Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo
Provinsie van die Oos Kaap: Department van Onderwys
Porafensie Ya Kapa Botjahabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2026

PHYSICAL SCIENCES: (CHEMISTRY) P2

MARKS: 150

TIME: 3 hours

This question paper consists of 17 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 subquestions, e.g. 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, etc. 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. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1–1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 Which ONE of the following combinations are correct regarding molecules from the same homologous series?

They have the same …

A molecular formula and functional group.

B general formula but different functional groups.

C functional group but different general formula.

D functional group and differ from each other by -CH_2- group. (2)

1.2 Which ONE of the following names is a possible name for an organic compound with the molecular formula $C_5H_{10}O$?

A Pentan-1-ol

B 2,2-dimethylpropanal

C 4-methylpentan-2-one

D Pentanoic acid (2)

1.3 Which ONE of the following compounds will have the highest boiling point?

A Butane

B 2-methylpropane

C Butan-1-ol

D Butanal (2)

1.4 Hydrogen gas (H_2) is passes through propene in the presence of platinum (Pt). The name for this reaction is …

A halogenation.

B hydrogenation.

C hydration.

D hydrohalogenation. (2)

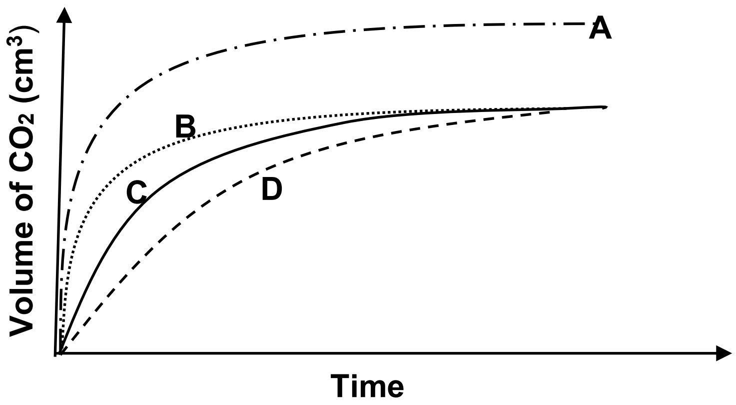
1.5 The reaction between sodium carbonate (Na_2CO_3) and EXCESS hydrochloric acid (HCℓ) is used to determine the factors that influences the reaction rate. The balanced equation for the reaction is:

$$Na_2CO_3\,(aq) + 2\,HC\ell\,(aq) \rightarrow 2\,NaC\ell\,(aq) + H_2O\,(\ell) + CO_2\,(g)$$

The reaction conditions used for four experiments is summarised in the table below.

EXP.	Mass of Na_2CO_3 (g)	Concentration of HCℓ ($mol{\cdot}dm^{-3}$)	Initial Temperature (°C)
1	15	1	30
2	15	0,5	30
3	15	1	40
4	25	2	40

Which ONE of the graphs below represent the results for experiment **2**?



(2)

1.6 The following system reaches equilibrium in a closed container.

$$2\,H_2S\,(g) \rightleftharpoons 2\,H_2\,(g) + S_2\,(g) \qquad \Delta H > 0$$

Which ONE of the following changes will increase the amount of H_2 (g) in the container?

A Cool the container

B Remove S_2 (g)

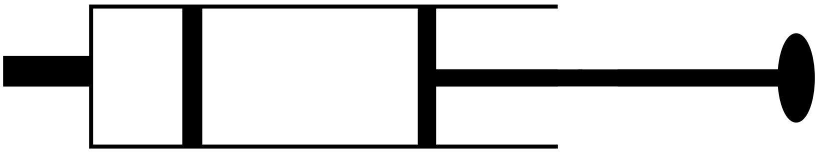
C Decrease the volume of the container

D Add a catalyst (2)

1.7 $PC\ell_5$ (g) is sealed in a gas syringe. The $PC\ell_5$ (g) decomposes according to the balanced equation:

$$PC\ell_5\ (g) \rightleftharpoons PC\ell_3\ (g) + C\ell_2\ (g)$$

The plunger is currently at point **P**.



What will happen to the CONCENTRATION OF $PC\ell_3$ and the EQUILIBRIUM CONSTANT, Kc-VALUE if the plunger is pushed to position **Q**?

	[$PC\ell_3$]	**Equilibrium constant, Kc-value**
A	INCREASES	DECREASES
B	DECREASES	INCREASES
C	INCREASES	REMAINS THE SAME
D	DECREASES	REMAINS THE SAME

(2)

1.8 Consider the following equation:

$$(COOH)_2\ (aq) + 2H_2O\ (\ell) \rightleftharpoons (COO)_2^{2-}\ (aq) + 2H_3O^+\ (aq)$$

The Lowry-Brønsted acids in the above reaction are …

A $(COOH)_2$ and H_2O

B $(COOH)_2$ and H_3O^+

C H_2O and $(COO)_2^{2-}$

D $(COOH)_2$ and $(COO)_2^{2-}$ (2)

1.9 One mole of NaOH and one mole HNO_3 is added to each other to make 1 dm^3 solution. The balanced equation for the reaction is:

$$NaOH\ (aq) + HNO_3\ (aq) \rightarrow NaNO_3\ (aq) + H_2O\ (\ell)$$

The concentration of the hydronium ion (H_3O^+) in the solution is …

A 7 $mol·dm^{-3}$

B 1×10^{-14} $mol·dm^{-3}$

C 0 $mol·dm^{-3}$

D 1×10^{-7} $mol·dm^{-3}$ (2)

1.10 If 12,5 cm^3 of sulphuric acid (H_2SO_4) with a concentration of x $mol·dm^{-3}$ neutralises 25 cm^3 of NaOH according to the balanced equation:

$$2\ NaOH\ (aq) + H_2SO_4\ (aq) \rightarrow Na_2SO_4\ (aq) + 2\ H_2O\ (\ell)$$

What will the concentration of the NaOH be in terms of x?

A x $mol·dm^{-3}$

B $2x$ $mol·dm^{-3}$

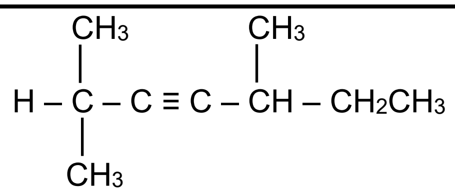
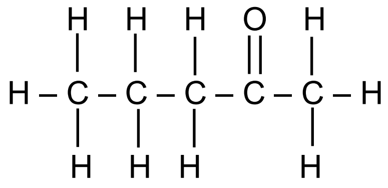
C $½\ x$ $mol·dm^{-3}$

D $3x$ $mol·dm^{-3}$ (2)

[20]

QUESTION 2 (Start on a new page.)

The letters **A–D** in the table below represents four organic compounds.

A $CH_3CH_2CH(CH_2CH_3)CH(CH_3)CHO$	**B** 
C Butyl ethanoate	**D** 

2.1 Write down the:

2.1.1 NAME of the FUNCTIONAL GROUP that is in compound **A** (1)

2.1.2 GENERAL FORMULA of the homologous series to which compound **C** belong (1)

2.2 Is compound **B** a SATURATED or UNSATURATED hydrocarbon?

Give a reason for the answer. (2)

2.3 Write down the IUPAC name of:

2.3.1 Compound **A** (3)

2.3.2 Compound **B** (2)

2.4 Draw the STRUCTURAL FORMULA of compound **C**. (2)

2.5 Compound **D** has three STRUCTURAL ISOMERS.

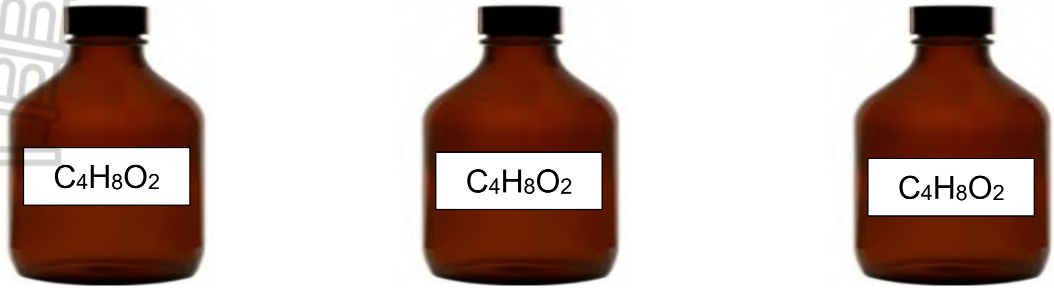
2.5.1 Give the IUPAC name of its STRAIGHT CHAIN FUNCTIONAL ISOMER. (2)

2.5.2 Draw the CONDENSED STRUCTURAL FORMULA of its POSITIONAL ISOMER. (2)

[15]

QUESTION 3 (Start on a new page.)

Three bottles containing different organic compounds with the same molecular formula are shown below.



A **B** **C**

A lab technician wants to identify these compounds by determining their boiling points.

3.1 Explain how the technician will be able to identify the compounds through their respective boiling points. (2)

3.2 To which homologous series does the compounds belong to? (2)

3.3 The experimental boiling points for compounds **A–C** are shown in the table below.

COMPOUND	BOILING POINT (°C)
A	155
B	163,5
C	57,1

3.3.1 Define the term *boiling point*. (2)

3.3.2 Which compound, **A**, **B** or **C**, will have the lowest vapour pressure?

Give a reason for the answer by referring to the data in the table. (2)

3.3.3 Give the IUPAC name of compound **A**. (2)

3.3.4 Fully explain the answer to QUESTION 3.3.3. (4)

[14]

QUESTION 4 (Start on a new page.)

4.1 Consider the equations for reactions **I** to **III**.

I	$CH_3CHC(CH_3)CH_3 + H_2O \rightarrow$ Compound **A** **(Major product)**
II	Compound **A** + HBr $\rightarrow$ Compound **B** + H_2O
III	Compound **B** + NaOH $\rightarrow$ Organic compound **C** + **D**

Write down the type of:

4.1.1 Reaction for reaction **I** (1)

4.1.2 Reaction for reaction **II** (1)

4.1.3 Reaction for reaction **III** (1)

4.1.4 Draw the STRUCTURAL FORMULA for compound **A**. (2)

4.1.5 Write down the IUPAC name of compound **B**. (3)

4.1.6 Is NaOH CONCENTRATED or DILUTED in reaction **III**? (1)

4.1.7 Write down the reaction conditions needed to convert compound **C** to $CH_3CHC(CH_3)CH_3$. (2)

4.2 Consider the cracking of decane ($C_{10}H_{22}$) to produce organic compounds **X** and **Y** according to the following equation:

$$C_{10}H_{22} \rightarrow \mathbf{Y} + \mathbf{X}$$

4.2.1 Define the term *cracking*. (2)

Compound **Y** burns in oxygen and the following reaction occurs:

$$2\ \mathbf{Y} + 25\ O_2 \rightarrow 16\ CO_2 + 18\ H_2O$$

4.2.2 Write down ONE reaction condition besides EXCESS oxygen for above reaction. (1)

4.2.3 Determine the IUPAC name of compound **Y**. (3)

4.2.4 Give a reason why the compound named in QUESTION 4.2.3 can be used as fuel. (1)

Bromine water (Br_2 (aq)) is added to compound **X**.

4.2.5 Write down ONE observation that can be seen in this reaction. (1)

4.2.6 Using STRUCTURAL FORMULAE, write down the balanced equation for the reaction. (5)

[24]

QUESTION 5 (Start on a new page.)

The reaction between magnesium carbonate ($MgCO_3$) and EXCESS hydrochloric acid (HCℓ) was used to investigate factors that affect the reaction rate. The balanced equation for the reaction is:

$$2\,HC\ell\,(aq) + MgCO_3\,(s) \rightarrow MgC\ell_2\,(aq) + H_2O\,(\ell) + CO_2\,(g)$$

The reaction conditions used and results for each experiment are summarised in the table below.

EXP.	CONCENTRATION HCℓ ($mol{\cdot}dm^{-3}$)	INITIAL TEMPERATURE (°C)	STATE OF DIVISION OF $MgCO_3$	REACTION TIME (s)
1	1,0	25	Whole tablet	46
2	1,0	25	Crushed tablet	40
3	1,5	25	Whole tablet	39
4	2,0	30	Whole tablet	31
5	2,0	27	Whole tablet	35

5.1 Define the term *reaction rate.* (2)

5.2 Is the comparison between experiment **1** and **4** a fair comparison?

Give a reason for the answer. (2)

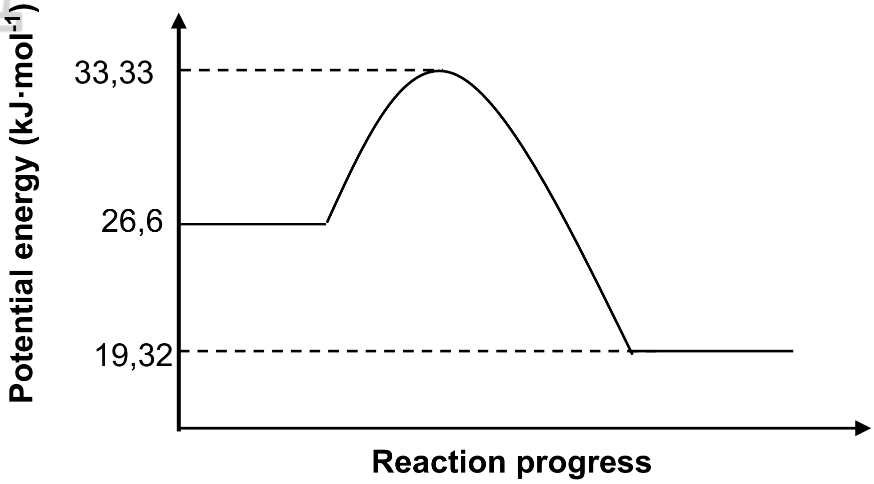
5.3 Write down the conclusion for the comparison of experiment **1** and **2**. (2)

5.4 Use the collision theory to explain the results when comparing experiment **1** and **3**. (3)

5.5 Calculate the mass of magnesium carbonate used if the average reaction rate for the CO_2 production in experiment **2** is 1,488 x 10^{-4} mol·s^{-1}. (5)

5.6 The graph below shows the changes in potential energy during the decomposition of N_2O_5.

$$2\ N_2O_5\ (g) \rightarrow 2\ N_2O_4\ (g) + O_2\ (g)$$

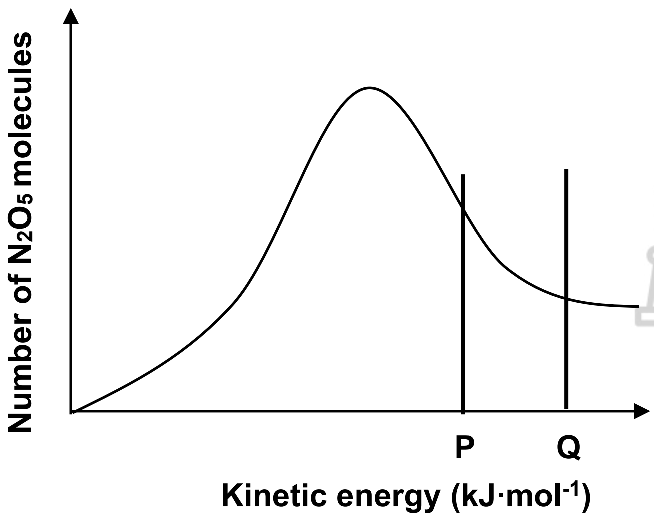


5.6.1 Is energy RELEASED or ABSORBED during this reaction?

Give a reason for the answer. (2)

5.6.2 Determine the activation energy. (2)

The Maxwell-Boltzmann distribution curve for the decomposition of N_2O_5 is shown below. **P** and **Q** represent the energy for a catalysed and uncatalyzed decomposition of N_2O_5.



5.6.3 Which one of, **P** or **Q**, is equal to the value calculated in QUESTION 5.6.2? (1)

5.6.4 Redraw the distribution curve in the ANSWER BOOK and label this curve as **R**.

On the same set of axes sketch the curve that will be obtained for a higher temperature at which N_2O_5 decomposes. Label the curve as **S**. (2)

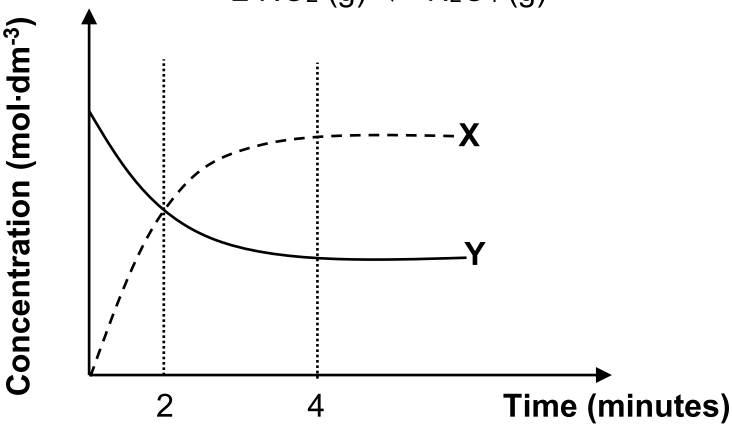
5.7 25 cm^3 of N_2O_5 was allowed to decompose. Only 10 cm^3 of O_2 gas was produced. Assume that the temperature and pressure remained constant during this reaction and the reaction occurred in a container that can expand.

Calculate the volume of N_2O_5 that remain inside the container. (3)
[24]

QUESTION 6 (Start on a new page.)

6.1 Nitrogen dioxide (NO_2) gas is sealed inside an empty container. The graph below shows the changes in concentration for the given reaction that occurred inside the container over time:

$$2\ NO_2\ (g) \rightleftharpoons N_2O_4\ (g)$$



6.1.1 Explain what is meant by *chemical equilibrium*. (2)

6.1.2 Which one of, **X** or **Y**, represents N_2O_4? (1)

6.1.3 Is the forward reaction PRODUCT FAVOURED or REACTANT FAVOURED?

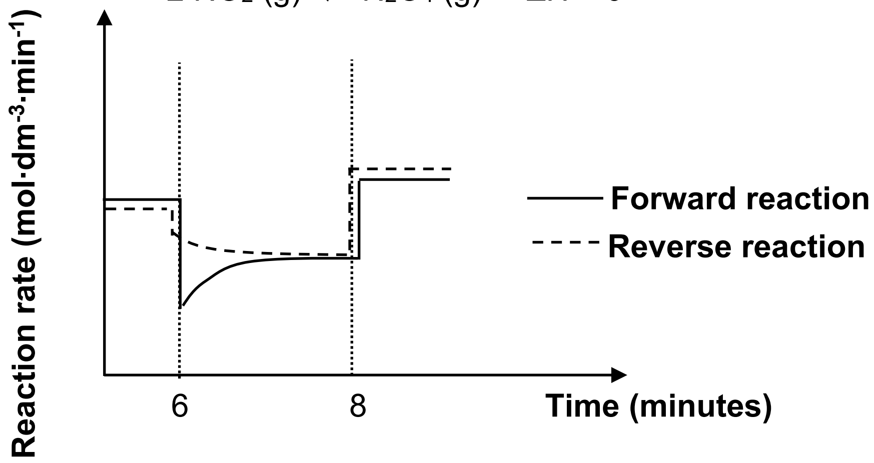
Give a reason for the answer. (2)

6.1.4 At what time interval, 2 minutes or 4 minutes, is the rate of the forward reaction equal to the rate of reverse reaction?

Give a reason for the answer. (2)

6.2 The graph below shows the rates of the forward and reverse reaction for the following reaction:

$$2\ NO_2\ (g) \rightleftharpoons N_2O_4\ (g) \qquad \Delta H < 0$$



6.2.1 What change was made to the equilibrium mixture at 6 minutes? Fully explain the answer. (4)

6.2.2 What change was made at 8 minutes? (1)

6.3 Consider the reversible reaction:

$$N_2\ (g) + O_2\ (g) \rightleftharpoons 2\ NO\ (g)$$

The table below shows the equilibrium constants, K_c-values for this reaction at varies temperatures.

TEMPERATURE	EQUILIBRIUM CONSTANT, K_c-VALUES
298 K	$4,5 \times 10^{-31}$
900 K	$6,5 \times 10^{-10}$
2 300 K	$1,7 \times 10^{-3}$

6.3.1 Define the term *reversible reaction.* (2)

6.3.2 Is the yield HIGH or LOW at 298 K?

Give a reason for the answer. (2)

6.3.3 Is the forward reaction EXOTHERMIC or ENDOTHERMIC?

Fully explain the answer by referring to Le Chatelier's principle. (4)

6.4 Consider the equilibrium at 25 °C.

$$2\ NOBr\ (g) \rightleftharpoons 2\ NO\ (g) + Br_2\ (g)$$

Initially 0,157 mol of NOBr (g) is sealed in an empty 0,5 dm^3 container. At equilibrium the concentration of Br_2 (g) is 0,0195 $mol{\cdot}dm^{-3}$.

6.4.1 Calculate the equilibrium constant, K_c-value at 25 °C. (7)

The volume of the container is now doubled.

6.4.2 Will the equilibrium constant, K_c-value INCREASE, DECREASE or REMAIN THE SAME? (1)

[28]

QUESTION 7 (Start on a new page.)

7.1 The pH-values of three acids with a concentration of 0,1 $mol{\cdot}dm^{-3}$ at 25 °C is shown in the table below:

ACID	pH-VALUE
CH_3COOH	2,88
HNO_3	1,00
$H_2C_2O_4$	2,59

7.1.1 Define a *weak acid*. (2)

7.1.2 Is it fair to compare the strength of HNO_3 to $H_2C_2O_4$ using the pH-values?

Give a reason for the answer. (2)

7.1.3 Which acid, CH_3COOH or HNO_3, will have a higher K_a-value?

Explain the answer. (4)

7.2 $HC_2O_4^-$ is an ampholyte.

7.2.1 Describe the term *ampholyte*. (2)

7.2.2 Is $HC_2O_4^-$ a conjugate base or acid of $H_2C_2O_4$?

Give a reason for the answer. (2)

7.3 Ammonium chloride ($NH_4C\ell$) is dissolved in water.

7.3.1 What is the name of the reaction between $NH_4C\ell$ and water? (1)

7.3.2 Will the solution be ALKALINE, ACIDIC or NEUTRAL?

Explain the answer by referring to the relevant equation. (4)

7.4 An unknown diprotic acid (H_2A) reacts with sodium hydroxide (NaOH) as shown in the equation below:

$$H_2A\ (aq) + 2\ NaOH\ (aq) \rightarrow Na_2A\ (aq) + 2\ H_2O\ (\ell)$$

45 g of the unknown diprotic acid (H_2A) is dissolved to make a 1 dm^3 solution. 25 cm^3 of the unknown diprotic acid (H_2A) is pipetted into an Erlenmeyer flask and phenolphthalein indicator is added.

7.4.1 Wat colour will the solution be if phenolphthalein indicator is added to the unknown diprotic acid? (1)

Sodium hydroxide (NaOH) with a concentration of 0,513 $mol{\cdot}dm^{-3}$ and an average volume of 29,1 cm^3 was used to neutralise the unknown diprotic acid.

The table below shows two possible acids that can be the unknown diprotic acid.

ACID	FORMULA
Tartaric acid	$H_2C_4H_4O_6$
Oxalic acid	$H_2C_2O_4$

7.4.2 Use a suitable calculation to identify the unknown acid from the table. (7)

[25]

TOTAL: 150

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

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·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

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1\times10^{-14}$ at/*by* 298 K	

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

KEY/ *SLEUTEL*

Elektronegatiwiteit Electronegativity →	1,9 **29 Cu**	← *Simbool* Symbol

Atomic number / *Atoomgetal* ↓ 29

Approximate relative atomic mass / *Benaderde relatiewe atoommassa* ↑

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

Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo
Provinsie van die Oos Kaap: Department van Onderwys
Porafensie Ya Kapa Botjahabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

JUNE/*JUNIE* 2026

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

MARKS/*PUNTE*: 150

This marking guideline consists of 15 pages./
Hierdie nasienriglyn bestaan uit 15 bladsye.

QUESTION/*VRAAG 1*

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

QUESTION/*VRAAG* 2

2.1.1 Formyl group / *Formielgroep* ✓ (1)

2.1.2 $C_nH_{2n}O_2$ ✓ (1)

2.2 Unsaturated. ✓ Contains a triple carbon-carbon bond. ✓
Onversadig. Bevat 'n drievoudige koolstof-koolstofbinding (2)

2.3.1 3-ethyl-2-methylpentanal ✓✓✓
3-etiel-2-metielpentanal

Marking criteria/ *Nasienkriteria*

- Correct stem – pentanal/
  Korrekte stam – pentanal
- Substituents correctly identified (ethyl and methyl)/
  Substituente korrek geïdentifiseer (etiel en metiel)/
- Whole name correct
  Hele naam korrek

(3)

2.3.2 2,5-dimethylhept-3-yne ✓✓
2,5-dimethyl-3-heptyne ✓✓

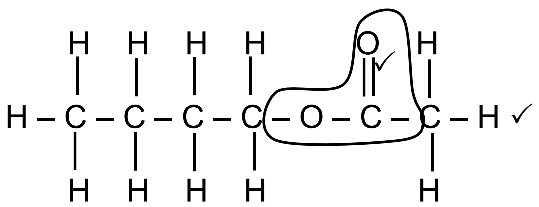
2,5-dimetielhept-3-yn
2,5-dimetiel-3-heptyn

Marking criteria/ *Nasienkriteria*

- Correct stem - hept-3-yne/
  Korrekte stam – hept-3-yn
- Whole name correct/
  Hele naam korrek

(2)

2.4



Marking criteria/ Nasienkriteria

- *Correct functional group/*
  Korrekte funksionele groep
- *Whole structure correct/*
  Hele struktuur korrek

(2)

2.5.1 Pentanal ✓✓ (2)

2.5.2 $CH_3CH_2COCH_2CH_3$ ✓✓

OR

$CH_3CH_2\overset{\overset{O}{||}}{C}CH_2CH_3$ ✓✓

Marking criteria/ *Nasienkriteria*

- Position of functional group on carbon 3/
  Posisie van die funksionele groep is op koolstof 3
- Whole structure correct/
  Hele struktuur korrek

(2)
[15]

QUESTION/*VRAAG* 3

3.1 The experimental boiling points of the compounds will be compared to the known boiling points of compounds ✓ with the given molecular formula. ✓

Die eksperimentele kookpunte van die verbindings sal vergelyk word met die bekende kookpunte van verbindings met die gegewe molekulêre formule. (2)

3.2 Esters ✓ and carboxylic acids ✓
Esters en karboksielsure (2)

3.3.1 **Marking criteria/ *Nasienriglyne***
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 word/frase

The temperature at which the vapour pressure of a substance equals the atmospheric pressure ✓✓
Die temperatuur waarby die dampdruk van stof gelyk is aan die atmosferiese druk (2)

3.3.2 **B** ✓ It has the highest boiling point/ *Dit het die hoogste kookpunt* ✓ (2)

3.3.3 2-methylpropanoic acid / *2-metielpropanoësuur* ✓✓ (2)

3.3.4 **MARKING CRITERIA /*NASIENKRITERIA***

- Identifying compound **C** has the weakest intermolecular forces
- Identifying compound **C** belong to esters.
- Identifying compounds **A** and **B** belong to the same homologous series.
- Identifying compound **A** has a shorter chain length than compound **B**

- *Identifiseer dat verbinding **C** wat die swakste intermolekulêre kragte het*
- *Identifiseer dat verbinding **C** aan die esters behoort.*
- *Identifiseer dat verbindings **A** en **B** aan dieselfde homoloëreeks behoort.*
- *Identifiseer dat verbinding **A** korter kettinglengte het as verbinding **B***

- Compound **C** has the lowest boiling point.
- Compound **C** will have the weakest intermolecular forces. ✓
- Compound **C** belongs to the ester ✓
- Compounds **A** and **B** boiling points are close to each other
- Compounds **A** and **B** belong to carboxylic acids/same homologous series ✓
- Compound **A** has a lower boiling point than compound **B**
- Compound **A** will have a shorter chain length than compound **B** ✓

- *Verbinding **C** het die laagste kookpunt*
- *Verbinding **C** het die swakste intermolekulêre kragte*
- *Verbinding **C** behoort aan die esters*

- *Verbinding **A** en **B** se kookpunte is naby mekaar*
- *Verbinding **A** en **B** behoort aan dieselfde homoloë reeks / karboksielsure*
- *Verbinding **A** het 'n korter kettinglengte as verbinding **B*** (4)

[14]

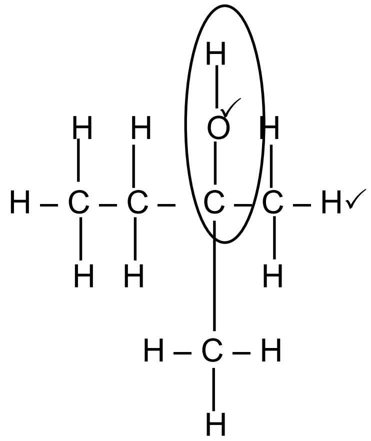
QUESTION/*VRAAG 4*

4.1.1 Addition / Hydration ✓
Addisie / Hidrasie (1)

4.1.2 Substitution / Hydrohalogenation of alcohols ✓
Substitusie / Hidrohalogenering van alkohole (1)

4.1.3 Substitution / Hydrolysis of haloalkanes ✓
Substitusie / Hidratering van haloalkane (1)

4.1.4



Marking criteria/ Nasienkriteria

- *Correct functional group/ Korrek funksionele groep*
- *Whole structure correct/ Hele struktuur korrek*

(2)

4.1.5 2-bromo-2-methylbutane ✓✓✓
2-bromo-2-metielbutaan

Marking criteria/ *Nasienkriteria*

- Correct stem – butane/ *Korrekte stam - butaan*
- Substituents correctly identified (bromo and methyl)/ *Substituente korrek geïdentifiseer (bromo en metiel)*
- Whole name correct/*Hele naam korrek*

(3)

4.1.6 Diluted / *Verdun* ✓ (1)

4.1.7 Conc/ *Gekons* H_2SO_4 / H_3PO_4 ✓ and / *en* heat / *hitte* (under reflux) ✓ (2)

4.2.1 The breaking up of long chain hydrocarbons into smaller more useful molecules ✓✓ **(2 or 0)**
Die opbreek van langkettingkoolwaterstowwe in kleiner, meer bruikbare molekules ***(2 of 0)*** (2)

4.2.2 Ignition/spark source is needed / *Ontstekings-/vonkbron is nodig* ✓ (1)

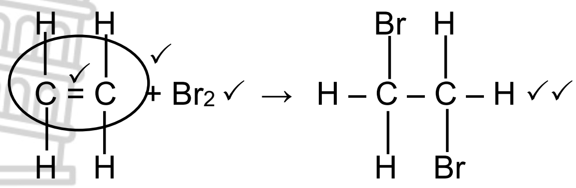
4.2.3 C = 16/ 2 = 8
H = 18x2 / 2 = 18 ✓

C_8H_{18}
Octane / *Oktaan* ✓✓ (3)

4.2.4 The combustion reaction is highly exothermic. / *Die verbrandingsreaksie is hoogs eksotermies.* ✓ (1)

4.2.5 Bromine water decolourises / *Broomwater ontkleur* ✓ (1)

4.2.6



<u>*Marking criteria for organic compounds/ Nasienkriteria vir organiese verbindings*</u>

- *Correct functional group/ Korrek funksionele groep*
- *Whole structure correct/ Hele struktuur korrek*

(5)

[24]

QUESTION/*VRAAG* 5

5.1

<u>Marking criteria/ *Nasienriglyne*</u>
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

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

ENIGE EEN

- *<u>Verandering in konsentrasie</u> van reaktante of produkte <u>per (eenheid) tyd.</u>*
- *<u>Verandering in hoeveelheid/aantal mol/volume/massa</u> van reaktante of produkte <u>per (eenheid) tyd.</u>*
- *<u>Verandering in hoeveelheid/aantal mol/volume/massa</u> van produkte wat gevorm word of reaktante wat <u>per (eenheid) tyd</u> gebruik word.*

OR/*OF*

The rate of changes in concentration/amount of moles/mumber of moles/volume/mass of reactants or products. ✓✓ **(2 or 0)**
Die tempo van veranderinge in konsentrasie/hoeveelheid mol/aantal mol/volume/massa van reaktante of produkte. ***(2 of 0)*** (2)

5.2 No. ✓ There is more than one independent variable / Both the concentration of HCℓ and the initial temperature is different. ✓
Nee. Daar is meer as een onafhanklike veranderlike/ Beide die konsentrasie van HCℓ en die aanvanklike temperatuur is verskillend. (2)

5.3 The larger the state of division the faster the reaction rate. ✓✓
Hoe groter die toestand van verdeeldheid, hoe vinniger die reaksietempo. (2)

5.4
- Experiment 3 has a higher concentration. ✓
- More particles with correct orientation/ higher average kinetic energy. ✓
- More effective collision per unit time/ Frequency of the effective collision increases. ✓

OR

- Experiment 1 has a lower concentration. ✓
- Less particles with correct orientation/ higher average kinetic energy. ✓
- Less effective collision per unit time/ Frequency of the effective collision decreases. ✓

- *Eksperiment 3 het 'n hoër konsentrasie.*
- *Meer deeltjies met korrekte oriëntasie/ hoër gemiddelde kinetiese energie.*
- *Meer effektiewe botsing per tydseenheid/ Frekwensie van die effektiewe botsing neem toe*

OF

- *Eksperiment 1 het laer konsentrasie.*
- *Minder deeltjies met korrekte oriëntasie/ hoër gemiddelde kinetiese energie.*
- *Minder effektiewe botsing per tydseenheid/ Frekwensie van die effektiewe botsing neem af* (3)

5.5

OPTION 1	OPTION 2
Marking criteria a) Substitution into rate equation *Vervanging in tempo vergelyking* b) Use of mole ratio to determine n ($MgCO_3$) *Gebruik van mol verhouding om n ($MgCO_3$) te bepaal* c) Formula/ *Formule* m = nM d) Subsitution into m = nM *Vervanging in m = nM* e) *Final answer / Finale antwoord* Rate/ *Tempo* $= \frac{\Delta n}{\Delta t}$ $1{,}488 \times 10^{-4} = \frac{n-0}{40}$ (a) ✓ n = $5{,}952 \times 10^{-3}$ mol n ($MgCO_3$) = n (CO_2) n ($MgCO_3$) = $5{,}952 \times 10^{-3}$ mol (b) ✓ m = nM (c) ✓ m($MgCO_3$) = ($5{,}952 \times 10^{-3}$)(84) (d) ✓ m($MgCO_3$) = 0,5 g (e) ✓	**Marking criteria** a) Comparing the rate of $MgCO_3$ and CO_2 ✓ *Vergelyk die tempo van $MgCO_3$ en CO_2* b) Substitution into rate equation *Vervanging in tempo vergelyking* c) Formula/ *Formule* m = nM d) Subsitution into m = nM *Vervanging in m = nM* e) Final answer / *Finale antwoord* Rate ($MgCO_3$) = rate (CO_2) (a) ✓ $1{,}488 \times 10^{-4} = -\frac{0 - n}{40}$ (b) ✓ n = $5{,}952 \times 10^{-3}$ mol m = nM (c) ✓ m($MgCO_3$) = ($5{,}952 \times 10^{-3}$)(84) (d) ✓ m($MgCO_3$) = 0,5 g (e) ✓

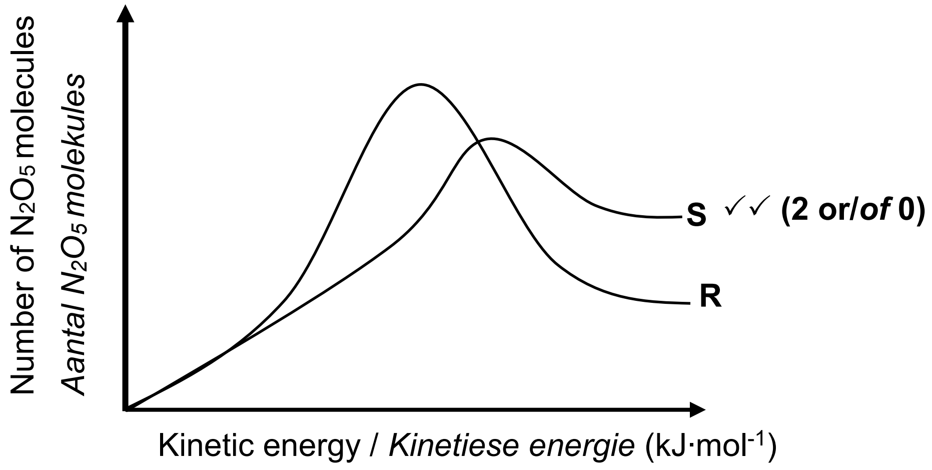
(5)

5.6 5.6.1 Released. ✓ Heat / Enthalpy of the reactants/ H_r is greater than the Heat / Enthalpy of the products/ H_p ✓
Vrygestel. Die warmte / entalpie van die reaktante / Hr is groter as die warmte / entalpie van die produkte / Hp (2)

5.6.2 $E_a = 33{,}33 - 26{,}6$ ✓ $= 6{,}73\ kJ \cdot mol^{-1}$ ✓ (2)

5.6.3 **Q** ✓ (1)

5.6.4



(2)

5.7 $V(N_2O_5)$ reacted / *reageer* = $2V(O_2)$

$V(N_2O_5)$ reacted / *reageer* = 2(10) ✓

$V(N_2O_5)$ reacted / *reageer* = 20 cm^3

$V(N_2O_5)$ remaining/ *oorbly* =25 – 20 ✓

$V(N_2O_5)$ remaining/ *oorbly* = 5 cm^3 ✓ (3)

[24]

QUESTION/*VRAAG* 6

6.1 6.1.1 The state at which the rate of the forward reaction equals the rate of the reverse reaction. ✓✓ **(2 or 0)**
Die toestand waarteen die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie. ***(2 of 0)*** (2)

6.1.2 **X** ✓ (1)

6.1.3 Product favoured ✓. The concentration of **X**/N_2O_4 is higher than the concentration of **Y**/NO_2 ✓
*Produkte bevoordeel. Die konsentrasie van **X**/N_2O_4 is hoër as die konsentrasie van **Y**/NO_2* (2)

6.1.4 4 minutes / *minute*. ✓
The concentrations of **X**/N_2O_4 and **Y**/NO_2 remains constant. ✓
*Die konsentrasies van **X**/N_2O_4 en **Y**/NO_2 bly constant.* (2)

6.2.1 Pressure was decreased ✓
- Both forward and reverse reaction rates drop instantly. ✓
- The forward reaction rate drops significantly more. ✓
- Reverse reaction was favoured/The equilibrium shifted towards the left. ✓

Druk was verlaag
- *Beide voorwaartse en terugwaartse reaksiestempo daal onmiddellik.*
- *Die voorwaartse reaksietempo daal aansienlik meer*
- *Terugwaartse reaksie is bevoordeel/Die ewewig het na links verskuif* (4)

6.2.2 Addition of a catalyst / *Addisie van 'n katalisator* ✓ (1)

6.3.1 It is a reaction in which products can be converted back to reactants (and vice versa) ✓✓
Dit is reaksie waarin produkte terug na reaktanse, (en omgekeerd) omgeskakel kan word. (2)

6.3.2 Low yield. ✓ The Kc-value is less than one. ✓
Lae opbrengs. Die Kc-waarde is kleiner as een. (2)

6.3.3 Endothermic ✓

- An increase in temperature favours the endothermic reaction. ✓
- The equilibrium constant, Kc-value increases as the temperature increases. ✓
- The forward reaction is favoured /The equilibrium position shifts towards the right. ✓

Endotermies

- *Toename in temperatuur bevoordeel die endotermiese reaksie.*
- *Die ewewigskonstante, Kc-waarde, neem toe soos die temperatuur toeneem.*
- *Die voorwaartse reaksie word bevoordeel / Die ewewigsposisie verskuif na regs.* (4)

6.4.1 **OPTION 1: MOLE OPTION**

a) Calculating the equilibrium mole of Br_2
b) Use the ratio to calculate the change in mole of NOBr and NO
c) Calculating the equilibrium mole of NOBr and NO
d) Calculating the equilibrium concentration of NOBr and NO
e) Correct equilibrium constant formula
f) Substituting into the correct equilibrium constant formula
g) Final answer

OPSIE 1: MOL OPSIE

a) Berekening van die ewewigsmol van Br_2
b) Gebruik die verhouding om die verandering in mol NOBr en NO te bereken
c) Berekening van die ewewigsmol van NOBr en NO
d) Berekening van die ewewigskonsentrasie van NOBr en NO
e) Korrekte formule vir ewewigskonstante
f) Vervanging in die korrekte ewewigskonstante formule
g) Finale antwoord

	2 NOBr(g)	⇌	2 NO(g)	Br_2 (g)
Initial mole *Aanvangsmol*	0,157 mol			
Change in mole *Verandering in mol*	<u>0,0195</u>		<u>0,0195</u> (b) ✓	$9,75 \times 10^{-3}$
Equilibrium mole / *ewewigsmol*	<u>0,1375</u>		<u>0,0195</u> (c) ✓	0,0195x0,5 (a) ✓ $= 9,75 \times 10^{-3}$
Equilibrium Concentration *Ewewigs konsentrasie* ($mol \cdot dm^{-3}$)	= <u>0,1375 / 0,5</u> = 0,275		= <u>0,0195/0,5</u> (d) ✓ = 0,039	0,0195

$$Kc = \frac{[Br_2][NO]^2}{[NOBr]^2} \text{ (e) } \checkmark$$

$$Kc = \frac{(0,0195)(0,039)^2}{(0,275)^2} \text{ (f) } \checkmark$$

$Kc = 3,92 \times 10^{-4}$ (g) ✓

OPTION 2: CONCENTRATION

a) Calculating the initial concentration of NOBr
b) Determine the change in concentration of Br_2
c) Use the ratio to calculate the change in concentration of NOBr and NO
d) Calculating the equilibrium concentration of NOBr and NO
e) Correct equilibrium constant formula
f) Substituting into the correct equilibrium constant formula
g) Final answer

OPSIE 2: KONSENTRASIE

a) Berekening van die aanvanklike konsentrasie van NOBr
b) Bepaal die verandering in die konsentrasie van Br_2
c) Gebruik die verhouding om die verandering in konsentrasie NOBr en NO te bereken
d) Berekening van die ewewigskonsentrasie van NOBr en NO
e) Korrekte formule vir ewewigskonstante
f) Vervanging in die korrekte ewewigskonstante formule
g) Finale antwoord (7)

	$2\ NOBr(g)$	$\rightleftharpoons$	$2\ NO(g)$	$Br_2\ (g)$
Initial conc. *Aanvang kons.*	0,157 / 0,5 = 0,314 (a) ✓			
Change in conc. *Verandering in kons*	0,039		0,039 (c) ✓	0,0195 (b) ✓
Equilibrium Concentration *Ewewigs konsentrasie* ($mol\cdot dm^{-3}$)	0,275		0,039 (d) ✓	0,0195

$$Kc = \frac{[Br_2][NO]^2}{[NOBr]^2} \quad \text{(e) ✓}$$

$$Kc = \frac{(0,0195)(0,039)^2}{(0,275)^2} \quad \text{(f) ✓}$$

$Kc = 3,92 \times 10^{-4}$ (g) ✓

6.4.2 REMAINS THE SAME / *BLY DIESELFDE* ✓ (1)

[28]

QUESTION/*VRAAG* 7

7.1.1

Marking criteria/ Nasienriglyne
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*

A weak acid ionizes incompletely in water to produce low concentrations of H_3O^+ ✓✓

'n Swak suur ioniseer onvolledig in water om lae konsentrasies van H_3O^+ te produseer. (2)

7.1.2 Yes ✓ Both acids have the same concentration. ✓
Ja. Beide sure het dieselfde konsentrasie. (2)

7.1.3 HNO_3 ✓
For the same concentrations of the acids, HNO_3 has a lower pH-value. ✓
HNO_3 have a higher concentration of H_3O^+ ✓
HNO_3 ionises to a greater extend. ✓

Vir dieselfde konsentrasies van die sure het HNO_3 'n laer pH-waarde.
HNO_3 het hoër konsentrasie H_3O^+
HNO_3 ioniseer tot groter mate. (4)

7.2.1 It is a substance that can act as either acid or base. ✓✓
Dit is 'n stof wat as 'n suur of basis kan optree. (2)

7.2.2 Conjugate base. ✓

$HC_2O_4^-$ has one less proton/H^+ than $H_2C_2O_4$ / $H_2C_2O_4$ is one more proton/H^+ than $HC_2O_4^-$ / $H_2C_2O_4$ donated one proton/H^+ to produce $HC_2O_4^-$. ✓

Gekonjugeerde basis

$HC_2O_4^-$ het een proton/H+ minder as $H_2C_2O_4$ / $H_2C_2O_4$ is een proton/H^+ meer as $HC_2O_4^-$ / $H_2C_2O_4$ het een proton/H^+ geskenk om $HC_2O_4^-$ te produseer. (2)

7.3.1 Hydrolysis / *Hidrolise* ✓ (1)

7.3.2 Acidic / *Suur* ✓

$NH_4^+ + H_2O$ ✓ $\rightleftharpoons NH_3 + H_3O^+$ ✓

Produces excess Hydronium / H_3O^+ ions ✓
Produseer oormaat hidronium- / H_3O^+-ione (4)

7.4.1 Colourless / *Kleurloos* ✓ (1)

7.4.2 **Marking Criteria**

a) Substituting c and V for NaOH into n = cV
b) Using correct mol ratio to calculate moles of H_2A
c) Calculating the concentration of H_2A
d) Formula c = m /MV
e) Substitution into c = m /MV
f) Calculation of molar mass of $H_2C_4H_4O_6$ or $H_2C_2O_4$
g) Final answer

Nasienkriteria

a) Vervanging van c en V vir NaOH in n = cV
b) Gebruik die korrekte molverhouding om mol H_2A *te bereken*
c) Berekening van die konsentrasie van H_2A
d) Formule c = m /MV
e) Vervanging in c = m /MV
f) Berekening van molêre massa van $H_2C_4H_4O_6$ *of* $H_2C_2O_4$
g) Finale antwoord

n (NaOH) =cV

n (NaOH) = $(0{,}513)(29{,}1 \times 10^{-3})$ (a) ✓
n (NaOH) = 0,0149 mol

n (H_2A) = ½ (0,0149) (b) ✓

n (H_2A) = $7{,}45\times10^{-3}$ mol

$$c(H_2A) = \frac{n}{V}$$

$$c(H_2A) = \frac{7{,}45\times10^{-3}}{25\times10^{-3}} \quad \text{(c) ✓}$$

c (H_2A) = 0,298 $mol{\cdot}dm^{-3}$

$$c(H_2A) = \frac{m}{MV} \quad \text{(d) ✓}$$

$$0{,}298 = \frac{45}{M(1)} \quad \text{(e) ✓}$$

M = 151 $g{\cdot}mol^{-1}$

M ($H_2C_4H_4O_6$) = 150 $g{\cdot}mol^{-1}$
M ($H_2C_2O_4$) = 90 $g{\cdot}mol^{-1}$
} Any one / *Enige een* (f) ✓

H_2A is tartaric acid / *wynsteensuur* / $H_2C_4H_4O_6$ (g) ✓ (7)

[25]

TOTAL/*TOTAAL*: 150