

MARKER CODE				



STUDENT ENROLMENT NUMBER (SEN)									

TONGA FORM SIX CERTIFICATE 2018 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 **SIX QUESTIONS** and is out of 80 Skill Level.

QUESTIONS	TOPICS	TOTAL SKILL LEVEL
ONE	ATOMIC STRUCTURE AND BONDING	20
TWO	QUANTITATIVE CHEMISTRY	10
THREE	INORGANIC CHEMISTRY	5
FOUR	REDOX	7
FIVE	PHYSICAL CHEMISTRY	10
SIX	ORGANIC CHEMISTRY	28
	TOTAL	80

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 addition sheet, number the questions clearly and insert them in the appropriate places in this booklet.
6. A group of the Periodic Table of the Elements is provided on **page 21**. The table gives the Symbol, Atomic Number and the Relative Atomic Mass of the elements. The Groups (columns) are numbered I, II, III, IV etc. NOTE: The symbol M is used for molar mass. $M(\text{Na}) = 23 \text{ g mol}^{-1}$ and $M(\text{CO}_2) = 44 \text{ g mol}^{-1}$
7. Check that this booklet contains pages **2-23** in the correct order and that page 23 has been deliberately left blank.

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

ATTEMPT ALL QUESTIONS IN THIS EXAM PAPER.

Write the answer to each question in the correct spaces provided.

QUESTION ONE: ATOMIC STRUCTURE AND BONDING

1. Write the electron configuration in terms of principal energy levels and **s**, **p**, **d**, **f** notations for the following atom and ion:

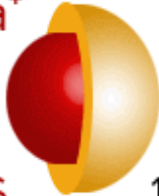
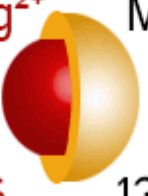
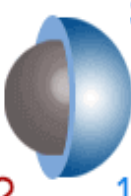
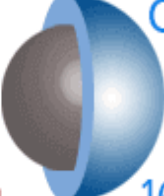
a. Oxygen atom

Skill level 1	
1	
0	
NR	

b. Oxide ion

Skill level 1	
1	
0	
NR	

2. The table below shows the atomic radii with its corresponding ion radii. Study it carefully to answer the questions that follow.

Na ⁺	Na	Mg ²⁺	Mg	Al ³⁺	Al	S	S ²⁻	Cl	Cl ⁻
									
116	154	86	130	68	118	102	170	99	167

a. Define the term atomic radii.

Skill level 1	
1	
0	
NR	

- b. Explain the trend of the ionic radii across the period from sodium ion to chloride ion.

Skill level 3	
3	
2	
1	
0	
NR	

A piece of copper can be easily reshaped without breaking into smaller pieces and used for electrical wiring.



3. Explain the property identified by relating the property to the structure and bonding within the solid.

Skill level 3	
3	
2	
1	
0	
NR	

-
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5. H_2CO is a colourless, acidic toxic gas and used for preservation.

- [illegible]

Name: _____

- b. Use the molecular shape and electron distribution to determine whether H_2CO molecule is polar or non-polar.

Skill level 3	
3	
2	
1	
0	
NR	

6. Describe the types of intermolecular forces present in water (H_2O).

Skill level 2	
2	
1	
0	
NR	

QUESTION TWO: QUANTITATIVE CHEMISTRY

Oxalic acid is a toxic substance used by laundries to remove rust stains. Its composition is 26.7% carbon, 2.2% hydrogen and 71.1% oxygen by mass. Its molar mass is 90 g mol^{-1} .

[Given: $M(\text{C}) = 12 \text{ g mol}^{-1}$, $M(\text{O}) = 16 \text{ g mol}^{-1}$ and $M(\text{H}) = 1 \text{ g mol}^{-1}$]

- Calculate the empirical formula of oxalic acid.

--	--

Skill level 2	
2	
1	
0	
NR	

- 10mL of a standard potassium carbonate solution, concentration 0.04 mol L^{-1} was prepared. The **aliquot** was then transferred into a conical flask. This sample was then titrated with hydrochloric acid of unknown concentration. The indicator (methyl orange) showed that the **end point** was reached when 25.0mL of hydrochloric acid was added.

- Define the following terms:

- aliquot:

Skill level 1	
1	
0	
NR	

- end point:

Skill level 1	
1	
0	
NR	

- b. Write a balanced equation for the reaction between potassium carbonate and hydrochloric acid.

Skill level 1	
1	
0	
NR	

- c. Calculate the number of moles of hydrochloric acid in the 25 mL titre.

Skill level 3	
3	
2	
1	
0	
NR	

- d. Calculate the concentration of hydrochloric acid.

Skill level 2	
2	
1	
0	
NR	

- | Group 1 | 2 | 13 | 14 | 15 | 16 | 17 |
|-----------------------|--------------|--|--------------------------------|--|----------------------------------|--|
| Li_2O | BeO | B_2O_3 | CO_2 | N_2O_3
N_2O_5 | O | OF_2 |
| Na_2O | MgO | Al_2O_3 | SiO_2 | P_2O_3
P_2O_5 | SO_2
SO_3 | Cl_2O
Cl_2O_7 |
| K_2O | CaO | Ga_2O_3 | GeO_2 | As_2O_5
As_2O_3 | SeO_2
SeO_3 | Br_2O |
| Rb_2O | SrO | In_2O_3
In_2O | SnO_2 | Sb_2O_5
Sb_2O_3 | TeO_2 | I_2O_5 |
| Cs_2O | BaO | Tl_2O | PbO_2
PbO | Bi_2O_3 | Po | At |

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Skill level 3	
3	
2	
1	
0	
NR	

2. Relate the melting points of period 3 elements chloride to their structure and bonding.

Formula	NaCl	MgCl ₂	AlCl ₃ / AlCl ₆	SiCl ₄	PCl ₃ / PCl ₅
Melting Point °C	801	714	178 sublimes	-70	-112

[illegible]

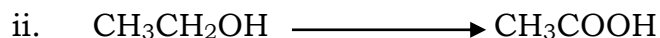
Skill level 2	
2	
1	
0	
NR	

QUESTION FOUR:**REDOX**

1. Due to the rise of road accidents in Tonga, the Ministry of Police is now using breathalyser testing. Drivers are required to blow through a tube containing orange crystals of potassium dichromate ($K_2Cr_2O_7$) with concentrated sulfuric acid. Under acidic conditions, alcohol in the breath will change the colour of the crystals. The concentrated sulfuric acid also generates heat as it reacts with moisture from the breath sample. This heat increases the speed of the oxidation reaction. A driver is considered to be over the limit if there is sufficient alcohol to change the colour of the crystals.



The two half equations for the above reaction are:



- a. Name the common oxidizing agent use in the explanation above.

Skill level 1	
1	
0	
NR	

- b. Define the term Reductant.

Skill level 1	
1	
0	
NR	

- c. Identify the reductant in the chemical reaction above.

Skill level 1	
1	
0	
NR	

- d. State the change of colour of the orange crystals if the driver is over the limit of sufficient alcohol.

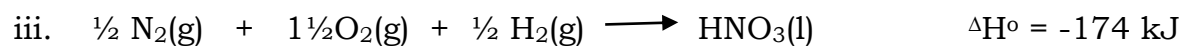
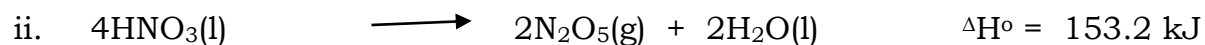
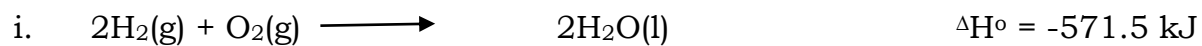
Skill level 1	
1	
0	
NR	

- e. Balance and combine the two half-equations above and write the full balanced equations for the redox reactions.

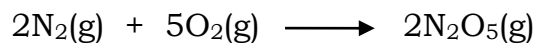
Skill level 3	
3	
2	
1	
0	
NR	

QUESTION FIVE: PHYSICAL CHEMISTRY

1. Given the following thermochemical equations,



a. Apply Hess Law to calculate the **enthalpy change** (ΔH°) for the reaction

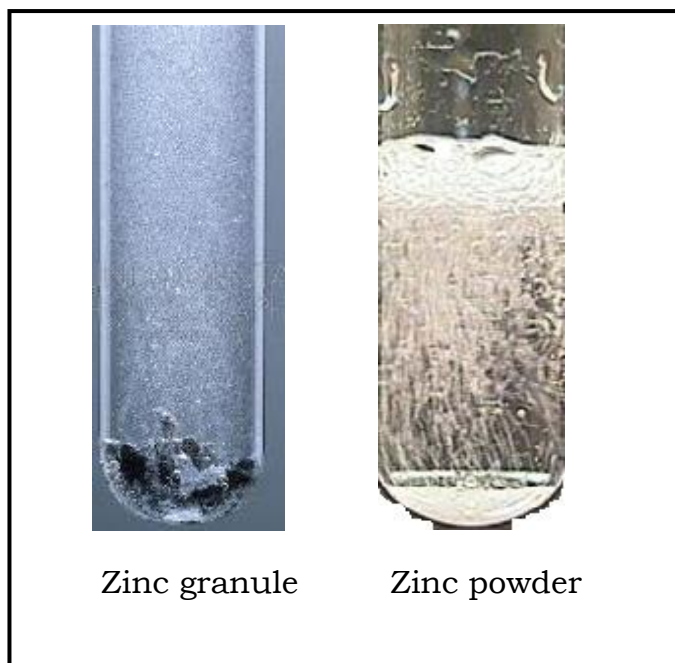


Skill level 3	
3	
2	
1	
0	
NR	

b. Define the term enthalpy change.

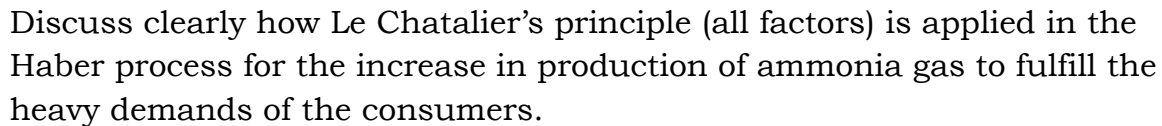
Skill level 1	
1	
0	
NR	

The diagram below shows how Zinc reacts with 2molL^{-1} hydrochloric acid. Zinc powder reacts rapidly with 2molL^{-1} hydrochloric acid where as Zinc granule reacts slowly with 2molL^{-1} hydrochloric acid.



2. Describe the effects of the factor affecting the rate of the above reaction in terms of simple collision theory.

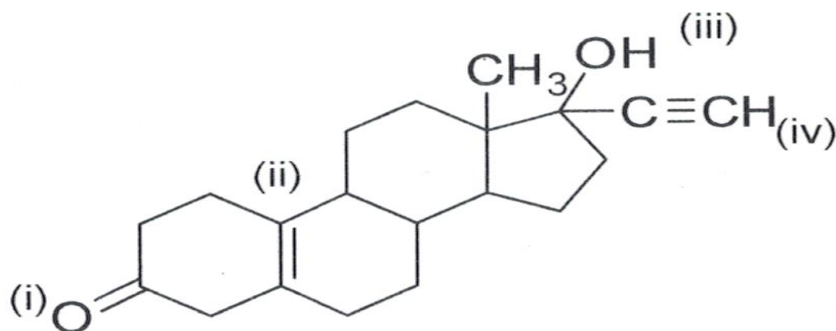
Skill level 2	
2	
1	
0	
NR	

[illegible]

Skill level 4	
4	
3	
2	
1	
0	
NR	

QUESTION SIX: ORGANIC CHEMISTRY

Study the structure given below carefully and answer the question that follow.



1. Name the **functional group** represented by:

Structure	Name
(i)	
(ii)	
(iii)	
(iv)	

Skill level 1	i	ii	iii	iv
1				
0				
NR				

2. Fats and oils are triglycerides. Triglycerides are esters. The animal fat and lard is a triglyceride of glycerol and the saturated fatty palmitic acid $(\text{CH}_3(\text{CH}_2)_{14}\text{COOH})$.

- a. Draw the structure of lard (triglyceride formed).



Skill level 1	
1	
0	
NR	

- You must (or can) include:

- i. The reagents required
- ii. Draw the structural formula of soap
- iii. State how the chemical nature of soap enhances its role as a cleaning agent.

[illegible]

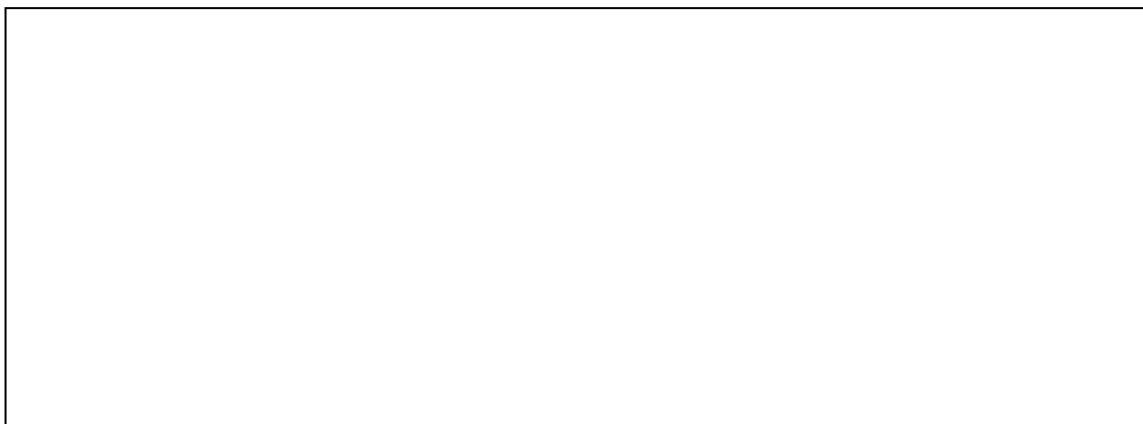
	Skill level 3	
	3	
	2	
	1	
	0	
	NR	

- With your knowledge on Polymerisation process, discuss clearly using the **structural formula** for the production of **plastic wraps** and **drainage pipes**.

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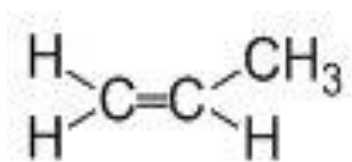
Skill level 4	
4	
3	
2	
1	
0	
NR	

4. Glucose can exist in two forms: Linear and branched.
Explain the differences in the **structure** by drawing the two forms **and** state the **property** of the two forms of glucose.



Skill level 3	
3	
2	
1	
0	
NR	

5. Study the structure below to answer the questions that follow.



The above molecule was reacted with hydrogen bromine.

- a. Draw the structure for the product formed.

Skill level 1	
1	
0	
NR	

- b. Name the product formed using IUPAC rules.

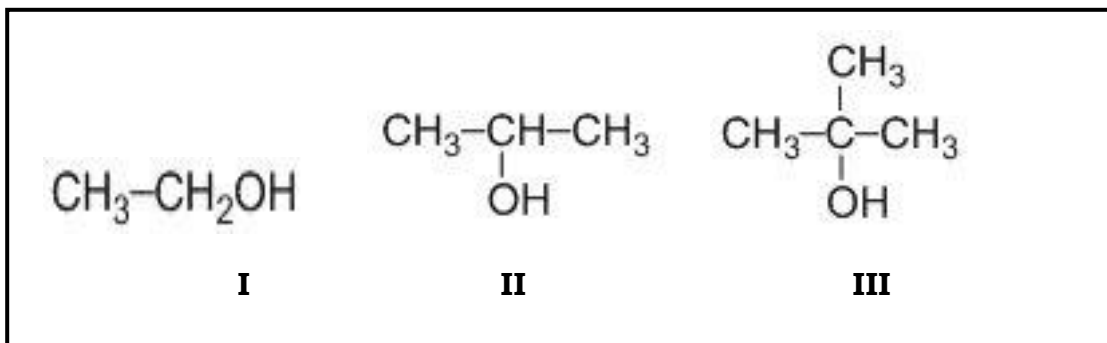
Skill level 1	
1	
0	
NR	

6. Write **equations** for the addition reaction of **ethyne with water** and name the final product formed. The final product consists of single bonds.

Name of final product: _____

Skill level 3	
3	
2	
1	
0	
NR	

Alcohols undergo oxidation reactions by reacting with potassium permanganate. Study the structures of the different types of alcohol below and answer the question that follow.



7. Deduce the products formed from the structures above when undergoing oxidation reaction.

Skill level 3	
3	
2	
1	
0	
NR	

8. Given below are structures of different organic compounds.



a. Name **Compound B**.

IUPAC name: _____

Skill level 1	
1	
0	
NR	

b. Identify the functional group in **Compound A**.

Skill level 1	
1	
0	
NR	

c. State the acidic behavior of **Compound B** and write the equation to show the reaction of **Compound B** with aqueous sodium hydroxide.

Skill level 3	
3	
2	
1	
0	
NR	

PERIODIC TABLE

I												VIII						
1	II											III	IV	V	VI	VII	2	
hydrogen 1 H 1.0079																	helium 2 He 4.0026	
lithium 3 Li 6.941	beryllium 4 Be 9.0122											boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180	
sodium 11 Na 22.990	magnesium 12 Mg 24.305											aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948	
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.64	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80	
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	ytrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29	
cesium 55 Cs 132.91	barium 56 Ba 137.33	* 57-70	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]
francium 87 Fr [223]	radium 88 Ra [226]	* 89-102	actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]		

* Lanthanide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]

* * Actinide series

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