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NATIONAL SENIOR CERTIFICATE NASIONALE SENIOR SERTIFIKAAT

GRADE 12/GRAAD 12

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

SEPTEMBER 2020

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

These marking guidelines consist of 12 pages and 3 pages with the cognitive grid.

Hierdie nasienriglyne bestaan uit 14 bladsye en 3 bladsye met die kognitiewe tabel.

QUESTION 1/VRAAG 1

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

[20]

QUESTION 2/QUESTION 2

- 2.1 Molecules with the same molecular formulae, but different structural formulae. ✓✓

Molekule met dieselfde molekulêre formule, maar verskillende struktuurformules.

(2)

2.2

2.2.1 A ✓

(1)

2.2.2 D ✓

(1)

2.2.3 B ✓✓

(2)

2.3

2.3.1 Esterification/Esterifikasie ✓

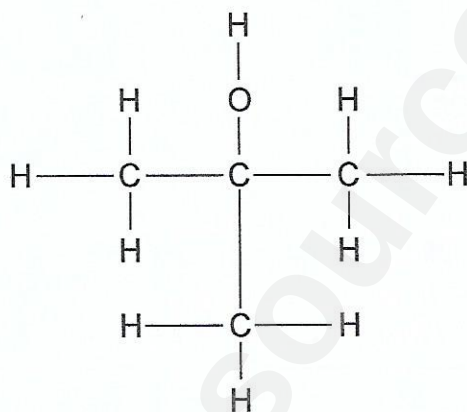
(1)

2.3.2 Acts as a catalyst/a substance that speeds up the rate of the reaction/dehydrating agent. ✓

Treë op as 'n katalisator/'n stof wat die tempo van 'n reaksie verhoog/dehidrateermiddel

(1)

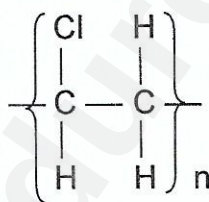
2.3.3



✓✓

(2)

2.4



✓✓

(2)

[12]

QUESTION 3/VRAAG 3

- 3.1 The temperature at which the vapour pressure of a substance equals atmospheric/external pressure. ✓✓

Die temperatuur waar die dampdruk van die stof gelyk is aan die atmosferiese/eksterne druk (2)

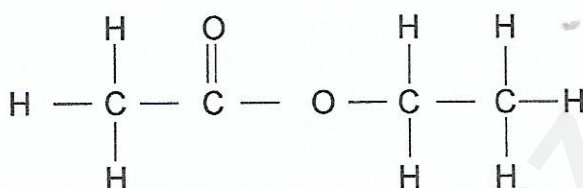
- 3.2 A ✓
Lowest boiling point/Shortest chain length✓
Laagste kookpunt/ Kortste kettinglengte

(2)

- 3.3
3.3.1 Ethyl ethanoate. ✓✓ /Etieletanoaat

(2)

3.3.2



✓✓

(2)

3.4

Marking guidelines/nasienriglyne

- BOTH have hydrogen bonding ✓ /BEIDE het waterstofbinding
 - Compare number of sites for hydrogen bonding ✓ /Vergelyk aantal plekke vir waterstofbinding
 - Compare strength of IMFs ✓ /Vergelyk sterkte van IMKs
 - Compare energy required ✓ /Vergelyk energie benodig
- Both compounds/C and D have (in addition to London forces and dipole-dipole forces) hydrogen bonding. ✓
Beide verbindings/C en D het (in addisie tot Londonkragte en dipool-dipoolkragte) waterstofbinding
 - Compound C/Ethanol/alcohol has one site for hydrogen bonding and compound D/Ethanoic acid/ carboxylic acid has two/more sites for hydrogen bonding. ✓
Verbinding C/etanol /alkohol het een plek vir waterstofbinding en verbinding D/etanoësuur/karboksielsuur het twee/meer plekke vir waterstofbinding.
 - Intermolecular forces in compound D/Ethanoic acid/ carboxylic acid are stronger than intermolecular forces in compound C/Ethanol/alcohol. ✓
Intermolekulêre kragte in verbinding D/etanoësuur /karboksielsuur is sterker as die intermolekulêre kragte in verbinding C/etanol/alkohol.

OR/OF

Intermolecular forces in compound **C**/Ethanol/alcohol are weaker than intermolecular forces in compound **D**/Ethanoic acid/ carboxylic acid.
Intermolekulêre kragte in verbinding C/etanol/alkohol is swakker as die intermolekulêre kragte in verbinding D/etanoësuur/karboksielsuur

- More energy is needed to overcome/break intermolecular forces in compound **D**/Ethanoic acid/ carboxylic acid than in compound **C**/Ethanol/alcohol. ✓
Meer energie word benodig om die intermolekulêre kragte in verbinding D /etanoësuur /karboksielsuur te breek/oorkom as in verbinding C/etanol /alkohol

OR/OF

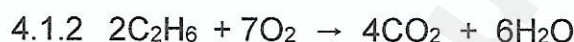
Less energy is needed to overcome/break intermolecular forces in compound **C**/Ethanol/alcohol than in compound **D**/Ethanoic acid/ carboxylic acid.
Minder energie word benodig om die intermolekulêre kragte in verbinding C/etanol /alkohol te breek/oorkom as in verbinding D/Ethanoic acid/ carboxylic acid.

(4)
[12]

QUESTION 4/VRAAG 4

4.1

4.1.1 Addition ✓ /Addisie (1)



Notes/Nota's

- Reactants /Reaktante ✓ Products/Produkte ✓
Balancing/Balansering ✓
- Ignore/ignoreer = and phases/en fases
- Marking rule/Nasienreël 6.3.10

(3)

4.2

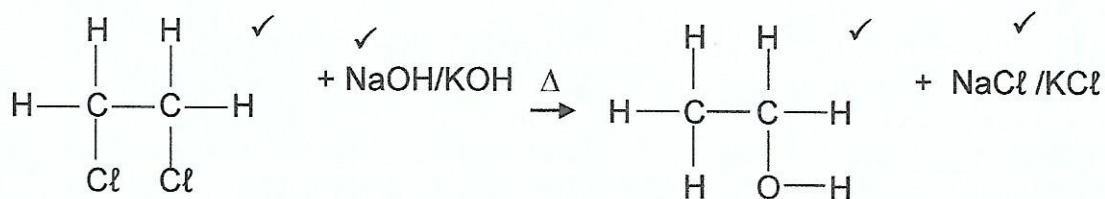
4.2.1 1,2-dichloroethane ✓✓ /1,2-dichloroetaan (2)

4.2.2 Halogenation/Chlorination ✓ /Halogenering/Chlorinerig (1)

4.3

4.3.1 Hydrolysis ✓ /Hidrolise (1)

4.3.2



(4)

4.4

4.4.1 Hydration ✓ /Hidrasie (1)

4.4.2 - ANY ONE /ENIGE EEN

- Excess water ✓ /Oormaat water

- Concentrated H_2SO_4 /Gekonsentreerde H_2SO_4 (1)

[14]

QUESTION 5/VRAAG 5

5.1 The influence/the effect of a catalyst ✓ /Invoed/effek van katalisator (1)

5.2 L✓ (1)

5.3 No-catalyst ✓✓ /Geen katalisator (2)

5.4 Change in concentration of products/ reactants ✓ per (unit) time ✓
Verandering in konsentrasie van produkte/reaktante per tydseenheid (2)**OR/OF**

Change in amount/number of moles/volume/mass of products or reactants per (unit) time

Verandering in die hoeveelheid/aantal mol/volume/massa van produkte/reaktante per tydseenheid

$$\begin{aligned}
 5.5 \quad \text{Average rate} &= - \frac{\Delta [H_2O_2]}{\Delta t} \\
 &= - \frac{0.0131 - 0.020}{400 - (0)} \quad \checkmark \\
 &= 1,73 \times 10^{-5} \text{ mol} \cdot \text{dm}^{-3} \text{ s}^{-1} \quad \checkmark \quad (3)
 \end{aligned}$$

5.6

MARK ALLOCATION/PUNTETOEKENNING

$$\bullet c = \frac{n}{V} \text{ or/of } c = \frac{m}{MV} \text{ or/of } n = \frac{m}{M} \quad \checkmark$$

 $\bullet$ Substitute/vervang (0,0200 – 0,0106) and/en $50 \times 10^3 \quad \checkmark$

$$\bullet n(O_2) = \frac{1}{2}(H_2O_2) \quad \checkmark$$

 $\bullet$ Using/gebruik $M = 32$ in $m = Mn$ or/of $n = \frac{m}{M}$ or/of ratio calculation/verhouding berekening $\checkmark$
 $\bullet$ Answer/antwoord: $7,52 \times 10^{-3} \text{ g}$ / $0,008 \text{ g}$ / $0,01 \text{ g} \quad \checkmark$

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
$C = \frac{n}{V} \checkmark$ $(0,0200 - 0,0106) = \frac{n}{50 \times 10^{-3}} \checkmark$ $n(O_2) = \frac{1}{2} n(H_2O_2) = \frac{1}{2}(4,7 \times 10^{-4}) \checkmark$ $= 2,35 \times 10^{-4} \text{ mol}$ $n = \frac{m}{M}$ $2,35 \times 10^{-4} = \frac{m}{32} \checkmark$ $m = 7,52 \times 10^{-3} \text{ g} \checkmark$	$\Delta c [H_2O_2] = 0,0200 - 0,0106$ $= 0,0094$ $\Delta c(O_2) = \frac{1}{2}(H_2O_2)$ $= \frac{1}{2}(0,0094) \checkmark$ $= 0,0047 \checkmark$ $C = \frac{m}{MV} \checkmark$ $\Delta m(O_2) = cMV$ $= (0,0047)(32) \checkmark (50 \times 10^{-3})$ $= 7,52 \times 10^{-3} \text{ g}$ $= 0,008 \text{ g}$ $= 0,01 \text{ g} \checkmark$ (5)

[14]

QUESTION 6/VRAAG 6

- 6.1 The stage in a chemical reaction when the rate of the forward reaction is equals to the rate of the reverse reaction. ✓✓
Stadium in 'n chemiese 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 of reactants and products remain constant.

Stadium in 'n chemiese reaksie waar die konsentrasie van reaktante en produkte konstant bly. (2)

- 6.2 STAY THE SAME. ✓ BLY DIESELFDE
 At equilibrium there are equal number of moles of gaseous reactants and products. ✓✓
 By ewewig is daar gelyke aantal mol gasagtige reaktante en produkte. (3)

- 6.3
 6.3.1 A very small amount of NO(g) is formed. ✓✓
 'n Baie klein hoeveelheid NO(g) is gevorm. (2)

6.3.2

	N ₂ (g)	O ₂ (g)	2NO(g)
Initial moles/Aanvangsmol	7	2	0
Moles reacted/mol gereageer	0,2	0,2	0,4 ✓
Moles at equilibrium/mol by ewewig	6,8	✓	0,4 ✓
Equilibrium concentration/ Ewewigskonsentrasie (mol·dm ⁻³)	3,4	0,9	0,2

Divide by 2/deel met 2)✓

$$\begin{aligned}
 K_c &= \frac{[\text{NO}]^2}{[\text{N}_2][\text{O}_2]} \quad \checkmark \\
 &= \frac{0,04}{(3,4)(0,9)} \quad \checkmark \\
 &= 0,013 \quad \checkmark
 \end{aligned}$$

(8)

OPTION 2/OPSIE 2

	N ₂	O ₂	2NO
Initial concentration <i>Aanvangskonsentrasie</i> (mol·dm ⁻³)	$\frac{7}{2} = 3,5$	$\frac{2}{2} = 1✓$	0
Change/ <i>verandering</i> (mol·dm ⁻³)	0,1✓	0,1	$\frac{0,4}{2} = 0,2✓$
Equilibrium concentration <i>konsentrasie by ewewig</i> (mol·dm ⁻³)	3,4	0,9	0,2 ✓

$$K_c = \frac{[NO]^2}{[N_2][O_2]}✓$$

$$= \frac{[0,2]^2}{(3,4)(0,9)}✓$$

$$= \frac{0,04}{3,06}✓$$

$$= 0,013✓$$

6.3.3

- When the system is heated, K_c increased✓, which implies that more NO(g) was formed. ✓
Met toename in temperatuur het die K_c verhoog, wat impliseer dat meer NO(g) gevorm het.
- The forward reaction is favoured. ✓
Die voorwaartse reaksie is bevoordeel.
- Increase in temperature favours the reaction which absorbs energy✓ / endothermic reaction.
Verhoging in temperatuur bevoordeel die reaksie wat energie absorbeer / endotermiese reaksie.

(4)
[19]

QUESTION 7/VRAAG 7

7.1

- 7.1.1 An acid that ionises completely in water. ✓✓
 'n Suur wat volledig ioniseer in water.

(2)

7.1.2

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$\text{pH} = -\log [\text{H}_3\text{O}^+] \checkmark$ $3 = -\log [\text{H}_3\text{O}^+] \checkmark$ $[\text{H}_3\text{O}^+] = 0,001 \text{ mol} \cdot \text{dm}^{-3} \checkmark \quad (3)$	$\text{pH} + \text{pOH} = 14$ $3 + \text{pOH} = 14$ $\text{pOH} = -\log [\text{OH}^-]$ $11 = -\log [\text{OH}^-]$ $[\text{OH}^-] = 1 \times 10^{-11}$ $K_w = [\text{H}_3\text{O}^+] [\text{OH}^-] = 14$ $[\text{H}_3\text{O}^+] = 0,001 \text{ mol} \cdot \text{dm}^{-3}$

- 7.1.3 No /Nee

(1)

- 7.1.4 The concentration of the hydrogen ions in the HX solution is lower than ✓ that of HCl of the same concentration . ✓
Die konsentrasie van die waterstofione in die HX oplossing is laer as die van HCl met dieselfde konsentrasie. (2)

OR/OF

The pH of HX is higher than that of HCl of the same concentration
 Die Ph van HX is hoër as die van HCl met dieselfde konsentrasie

7.2

- 7.2.1 A substance that can react as an acid or a base in a chemical reaction. ✓✓
 'n Stof wat beide as 'n suur en 'n basis kan optree in 'n chemiese reaksie (2)

- 7.2.2 $\text{HSO}_3^- \checkmark$ (1)

- 7.2.3 Sulphite ion ✓ Sulfietioon (1)

7.3

- 7.3.1 $c(\text{H}_2\text{SO}_4) = \frac{n}{V} \checkmark$
 $0,2 = \frac{n}{0,1} \checkmark$
 $n = 0,02 \text{ mol} \checkmark$ (3)

$$\begin{aligned}
 7.3.2 \quad n[\text{Mg}(\text{OH})_2] &= cV \\
 &= (0,2) \times (0,02) \checkmark \\
 &= 0,004 \text{ mol}
 \end{aligned}$$

$$n(\text{H}_2\text{SO}_4 \text{ in excess/oormaat}) = 0,004 \text{ mol} \checkmark \text{ (mol ratio)}$$

$$\begin{aligned}
 n(\text{H}_2\text{SO}_4) \text{ reacts with/reageer met } \text{Na}_2\text{CO}_3 &= 0,02 - 0,004 \checkmark \\
 &= 0,016 \text{ mol}
 \end{aligned}$$

$$n(\text{Na}_2\text{CO}_3) = n(\text{H}_2\text{SO}_4) = 0,016 \text{ mol} \checkmark \text{ (mol ratio)}$$

$$\begin{aligned}
 m(\text{Na}_2\text{CO}_3) &= nM \\
 &= 0,016 \times 106 \checkmark \\
 &= 1,696 \text{ g}
 \end{aligned}$$

$$\begin{aligned}
 \text{Mass of impurity/massa onsuiverheid} &= 5 - 1,696 \checkmark \\
 &= 3,304 \text{ g} \checkmark
 \end{aligned}$$

(7)
[22]**QUESTION 8/VRAAG 8**

8.1 The substance/ species which gains electrons. $\checkmark\checkmark$
Stof wat elektrone bykry.

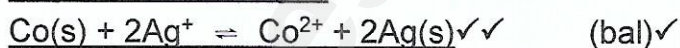
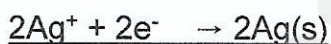
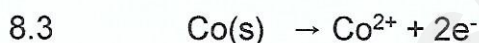
(2)

8.2 **B/** Ag^+ $\checkmark$

Silver ions (Ag^+) has a stronger oxidising ability than cobalt (Co) $\checkmark$, and silver ions (Ag^+) will be reduced to silver $\checkmark$.

Silwer ione (Ag^+) het 'n sterker oksideervermoë as kobalt (Co), en silwer (Ag^+) sal gereduseer word na silwer

(3)



(3)

8.4 $E^\ominus_{\text{cell}} = E^\ominus_{\text{cathode/katode}} - E^\ominus_{\text{anode}} \checkmark$

$$E^\ominus_{\text{sel}} = E^\ominus_{\text{katode/katode}} - E^\ominus_{\text{anode}}$$

$$= +0,80 \checkmark - (-0,28) \checkmark$$

$$= 1,08 \text{ V} \checkmark$$

Accept any other correct formula from the data sheet.
 Aanvaar enige ander korrekte formule vanaf gegewensblad.

$E^\ominus_{\text{cell/sel}} < 1,5 \text{ V}$, thus the bulb will not glow or light up/ gloeilamp sal nie brand. $\checkmark$

(5)
[13]

QUESTION 9/VRAAG 9

- 9.1 Electrical energy is converted to chemical energy. ✓✓
Elektriese energie word omgeskakel in chemiese energie. (2)
- 9.2 Cathode/katode ✓ (1)
- 9.3.1 Cryolite/krioliet ✓ (Na_3AlF_6) ✓ (2)
- 9.3.2 $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ ✓✓ (2)
- 9.4 Carbon in the electrodes reacts with O_2 gas produced, forming CO_2 ✓
 carbon is used up ✓ causing electrodes to disintegrate/corrode away.
Koolstof in die elektrodes reageer met O_2 gas wat vorm en vorm CO_2 /
Koolstof word opgebruik wat veroorsaak dat elektrodes disintegreer/
weggevreë word (2)
[9]

QUESTION 10/VRAAG 10

- 10.1
- 10.1.1 Combustion (process) ✓ *Verbrandings(proses)* (1)
- 10.1.2 $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$ ✓ bal ✓ (3)
- 10.2
- 10.2.1 Neutralisation (Acid-Base) ✓ *Ineutralisasie (Suur-basis)* (1)
- 10.2.2 $\text{HNO}_3 + \text{NH}_3 \rightarrow \text{NH}_4\text{NO}_3$ ✓ bal ✓ (3)
- 10.3
- 10.3.1 Haber ✓ (1)
- 10.3.2 Fe/iron/yster ✓ (1)
- 10.4
- 10.4.1 The ratio of nitrogen, phosphorus and potassium in the
 fertiliser ✓ ✓ *IDie verhouding stikstof, suurstof fosfor en kalium in die*
kunsmis. (2)
- 10.4.2 Pure fertiliser/Suiwer kunsmis = $\frac{10 \text{ kg} \times 23}{100}$ ✓
 = 2,3 kg ✓ (3)
[15]

TOTAL/TOTAAL: 150