MARKER CODE				

STUDENT ENROLMENT NUMBER (SEN)									

TONGA FORM SIX CERTIFICATE

2022

CHEMISTRY

QUESTION AND ANSWER BOOKLET

Time allowed: 3 Hours

INSTRUCTIONS:

1. Write your **Student Enrolment Number (SEN)** on the top right-hand corner of this page.
2. This paper consists of **SEVEN SECTIONS** and is out of 82 weighted scores.

SECTION	STRANDS	TOTAL SKILL LEVEL
ONE	ATOMIC STRUCTURE	22
TWO	SOLID PROPERTIES	11
THREE	KINETIC CHEMISTRY	10
FOUR	QUANTITATIVE CHEMISTRY	5
FIVE	INORGANIC CHEMISTRY	6
SIX	ORGANIC CHEMISTRY	21
SEVEN	REDOX	7
	TOTAL	82

3. Answer ALL QUESTIONS. Write your answers in the spaces provided in this booklet.
4. Use a **BLUE** or **BLACK** ball point pen only for writing. Use a pencil for drawing if required.
5. If you need more spaces 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.
6. NOTE: There is a group of the Periodic Table of the Elements provided on page **19**. The table gives the Symbol, Atomic Number and the Relative Atomic Mass of the elements. The Groups (columns) are numbered 1, 2, 3, 4 etc. NOTE: The symbol M is used for molar mass. M (Na) = gmol −1 and M (CO2) = 44 gmol −1.
7. Check that this booklet contains pages 2-19 in the correct order and that page 18 has been deliberately left blank.

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

SECTION ONE: ATOMIC STRUCTURE

1. Write the electron configuration of potassium ion.

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Skill level 2	
2	
1	
0	
NR	

2. Given the electron arrangement of **X**, name the element.

X: $1s^2\ 2s^2\ 2p^6\ 3s^1$

_____

_____

Skill level 1	
1	
0	
NR	

3. Element **Y** gain electrons to form ion, **Z**.

Y: $1s^2\ 2s^2\ 2p^4$

a. Name ion Z.

_____

Skill level 1	
1	
0	
NR	

b. Write the symbol of ion Z.

_____

Skill level 1	
1	
0	
NR	

4. Draw the Lewis structure of methane, CH_4

Skill level 3	
3	
2	
1	
0	
NR	

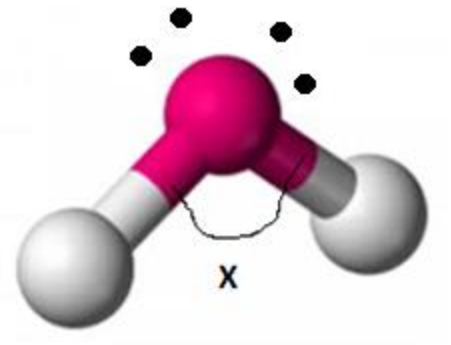
5. a. **Draw** the shape of the ammonia NH_3 molecule.

Skill level 3	
3	
2	
1	
0	
NR	

b. **Name** the shape drawn above.

Skill level 1	
1	
0	
NR	

6. State the **ideal bonding angle** labelled X of the shape provided.



Skill level 1	
1	
0	
NR	

7. Differentiate between polar and nonpolar covalent bonds.

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Skill level 3	
3	
2	
1	
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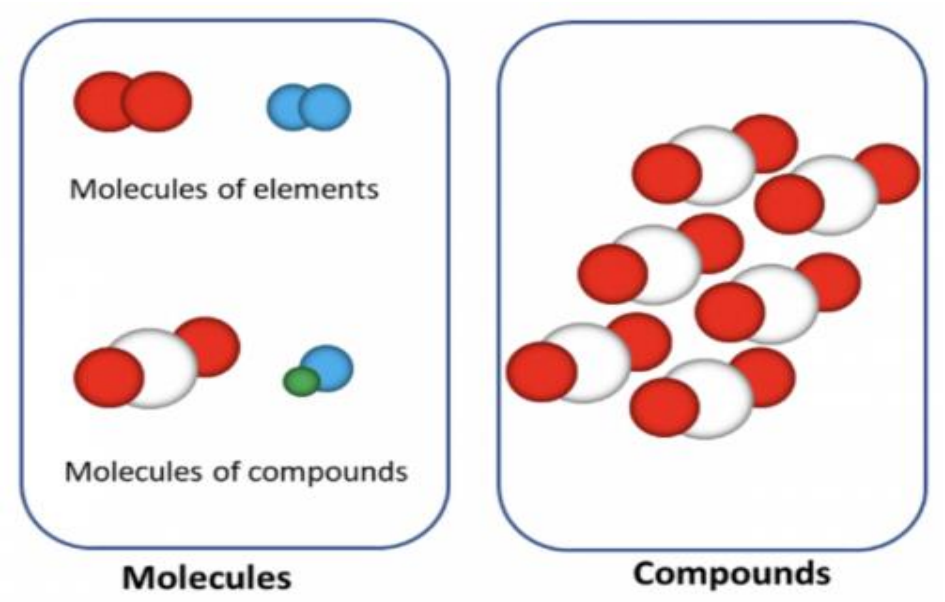
8. The diagram below represents a model of different types of molecules and compound.



a. Define the term "molecule".

_____

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Skill level 1	
1	
0	
NR	

b. Give an example of a compound shown by the model in the diagram.

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Skill level 1	
1	
0	
NR	

9. The table below show the electronegativity values for two elements.

Elements	Electronegativities
P	2.1
Cl	3.0

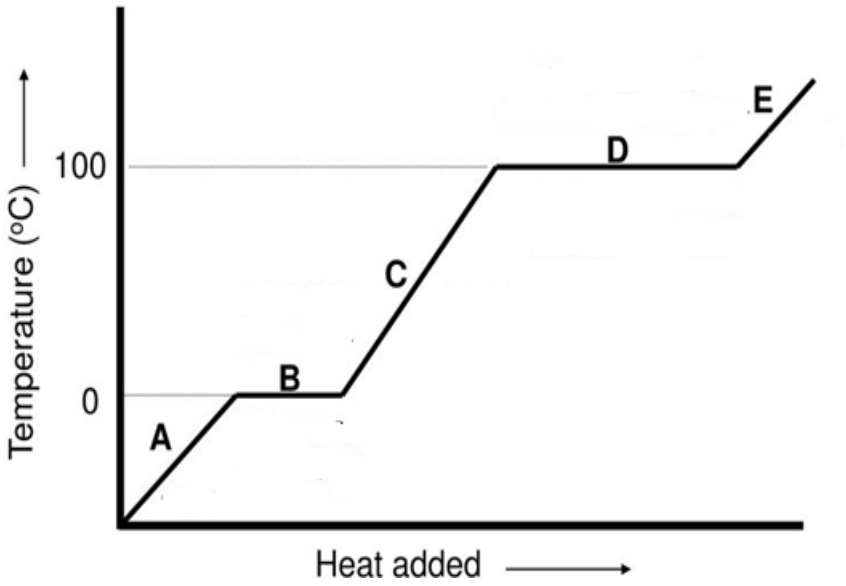
Discuss the most probable type of bond that will exist between **P** and **Cl** based on electronegativity difference.

Skill level 4	
4	
3	
2	
1	
0	
NR	

SECTION TWO: SOLID PROPERTIES

1. The diagram below shows the changes in temperature when heating a container of water. The water particles in the container undergo changes in the states of matter at different Sections labelled **A**, **B**, **C**, **D** and **E**.

   Study the graph carefully to answer the questions that follow.



a. Identify the state of matter of water at Section **A** in the graph.

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_____

Skill level 1	
1	
0	
NR	

b. Name the **process of changing** the state of water at section **D**.

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Skill level 1	
1	
0	
NR	

c. Describe the **nature of water particles** in section **C**.

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Skill level 2	
2	
1	
0	
NR	

2. **Differentiate** the **strengths of bonds** disrupted when a metal melts and those disrupted when a discrete molecular solid melts.

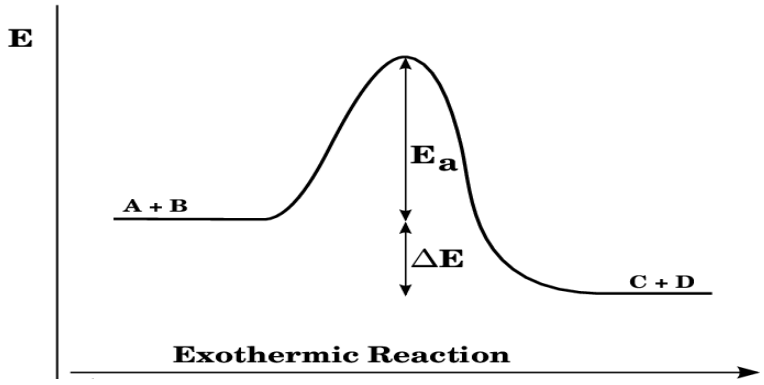
Skill level 3	
3	
2	
1	
0	
NR	

3. Discuss why ionic substances **conduct electricity** in molten form but not in solid form.

Skill level 4	
4	
3	
2	
1	
0	
NR	

SECTION THREE: KINETIC CHEMISTRY

1. The diagram below shows an energy diagram for an exothermic reaction.

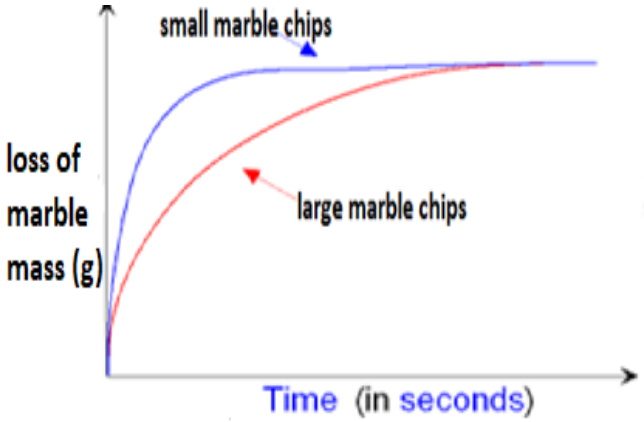


Determine from the diagram the part that represents **the ∑Δproducts**.

Skill level 1	
1	
0	
NR	

2. The graph below shows the result of an experiment titled as "the effects of particle size on the rate of reaction" conducted by Form 6 Chemistry students.

Study the graph below carefully to answer the question that follow.



Describe how the **particle size of the marble chips** affects the rate of reaction.

Skill level 2	
2	
1	
0	
NR	

3. The equilibrium reaction shown below is part of the contact process in the commercial production of sulphuric acid.

$$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g) \qquad \Delta H = -192 kJ\ mol^{-1}$$

Explain how the **Le Chatelier's principle** is **applied** to this equilibrium reaction to produce more sulfur trioxide, SO_3.

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Skill level 3	
3	
2	
1	
0	
NR	

4. Use Hess Law to evaluate **the enthalpy change** for the production of Nitrogen monoxide, NO given reactions 1, 2 and 3 then **state** whether the overall reaction is **exothermic** or **endothermic**.

$N_2O_{(g)} + NO_{2(g)} \longrightarrow 3\ NO_{(g)} \qquad \Delta H^0 = \_\_\_\_\_$

reaction 1: $2\ N_{2(g)} + O_{2(g)} \longrightarrow 2\ N_2O_{(g)} \qquad \Delta H^0 = 164.1\ kJ$

reaction 2: $N_{2(g)} + O_{2(g)} \longrightarrow 2\ NO_{(g)} \qquad \Delta H^0 = 180.5\ kJ$

reaction 3: $N_{2(g)} + 2\ O_{2(g)} \longrightarrow 2\ NO_{2(g)} \qquad \Delta H^0 = 66.4\ kJ$

Skill level 4	
4	
3	
2	
1	
0	
NR	

SECTION FOUR: QUANTITATIVE CHEMISTRY

1. Calculate the **empirical formula** of a compound that has:

   52.14% Carbon, 13.13% Hydrogen and 34.73% Oxygen

Skill level 2	
2	
1	
0	
NR	

2. 10g of Butane (C_4H_{10}), is combusted. Calculate the **amount** of carbon dioxide formed from the complete combustion of butane using stoichiometric analysis.

   M (C_4H_{10}) = 58 g/mol

Skill level 3	
3	
2	
1	
0	
NR	

SECTION FIVE: INORGANIC CHEMISTRY

1. State the **colour** of the complex ion $[FeSCN]^{+2}$

Skill level 1	
1	
0	
NR	

2. Describe **the type of bond** formed between oxygen and sulfur atoms in a compound.

Skill level 2	
2	
1	
0	
NR	

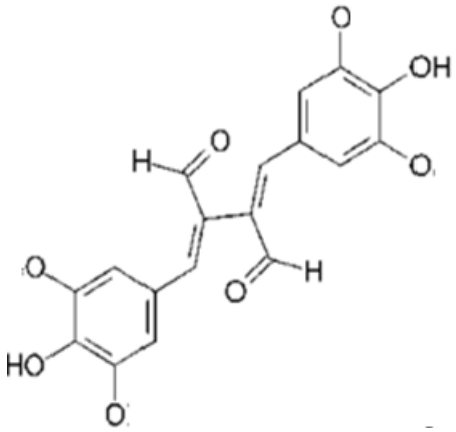
3. **Relate** the melting points of chlorides provided in the table below to their structure and bonding.

CHLORIDES	$MgCl_2$	PCl_3
Melting point (^{0}C)	714	-112

Skill level 3	
3	
2	
1	
0	
NR	

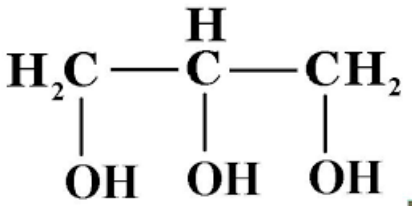
SECTION SIX: ORGANIC CHEMISTRY

1. Identify by **circling the functional group** of an aldehyde from the diagram below.



Skill level 1	
1	
0	
NR	

2. Name using *IUPAC naming system* for the **polyhydric alcohol** structure below.



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Skill level 1	
1	
0	
NR	

3. Define **Fehling's reagent**.

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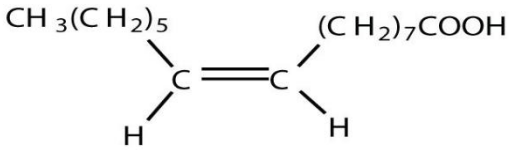
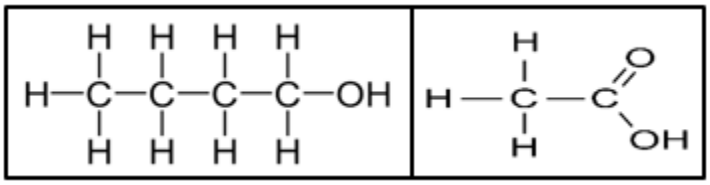
Skill level 1	
1	
0	
NR	

4. Draw the structure of the **triglyceride** given the formulae of the constituent fatty acid.



Skill level 2	
2	
1	
0	
NR	

5. Write the equation for the **formation of ester** from the two structures given below.



ester

Skill level 2	
2	
1	
0	
NR	

6. Explain why **stereoisomerism** can occur in butene, $CH_2CHCH_2CH_3$ but **not** in butane, $CH_3CH_2CH_2CH_3$.

Skill level 3	
3	
2	
1	
0	
NR	

7. Account for the possible **two products** formed in the **oxidation** of primary alcohol.

Skill level 3	
3	
2	
1	
0	
NR	

8. 2-pentene is reacted with water. This reaction is called an addition reaction.

a. Define **addition** reaction.

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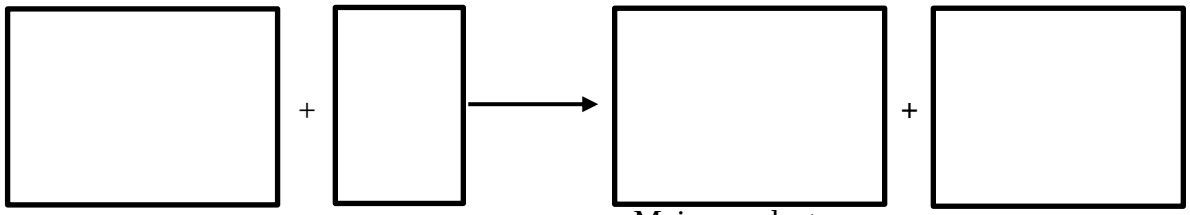
Skill level 1	
1	
0	
NR	

b. Write the **balanced equation** for the reaction of 2-pentene with water.



Major product

Skill level 3	
3	
2	
1	
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9. Discuss the **environmental problems** caused by PolyVinylChloride and polythene products.

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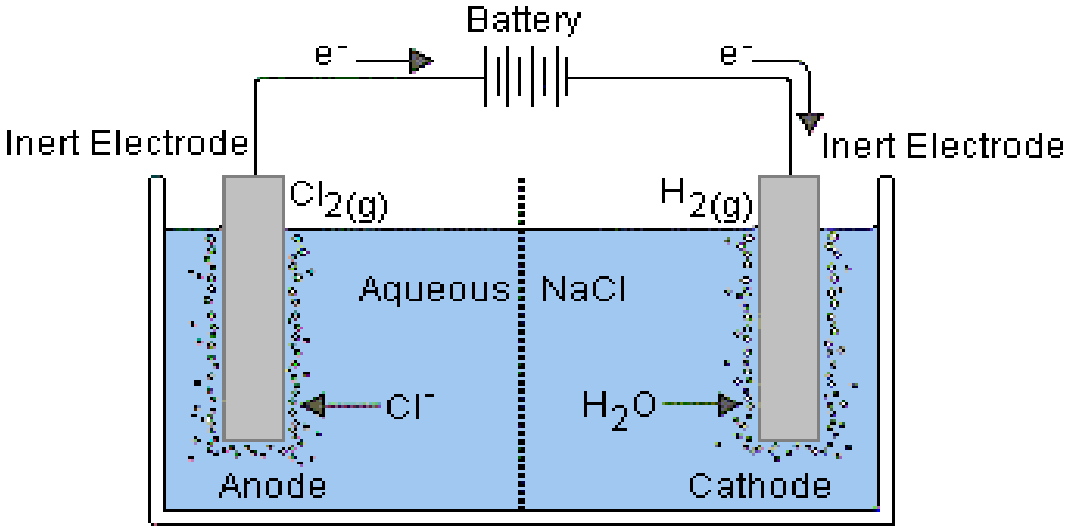
Skill level 4	
4	
3	
2	
1	
0	
NR	

QUESTION SEVEN: REDOX

1. The diagram shows the **electrolysis of** sodium chloride **NaCl** in solution form.



a. Define the term **electrolysis.**

Skill level 1	
1	
0	
NR	

b. Identify the **reductant** in this electrolysis of sodium chloride solution.

Skill level 1	
1	
0	
NR	

c. Write the **balanced half-equations** for the **reduction reaction** in the electrolysis of sodium chloride solution.

Skill level 2	
2	
1	
0	
NR	

2. Analyze the possible changes in the **breathalyzer test** under various acidic conditions.

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Skill level 3	
3	
2	
1	
0	
NR	

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PERIODIC TABLE