remains the same ✓/ *bly dieselfde* (1)

[24]

QUESTION 7/VRAAG 7

7.1 Burette ✓/ Buret (1)

7.2 C ✓
Titration of a weak acid and strong base✓ OR
CH_3COOH is a weak acid and NaOH a strong base
T *itrasie van 'n swak suur en sterk basis OF*
CH_3COOH is 'n swak suur en NaOH "n sterk basis. (2)

7.3 Weak acids ionizes incompletely in water ✓to form a low concentration of H_3O^+ ions.✓
Swak sure ioniseer onvolledig in water om 'n lae konsentrasie H_3O^+-ione te vorm (2)

7.4 $NaOH \rightarrow Na^+(aq) + OH^-(aq)$
$[OH^-] = 0,11 mol \cdot dm^{-3}$ ✓ (1 mark for 0,11/ *1 punt vir 0,11*))

$K_w = 1x10^{-14} = [H_3O^+][OH^-]$ ✓
$1x10^{-14} = [H_3O^+](0,11)$
$[H_3O^+] = 9,09x10^{-14}$ ✓

$pH = -log[H_3O^+]$ ✓
$= - log (9,09x10^{-14})$
$= 13,04$✓

OR
$[OH^-] = 0,11 mol \cdot dm^{-3}$ ✓
$pOH = -log[OH^-]$ ✓
$= - log 0,11$
$= 0,06$ ✓
$pH = 14 – pOH$ ✓$= 14 – 0,06 = 13,04$✓ (5)

7.5 $n = c \times V$
$= 0,11 \times 0,0285$ ✓
$= 0,0031 mol$ ✓ *(0,003135)* (2)

7.6 **Positive marking from QUESTION 7.5/ *Positiewe nasien vanaf VRAAG 7.5***

$n_{acid/suur} : n_{base/basis} = 1:1$

$n_{acid/suur} = 0,0031 mol$✓

$m_{acid/suur}$ in $25cm^3 = nxM = 0,0031 \times 60 = 0,186g$ ✓

$m_{acid/suur}$ in $100 cm^3 = 0,186 \times 4$ ✓$= 0,744g$

% etanoic acid/ *etanoësuur* $= \frac{0,744}{7,5}$ ✓$\times 100 = 9,9$ % ✓(9,8 – 10) (5)

[17]

QUESTION 8/*VRAAG 8*

8.1 Diprotic ✓/Diproties (1)

8.2 $pH = -\log[H_3O^+]$
$1,6 = -\log[H_3O^+]$ ✓
$[H_3O^+] = 0,025$ ✓
$[H_2SO_4] = 0,0125\ mol \cdot dm^{-3}$ ✓ (3)

8.3.1 Reaction of a salt with water✓✓ / Die reaksie van 'n sout met water (2)

8.3.2 Acidic ✓/ Suur
$NH_4^+(aq) + H_2O$ ✓$\rightarrow NH_3 + H_3O^+(aq)$✓
$[H_3O^+]$ increases ✓/*$[H_3O^+]$ neem toe* (4)
[10]

TOTAL/ *TOTAAL*: 150