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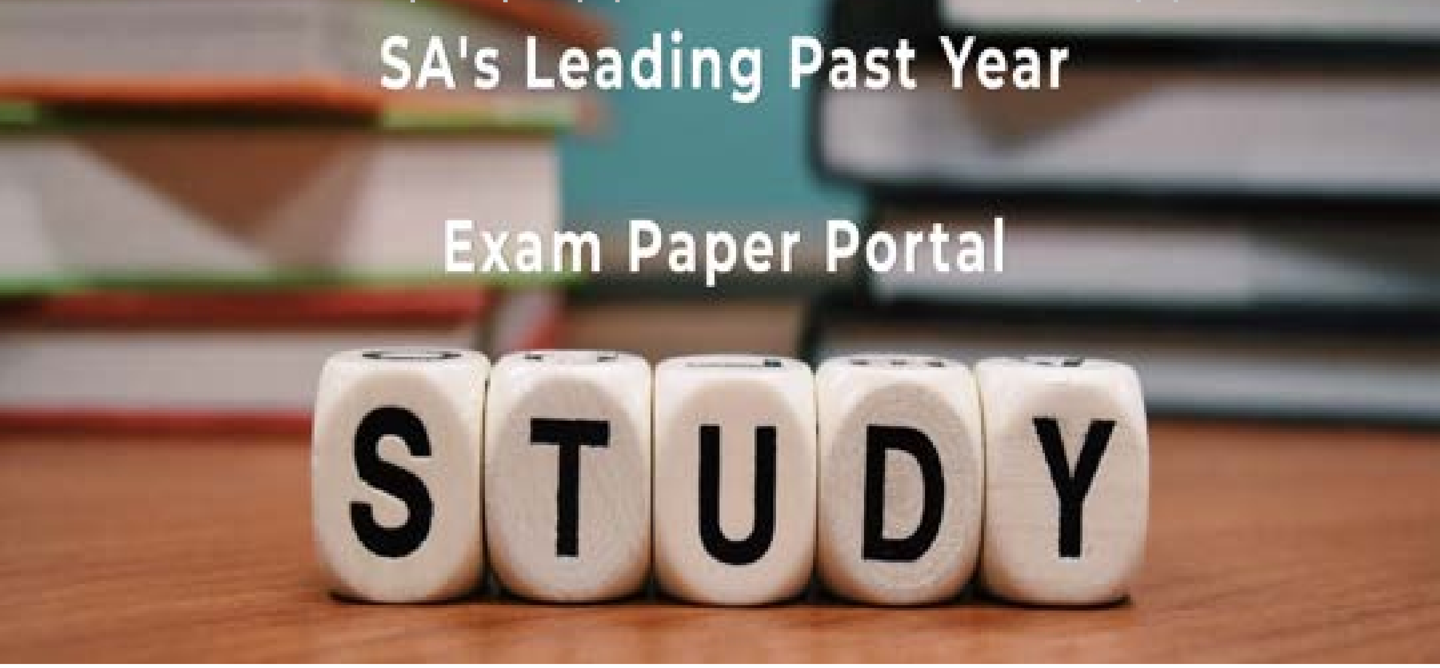

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KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GRADE 12

NATIONAL SENIOR CERTIFICATE

PHYSICAL SCIENCES P2 (CHEMISTRY)

COMMON TEST

JUNE 2024

MEMORANDUM FINAL

MARKS: 100

This memorandum consists of 10 pages.

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QUESTION 1

1.1 C ✓✓ (2)

1.2 B✓✓ (2)

1.3 B ✓✓ (2)

1.4 A ✓✓ (2)

1.5 B✓✓ (2)

1.6 D✓✓ (2)
[12]

QUESTION 2

2.1.1 2 – methylbutan – 2 – ol✓✓

Marking criteria:
- correct stem i.e. butanol✓
- IUPAC name completely correct including numbering, sequence and hyphen ✓

(2)

2.1.2 DO NOT MARK

2.2 Tertiary. ✓
The hydroxyl group/OH✓ is bonded to a carbon that is bonded to 3 other carbon atoms/tertiary carbon. ✓ (3)

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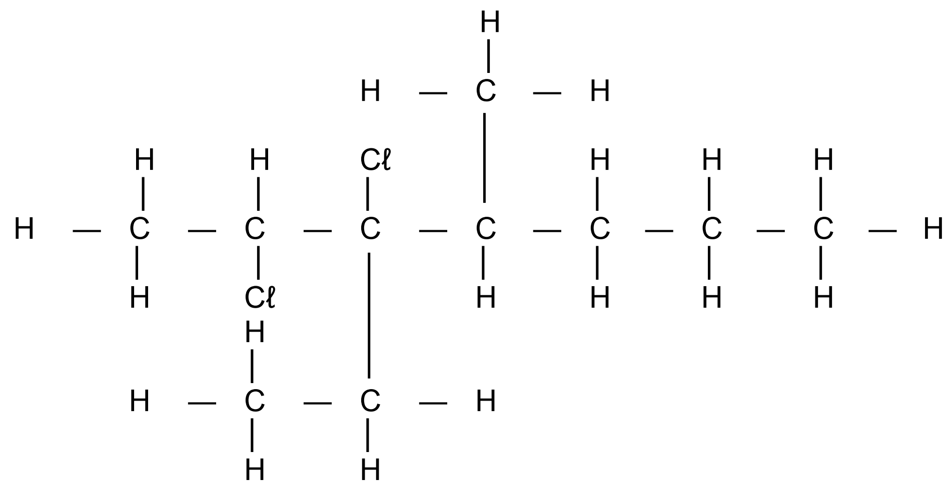
2.3.1



Marking criteria:
- Seven C atoms in longest chain.✓
- Cℓ on second and third carbon atoms, Ethyl substituent on third carbon and methyl substituent on fourth carbon. ✓
- Everything else correct✓

(3)

2.3.2

Marking criteria:
- The elements C, H and O.✓
- The correct ratio of the elements 3:6:1. ✓

C_3H_6O✓✓ (2)

CONVERSION TABLE

0	1	2	3	4	5	6	7	8	9	10
0	1	2	4	5	6	7	8	10	11	12

[12]

QUESTION 3

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

Marking criteria:

If any one of the underlined key words/phrases in the correct context is omitted, deduct 1 mark
NOTE: If "temperature" is not referred to, then 0/2.

(2)

3.2 A✓
A has a lower boiling point. ✓ (2)

3.3.1 Boiling point✓ (1)

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3.3.2 Homologous series/functional group/type of intermolecular force✓ (1)

3.4

Marking criteria:

- Identify intermolecular forces in A ✓ and in B. ✓
- Compare the strength of the intermolecular forces✓ and
- Compare the energy required to overcome the intermolecular ✓ forces. ✓
- Compare boiling points. ✓

- Intermolecular forces between molecules of A are dipole-dipole✓ and between molecules of B hydrogen bonding.✓
- The intermolecular forces are stronger in B than that in A / Hydrogen bonding is stronger than dipole-dipole forces ✓
- More energy is required to overcome the intermolecular forces in B. ✓
- B has a higher boiling point than A.✓ [*If this is not stated, and the explanation is correct, award this mark to any of the preceding bullets*] (5)

3.5.1 Higher than✓ (1)

3.5.2 Lower than✓ (1)
[13]

QUESTION 4

4.1.1 Substitution✓ (1)

4.1.2 $C_4H_9Br + NaOH \rightarrow C_4H_{10}O + NaBr$
OR
$C_4H_9Br + KOH \rightarrow C_4H_{10}O + KBr$
OR
$C_4H_9Br + LiOH \rightarrow C_4H_{10}O + LiBr$
OR
$C_4H_9Br + H_2O \rightarrow C_4H_{10}O + HBr$

Marking criteria:
- Both reactants✓
- Both products✓
- Balancing ✓

NOTE: *Accept if C_4H_9OH is given instead of $C_4H_{10}O$*

(3)

4.2 Addition/hydration ✓ (1)

4.3.1 alkenes✓ (1)

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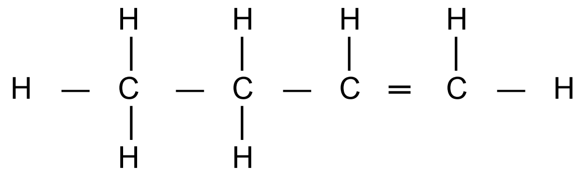
4.3.2

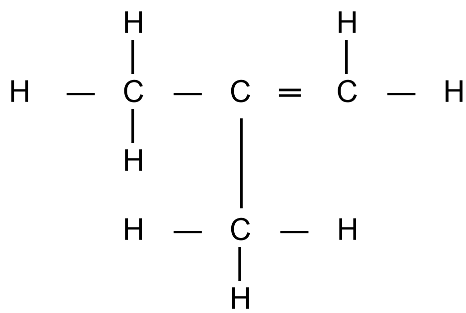


<u>Marking criteria</u>:
- double bond between the first and second carbon✓
- Whole structure correct ✓

<u>NOTE</u>: If correct structure given for but-2-ene: $^1/_2$

(2)

4.3.3



<u>Marking criteria for structural formula</u>:
- 3 carbon atoms in longest chain. ✓
- Methyl substituent and double bond.✓
- Whole structure correct ✓

The <u>molecular formula is the same,</u> ✓ <u>but the isomer is branched</u>/ <u>length of the (parent) carbon chain is different</u>. ✓ (5)

4.4 Ethanoic acid✓ (1)

[14]

QUESTION 5

5.1.1
- <u>Change in concentration</u> ✓ of products/reactants <u>per (unit) time</u>. ✓ OR
- <u>Change in amount/number of moles/volume/mass</u> ✓ of products/reactants <u>per (unit) time</u>. ✓ OR
- <u>Amount/number of moles/volume/mass of products formed/reactants used</u>✓ per (unit) time. ✓ OR
- Rate of change of concentration/amount/no. of moles/volume/mass. ✓✓ (**2 or 0**)

(2)

5.1.2 The HCℓ is the limiting reagent/reactant / Mg is the excess reagent✓ (1)

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5.1.3 **Marking criteria:**

- Substitute 15 in $\frac{\Delta(V(H_2))}{\Delta t}$ ✓
- Substitute 12 in $\frac{\Delta(V(H_2))}{\Delta t}$ ✓
- Substitute V and V_m in $\frac{V}{V_m}$ ✓✓
- Correct Ratio of HCℓ to H_2✓
- Equation $c = \frac{n}{V}$ ✓
- Substitute for n and V in the above equation✓
- Final answer 0,023 $mol.dm^{-3}$✓

$$\text{rate} = \frac{\text{change in volume of } H_2(g)}{\Delta t}$$

$$15 ✓ = \frac{\Delta(V(H_2)}{12 ✓}$$

$$\Delta(V(H_2)) = 180 \text{ cm}^{-3}$$
$$= 0{,}18 \text{ dm}^3$$

$$n(H_2)\text{produced} = \frac{V}{V_m}$$
$$= \frac{0{,}18 ✓}{26{,}49 ✓}$$
$$= 6{,}795 \times 10^{-3} \text{ mols}$$

$$n(HCℓ) = 2n(H_2) ✓$$
$$= 2(6{,}795 \times 10^{-3})$$
$$= 0{,}01359 \text{ mol}$$

$$c(HCℓ) = \frac{n}{V} ✓$$
$$= \frac{0{,}01359}{0{,}6} ✓$$
$$= 0{,}02265 \text{ mol.dm}^{-3} ✓$$ (8)

5.2.1 REMAINS THE SAME✓ (1)

5.2.2 Powdered magnesium increases the surface area but <u>mass remains the same</u> ✓
The rate of the reaction increases. ✓
HCl is the limiting reagent / Mg is the excess reagent. ✓
The number of effective collisions remains constant / The number of effective collisions per unit time increases✓ (4)

[16]

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QUESTION 6

6.1.1 The rate of the forward reaction equals the rate of the reverse reaction.
OR The amount/concentration of reactants and products remain constant. ✓✓ (2)

6.1.2

Marking criteria:
If any one of the underlined key words/phrases in the correct context is omitted, deduct 1 mark. The underlined phrase must be in the correct context.

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.✓✓ (2)

6..1.3 EXOTHERMIC. ✓

- Reaction rate decreased/Temperature decreased. ✓
- Concentration of products increased/concentration of reactants decreased / Forward reaction favoured / According to Le Chatelier's principle a decrease in temperature favours the exothermic reaction. ✓ (3)

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6.2

Marking criteria:
(a) Calculating initial number of moles of reactants. ✓
(b) Changing equilibrium concentration to equilibrium moles for O_2, and equilibrium moles to equilibrium concentrations for NO and NO_2.✓
(c) Calculating ∆ moles of O_2 (0,375 mol), and equilibrium moles of NO and NO_2. ✓
(d) Apply ratio 2:1:2 to calculate change in number of moles of NO and NO_2. ✓
(e) K_c expression✓
(f) Correct substitution of K_c in expression✓
(g) Correct substitution of equilibrium concentrations into K_c expression ✓
(h) Final answer 2,6 mols✓

OPTION 1	NO	O_2	NO_2	
Initial quantity (mol)	4	2,5	✓ x	
Change (mol)	0,75	0,375	0,75	✓
Quantity at equilibrium (mol)	3,25	2,125	x + 0,75	✓
Equilibrium concentration (mol.dm^{-3})	6,5	4,25	$\frac{x+0,75}{0,5}$	✓

$K_c = \frac{[NO_2]^2}{[NO]^2[O_2]}$ ✓

$\therefore 0,25✓ = \frac{[\frac{x+0,75}{0,5}]^2}{(6,5)^2(4,25)}$✓

x = 2,6 mols ✓

No K_c expression, correct substitution: Max $\frac{7}{8}$

Wrong K_c expression: Max $\frac{5}{8}$

OPTION 2	NO	O_2	NO_2	
Initial quantity (mol)	4	2,5	✓2.6✓	
Change (mol)	0,75	0,375	0,75	✓
Quantity at equilibrium (mol)	3,25	2,125	3,35	✓
Equilibrium concentration (mol.dm^{-3})	6,5	4,25	6,7	✓

$K_c = \frac{[NO_2]^2}{[NO]^2[O_2]}$ ✓

$\therefore 0,25✓ = \frac{[NO_2]^2}{(6,5)^2(4,25)}$✓

$[NO_2]$ = 6,7 mol·dm^{-3}

No K_c expression, correct substitution: Max $\frac{7}{8}$

Wrong K_c expression: Max $\frac{5}{8}$

(8)
[15]

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QUESTION 7.

7.1.1	H_2SO_4✓	(1)
7.1.2	H_2SO_4 donates a proton (to H_2O). ✓	(1)
7.1.3	HSO_4^-. ✓	(1)
7.1.4	H_2SO_4✓	(1)
7.2.1	(The point) where the indicator changes colour. ✓	(1)
7.2.2	Methyl orange✓	(1)
7.2.3	Reaction between strong acid and weak base. ✓ pH will be less than 7 at endpoint, ✓ which corresponds to pH range when indicator changes colour.	(2)

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7.3

Marking criteria:

- Substutute 1,2 and 0,175 in n = cV to calculate $n(HNO_3)_{initial}$✓
- Ratio HNO_3 : Na_2CO_3 = 2:1✓
- Substitute 0,65 and 0,01294 $n(HNO_3)_{initial}$ to calculate $n(HNO_3)_{excess}$ in 25 cm^3 ✓
- Calculate $n(HNO_3)_{excess}$ in 175 cm^3✓
- $n(HNO_3)_{inital}$ - $n(HNO_3)_{excess}$ = $n(HNO_3)_{reacted}$✓✓ (for subtraction)
- Ratio HNO_3 : KOH = 1:1 to calculate $n(KOH)_{pure}$✓
- Substitute molar mass of KOH (56 g) to calculate mass of $(KOH)_{pure}$✓
- Substitute pure and impure mass in percentage purity formula ✓
- Final answer: 64,57 %✓ Range (63 – 64,57%)

$n(HNO_3)_{initial}$ = cV

= $(1,2)\frac{(175)}{(1000)}$ ✓

= 0,21 mol

$n(HNO_3)_{excess}$ in 25 cm^3 = $2n(Na_2CO_3)$ ✓

= 2cV

= $2(0,65)\frac{(12,94)}{(1000)}$ ✓

= 0,016822 mol

$n(HNO_3)_{excess}$ in 175 cm^3 = (0,016822)(7) ✓

= 0,117754 mol

$n(HNO_3)_{reacted}$ with KOH = 0,21 - 0,117754 (for subtraction) ✓✓

= 0,092246 mol

$n(KOH)_{pure}$ = $n(HNO_3)_{reacted}$✓

= 0,092246 mol

$n(KOH)_{pure}$ = $\frac{m}{M}$

0,092246 = $\frac{m}{56}$✓

$m(KOH)_{pure}$ = 5,165776 g

% purity = $\frac{5,165776}{8} \times 100$ ✓

= 64,57 %✓

Range (63 – 64,57%)

(10)
[18]

TOTAL: 100

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