Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2024

PHYSICAL SCIENCES: (CHEMISTRY) P2

MARKS: 150

TIME: 3 hours

This question paper consists of 19 pages, including 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and surname in the appropriate space on the ANSWER BOOK.
2. This question paper consists of SEVEN questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your FINAL numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, et cetera. where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 E.

1.1 The homologous series that contain a carbon-carbon triple bond is …

A alkanes.

B alkenes.

C alkynes.

D haloalkanes. (2)

1.2 Consider the following compounds:

Compounds	
A	Pentan-1-ol
B	Butan-1-ol
C	Pentanoic acid

Which ONE of the following correctly rank the above pure substances in the order of increasing strength of intermolecular forces?

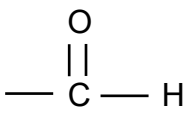
A Pentan-1-ol, butan-1-ol, pentanoic acid

B Pentanoic acid, butan-1-ol, pentan-1-ol

C Butan-1-ol, pentanoic acid, pentan-1-ol

D Butan-1-ol, pentan-1-ol, pentanoic acid (2)

1.3 Consider the structural formula:



Which ONE of the following compounds contains the above functional group?

A Propanal

B Propanone

C Propan-1-ol

D Propanoic acid (2)

1.4 2-methylpropan-1-ol can form two isomers. Which ONE of the following combinations CORRECTLY identifies the ISOMER and the TYPE OF ISOMER?

	NAME OF ISOMER	TYPE OF ISOMER
A	Butan-1-ol	Positional
B	2-methylpropan-2-ol	Chain
C	Butan-1-ol	Functional
D	2-methylpropan-2-ol	Positional

(2)

1.5 The conversion of CH_3CHCH_2 to $CH_3CH_2CH_3$ is known as …

A hydration.

B hydrogenation.

C halogenation.

D hydrohalogenation. (2)

1.6 Hydrochloric acid reacts with EXCESS zinc according to the balanced equation:

$$2\ HC\ell\ (aq) + Zn\ (s) \rightarrow ZnC\ell_2\ (aq) + H_2\ (g)$$

Which ONE of the following factors will influence the yield of H_2 (g) but not on the rate of production of H_2 (g)?

A Temperature

B Volume of $HC\ell$

C State of division of Zn

D Concentration of $HC\ell$ (2)

1.7 Carbonic acid, H_2CO_3, ionises in water in two steps. The first step of the ionisation is given by the equation:

$$H_2CO_3\ (aq) + H_2O\ (\ell) \rightleftharpoons HCO_3^-\ (aq) + H_3O^+\ (aq)$$

Which ONE of the following substances in the above reaction can act as an ampholyte?

A H_2CO_3 and H_2O

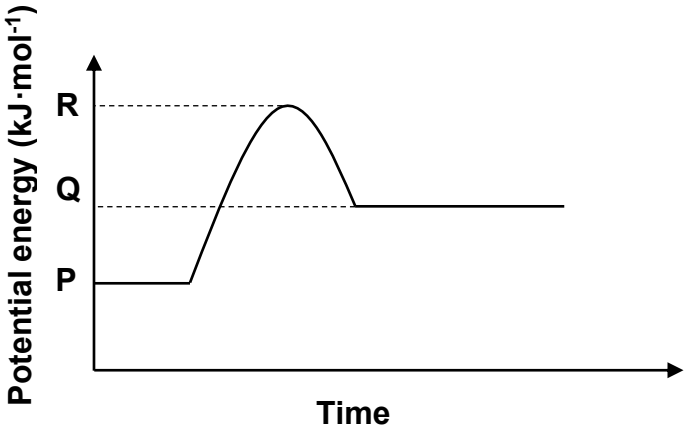
B HCO_3^- and H_3O^+

C H_2O and HCO_3^-

D H_2CO_3 and HCO_3^- (2)

1.8 The potential energy diagram for the following reversible hypothetical reaction is given:

$$2\ AB\ (g) \rightleftharpoons A_2\ (g) + Br_2\ (g)$$



Consider the following statements regarding the energy diagram.

I Δ H for the forward reaction is positive

II Catalyst would lower P–Q

III Reversible reaction is exothermic

Which of the statement(s) above is/are TRUE?

A **I** only

B **I** and **II** only

C **I** and **III** only

D **II** and **III** only (2)

1.9 Consider the following reversible reaction at equilibrium in a sealed container:

$$C\ (s) + CO_2\ (g) \rightleftharpoons 2\ CO\ (g)$$

The volume inside the container is decreased while the temperature remains constant.

Which ONE of the following combinations are CORRECT regarding the amount of CO and the rate at which the new equilibrium is reached?

	AMOUNT OF CO	REACTION RATE
A	Higher	Lower
B	Lower	Higher
C	Higher	Higher
D	Lower	Lower

(2)

1.10 Consider two solutions of $Ba(OH)_2$ (aq) and KOH (aq) each with a concentration of 0,1 $mol \cdot dm^{-3}$.

Consider the following statements regarding the two solutions.

I Both KOH and $Ba(OH)_2$ can be regarded as Arrhenius bases

II $Ba(OH)_2$ will produce a higher concentration of OH^- than KOH when it dissociates

III Double the amount of $HC\ell$ is needed to neutralise KOH than $Ba(OH)_2$

Which of the statement(s) above is/are TRUE?

A **I** only

B **I** and **II** only

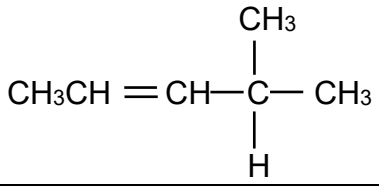
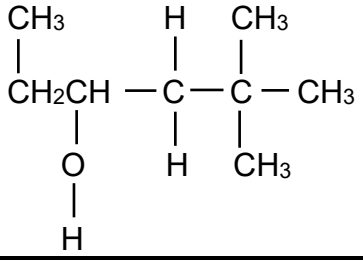
C **II** and **III** only

D **I** and **III** only

(2)
[20]

QUESTION 2 (Start on a new page.)

The table below shows organic molecules **A** to **E** from different homologous series.

A	$CH_3C\ell$	**B**	
C	Butanone	**D**	
E	$C_xH_yO_2$		

2.1 Define *homologous series.* (2)

2.2 Write down the LETTER that represents the following compounds:

2.2.1 Hydrocarbon (1)

2.2.2 Haloalkane (1)

2.2.3 Alkene (1)

2.2.4 The compound that contains the carbonyl group that is bonded to two saturated carbon atoms (1)

2.3 Is compound **D** a PRIMARY, SECONDARY OR TERTIARY ALCOHOL? Give a reason for the answer. (2)

2.4 Write down the:

2.4.1 General formula for the homologous series to which compound **B** belong. (1)

2.4.2 IUPAC name of compound **B** (2)

2.4.3 IUPAC name of compound **D** (3)

2.5 Compound **C** has a functional isomer.

2.5.1 Define the term *functional isomer.* (2)

2.5.2 Draw the STRUCTURAL FORMULA of the functional isomer of compound **C**. (2)

2.6 Compound **E** ($C_xH_yO_2$) reacts with alcohol **P** in the presence of concentrated sulphuric acid (H_2SO_4) to produce organic compound **Q** as shown by the incomplete equation below:

$$C_xH_yO_2 + \text{alcohol } \mathbf{P} \rightarrow \text{organic compound } \mathbf{Q} + H_2O$$

The percentage composition of compound **Q** is:

Organic compound **Q**		
Carbon	Hydrogen	Oxygen
58,82%	9,81%	31,37%

The molecular mass of the compound **Q** is EQUAL to the formula mass.

2.6.1 Write down the name of the type of reaction that occurred. (1)

2.6.2 Determine, by calculation, the molecular formula of organic compound **Q**. (5)

Compound **E** ($C_xH_yO_2$) has a molecular mass of 74 $g \cdot mol^{-1}$.

2.6.3 Determine the compound **E** ($C_xH_yO_2$) and write down its IUPAC name. (4)

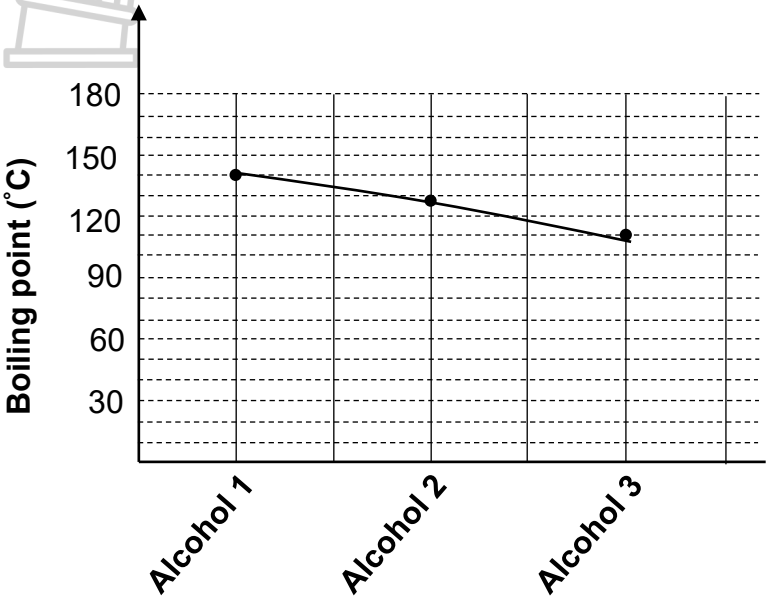
2.6.4 Determine the organic compound **Q** that was produced, write down its IUPAC name and STRUCTURAL FORMULA. (6)

[34]

QUESTION 3 (Start on a new page.)

An investigation is carried out to determine the effect of branching on the boiling points of an organic compounds. Three PRIMARY ALCOHOLS that each contains 5 carbon atoms are used during this investigation.

Equal volumes of each alcohol are heated separately in a water bath.



3.1 Define *boiling point.* (2)

3.2 What property of alcohols requires them to be heated in a water bath? (1)

3.3 Write down the boiling point of alcohol **1**. (1)

3.4 Is this a fair investigation? Write only YES or NO.
Give a reason for the answer. (2)

3.5 Give the IUPAC name of alcohol **2**. (2)

3.6 Which alcohol has the shortest chain length?

Write down only ALCOHOL **1**, ALCOHOL **2** or ALCOHOL **3**. (1)

3.7 Fully explain the answer to QUESTION 3.6. (3)

3.8 A second investigation is carried out to determine the effect of intermolecular forces on the vapour pressure.

The table below summarises the results from two organic compounds.

	COMPOUND	VAPOUR PRESSURE AT 20 °C (kPa)
A	Butanone	9,47
B	Butan-1-ol	0,58

3.8.1 Define *vapour pressure.* (2)

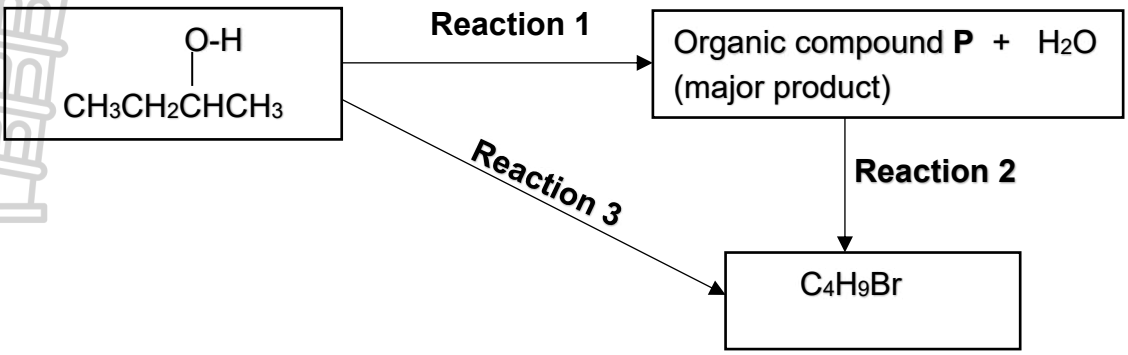
3.8.2 Explain the difference in vapour pressures by referring to the intermolecular forces involved. (4)

3.8.3 Will the vapour pressure of the above compounds INCREASE, DECREASE or REMAIN THE SAME at a higher temperature? (1)

[19]

QUESTION 4 (Start on a new page.)

4.1 Consider the flow diagram showing organic reactions given below.



Consider **REACTION 1**.

Write down the:

4.1.1 Name of the type of elimination reaction (1)

4.1.2 Name or formula of the inorganic reagent needed (1)

4.1.3 Balanced equation using STRUCTURAL FORMULAE for the organic compounds (4)

Consider **REACTION 2**.

Write down the:

4.1.4 Name the type of reaction taking place (1)

4.1.5 STRUCTURAL FORMULA and IUPAC name for the major product formed (4)

Consider **REACTION 3**.

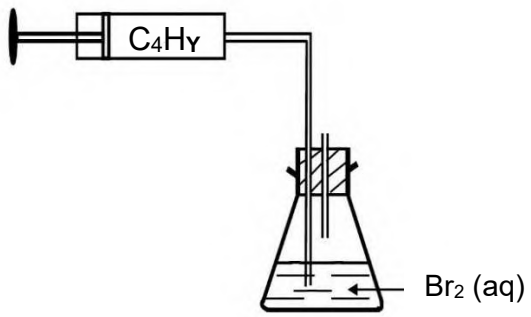
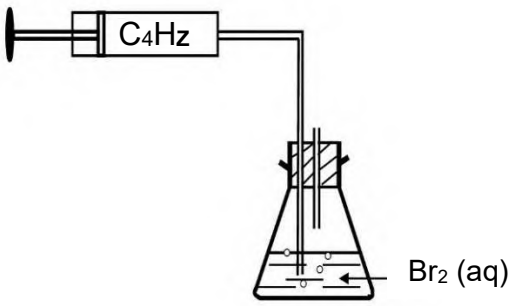
Write down the:

4.1.6 TWO reaction conditions needed (2)

4.2 Octane can be cracked according to the incomplete equation:

$$C_8H_{18} \rightarrow C_4H_Y + C_4H_Z$$

The two STRAIGHT CHAIN organic compounds, C_4H_Y and C_4H_Z, are now passed through bromine water (Br_2 (aq)) at room temperature in a darken room. The following observations are made:

EXPERIMENT 1	**EXPERIMENT 2**
Syringe  	Syringe 
When compound C_4H_Y is bubbled through the bromine water, no changes are observed.	When compound C_4H_Z is bubbled through the bromine water, the yellowish colour of the bromine water immediately turns colourless and bubbles are observed in the flask.

4.2.1 Define *cracking.* (2)

4.2.2 Give a reason why experiments **1** and **2** is carried out in a darken room. (1)

4.2.3 Which compound, C_4H_Y or C_4H_Z, is UNSATURATED?
Give a reason for the answer. (2)

Compound C_4H_Y undergoes the following reactions:

I	$C_4H_Y + C\ell_2 \xrightarrow{\text{UV-light}}$ Primary haloalkane $+ HC\ell$
II	Primary haloalkane + NaOH (conc) $\longrightarrow$ $C_4H_Z + NaC\ell + H_2O$

Write down the:

4.2.4 STRUCTURAL FORMULA for compound C_4H_Z (2)

4.2.5 Combustion reaction of compound C_4H_Y using MOLECULAR FORMULAE (3)

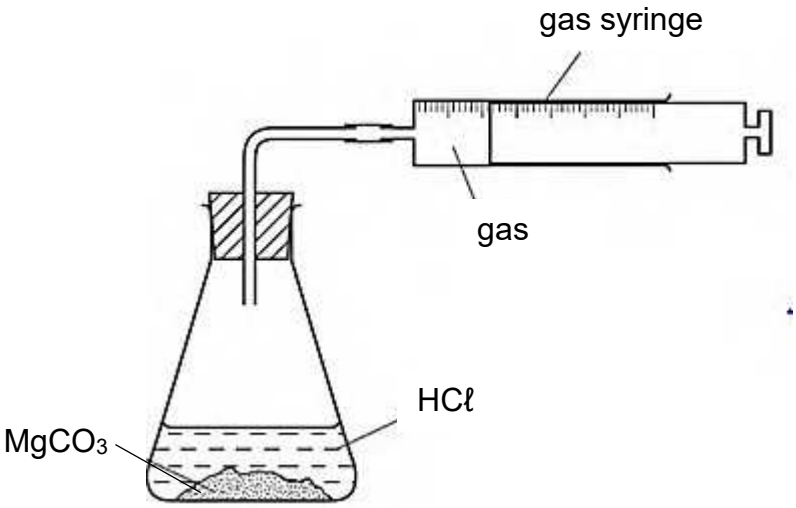
[23]

QUESTION 5 (Start on a new page.)

A group of learners use the reaction between magnesium carbonate ($MgCO_3$) and EXCESS hydrochloric acid ($HC\ell$) to investigate some of the factors that affect the reaction rate. The balanced equation for the reaction is:

$$MgCO_3\ (aq) + 2\ HC\ell\ (aq) \longrightarrow MgC\ell_2\ (aq) + H_2O\ (\ell) + CO_2\ (g)$$

The learners used the apparatus illustrated below.



The table below summarises the reaction conditions:

EXPERIMENT	REACTION CONDITIONS		
	CONCENTRATION OF $HC\ell$ ($mol{\cdot}dm^{-3}$)	STATE OF DIVISION OF $MgCO_3$	INITIAL TEMPERATURE (˚C)
1	0,9	Powder	25
2	0,9	Powder	30
3	0,9	Lumps	30

5.1 Define *reaction rate.* (2)

5.2 Write down the independent variable for the comparison between experiment **1** and **2.** (1)

5.3 Experiment **2** and **3** is now compared.

5.3.1 Which experiment, **2** or **3**, will have the highest reaction rate? (1)

5.3.2 Explain the answer to QUESTION 5.3.1 by referring to the collision theory. (3)

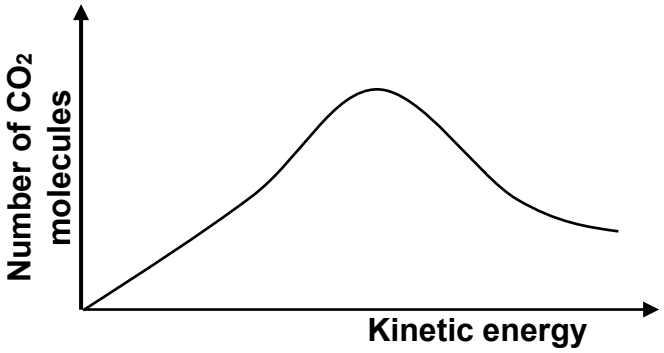
5.4 The learners measured the rate at which CO_2 was produced in experiment **2** and found it to be 0,25 $g \cdot min^{-1}$. It took 10,44 minutes to measure the time taken for the reaction to reach completion.

Calculate the:

5.4.1 Mass of $MgCO_3$ that was used (6)

5.4.2 Molar volume of CO_2 if 1,47 dm^3 of CO_2 was released (3)

5.5 The graph below represents Maxwell-Boltzmann distribution curve for $CO_2(g)$ produced experiment **1**.



Redraw the graph in your ANSWER BOOK. Clearly label the curve as **A**.

On the same set of axes, sketch the curve that will be obtained for $CO_2(g)$ if the mass of $MgCO_3$ used is increased.
Label this curve as **B**. (2)
[18]

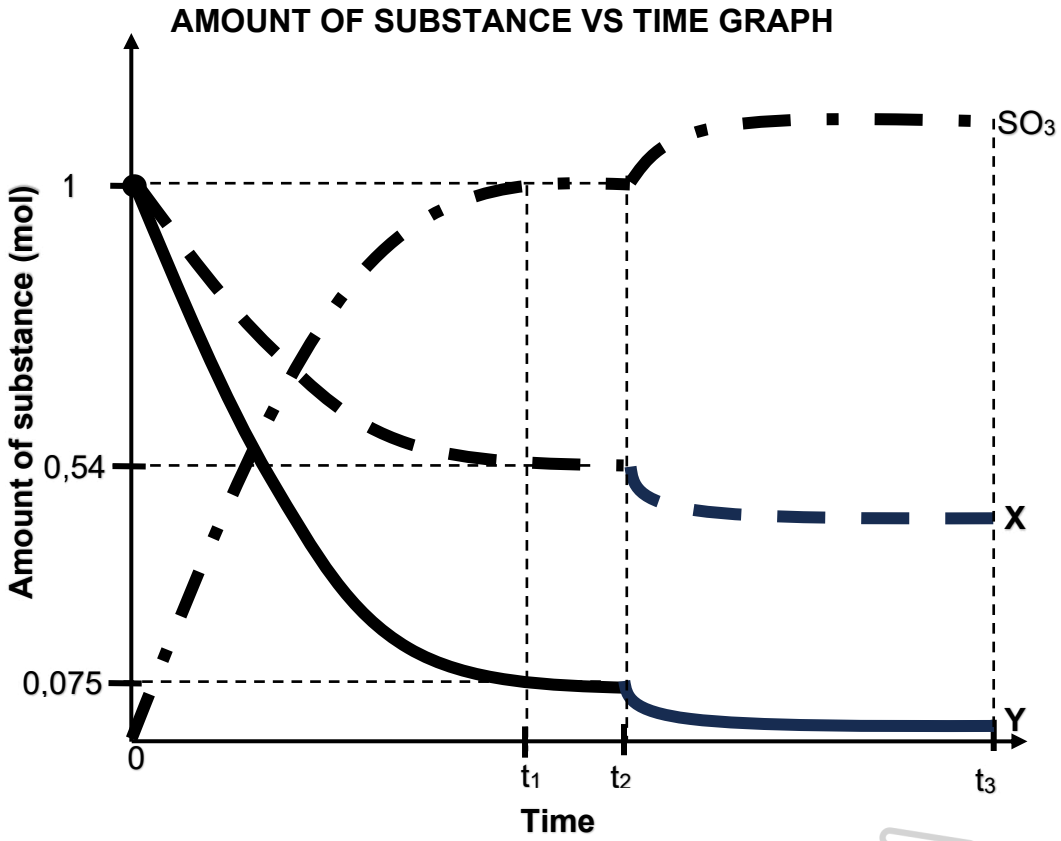
QUESTION 6 (Start on a new page.)

6.1 Initially 1 mol of sulphur dioxide SO_2 (g) and oxygen O_2 (g) are allowed to react in a sealed container according to the balanced equation:

$$2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g)$$

The graph below shows the change in amounts of reactants and products over time.

Graph is NOT drawn to scale.



6.1.1 State Le Chatelier's principle in words. (2)

6.1.2 How will the rate of the forward reaction compare to the rate of the reverse reaction between t_1 and t_2?

Choose from HIGHER THAN, LOWER THAN or EQUAL TO.

Give a reason for the answer. (2)

6.1.3 Which curve, **X** or **Y**, represent SO_2?

Give a reason for the answer. (2)

The temperature of the reaction mixture was decreased at t_2.

6.1.4 Is the heat of the reaction (ΔH) POSITIVE or NEGATIVE for the forward reaction? (1)

6.1.5 Explain the answer to QUESTION 6.1.4 by referring to Le Chatelier's principle. (3)

6.2 2,5 mol of NOCℓ was initially placed in a 1,5 dm^3 sealed container at 400 °C. After the equilibrium was established, it was found that 28% of the NOCℓ dissociated according to the balanced equation:

$$2\ NOC\ell\ (g) \rightleftharpoons 2\ NO\ (g) + C\ell_2\ (g)$$

6.2.1 Calculate the equilibrium constant, Kc-value at 400 °C. (7)

6.2.2 More NOCℓ is added to the equilibrium mixture. How will this change affect the equilibrium constant, Kc?

Write down only INCREASES, DECREASES or REMAINS THE SAME.

Give a reason for your answer. (2)
[19]

QUESTION 7 (Start on a new page.)

7.1 The balanced equation below represents the first step of the ionisation reaction of sulphuric acid (H_2SO_4):

$$H_2SO_4\ (aq) + H_2O(\ell) \rightleftharpoons HSO_4^-\ (aq) + H_3O^+\ (aq)$$

7.1.1 Define an *acid* according to the *Arrhenius theory*. (2)

Write down the:

7.1.2 FORMULAE of the TWO BASES in the above reaction (2)

7.1.3 Balanced chemical equation for the reaction between sulphuric acid (H_2SO_4) and potassium hydroxide (KOH) (3)

7.2 A standard solution of sodium hydroxide (NaOH) is prepared by dissolving 3,812 g to make a 100 cm^3 NaOH solution.

7.2.1 Calculate the concentration of sodium hydroxide (NaOH) solution. (3)

Household vinegar contains **x** % ethanoic acid (CH_3COOH) by mass. 25 cm^3 of vinegar reacts with 21,8 cm^3 sodium hydroxide (NaOH) solution prepared in QUESTION 7.2.1.

The balanced equation is:

$$CH_3COOH\ (aq) + NaOH\ (aq) \rightarrow CH_3COONa\ (aq) + H_2O(\ell)$$

7.2.2 Calculate the percentage mass of the ethanoic acid (value of **x**) found in the vinegar if 1 cm^3 of household vinegar has a mass of 1 g. (7)

[17]

TOTAL: 150

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DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^{5}$ Pa
Molar gas volume at STP *Molêre gasvolume teen STD*	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron Lading op elektron	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant Avogadro se konstante	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$ or/of $n = \frac{N}{N_A}$ or/of $n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$ $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$ $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/by 298 K

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/*TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 1 H 1																	2 He 4
1,0 3 Li 7	1,5 4 Be 9											2.0 5 B 11	2.5 6 C 12	3.0 7 N 14	3.5 8 O 16	4.0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1.5 13 Aℓ 27	1.8 14 Si 28	2.1 15 P 31	2.5 16 S 32	3.0 17 Cℓ 35,5	18 Ar 40
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1,5 22 Ti 48	1,6 23 V 51	1,6 24 Cr 52	1,5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1,6 31 Ga 70	1,8 32 Ge 73	2,0 33 As 75	2,4 34 Se 79	2,8 35 Br 80	36 Kr 84
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1,4 40 Zr 91	41 Nb 92	1,8 42 Mo 96	1,9 43 Tc	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1,7 49 In 115	1,8 50 Sn 119	1,9 51 Sb 122	2,1 52 Te 128	2,5 53 I 127	54 Xe 131
0,7 55 Cs 133	0,9 56 Ba 137	57 La 139	1,6 72 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	1,8 81 Tℓ 204	1,8 82 Pb 207	1,9 83 Bi 209	2,0 84 Po	2,5 85 At	86 Rn
0,7 87 Fr	0,9 88 Ra 226	89 Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

KEY/ *SLEUTEL*

Atoomgetal

Atomic number

Elektronegatiwiteit / Electronegativity

29 / 1,9 / Cu

Simbool / Symbol

Benaderde relatiewe atoommassa

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Website: www.ecdoe.gov.za

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Enquire: Mrs P. Japhta Fax: 040 608 7295

ERRATUM

TO: **CHIEF EDUCATION SPECIALISTS**
DISTRICT CURRICULUM COORDINATORS
DISTRICT ASSESSMENT OFFICIALS (DAOs
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PRINCIPALS OF SCHOOLS IN THE FET BAND

SUBJECT: **ERRATUM – PHYSICAL SCIENCES P2 GRADE 12 JUNE COMMON 2024**

DATE: **07 JUNE 2024**

The Physical Sciences P2 Grade 12 June Common Examination was written on Monday, 03 June 2024. We were made aware of certain amendments and omissions that were discovered during the marking process and memorandum discussion on the provided marking guideline.

In order to address this and to ensure that learners are not disadvantaged, the following standardised approach to marking must be adopted across the Province. The following guidelines regarding marking was prepared in conjunction with the examiner and moderator.

Page	Question		Recommendation
3	1.3	No correct answer in Afrikaans version: Current answer: A	Mark Question 1 out of 18 marks
5	1.8	Language error in English version. Current answer: C	Accept both A and C

11	4.1.6	Incorrect answer on marking guideline / Current answer: <u>Mild heat</u> and <u>dilute strong base</u>/LiOH/KOH/NaOH	Correct answer: High temperature and HBr (see CAPS page 112)
	4.2.5	Error on marking guideline: 2 C_4H_{10} + 13 O_2→ 8 CO_2 + 8 H_2O	Correct answer 2 C_4H_{10} + 13 O_2→ 8 CO_2 + **10** H_2O

The Afrikaans version has no correct answer on Question 1.3.

Mark the Afrikaans paper out of 148 and convert it to 150 marks as shown below

Converted mark $= \frac{leaner\ mark}{148} \times 150$

Example

if a learner got 80 out of 148 the converted mark must be calculated as follows:

Converted mark = $\frac{80}{148} \times 150$ = 81,08 ∴ **= 81**

We sincerely apologise for any inconvenience we might have caused.

Yours in education.

7 June 2024

MRS P.E. JAPHTA
(A) CES: AIDIBM SUBDIRECTORATE

DATE

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EDUCATION

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIORSERTIFIKAAT*

GRADE/*GRAAD 12*

JUNE/*JUNIE* 2024

PHYSICAL SCIENCES: CHEMISTRY P2/ *FISIESE WETENSKAPPE: CHEMIE V2* MARKING GUIDELINE/*NASIENRIGLYN*

MARKS/*PUNTE*: **150**

This marking guideline consists of 19 pages./
Hierdie nasienriglyn bestaan uit 19 bladsye.

QUESTION 1/*VRAAG 1*

1.1 C ✓✓ (2)

1.2 D ✓✓ (2)

1.3 A ✓✓ (2)

1.4 D ✓✓ (2)

1.5 B ✓✓ (2)

1.6 B ✓✓ (2)

1.7 C ✓✓ (2)

1.8 C ✓✓ (2)

1.9 B ✓✓ (2)

1.10 B ✓✓ (2)

[20]

QUESTION 2/*VRAAG 2*

2.1 A series of organic compounds that can be described by the same general formula ✓✓

'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word.

OR/*OF*

A series of organic compounds in which one member differs from the next with a CH_2 group ✓✓

'n Reeks organiese verbindings waarin een lid van die volgende verskil met 'n CH_2 -groep (2)

2.2 2.2.1 B ✓ (1)

2.2.2 A ✓ (1)

2.2.3 B ✓ (1)

2.2.4 C ✓ (1)

2.3 Secondary alcohol / *Sekondêre alkohol* ✓
The carbon that contains the hydroxyl group/ -OH is bonded to two carbon atoms. ✓
Die koolstof wat die hidroksielgroep / -OH bevat is verbind aan twee ander koolstowwe

OR/*OF*

The hydroxyl group / -OH is bonded to a secondary carbon.
Die hidroksielgroep / -OH is verbind aan 'n sekondêre koolstof

OR/OF

The carbon that contains the hydroxyl group / *OH* contains one hydrogen atom
Die koolstof wat die hidroksielgroep / OH bevat het een waterstof-atoom (2)

2.4 2.4.1 C_nH_{2n} ✓ (1)

2.4.2 4-methylpent-2-ene ✓✓
4-metielpen-2-een
OR/*OF*
4-methyl-2-pentene ✓✓
4-metiel-2-penteen

Marking criteria/*Nasienkriteria*:
- Pent-2-ene / 2-pentene✓ *Pent-2-een / 2-penteen*
- Whole name correct ✓ *Hele naam korrek*

(2)

2.4.3 5,5-dimethylhexan-3-ol ✓✓✓
5,5-dimetielhexan-3-ol
OR/*OF*
5,5-dimethyl-3-hexanol ✓✓✓
5,5-dimetiel-3-hexanol

Marking criteria/*Nasienkriteria*:
- Hexan-3-ol / 3-hexanol ✓
- Dimethyl / *dimetiel* ✓
- Whole name correct / *hele naam korrek* ✓

(3)

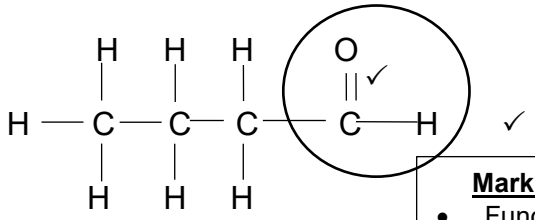
2.5 2.5.1

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: -1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 punt per woord/frase.

Compounds that have the same molecular formula but different functional groups. ✓✓

Verbindings met dieselfde molekulêre formule maar verskillende funksionele groepe. (2)

2.5.2



✓ ✓

Marking criteria/*Nasienkriteria*
- Functional group / *funksionele groep* ✓ 1/2
- Whole structure correct / *Hele struktuur korrek* ✓2/2

(2)

2.6 2.6.1 Esterification / Condensation / *Esterifikasie / Kondensasie* ✓ (1)

2.6.2

Mol C	:	Mol H	:	Mol O
$\frac{58,82}{12}$ ✓	:	$\frac{9,81}{1}$ ✓	:	$\frac{31,37}{16}$ ✓
4,90	:	9,81	:	1,96
2,5	:	5	:	1
5	:	10	:	2 ✓

Marking criteria/*Nasienkriteria*
- % C divide by M (C/) *% C gedeel deur M (C)*
- % H divide by M (H)/ *% H gedeel deur M(H)*
- % O divide by M (O)/ *% O gedeel deur M (O)*
- Simplest mole ratio/ *Eenvoudigste molverhouding*
- Molecular formula/ *Molekulêre formule*

Empirical formula / Empiriese formule: $C_5H_{10}O_2$

Molecular Formula / Molekulêre formule: $C_5H_{10}O_2$ ✓ (5)

2.6.3 $M\ (C_xH_yO_2) = 74\ g\cdot mol^{-1}$

$12n + 2n + 2(16) = 74$ ✓

$n = 3$ ✓

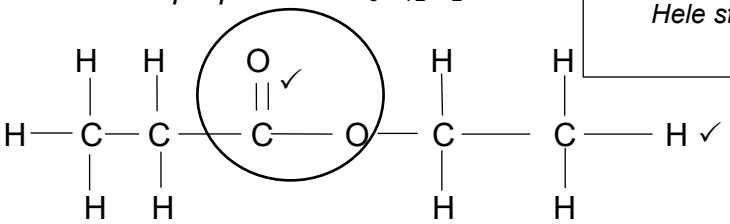
Propanoic acid/Propanoësuur ✓✓ (4)

2.6.4 **Marking criteria/*Nasienkriteria***

- Determining the molar mass of alcohol **P** / *Bepaal die molekulêre massa van alkohol **P*** ✓
- Identifying alcohol **P** / *Identifiseer alkohol **P*** ✓
- Name of ester / *Naam van ester* ✓✓
- Structural formula of the ester/ *Struktuurformule van die ester* ✓✓

Propanoic acid + alcohol **P** → ester + H_2O
*Propanoësuur + alkohol **P***→ ester + H_2O
M (Alcohol / *Alkohol* P) = 102 + 18 – 74 = 46 g·mol^{-1} ✓
Alcohol / *Alkohol* P = Ethanol / *etanol* ✓

Ester = ethyl ✓ propanoate ✓
Ester = etielpropanoaat $C_6H_{12}O_2$



Marking criteria/*Nasienkriteria*
- Functional group / *funksionele groep* ✓ 1/2
- Whole structure correct / *Hele struktuur korrek* ✓2/2

(6)
[34]

QUESTION 3/*VRAAG 3*

Marking criteria/ *Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.
*Indien enige van die sleutelwoorde frases in die **korrekte konteks** weggelaat word: -1 punt per woord/frase.*

3.1 Boiling point is the temperature at which the vapour pressure of a liquid / substance equal the atmospheric pressure ✓✓

Kookpunt is die temperatuur waarby die dampdruk van 'n vloeistof/stof gelyk aan die atmosferiese druk is. (2)

3.2 Alcohols are flammable / *Alkohole is vlambaar* ✓ (1)

3.3 140 (˚C) ✓ (1)

3.4 YES. ✓ Compounds have the same molecular mass/ compounds are Isomers / only one independent variable. ✓
JA. Verbindings het dieselfde molekulêre massa/ verbindings is isomere / slegs een onafhanklike veranderlike. (2)

3.5 2-methylbutan-1-ol ✓✓ *2-metielbutan-1-ol*
OR/*OF*
2-methyl-1-butanol ✓✓ *2-metiel-1-butanol*

Marking criteria/*Nasienkriteria*:
- butan-1-ol ✓
- Whole name correct / *hele naam korrek* ✓

(Accept/*Aanvaar*)

3-methylbutan-1-ol ✓✓ *3-metielbutan-1-ol*
OR/*OF*
3-methyl-1-butanol ✓✓ *3-metiel-1-butanol* (2)

3.6 Alcohol **3** ✓ accept: 2,2-dimethylpropan-1-ol / 2,2-dimethyl-1-propanol
*Alkohol **3*** *aanvaar: 2,2-metielpropan-1-ol/ 2,2-dimetiel-1-propanol* (1)

3.7 **Marking criteria / *Nasienkriteria***
- Chain length decreases from **1** to **3**
  *Kettinglengte neem af vanaf **1** tot **3***
- Decrease in the strength of the London forces/dispersion forces/induced dipole forces from 1–3
  Afname in die sterkte van die Londonkragte/verspreidingskragte/ Geïnduseerde dipool-dipool kragte vanaf 1–3
- Relate the strength of London forces/dispersion forces/induced dipole to energy involved
  Vergelyk the sterkte van die Londonkragte/verspreidingskragte/ Geïnduseerde dipool-dipool kragte na die energie

From **1** to **3**

- Surface area / chain length decreases / increased in the number of branches ✓
  Oppervlakte / kettinglengte neem af / toename in die aantal takke
- Strength of London forces/dispersion forces/induced dipole forces decreases ✓
  Sterkte van die Londonkragte/verspreidingskragte/geïnduseerde dipool-dipool kragte neem af
- Less energy is needed to overcome intermolecular forces ✓
  Minder energie word benodig om die intermolekulêre kragte te oorkom

OR/*OF*

Marking criteria/Nasienkriteria
• Chain length increases from ***3*** *to* ***1***   *Kettinglengte neem toe vanaf* ***3*** *na* ***1***
• Increase in the strength of the London forces/dispersion forces/induced dipole forces from 3 to 1   *Toename in die sterkte van die Londonkragte/Verspreidingskragte / geïnduseerde dipool-dipool kragte vanaf 3 na 1*
• Relate the strength of London forces to energy involved.   *Vergelyk the sterkte van die Londonkragte/Verspreidingskragte/ geïnduseerde dipool-dipool kragte na die energie*

From **3** to **1** */ Vanaf* ***3*** *tot* ***1***

- Surface area / chain length increases/ decreased in the number of branches ✓
  Oppervlakte/ kettinglengte neem toe/ afname in die aantal takke
- Strength of London forces/Dispersion forces/Induced dipole forces increases ✓
  Sterkte van die Londonkragte/Verspreidingskragte /Geïnduseerde dipool-dipool kragte neem toe
- More energy needed to overcome intermolecular forces ✓
  Meer energie word benodig om die intermolekulêre kragte te oorkom (3)

3.8 3.8.1

Marking criteria/ *Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.   *Indien enige van die sleutelwoorde/frases in die* ***korrekte konteks*** *weggelaat word: - 1 punt per woord/frase.*

The pressure exerted by a vapour at equilibrium with its liquid in a closed system. ✓✓/
Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem. (2)

3.8.2 **Marking criteria/*Nasienkriteria***

- Butan-1-ol has hydrogen bonds ✓/
  Butan-1-ol het waterstofbinding
- Butanone has dipole-dipole forces ✓ /
  Butanoon het dipool-dipool kragte /
- Compare the strength of the hydrogen bonds to dipole-dipole forces ✓/
  Vergelyk die sterkte van die waterstofbinding met dipool-dipoolkragte /
- Relate strength intermolecular forces to vapour pressure ✓/
  Verwys die sterkte van die intermolekulêrekragte met die dampdruk

- Butan-1-ol has hydrogen bonds (and London forces) ✓/
  Butan-1-ol het waterstofbinding (en Londonkragte)
- Butanone has dipole-dipole forces (and London forces) ✓/
  Butanoon het dipool-dipoolkragte (en Londonkragte)
- Hydrogen bonds is stronger than the dipole-dipole forces ✓/
  Waterstofbinding is sterkter as die dipool-dipoolkragte
- Stronger intermolecular forces result in lower vapour pressure ✓/
  Sterker intermolekulêrekragte lei tot laer dampdruk

OR/*OF*

- Butan-1-ol has for hydrogen bonds (and London forces) ✓/
  Butan-1-ol het waterstofbinding (en Londonkragte)
- Butanone has dipole-dipole forces (and London forces) ✓/
  Butanoon het dipool-dipoolkragte (en Londonkragte)
- Dipole-dipole forces weaker than the hydrogen bonds ✓/
  Dipool-dipoolkragte is swakker as die waterstofbinding
- Weaker intermolecular forces result in higher vapour pressure ✓/
  Swakker intermolekulêrekragte sal tot 'n hoër dampdruk lei (4)

3.8.3 INCREASE / *TOENEEM* ✓ (1)

[19]

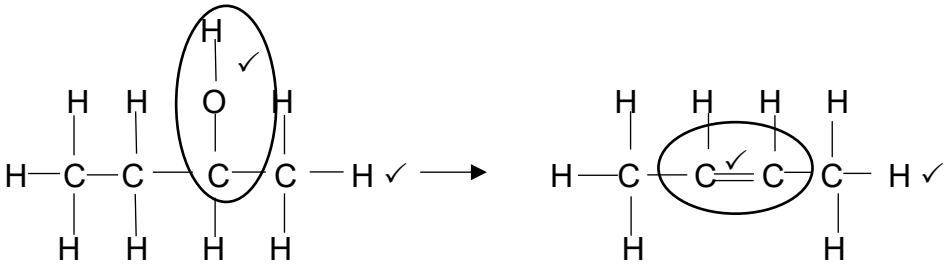
QUESTION 4/*VRAAG 4*

4.1 4.1.1 Dehydration / *Dihidratering / dihidrasie* ✓ (1)

4.1.2 Sulphuric acid / *swawelsuur* / H_2SO_4 ✓ (1)

4.1.3

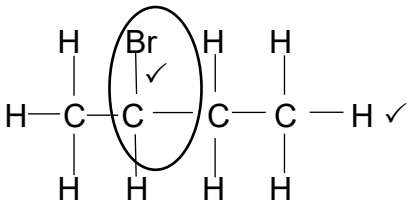
Marking criteria/*Nasienkriteria*:
Organic compounds only/ *Slegs vir organiese verbinding*
- Functional group/ *funksionele groep* ✓ 1/2
- Whole structure correct / *Hele struktuur korrek* ✓ (2/2)
  Hele struktuur korrek ✓ *2/2*



\+ H_2O (4)

4.1.4 Addition / hydrohalogenation / *Addisie / hidrohalogenering/ hidrohalogenasie* ✓ (1)

4.1.5 2-bromobutane ✓✓/
2-bromobutaan



Marking criteria/ *Nasienkriteria*
Name of compound / *Naam van verbinding*
- Butane / *butaan* ✓ 1/2
- Whole name correct ✓ *2/2*
  hele naam korrek

Structure /
- Functional group ✓ 1/2
  funksionele groep
- Whole structure correct ✓/*Hele struktuur korrek 2/2*

(4)

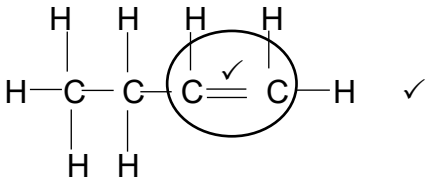
4.1.6 Mild heat ✓ and dilute strong base /LiOH/KOH/NaOH ✓/
Matige hitte en verdunde sterk basis /LiOH/KOH/NaOH (2)

4.2 4.2.1 Breaking down of long chain hydrocarbon molecules into more useful shorter chains ✓✓ **(2 or 0)** /
Die proses waarin langer kettingkoolwaterstof-molekule afgebreek word in korter, meer bruikbare, molekule ***(2 of 0)*** (2)

4.2.2 Minimize the UV light present / No substitution reaction can occur in the saturated hydrocarbon ✓/
Verminder die teenwoordige UV-lig / Geen substitusiereaksie kan in die versadigde koolwaterstof plaasvind nie (1)

4.2.3 C_4H_2. ✓ It readily reacts with bromine (without the presence of UV-light) ✓
C_4H_2. Dit reageer geredelik met broom (sonder die teenwoordigheid van UV-lig) (2)

4.2.4



✓

Marking criteria/*Nasienkriteria*
- Functional group ✓ ½
  Funksionele groep
- Whole structure correct/ ✓ *2/2*
  Hele struktuur korrek

(2)

4.2.5 $2\ C_4H_{10} + 13\ O_2$ ✓ → $8\ CO_2 + 8\ H_2O$ ✓ (✓ bal.)

Marking criteria / *Nasienkriteria*
- Reactants / *Reaktanse* 1/3
- Products / *Produkte* *2/3*
- Balancing / *Balansering* *3/3*

(3)
[23]

QUESTION 5/*VRAAG 5*

5.1

Marking criteria/ *Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase. /
*Indien enige van die sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase*

ANY ONE
Change in concentration ✓ of reactant or product per (unit) time. ✓

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

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

ENIGE EEN
Verandering in konsentrasie van reaktanse of produkte per (eenheid) tyd.

Verandering in hoeveelheid/getal mol/volume/massa van reaktanse of produkte per (eenheid) tyd.

Verandering in hoeveelheid/getal mol/volume/massa van produkte gevorm / reaktanse gebruik per (eenheid) tyd.

OR/*OF*

The rate of change in concentration/amount of moles/number of moles / volume / mass. ✓✓ **(2 or 0)**

Die tempo van verandering in konsentrasie / hoeveelheid mol / getal mol / volume / massa. ***(2 of 0)*** (2)

5.2 Temperature / *Temperatuur* ✓ (1)

5.3 5.3.1 Experiment / *Eksperiment* **2** ✓ (1)

5.3.2 **OPTION 1 / *OPSIE 1***

- In experiment 2 more particles are exposed / larger surface area ✓
- More particles will collide with the correct orientation ✓
- More effective collisions per unit time / Frequency of the effective collisions increases ✓

- *In eksperiment 2 word meer deeltjies blootgestel / groter oppervlakte*
- *Meer deeltjies sal met die korrekte oriëntasie bots*
- *Meer effektiewe botsings per tydseenheid / Frekwensie van die effektiewe botsings neem toe*

OR/*OF*

OPTION 2 / *OPSIE 2*

- In experiment 3 less particles are exposed / smaller surface area ✓
- Less particles will collide with the correct orientation ✓
- Less effective collisions per unit time / Frequency of the effective collisions decreases ✓

- *In eksperiment 3 word minder deeltjies blootgestel / kleiner oppervlakte*
- *Minder deeltjies sal met die korrekte oriëntasie bots*
- *Minder effektiewe botsings per tydseenheid / Frekwensie van die effektiewe botsings neem af* (3)

5.4 5.4.1

Marking criteria /	***Nasienkriteria***
• Subst. Into the rate equation • Subst. into n = m/M • Using the mol ratio CO_2 : $MgCO_3$ • Formula m = nM • Subst. into m = nM • Final answer	• *Vervang in die tempo vergelyking* • *Vervang in n = m/M* • *Gebruik die mol verhouding CO_2 : $MgCO_3$* • *Formule m = n/M* • *Vervanging in m = n/M* • *Finale antwoord*

$$\text{Rate/ } \textit{Tempo} = \frac{\Delta m}{\Delta t}$$

$$0,25 = \frac{m - 0}{10,44} \checkmark$$

$$m = 2,61 \text{ g}$$

$$n = \frac{M}{m}$$

$$n = \frac{2,61}{44} \checkmark$$

$$n = 0,0593 \text{ mol}$$

$n (CO_2) = n (MgCO_3) = 0,0593$ mol ✓

$m = nM$ ✓

$m = (0,0593)(84)$ ✓

$m = 4,9812$ g ✓ (6)

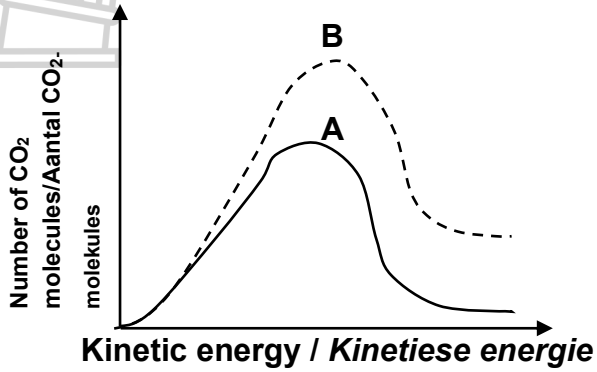
5.4.2

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

$$0,0593 = \frac{1,47}{V_m} \checkmark$$

$$V_m = 24,79 \text{ dm}^3 \checkmark \quad (3)$$

5.5



Marking criteria / *Nasienkriteria*

- Shape of **B** starting at the origin ✓
  *Vorm van **B** begin by oorsprong*
- Curve of **B** is higher / *Kurwe **B** is hoër* ✓

NOTE: A or B must be indicated
Ignore the labels of the axes.
LET WEL: A of B moet aangedui word.
Ignoreer die benoeming van die asse.

(2)
[18]

QUESTION 6/*VRAAG 6*

6.1 6.1.1

Marking criteria/ *Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.
*Indien enige van die sleutelwoorde/frases in die **korrekte konteks** weggelaat word: - 1 punt per woord/frase*

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

Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n nuwe ewewig deur die reaksie wat die versteuring teenwerk, te bevoordeel (2)

6.1.2 EQUAL TO / *GELYK AAN* ✓
Chemical equilibrium is reached / *Chemiese ewewig word bereik* ✓ (2)

6.1.3 Y ✓
2 mol of SO_2 will react for every 1 mol of O_2 ✓/
2 mol van SO_2 sal reageer met elke 1 mol van O_2

OR/*OF*

The rate at which SO_2 is consumed is twice that of O_2./
Die tempo waarteen SO_2 verbruik word is twee keer as dié van O_2

OR/*OF*

0,925 mol of SO_2 reacted with 0,46 mol of O_2 ✓/
0,925 mol van SO_2 reageer met 0,46 mol O_2 (2)

6.1.4 NEGATIVE / *NEGATIEF* ✓ (1)

6.1.5
- The amount/concentration of SO_3 increased / SO_2 and O_2 decreased ✓
- (According to Le Chatelier's principle) A decrease in temperature favours the exothermic reaction. ✓
- The forward reaction was favoured / The equilibrium position shifted towards the right ✓

- *Die hoeveelheid/konsentrasie van SO_3 neem toe / SO_2 en O_2 verlaag*
- *(Volgens Le Chatelier se beginsel) 'n Afname in temperatuur bevoordeel die eksotermiese reaksie*
- *Die voorwaartse reaksie word bevoordeel / Die ewewigsposisie verskuif na regs* (3)

6.2 6.2.1 **OPTION 1: MOLE CALCULATIONS / *OPSIE 1: MOLBEREKENINGE***

a. Determine the change in mol of NOCℓ / *Bepaal die verandering in mol van NOCℓ*
b. Correct ratio NOCℓ : NO : $Cℓ_2$ / *Korrekte verhouding NOCℓ : NO : $Cℓ_2$*
c. Determine the equilibrium mol for NOCℓ , NO and $Cℓ_2$ / *Bepaal die ewewig mol van NOCℓ , NO en $Cℓ_2$*
d. Dividing by/ *Deel deur* 1,5
e. Correct Kc expression with square brackets / *Korrekte Kc uitdrukking met vierkanthakkies*
f. Subst. into the correct Kc expression /*Vervanging in korrekte Kc uitdrukking*
g. Final answer / *Finale antwoord*

Δn (NOCℓ) = 2,5 x 28/100 = 0,7 ✓ (a)

	2 NOCℓ	2 NO (g)	$Cℓ_2$ (g)	
Initial mol *Aanvangsmol*	2,5	-	-	
Change in mol *Verandering in mol*	0,7	0,7	0,35	(b) ✓
Equilibrium mol *Ewewigsmol*	1,8	0,7	0,35	(c) ✓
Concentration *Konsentrasie*	=1,8 / 1,5 = 1,2	= 0,7 / 1,5 = 0,47	=0,35 / 1,5 0,23	(d) ✓

$$K_c = \frac{[NO]^2[Cℓ_2]}{[NOCℓ]^2} \quad \text{(e) ✓}$$

$$K_c = \frac{(0,47)^2(0,23)}{(1,2)^2} \quad \text{(f) ✓}$$

K_c = 0,035 ✓ (g)

OPTION 2: CONCENTRATION CALCULATIONS / *OPSIE 2: KONSENTRASIE BEREKENINGE*

a. Determine the initial concentration NOCℓ / *Bepaal die aanvanklike konsentrasie van NOCℓ*
b. Determine the change in conc of NOCℓ / *Bepaal die verandering in konsentrasie van NOCℓ*
c. Correct ratio NOCℓ : NO : $C\ell_2$ / *Korrekte verhouding NOCℓ : NO : $C\ell_2$*
d. Determine the equilibrium conc. for NOCℓ , NO and $C\ell_2$ / *Bepaal die ewewigs konsentrasie van NOCℓ , NO en $C\ell_2$*
e. Correct Kc expression with square brackets / *Korrekte Kc uitdrukking met vierkanthakkies*
f. Subst. into the correct Kc expression/ *Vervanging in korrekte Kc uitdrukking*
g. Final answer / *Finale antwoord*

c_i (NOCℓ) = 2,5 ÷ 1,5 = 1,67 ✓ (a)
Δc (NOCℓ) = 1,67 x 28 / 100 = 0,47 ✓ (b)

	2 NOCℓ	2 NO (g)	$C\ell_2$ (g)	
Initial concentration *Aanvangskonsentrasie*	1,67	-	-	
Change in concentration *Verandering in konsentrasie*	0,47	0,47	0,235	(c) ✓
Equilibrium concentration *ewewigskonsentrasie*	1,2	0,47	0,235	(d) ✓

$$K_c = \frac{[NO]^2[C\ell_2]}{[NOC\ell]^2}$$ (e) ✓

$$K_c = \frac{(0,47)^2(0,23)}{(1,2)^2}$$ (f) ✓

a. K_c = 0,035 ✓ (g) (7)

6.2.2 REMAINS THE SAME / *BLY DIESELFDE* ✓

Only temperature has an effect on the value of the equilibrium constant. ✓/
Slegs temperatuur het 'n effek op die waarde van die ewewigskonstante (2)
[19]

QUESTION 7/*VRAAG 7*

7.1 7.1.1 Acids produce hydrogen ions (H^+/H_3O^+/ hydronium ions) in aqueous solutions. ✓✓/

'n Suur is 'n stof wat waterstof-ione (H^+/H_3O^+/ hydroniumione) vorm wanneer dit in water oplos (2)

7.1.2 H_2O ✓and / *en* HSO_4^- ✓ (2)

7.1.3 $H_2SO_4 + 2\ KOH$ ✓ → $K_2SO_4 + 2\ H_2O$ ✓ (✓ bal.)

Marking criteria/ *Nasienkriteria*
• Reactants / *Reaktanse*
• Products /*Produkte*
• Balancing / *Balansering*

(3)

7.2 7.2.1

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
$c = \frac{m}{MV}$ ✓	$n = \frac{m}{M}$
$c = \frac{3,812}{(40)(100x10^{-3})}$ ✓	$n = \frac{3,812}{40}$
$c = 0,953\ mol\cdot dm^{-3}$ ✓	$n = 0,0953\ mol$
	$c = \frac{n}{V}$ ✓
	$c = \frac{0,0953}{100x10^{-3}}$ ✓
	$c = 0,953\ mol\cdot dm^{-3}$ ✓

(3)

7.2.2 **OPTION 1 / *OPSIE 1***

Marking criteria/ *Nasienkriteria*

- Subst. c and V of NaOH into n = cV / *Vervang van c en V van NaOH in n = Cv*
- Use of **ratio** CH_3COOH : NaOH
- *Gebruik van **verhouding** CH_3COOH : NaOH*
- Subst. of n and V of CH_3COOH into c = n/V / *Vervang van c en V van CH_3COOH in n = cV*
- Formula / *Formule* m = cMV
- Subst. into / *Vervanging in* m = cMV
- Subst. into percentage formula / *Vervanging in persentasie-formule*
- Final answer / *Finale antwoord*

n (NaOH) = cV

n (NaOH) = $(0,953)(21,8 \times 10^{-3})$ ✓

n (NaOH) = 0,0207754 mol

n (CH_3COOH) = n (NaOH) = 0,0207754 mol ✓

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

$$c = \frac{0,0207754}{25 \times 10^{-3}} \checkmark$$

$$c = 0,831016 \text{ mol·dm}^{-3}$$

m = cMV ✓

m = $(0,831016)(60)(25 \times 10^{-3})$ ✓

m = 1,2465 g

Percentage mass / *Persentasie massa* $= \frac{1,2465}{25} \times 100\ \%$ ✓

Percentage mass / *Persentasie massa* = 4,986 % ✓

OPTION 2 / *OPSIE 2*

Marking criteria / *Nasienkriteria*

- Subst. into / *Vervang in* n_a and/ *en* n_b $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$
- Subst. into / *Vervang in* V_a $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$
- Subst. into / *Vervang in* c_b and/ *en* V_b $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$
- Formula /*Formule* m = cMV
- Subst into / *Vervanging in* m = cMV
- Subst into percentage formula / *Vervanging in persentasie formule*
- Final answer / *Finale antwoord*

$$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$$

$$\frac{c_a(25)\ \checkmark}{(0,953)(21,8)\ \checkmark} = \frac{1}{1}\ \checkmark$$

$$c_a = 0,831016\ mol\cdot dm^{-3}$$

m = cMV ✓

m = (0,831016)(60)(25 x 10^{-3}) ✓

m = 1,2465 g

$$\text{Percentage mass / } \textit{Persentasie massa} = \frac{1,2465}{25} \text{ X } 100\% \ \checkmark$$

Percentage mass / *Persentasie massa* = 4,986% ✓ (7)

[17]

TOTAL/*TOTAAL*: 150