

MARKER CODE				



STUDENT ENROLMENT NUMBER (SEN)									

TONGA NATIONAL FORM SEVEN CERTIFICATE

2020

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 **EIGHT QUESTIONS** and is out of 70 weighted scores.

QUESTIONS	STRANDS	TOTAL SKILL LEVEL
ONE	ATOMIC STRUCTURE, BONDING AND RELATED PROPERTIES	12
TWO	SOLIDS AND RELATED PROPERTIES	5
THREE	KINETIC CHEMISTRY	6
FOUR	QUANTITATIVE CHEMISTRY : EQUILIBRIUM SYSTEM	10
FIVE	INORGANIC CHEMISTRY	6
SIX	ORGANIC CHEMISTRY	18
SEVEN	OXIDATION AND REDUCTION REACTIONS	8
EIGHT	NUCLEAR CHEMISTRY	5
TOTAL		70

3. Answer ALL QUESTIONS. Write your answers in the spaces provided in this booklet.
4. You are expected to apply the principles and knowledge learned from the Chemistry curriculum taught throughout this academic year.
5. Use a **BLUE** or **BLACK** ball point pen only for writing. Use a pencil for drawing if required.
6. 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 part of your booklet.
7. Show all necessary working. The **Periodic table** is provided.
8. Check that this booklet contain pages **2-19** in the correct order and that page 19 have been deliberately left blank.

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

QUESTION ONE: ATOMIC STRUCTURE, BONDING AND RELATED PROPERTIES

1. Define "Quantum Theory" in terms of electron arrangement.

Skill level 1	
1	
0	
NR	

2. Write the ground state electron configuration using s, p, d, f notation of a copper atom.

Skill level 2	
2	
1	
0	
NR	

3. Describe how the electron configuration of Chromium differs from that of a Vanadium atom.

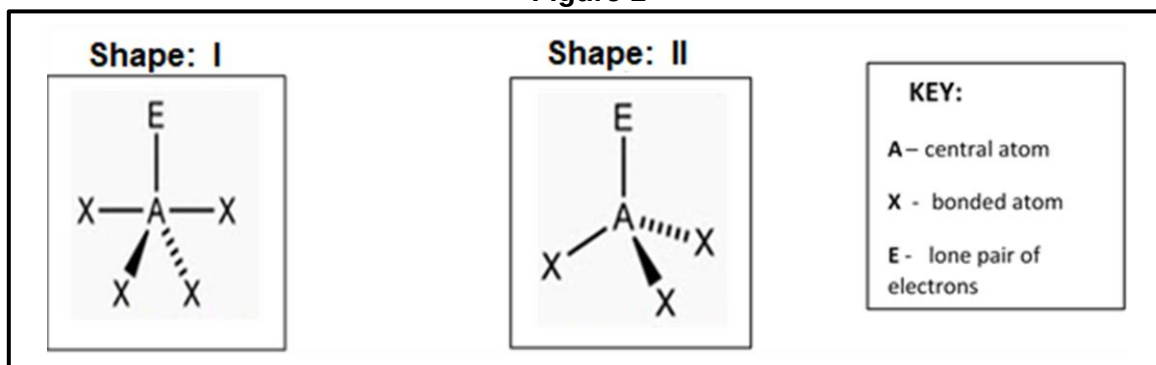
Skill level 2	
2	
1	
0	
NR	

4. Describe how emission spectrum is a "fingerprint" of an atom.

Skill level 2	
2	
1	
0	
NR	

5. **Figure 1** below shows two different geometric oxyanion shapes. Study it carefully and answer the questions that follow.

Figure 1



- a. Describe factors that contribute to the distortion from the ideal geometric shape of ion II above.

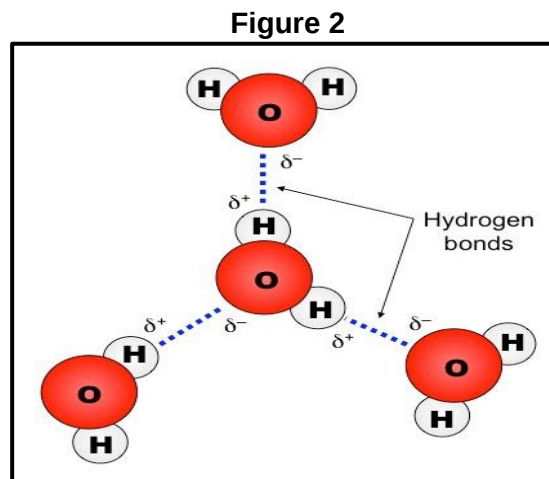
Skill level 2	
2	
1	
0	
NR	

- b. Predict the bonding angles in the **oxyanion I** above, giving reasons.

Skill level 3	
3	
2	
1	
0	
NR	

QUESTION TWO: SOLIDS AND RELATED PROPERTIES

1. **Figure 2** below shows water molecules with the presence of hydrogen bonds.



Describe the special features within the water molecule that enable it to form hydrogen bond.

Skill level 2	
2	
1	
0	
NR	

2. Account for the differences in electrical conductivity of the solids given in **Table 1** below.

Table 1

NAME OF SOLID	STATE OF SOLID
Sodium	SOLID
Sodium chloride	LIQUID
Sulfur dichloride	LIQUID

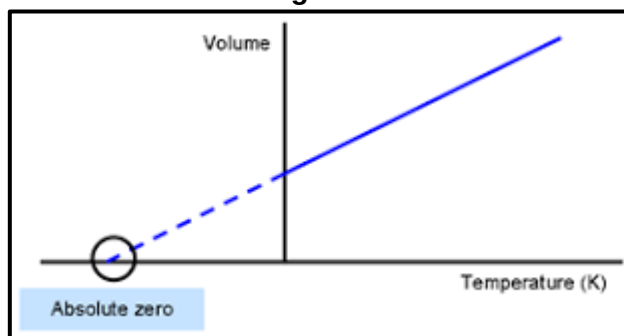
Skill level 3	
3	
2	
1	
0	
NR	

QUESTION THREE:

KINETIC CHEMISTRY

1. The graph in **Figure 3** below shows **absolute Zero temperature**. Study the graph carefully then answer the question that follow.

Figure 3



Describe the nature of particles of matter at absolute zero temperature.

Skill level 2	
2	
1	
0	
NR	

2. Dinitrogen monoxide, N_2O , can decompose into nitrogen and oxygen gas.



The structure of N_2O is $\text{N} \equiv \text{N}-\text{O}$.

The bond enthalpy data is given below in Table 2.

Table 2

Bond	Energy kJ/mol
$\text{N}=\text{O}$	587
$\text{O}=\text{O}$	498
$\text{N}=\text{N}$	945

a. Define the term “bond energy”.

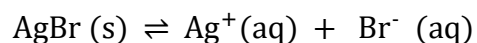
Skill level 1	
1	
0	
NR	

b. Calculate the bond enthalpy for N-O.

Skill level 3	
3	
2	
1	
0	
NR	

QUESTION FOUR: QUANTITATIVE CHEMISTRY: EQUILIBRIUM SYSTEM

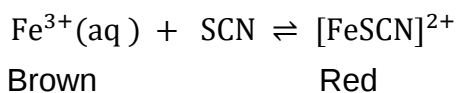
1. 40.0 mL of 0.150 mol L⁻¹ HBr solution was added to 25.0 mL of a saturated silver bromide, AgBr, solution.



Describe how the above equilibrium system will response to the addition HBr.

Skill level 2	
2	
1	
0	
NR	

2. When thiocyanate ions are added to an aqueous solution of iron (III) the following equilibrium reaction occurs.



When fluoride ions are added to a solution containing Fe³⁺ ions the colourless complex ion [FeF₆]³⁻ is formed.

Describe the expected observation in the above equilibrium when solid NaF is added.

Skill level 2	
2	
1	
0	
NR	

3. Ammonia, NH_3 , is a weak base and plays a major role as a cleaning agent used in many households.

The pK_a of NH_4^+ is 9.24

Use the information above and your own knowledge of weak bases to calculate the equilibrium concentration of ammonia with a **pH of 11.1**.

Skill level 3	
3	
2	
1	
0	
NR	

4. **Table 3** below provides information on 0.100 mol/L solutions of ammonia and sodium hydroxide.

Table 3

Solutions	$[\text{H}_3\text{O}^+]$ (mol/L)
NH_3	8×10^{-12}
NaOH	8×10^{-6}

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Skill level 3	
3	
2	
1	
0	
NR	

- State the colour of Ferrous sulphide.

Write the balanced equation for the formation of the **complex ion Z**.

[illegible]

Account for the fact that compounds containing Sc^{2+} and Zn^{2+} are not coloured, whereas compounds containing Co^{2+} are coloured.

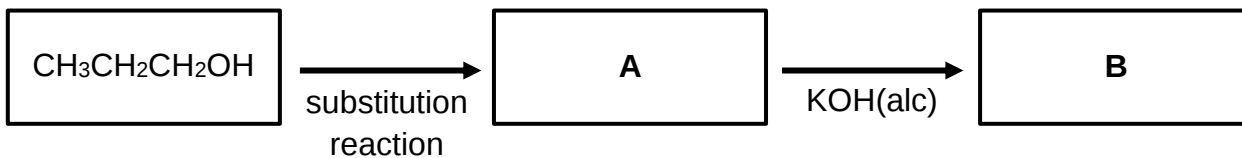
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Skill level 3	
3	
2	
1	
0	
NR	

3. Study the reaction scheme below and use it to answer the questions that follow.



- a. Define **substitution reaction**.

Skill level 1	
1	
0	
NR	

- b. Write the **structural formula of the two main products** formed from the above reaction scheme.

A. _____

B.

Skill level 2	
2	
1	
0	
NR	

4. Explain the reaction mechanism of **nucleophilic substitution** reaction of chloroethane with water and ammonia, giving examples.

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Skill level 3	
3	
2	
1	
0	
NR	

5. Write the structural formula of the products formed from the reaction of the amine and the acid chloride given below.



Product 1 : _____

Product 2 : _____

Skill level 2	
2	
1	
0	
NR	

6. Name the **major product 1 formed** from the reaction in question (5) above.

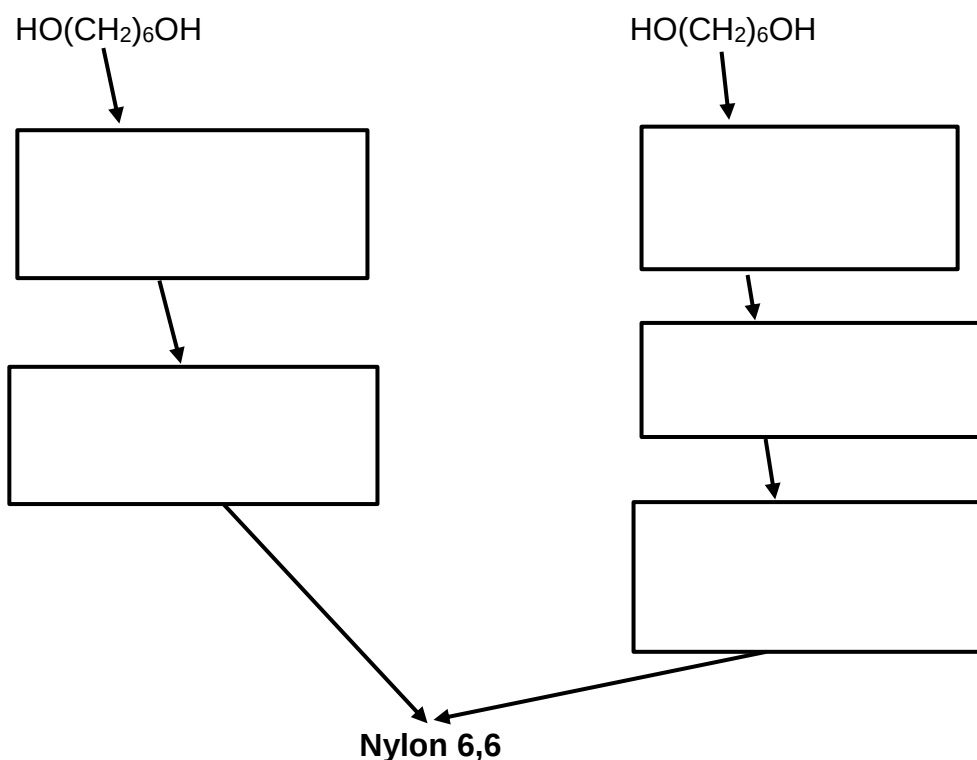
Name: _____

Skill level 1	
1	
0	
NR	

7. **Nylon 6,6** are used as an artificial fibre in clothing.

Study the reaction scheme below and apply your knowledge to complete the scheme to produce the polymer nylon 6,6.

[hint: all answers in each box are different]



Skill level 4	
4	
3	
2	
1	
0	
NR	

QUESTION SEVEN: OXIDATION AND REDUCTION REACTIONS

1. Determine the oxidation number of chromium in potassium dichromate $\text{Cr}_2\text{O}_7^{2-}$.

Skill level 2	
2	
1	
0	
NR	

2. When a piece of zinc is placed in dilute sulfuric acid solution, hydrogen gas is given off, but there is no observation made when a copper metal is placed in this same acid.

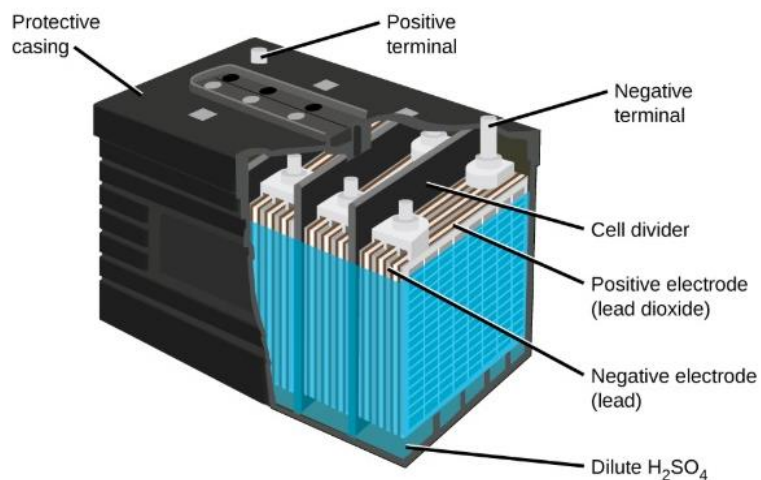
Table 4

Redox couple	E° / V
$\text{Cu}^{+2} / \text{Cu}$	+ 0.34
$\text{Zn}^{+2} / \text{Zn}$	-0.76
H^+ / H_2	0.00

Use the E° values in **Table 4** to predict whether the reaction described above is spontaneous or non-spontaneous.

Skill level 3	
3	
2	
1	
0	
NR	

3. Write the overall balanced equation for the redox reaction in the lead-acid battery given below. (Show ALL necessary equation/ steps taken to the formation of the overall balanced equation)



Source: <http://www.google.com/bccourier.com>

Skill level 3	
3	
2	
1	
0	
NR	

QUESTION EIGHT:

NUCLEAR CHEMISTRY

1. Define Einstein's equation: **$E = mc^2$** .

Skill level 1	
1	
0	
NR	

2. Discuss the biological effects of radiation on humans.

[illegible]

Skill level 4	
4	
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2	
1	
0	
NR	

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