education
DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY P2

JUNE 2021

MARKS: 150

TIME: 3 hours

This question paper consists of 15 pages and 4 data sheets.

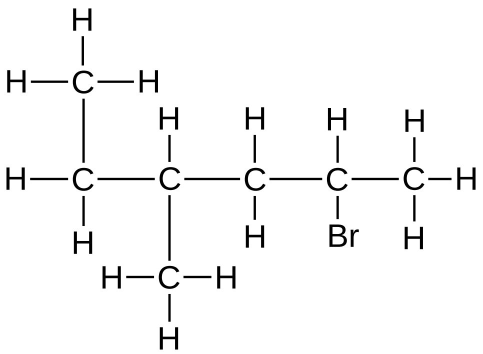
INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of TEN 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. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a MINIMUM of TWO decimal places.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

OUESTION 1 : MULTIPLE-CHOICE QUESTIONS

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

1.1 The correct IUPAC name of the compound with the structural formula shown below, is …



A 1,2-dimethyl-4-bromopentane

B 2-bromo-4,5-dimethylpentane

C 4-methyl-2-bromohexane

D 2-bromo-4-methylhexane (2)

1.2 Which ONE of the formulae below represents an ALDEHYDE?

A $C_2H_4O_2$

B C_4H_8O

C $C_5H_{12}O$

D CH_2O_4 (2)

1.3 In which ONE of the following options are the four compounds arranged in order of DECREASING boiling points?

A	$CH_3CH_2CH_3$	CH_3CH_2CHO	$CH_3CH_2CH_2OH$	CH_3CH_2COOH
B	CH_3CH_2CHO	$CH_3CH_2CH_2OH$	$CH_3CH_2CH_3$	CH_3CH_2COOH
C	CH_3CH_2COOH	$CH_3CH_2CH_2OH$	CH_3CH_2CHO	$CH_3CH_2CH_3$
D	CH_3CH_2COOH	CH_3CH_2CHO	$CH_3CH_2CH_2OH$	$CH_3CH_2CH_3$

(2)

1.4 Refer to the flow diagram below.

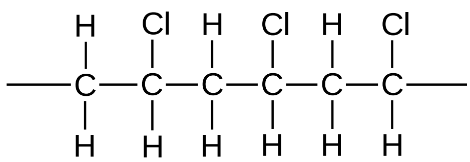
$$\boxed{\text{But-1-ene}} \xrightarrow{HC\ell} \boxed{\text{Main product A}}$$

The name of main product A as well as the type of reaction taking place are:

	MAIN PRODUCT A	**TYPE OF REACTION**
A	2-chlorobutane	Halogenation
B	2-chlorobutane	Hydrohalogenation
C	1-chlorobutane	Halogenation
D	1-chlorobutane	Hydrohalogenation

(2)

1.5 The following polymer is the result of addition polymerisation.



Which ONE of the following is the monomer of the above mentioned polymer?

A Ethene

B Propene

C Chloroethene

D Chloromethane (2)

1.6 The reaction for a saturated salt solution is shown below:

$$NaC\ell(s) \rightleftharpoons Na^{+}(aq) + C\ell^{-}(aq)$$

Which ONE of the following changes will favour the reverse reaction?

A Heat the solution

B Increase the pressure on the system

C Add concentrated hydrochloric acid ($HC\ell$).

D Bubble chlorine ($C\ell_2$) gas through the solution. (2)

1.7 Consider the chemical reaction represented by the equation below:

$$Mg(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2(g)$$

Which ONE of the following changes will increase the rate of production of $H_2(g)$?

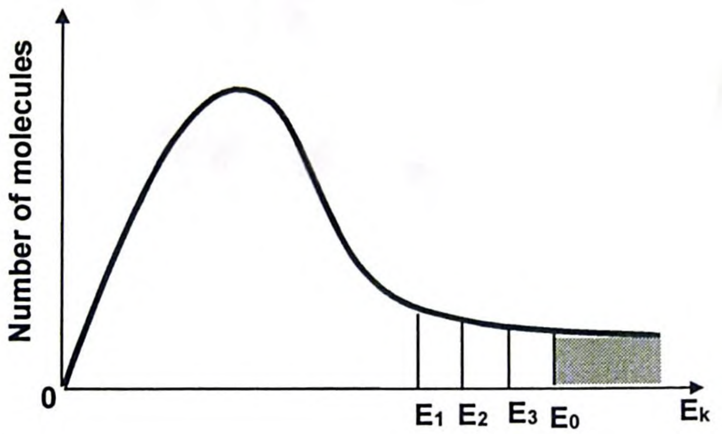
A Increase pressure

B Increase volume of $HC\ell(aq)$

C Decrease concentration of $HC\ell(aq)$

D Increase temperature (2)

1.8 THREE catalysts are used separately to increase the rate of a hypothetical reaction. In the diagram below, E_1, E_2 and E_3 represent the effect of each catalyst on the activation energy (E_0) for the reaction.



Which ONE of the following is the activation energy for the reaction with the highest rate?

A E_1

B E_2

C E_3

D E_0 (2)

1.9 If the concentration of a sodium hydroxide (NaOH) solution is 0,01 mol·dm^{-3}, then the OH^-(aq) concentration of the NaOH(aq) and the pH-value of the NaOH(aq) at 25 °C will be …

	[OH^-] (mol·dm^{-3})	**pH**
A	10^{-12}	12
B	10^{-12}	2
C	10^{-2}	12
D	10^{-2}	2

(2)

1.10 If base **X** is titrated against acid **Y**, the pH at the endpoint is 9.

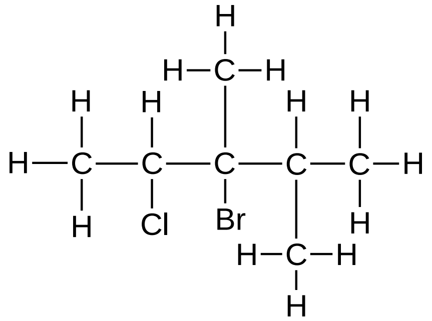
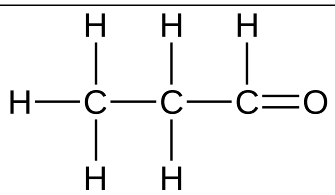
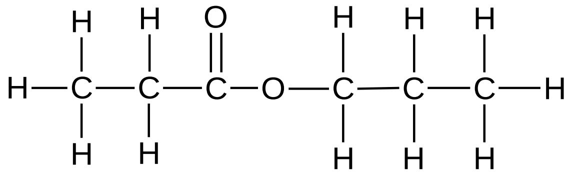
Which ONE of the following combinations CORRECTLY represents base **X** and acid **Y**?

	Base X	**Acid Y**
A	KOH	HNO_3
B	NaOH	CH_3COOH
C	NH_3	H_2SO_4
D	$NaHCO_3$	$HC\ell$

(2)
[20]

QUESTION 2 (Start on a new page)

Consider the following eight organic compounds represented by letters **A** to **H.**

A	Propanone	**B**	C_2H_4
C	$CH_3CH_2CH_2OH$	**D**	
E		**F**	CH_3COOH
G	2,2-dimethylpropane	**H**	

2.1 Write down the LETTER that represents the following:

2.1.1 A weak monoprotic acid. (1)

2.1.2 A CHAIN ISOMER of $CH_3(CH_2)_3CH_3$. (1)

2.1.3 A compound used as reactant in the preparation of compound **H**. (1)

2.2 Write down the:

2.2.1 Structural formula of the functional group of compound **A**. (2)

2.2.2 Name of the homologous series to which compound **F** belongs. (1)

2.2.3 IUPAC name of compound **H** (2)

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

2.3 Compound **C** is a primary alcohol

2.3.1 Define the term *primary alcohol*. (2)

2.3.2 Write down the STRUCTURAL FORMULA of the POSITIONAL isomer of compound **C**. (2)

2.4 Compound **B** is considered as *unsaturated*.

2.4.1 Give a reason why compound **B** is unsaturated. (1)

2.4.2 Write down the NAME of a solution that you can use in the laboratory to test whether compound **B** is unsaturated. (1)

2.4.3 What will be observed when this solution is added to compound **B**? (2)

2.4.4 Write down the IUPAC name of the product formed. (2)
[21]

QUESTION 3 (Start on a new page)

An experiment is conducted to determine the boiling point of organic compounds from different homologous series under the same conditions.

COMPOUND	NAME	MOLECULAR FORMULA
P	Hexane	C_6H_{14}
Q	2,3-dimethylbutane	C_6H_{14}
R	Methyl propanoate	$C_4H_8O_2$
S	Pentan-1-ol	$C_5H_{12}O$

Consider the boiling points of compounds **P** to **S** given in random order below and use them, where applicable, to answer the questions that follow.

79,8 °C	68 °C	138,5 °C	57,9 °C

3.1 Write down the:

3.1.1 Independent variable for this experiment (1)

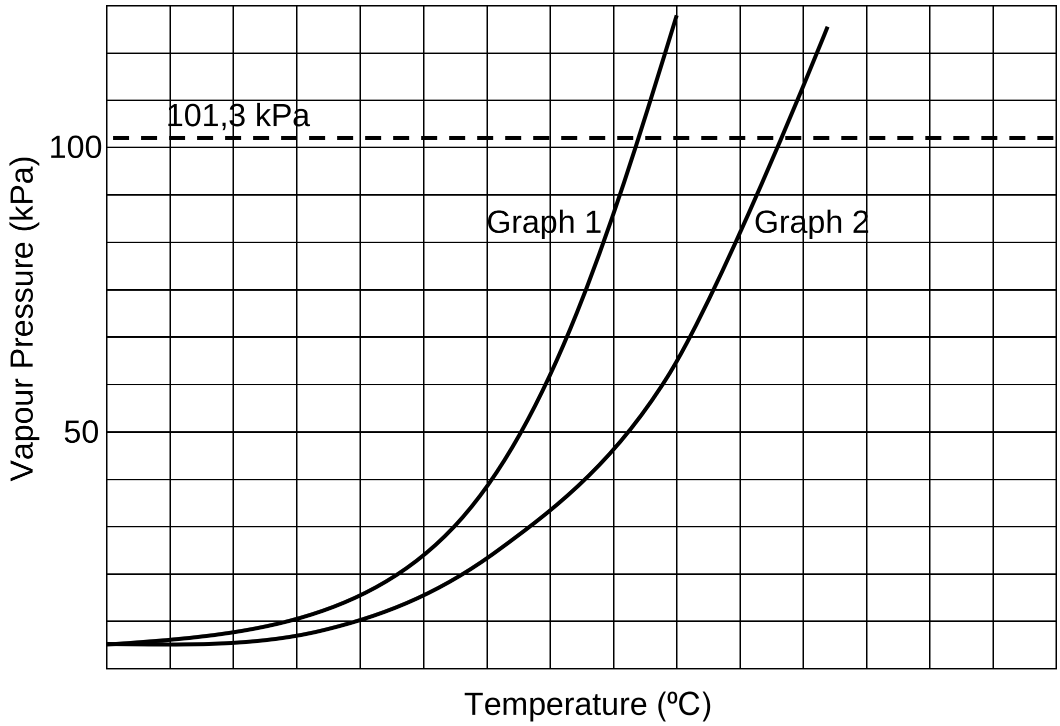
3.1.2 STRUCTURAL FORMULA of compound **R**. (2)

3.1.3 Boiling point of compound **R**. (1)

3.1.4 Boiling point of compound **S**. (1)

3.2 Explain the difference in boiling points between compounds **R** and **S**. (4)

3.3 The following graph shows the relationship between vapour pressure and temperature of compounds **P** and **Q.** The dotted line indicates the external atmospheric pressure.



3.3.1 Define the term *vapour pressure*. (2)

3.3.2 Using molecular formulae, write down the balanced equation for the complete combustion of compound **P**. (3)

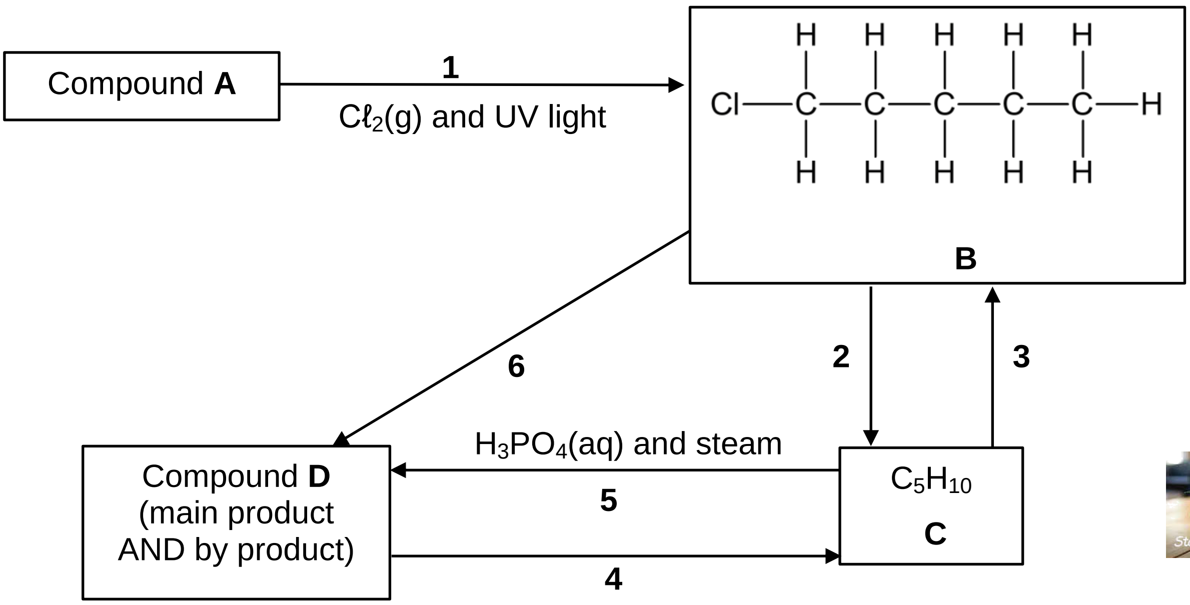
3.3.3 Which ONE of the compounds **P** or **Q** is represented by GRAPH 2? (1)

3.3.4 Fully explain the answer to QUESTION 3.3.3 (3)

3.3.5 Redraw graph 2 in your answer book. On the same set of axes sketch the curve that will be obtained for compound **S**. Label this curve **S.** (2)
[20]

QUESTION 4 (Start on a new page)

Consider the flow chart below showing different organic reactions, and answer the questions that follow. **A** to **D** are organic compounds, and **1** to **6** are organic reactions.



4.1 Compound **A** is a hydrocarbon

4.1.1 Define the term *hydrocarbon.* (2)

4.1.2 Write down the IUPAC name of compound **A**. (1)

4.2 Identify the TYPE of reaction for each of the following:

4.2.1 Reaction **1** (1)

4.2.2 Reaction **5** (1)

4.2.3 Reaction **6** (1)

4.3 Draw the structural formula of the main product for reaction **5** and write down its IUPAC name. (3)

4.4 Write down the type of addition reaction represented at reaction **3**. (1)

4.5 Write down the NUMBER of the reaction that would take place if the relevant organic compound was heated strongly in the presence of concentrated alcoholic potassium hydroxide. (1)
[11]

QUESTION 5: **(Start on a new page)**

Study the following chemical equation:

$$CO(g) + NO_2(g) \rightarrow CO_2(g) + NO(g) \qquad \Delta H = -60 kJ \cdot mol^{-1}$$

5.1 Use the above equation and draw a potential energy diagram. Label the specific reactants and products, as well as the activation energy and heat of reaction. (4)

5.2 Define the term *catalyst*. (2)

5.3 The following table shows two catalysts that can be used for this reaction and their corresponding activation energies.

Catalyst	**Activation energy ($kJ \cdot mol^{-1}$)**
Platinum catalyst	70,6
Osmium catalyst	104,6

Which catalyst, PLATINUM or OSMIUM will be more effective for this reaction? Use the collision theory to explain the answer. (4)
[10]

QUESTION 6: **(Start on a new page)**

A student investigates the reaction rate between magnesium and sulphuric acid. The balanced equation for the reaction that takes place is:

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

The student repeats the experiment a few times with different concentrations of sulphuric acid. All the other variables are kept constant.

The results are recorded in the table below:

Concentration of sulphuric acid ($mol \cdot dm^{-3}$)	**Rate of reaction ($cm^3 \cdot s^{-1}$)**
0,4	4,2
0,8	8,5
1,6	17,0

6.1 Formulate an investigative question for this investigation. (2)

6.2 Write down ONE variable that must be kept constant. (1)

6.3 What will be the effect on the reaction rate if lumps of magnesium are used (1) instead of powered magnesium? Write only: INCREASE, DECREASE or REMAIN THE SAME.

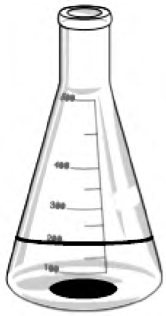
6.4 Use the collision theory to explain the answer to QUESTION 6.3. (3)

6.5 What will be the effect on the rate of reaction if the temperature increases from 20°C to 30°C? Write only: INCREASE, DECREASE or REMAIN THE SAME. (1)

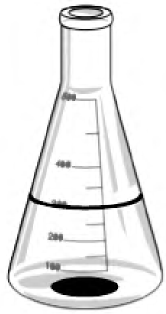
An experiment was conducted to investigate the rate of reaction between EXCESS calcium carbonate and dilute nitric acid. The balanced chemical equation for this reaction is given below.

$$CaCO_3(s) + 2HNO_3(aq) \rightarrow Ca(NO_3)_2(aq) + H_2O(\ell) + CO_2(g)$$

Flask A **Flask B**



4,5 g lump $CaCO_3$(s)



200 cm^3, 0,3 $mol{\cdot}dm^{-3}$ HNO_3(aq) at 25°C

300 cm^3, 0,3 $mol{\cdot}dm^{-3}$ HNO_3(aq) at 25°C

6.6 Calculate the volume of CO_2(g) produced at STP in flask A. (4)

6.7 Use the answer in QUESTION 6.6 to calculate the rate of reaction in flask A for the first 20 s in ($dm^3{\cdot}s^{-1}$) (3)

6.8 How will the rate of reaction in flask B compare to that in flask A? Choose from GREATER THAN A, LESS THAN A or EQUAL TO A. (1)

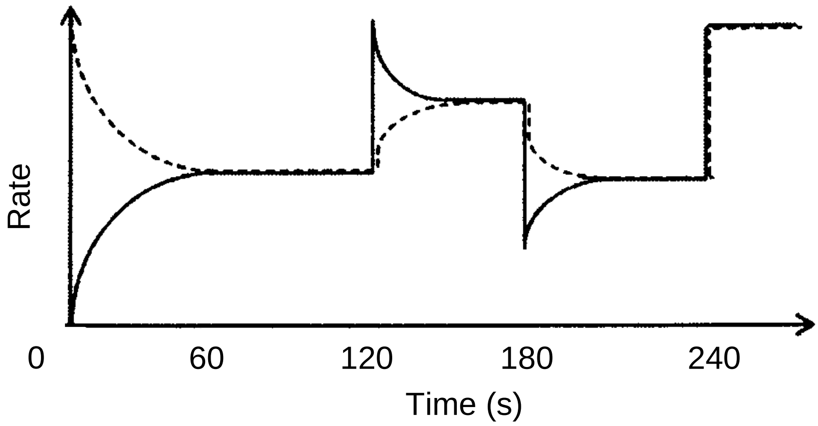
[16]

QUESTION 7: **(Start on a new page)**

Gas $\mathbf{A_2B}$ is introduced into a flask, which is then sealed , and allowed to reach dynamic chemical equilibrium at a certain temperature. The balanced chemical equation for the reaction is:

$$2A_2B(g) \rightleftharpoons 2A_2(g) + B_2(g)$$

The graph below shows the change in the rates of the forward and reverse reactions with time. The solid line represents the reverse reaction.



7.1 Define the term *dynamic equalibrium*. (2)

7.2 At t = 120 s the volume of the container is decreased, which leads to an increase in pressure.

7.2.1 The graph shows that at t = 120 s, both the forward and reverse reactions initially (immediately) increase at the same rate. Explain this observation. (2)

7.2.2 Which reaction is favoured between t = 120 s and t = 150 s? (FORWARD or REVERSE) (1)

7.2.3 Using Le Chatelier's Principle explain the answer to QUESTION 7.2.2. (2)

7.3 At t = 180 s the temperature in the container is decreased. Is the forward reaction EXOTHERMIC or ENDOTHERMIC? Explain the answer. (3)

7.4 What change was made at t = 240 s? (1)

7.5 How does the consentration of A_2B change between t = 230 s and t = 250 s? Write only INCREASES, DECREASES or REMAINS THE SAME. Explain the answer. (3)

7.6 What will the effect be on the equilibrium constant (K_c) for …
(Write only INCREASE, DECREASE or NO EFFECT.)

7.6.1 The increase in pressure at t = 120 s. (1)

7.6.2 The decrease in temperature at t = 180 s. (1)

7.7 Initially 5,1 moles of gas A_2B are introduced into a reaction flask. The flask is then sealed and kept at a constant temperature. The gas A_2B decomposes as shown in the balanced chemical equation below:

$$2A_2B(g) \rightleftharpoons 2A_2(g) + B_2(g)$$

When dynamic chemical equilibrium is reached, 3,6 mol A_2 gas remained in the flask. The concentration of gas A_2 in the flask at equilibrium is 1,2 mol·dm^{-3}. Calculate the value of the equilibrium constant (K_c) for this reaction at this constant temperature. (7)
[23]

QUESTION 8: **(Start on a new page)**

8.1 A learner prepares a sulphuric acid (H_2SO_4) solution with a concentration of 0,25 mol·dm^{-3}.

8.1.1 Give a reason why sulpuric acid is referred to as a diprotic acid. (2)

8.1.2 Determine the pH of this solution. (4)

8.1.3 The learner takes 20 cm^3 of this solution and dilutes it to a solution with a concentration of 0,1 mol·dm^{-3}. Calculate the volume of water that was added to the initial 20 cm^3 solution. (4)

8.2 A few crystals of ammonium chloride ($NH_4C\ell$) are added to water in a test tube. The pH of the solution is less than 7.

Explain with the aid of a balanced equation why the pH is less than 7. (3)

8.3 The hydrogen sulphate ion (HSO_4) can act as both an acid and a base. It reacts with water according to the following balanced equation:

$$HSO_4^-(aq) + H_2O(\ell) \rightleftharpoons SO_4^{2-}(aq) + H_3O^+(aq)$$

8.3.1 Write down ONE word for a substance that can act as both an acid and a base. (1)

8.3.2 Write down the FORMULAE of two bases in the above reaction. (2)

8.4 A small amount of NaOH is added to pure water at a temperatures of 25 °C. How will this affect the:

(Choose between: INCREASES, DECREASES or NO CHANGE.)

8.4.1 K_w (1)

8.4.2 $[H_3O^+]$ (1)

8.5 A learner wants to determine the percentage magnesium oxide in a health tablet. She dissolves the tablet in 50 cm^3 of 0,8 $mol \cdot dm^{-3}$ hydrochloric acid solution. The balanced equation for the reaction is:

$$MgO(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2O(\ell)$$

8.5.1 Calculate the number of moles of acid present in 50 cm^3 of a 0,8 $mol \cdot dm^{-3}$ hydrochloric acid solution. (3)

Not all of the hydrochloric acid reacts. She titrates the excess hydrochloric acid with a sodium hydroxide solution. It takes 20 cm^3 of the 0,5 $mol \cdot dm^{-3}$ of sodium hydroxide solution to neutralise the excess hydrochloric acid. The hydrochloric acid and sodium hydroxide react as shown in the balanced equation below.

$$NaOH(aq) + HC\ell(aq) \rightarrow NaC\ell\,(aq) + H_2O(\ell)$$

8.5.2 The original mass of the tablet is 0,96 g. Calculate the percentage of magnesium oxide in the tablet. (8)

[29]

GRAND TOTAL [150]

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 by STD	V_m	$22{,}4\ dm^{3}\cdot mol^{-1}$
Standard temperature Standaardtemperatuur	T^{θ}	273 K
Avogadro's constant	N_A	$6{,}023 \times 10^{23}\ mol^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{n_a}{n_b} = \frac{c_a V_a}{c_b V_b}$	$pH = -\log[H_3O^{+}]$
$K_w = [H_3O^{+}][OH^{-}] = 1 \times 10^{-14}$ at/ by 298 K	
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ OR/*OF* $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ OR/*OF* $E^{\theta}_{cell} = E^{\theta}_{oxidising agent} - E^{\theta}_{reducing agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

Half-reactions/*Halfreaksies*			E^θ (V)
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$2H^+ + 2e^-$	**⇌**	**$H_2(g)$**	**0,00**
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 1,66
$Mg^{2+} + 2e^-$	⇌	Mg	− 2,36
$Na^+ + e^-$	⇌	Na	− 2,71
$Ca^{2+} + 2e^-$	⇌	Ca	− 2,87
$Sr^{2+} + 2e^-$	⇌	Sr	− 2,89
$Ba^{2+} + 2e^-$	⇌	Ba	− 2,90
$Cs^+ + e^-$	⇌	Cs	- 2,92
$K^+ + e^-$	⇌	K	− 2,93

Increasing reducing ability/*Toenemende reduserende vermoë* ↓

$Li^+ + e^-$	⇌	Li	− 3,05

TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE

Half-reactions/*Halfreaksies*			**E^θ (V)**
$Li^+ + e^-$	⇌	Li	− 3,05
$K^+ + e^-$	⇌	K	− 2,93
$Cs^+ + e^-$	⇌	Cs	− 2,92
$Ba^{2+} + 2e^-$	⇌	Ba	− 2,90
$Sr^{2+} + 2e^-$	⇌	Sr	− 2,89
$Ca^{2+} + 2e^-$	⇌	Ca	− 2,87
$Na^+ + e^-$	⇌	Na	− 2,71
$Mg^{2+} + 2e^-$	⇌	Mg	− 2,36
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$2H^+ + 2e^-$	**⇌**	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81

$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87

Increasing oxidising ability/***Toenemende oksiderende vermoë***

Increasing reducing ability/***Toenemende reduserende vermoë***

TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

Electronegativity / *Elektronegatiwiteit*	Atomic number / *Atoomgetal*	Symbol / *Simbool*	Approximate relative atomic mass / *Benaderde relatiewe atoommassa*
1,9	29	Cu	63,5

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

education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

NATIONAL SENIOR CERTIFICATE EXAMINATION

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P2)

June 2021

MARKING GUIDELINE

MARKS/PUNTE: 150

This memorandum consists of 11 pages

Hierdie memorandum bestaan uit 11 bladsye

QUESTION 1 / VRAAG 1

1.1 D ✓✓

1.2 B ✓✓

1.3 C ✓✓

1.4 B ✓✓

1.5 C ✓✓

1.6 C ✓✓

1.7 D ✓✓

1.8 A ✓✓

1.9 C ✓✓

1.10 B ✓✓

[20]

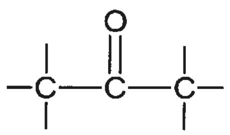
QUESTION 2 / VRAAG 2

2.1.1 F✓ (1)

2.1.2 G✓ (1)

2.1.3 C✓ (1)

2.2.1



✓✓ (2)

2.2.2 Carboxylic acid / *Karboksielsuur* ✓ (1)

2.2.3 Propyl✓ propanoate✓ / *Propielpropanoaat* (2)

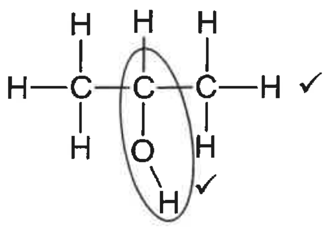
2.2.4 3-bromo-2-chloro-3,4-dimethylpentane / *3-broom-2-chloor-3,4-dimetielpentaan*

Marking criteria / *Nasienriglyne*
• 3-bromo-2-chloro / *3-broom-2-chloor*✓
• 3,4-dimethyl / *3,4-dimetiel*✓
• Pentane / *pentaan*✓
• Any error e.g. hyphens omitted and/or incorrect sequence Max / *Maks* $^{2}/_{3}$

(3)

2.3.1 The C atom bonded to the functional group / hydroxyl (group) / -OH ✓is bonded to one other C atom. ✓
Die C-atoom gebind aan die funksionele groep/hidroksiel (groep)/-OH is gebind aan slegs een ander C-atoom (2)

2.3.2



Marking criteria / *Nasienriglyne*
- Only functional group correct / *Slegs funksionele groep korrek* ✓
- Whole structure correct / *Hele struktuur korrek* ✓

(2)

2.4.1 Compound B is an alkene and it has one or more multiple bonds between C atoms in its hydrocarbon chains. ✓
Verbinding B is 'n alkeen waarin een of meer meervoudige bindings voorkom tussen C-atome in hul koolwaterstofkettings. (1)

2.4.2 Bromine water/*Broomwater*✓ (1)

2.4.3 The orange brown colour of bromine water will disappear immediately/decolourises immediately✓✓
Die oranjebruin kleur van die broom water gaan dadelik verdwyn/ ontkleur dadelik (2)

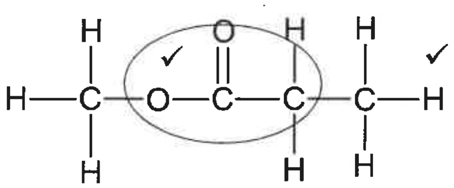
2.4.4 Chloroethane / *Chloor etaan*✓✓ (2)

[21]

QUESTION 3 / VRAAG 3

3.1.1 Type of compound/homologous series/ *Tipe verbinding / homoloëreeks* ✓ (1)

3.1.2



Marking criteria / *Nasienriglyne*
- Only functional group correct / *Slegs funksionele groep korrek* ✓
- Whole structure correct / *Hele struktuur korrek* ✓

(2)

3.1.3 79,8 °C✓ (1)

3.1.4 138,5°C ✓ (1)

3.2
- In **R**/Methyl propanoate/Ester: dipole-dipole forces✓ (in addition to London forces/dispersion forces/induced dipole forces.
- In **S**/ Pentan-1-ol: Hydrogen bonding✓ (in addition to London forces/dispersion forces/induced dipole forces.
- Intermolecular forces in **R**/ methyl propanoate are weaker✓ than in **S**/pentan-1-ol.
  OR intermolecular forces in **T**/pentan-1-ol are stronger than methyl propanoate/ ester **OR** dipole-dipole forces are weaker than hydrogen bonds in **S**

- More energy needed to overcome/break intermolecular forces in **S**.✓
- *In **R** /metielpropanoaat/Ester: dipool-dipoolkragte (tesame met Londonkragte / dispersiekragte/geïnduseerde dipoolkragte).*
- *In **S** / pentan-1-ol: Waterstofbindings (tesame met Londonkragte / dispersiekragte / geïnduseerde dipoolkragte).*
- *Intermolekulêre kragte in **R** swakker as in **S** / pentan-1-ol **OF** intermolekulêre kragte in **S**/ pentan-1-ol is sterker as in **P**/ metielpropanoaat/ester. **OR** dipool-dipoolkragte is swakker as waterstofbindings*
- *Meer energie benodig om intermolekulêre kragte te oorkom / breek in **S**.* (4)

3.3.1 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)

3.3.2 $2C_6H_{14} + 19O_2$ ✓ $\rightarrow 12\ CO_2 + 14H_2O$✓ bal✓

Notes/ *Aantekeninge*

- Reactants ✓ Products ✓ Balancing ✓
- *Reaktante* *Produkte* *Balansering*
- Marking rule /*Nasienreël 3.9*

(3)

3.3.3 P✓ (1)

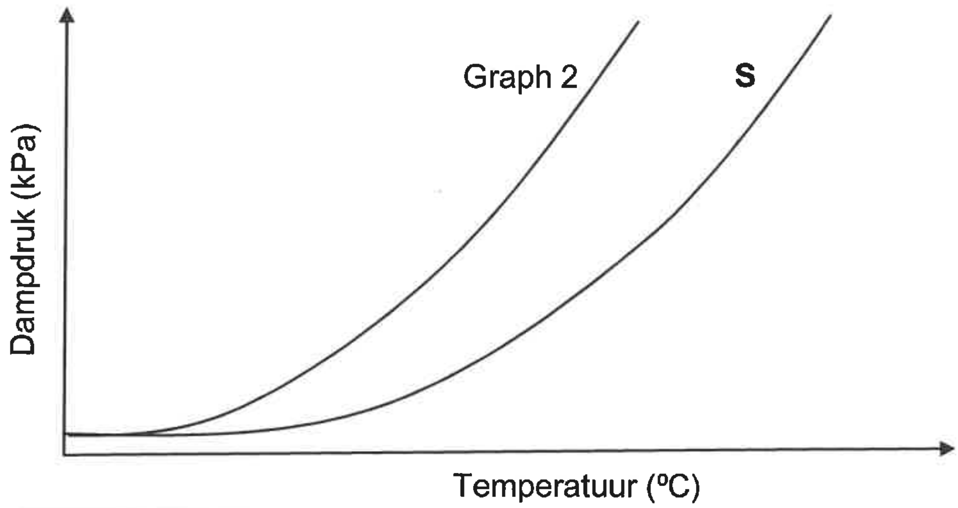
3.3.4
- **P** is less branched / less compact / less spherical/longer chain length / larger surface area (over which intermolecular forces act).✓
  ***P** is minder vertak / minder kompak / minder sferies / langer kettinglengte / groter oppervlak (waaroor intermolekulêre kragte werk).*
- Stronger / more intermolecular forces / Van der Waals forces / London forces / dispersion forces. ✓
  Sterker / meer intermolekulêre kragte / Van der Waalskragte / Londonkragte / dispersiekragte.
- More energy needed to overcome or break intermolecular forces / Van der Waals forces. ✓
  More energie benodig om intermolekulêre kragte / Van der Waalskragte/ dispersiekragte / London-kragte te oorkom.

OR

- **Q** is more branched / more compact / more spherical/shorter chain length / smaller surface area (over which intermolecular forces act).✓
  ***Q** is meer vertak / meer kompak / meer sferies / korter kettinglengte / kleiner oppervlak (waaroor intermolekulêre kragte werk).*
- Weaker / less intermolecular forces / Van der Waals forces / London forces / dispersion forces. ✓
  Swakker / minder intermolekulêre kragte / Van der Waalskragte / Londonkragte / dispersiekragte.
- Less energy needed to overcome or break intermolecular forces / Van der Waals forces. ✓
  Minder energie benodig om intermolekulêre kragte / Van der Waalskragte/ (3)

dispersiekragte / London-kragte te oorkom.

3.3.5



Marking guidelines/ *Nasienriglyne*
• Starting at the same pressure / Begin by dieselfde druk ✓ • Graph **S** must be below Graph 2 / *Grafiek S moet onder Grafiek 2 wees*✓

(2)
[20]

QUESTION 4/ *VRAAG 4*

4.1.1 Organic compounds that consist of hydrogen and carbon only.✓✓
Organiese verbindings wat slegs uit waterstof en koolstof bestaan. (2)

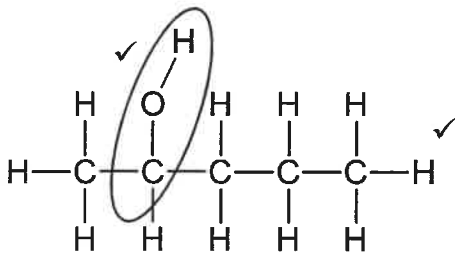
4.1.2 Pentane /*Pentaan* ✓ (1)

4.2.1 Halogenation / Substitution /*Halogenering / Substitusie* ✓ (1)

4.2.2 Hydration /Addition / *Hidrasie / Hidratering /Addisie*✓ (1)

4.2.3 Hydrolysis/Substitution / *Hidrolise/Substitusie*✓ (1)

4.3



Marking criteria / *Nasienriglyne*
• Only functional group correct / *Slegs funksionele groep korrek* ✓ • Whole structure correct / *Hele struktuur korrek* ✓

Notes / *Aantekeninge*
• Accept -OH as condensed. / *Aanvaar -OH as gekondenseer* ✓ • Condensed structural formula / *Gekondenseerde struktuurformule*✓ Maks: $^1/_2$

Propan-2-ol / 2-Propanol ✓

Notes / *Aantekeninge*
• Whole name correct / *Hele naam korrek* ✓

(3)

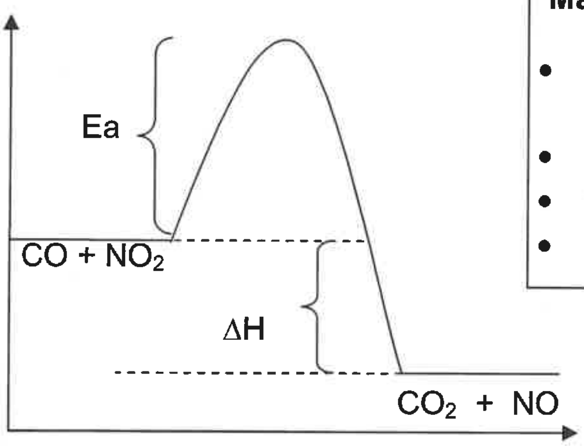
4.4 Hydrohalogenation / *Hidrohalogenasie / Hidrohalogenering* ✓ (1)

4.5 Reaction 2 / *Reaksie 2* ✓ (1)

[11]

QUESTION 5/ *VRAAG 5*

5.1



Marking criteria / Nasienriglyne
• reactants and products / *reaktante en produkte* ✓
• activation energy / *aktieveringsenergie* ✓
• heat of reaction / *reaksiewarmte* ✓
• shape / *vorm van grafiek* ✓

(4)

5.2 A catalyst is a substance that increase the rate of the chemical reaction without undergo a permanent change itself. /A substance that increases the rate of a reaction by providing an alternative path of lower activation energy. ✓✓
'n Katalisator is 'n stof wat die tempo van 'n chemiese reaksie verhoog sonder om self 'n pernamente verandering te ondergaan. Is 'n stoft wat die tempo van 'n reaksie verhoog deur 'n alternatiewe roete van laer aktiveringsenergie te verskaf (2)

5.3 Platinium. ✓

- A catalyst decreases the activation energy by providing an alternative route for the reaction to take place. ✓
  'n Katalisator verlaag die aktiveringsenergie en versakaf 'n alternatiewe roete vir die reaksie om plaas te vind.
- The lower the activation energy the higher the rate of reaction. ✓
  Hoe laer die aktieverings energie hoe hoër die tempo van die reaksie.
- More particles have $E_K \geq E_A$ / More particles have a E_K that is eaual or greater than E_A ✓
  Meer deeltjies het 'n $E_K \geq E_A$ /Meer deeltjie het 'n groter E_K om die Ea te oorkom.

(4)

[10]

QUESTION 6 / *VRAAG 6*

6.1

Criteria for investigative question / *Riglyne vir ondersoekende vraag*	
The dependent and independent variables are stated. *Die afhanklike en onafhanklike veranderlikes is genoem.*	✓
Ask a question about the relationship between the independent and dependent variables. *Vra 'n vraag oor die verwantskap tussen die onafhanklike en afhanklike veranderlikes.*	✓

<u>Example / *Voorbeeld*</u>
What is the relationship between the concentration of sulphuric acid and the rate of the reaction? / *Wat is die verhouding tussen die konsentrasie van swawelsuur en die tempo van die reaksie?* ✓ ✓ (2)

6.2 temperature/mass of Mg/surface area of Mg/ *temperatuur/ massa van Mg/ reaksieoppervlak van Mg* ✓ (1)

6.3 Decrease / *Afneem* ✓ (1)

6.4 Less particles are available for collisions to take place /Fewer particles are exposed ✓
Less particles collide with correct orientation✓
Less effective collisions per unit time/per second✓
Minder deeltjies is besikbaar vir botsings om plaas te vind.
Minder deeltjies bots met die regte oriëntasie
Minder effektiewe botsings per eenheids tyd/per sekonde. (3)

6.5 Increase / *Toeneem* ✓ (1)

6.6

$c=\frac{n}{V}$ ✓

$0,3=\frac{n}{0,2}$ ✓

$n=0,06$ mol

$n(HC\ell) = \frac{1}{2} n(CO_2)$

$n(CO_2)= 0,03$ mol✓

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

$0,03=\frac{V}{22,4}$

$V=0,672\ dm^3$ ✓ (4)

Marking criteria / Nasienriglyne

- Any formula/*Enige formule:* $c = \frac{n}{V}$ / $n =\frac{V}{Vm}$ ✓
- Substitution of / Vervanging van 0,3 and 0,2✓
- Use mol ratio / Gebruik molverhouding: 2:1
  $n(HC\ell) = \frac{1}{2} n(CO_2)$✓ ✓
- Final answer / Finale antwoord: 0,672 dm^3✓

6.8 rate/tempo=$\frac{\Delta V}{\Delta t}$ (3)

$$= \frac{0{,}672-(0)✓}{20-(0)✓}$$

$V=0{,}03\ (dm^3 \cdot s^{-1})$✓

6.9 Equal to / *Gelyk aan* ✓ (1)

[16]

QUESTION 7 / *VRAAG 7*

7.1 (The stage in a chemical reaction when the) rate of the forward reaction equals the rate of reverse reaction. ✓✓
(Die stadium in 'n chemiese reaksie wanneer die) tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie. (2)

7.2.1 The pressure of both reactions increases/ the volume decreased, and the concentration of both the reactants and products increases. ✓ Both reaction rates increase. ✓
Die druk vir beide reaksie is verhoog /die volume verminder wat veroorsaak dat die konsentrasie van beide die reaktante en produkte verhoog. Beide reaksie tempo's word verhoog. (2)

7.2.2 Reverse / Terugwaars ✓ (1)

7.2.3 When pressure is increased the reaction that leads to the smaller amount of mole of gas is favoured. ✓
The reverse reaction is favoured, more A_2B is formed/more reactants are formed.✓
Wanneer die druk verhoog word die reaksie wat tot die kleiner hoeveelheid mol bevoordeel.
Die terugwaartse reaksie word bevoordeel, meer A_2B word gevorm/meer reaktante word gevorm. (2)

7.3 Endothermic / Endotermies ✓
Decrease in temperature favours the exothermic reaction✓
The reverse reaction is favoured /The number of moles of A_2B increases /The concentration of A_2B increases / The amount of product decreases. ✓
Afname in temperatuur bevoordeel die eksotermiese reaksie
Terugwaartse reaksie word bevoordeel./ Die getal mol A_2B neem toe/ Die konsentrasie van A_2B verhoog / Die hoeveelheid produkte verlaag (3)

7.4 A catalyst was added. / 'n Katalisator is bygevoeg. (1)

7.5 Remains the same.✓
A catalyst was added to the reaction✓ both the rate of the forward and reverse reaction increased. ✓
Bly dieselfde.
'n Katalisator is by die reaksie gevoeg. die tempo van beide die voorwaartse en terugwaartse reaksies verhoog. (3)

7.6.1 No effect / Geen effek. ✓ (1)

7.6.2 Decrease✓ (1)

7.7 **CALCULATIONS USING NUMBER OF MOLES BEREKENINGE WAT GETAL MOL GEBRUIK**

Marking guidelines / *Nasienriglyne*

- n(A_2 and B_2)$_{change/verandering}$ = n(A_2 and B_2)$_{initial/begin}$ – n(A_2 and B_2)$_{final/finaal}$ ✓
- Use mole ratio / *Gebruik molverhouding*: 2:2:1✓
- Calculation of volume / *Berekening van volume* (3 dm^3) ✓
- Divide moles at equibrium with calculated volume / *Deel mol by ewewig deur berekende volume.* ✓
- Correct K_c expression / *Korrekte K_c-uitdrukking* ✓
- Substitution of concentration into K_c expression / *Vervanging van konsentrasies in K_c-uitdrukking.* ✓
- Final answer / *Finale antwoord.* (3,456) ✓

	$2A_2B$	$2A_2$	B_2
Initial quantity (mol) Aanvangs hoeveelheid (mol)	5,1	0	0
Change (mol) Verandering (mol)	-3,6	+3,6	+1,8
Quantity at equilibrium (mol) Hoeveelheid by ewewig (mol)	1,5	3,6	1,8
Equilibrium concentration ($mol\cdot dm^{-3}$) Ewewigskonsentrasie ($mol\cdot dm^{-3}$)	0,5	1,2	0,6

Ratio ✓

Change in A_2B and B_2 ✓

Divide by volume ✓

✓

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

$$1,2 = \frac{3,6}{V}$$

$$V = 3\ dm^3$$

$$Kc = \frac{[A_2]^2[B_2]}{[A_2B]^2} \checkmark$$

$$= \frac{(1,2)^2(0,6)}{(0,5)^2} \checkmark$$

$$= 3,456 \checkmark$$

CALCULATIONS USING CONCENTRATION / *BEREKENINGE WAT KONSENTRASIE GEBRUIK*

Marking guidelines / *Nasienriglyne*

- Calculation of volume / *Berekening van volume* (3 dm^3) ✓
- Initial n(A_2B) divide by 3 dm^3. / *Aanvanklike n(A_2B) gedeel deur 3 dm^3.* ✓
- c(A_2 and B_2)$_{change/verandering}$ = c(A_2 and B_2)$_{initial/begin}$ – c(A_2 and B_2)$_{final/finaal}$ ✓
- Use mole ratio / *Gebruik molverhouding*: 2:2:1✓
- Correct K_c expression / *Korrekte K_c-uitdrukking* ✓
- Substitution of concentration into K_c expression / *Vervanging van konsentrasies in K_c-uitdrukking.* ✓
- Final answer / *Finale antwoord.* (3,456) ✓

	$2A_2B$	$2A_2$	B_2
Initial concentration ($mol \cdot dm^{-3}$) Aanvangs konsentrasie ($mol \cdot dm^{-3}$)	1,7✓	0	0
Change ($mol \cdot dm^{-3}$) Verandering ($mol \cdot dm^{-3}$)	1,2	1,2	0,6
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)	0,5	1,2	0,6

Ratio ✓

Change in A_2B and B_2 ✓

$$Kc = \frac{[A_2]^2[B_2]}{[A_2B]^2} \checkmark$$

$$= \frac{(1,2)^2(0,6)}{(0,5)^2} \checkmark$$

$$= 3,456 \checkmark$$

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

$$1,2 = \frac{3,6}{V}$$

$$V = 3\ dm^3 \checkmark$$

(7)
[23]

QUESTION 8 / *VRAAG 8*

8.1.1 It can donate two protons per molecule. ✓✓
Dit kan twee protone skenk per molekule. (2)

8.1.2 $pH = -\log [H_3O^+]$ ✓
$= -\log (0,5)$ ✓
$= 0,3$ ✓

$c[H_3O^+] = 2(0,25) = 0,5\ mol \cdot dm^{-3}$ ✓ (4)

8.1.3 $c_1V_1 = c_2V_2$ ✓
$(0,25)(20) = (0,1)\ V_2$ ✓
$V_2 = 50\ cm^3 / 0,05\ dm^3$ ✓
Add $30\ cm^3$/$0,03\ dm^3$ water / *Voeg $30\ cm^3$ / $0,03\ dm^3$ water by* ✓ (4)

8.2 $NH_4^+ + H_2O$ ✓ $\rightleftharpoons NH_3 + H_3O^+$ ✓
The H_3O^+ ions formed is a strong acid. / *Die H_3O^+ ione gevorm is 'n sterk suur.* ✓ (3)

8.3.1 Ampholyte/*Amfoliet* ✓ (1)

8.3.2 H_2O✓ and/*en* SO_4^{2-} ✓ (2)

8.4.1 No change/ *Geen verandering* ✓ (1)

8.4.2 Decreases/ *Afneem* ✓ (1)

8.5.1 $n = c \times V$ ✓ (3)

= 0,8 x 0,05 ✓
= 0,04 mol ✓

8.5.2

Marking criteria / Nasienriglyne

- Calculate the number of moles of NaOH✓
  Bereken die getal mol van NaOH
- Use of ratio (NaOH: HCℓ) - /1:1✓
  Gebruik die verhouding (NaOH: HCℓ) -1:1
- Calculate the number of moles of HCℓ that reacted✓
  Bereken die getal mol HCℓ wat gereageer het
- Use of ratio (HCℓ: MgO) - 2:1✓
  Gebruik van verhouding (HCℓ: MgO) - 2:1
- Use of formula m = n x M✓
  Gebruik formule m = n x M
- Use of molar mass 40✓
- Final answer / *Finale antwoord*✓

n(NaOH) = c x V
= 0,5 x 0,02
= 0,01 mol ✓

n(HCℓ) = n(NaOH)) = 0,01 mol ✓

0,01 mol HCℓ was in excess

0,04 – 0,01✓ = 0,03 mol HCℓ reacted

n(MgO) = ½ n(HCℓ)= 0,015 mol✓

0,015 mol MgO reacted ✓

m = n x M ✓
= 0,015 x 40✓
= 0,6g

$\% \text{ MgO} = \frac{0,6}{0,96} \times 100 = 62,5\%$ ✓

(8)
[29]

TOTAL 150