

**HILLCREST HIGH SCHOOL**  
**PHYSICAL SCIENCE**  
**GRADE 12**  
**PAPER 2 - CHEMISTRY**



**TRIALS 2022**

**EXAMINER: J. KNOX-WHITEHEAD**

**TIME: 3 HRS  
TOTAL 150**

**SECTION A**

**QUESTION 1: MULTIPLE CHOICE QUESTIONS**

- 1.1 D ✓✓
- 1.2 B
- 1.3 D
- 1.4 B
- 1.5 D
- 1.6 D
- 1.7 C
- 1.8 B
- 1.9 C
- 1.10 C

**10 x2 = [20]**

**SECTION B**

**QUESTION/VRAAG 2**

- 2.1.1 A or/of C ✓ (1)
- 2.1.2 B ✓ (1)
- 2.1.3 F ✓ (1)
- 2.1.4 D ✓ (1)

- 2.2.1 A functional group is a bond or an atom or a group of atoms that determines the physical and chemical properties of a group of organic compounds. ✓✓ (2)

2.2.2 Carbonyl ✓ (1)

2.2.3 butanal ✓ (1)

2.3.1 4,5-dimethyl ✓ hex-2-ene ✓ / 4,5-dimetieselheks-2-ene

**Marking criteria 2.2.1-2.2.3/Nasienriglyne:**

Only functional group correct/Slegs funksionele groep korrek: Max/Maks:  $\frac{1}{2}$

Whole structure correct/Hele struktuur korrek:  $\frac{2}{2}$  (2)

2.3.2 2,3-dibromo-5-methyl ✓ heptane ✓

2,3-dibromo-5-metieselheptaan (2)

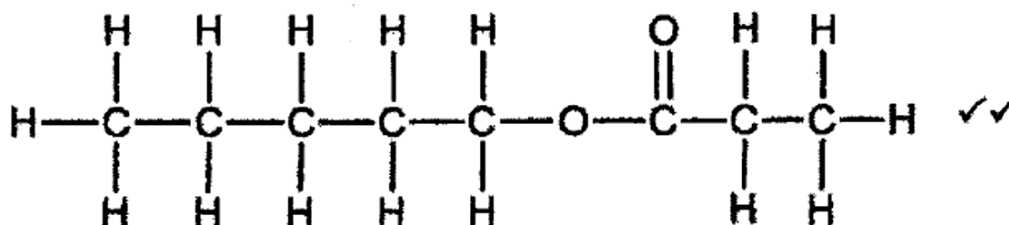
2.3.3 4-methyl ✓ pent-2-yne ✓

4-metieselpent-2-yn (2)

2.4.1 Vapours of the alcohol are flammable so should not be heated directly over an open flame. (1)

2.4.2 A catalyst is a substance that increases the rate of a chemical reaction without itself undergoing a permanent change. ✓✓ (2)

2.4.3



(2)

**Marking criteria/Nasienriglyne**

- Only functional group correct/Slegs funksionele groep korrek:

Max/Maks:  $\frac{1}{2}$

- Whole structure correct: /hele struktuur korrek  $\frac{2}{2}$

2.4.4 Propanoic acid ✓✓

Propanoësuur (1)

2.4.5 H<sub>2</sub>SO<sub>4</sub>

(1)

[21]

## QUESTION 3

- 3.1 The temperature at which the vapour pressure of a substance equals the atmospheric pressure. ✓✓ (2)
- 3.2 Functional group / homologous series ✓ (accept either) (1)
- 3.3.1 163°C ✓ (1)
- \* 3.3.2 The acid (A) has TWO sites for hydrogen bonding ✓ while the alcohol (B) has only one site. ✓  
The carboxylic acid molecules require more energy to overcome the intermolecular forces ✓  
Carboxylic acid will have a higher boiling point. ✓ (4)
- 3.4.1 LESS THAN ✓ (1)
- 3.4.2 The second compound has a shorter chain length, therefore smaller molecular size/surface area. ✓  
This means the London forces will be weaker ✓ and therefore less energy required to separate the molecules. ✓ (3)

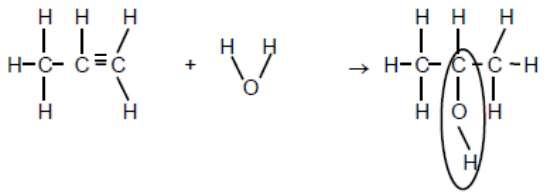
[12]

## QUESTION 4

4.1.1 Addition / hydration ✓

(1)

4.1.2

 <p><b>Note: If condensed formula used: -1 mark/Opmerking: Indien gekondenseerde formule gebruik word: -1 punt</b></p>	<p><b>Marking criteria/ Nasienkriteria</b></p> <ul style="list-style-type: none"> <li>• Correct structural formula of reactants ✓✓ / Korrekte struktuurformule van reaktante</li> <li>• Correct structural formula of product ✓ / Korrekte struktuurformule van produk</li> </ul>	(3)
4.1.3 secondary Ca with 4.1.2		
4.2 H <sub>2</sub> O ✓		(1)
4.3.1	<p><b>Marking Criteria/Nasienkriteria</b></p> <ul style="list-style-type: none"> <li>• Br atom on carbon number 2 ✓ / Br-atoom op koolstofgetal 2</li> </ul>	(1)
4.3.2	Substitution ✓ / Substitusie	(1)
4.4.1	Addition / hydrohalogenation ✓	(1)
4.4.2	Substitution / hydrolysis ✓	(1)
4.4.3	No water must be present / heated / sunlight (UV light) ✓ (any one)	(1)
		<b>[10]</b>

**QUESTION/VRAAG 5**5.1 Carbon dioxide/CO<sub>2</sub> ✓*Koolstofdioksied/CO<sub>2</sub>*

(1)

5.2 The decrease in concentration of hydrochloric acid per unit time. ✓✓

OR The increase in volume of hydrogen gas per unit time. / The decrease in mass of CaCO<sub>3</sub> per unit time.

(2)

5.3 <sup>\*</sup>  
Concentration (of the acid) ✓*Konsentrasie (van die suur)* ✓

(1)

5.4 Experiment 2 ✓

(1)

- 5.5
- Higher acid concentration in experiment 2 means more particles/molecules per unit volume ✓
  - This results in more collisions ✓ and therefore...
  - More effective collisions per unit time/frequency of effective collisions increases ✓
  - Rate of effective collisions increases. ✓

(3)

5.6.1  $n(\text{CaCO}_3) = m/M$

$= 4/100 \checkmark = 0,04 \text{ mol}$

$n(\text{HCl}) : n(\text{CaCO}_3) = 2 : 1$

$n(\text{HCl}) = 2(0,04) \checkmark = 0,08 \text{ mol}$

$c(\text{HCl}) = n/V$

$0,4 = 0,08/V \checkmark$

$V = 0,2 \text{ dm}^{-3} = 200 \text{ cm}^3 \checkmark$

**Marking Criteria**

- Substituting 100 into formula  $m/M$
- Using ratio 2:1
- Substituting the number of moles into formula  $c = n/v$
- Final answer

**Nasienriglyne:**

- Vervang 100 in formule  $m/M$
- Gebruik verhouding 2:1
- Vervang getal mol in formule  $c = n/V$
- Finale antwoord

(4)

$$\begin{aligned}
 5.6.2 \quad \text{Avg rate} &= \Delta m / \Delta t \quad \checkmark \\
 &= (4-0) / (0-14,8) \quad \checkmark \\
 &= (-)0,27 \text{ g}\cdot\text{min}^{-1} \quad \checkmark
 \end{aligned}$$

(3)

**[15]****QUESTION 6**

6.1 Le Chatelier's principle – When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance.  $\checkmark\checkmark$  (2)

6.2.1 Equilibrium was reached. (1)

6.2.2 Increase in pressure / decrease in volume. (1)

6.2.3 Brown colour will decrease/become lighter. (1)

6.2.4 If pressure is increased the equilibrium will shift to the side with fewest number of moles of gas  $\checkmark$ , therefore in this case will shift to the right, favouring the forward reaction  $\checkmark$  and decreasing the amount of brown  $\text{NO}_2(\text{g})$ .  $\checkmark$  (3)

6.3.1.1 Remains the same (1)

6.3.1.2 Increases (1)

$$6.3.2 \quad K_c = [\text{NH}_3][\text{H}_2\text{S}] \checkmark = 1,2 \times 10^{-4}$$

$$[\text{NH}_3] = [\text{H}_2\text{S}] = 0,01095 \text{ mol}\cdot\text{dm}^{-3} \checkmark$$



Initial mol	x	0	0	
Change in mol	-0,055	+ 0,055	+0,055	$\checkmark$
Equilibrium mol		0,055	0,055	$\checkmark$
$C = n/V$		0,01095	0,01095	

Require at least 0,055mol  $\text{NH}_4\text{HS}(\text{s})$  to achieve equilibrium moles of product.

$$\text{Minimum } m = n \times M$$

$$= 0,055 \times (14 + (5 \times 1) + 32) \checkmark$$

$$= 2,81 \text{g} \checkmark$$

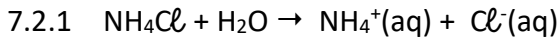
(6)

**[16]**

**QUESTION 7**

7.1.1 A weak acid is one that ionises partially in water ✓ to give a low concentration of  $\text{H}_3\text{O}^+$ . ✓ (2)

7.1.2  $K_a < 1$  (1)



7.2.2 red (1)

7.3.1  $C = n/V$   $n = m/M$

$0,20 = n \div (500/1000) ✓$   $0,1 = m \div (24 + 2(16+1)) ✓$

$n = 0,1 \text{ mol}$   $m = 5,8 \text{ g} ✓$  (4)

7.3.2 The pH of any medicine safe for human consumption must lie between pH = 4 and pH = 9.

$[\text{Mg}(\text{OH})_2] = 0,20 \text{ mol} \cdot \text{dm}^{-3}$

$[\text{OH}^-] = 0,20 \times 2 ✓ = 0,40 \text{ mol} \cdot \text{dm}^{-3}$

$\text{pOH} = -\log [\text{OH}^-]$

$= -\log (0,40) ✓$

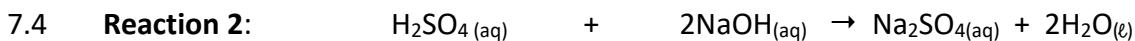
$= 0,3979$

$\text{pH} = 14 - \text{pOH}$

$= 14 - 0,3979 ✓$

$= 13,60 ✓$

No this is not safe for human consumption as the pH is  $> 9$ . ✓ (5)



Given:

$V = 28/1000 ✓$

$= 0,028 \text{ dm}^3$

$n = C \times V ✓$

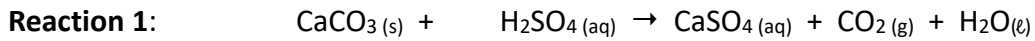
$= 0,5 \times 0,028 ✓$

$= 0,014 \text{ mol}$

Used:  $n = 0,014 \div 2 \times 1 ✓$

$= 0,007 \text{ mol}$

$$\text{Original H}_2\text{SO}_4: n = C \times V = 1,0 \times 0,05 \checkmark = 0,05 \text{ mol}$$



Used:  $n = 0,05 - 0,007 \checkmark$

$$= 0,043 \text{ mol}$$

$$n = 0,043 \div 1 \times 1 \checkmark$$

$$= 0,043 \text{ mol}$$

$$m = n \times M$$

$$= 0,043 \times (40 + 12 + (3 \times 16)) \checkmark$$

$$= 4,3 \text{ g} \checkmark$$

(9)

**[25]****QUESTION 8**

8.1 Galvanic (1)

8.2  $\text{Al}(s) | \text{Al}^{3+}(aq)(1 \text{ mol} \cdot \text{dm}^{-3}) || \text{Cu}^{2+}(aq)(1 \text{ mol} \cdot \text{dm}^{-3}) | \text{Cu}(s)$  (3)

✓

✓

✓

8.3 Al to the Cu (1)

8.4  $\text{Al}(s) \rightarrow \text{Al}^{3+}(aq) + 3e$  ✓✓ Phases missing -1; (2)

double arrow -1

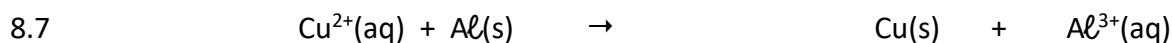
8.5  $E_{\text{cell}} = E_{\text{red}} - E_{\text{ox}}$  ✓

$$= 0,34 \checkmark - (-1,66) \checkmark$$

$$= 2,00 \text{ V} \checkmark$$
 (4)

8.6 Temperature  $25^\circ\text{C}$  ✓

Concentration of electrolytes  $1 \text{ mol} \cdot \text{dm}^{-3}$  ✓ (2)

Used:

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

$$n = m/M$$

$$= 1,05 / 27 \quad \checkmark$$

$$= 0,0389 \text{ mol}$$

Produce:

$$n = 0,0389 \div 2 \times 3 \quad \checkmark$$

$$= 0,0583 \text{ mol}$$

$$m = n \times M$$

$$= 0,0583 \times 63,5 \quad \checkmark m$$

$$= 3,71 \text{ g} \quad \checkmark$$

(4)

8.8.1 DECREASES

(1)

8.8.2 **NEGATIVE MARKING FROM 8.6.1/NEGATIEWE NASIEN VANAF 8.6.1**

The concentration of  $\text{Al}^{3+}$  will increase. According to Le Chatelier the system needs to decrease the concentration. ✓

The reverse reaction will be favoured. ✓

Therefore the reading will decrease. ✓

(3)

**[21]****QUESTION 9**

9.1 electrical energy to chemical energy (1)

9.2 ENDOTHERMIC (1)

9.3 An electrolyte is a substance that dissolves in water to give a solution that conducts electricity / a substance of which the aqueous solution contains ions. **\*\*NEW DEFINITIONS\*\*** (2)

When the power source is switched on, the colour of the electrolyte around electrode Y changes from green to purple.

9.4.1  $2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$  ✓✓ Phases missing -1; double arrow -1 (2)

9.4.2 Chlorine (1)

9.5  $\text{Na}^+$  is a weaker oxidising agent than  $\text{H}_2\text{O}$  ✓ and therefore the  $\text{H}_2\text{O}$  will be reduced in preference to the  $\text{Na}^+$ . ✓ **(Note – You must talk about REACTANTS for this answer, not hydrogen which is a PRODUCT)**OR  $\text{H}_2\text{O}$  is a stronger oxidising agent than  $\text{Na}^+$  ✓ and therefore the  $\text{H}_2\text{O}$  will be reduced in preference to the  $\text{Na}^+$ . ✓ (2)**[9]**