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**NATIONAL SENIOR  
CERTIFICATE/  
NASIONALE SENIOR  
SERTIFIKAAT**

**GRADE/GRAAD 12**

**JUNE/JUNIE 2022**

**PHYSICAL SCIENCES: CHEMISTRY P2  
MARKING GUIDELINE/  
FISIESE WETENSKAPPE: CHEMIE V2  
NASIENRIGLYN**

**MARKS/PUNTE: 150**

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This marking guideline consists of 13 pages./  
*Hierdie nasienriglyn bestaan uit 13 bladsye.*

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**QUESTION/VRAAG 1**

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

## QUESTION/VRAAG 2

2.1 2.1.1 Alkyne ✓ (1)

2.1.2 Haloalkane ✓ (1)

2.2 2.2.1 E ✓ (1)

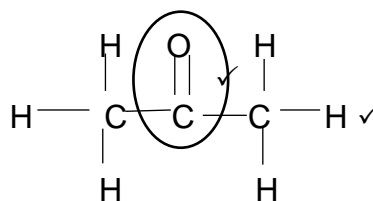
2.2.2 D ✓ (1)

2.3 2.3.1 Compound that contains carbon and hydrogen atoms only. ✓✓ (2 or 0)  
*Verbinding wat slegs koolstof- en waterstof-atome bevat. (2 of 0)* (2)

2.3.2 UNSATURATED ✓ Contains triple bond ✓/multiple bonds (between the C-atoms in die hydrocarbon chain)  
*ONVERSADIG Bevat 'n drievoudige binding/ meervoudige bindings (tussen C-atome in die koolwaterstofketting)* (2)

2.3.3 6-ethyl ✓-2-methyl ✓ oct-4-yne ✓ / 6-ethyl-2-methyl-4-octyne  
*6-etiel-2-metielokt-4-yne / 6-etiel-2-metiel-4-oktyn* (3)

2.4



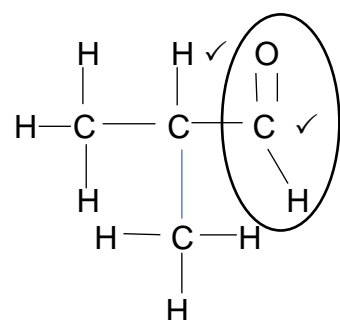
**Marking criteria/Nasienkriteria:**

- Whole structure correct/*Hele struktuur korrek: (2/2)*
- Only functional group correct  
*Slegs funksionele groep korrek Max./Maks. (1/2)*

(2)

2.5 2.5.1 Butanal ✓✓ (2)

2.5.2



**Marking criteria/Nasienriglyne**

- Whole structure correct/*Hele struktuur korrek: (2/2)*
- Only functional group correct  
*Slegs funksionele groep korrek Max./Maks. (1/2)*

(2)

2.6 2.6.1 Combustion ✓/Oxidation  
*Verbranding / Oksidasie* (1)

2.6.2  $2 \text{C}_6\text{H}_{14} + 19 \text{O}_2 \checkmark \rightarrow 12 \text{CO}_2 + 14 \text{H}_2\text{O} \checkmark$  (✓ Balancing/ *balansering*) (3)

2.6.3 Compound A reacts exothermically with oxygen / releases heat when it reacts with oxygen. ✓  
*Verbinding A reageer eksotermies met suurstof / hitte word vrygestel wanneer dit met suurstof reageer.* (1)

[22]

## QUESTION/VRAAG 3

- 3.1 3.1.1 Boiling point is the temperature ✓ at which the vapour pressure of a liquid equals the atmospheric pressure. ✓  
*Kookpunt is die temperatuur waarby die dampdruk van 'n vloeistof gelyk is aan die atmosferiese druk.* (2)
- 3.1.2 Functional group/ ✓ Homologous series/ Type of intermolecular forces.  
*Funksionele groep / Homoloë reeks / Tipe intermolekulêre kragte.* (1)
- 3.1.3 London forces ✓ / induced dipole forces / dispersion forces.  
*Londonkragte / geïnduseerde dipool kragte / verspreidingskragte.* (1)
- 3.1.4 **C** has hydrogen bonds ✓ (in addition to London forces)  
**B** has dipole-dipole forces ✓ (in addition to London forces)  
 Hydrogen bonds are stronger than dipole dipole-forces ✓  
 More energy is needed to overcome intermolecular forces in **C** ✓  
***C** het waterstofbinding (bykomend tot Londonkragte)*  
***B** het dipool-dipoolkragte (bykomend tot Londonkragte)*  
*Waterstofbindings is sterker as die dipool-dipoolkragte*  
*Meer energie word benodig om die intermolekulêre kragte te oorkom in **C***
- OR/OF**
- C** has hydrogen bonds ✓ (in addition to London forces)  
**B** has dipole-dipole forces ✓ (in addition to London forces)  
 Dipole dipole forces are weaker than hydrogen bonds ✓  
 Less energy is needed to overcome intermolecular forces in **B** ✓  
***C** het waterstofbinding (bykomend tot Londonkragte)*  
***B** het dipool-dipoolkragte (bykomend tot Londonkragte)*  
*Dipool-dipool is swakker as die waterstofbindings*  
*Minder energie word benodig om die intermolekulêre kragte te oorkom in **B*** (4)
- 3.2 3.2.1 Vapour pressure is the pressure exerted by a vapour ✓ in equilibrium with its liquid in a closed container. ✓  
*Dampdruk is die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem.* (2)
- 3.2.2  $p_1 = 100$  (kPa) ✓ / 101,3 (kPa) / 1 atmosphere / *atmosfeer* (1)
- 3.2.3 Gas ✓ **A** is above its boiling point / *Bo **A** se kookpunt* ✓ (2)
- 3.2.4 LOWER THAN/LAER AS ✓ (1)

- 3.2.5 Compound C only reached its boiling point at 117,7 °C where its vapour pressure will equal 101,3 kPa. ✓✓  
*Verbinding C bereik eers sy kookpunt by 117,7 °C waar sy dampdruk eers gelyk aan 101,3 kPa gaan wees.*

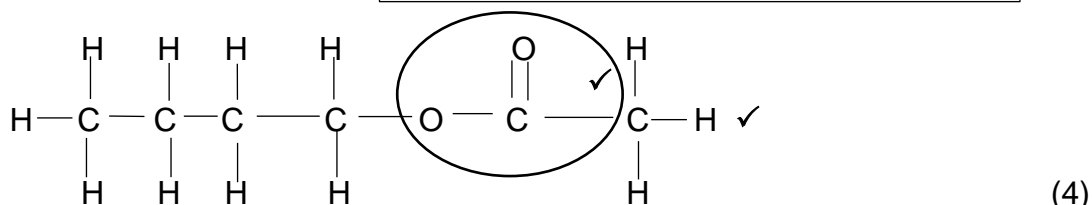
(2)  
**[16]**

## QUESTION/VRAAG 4

- 4.1 Substitution ✓/Hydrolysis (of haloalkanes)  
*Substitusie / Hidrolise (van haloalkane)* (1)
- 4.2  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$  ✓✓ (2)
- 4.3 Primary alcohol ✓  
The carbon atom that contains the hydroxyl group (-OH) is bonded to one other carbon atom only. ✓  
*Primêre alkohol*  
*Die koolstof-atoom wat die hidroksielgroep (-OH) bevat is verbind aan slegs een ander koolstof-atoom.* (2)
- 4.4 Esterification/Condensation ✓  
*Esterifikasie / Kondensasie* (1)
- 4.5 Butyl ethanoate / *Butiel-etanoaat* ✓✓

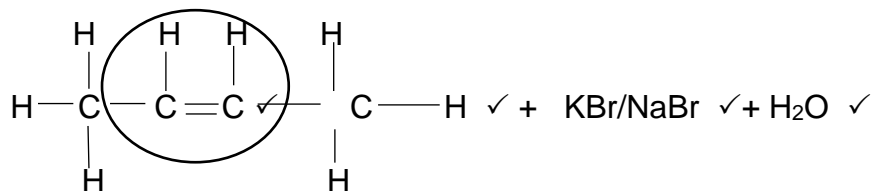
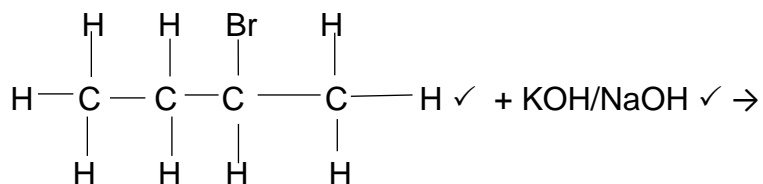
**Marking criteria/Nasienkriteria:**

- Functional group/*Funksionele groep.* ✓ (1/2)
- Whole structure correct/  
*Hele struktuur korrek* ✓ (2/2)



- 4.6 Dehydration / *Dehidrasie* ✓ (1)
- 4.7 (concentrated / *gekonsentreerde*)  $\text{H}_2\text{SO}_4$  ✓ (1)
- 4.8 Compounds with same molecular formula ✓ but different positions of the functional group ✓/side chains/substituent on the parent chain./  
*Verbindings met dieselfde molekulêre formule* maar *verskillende posisies van die funksionele groep/sykettings/substituent op die stamketting.* (2)

4.9

**Marking criteria/ Nasienkriteria****Reactants / Reaktanse**

- Organic molecule correct/ *Organiese molekule korrek* ✓
- KOH/NaOH ✓

**Products / Produkte**

- **Organic molecule / Organiese molekule**
- Functional group/*Funksionele groep.* ✓ (1/2)
- Whole structure correct/  
*Hele struktuur korrek* ✓ (2/2)

**Inorganic products / Anorganiese produkte**

- KBr/NaBr ✓
- H<sub>2</sub>O ✓

(6)  
[20]



**QUESTION 5/VRAAG 5**

- 5.1 Change in concentration ✓ per unit time. ✓ / Amount of product formed/reactant used up per unit time.  
Verandering in konsentrasie per eenheid tyd / Hoeveelheid produk gevorm / reaktanse opgebruik per eenheidstyd.

**OR/OF**

Rate of change in concentration **(2 or 0)**  
*Tempo van verandering in konsentrasie (2 of 0)* (2)

- 5.2 Concentration ✓ and a catalyst. ✓ /  
*Konsentrasie en 'n katalisator.* (2)

- 5.3 5.3.1 Concentration (of H<sub>2</sub>O<sub>2</sub>) decreases / *Konsentrasie (van H<sub>2</sub>O<sub>2</sub>) verlaag* ✓✓ (2)

- 5.3.2  $t = 5\,000\text{(s)}$  ✓ (1)

- 5.3.3 Rate/tempo =  $-\Delta c/\Delta t = - (1,0 - 0) / (0 - 5\,000)$  ✓  
 $= 2 \times 10^{-4} \text{ mol}\cdot\text{dm}^{-3}\cdot\text{s}^{-1}$  ✓ (3)

- 5.3.4  $\Delta c = 0,8 \text{ mol}\cdot\text{dm}^{-3}$

$$\begin{aligned} n(\text{H}_2\text{O}_2) &= cV \\ &= 0,8 \times (0,15) \text{ ✓} \\ &= 0,12 \text{ mol} \end{aligned}$$

$$n(\text{H}_2\text{O}_2) = n(\text{O}_2) = 0,12 \text{ mol} \text{ ✓ (Ratio / verhouding)}$$

$$n = V/V_m \text{ ✓}$$

$$0,12 = V/25\,000 \text{ ✓}$$

$$V = 3\,000 \text{ cm}^3 \text{ ✓} / (3 \text{ dm}^3) \quad (5)$$

- 5.4 5.4.1 Decrease / *Verlaag* ✓ (1)

- 5.4.2 Remains the same / *Bly dieselfde* ✓ (1)

- 5.5 5.5.1 Minimum energy required for a reaction to take place. ✓✓ /  
*Minimum energie benodig vir 'n reaksie om plaas te vind.* (2)

- 5.5.2 Particles with sufficient kinetic energy to react. ✓ /  
*Deeltjies met genoeg kinetiese energie om te reageer.* (1)

5.5.3 E<sub>2</sub> ✓

Catalyst lowers the activation energy ✓

More particles have sufficient kinetic energy to react ✓

More effective collisions per unit time ✓ / Frequency of effective collisions increases

*'n Katalisator verlaag die aktiveringsenergie.*

*Meer deeltjies het genoeg kinetiese energie om te reageer*

*Meer effektiewe botsings per eenheid tyd / Frekwensies van die effektiewe botsings neem toe*

(4)  
[24]

**QUESTION 6/VRAAG 6**

6.1 6.1.1 Reversible ✓ (reaction) / Omkeerbare (reaksie) (1)

6.1.2 HIGHER THAN / HOËR AS ✓✓ (2)

6.1.3 EQUAL TO / GELYK AAN ✓ (1)

6.2 **OPTION 1/ OPSIE 1 : MOLE OPTION / MOL OPSIE**

**Marking Criteria/ Nasienkriteria:**

- Divide by 17 to calculate  $n(\text{NH}_3)_{\text{equilibrium}}$ . ✓  
*Deel deur 17 om  $n(\text{NH}_3)_{\text{ewewig}}$  te bereken.*
- $\Delta n \text{ NH}_3$  ✓
- Use mole ratio  $\text{N}_2:\text{H}_2:\text{NH}_3$  / *Gebruik mol verhouding  $\text{N}_2:\text{H}_2:\text{NH}_3$*  ✓
- $n_{\text{equilibrium}}$  / *ewewig  $\text{N}_2$  and/en  $\text{H}_2$*  ✓
- Divide  $2 \text{ dm}^3$  all  $n_{\text{equilibrium}}$  / *Deel deur  $2 \text{ dm}^3$  in alle  $n_{\text{ewewig}}$*  ✓
- Correct  $K_c$  expression / *Korrekte  $K_c$  uitdrukking.* ✓
- Substitution into  $K_c$  expression ✓ / *Vervanging in  $K_c$  uitdrukking.*
- Final answer / *Finale antwoord (0,41)* ✓

$$n(\text{NH}_3) = m/M = 41,48/17 \checkmark = 2,44 \text{ mol}$$

	$\text{N}_2$	$3 \text{ H}_2$	$2 \text{ NH}_3$	
$n_i$	4,88	6,18	0	
$\Delta n$	1,22	3,66	2,44 ✓	<b>Ratio / verhouding</b>
$n_e$	3,66	2,52 ✓	2,44 ✓	
$C_e$	1,83	1,26	1,22 ✓	<b>(Div/by deel met <math>2 \text{ dm}^3</math>)</b>

$$\begin{aligned} K_c &= \frac{[\text{NH}_3]^2}{[\text{N}_2] \cdot [\text{H}_2]^3} \checkmark \\ &= \frac{1,22^2}{1,83 \times 1,26^3} \checkmark \\ &= 0,41 \checkmark \end{aligned}$$

**OPTION 2: CONCENTRATION / OPSIE 2: KONSENTRASIE****Marking criteria/ Nasienkriteria:**

- Calculate  $c(\text{NH}_3)_{\text{equilibrium}}$ . ✓  
*Bereken  $c(\text{NH}_3)_{\text{ewewig}}$*
- $\Delta c \text{ NH}_3$  ✓
- $c_i \text{ N}_2$  and/en  $\text{H}_2$  ✓
- Use conc. ratio  $\text{N}_2:\text{H}_2:\text{NH}_3$ /Gebruik gekonsen. verhouding  $\text{N}_2:\text{H}_2:\text{NH}_3$  ✓
- $c$  equilibrium /ewewig  $\text{N}_2$  and/en  $\text{H}_2$  ✓
- Correct  $K_c$  expression/Korrekte  $K_c$  uitdrukking. ✓
- Substitution into  $K_c$  expression ✓/Vervanging in  $K_c$  uitdrukking.
- Final answer/Finale antwoord (0,41) ✓

$$n(\text{NH}_3) = m/M = 41,48/17 = 2,44 \text{ mol}$$

$$c_e(\text{NH}_3) = n/V = 2,44/2 \quad \checkmark \quad = 1,22 \text{ mol}\cdot\text{dm}^{-3}$$

$$c_i(\text{N}_2) = n/V = 4,88/2 = 2,44 \text{ mol}\cdot\text{dm}^{-3}$$

$$c_i(\text{H}_2) = n/V = 6,18/2 = 3,09 \text{ mol}\cdot\text{dm}^{-3}$$

	$\text{N}_2$	$3 \text{ H}_2$	$2 \text{ NH}_3$	
$c_i$	2,44	3,09	0	
$\Delta c$	0,61	1,83	1,22 ✓	Ratio / verhouding
$c_e$	<u>1,83</u>	<u>1,26</u> ✓	1,22 ✓	

$$K_c = [\text{NH}_3]^2/[\text{N}_2]\cdot[\text{H}_2]^3 \quad \checkmark$$

$$= 1,22^2/1,83 \times 1,26^3 \quad \checkmark$$

$$= 0,41 \quad \checkmark$$

(8)

6.3 Temperature / *Temperatuur* ✓

(1)

6.4 **A** ✓At a given temperature the yield of  $\text{NH}_3$  is the highest ✓ (in graph **A**)

Increase pressure favours reaction which produces less gas moles ✓

Forward reaction is favoured ✓

*By 'n gegewe temperatuur is die opbrengs van  $\text{NH}_3$  die hoogste (in grafiek **A**)**Toename in druk bevoordeel die reaksie wat die minste gas mol produseer**Voorwaartse reaksie word bevoordeel*

(4)

6.5 6.5.1 Increase / *Toeneem* ✓

(1)

6.5.2 No effect / *Geen effek* ✓

(1)

6.5.3 Decrease/ *Afneem* ✓

(1)

**[20]**

## QUESTION 7/VRAAG 7

7.1 7.1.1 An acid is a proton ( $H^+$ -ion) donor ✓✓  
*'n Suur is 'n proton ( $H^+$ -ioon) -skenker* (2)

7.1.2  $H_2O$  ✓ and / en  $H_2SO_4^-$  ✓ (2)

7.1.3  $H_2O$  or/of  $HSO_4^-$  (Any ONE / Enige EEN ✓) (1)

7.2 7.2.1 WEAK ACID ✓ Low  $K_a$  value/  $K_a < 1$  ✓  
*SWAKSUUR Lae  $K_a$ -waarde /  $K_a < 1$*  (2)

7.2.2  $H_2SO_4$  ✓ (1)

7.2.3  $pH = -\log [H_3O^+]$  ✓

$$3 = -\log [H_3O^+] \quad \checkmark$$

$$[H_3O^+] = 1 \times 10^{-3} \text{ mol}\cdot\text{dm}^{-3}$$

$$[H_2SO_4] = \frac{1}{2} \times 10^{-3} \quad \checkmark$$

$$= 5 \times 10^{-4} \text{ mol}\cdot\text{dm}^{-3} \quad \checkmark \quad (4)$$

7.2.4  $CO_3^{2-} + H_2O \quad \checkmark \quad \rightarrow \quad HCO_3^- + OH^- \quad \checkmark$



(Excess)  $OH^-$  formed / (oormaat)  $OH^-$  word geproduseer ✓ (3)

7.3.1 It is a solution of known concentration ✓✓  
*Dit is 'n oplossing van bekende konsentrasie* (2)

7.3.2	<p><b><u>OPTION 1 / OPSIE 1:</u></b>  <math>n = m/M</math>  <math>n = 1,74/58 \quad \checkmark</math>  <math>= 0,03 \text{ mol}</math>  <math>c = n/V</math>  <math>= 0,03 / 0,2 \quad \checkmark</math>  <math>= 0,15 \text{ mol}\cdot\text{dm}^{-3}</math></p>	<p><b><u>OPTION 2 / OPSIE 2:</u></b>  <math>c = m/MV</math>  <math>c = 1,74 / (58)(0,2) \quad \checkmark \checkmark</math>  <math>= 0,15 \text{ mol}\cdot\text{dm}^{-3}</math></p>
	<p><b><u>OPTION 3 / OPSIE 3:</u></b>  <math>n = cV</math>  <math>= (0,15)(0,2) \quad \checkmark</math>  <math>n = 0,3 \text{ mol}</math>  <math>m = nM</math>  <math>= (0,3)(58) \quad \checkmark</math>  <math>= 1,74 \text{ g}</math></p>	<p><b><u>OPTION 4 / OPSIE 4:</u></b>  <math>m = cMV</math>  <math>= (0,15)(58)(0,2) \quad \checkmark \checkmark</math>  <math>m = 1,74 \text{ g}</math></p>

(2)

7.3.3 **Marking guideline / Nasienriglyn**

- Calculating mole for  $\text{Mg}(\text{OH})_2$  / *Bereken mol vir  $\text{Mg}(\text{OH})_2$*
- Calculating the diluted concentration for HCl / *Bereken die verdunde konsentrasie van HCl*
- Calculating the total mole for HCl / *Bereken die totale mol van HCl*
- Calculating the reacted mole for HCl / *Bereken die mol van HCl wat gereageer het*
- Determining the remaining mole for HCl / *Bepaal die mol van HCl wat oorbly*
- Use of formula  $c = n/V$  in calculating the concentration of excess ions / *Gebruik formule  $c = n/V$  om die konsentrasie van die oormaat ione te bereken*
- Substituting into / *Vervanging in  $c = n/V$*
- Final answer/ *Finale antwoord*

$$\begin{aligned} n[\text{Mg}(\text{OH})_2] &= cV \\ &= 0,15 \times 0,04 \checkmark \\ &= 0,006 \text{ mol} \end{aligned}$$

$$\begin{aligned} c_1V_1 &= c_2V_2 \\ 5 \times 10 &= c_2(100) \checkmark \\ c_2 &= 0,5 \text{ mol}\cdot\text{dm}^{-3} \end{aligned} \quad \text{OR/OF}$$

$$\begin{aligned} n &= cV \\ &= (10)5 \times 10^{-3} \\ n &= 0,05 \text{ mol} \\ c &= \frac{n}{V} \\ &= \frac{0,05}{0,1} \\ c &= 0,5 \text{ mol}\cdot\text{dm}^{-3} \end{aligned} \quad \checkmark$$

$$\begin{aligned} n(\text{HCl}) &= cV \\ &= 0,5 \times 0,05 \checkmark \\ &= 0,025 \text{ mol} \end{aligned}$$

$$n(\text{HCl}) \text{ reacting} = 2 \times 0,006 \checkmark = 0,012 \text{ mol}$$

$$n(\text{HCl}) \text{ remaining} = 0,025 - 0,012 \checkmark\checkmark = 0,013 \text{ mol}$$

$$c(\text{HCl}) = n/V \checkmark = 0,013 / (0,09) \checkmark = 0,14 \text{ mol}\cdot\text{dm}^{-3} \checkmark$$

(9)  
[28]

**TOTAL/TOTAAL: 150**