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KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

GRADE 12

**NATIONAL
SENIOR CERTIFICATE**

PHYSICAL SCIENCES P2 (CHEMISTRY)

JUNE 2023

COMMON TEST

MARKING GUIDELINES

MARKS: 150

This memorandum consists of 11 pages

QUESTION 1

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

QUESTION 2

- 2.1.1 4,5,5 – trimethylhexa – 1,3 - diene
- REMOVED **Marking criteria:**
- correct stem i.e. hexadiene✓
 - all substituents trimethyl correctly identified✓
 - IUPAC name completely correct including numbering, sequence and hyphen and commas✓
- (3)
- 2.1.2 2 – methylbutan – 2 – ol **OR** 2 – methyl -2-butanol
- Marking criteria:**
 - correct stem i.e. butanol✓
 - substituent methyl correctly identified✓
 - IUPAC name completely correct including numbering, sequence and hyphen and commas✓
- (3)
- 2.2.1 F✓ (1)
- 2.2.2 E✓ (1)

- 2.3.1 A bond/an atom/a group of atoms that determine(s) the (physical and) chemical properties of a group of organic compounds.

Marking criteria:

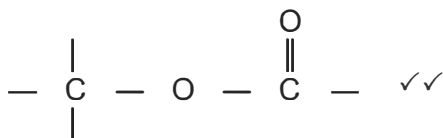
If any one of the underlined key phrases in the correct context is omitted, deduct 1 mark

(2)

- 2.3.2 carboxyl✓

(1)

- 2.3.3



Marking criteria:

Whole structure correct
2 or zero

(2)

- 2.3.4 $\text{C}_2\text{H}_4\text{O}_2 \checkmark + \text{C}_2\text{H}_6\text{O} \checkmark \rightarrow \text{C}_4\text{H}_8\text{O}_2 \checkmark + \text{H}_2\text{O} \checkmark$ balancing ✓

Marking criteria:

- 1 for each correct reactant and product
- 1 for correct balancing
- If structural formulae are used Max 4/5
- Any additional reactant or product: -1 mark

(5)

- 2.3.5 Sulphuric acid/ H_2SO_4 ✓

(1)

- 2.3.6 ethanol✓✓

(2)

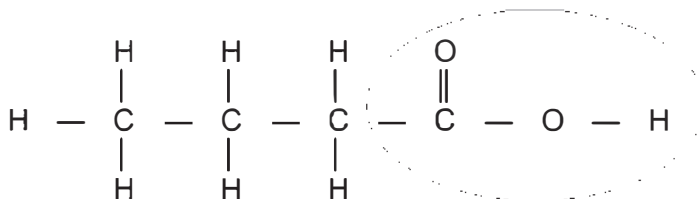
- 2.4 Compounds with the same molecular formula ✓ but different functional groups/homologous series. ✓

Marking criteria:

If any one of the underlined key phrases in the correct context is omitted, deduct 1 mark

(2)

- 2.5



Marking criteria:

- Only Functional group correctly drawn✓ $\frac{1}{2}$
- Whole structure correct ✓ $\frac{2}{2}$

(2)

QUESTION 3

- 3.1.1 The temperature at which the vapour pressure of a substance equals atmospheric pressure. ✓✓

Marking criteria:

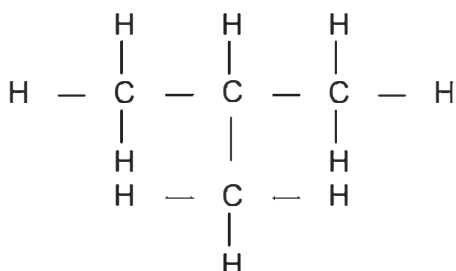
If any one of the underlined key phrases in the correct context is omitted, deduct 1 mark

(2)

- 3.1.2 Compound X / methylpropane is branched / has a smaller surface area / is less spherical while compound Y / butane has a straight chain / is unbranched / has a bigger surface area / is more spherical ✓
The intermolecular forces in compound Y are stronger than the intermolecular forces in compound X. ✓
More energy is required to overcome the intermolecular forces in compound Y. ✓

(3)

3.1.3



Marking criteria:

- 3 carbons in the longest chain ✓
- substituent methyl on the second carbon and everything else correct ✓

(2)

- 3.2.1 Butanoic acid ✓✓
The compounds must be of comparable molecular mass OR butanoic acid has the same molecular mass as pentan - 1 - ol ✓

OR

Pentanoic acid ✓✓

The compounds must be of comparable chain length OR butanoic acid has the same chain length as pentan - 1 - ol ✓

(3)

- 3.2.2 GREATER THAN ✓

(1)

- 3.2.3 The carboxylic acid has 2 sites for hydrogen bonding while the alcohol has only 1 site for hydrogen bonding. ✓
The intermolecular forces will therefore be stronger between the molecules of the carboxylic acid. ✓
More energy will therefore be required to overcome the intermolecular forces between the molecules of the acid. ✓

(3)

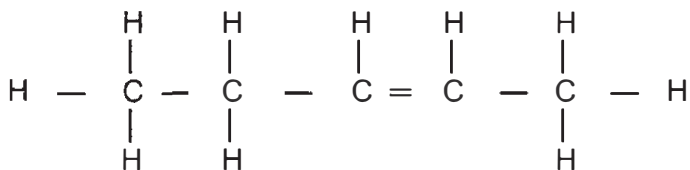
[14]

QUESTION 4

4.1.1 Elimination. ✓

(1)

4.1.2



Marking criteria:

- Double bond on second carbon ✓ $\frac{1}{2}$
- Whole structure correct ✓ $\frac{2}{2}$

(2)

4.1.3 concentrated sulphuric acid ✓✓ (If concentrated is not mentioned, then 1/2)

(2)

4.2.1 Hydrogenation ✓

(1)

4.2.2 Hydrogen/H₂ ✓

(1)

4.2.3 Platinum/Pt catalyst ✓

(1)

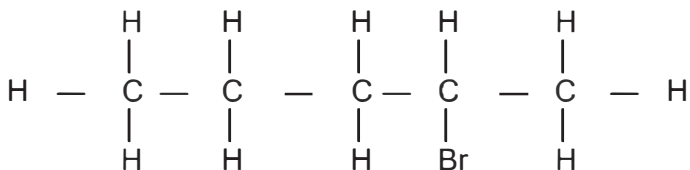
4.3.1 Halogenation/bromination/substitution ✓

(1)

4.3.2 Require uv light. Or heat ✓

(1)

4.3.3

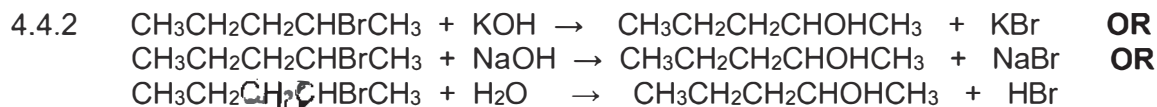


Marking criteria:

- Br on second carbon ✓ $\frac{1}{2}$
- Whole structure correct ✓ $\frac{2}{2}$

(2)

4.4.1 Dilute strong base/KOH/NaOH/H₂O✓ (1)



Marking criteria:

- Correct reactants✓
- Correct products✓
- Balancing✓

(3)

4.5 Dehydrohalogenation/dehydrobromination✓ (1)
[17]

QUESTION 5

5.1

Marking criteria:

Give the mark for per unit time only if in context of reaction rate.

ANY ONE

- Change in concentration ✓ of products/reactants per (unit) time. ✓
- Change in amount/number of moles/volume/mass✓ of products or reactants per (unit) time. ✓
- Amount/number of moles/volume/mass of products formed/reactants used per (unit) time. ✓✓
- Rate of change in concentration/amount of moles/number of moles/volume/mass. ✓✓ (2 or 0) (2)

5.2 Change in the mass of the flask and contents✓ decreases per unit time / per second / every 30 seconds. ✓ (2)

5.3 Mass of CaCO₃ decreases or is used up. ✓
 A decrease in the exposed surface area. ✓
 The number of effective collisions per unit time decreases. ✓

OR

HCl is used up. ✓
 Concentration of the HCl decreases. ✓
 The number of effective collisions per unit time decreases. ✓

NOTE: If no mention made of CaCO₃ or HCl used up, award 2 marks to second bullet.

(3)

5.4 REMAINS THE SAME. ✓ (1)

5.5

$$\begin{aligned}\text{Average rate} &= - \frac{\Delta m}{\Delta t} \\ 6,58 \times 10^{-2} \checkmark &= - \frac{X - 217,50}{180 - 0} \checkmark \\ X &= 205,66 \text{ g} \checkmark\end{aligned}$$

Marking criteria:

- Substitute rate ✓
- Substitute Δm ✓
- Δt ✓
- Final answer ✓

(4)

5.6

203,95 g ✓

Reaction has reached completion. ✓

(2)

5.7

Marking criteria:

- Calculate mass of pure CO_2 ✓

- Formula: $n = \frac{m}{M}$

- Correct substitution of 44 ($\frac{13,55}{44} \checkmark$) in the above formula

✓ Either equation

- Formula $n(\text{CO}_2)_{\text{produced}} = \frac{V}{V_m}$

- Substitute $n = 0,31$ ✓

- Substitute $V_m = 22,4$ ✓

- Final answer = $6,944 \text{ dm}^3$ ✓

$$m(\text{CO}_2) = 217,50 - 203,95 \checkmark = 13,55 \text{ g}$$

$$n(\text{CO}_2) = \frac{m}{M}$$

$$= \frac{13,55}{44} \checkmark$$

$$= 0,31 \text{ mols}$$

✓ Either equation

$$n(\text{CO}_2)_{\text{produced}} = \frac{V}{V_m}$$

$$0,31 \checkmark = \frac{V}{22,4} \checkmark$$

$$V = 6,944 \text{ dm}^3 (6,90) \checkmark$$

(6)

5.8

A catalyst provides an alternate pathway of lower activation energy / lowers the activation energy ✓

More molecules will therefore have sufficient energy ✓

The number of effective collisions per unit time increases ✓

(3)

5.9.1

REMAINS THE SAME ✓

(1)

5.9.2

DECREASES ✓

(1)

[25]

QUESTION 6

- 6.1.1 The reaction is in a state of (dynamic) equilibrium. ✓✓
OR The rate of forward reaction equals the rate of reverse reaction.
OR The concentrations of the reactants and products remain constant.

Note

IF: Forward reaction equals reverse reaction. $\frac{1}{2}$ (2)

- 6.1.2 Less than ✓ (1)

- 6.1.3 t_1 ✓
The concentration of N_2 was increased./graph shows an increase in concentration of N_2 ✓ (2)

- 6.1.4

Marking criteria:

If any one of the underlined key phrases in the correct context is omitted, deduct 1 mark.

When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will cancel/oppose the disturbance. ✓✓ (2)

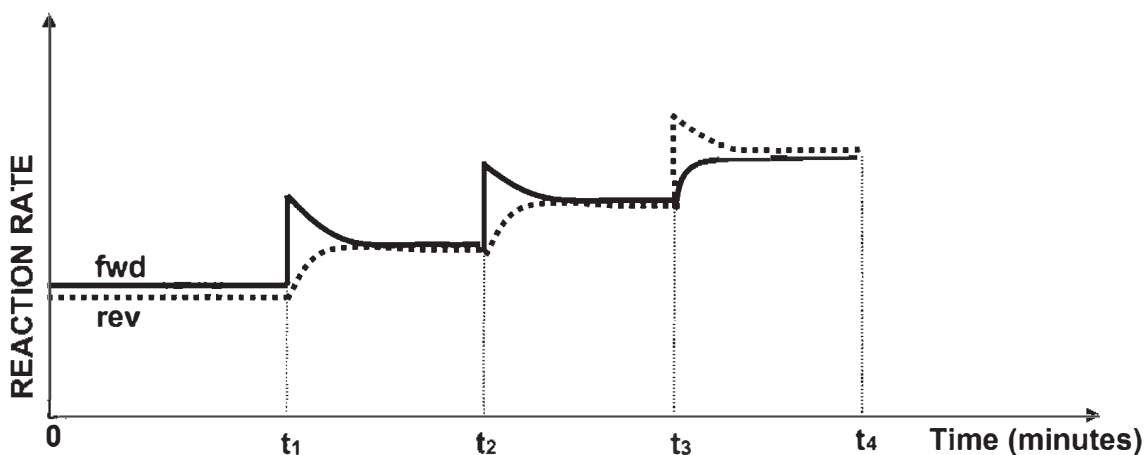
- 6.1.5 temperature ✓ (1)

- 6.1.6 INCREASED ✓
According to the graph the concentration of the reactants increases OR the concentration of the products decreases. ✓
Therefore the reverse reaction / endothermic reaction is favoured. ✓
(According to Le Chatelier's Principle) an increase in temperature favours the endothermic reaction. ✓ (4)

- 6.1.7

MARKING CRITERIA

- At t_1 , forward reaction is favoured (vertical upward climb of solid line) ✓
- At t_2 , forward reaction is favoured (vertical upward climb of solid line) ✓
- At t_3 , reverse reaction is favoured (vertical upward climb of broken line) ✓
- Vertical upward increase in rates at t_2 , t_3 and t_4 . ✓
- Equilibrium rate at t_4 .> equilibrium rate at t_3 > equilibrium rate at t_2 ✓



(5)

6.2.1 Products can be converted back to reactants. ✓✓

(2)

6.2.2 REVERSE ✓

(1)

6.3

Marking criteria:

- Change in no. of mol of C = 1 ✓
- Using the correct ratio ✓
- Subtraction: initial mol X – change in mol of X AND initial mol Y – change in mol of Y. ✓
- Equilibrium mol of X and Y; divide by 2 ✓
- Correct K_c expression (formulae in square brackets) ✓
- Substitution of equilibrium concentrations into K_c expression. ✓
- Final answer 0,71 ✓

	X	Y	C	
Ratio	2	1	2	
Initial quantity (mol)	2,5	1,75	0	
Change (mol)	1	0,5	1 ✓	Using ratio ✓
Quantity at equilibrium (mol)	1,5	1,25	1	✓
Equilibrium concentration (mol·dm ⁻³)	0,75	0,625	0,5	✓ Divide by 2

$$K_c = \frac{[C]^2}{[X]^2[Y]} \checkmark$$

$$\therefore = \frac{[0,5]^2}{[0,75]^2[0,625]} \checkmark$$

$$= 0,71 \checkmark$$

No K_c expression, correct substitution. 6/7

Wrong K_c expression 4/7

(7)
[27]

QUESTION 7

- 7.1.1 acids produce hydrogen ions ($\text{H}^+/\text{H}_3\text{O}^+/\text{hydronium ions}$) in aqueous solutions. ✓✓

Marking criteria:

If any one of the underlined key phrases in the correct context is omitted, deduct 1 mark.

(2)

- 7.1.2 Hydrogen sulphate ion/ HSO_4^- ✓
Acts as an acid and a base ✓

(2)

- 7.2.1 H_2O ✓
 $(\text{COO})_2^{2-}$ ✓

(2)

- 7.2.2 Oxalic acid. ✓
Has a higher K_a value. ✓
Ionises to a greater extent / more completely. OR has a higher ion concentration. ✓

(3)

- 7.3.1 REMAINS THE SAME ✓

(1)

- 7.3.2 DECREASES ✓ The volume increases while number of moles is constant /
The number of moles of acid decreases in proportion to the volume of water ✓

(2)

- 7.4.1 The point at which the acid has completely reacted with the base /
The point at which the base has completely reacted with the acid ✓✓

(2)

7.4.2

Marking criteria:

- Formula $\frac{C_A V_A}{C_B V_B} = \frac{n_A}{n_B} / n = cV$ ✓
- Substitution for C_A , V_A and V_B in the above formula/cV ✓
- Ratio $n_A : n_B$ ✓
- Final answer: 0,365 mol.dm⁻³ ✓

$$\frac{C_A V_A}{C_B V_B} = \frac{n_A}{n_B} \quad \checkmark$$

$$\frac{0,29 \times 12,58}{C_B \times 20} = \frac{1}{2} \quad \checkmark$$

$$C_B = 0,365 \text{ mol.dm}^{-3} \quad \checkmark$$

OR

$$\begin{aligned} n(\text{NaHCO}_3) &= 2 n(\text{H}_2\text{SO}_4) \\ &= 2 cV \quad \checkmark \\ &= 2(0,29)(0,01258) \\ &= 7,2964 \times 10^{-3} \text{ mols} \\ c(\text{NaHCO}_3) &= \frac{n}{V} \quad \checkmark \\ &= \frac{7,2964 \times 10^{-3}}{0,02} \\ &= 0,365 \text{ mol.dm}^{-3} \quad \checkmark \end{aligned}$$

(4)

7.4.3 POSITIVE MARKING FROM QUESTION 7.4.2

Marking criteria:

- Any Formula: $n = CV / m = nM / m = CMV$ Formula: $m = nM$ ✓
- Substitution: 0,365 from 7.3.1 and 0,25 ✓
- Substitute $M = 84$ ✓ in any of the above formulae
- Final answer: 7,665 g ✓

OPTION1

$$\begin{aligned} n(\text{NaHCO}_3) \text{ in } 250 \text{ cm}^3 &= cV \quad \checkmark \\ &= (0,365)(0,25) \quad \checkmark \\ &= 0,09125 \text{ mols} \\ m(\text{NaHCO}_3) \text{ in } 250 \text{ cm}^3 &= nM \\ &= 0,09125 \times 84 \quad \checkmark \\ &= 7,67 \text{ g} \quad \checkmark \end{aligned}$$

OPTION2

$$\begin{aligned} m &= CMV \quad \checkmark \\ &= (0,365)(0,25) \quad \checkmark (84) \quad \checkmark \\ &= 7,67 \text{ g} \quad \checkmark \end{aligned}$$

(4)

[22]
150

TOTAL: