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STUDENT ENROLMENT NUMBER (SEN)									

TONGA NATIONAL FORM SEVEN CERTIFICATE

2019

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 Skill Level.

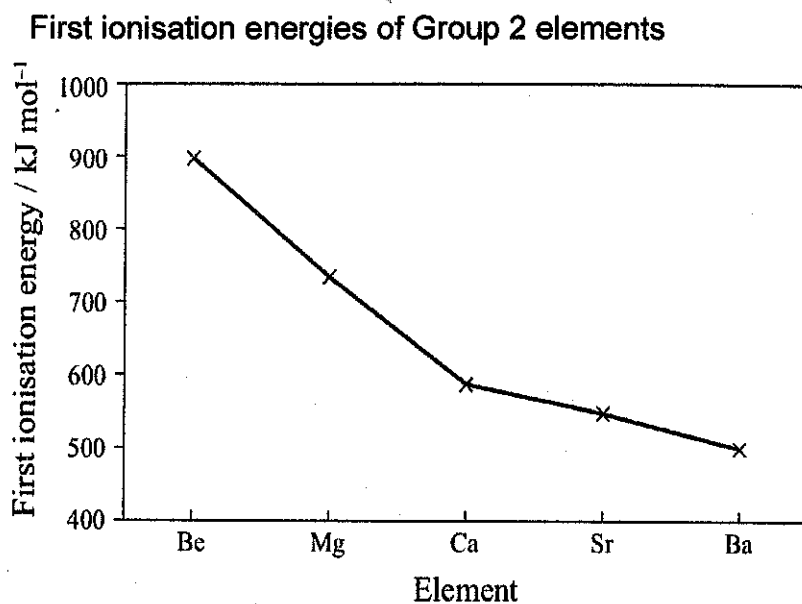
QUESTIONS	TOPICS	Total Weight
ONE	ATOMIC STRUCTURE AND BONDING	12
TWO	SOLIDS AND RELATED PROPERTIES	6
THREE	REDOX CHEMISTRY	7
FOUR	KINETIC CHEMISTRY	6
FIVE	EQUILIBRIUM SYSTEM	11
SIX	INORGANIC CHEMISTRY	9
SEVEN	ORGANIC CHEMISTRY	14
EIGHT	NUCLEAR CHEMISTRY	5
	TOTAL	70

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 **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 addition sheet, number the questions clearly and insert them in the appropriate part of your booklet.
7. Show all working. Periodic table are given on Sheet 1 provided.
8. Check that this booklet contains pages 2-19 in the correct order and that none of the pages is blank.

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

QUESTION ONE: ATOMIC STRUCTURE AND BONDING.

1. The following graph shows the first ionization energies of the Group 2 elements from Be to Ba.



- (a) Write an equation to show the first ionization energy for the element calcium.

Skill level 1	
1	
0	
NR	

- (b) Describe the trend shown of first ionization energies of the Group 2 elements.

Skill level 2	
2	
1	
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2. Describe the data for the following pair of particles.

Atom	Electronegativity
O	3.44
Se	2.55

[illegible]

Skill level 2	
2	
1	
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NR	

3. Complete the table below.

	AsF₅	BrF₅
Lewis diagram		
Name of shape		

Skill level 3	
3	
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- 10



Skill level 4	
4	
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QUESTION TWO: SOLIDS AND RELATED PROPERTIES

1. Chlorine, Cl_2 , bromine, Br_2 , and iodine, I_2 , are all halogens.
Bromine is a liquid at room temperature

(a) In the box below, tick the type(s) of intermolecular attraction in **liquid** bromine

Intermolecular attraction	Tick (✓)
Temporary dipole-dipole attractions	
Permanent dipole-dipole attractions	
Hydrogen bonding	

Skill level 1	
1	
0	
NR	

(b) Describe why bromine is a liquid at room temperature, whereas chlorine is a gas.

Skill level 2	
2	
1	
0	
NR	

2.

Molecule	$M / \text{g mol}^{-1}$
Hydrazine, N_2H_4	32
Decane, $\text{C}_{10}\text{H}_{22}$	142

Use the information in the table above and your knowledge of intermolecular forces to explain why the solubility of hydrazine in water is greater than that of decane in water.

Skill level 3	
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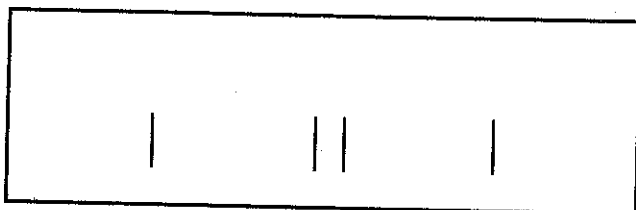
QUESTION THREE: REDOX CHEMISTRY

1. A layer of copper can be deposited on an iron nail by placing the iron nail in an aqueous solution of copper sulfate. An electrochemical cell is set up based on the reaction between the iron nail and copper sulfate solution.

$$E^{\circ}(\text{Fe}^{2+}/\text{Fe}) = -0.44 \text{ V}$$

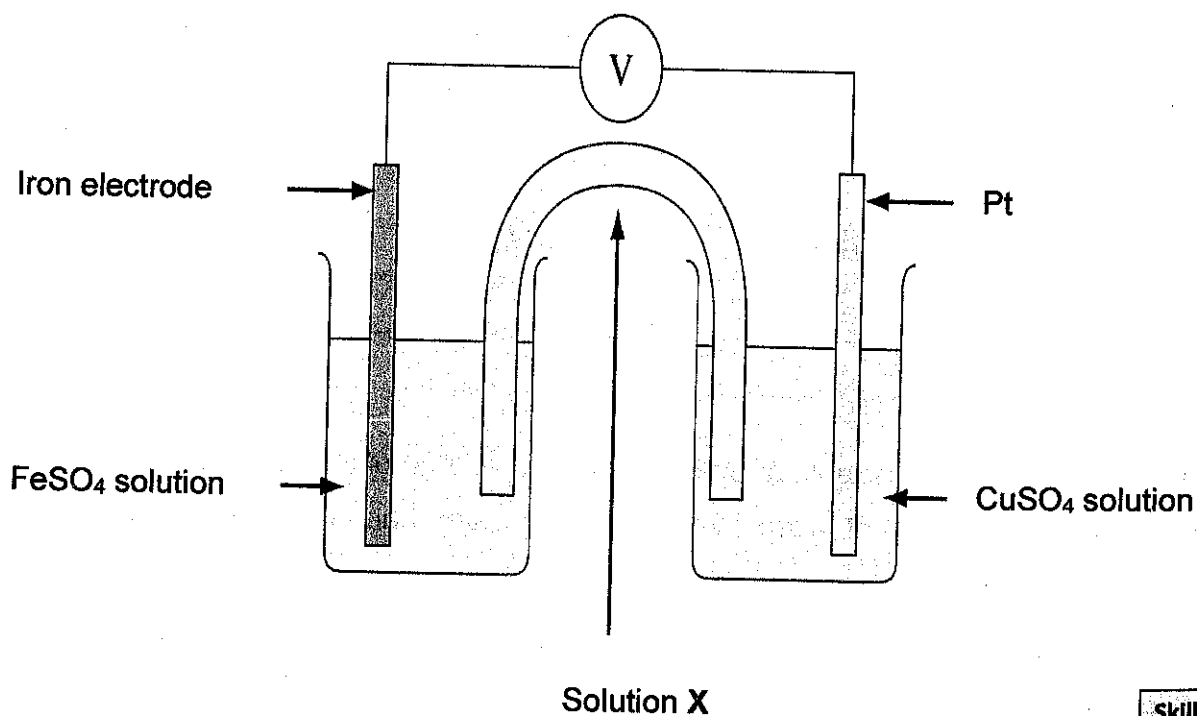
$$E^{\circ}(\text{Cu}^{2+}/\text{Cu}) = -0.34 \text{ V}$$

- (a) Complete the standard cell diagram for this cell.



Skill level 2	
2	
1	
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- (b) A student assembled the apparatus below to measure the cell voltage of the electrochemical cell above.



Identify Solution X.

Solution X: _____

Skill level 1	
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Skill level 4	
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QUESTION FOUR: KINETIC CHEMISTRY

1. Define **standard heat of vapourisation**, $\Delta_{\text{vap}}H$.

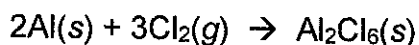
Skill level 1	
1	
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2. Write a balanced thermochemical equation for the given standard enthalpy of Combustion of propanol:

$$\Delta_c H(\text{C}_3\text{H}_7\text{OH}(l)) = -2071 \text{ kJ mol}^{-1}$$

Skill level 2	
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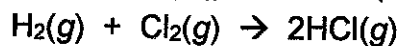
3. The equation for the formation of $\text{Al}_2\text{Cl}_6(s)$ is:



Calculate the enthalpy change, $\Delta_r H^\circ$, for this reaction using the following data:



$$\Delta_r H^\circ = -1003 \text{ kJ mol}^{-1}$$



$$\Delta_r H^\circ = -184 \text{ kJ mol}^{-1}$$



$$\Delta_r H^\circ = -72.4 \text{ kJ mol}^{-1}$$



$$\Delta_r H^\circ = -643 \text{ kJ mol}^{-1}$$

Skill level 3	
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QUESTION FIVE: EQUILIBRIUM SYSTEM

1. A sparingly soluble salt lead (II) chloride dissolves in water.

(a) Write the solubility product expression, K_s , for lead(II) chloride.

Skill level 1	
1	
0	
NR	

(b) Calculate the solubility, in mol L⁻¹, of PbCl₂ in water at 25°C.

$$K_s(\text{PbCl}_2) = 1.60 \times 10^{-5} \text{ at } 25^\circ\text{C}$$

Skill level 2	
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(c) Sea water contains many dissolved salts. The chloride ion concentration in a sample of sea water is 0.440 mol L^{-1} .

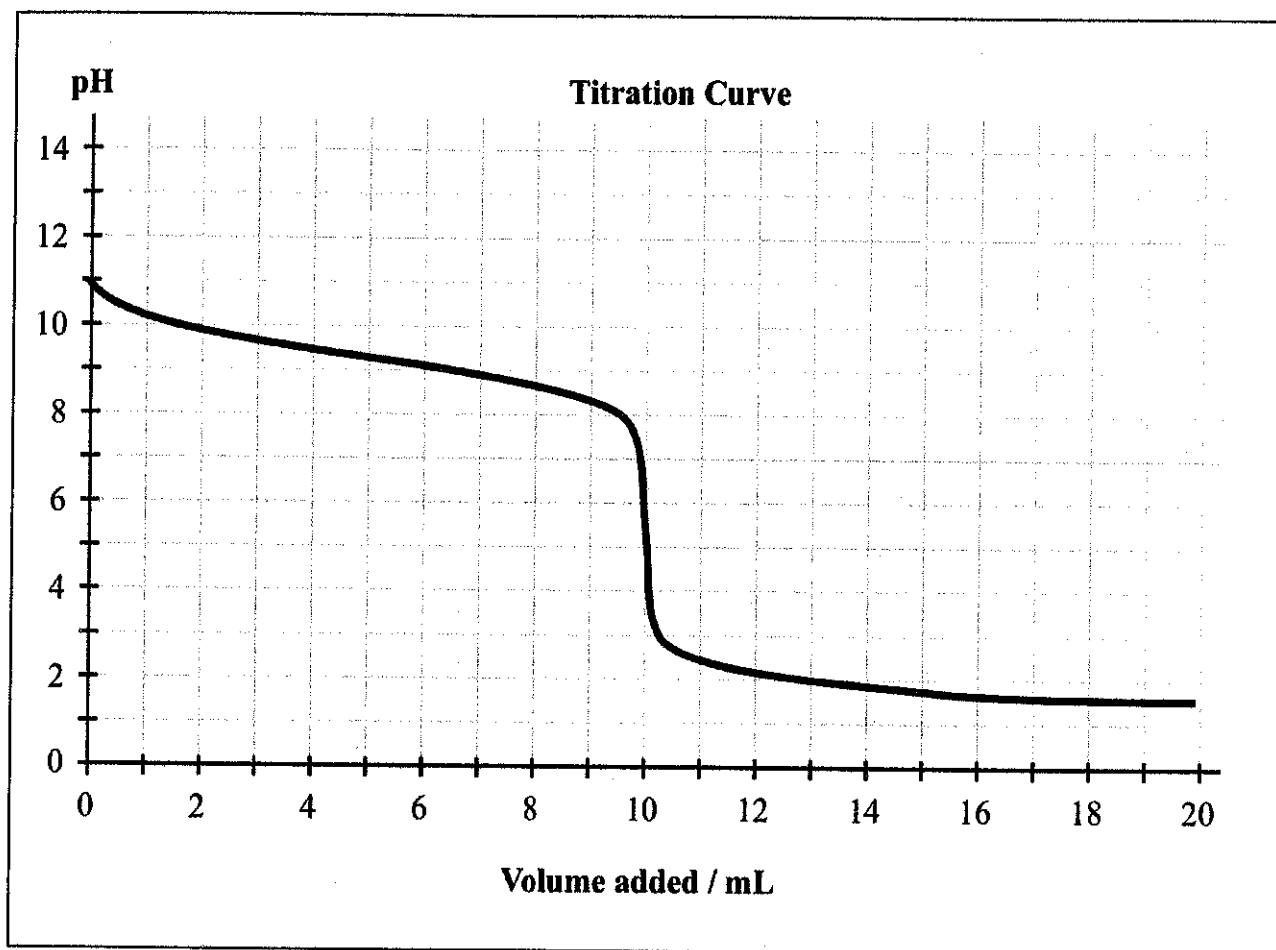
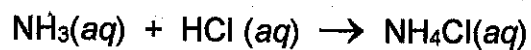
Determine whether a precipitate of lead (II) chloride will form when a 1.00 g sample of lead(II) nitrate is added to 500 mL of the sea water. Your answer must be clearly justified.

$$M(\text{Pb}(\text{NO}_3)_2) = 331 \text{ g mol}^{-1}$$

Skill level 3	
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2. The graph below shows the change in pH when 40.0 mL of 0.0500 mol L⁻¹ aqueous NH₃ is titrated with 0.200 mol L⁻¹ aqueous HCl.

The equation for the reaction occurring during the titration is:



- (a) Use the curve to determine $\text{p}K_a(\text{NH}_4^+)$ and hence calculate $K_a(\text{NH}_4^+)$.

$\text{p}K_a(\text{NH}_4^+)$ _____

$K_a(\text{NH}_4^+)$ _____

Skill level 2	
2	
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[illegible]

Skill level 3	
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QUESTION SIX: INORGANIC CHEMISTRY

1. Write the electron configuration using *s*, *p*, *d* notation for:

Mn : _____

Cr^{3+} _____

 Zn^{2+}

Skill level 1	
1	
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2. Explain why manganese and chromium form a variety of different compounds and ions with oxygen.

[illegible]

Skill level 3	
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3. Zinc can also form a complex ion. Complete the chemical equation for the formation of a complex ion when the zinc(II) hydroxide precipitate dissolves in excess ammonia.

Skill level 2	
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4. The hydrogen halides are colourless gases at room temperature. The boiling points of the hydrogen halides are as follows:

Hydrogen halide	Boiling point (°C)
HF	20
HCl	-85
HBr	-67
HI	-35

Discuss the different boiling points of hydrogen fluoride (HF), hydrogen chloride (HCl), hydrogen bromide (HBr) and hydrogen iodide (HI) in terms of the relative strengths of the intermolecular forces between the particles involved.

[illegible]

Skill level 3	
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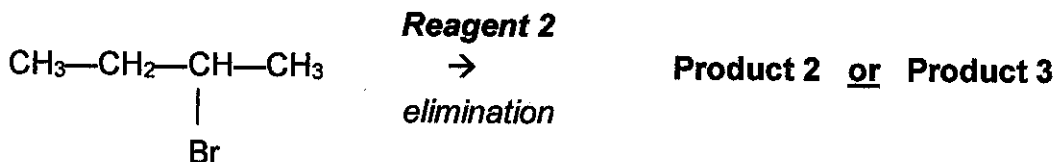
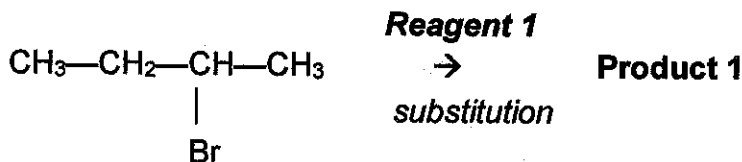
QUESTION SEVEN: ORGANIC CHEMISTRY

1. 2-bromobutane reacts by **substitution** to form 2-butanol. However, if the reaction conditions are changed, an **elimination reaction** occurs. There are two possible products for the elimination reaction.

(a) Define what is meant by the term **elimination reaction**.

Skill level 1	
1	
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- (b) Complete the following reaction scheme by indicating the reagents (**Reagent 1** and **2**) and the organic products (**Product 1, 2 and 3**) for each of these reactions of 2-bromobutane.



Reagent 1: _____

Reagent 2: _____

Product 1: _____

Product 2: _____

Product 3: _____

Skill level 1	
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Skill level 2	
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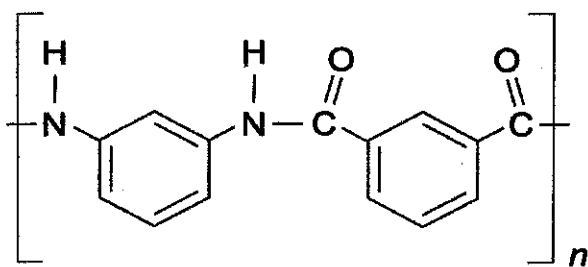
2. Some organic compounds can exist as enantiomers (optical isomers). An example is a secondary alcohol with the molecular formula C_4H_9OH . Explain what is meant by the term enantiomers (optical isomers).

In your answer, you should:

- draw the enantiomers of C_4H_9OH in the box below.
- identify the structural requirement for a molecule, such as C_4H_9OH , to exist as enantiomers
- explain how enantiomers can be distinguished from each other.

[illegible]

Skill level 3	
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is a benzene ring and does not change when the monomers bond together to form the polymer.

Explain the structure of the polymer, Nomex.

In your answer, you should include:

- the name of the functional group linking the monomers
- a drawing of both monomers
- a classification of the type of polymer formed, with an explanation to justify your choice.

[illegible]

Skill level 3	
3	
2	
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4. Unknown Y has the molecular formula $C_4H_8O_3$ and undergoes the following reactions:

- It reacts with sodium carbonate solution to release carbon dioxide gas.
- When Y is heated with acidified potassium dichromate, the colour changes from orange to green, but the product does not react with Benedict's solution.
- Y undergoes an elimination reaction with concentrated sulfuric acid to produce two organic products.

Based on the information above, draw the structural formula of Unknown Y. Justify your structural formula of Y, including:

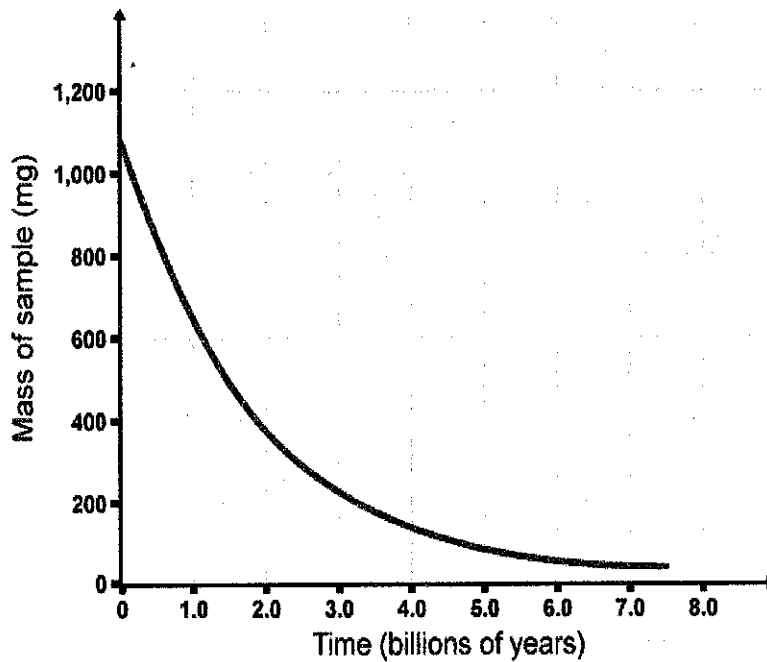
- structural formulae of any organic products
- an explanation of any major and minor products.

[illegible]

Skill level 4	
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QUESTION EIGHT: NUCLEAR CHEMISTRY

1. The graph shows how the activity of a sample of potassium-40 changes over time.



Source: <https://www.bbc.co.uk/bitesize>

Use the decay graph to determine the **half-life** of potassium-40.

Skill level 1	
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With your knowledge on nuclear energy, discuss your opinion on whether you agree with the Form 7 student's idea. (Provide at least three reasons with clarifications and examples or other supportive evidences.)

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