FINAL

KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GRADE 12

NATIONAL SENIOR CERTIFICATE

PHYSICAL SCIENCES P2 (CHEMISTRY)

JUNE 2025 EXAMINATION

MEMORANDUM

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MARKS: 150

This memorandum consists of 13 pages.

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QUESTION 1

1.1 C✓✓ (2)

1.2 C ✓✓ (2)

1.3 A ✓✓ (2)

1.4 D ✓✓ (2)

1.5 A ✓✓ (2)

1.6 D ✓✓ (2)

1.7 B ✓✓ (2)

1.8 C✓✓ (2)

1.9 D ✓✓ (2)

1.10 B ✓✓ (2)

[20]

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QUESTION 2

2.1.1 C✓ (1)

2.1.2 A✓ (1)

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2.2 The alcohol for which the <u>functional group/OH/hydroxyl is attached to a carbon</u>✓ that is <u>bonded to 2 other carbon atoms.</u> ✓

<u>Marking criteria</u>*:*
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.

(2)

2.3 B✓✓ (2)

2.4.1 propyl ethanoate✓✓✓

<u>Marking criteria</u>*:*
• correct homologous series ✓ • alkyl group 3 carbon atoms✓ • alkanoate 2 carbon atoms ✓

(3)

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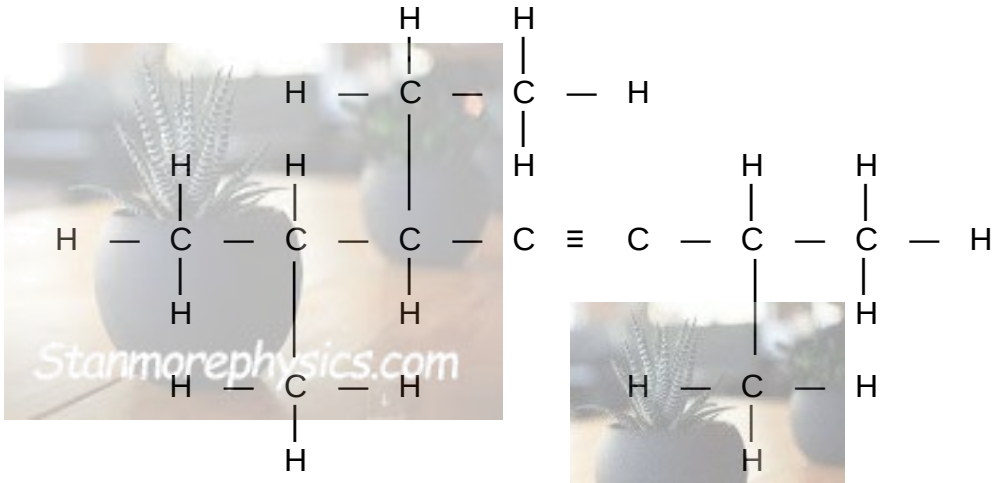
2.4.2 1 – chloro – 2,4,5 - trimethylhexane✓✓✓

Marking criteria:
- correct stem i.e. hexane ✓
- substituents correctly identified i.e. chloro,trimethyl✓
- IUPAC name completely correct including numbering, sequence and hyphen ✓

(3)

2.5.1 alkynes✓ (1)

2.5.2



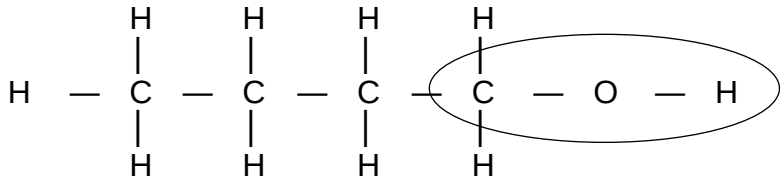
Marking criteria:
- Triple bond on 3rd carbon atom✓
- 2 methyl groups and ethyl group shown✓
- Whole structure correctly drawn with the substituents on the correct C atoms ✓

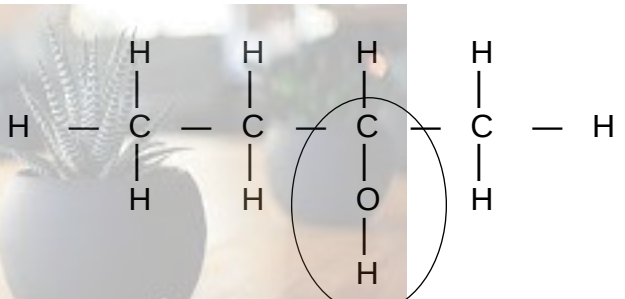
(3)

2.6

Same molecular formula, but different positions of the side chain, substituents or functional groups on the parent chain✓✓ **(2 or 0)** (2)

2.7





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Marking criteria:

- Both compounds have the hydroxyl/OH functional group correctly drawn✓
- Functional group shown on first carbon for the one compound. ✓
- Functional group shown on second carbon for the other compound. ✓
- Whole structure correctly drawn for both compounds✓ (If -OH is used ¾ max)



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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.

(2)

3.2 The molecular mass for both compounds is the same. ✓ (1)

3.3 Homologuous series/functional group ✓ (1)

3.4.1 HIGHER THAN✓ (1)

3.4.2
- Both compounds have hydrogen bonds, (London forces and dipole – dipole forces) ✓
- Compound P has 2 sites for hydrogen bonding while compound R has only 1 site for hydrogen bonding✓
- The intermolecular forces between molecules of P are stronger than the intermolecular forces between molecules of compound R✓
- More energy is required to overcome the intermolecular forces between molecules of P✓

Marking criteria:
- Identify type of intermolecular forces. ✓
- Compare number of sites for hydrogen bonding. ✓
- Compare the strength of the intermolecular forces. ✓
- Compare the energy required to overcome the intermolecular forces. ✓

(4)

3.5.1 B✓ (1)

3.5.2
- Graph B represents a lower vapour pressure. ✓
- The lower the vapour pressure the higher the boiling point. ✓
- P has a higher boiling point. ✓

Marking criteria:
- Identify graph B as lower pressure.✓
- State the relationship between vapour pressure and boiling point. ✓
- State that P has a higher boiling point. ✓

(3)

3.6 REMAINS THE SAME✓ (1)

3.7.1 LOWER THAN 97 °C✓ (1)

3.7.2	• Both compounds R and S have London forces/Dispersion forces and Hydrogen Bonding. ✓ • However, S has a smaller surface area than R, over which the intermolecular forces act. ✓ • The intermolecular forces between molecules of S are weaker. ✓ • Less energy will be required to overcome the intermolecular forces between molecules of S. ✓	
	OR	
	• Both compounds R and S have London forces/Dispersion forces and Hydrogen Bonding. ✓ • However, R has a larger surface area than S, over which the intermolecular forces act. ✓ • The intermolecular forces between molecules of R are stronger. ✓ • More energy will be required to overcome the intermolecular forces between molecules of R. ✓	(4)

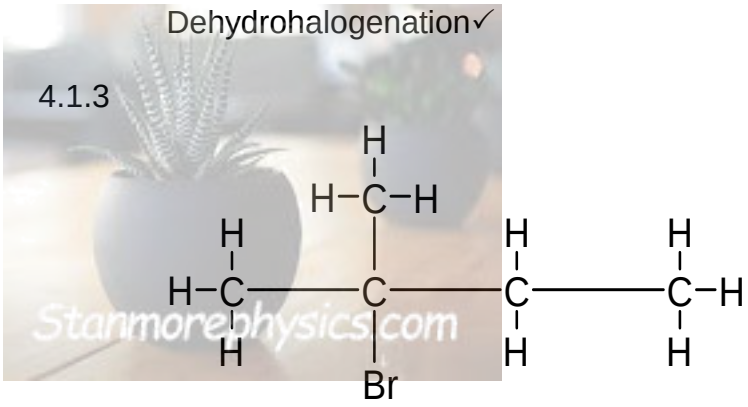
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QUESTION 4

4.1.1 Potassium hydroxide/KOH✓ (1)

4.1.2 Elimination✓
Dehydrohalogenation✓ (2)

4.1.3



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Marking criteria:
- Br on 2nd carbon atom✓
- Four carbons in longest chain✓
- One methyl substituent on C2 ✓

(3)

4.2.1 hydrohalogenation ✓ (1)

4.2.2 The presence of water will result in a hydration reaction/formation of an alcohol✓✓ (2)

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4.3.1 Water/H_2O✓ (1)

4.3.2 Reaction 4✓ (1)

4.3.3 Reaction 3✓ (1)

4.3.4 $C_5H_{11}Br + H_2O \rightarrow C_5H_{12}O + HBr$

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

(3)

4.4.1 The (reddish – brown) colour of Br_2 disappears immediately✓ (1)

4.4.2 1,2 – dibromo – 2 - methylbutane✓✓

Marking criteria:
- correct stem i.e. butane, substituents correctly identified i.e. dibromo, methyl✓
- IUPAC name completely correct including numbering, sequence and hyphen ✓

(2)

4.5 $C_5H_{12} + 8\ O_2 \rightarrow 5\ CO_2 + 6\ H_2O$

Marking criteria:
- Reactant C_5H_{12}✓
- Reactant O_2✓
- Both products correct✓
- Balancing✓

(4)
[22]

QUESTION 5

5.1
- Change in concentration ✓ of products/reactants per (unit) time. ✓
- Change in amount/number of moles/volume/mass ✓ of products/reactants per (unit) time. ✓

Marking criteria:

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

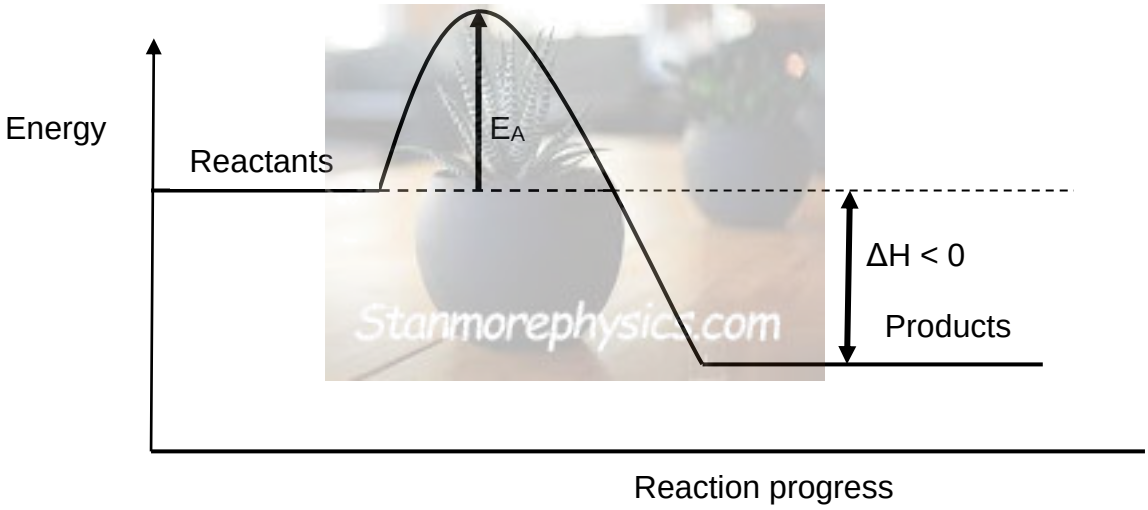
OR
- Amount/number of moles/volume/mass of products formed/reactants used per (unit) time. ✓✓(**2 or 0**)
- Rate of change in concentration/amount/number of moles/volume/ mass. ✓✓ (**2 or 0**)

(2)

5.2 Exothermic✓ (1)

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5.3



Marking Criteria

- Energy of reactants correctly shown✓
- Energy of products correctly shown✓
- Activation energy shown✓
- Heat of reaction correctly indicated✓
- Diagram correctly labeled✓

5.4

- Reaction rate is higher in the first 60 s✓ because there are more reactants in the reaction vessel (than when the reaction has proceeded for some time). ✓
- More effective collisions per unit time/second/ Frequency of effective collisions is higher. ✓
- More molecules have enough/sufficient kinetic energy for an effective collision/ More molecules have kinetic energy/Ek equal to or greater than the activation energy. ✓ (4)

5.5

- Provides an alternate pathway of lower activation. ✓
- More molecules have sufficient energy/energy equal to or greater than the activation. ✓
- More effective collisions per unit time. ✓ (3)

5.6

Marking criteria

- Correct Equation✓
- Substitute correctly into equation ✓
- $V(O_2)$ = 116,004 cm^3✓
- Correct substitution into $n = \frac{V}{V_m}$ to calculate $n(O_2)$produced✓
- Correct ratio: H_2O_2 : O_2 = 1 : 2 ✓
- Calculate $n(H_2O_2)$initial✓
- Calculate $n(H_2O_2)$final✓
- .Conclusion: H_2O_2 NOT completely used up✓

$$\text{rate} = \frac{\text{change in volume of } O_2(g)}{\Delta t} \checkmark$$

$$16{,}572 = \frac{y - 0}{7 - 0} \checkmark$$

$$y = 116{,}004\ cm^3 \checkmark$$

$$n = \frac{V}{V_m}$$

$$= \frac{0{,}116}{22{,}4} \checkmark$$

$$= 0{,}01\ mol$$

$$n(H_2O_2)\text{reacted} = 2\,n(O_2)$$

$$= 2(0{,}01) \checkmark$$

$$= 0{,}02\ mol$$

$$n(H_2O_2)\text{initial} = cV$$

$$= (0{,}2)(0{,}2) \checkmark$$

$$= 0.04\ mol$$

$$n(H_2O_2)\text{excess} = 0{,}04 - 0{,}02 \checkmark$$

$$= 0{,}02\ mol$$

- Reaction has not reached completion.
- 0,02 mol of H_2O_2 has not decomposed. ✓

(8)
[23]

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QUESTION 6

6.1.1

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)

6.1.2 INCREASE. ✓
According to Le Chatliers Principle when the pressure decreases, the reaction that leads to an increase in the number of moles will be favoured. ✓
The forward reaction produces a greater number of moles than the reverse reaction. ✓
In this case the forward reaction is favoured/equilibrium position shifts to the right.✓ (4)

6.2.1

Marking criteria:

- REVERSE✓
- Kc expression✓
- Correct Substitution of Kc, [NO], [N_2O], [O_2]✓
- Calculating the [NO_2] ✓
- Comparing the calculated value of [NO_2] with the new value. ✓

REVERSE✓

$$Kc = \frac{[N_2O][O_2]}{[NO_2][NO]} \quad ✓$$

$$3{,}93 = \frac{(0{,}18)(0{,}38)}{[NO_2][0{,}29]} \quad ✓$$

$$[NO_2] = 0{,}060 \text{ mol.dm}^{-3} \quad ✓$$

The concentration of NO_2 has increased from 0,06 mol.dm^{-3} to 0,12 mol.dm^{-3} ✓ (5)

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6.2.2

Marking criteria:
- Initial concentrations of all substances✓
- Concentration of NO_2 at equilibrium✓
- Using the correct mol ratio✓
- Calculating the concentration at equilibrium of all three substances ✓
- Correct substitution of equilibrium concentrations into K_c expression ✓
- Kc = 0,91✓
- Identifying that the condition changed is temperature. ✓
- Kc value changed. ✓

Temperature✓

	NO_2	NO	N_2O	O_2	
Initial concentration ($mol.dm^{-3}$)	0,06	0,29	0,18	0,38	✓
Change ($mol.dm^{-3}$)	0,06	0,06	0,06	0,06	✓
Equilibrium concentration ($mol.dm^{-3}$)	0,12✓	0,35	0,12	0,32	✓

$$Kc = \frac{[N_2O][O_2]}{[NO_2][NO]}$$

$$= \frac{(0,12)(0,32)}{[0,12][0,35]} \checkmark$$

$$= 0,91 \checkmark$$

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Kc value has changed (decreased). ✓

(8)

6.2.3 Decreased. ✓
Reverse reaction was favoured. ✓
According to Le Chatelier's Principle a decrease in temperature favours the exothermic reaction. ✓ (3)

[22]

QUESTION 7

7.1.1 A substance that can act as an acid or as a base. ✓✓ **(2 or 0)** (2)

7.1.2 HCO_3^- ✓
H_2O ✓ (2)

7.1.3 $HCO_3^-(aq) + H_2O(\ell) \rightleftharpoons H_2CO_3(aq)$ ✓ + OH^- (aq) ✓

(2)

7.2.1 Strong base dissociates completely✓ in water to form a high concentration of OH^-/hydroxide ions. ✓

Marking criteria:

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

(2)

7.2.2 bromothymol blue✓✓ (2)

7.2.3

Marking criteria:

- Formula: pH = - log$[H_3O^+]$
- Correct substitution✓
- Ratio of $[H_3O^+]$ to $[H_2SO4]$ = 2:1✓
- H_2SO_4 undergoes complete ionisation.✓

pH = - log$[H_3O^+]$ ✓

1 = - log$[H_3O^+]$ ✓

$[H_3O^+]$ = 0,1 mol.dm^{-3}

$[H_2SO_4]$ = ½$[H_3O^+]$

= ½(0,1) ✓

= 0,05 mol.dm^{-3}

All the H_2SO_4 is ionised to $[H_3O^+]$ ✓

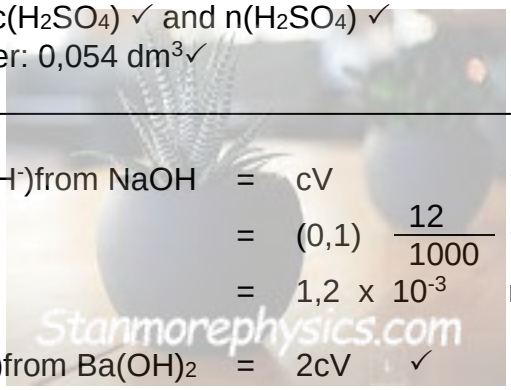


(4)

7.2.4

Marking criteria:

- Equation n = cV✓
- Substitute for c and V in n = cV to calculate n(OH^-) from NaOH✓
- Substitute for c and V in n = cV to calculate n(OH^-) from $Ba(OH)_2$✓
- Add above values to obtain total n(OH^-)✓
- Use correct ratio to calculate n(H_2SO_4)✓
- Substitute c(H_2SO_4) ✓ and n(H_2SO_4) ✓
- Final answer: 0,054 dm^3✓



n(OH^-)from NaOH = cV ✓

= (0,1) $\frac{12}{1000}$ ✓

= 1,2 x 10^{-3} mols

n(OH^-)from $Ba(OH)_2$ = 2cV ✓

= 2(0,04375) $\frac{12}{1000}$ ✓

= 4,2 x 10^{-3} mols

n(OH^-)$_{Total}$ = 1,2 x 10^{-3} + 4,2 x 10^{-3} ✓(for addition)

$= 5,4 \times 10^{-3}$ mols

$n(H_2SO_4) : n(OH^-)_{Total} = 1:2$ ✓ for ratio

$n(H_2SO_4) = ½(5,4 \times 10^{-3})$

$= 2,7 \times 10^{-3}$ mols

$$c(H_2SO_4) = \frac{n}{V}$$

$$0,05 = \frac{2,7 \times 10^{-3}}{V}$$ ✓

$V = 0,054\ dm^3$ ✓

(8)

[22]

TOTAL: 150



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