

MARKER CODE				



STUDENT ENROLMENT NUMBER (SEN)									

TONGA FORM SIX CERTIFICATE

2024

CHEMISTRY

QUESTION AND ANSWER BOOKLET

Time allowed: 3 Hours

INSTRUCTIONS:

- Write your **Student Enrolment Number (SEN)** on the top right-hand corner of this page.
- This paper consists of **FOUR SECTIONS** and is out of 70 weighted scores.

SECTION	STRANDS	TOTAL SKILL LEVEL
ONE	ATOMIC STRUCTURE AND BONDING	22
TWO	NATURE OF PARTICLES AND POLARITY	5
THREE	EQUATIONS AND CALCULATIONS	22
FOUR	ORGANIC REACTIONS	21
TOTAL		70

- Answer **ALL QUESTIONS**. Write your answers in the spaces provided in this booklet.
- Use a **BLUE** or **BLACK** ball point pen only for writing. Use a pencil for drawing if required.
- If you need more space for answers, ask the supervisor for extra paper. Write your **Student Enrolment Number (SEN)** on each additional sheet, number the questions clearly and insert them in the appropriate places in this booklet.
- There is a **periodic table** of the elements provided on page 18.
- Check that this booklet contain pages **2-19** in the correct order and that page 19 has been deliberately left blank.

YOU MUST HAND IN THIS BOOKLET TO THE SUPERVISOR BEFORE YOU LEAVE THE EXAMINATION ROOM.

SECTION ONE: ATOMIC STRUCTURE AND BONDING

1. Nitrogen has two stable **isotopes**: Nitrogen- 14 and Nitrogen – 15.

Describe the **components** of the **isotopes** of Nitrogen.

Skill level 2	
2	
1	
0	
NR	

2. Phosphorus has an **atomic number** of 15. It has 5 **valence electrons** in its valence shell.

- a. Define the following terms:

- i. **valence electrons**

Skill level 1	
1	
0	
NR	

- ii. **valence shell**

Skill level 1	
1	
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- b. Describe how the **electrons** in the phosphorus atom **occupy** the **orbitals** in the main energy levels.

Skill level 2	
2	
1	
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NR	

3. Copper is a metal and is used in many industries as electrical appliances and cooking wares. Copper can also form an ion such as **Cu⁺** and **Cu⁺²** which further reacts to form the complex ion.

- a. State the **bond disrupted** when copper **melts**.

Skill level 1	
1	
0	
NR	

- b. Describe how Cu⁺² forms the **complex ion**, [Cu(NH₃)₄]⁺².

Skill level 2	
2	
1	
0	
NR	

4. The table below shows the **melting points** of some solids:

SUBSTANCE	MELTING POINT (°C)
Copper Cu	1084
Sodium chloride NaCl	801

- a. State the **components** of sodium chloride.

Skill level 1	
1	
0	
NR	

- b. State the **bonds disrupted** when Sodium chloride **melts**.

Skill level 1	
1	
0	
NR	

5. Describe how **discrete molecular solids melt**.

Skill level 2	
2	
1	
0	
NR	

6. The table below shows **electrical conductivity**, **structures** and **bonding** of period 3 chlorides.

CHLORIDES	NaCl	MgCl ₂	Al ₂ Cl ₆	SiCl ₄	PCl ₃ , Cl ₅	Cl ₂
Structure	Giant ionic		Simple molecular			
Bonding	ionic		Covalent			
Electrical conductivity	conduct		poor			

- a. State the **charge** of a chloride ion.

Skill level 1	
1	
0	
NR	

- b. Determine the **oxidation** state of chloride ion.

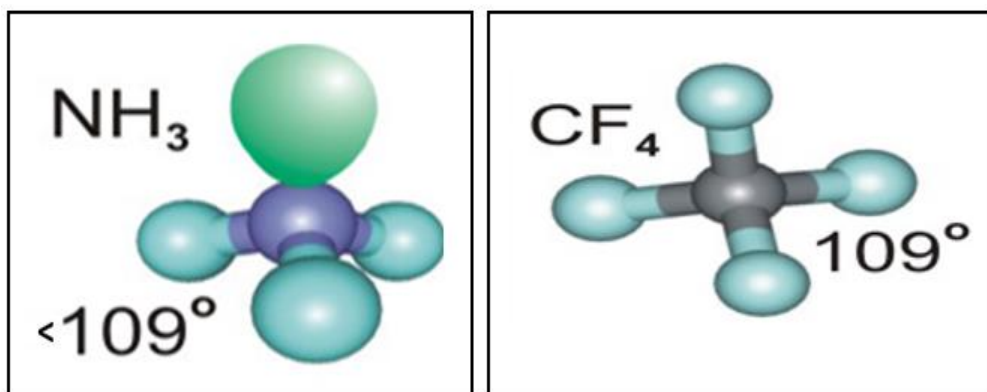
Skill level 1	
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NR	

- c. Study the table carefully then **relate** the **electrical conductivity** of chlorides to their **structures** and **bonding**.

[illegible]

Skill level 3	
3	
2	
1	
0	
NR	

7. The diagram below shows two molecules namely **ammonia**, NH_3 and **tetrafluoromethane**, CF_4 with their different **bonding angles** $\approx 109^\circ$ and 109° respectively.



Study the diagram carefully and discuss **why ammonia, NH_3 and tetrafluoromethane, CF_4 have different bond angles.**

[illegible]

Skill level 4	
4	
3	
2	
1	
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NR	

SECTION TWO: NATURE OF PARTICLES AND POLARITY

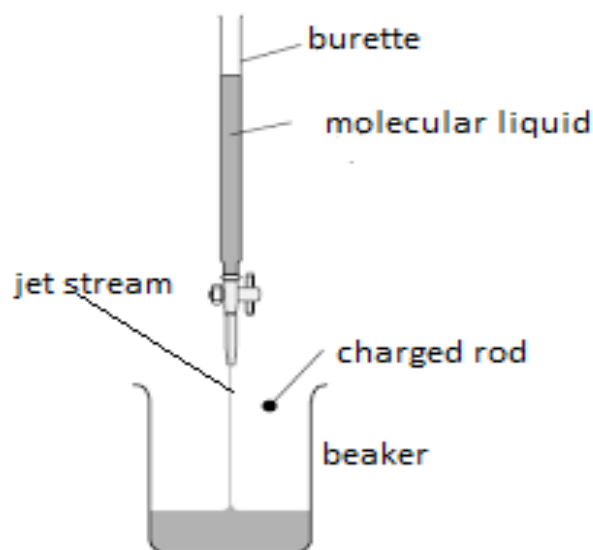
1. The table below shows the **states of water** labelled as **X**, **Y** and **Z** in different **temperatures**:

State of water	Temperature ($^{\circ}\text{C}$)
X	0
Y	23
Z	100

Describe the **nature of particles** of water during the process of change from the state of water **X** to **Y**.

Skill level 2	
2	
1	
0	
NR	

2. An experiment was conducted for the testing of **polarity of molecules** in liquid form. Two molecular liquids labelled **A** and **B** were poured into two different burettes. A charged rod was placed close to the jet streams.



Observations were recorded as shown in the table below:

MOLECULAR LIQUID	JETSTREAM OBSERVATION
A	Bend towards the charged rod
B	Did not bend

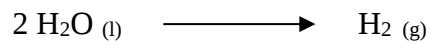
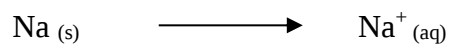
[illegible]

Skill level 3	
3	
2	
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SECTION THREE:

EQUATIONS AND CALCULATIONS

1. **Balance** the two **half equations** below **then** combine to write a **full balanced equation** for a redox reaction.

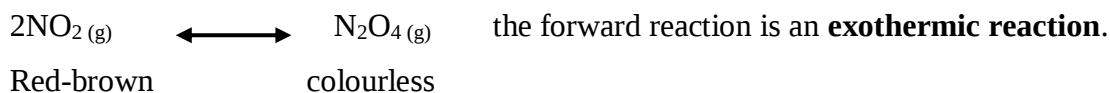


Skill level 3	
3	
2	
1	
0	
NR	

2. Calculate the **molar mass** of glucose $\text{C}_6\text{H}_{12}\text{O}_6$. Providing the **relative atomic mass** of each element: carbon, 12.01 g/mol; hydrogen, 1.00 g/mol; and oxygen, 15.99 g/mol.

Skill level 3	
3	
2	
1	
0	
NR	

3. Nitrogen dioxide, NO_2 , exists in **equilibrium** with Dinitrogen tetroxide, N_2O_4 .



At equilibrium, both gases are present in the mixture and a constant pale brown color may be observed.

- a. Define **Le Chatelier's principle**.

Skill level 1	
1	
0	
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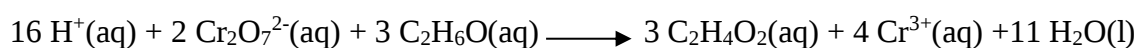
- b. Account for the production of more red-brown gas if the temperature of the mixture is changed.

Consider in your response the following:

- Type of temperature change that results in the production of more red-brown gas.
- How this temperature change causes the production of more red-brown gas.

Skill level 3	
3	
2	
1	
0	
NR	

4. A **breathalyser test** is commonly used nowadays in Tonga to minimize road death toll.



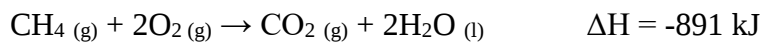
- a. Define the term **breathalyser test**.

Skill level 1	
1	
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NR	

- b. Name the **oxidant** used in the **breathalyser test**.

Skill level 1	
1	
0	
NR	

5. **Apply** Hess' Law to **calculate** the **energy change** for the production of methane using the following data.



Skill level 3	
3	
2	
1	
0	
NR	

6. A student is attempting to determine how many water molecules there are in the hydrate $\text{CoSO}_4 \cdot x\text{H}_2\text{O}$, where x is an integer.
The student weighs a sample of the hydrated compound and heats it until the mass remains constant.

Using the experiment results below, determine the value of x .

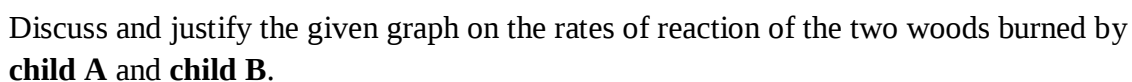
[Co = 59 g/mol, S = 32 g/mol, O = 16 g/mol, H = 1 g/mol]

Mass of hydrated $\text{CoSO}_4 = 4.97\text{g}$

mass of anhydrous $\text{CoSO}_4 = 2.74\text{g}$

Skill level 3	
3	
2	
1	
0	
NR	

- The data recorded by **child A** and **child B** were then used to draw a graph as shown below.



[include in your answer: *clearly discuss with reasons which graph is child A's graph and which is child B's graph, also what is your advice to the family on which wood to be used for the campfire*]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

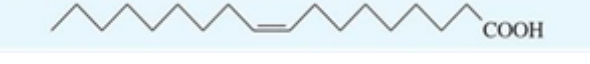
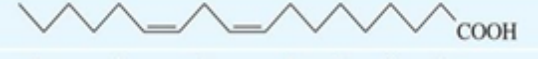
[illegible]

Skill level 4	
4	
3	
2	
1	
0	
NR	

SECTION FOUR: ORGANIC REACTIONS

SECTION FOUR: ORGANIC REACTIONS

1. The table below shows **structures** and **melting points** of some common fatty acids.

NAME	NUMBER OF CARBON	STRUCTURE	MELTING POINT (°C)
Stearic acid	18		70
Oleic acid	18		4
Linoleic acid	18		-5
Linolenic acid	18		-11

Study the table above carefully and **relate** the trend of **rising melting points** with **increasing saturation** of fatty acids.

[illegible]

Skill level 3	
3	
2	
1	
0	
NR	

4. Describe Markovnikov's rule in the reaction shown below:

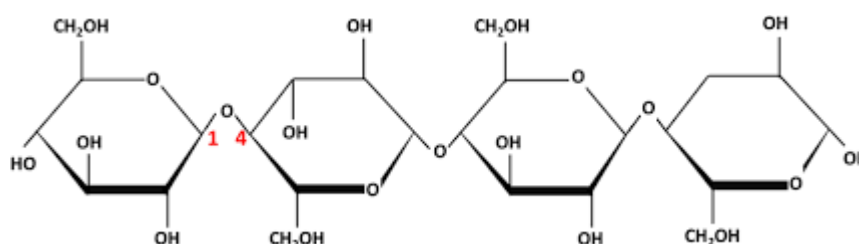


Skill level 2	
2	
1	
0	
NR	

5. PVC and Polythene products are very important in everyday life. PVC are used as water drainages and polythene are used in the form of plastics to pack and store food. Despite their importance to humans, they also cause environmental problems. Describe the **environmental problems** caused by the PVC and polythene products.

Skill level 2	
2	
1	
0	
NR	

6. The diagram below shows the **polymer** of carbohydrate.



- a. Define the term **Polymer**.

Skill level 1	
1	
0	
NR	

- b. Identify the monomer of carbohydrate.

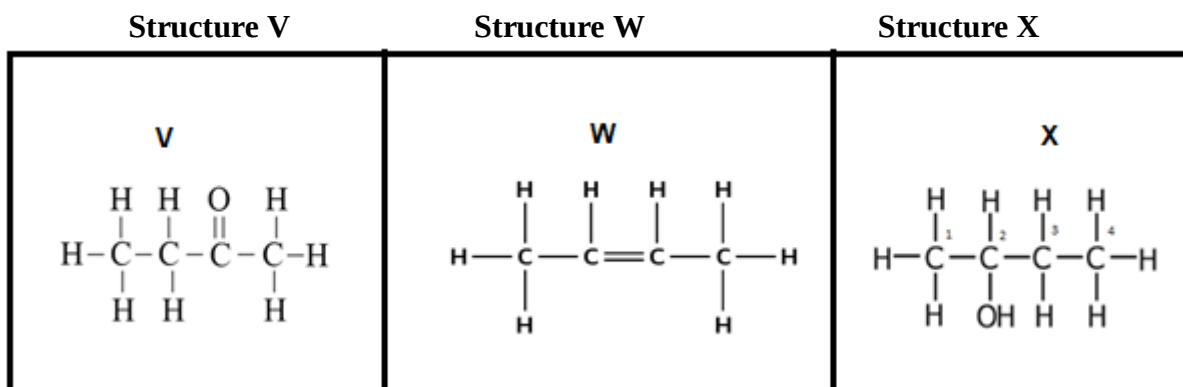
Skill level 1	
1	
0	
NR	

- c. Write a balanced equation for the Fehling's test for the monomer of carbohydrate.

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Skill level 2	
2	
1	
0	
NR	

7. The following structures are labelled as **V**, **W** and **X**. Study the structures carefully and answer the questions that follows:



- a. Identify by **circling** the functional group of structure **V**.

Skill level 1	
1	
0	
NR	

- b. Structure **W** can form geometric isomer. Define **geometric isomer**.

Skill level 1	
1	
0	
NR	

- c. Use IUPAC rules to name structure **X**.

Skill level 1	
1	
0	
NR	

- d. Structure **V** can undergo substitution reaction to produce 2-chlorobutane. Define **substitution reaction**.

Skill level 1	
1	
0	
NR	

PERIODIC TABLE

		Atomic number																	
		Molar mass / g mol ⁻¹																	
1	2																	18	2
3 Li 6.9	4 Be 9.0																	5 B 10.8	6 C 12.0
11 Na 23.0	12 Mg 24.3																	13 Al 27.0	14 Si 28.1
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.9	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8	37 Rb 85.5	38 Sr 87.6
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.9	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131	55 Cs 133	56 Ba 137
87 Fr 223	88 Ra 226	103 Lr 262	104 Rf 261	105 Db 262	106 Sg 263	107 Bh 264	108 Hs 265	109 Mt 268	110 Ds 271	111 Rg 272	112 Cn 277	113 Nh 284	114 Fl 289	115 Mc 290	116 Lv 292	117 Ts 294	118 Og 294	119 Uu 295	120 Uub 296
57 La 139	58 Ce 140	59 Pr 141	60 Nd 144	61 Pm 147	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	72 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190
89 Ac 227	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu 239	95 Am 241	96 Cm 244	97 Bk 249	98 Cf 251	99 Es 252	100 Fm 257	101 Md 258	102 No 259	103 Lr 262	104 Rf 261	105 Db 262	106 Sg 263	107 Bh 264	108 Hs 265

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