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TONGA NATIONAL FORM SEVEN CERTIFICATE 2023

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.
- 2. This paper consists of **FIVE SECTIONS** and is out of 70 weighted scores.

SECTION	STRANDS	TOTAL SKILL LEVEL
ONE	ATOMIC STRUCTURE, BONDING, SOLIDS AND RELATED PROPERTIES	9
TWO	KINETIC AND NUCLEAR CHEMISTRY	17
THREE	INORGANIC CHEMISTRY	13
FOUR	QUANTITATIVE CHEMISTRY AND REDOX CHEMISTRY	19
FIVE	ORGANIC CHEMISTRY	12
	Total	70

- 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.
- 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.
 - NOTE: A **Periodic Table** is provided at the back of this booklet in page 15.
- 6. Check that this booklet contain pages 2-15 in the correct order and that none of the pages is blank.

SECTION ONE: ATOMIC STRUCTURE, BONDING, SOLIDS AND RELATED PROPERTIES

The melting points of selected elements in the Periodic Table including Sodium are given in the table below: Element Melting Point (°C) Sodium 98 Aluminium 660 Chlorine -101	Write the corresponding balanced equation for the second ionization energy of the element Sodium, Na. Skill leve 2	Def	fine the second	i ionization energy of	f the element Sodium, I	Na.	Skill le	ve
Write the corresponding balanced equation for the second ionization energy of the element Sodium, Na. Skill lev 2	Write the corresponding balanced equation for the second ionization energy of the element Sodium, Na. Skill leve 2						1	
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The melting points of selected elements in the Periodic Table including Sodium are given in the table below: Element Melting Point (°C)	The melting points of selected elements in the Periodic Table including Sodium are given in the table below: Element Melting Point (°C)							<u> </u>
The melting points of selected elements in the Periodic Table including Sodium are given in the table below: Element Melting Point (°C) Sodium 98 Aluminium 660 Chlorine -101	The melting points of selected elements in the Periodic Table including Sodium are given in the table below: Element Melting Point (°C)							
	Sodium, Aluminum and Chlorine.			Element	Melting Point (°C)		-	
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	<u> </u>	give	en in the table t Account for th	Sodium Aluminium Chlorine ne differences in the	Melting Point (°C) 98 660 -101		Skill le	ve
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		give	en in the table t Account for th	Sodium Aluminium Chlorine ne differences in the	Melting Point (°C) 98 660 -101		Skill le 3 2 1	W

possible melting point for	r the elemei	nt, Potas s	sium , ai	nd justify your cl	noice.		
Melting point (°C): (Circle best possible)	1464	181	63	-7			
Justification:							
						Skill lev	vel 3
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						2	
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						0	

Relative to the melting points in the Table in a. (page 2), predict by circling the best

b.

SECTION TWO: KINETIC AND NUCLEAR CHEMISTRY

Nuclear Chemistry

1. Nuclear reaction differs from a chemical reaction.

_	Define (muclear reaction)		
a.	Define 'nuclear reaction'.	Skill lev	vel 1
		1	
		0	
		NR	

b. Americium-241 decays to form Neptunium-237 and an alpha particle.
 Write the complete nuclear equation representing this decay.
 (Word Equation is NOT acceptable)

CL:III.I-	
Skill lev	vel 2
2	
1	
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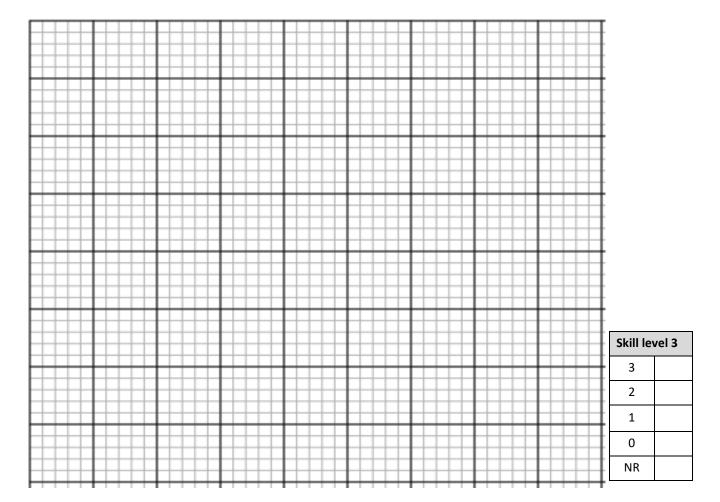
c. Use the data given below to determine the **amount of energy in Joules** released during the following nuclear decay:

Polonium-218 form Lead-214 plus an alpha particle

Initial mass of Polonium-218 = $362.0124 \times 10^{-27} \text{ kg}$ Mass of Lead-214 produced = $355.3550 \times 10^{-27} \text{ kg}$, Mass of an alpha particle = $6.6460 \times 10^{-27} \text{ kg}$ Speed of light = $3.00 \times 10^8 \text{ ms}^{-1}$

Skill lev	vel 2
2	
1	
0	
NR	

d. Plot a graph on the axis below of the **decay of 40 grams of radioactive plutonium-239** that has a half-life of 24100 years.



Kinetic Chemistry

2.	Define 'standard heat (or enthalpy) of combustion, $\Delta_c H^{\circ}$ '.	Skill lev	vel 1
		1	
		0	

3. Consider these two standard heat or enthalpies of combustion of water:

$$\Delta_{c}H^{\circ}(H_{2}O_{(g)}) = -242 \text{ kJmol}^{-1}$$

 $\Delta_{c}H^{\circ}(H_{2}O_{(I)}) = -286 \text{ kJmol}^{-1}$

SKIII I
 3
 2
 1
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NR

4. Hydrazine, N_2H_4 is used in cancer researches, amongst many others. It has the following structure:

$$N-N$$

The **standard enthalpy of formation** of hydrazine liquid at 25°C is 95.55 kJmol⁻¹.

a. Write the **balanced thermochemical equation** for the **standard enthalpy of formation** of hydrazine liquid.



Skill lev	vel 2
2	
1	
0	
NR	

NR

Associated bond energies for the formation of hydrazine are given:		
N-N is 159 kJmol ⁻¹		
H-H is 436 kJmol ⁻¹		
N-H is 389 kJmol ⁻¹		
Apply Hess' Law to find the NEN bond energy .		
	Skill lev	vel 3
	2	
	1	
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b.

SECTION THREE:

INORGANIC CHEMISTRY

Inorganic Compounds

	hosphate.	Skill le	vel
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		0	
		NR	
e is very soluble in water e of species present in	solution when ammonium chloride		•
 		Skill le	ve
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		Skill le	Ve
			ve
		2	
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ural source of each.	not found free in nature , giving an Bromine	0	
ural source of each.		0 NR	
ural source of each.		0 NR	ve
ural source of each.		O NR	ve
ural source of each.		O NR Skill le 3	ve
ural source of each.		O NR	ve

Complex Ions

						Skill le
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Account for the	formation of th	ne chloro con	plex ion of C	Chromium (III).		
Account for the	formation of tl	ne chloro con	nplex ion of C	Chromium (III).		
Account for the	formation of tl	ne chloro con	nplex ion of C	Chromium (III).	· 	Skill le
Account for the	formation of tl	ne chloro con	nplex ion of C	Chromium (III).		Skill le

SECTION FOUR: QUANTITATIVE CHEMISTRY AND REDOX CHEMISTRY

Equilibrium System

- A beaker contains solid calcium hydroxide, Ca(OH)_{2(s)}, in equilibrium with its dissolved ions in aqueous solutions.
 - Write the balanced equation for the equilibrium existing in the saturated a. solution of Ca(OH)_{2(s)}.



Write the solubility product expression, K_s for the equilibrium in the saturated solution of Ca(OH)_{2(s)}.

Skill lev	/el 1
1	
0	
NR	

Calculate the **solubility in molL-1** of calcium hydroxide in water at 25°C. C.

 K_s (Ca(OH)₂) = 5.02 x 10⁻⁶ (at 25°C)

Skill lev	vel 3
3	
2	
1	
0	
NR	

Describe how the equilibrium system in the beaker respond to an increase in d. the Ph of the solution.

Skill lev	vel 2
2	
1	
0	
NR	

Discuss the pH of the buffer solution and write equations where appropria	ate.	
Include in your discussion the following:		
 Appropriate equation for the reaction in the buffer. 		
 Calculation of the pH of the buffer, 		
 Species in solution that contribute to the pH value of the solution. 		
		
		
		
	 -	
		
		
		
		
		
	Skill le	21/6
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	4	+
	3	1
	2	
		1
	1	
	1	+

A buffer solution contains 0.600 molL⁻¹ of propanoic acid and 0.800 molL⁻¹ of sodium

2.

Redox Chemistry

3. Consider the **standard electrode potential** of these two half-cells:

 $E^{0}_{(Cu/Cu2+)}$ is +0.34V $E^{0}_{(Zn/Zn2+)}$ is +0.80V

a. Determine the **most** probable reaction that will occur.

Skill lev	/el 2
2	
1	
0	
NR	

b. Determine the **cell potential**, E° of the feasible reaction identified in **a.**

Skill lev	vel 2
2	
1	
0	
NR	

4. An electrochemical cell has different forms of representations.

Shown below is the representation of an electrochemical cell using a **cell notation**.

 $Cu_{(s)}|Cu^{2+}_{(aq)}||Fe^{2+}_{(aq)},Fe^{3+}_{(aq)}|Pt_{(s)}$

Draw a labelled diagram of the electrochemical cell given above.

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1			
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Skill level 3

SEC.			<i>-</i>
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ORGANIC CHEMISTRY

rg	anic Compound	ds.				Skill lev	vel 1
	Circle the comp	oound (s) belov	w that is an al d	dehyde.		1	
						0	
	СН₃СООН	CH₃OCH₃	CH₃CHO	CH₃CH₂OH	CH₃COCH₃	NR	
-		uctural formu	la of the two r	eactants that fo	ormed butyl ethanoate		
	REACTANT 1:					Skill lev	vel 2
						2	
	REACTANT 2:					1	
						0	
						NR	
	hydroxide, NaO	0H _(aq) is added	to bromoethar	ne, CH ₃ CH ₂ Br.	olution of sodium		
						Skill lev	vel 2

Explain why citric acid can or cannot show optical iso i	nerism.	 	
		 Skill le	eve
		 3	
		 2	
		 1	
		 0	
		NR	
Use ethane, ethene and ethyne as examples in your re-	sponse.		
Use ethane, ethene and ethyne as examples in your re	sponse.		
Use ethane, ethene and ethyne as examples in your re-	sponse.		
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Use ethane, ethene and ethyne as examples in your re-	sponse.	4 3 2	eve
Jse ethane, ethene and ethyne as examples in your re-	sponse.	4 3	eve

4.

Unripe fruits often contain **citric acid** as shown below:

PERIODIC TABLE

Atomic number H H H H H H H H H		259	H	257	252	H	251	249	244	241	239 2	H	23	238	231	232	227		
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Atomic number 1		s	٣	Si	≥													βW	Na
Atomic number H		16	15	14														12	
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