GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION
GRADE 12

2023

PHYSICAL SCIENCES: (CHEMISTRY)

(PAPER 2)

TIME: **3 hours**

MARKS: **150**

12 pages and 2 data sheets

INSTRUCTIONS AND INFORMATION

1. Write your name on your ANSWER BOOK.
2. This question paper consists of 7 questions. Answer ALL the questions in the ANSWER BOOK.
3. Start the answers to each question on a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line open between 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 TWO decimal places.
11. Give brief discussions, et cetera where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are given as possible answers to the following questions. Each question has only correct answer. Write only the letter (A – D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 The compound with the hydroxyl group is …

A $NaOH$.
B CH_3COOH.
C CH_3CH_2OH.
D CH_3CHO. (2)

1.2 Which of the following compounds represents the first member of the ketones?

A $HCHO$
B CH_3OH
C CH_3COCH_3
D CH_3CH_2COOH (2)

1.3 Which of the following compounds has the highest boiling point?

A CH_3CH_3
B $CH_3(CH_2)_4CH_3$
C $CH_3CH_2CH_2CH_3$
D $CH_3CH_2CH_2CH_2CH_3$ (2)

1.4 When CH_3CH_3 is converted to $CH_2{=}CH_2$, the type of reaction is …

A dehydration.
B dehalogenation.
C substitution.
D dehydrogenation. (2)

1.5 Which of the following changes will increase the rate of production of $H_2(g)$ in the reaction given below?

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

A Increase the pressure by decreasing the volume.
B Add water to the reaction mixture.
C Increase the volume of the $H_2SO_4(aq)$.
D Increase the concentration of the $H_2SO_4(aq)$. (2)

1.6 Consider the following reversible reaction:

$$3\ Y_2(g) \rightleftharpoons 2\ Y_3(g) \quad \Delta H = -80\ kJ$$

If the activation energy for the reverse reaction is 180 kJ, then the activation energy for the forward reaction is …

A – 80 kJ.
B 80 kJ.
C 100 kJ.
D 180 kJ. (2)

1.7 Consider the gas phase equilibrium system represented by the following equation:

$$2\ H_2O\ (g) \rightleftharpoons 2\ H_2\ (g) + O_2\ (g) \qquad \Delta H>0$$

Which of the following changes will DECREASE the equilibrium amount of H_2O?

A Decreasing the volume of the container at constant temperature
B Adding more oxygen
C Adding a catalyst
D Increasing the temperature at constant pressure (2)

1.8 The following equilibrium constant expression is given for a hypothetical reaction:

$$Kc = \frac{[Y_2Z]^4[XZ_2]^3}{[X_3Y_8][Z_2]^5}$$

For which of the following reactions is the above expression of Kc correct?

A $X_3Y_8\ (g) + 5Z_2(g) \rightleftharpoons 4Y_2Z(g) + 3XZ_2\ (g)$
B $4Y_2Z\ (g) + 3XZ_2\ (g) \rightleftharpoons X_3Y_8\ (g) + 5Z_2\ (g)$
C $2X_3Y_8\ (g) + 7Z_2\ (g) \rightleftharpoons 6XZ_2\ (g) + 8Y_2Z\ (g)$
D $X_3Y_8\ (g) + 5Z_2\ (g) \rightleftharpoons 3Y_2Z\ (g) + 4XZ_2\ (g)$ (2)

1.9 HPO_4^{2-} can act as an ampholyte. In which of the following reactions does HPO_4^{2-} act as a Brønsted-Lowry acid?

A $HPO_4^{2-} + H^+ \rightarrow H_2PO_4^{1-}$
B $HPO_4^{2-} + HPO_4^{2-} \rightarrow 2HPO_4^{2-}$
C $HPO_4^{2-} + H_2O \rightarrow PO_4^{3-} + H_3O^+$
D $HPO_4^{2-} + H_2O \rightarrow H_2PO_4^{1-} + OH^{1-}$ (2)

1.10 Which of the following weak acids, each of concentration 0,1 mol·dm^{-3}, has the lowest $H_3O^+(aq)$ concentration?

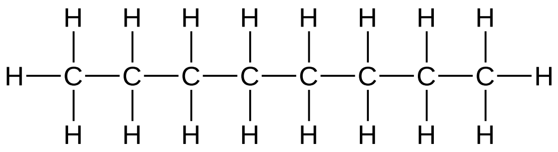
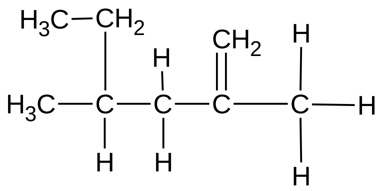
	ACID	K_a VALUE
A	$H_2SO_3(aq)$	$1,2 \times 10^{-2}$
B	$H_2CO_3(aq)$	$4,2 \times 10^{-7}$
C	$(COOH)_2(aq)$	$5,6 \times 10^{-2}$
D	$H_2S(aq)$	$1,0 \times 10^{-7}$

(2)

[20]

QUESTION 2 (Start on a new page.)

The letters **A** to **F** in the table below represent six organic compounds.

A 	**B** 
C $C_3H_7C\ell$	**D** Propanoic acid
E Pentanal	**F** $C_nH_{2n}O_2$

2.1 Define the term *unsaturated hydrocarbon.* (2)

2.2 Consider the unsaturated hydrocarbon in the table.

2.2.1 Write down the letter of this compound. (1)

2.2.2 The compound is passed through bromine water $Br_2(aq)$ in a test tube, at room temperature. State an observable change in the test tube. (2)

2.3 Write down:

2.3.1 The IUPAC name of compound **B** (2)

2.3.2 The STRUCTURAL FORMULA of compound **E** (2)

2.3.3 The NAME of the functional group of compound **E** (1)

2.3.4 The homologous series that is a functional isomer of compound **D** (1)

2.4 Compound **A** is an alkane. Write down:

2.4.1 The GENERAL FORMULA for alkanes (1)

2.4.2 The MOLECULAR FORMULAE for each of the two products obtained during the complete combustion of compound **A** (2)

2.5 Compound **C** is a primary haloalkane.

2.5.1 Define the term *primary haloalkane.* (2)

2.5.2 Write down the STRUCTURAL FORMULA **and** IUPAC name of an ISOMER of compound **C**. (2)

2.5.3 Classify the isomer in QUESTION 2.5.2 as CHAIN, POSITIONAL or FUNCTIONAL. (1)

2.6 A chemical analysis of compound **F** shows that it has the following percentage composition:

x% carbon (C), **y%** hydrogen (H) and **12,5%** oxygen (O).

Use a calculation to determine the value of **x**. (4)

[23]

QUESTION 3 (Start on a new page.)

Haloalkanes play an important role in the chemical industry. Haloalkanes can be made from alcohols.

The following tables can be used to compare the boiling points of some haloalkanes:

Table 1

	Compound	**Formula**	**Boiling point (ºC)**
A	chloromethane	$CH_3C\ell$	-24,1
B	dichloromethane	$CH_2C\ell_2$	40,1
C	trichloromethane	$CHC\ell_3$	61,8
D	tetrachloromethane	$CC\ell_4$	76,6

Table 2

	Compound	**Formula**	**Boiling point (ºC)**
E	fluoromethane	CH_3F	-78,4
F	methanal	CH_2O	-19
G	methanol	CH_3OH	64,7
H	methanoic acid	CH_2O_2	110,8

Use the information given in the tables above to answer QUESTIONS 3.1 to 3.6 below.

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

3.2 Write down the formula of TWO haloalkanes that are the most dangerous at 25 °C. Give a reason for the answer. (3)

3.3 Describe the trend in boiling point illustrated by **Table 2**. Explain this trend. (4)

3.4 Consider **Table 1**.

3.4.1 What is the relationship between the number of chlorine atoms and the boiling point? (2)

3.4.2 Explain the difference in boiling point between chloromethane and tetrachloromethane by referring to the intermolecular force and energy. (3)

3.4.3 State TWO factors that should be kept constant in this investigation to make it a fair test. (2)

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

3.6 Consider the compounds of methanol and methanoic acid in **Table 2.**

3.6.1 Which ONE of these two compounds will have the lower vapour pressure? (1)

3.6.2 Explain the answer to QUESTION 3.6.1. (3)

[22]

QUESTION 4 (Start on a new page.)

4.1 A group of Grade 12 learners is in a school laboratory preparing an organic compound with the distinct smell of pineapple. They use ethanol and propanoic acid. The balanced chemical equation for this reaction is:

$$C_2H_6O + C_3H_6O_2 \rightarrow C_5H_{10}O_2 + H_2O$$

4.1.1 What type of reaction takes place? (1)

4.1.2 Name ONE precaution that needs to be taken when heating the alcohol. (1)

4.1.3 Write down the IUPAC name of the organic compound that is formed. (2)

4.1.4 When 50 g of impure ethanol fully reacts with excess propanoic acid, it produces 68,88 g $C_5H_{10}O_2$. Calculate the percentage purity of the ethanol. (5)

4.2 Prop-1-ene, an UNSATURATED hydrocarbon, and compound **X,** a SATURATED hydrocarbon, react with chlorine, as represented by the incomplete equations below.

Reaction I: Prop-1-ene + $C\ell_2$ → ___________________

Reaction II: **X** + $C\ell_2$ → 2–chlorobutane + **Y**

4.2.1 What type of reaction (ELIMINATION, ADDITION or SUBSTITUTION) takes place in **Reaction I** and **Reaction II**? (2)

4.2.2 Write down the STRUCTURAL FORMULA and NAME of the product formed in **Reaction I**. (2)

4.2.3 List the reaction condition necessary for **Reaction II** to take place. (1)

4.2.4 Write down the IUPAC name for reactant **X**. (1)

4.2.5 Write down the NAME or FORMULA of product **Y**. (1)

4.3 Consider the organic compound of 2-chlorobutane. This compound can either undergo elimination or substitution reactions in the presence of a strong base such as sodium hydroxide.

4.3.1 Which reaction will preferably take place when 2-chlorobutane is heated in the presence of **CONCENTRATED** sodium hydroxide in ethanol. Write down only SUBSTITUTION or ELIMINATION. (1)

4.3.2 Write down the IUPAC name of the major organic compound formed in QUESTION 4.3.1. (2)

4.3.3 Use structural formulae to write down a balanced equation for the reaction that takes place when 2-chlorobutane reacts with a DILUTE sodium hydroxide solution. (4)

4.3.4 Write down the name of the type of substitution reaction that takes place in QUESTION 4.3.3. (1)

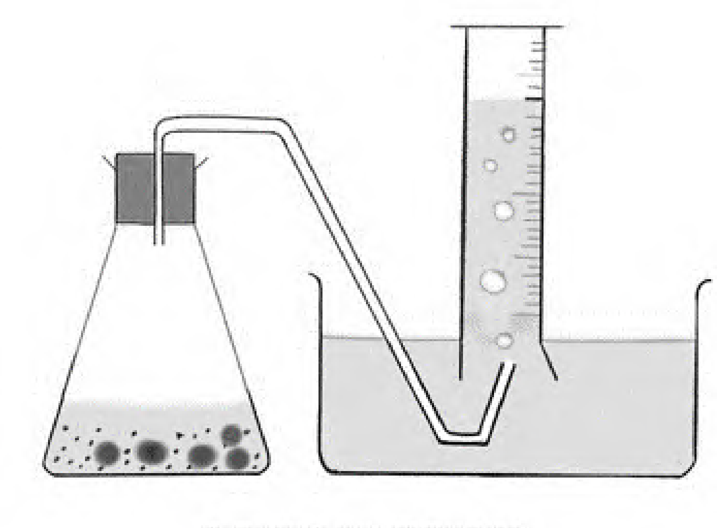
[24]

QUESTION 5 (Start on a new page.)

A group of learners uses the reaction of magnesium ribbon with dilute hydrochloric acid to investigate factors that influence reaction rate. The balanced equation for the reaction is:

$$Mg(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2(g) \qquad \Delta H < 0$$

The hydrogen gas produced in the reaction was collected as shown in the diagram.



shutterstock.com · 2072659547

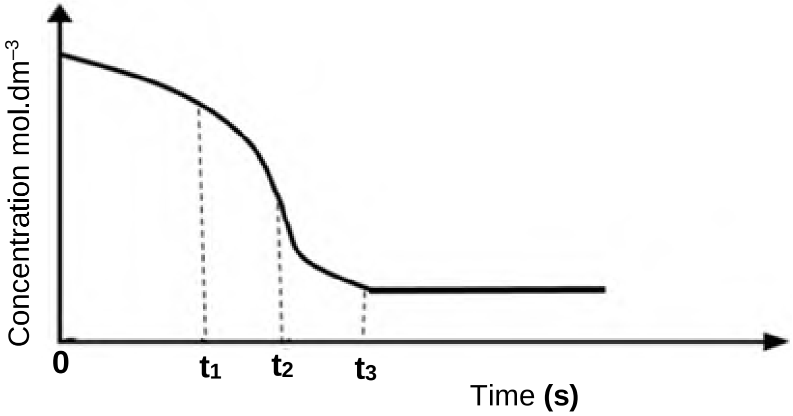
5.1 Is the above reaction EXOTHERMIC or ENDOTHERMIC? Give a reason for the answer. (2)

5.2 Describe the method used to collect the hydrogen gas. (1)

5.3 In one of the experiments, 5 g magnesium ribbon was added to the hydrochloric acid solution.

5.3.1 If the average reaction rate is 7,5 x 10^{-4} mol·s^{-1}, calculate the **VOLUME** (in cm^3) of dilute hydrochloric acid USED UP in 1 minute if the solution has a concentration of 1,5 mol·dm^{-3}. (5)

The concentration of the acid used as a function of time in this experiment is represented by the graph below.
(The graph is NOT drawn to scale.)

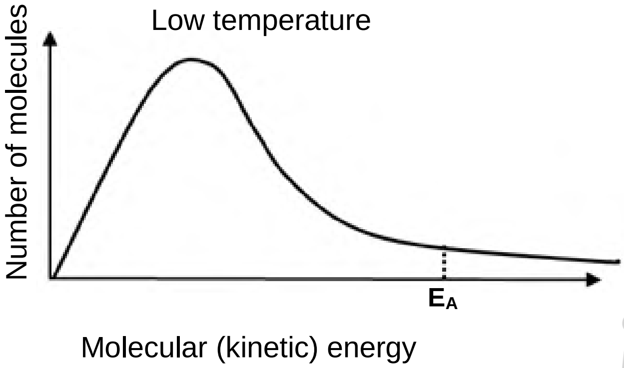


5.3.2 How does the rate of the reaction change between **t_1** and **t_2**? Only write INCREASES, DECREASES or NO CHANGE. (1)

5.3.3 Explain the answer to QUESTION 5.3.2 by making use of the collision theory. (3)

5.3.4 Explain the shape of the graph and what happened after **t_3**. (2)

5.4 The following Maxwell-Boltzmann distribution graph was obtained at a low temperature.



5.4.1 Copy the graph given above in your ANSWER BOOK. Use a dotted line and indicate on the graph how this distribution would change at a **HIGHER TEMPERATURE**. (3)

5.4.2 A catalyst was added to the reaction. Refer to the graph to explain FULLY how the catalyst affects the rate of the reaction. (3)

[20]

QUESTION 6 (Start on a new page.)

During the industrial preparation of ammonia, nitrogen gas and hydrogen gas react in a closed container until the following equilibrium is established at a constant temperature of 472 °C.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92 kJ\cdot mol^{-1}$$

6.1 State *Le Chatelier's Principle*. (2)

6.2 After equilibrium has been established, the temperature remained constant. Explain this observation. (2)

6.3 A catalyst is now added. How will this affect the equilibrium? Write only INCREASES, DECREASES or NO EFFECT. (1)

6.4 The temperature is increased to 672°C.

Use Le Chatelier's Principle to explain what will happen to the concentration of the ammonia. (3)

6.5 The equilibrium constant (Kc) for this reaction is 4,96 at the original temperature of 472 °C.

The volume of the container is 0,5 dm^3. The equilibrium concentrations are: $[NH_3]$ = 0,28 $mol\cdot dm^{-3}$ and $[H_2]$ = 0,16 $mol\cdot dm^{-3}$ respectively.

Calculate the concentration of nitrogen gas at equilibrium. (3)

6.6 Calculate the **initial mass of nitrogen** that was used. (7)

[18]

QUESTION 7 (Start on a new page.)

7.1 Define an *acid* according to the Brønsted-Lowry theory. (2)

7.2 The table below shows the ionisation constants (Ka) of two acids of equal concentrations.

NAME	FORMULA	K_a
Sulfuric acid	H_2SO_4	$1,0 \times 10^3$
Sulfurous acid	H_2SO_3	$1,54 \times 10^{-2}$

7.2.1 Which ONE of these acids will have a higher electric conductivity? Give a reason for the answer. (2)

7.2.2 Make use of a chemical reaction to show the ionisation of sulfuric acid in water. (3)

7.3 A standard solution of sulfuric acid, H_2SO_4, with a pH of 0,22 was titrated against a potassium hydroxide, KOH, solution with an unknown concentration. The balanced equation for the reaction is:

$$2\,KOH\,(aq) + H_2SO_4\,(aq) \rightarrow K_2SO_4\,(aq) + 2\,H_2O\,(\ell)$$

7.3.1 Define the term *standard solution.* (2)

7.3.2 Calculate the concentration of the hydroxide ions in the standard solution of sulphuric acid at 25 ^{0}C. (5)

7.3.3 20 cm^3 of H_2SO_4 neutralises exactly 30 cm^3 of KOH. Calculate the concentration of the potassium hydroxide solution. (5)

7.4 An aqueous solution of ammonium sulphate ($(NH_4)_2SO_4$) was mixed in a beaker. A few drops of bromothymol blue were added to the solution.

7.4.1 What is the expected colour? (1)

7.4.2 Explain the answer to QUESTION 7.4.1 by using a HYDROLYSIS reaction. (3)

[23]

TOTAL: 150

END

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

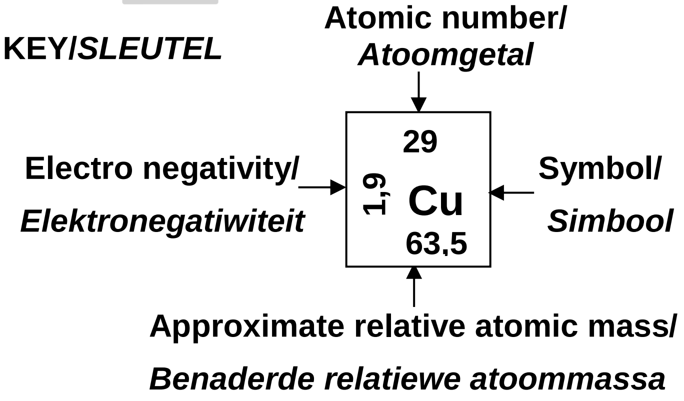
NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22{,}4\ dm^3{\cdot}mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}$ 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 $c = \frac{m}{MV}$	$n = \frac{V}{V_M}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/by 298 K	
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode} / E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ Or/of $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation} / E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ Or/of $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent} / E^{\theta}_{sel} = E^{\theta}_{oksideer\ middel} - E^{\theta}_{reduseer\ middel}$	

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

KEY/*SLEUTEL*



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

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION
JUNIE EKSAMEN

GRADE/*GRAAD* 12

2023

MARKING GUIDELINES/
NASIENRIGLYNE

PHYSICAL SCIENCES: CHEMISTRY/
FISIESE WETENSKAPPE: CHEMIE

(PAPER/*VRAESTEL* 2)

12 pages/*bladsye*

QUESTION/*VRAAG* 1: MULTIPLE-CHOICE QUESTIONS/ *MEERVOUDIGEKEUSE-VRAE*

1.1 C ✓✓ (2)

1.2 C ✓✓ (2)

1.3 B ✓✓ (2)

1.4 D ✓✓ (2)

1.5 D ✓✓ (2)

1.6 C ✓✓ (2)

1.7 D ✓✓ (2)

1.8 A ✓✓ (2)

1.9 C ✓✓ (2)

1.10 B ✓✓ (2)
[20]

QUESTION/*VRAAG* 2

2.1 A hydrocarbon with multiple bonds between the carbon atoms ✓✓ (2 or nothing)

'n Koolwaterstof waarin meervoudige bindings tussen koolstofatome in hul koolwaterstofkettings voorkom. (2 of niks) (2)

2.2 2.2.1 B ✓ (1)

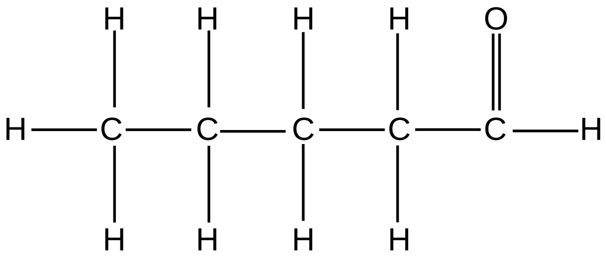
2.2.2 The reddish brown ✓ Br_2 solution will change to colourless. ✓

Die rooibruin ✓ *Br_2-oplossing sal na kleurloos verander.* ✓ (2)

2.3 2.3.1 2,4 – dimethylhex-1-ene ✓✓/*2,4-dimetielheks-1-een*

<u>Marking guide/*Nasienriglyn*</u>
✓ dimethyl and hexane/*dimetiel en hekseen*
✓ numbers, commas, hyphens/*nommers, kommas, koppeltekens* (2)

2.3.2



<u>Marking guideline/</u>
<u>*Nasienriglyn*</u>
✓ functional group/ *funksionele groep*
✓ whole structure/ *hele struktuur*

(2)

2.3.3 Formyl group ✓/*formielgroep* (1)

2.3.4 Ester ✓ (1)

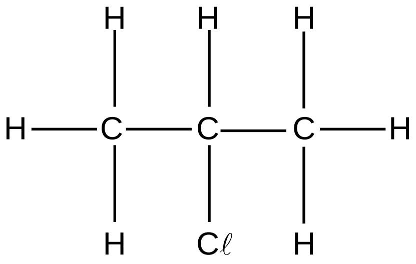
2.4 2.4.1 C_nH_{2n+2} ✓ (1)

2.4.2 CO_2 ✓ and/*en* H_2O ✓ (2)

2.5 2.5.1 The halogen is bonded to a carbon that is bonded to one other carbon. ✓✓ (2 or nothing)

Die halogeen is gebind aan 'n koolstof wat aan een ander koolstof verbind is. (2 of niks) (2)

2.5.2



2-chloropropane/*2-chloropropaan* ✓✓ (2)

2.5.3 positional✓/*posisioneel* (1)

2.6 **Option/*Opsie* 1**

%O = $\frac{m}{M}$ x 100 ✓

12,5 = $\frac{2x16}{M}$ x 100

M = 256 g.mol^{-1}

12n + 2n(1) + 32 = 256 ✓

n = 16

%C = $\frac{m}{M}$ x 100

x = $\frac{12x16}{256}$ x 100✓

x = 75% ✓

Option/*Opsie* 2

100 – 12,5 = 87,5 % ✓

C : H

12n : 2n x 1 ✓

6:1

% C = $\frac{6}{7}$x 87,5✓

x = 75% ✓

(4)
[23]

QUESTION/*VRAAG* 3

3.1 The temperature where the vapour pressure is equal to the atmospheric pressure. ✓✓ (2 or nothing)

Die temperatuur waar die dampdruk gelyk is aan die atmosferiese druk. (2 of niks) (2)

3.2 $CH_3C\ell$ ✓ and/*en* CH_3F✓
They are gases at room temperature✓, very dangerous to inhale.

Hulle is gasse by kamertemperatuur, baie gevaarlik om in te asem. (3)

3.3
- As the strength of the intermolecular forces increase, the boiling point increases. ✓
- Compound E to H all contain dipole-dipole forces between their molecules but the strongest intermolecular force is H, then G then F then E ✓ **OR** Intermolecular forces increase from top to bottom in the table with E and F having dipole-dipole forces and G and H having hydrogen bonds, with G having site for one hydrogen bond and H having sites for two hydrogen bonds.
- More energy is required to overcome the stronger intermolecular forces and therefore ✓
- the boiling points become higher lower down the table. ✓ **OR** the boiling points increase from E to H in the table, **OR** boiling points increase from top to bottom of the table.

- *Soos die sterkte van die intermolekulêre kragte toeneem, neem die kookpunt toe.*
- *Verbindings E tot H bevat almal dipool-dipoolkragte tussen hul molekule maar die sterkste intermolekulêre krag is H, dan G dan F dan E* ***OF*** *Intermolekulêre kragte neem toe van bo na onder in die tabel met E en F wat dipool-dipoolkragte het en G en H wat waterstofbindings het, met G wat plek vir een waterstofbinding het en H met plekke vir twee waterstofbindings.*
- *Meer energie word benodig om die sterker intermolekulêre kragte te oorkom en daarom*
- *Word die kookpunte hoër laer af in die tabel.* ***OF*** *Die kookpunte neem toe van E na H in die tabel,* ***OF*** *Kookpunte neem toe van bo na onder in die tabel.* (4)

3.4 3.4.1 As the number of $C\ell$ -atoms increase, the boiling point increases. ✓✓

Soos die getal $C\ell$-atome verhoog, sal die kookpunt verhoog. (2)

3.4.2
- Because $CC\ell_4$ has a <u>larger surface area/increasing molecular mass</u> than $CH_3C\ell$, this causes more intermolecular forces ✓
- The intermolecular forces are stronger in $CC\ell_4$ than in $CH_3C\ell$ ✓
- <u>More energy needed to overcome intermolecular forces in</u> $CC\ell_4$ ✓

- *Omdat $CC\ell_4$ <u>'n groter oppervlakte het/toenemende molekulêre massa</u> as $CH_3C\ell$, veroorsaak dit meer intermolekulêre kragte* ✓
- *Die intermolekulêre kragte is sterker in $CC\ell_4$ as in $CH_3C\ell$* ✓
- *<u>Meer energie word benodig om intermolekulêre kragte te oorkom</u> $CC\ell_4$* ✓ (3)

3.4.3 1. The type of halogen group✓
2. The number of carbons in the chain✓

1. Die tipe halogeengroep ✓
2. Die aantal koolstofstowwe in die ketting ✓ (2)

3.5 The pressure exerted by a vapour at equilibrium with its liquid in a closed system (2 ✓✓ or nothing)

Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem (2 of niks) (2)

3.6 3.6.1 Methanoic acid ✓/*metanoësuur* (1)

3.6.2
- Methanol and methanoic acid both have hydrogen bonds but methanoic acid has two sites compared to methanol's one site for hydrogen bonds. ✓
- The intermolecular forces of methanoic acid are therefore stronger than methanol. ✓
- More energy is required to overcome these force therefore the vapour pressure is lower. ✓

- *Metanol en metanoësuur het albei waterstofbindings, maar metanoësuur het twee plekke in vergelyking met metanol se een plek vir waterstofbindings.* ✓
- *Die intermolekulêre kragte van metanoësuur is dus sterker as metanol.* ✓
- *Meer energie is nodig om hierdie kragte te oorkom, daarom is die dampdruk laer.* ✓ (3)

[22]

QUESTION/*VRAAG* 4

4.1 4.1.1 Esterification ✓ or condensation/*Verestering of Esterifikasie of kondensasie* (1)

4.1.2 Do not heat alcohol over an open flame (since it is flammable). ✓
OR Heat the alcohol in a water bath.

Moenie alkohol oor 'n oop vlam verhit nie (aangesien dit vlambaar is).
OF *Verhit die alkohol in 'n waterbad.* (1)

4.1.3 Ethyl ✓ propanoate ✓/*etiel propanoaat* (2)

4.1.4

$n_{C_5H_{10}O_2} = \frac{m}{M}$

$= \frac{68,88}{102}$ ✓

= 0,675 mol

$n_{C_2H_6O} = n_{C_5H_{10}O_2}$ = 0,675 mol ✓

m = nxM

= 0,675 x 46 ✓

= 31,05g

%purity = $\frac{m_{actual}}{m_{theory}} x100$

$= \frac{31,05}{50} x100$ ✓

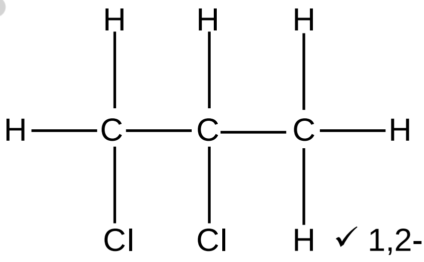
= 62,1% ✓ (5)

Marking guideline
- Substitute mass and molar mass
- Mole ratio
- Multiply n with 46
- Express m/50 x 100
- Answer

Nasienriglyn
- *Vervang mass en molêre massa*
- *Mol verhouding*
- *Vermenigvuldig met 46*
- *Uitdrukking m/50 x 100*
- *Antwoord*

4.2 4.2.1 Reaction I = Addition ✓/*Addisie*
Reaction II = Substitution ✓/*substitusie* (2)

4.2.2



✓ 1,2-dichloropropane/*1,2-dichloropropaan* ✓ (2)

4.2.3 Heat or Light ✓/*Hitte of lig* (1)

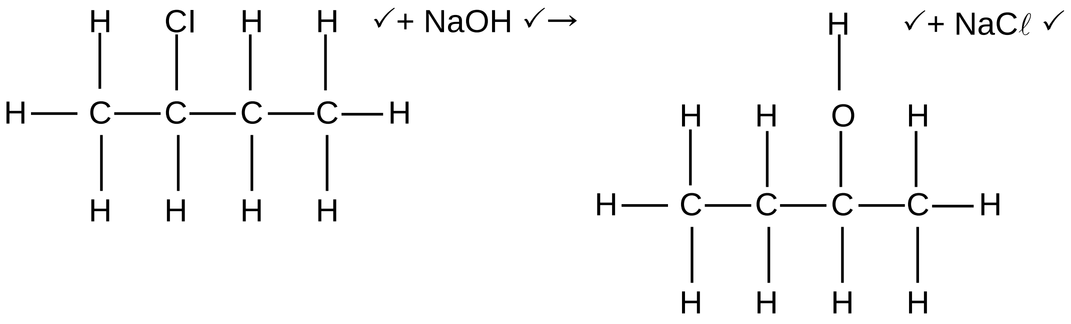
4.2.4 butane ✓/*Butaan* (1)

4.2.5 Hydrogen chloride **OR** HCℓ ✓/*Waterstofchloried* ***OF*** HCℓ ✓ (1)

4.3 4.3.1 Elimination ✓/*Eliminasie* (1)

4.3.2 but-2-ene ✓✓/*but-2-een* (2)

4.3.3



(4)

4.3.4 Hydrolysis✓/*Hidrolise* (1)

[24]

QUESTION/*VRAAG* 5

5.1 Exothermic ✓/*Eksotermies*
Heat of reaction is less than zero. ✓/*Reaksiewarmte is kleiner as nul.* (2)

5.2 Downward displacement of water ✓
OR Gas pushes water down in the cylinder as it moves up in the cylinder.

Afwaartse verplasing van water ✓
OF *Die gas druk water in die silinder af terwyl dit in die silinder opbeweeg*. (1)

5.3 5.3.1 Rate of reaction/*Tempo van reaksie* = $\frac{\Delta n}{\Delta t}$

$-7,5 \times 10^{-4} = \frac{0-n_i}{60-0}$ ✓✓

n = 0,045 mol

c = $\frac{n}{V}$ ✓

1,5 = $\frac{0,045}{V}$✓

V = 0,03 dm^3 thus 30 cm^3✓ (5)

5.3.2 Increases ✓/*Verhoog* (1)

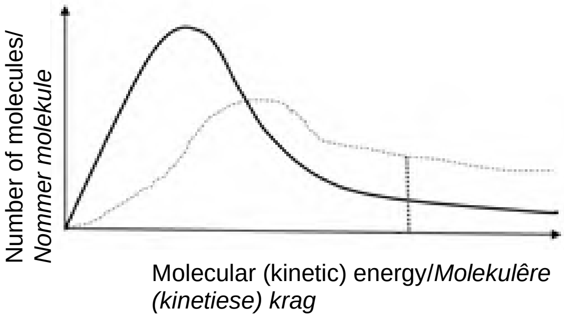
5.3.3
- The reaction is exothermic so the temperature will increase which will increase the kinetic energy of the particles. ✓
- More molecules have enough/sufficient kinetic energy. ✓
- More effective collisions per unit time. ✓

- *Die reaksie is eksotermies so die temperatuur sal toeneem soos die kinetiese energie van die deeltjies verhoog.* ✓
- *Meer molekules het genoeg/voldoende kinetiese energie.* ✓
- *Meer effektiewe botsings per tydseenheid.* ✓ (3)

5.3.4 The graph is a straight line. ✓
The reaction ran to completion **OR** Some of the reactants are depleted. ✓

Die grafiek is 'n reguitlyn. ✓
Die reaksie het tot voltooiing geloop ***OF*** *Sommige van die reaktante is uitgeput.* ✓ (2)

5.4 5.4.1



<u>Marking guideline/</u>
<u>*Nasienriglyn*</u>

- Dotted line highest point below solid line/*hoogste punt van stippellyn onder soliede lyn* ✓
- E_A at same place/*E_A by dieselfde plek* ✓
- Dotted line above solid line after E_A /*stippellyn bo soliede lyn na E_A* ✓

(3)

5.4.2

- The position of the activation energy moves to the left since activation energy becomes lower. ✓
- More particles will have sufficient energy. ✓
- More effective collisions per unit time. ✓

- *Die posisie van die aktiveringsenergie beweeg na links aangesien aktiveringsenergie laer word.* ✓
- *Meer deeltjies sal genoeg energie hê.* ✓
- *Meer effektiewe botsings per tydseenheid.* ✓

(3)
[20]

QUESTION/*VRAAG* 6

6.1 When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. (2 ✓✓ or nothing)

Wanneer die ewewig in ’n geslote sisteem versteur word, sal die stelsel ’n nuwe ewewig herstel deur die reaksie te bevoordeel wat die versteuring sal teenstaan. (2 ✓✓ of nul) (2)

6.2 When equilibrium is reached the rate of the forward reaction equals the rate of the reverse reaction ✓ so the rate of the exothermic reaction is the same as the endothermic reaction. ✓

Wanneer ewewig bereik word, is die tempo van die voorwaartse reaksie gelyk aan die tempo van die terugwaartse reaksie ✓ *dus is die tempo van die eksotermiese reaksie dieselfde as die endotermiese reaksie.* ✓ (2)

6.3 No effect ✓/*Geen effek* (1)

6.4 Concentration of NH_3 decreases ✓
A temperature increase favours an endothermic reaction. ✓
The reverse (endothermic) reaction will therefore be favoured. ✓

Konsentrasie van NH_3 neem af ✓
'n Temperatuurverhoging bevoordeel 'n endotermiese reaksie. ✓
Die omgekeerde (endotermiese) reaksie sal dus bevoordeel word. ✓ (3)

6.5 $$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} \checkmark$$

$$4{,}96 = \frac{(0{,}28)^2}{[N_2](0{,}16)^3} \checkmark$$

$$\therefore [N_2] = 3{,}86\ mol.dm^3 \checkmark$$ (3)

6.6 Positive marking from/*Positiewe nasien vanaf* 6.5

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

$$3{,}86 = \frac{n}{0{,}5} \quad \checkmark$$

n = 1,93 mol N_2

Marking guideline/*Nasienriglyn*
- Substitute the c and V ✓/*Substituut die c en V*
- mol at equilibrium ✓/*mol by ewewig*
- changed moles ✓/*veranderde mol*
- ratio 2:1 ✓/*verhouding* 2:1
- $n_{eq} + n_{changed} = n_{initial}$ ✓/
- M = 28 in m = nxM ✓
- Answer/*Antwoord* 56g ✓

(7)

	N_2	**H_2**	**NH_3**
Ratio/*Verhouding*	1	3	2
Initial mol/*Aanvankllike mol*	2 ✓	0,29	0
Change in mol/*Verandering in mol*	–0,07 ✓	–0,21	+0,14 ✓
Equilibrium/*Ewewig*	1,93	0,8	0,14 ✓

m = nxM

= 2 x 28✓

= 56g of N_2✓ **[18]**

QUESTION/*VRAAG* 7

7.1 Acid is a proton donor. (2 ✓✓ or nothing)/*Suur is 'n protonskenker. (2 of niks)* (2)

7.2 7.2.1 H_2SO_4 ✓
More ions when completely ionised ✓/*Meer ione wanneer volledig geïoniseer*
It is a strong acid which ionises completely./*Dit is 'n sterk suur wat volledig ioniseer.* (2)

7.2.2 $H_2SO_4 + H_2O \leftrightarrows HSO^{-}_{4} + H_3O^{+}$

OR/*OF* reactant ✓ products ✓ balance ✓

$H_2SO_4 + 2H_2O \leftrightarrows SO^{-2}_{4} + H_3O^{+}$
Reaktante ✓produkte ✓gebalanseer ✓ (3)

7.3 7.3.1 A solution with a known concentration✓✓/*'n Oplossing met 'n bekende konsentrasie* (2)

7.3.2 $pH = -\log[H_3O^{+}]$ ✓
$0,22$ ✓ $= -\log[H_3O^{+}]$
$[H_3O^{+}] = 0,60 \text{ mol.dm}^{-3}$

$K_w = [H_3O^{+}][OH^{-}]$ ✓
$1 \times 10^{-14} = 0,60[OH^{-}]$ ✓
$[OH^{-}] = 1,67 \times 10^{-14} \text{ mol.dm}^{-3}$ ✓ (5)

7.3.3 Positive marking from/*Positiewe nasien vanaf* 7.3.3
$c_{(H2SO4)} = 2x[H_3O^{+}]$
$= 1,2 \text{ mol.dm}^{-3}$✓

$$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \checkmark$$

$$\checkmark \frac{(1,2)20}{c_b 30} = \frac{1}{2} \checkmark$$

$c_b = 1,6 \text{ mol.dm}^{-3}$✓ (5)

7.4 7.4.1 Yellow✓/*Geel* (1)

7.4.2 $NH^{+}_{4} + H_2O \leftrightarrows NH_3 + H_3O^{+}$✓✓
The solution will be acid due to H_3O^{+}✓/
Die oplossing sal suur wees as gevolg van H_3O^{+} (3)
[23]

TOTAL/*TOTAAL*: 150