MARKER CODE				



Student Personal Identification Number (SPIN)					

TONGA GOVERNMENT

MINISTRY OF EDUCATION AND TRAINING

Tonga National Form Seven Certificate

CHEMISTRY 2015

QUESTION and ANSWER BOOKLET

Time allowed: Three Hours

INSTRUCTIONS

- Write your Student Personal Identification Number (SPIN) on the top right hand corner of this booklet.
- 2. Answer ALL QUESTIONS. Write your answers in the spaces provided in this booklet.
- 3. If you need more space for answers, ask the Supervisor for extra paper. Write your SPIN on all extra sheets used and clearly number the questions. Attach the extra sheets at the appropriate places in this booklet.
- 4. Show all working. Unless otherwise stated, numerical answers correct to three significant figures will be adequate.

	QUESTION	Pages	Time (mins)	Total
QUESTION 1	Atomic structure, bonding & related properties	2-3	18	10
QUESTION 2	Organic chemistry	4-5	18	10
QUESTION 3	Energy changes in chemical and physical processes	6-7	18	10
QUESTION 4	Organic, oxidation and reduction reactions	8-9	18	10
QUESTION 5	Oxidation & reduction	10 -11	18	10
QUESTION 6	Equilibrium	12-14	18	10
QUESTION 7	Atomic structure and bonding	15-16	18	10
QUESTION 8	Organic chemistry	17-18	18	10
QUESTION 9	Atomic structure and bonding	19-20	18	10
QUESTION 10	Equilibrium	21-23	18	10
	TOTAL	23 pages	180 mins	100 Marks

Check that this booklet contains pages 2-27 in the correct order. Pages 24 and 26 have been deliberately left blank.

A periodic table has been provided at the end of this booklet (page 25).

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Question 1: Atomic Structure, Bonding & Related properties

10 Marks

a) Name the following complex ions:

i $[Zn(OH)4]^{2-}$

Skill level 1		
1		
0		
NR		

ii [Cu(NH3)4]²⁺

Skill level 1		
1		
0		
NR		

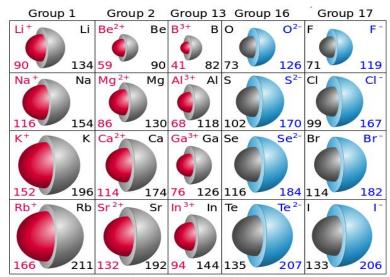
b) i Write the balanced chemical equation for the formation of the complex ion:

[Ag(NH3)2]+

Skill level 3		
3		
2		
1		
0		
NR		

ii Name the complex ion [Ag(NH₃)₂]⁺

Table 1: Trends in the sizes of some atoms and their ions.



Sizes of atoms and their ions (in pm)

Use **Table 1** above to:

i Explain the trend in size from Lithium atom (Li $^+$) to the Oxide ion (O 2 -).

Skill level 2		
2		
1		
0		
NR		

ii State the trend in the sizes of the ions of aluminium and explain this trend.

			-

3	
2	
1	
0	
NR	

Skill level 3

Question 2: Organic Chemistry

10 Marks

a) State the IUPAC name of the chloroalkane that has the following structural formula.



Skill level 1	
1	
0	
NR	

IUPAC name: _____

- b) **Propanone** is a ketone.
 - i. Write down the structural formula of a *functional isomer* of **propanone**.

ii. Explain your answer in i) above.

	Skill level 2	
	2	
	1	
	0	
	NR	

c) If a haloalkane such as 1-chloropropane is heated under reflux with a solution of sodium hydroxide, the chemical reaction shown below takes place:

1-chloropropane + NaOH \rightarrow substance A + NaCl

i. What is the chemical formula for substance A?

ii. What is the name given to the type of reaction happening above?

iii. Describe how the reaction in (ii) takes place.

Sk	Skill level 3		
	3		
	2		
	1		
	0		
ı	NR		

d) An important chemical reaction is shown below.

Reactant C

i.	Write the structural formula for Reactant B.	
ii.	Name Reactant C.	
iii.	What is the IUPAC name for the product CH ₃ CH ₂ CH ₂ COOCH ₂ CH ₃ ?	Sk

Skill level 4		
4		
3		
2		
1		
0		
NR		

iv. Name the type of reaction that takes place here.

Question 3: Energy Changes in chemical and Physical processes 10 Marks

Define the following terms:	
Heat of fusion	
	Skill I
	1
	0
	NR
Standard heat of reaction	
Standard fleat of reaction	Skill
	1
	0
	NR
In terms of a chemical reaction being endothermic or exothermic, which one occurs during the process of bond formation?	
one occurs during the process of bond formation:	Skill I
	1
	0

c) Use the bond enthalpies in **Table 2** to calculate the enthalpy change of the following reaction:

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

Table 2: Bond Enthalpies

Table of bond enthalpies / kJ mol ⁻¹		
C-C	348	
C-H	412	
C-O	360	
C=C	612	
C=O	743	
CI-CI	242	
O-H	463	
CI-H	431	
C-CI	338	
0=0	496	
Ref: CRC Handbook of chemistry and physics - Edition 44		

Skill level 3		
3		
2		
1		
0		
NR		

d) Use the given values for standard enthalpy of formation to calculate the standard enthalpy change for the reaction:

$$NH_3(g) + HCI(g) \rightarrow NH_4CI(s)$$

$$\Delta H_f (NH_3 (g)) = -46.1 \text{ kJ mol}^{-1}$$

 $\Delta H_f (HCl(g)) = -92.3 \text{ kJ mol}^{-1}$
 $\Delta H_f (NH_4Cl(s)) = -314.4 \text{ kJ mol}^{-1}$

Skill lev	vel 4
4	
3	
2	
1	
0	
NR	

Question 4: Organic, Oxidation and Reduction Reactions

10 Marks

a) Use the IUPAC naming system to name the following organic isomers.

CH ₃ -CH-CH ₂ -OH	
- 1 TO	
CH ₃	

i				
-		 	 	

i _____

Skill level 1				
1				
0				
NR				

Skill level 1				
1				
0				
NR				

iii

iv

1	Skill level 1	
0		
NR		

Skill level 1	
1	
0	
NR	

b) Polyethylene is a rubber-like substance, which is stretchable under force but returns to its original state upon release. Relate the structure and bonding of polyethylene to this property.

Skill le	vel 3
3	
2	
1	
0	
NR	

c) The diagram below demonstrates black tarnish on silver metal. It is known that the black tarnish is primarily Ag₂S.

By using the right reducing agent, the black tarnish (Ag₂S) can be removed as shown in the half-equation below:

$$Ag_2S(s) + 2e^- \rightarrow 2Ag(s) + S^{2-}(aq)$$

The standard reduction potentials for Zn and Ag₂S are shown below:

Half reaction	E° (V)
$Zn^{2+}(aq) + 2 e^{-} \rightleftharpoons Zn (s)$	- 0.7681
$Ag_2S(s) + 2e^{-} \implies 2Ag(s) + S^{2-}(aq)$	- 0.71

i. Determine the overall redox reaction for the possible reduction of Ag_2S by Zn metal.

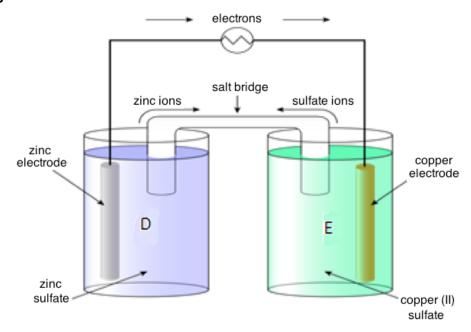
ii. Use the E° cell value to predict whether the above reaction is possible.

Skill level 3		
3		
2		
1		
0		
NR		

Question 5: Oxidation & Reduction

10 Marks

a) Figure 2: Redox



i. At which half-cell (D or E) does the **oxidation** reaction take place?

Skill le	vel 1
1	
0	
NR	

ii. At which half-cell (D or E) does the reduction reaction take place?

Skill level 1	
1	
0	
NR	

Chill Issuel 3

b) Write the **balanced half-equation** for the reaction in half-cell E.

Skill level 2		
2		
1		
0		
NR		

c) Describe the difference between an **electrochemical** and an **electrolytic** cell.

Skill level 2	
2	
1	
0	
NR	

d) The standard reduction potentials for selected half reactions are shown below:

Half reaction	E° (V)
$Sn^{2+}(aq) + 2e^{-} \rightleftharpoons Sn (s)$	- 0.14
Be ²⁺ + 2e ⁻	- 1.99

Predict whether the reaction below will occur spontaneously:

Sn (s) + Be²⁺ (aq)
$$\rightarrow$$
 Sn²⁺ (aq) + Be (s)

Skill level 4		
4		
3		
2		
1		
0		
NR		

Question 6: Equilibrium

10 Marks

What happens to the equilibrium constant (Kc) of a system	Skill level 1	
when the pressure is increased?	1	
	0	
	NR	
Explain how a buffer solution of CH ₃ COONH ₄ works when a		
Explain how a buffer solution of CH ₃ COONH ₄ works when a small amount of a strong acid is added to it.	Skill le	vel 2
·	Skill le	vel 2
·		vel 2
·	2	vel 2

Calculate the pH and the $[H_3O^+]$ of a buffer that is made up of 0.6M HNO ₂ and 0.75M of KNO ₂ . Ka = 7.1 x 10 ⁻⁴ .

Skill level 3			
3			
2			
1			
0			
NR			

d)	What is the concentration of silver ions in 1 L of solution
	containing 0.02 mol of AgCl and 0.02 mol of Cl-ions in the
	following equilibrium?

$$\mathsf{AgCI}\,(\mathsf{s}) \;\; \ \, \rightleftharpoons \quad \, \mathsf{Ag^+}\,(\mathsf{aq}) \;\; \mathsf{+}\;\; \mathsf{CI^-}\,(\mathsf{aq})$$

The equilibrium constant is 1.5 x 10 ⁻¹⁰			

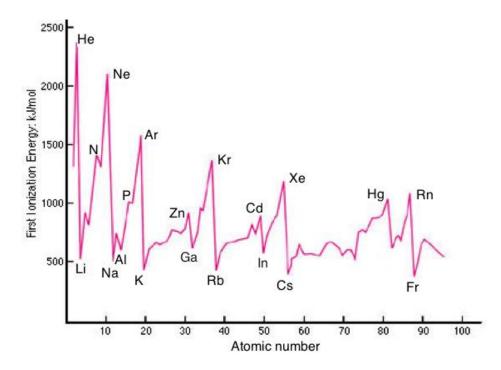
Skill level 4			
4			
3			
2			
1			
0			
NR			

Question 7: Atomic Structure and Bonding

10 Marks

vvnai c	does the high melting point of Ni suggests?	
		Skill
		1
		o
		NR
Descril	be the differences between nuclear fusion and nuclear fission.	
		Skill
		$ \begin{bmatrix} 1 \\ 0 \end{bmatrix}$
		NR
Determ	nine the shape of BF ₃ showing how you arrive at your answer.	
		Skill I
		3
		2
		1
		o
		<u> </u>

d) Figure 4: First Ionisation Energy of some elements from the periodic table.



Explain why the first ionization of He, Ne and Ar differs from those of Li, Na, K and Al.

Skill level 4				
4				
3				
2				
1				
0				
NR				

Question 8: Organic Chemistry

10 Marks

a) i Write down the structural formula of the missing product (F) of the following reaction.

SOCI ₂	+	H_C_C_C_H	→	
_		Ĭ Н ОН		F

Skill le	vel 2
2	
1	
0	
NR	

ii What precaution that needs to be taken during this reaction?

Skill level 1		
1		
0		
NR		

b) Use the following reactions to identify the unknown compounds **G** and **H**.

Reaction 1:

Reaction 2:

H₃C
$$C=O$$
 + LiAlH₄ \longrightarrow Compound H

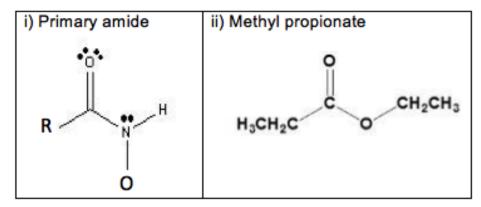
Write the structural formulae of G and H.

G:

H:

Skill lev	vel 3
3	
2	
1	
0	
NR	

c) You have been asked to review a chapter of an organic textbook. A sample of the structural formulae and names of the chemicals is presented below.



Would you approve for the chapter to be printed? Justify your decision. Write your answer in the space below.

-	

Skill level 4	
4	
3	
2	
1	
0	
NR	

Question 9: Atomic Structure and Bonding

a)

There are 6 fundamental nuclear decay reactions.

10 Marks

	:\	Name the nuclear decay that regults in the emission of a belium stam		
	i)	Name the nuclear decay that results in the emission of a helium atom.	Skill le	vel 1
			1	
			0	
			NR	
	ii)	Name the nuclear decay that results in the conversion of a neutron to a		
		proton and a high energy electron is emitted.	Skill le	vel 1
			1	
			0	
			NR	
	iii)	Define enthalpy change.		
			Skill lev	el 1
			1	
			0	
			NR	
b)		One of the characteristic properties of transition metals are the differences in colour of their compounds. Describe the colour differences of the following compounds of transition metals: K2Cr2O7, NiCl2 and CuSO4		
			Skill le	vel 2
			2	
			1	
			0	<u> </u>
			NR	1

escribe the relationship between a polar molecule such as vydrogen bonding.	vater and
	Skill
	2
	1
	0
	NR
adioactive lodine-131 is used in the Hospitals in the treatment ancerous thyroid tissues. Iodine-131 has a half-life of 8 days foldine-131 is given to a patient how much of it is left after 3	. If 20 mg
	Ski
	3
	3
	3

Question 10: Equilibrium

10 Marks

a) Define buffer solution.

Skill level 1	
1	
0	
NR	

b) Consider the following reaction:

 $PCI_3(g) + CI_2(g) \rightleftharpoons PCI_5(g)$

Describe how the equilibrium position will be affected by an increase in the PCl_3 concentration.

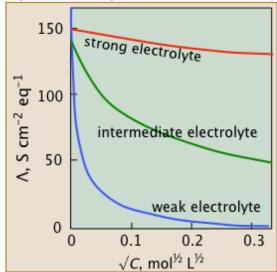
 ·		

Skill level 2						
2						
1						
0						
NR						

What concentration of Ag ⁺ ion will be in equilibrium with a saturated solution of AgCrO ₄ and CrO ₄ ²⁻ ion concentration of 0.4 molL ⁻¹ . Ksp of AgCrO ₄ is 1.1 x 10 ⁻¹¹ .				
AgCrO₄ is 1.1 x 10 ⁻¹¹ .				
		Skill l	ε	е
		3	_	_
	.	2	_	
		0		
		NR	_	_

d) Compare the conductance and pH of KCl, NH₃, and CH₃COONa to those of the strong, intermediate and weak ones shown in **Figure 4** below. In your answer, explain why KCl, NH₃, and CH₃COONa are considered as either a strong, intermediate or weak electrolyte.

Figure 4: Strength of Different Electrolytes.



Skill level 4					
4					
3					
2					
1					
0					
NR					

THIS PAGE HAS BEEN DELIBERATELY LEFT BLANK.

The periodic table:

hydrogen	8 8 70		1073	85%	2876	5	656	5	953	7/51	550	1000	921	765	\$150	70	55	helium 2
Ĥ																		Н́е
1.0079																		4.0026
lithium	beryllium												boron	carbon	nitrogen	oxygen	fluorine	neon
3	4												5	6	1	8	9	10
Li	Be												В	C	N	0	F	Ne
6.941	9,0122												10.811	12.011	14.007	15,999	18.998	20.180
sodium 11	magnesium 12												aluminium 13	silicon 14	phosphorus 15	sulfur 16	chlorine 17	argon 18
													- 223	028		992.0		
Na	Mg												AI	Si	Р	S	CI	Ar
22.990	24.305		F	William Co.		1		7	- Constant	I service	r	10/000	26.982	28,086	30.974	32.065	35.453	39.948
potassium 19	calcium 20		scandium 21	titanium 22	vanadium 23	chromium 24	manganese 25	iron 26	cobalt 27	nickel 28	copper 29	zinc 30	gallium 31	germanium 32	arsenic 33	selenium 34	bromine 35	krypton 36
															_			
					\ \ /	C	N/II									C		
K	Ca		Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
39.098	40.078		44.956	47.867	50.942	51.996	54.938	55.845	58.933	58.693	63.546	65.39	69.723	72.61	74.922	78.96	79.904	83.80
39.098 rubidium	40.078 strontium		44.956 yttrium	47.867 zirconium	50.942 niobium	51.996 molybdenum	54.938 technetium	55,845 ruthenium	58,933 rhodium	58,693 palladium	63,546 silver	65,39 cadmium	69.723 indium	72.61 tin	74.922 antimony	78.96 tellurium	79.904 iodine	83.80 xenon
39,098 rubidium 37	40.078 strontium 38		44.956 yttrium 39	47.867 zirconium 40	50.942 niobium 41	51.996 molybdenum 42	54.938 technetium 43	55,845 ruthenium 44	58.933 rhodium 45	58.693 palladium 46	63,546 silver 47	65,39 cadmium 48	69.723 indium 49	72.61 tin 50	74.922 antimony 51	78.96 tellurium 52	79.904	83.80 xenon 54
39.098 rubidium 37 Rb	40.078 strontium 38 Sr		44.956 yttrium 39	47.867 zirconium	50,942 niobium 41 Nb	51,996 molybdenum 42 Mo	54.938 technetium	55.845 ruthenium 44 Ru	58,933 rhodium	58,693 palladium	63,546 silver	65,39 cadmium	69.723 indium	72.61 tin	74.922 antimony	78.96 tellurium	79.904 iodine	83.80 xenon 54 Xe
39.098 rubidium 37 Rb 85.468	40.078 strontium 38 Sr 87.62		44.956 yttrium 39 Y 88.906	47.867 zirconium 40 Zr 91.224	50,942 niobium 41 Nb 92,906	51.996 molybdenum 42 Mo 95.94	54.938 technetium 43 Tc [98]	55.845 ruthenium 44 Ru 101.07	58.933 rhoclium 45 Rh 102.91	58.693 palladium 46 Pd 106.42	63,546 silver 47 Ag 107,87	65.39 cadmium 48 Cd 112.41	69.723 indium 49 In 114.82	72.61 tin 50 Sn	74.922 antimony 51 Sb 121.76	78.96 tellurium 52 Te 127.60	79.904 lodine 53	83.80 xenon 54 Xe 131.29
39.098 rubidium 37 Rb 85.468 caesium	40.078 strontium 38 Sr 87.62 barium	57-70	44.956 yttrium 39 Y 88.906 lutetium	47.867 zirconium 40 Zr 91.224 hafnium	50.942 niobium 41 Nb 92.906 tantalum	51.996 molybdenum 42 Mo 95.94 tungsten	54.938 technetium 43 TC [98] rhenium	ruthenium 44 Ru 101.07 osmium	58.933 rhodium 45 Rh 102.91 iridium	58.693 palladium 46 Pd 106.42 platinum	63,546 silver 47 Ag	65.39 cadmium 48 Cd 112.41 mercury	69.723 indium 49 In 114.82 thallium	72.61 tin 50 Sn 118.71 lead	74.922 antimony 51 Sb 121.76 bismuth	78.96 tellurium 52 Te 127.60 polonium	79.904 iodine 53 126.90 astatine	83.80 xenon 54 Xe 131.29 radon
39,098 rubidium 37 Rb 85,468 caesium 55	40.078 strontium 38 Sr 87.62 barium 56	57-70 ×	44.956 yttrium 39 Y 88.906 lutetium 71	47.867 zirconium 40 Zr 91.224 hafnium 72	50.942 niobium 41 Nb 92.906 tantalum 73	51.996 molybdenum 42 Mo 95.94 tungsten 74	54,938 technetium 43 TC [98] rhenium 75	55,845 ruthenium 44 Ru 101.07 osmium 76	58.933 rhodium 45 Rh 102.91 iridium 77	58.693 palladium 46 Pd 106.42 platinum 78	63.546 silver 47 Ag 107.87 gold 79	65,39 cadmium 48 Cd 112,41 mercury 80	69.723 indium 49 In 114.82	72.61 tin 50 Sn 118.71 lead 82	74.922 antimony 51 Sb 121.76 bismuth 83	78.96 tellurium 52 Te 127.60 polonium 84	79.904 iodine 53 126.90 astatine 85	83,80 xenon 54 Xe 131,29 radon 86
39.098 rubidium 37 Rb 85.468 caesium 55 Cs	strontium 38 Sr 87.62 barium 56 Ba	57-70 ★	44.956 yttrium 39 Y 88.906 lutetium 71 Lu	47.867 zirconium 40 Zr 91.224 hafnium 72 Hf	50.942 nlobium 41 Nb 92.906 tantalum 73 Ta	51.996 molybdenum 42 Mo 95.94 tungsten 74 W	technetium 43 Tc [98] rhenium 75 Re	ruthenium 44 Ru 101.07 osmium 76 Os	58,933 rhodium 45 Rh 102,91 indium 77 Ir	palladium 46 Pd 106.42 platinum 78 Pt	63.546 silver 47 Ag 107.87 gold 79 Au	cadmium 48 Cd 112.41 mercury 80 Hg	69,723 indium 49 In 114.82 thailium 81	72.61 tin 50 Sn 118.71 lead 82 Pb	74.922 antimony 51 Sb 121.76 bismuth 83 Bi	78.96 tellurium 52 Te 127.60 polonium 84 Po	79,904 iodine 53 126,90 astatine 85 At	83.80 xenon 54 Xe 131.29 radon 86 Rn
39,098 rubidium 37 Rb 85,468 caesium 55 Cs 132,91	40.078 strontium 38 Sr 87.62 barium 56 Ba 137.33		44,956 yttrium 39 Y 88,906 lutetium 71 Lu 174,97	47.867 zirconium 40 Zr 91.224 hafnium 72 Hf 178.49	50,942 niobium 41 Nb 92,906 tantalum 73 Ta 180,95	51.996 molybdenum 42 Mo 95.94 tungsten 74 W	54.938 technetium 43 TC [98] rhenium 75 Re 186.21	55,845 ruthenium 44 Ru 101.07 osmium 76 Os 190.23	58,933 rhodium 45 Rh 102,91 iridium 77 Ir 192,22	58,693 palladium 46 Pd 106.42 platinum 78 Pt 195.08	63,546 silver 47 Ag 107,87 gold 79 Au 196,97	65.39 cadmium 48 Cd 112.41 mercury 80 Hg 200.59	69.723 indium 49 In 114.82 thallium	72.61 tin 50 Sn 118.71 lead 82 Pb 207.2	74.922 antimony 51 Sb 121.76 bismuth 83	78.96 tellurium 52 Te 127.60 polonium 84	79.904 iodine 53 126.90 astatine 85	83,80 xenon 54 Xe 131,29 radon 86
39.098 rubidium 37 Rb 85.468 caesium 55 Cs 132.91 francium	40.078 strontium 38 Sr 87.62 barium 56 Ba 137.33 radium		44,956 yttrium 39 Y 88,906 lutetium 71 Lu 174,97 lawrencium	47.867 zirconium 40 Zr 91.224 hafnium 72 Hf 178.49 rutherfordium	50,942 niobium 41 Nb 92,906 tantalum 73 Ta 180,95 dubnium	51.996 molybdenum 42 Mo 95.94 tungsten 74 W 183.84 seaborgium	technetium 43 TC [98] rhenium 75 Re 186.21 bohrium	ruthenium 44 Ru 101.07 osmium 76 Os	58,933 rhodium 45 Rh 102,91 indium 77 Ir	palladium 46 Pd 106.42 platinum 78 Pt	63.546 silver 47 Ag 107.87 gold 79 Au	65.39 cadmium 48 Cd 112.41 mercury 80 Hg 200.59 ununbium	69,723 indium 49 In 114.82 thailium 81	72.61 tin 50 Sn 118.71 lead 82 Pb 207.2 ununquadium	74.922 antimony 51 Sb 121.76 bismuth 83 Bi	78.96 tellurium 52 Te 127.60 polonium 84 Po	79,904 iodine 53 126,90 astatine 85 At	83.80 xenon 54 Xe 131.29 radon 86 Rn
39.098 rubidium 37 Rb 85.468 caesium 55 Cs 132.91 francium 87	40.078 strontium 38 Sr 87.62 barium 56 Ba 137.33 radium 88	× 89-102	44,956 yttrium 39 Y 88,906 lutetium 71 Lu 174,97 lawrencium 103	47.867 zirconium 40 Zr 91.224 hafnium 72 Hf 178.49 rutherfordium 104	50,942 niobium 41 Nb 92,906 tantalum 73 Ta 180,95 dubnium 105	51.996 molybdenum 42 Mo 95.94 tungsten 74 W 183.84 seaborgium 106	technetium 43 TC [98] rhenium 75 Re 186.21 bohrlum 107	55,845 ruthenium 44 Ru 101.07 osmium 76 OS 190.23 hassium 108	58,933 rhodium 45 Rh 102,91 iridium 77 Ir 192,22 meitnerium 109	58,693 palladium 46 Pd 106,42 platinum 78 Pt 195,08 ununnilium 110	63,546 silver 47 Ag 107,87 gold 79 Au 196,97 unununium 111	65.39 cadmium 48 Cd 112.41 mercury 80 Hg 200.59 ununbium 112	69,723 indium 49 In 114.82 thailium 81	72.61 tin 50 Sn 118.71 lead 82 Pb 207.2 ununquadium 114	74.922 antimony 51 Sb 121.76 bismuth 83 Bi	78.96 tellurium 52 Te 127.60 polonium 84 Po	79,904 iodine 53 126,90 astatine 85 At	83.80 xenon 54 Xe 131.29 radon 86 Rn
39.098 rubidium 37 Rb 85.468 caesium 55 Cs 132.91 francium	40.078 strontium 38 Sr 87.62 barium 56 Ba 137.33 radium	*	44,956 yttrium 39 Y 88,906 lutetium 71 Lu 174,97 lawrencium	47.867 zirconium 40 Zr 91.224 hafnium 72 Hf 178.49 rutherfordium	50,942 niobium 41 Nb 92,906 tantalum 73 Ta 180,95 dubnium	51.996 molybdenum 42 Mo 95.94 tungsten 74 W 183.84 seaborgium	technetium 43 TC [98] rhenium 75 Re 186.21 bohrium	55,845 ruthenium 44 Ru 101.07 osmium 76 Os 190.23 hassium	58,933 rhodium 45 Rh 102.91 iridium 77 Ir 192.22 meitnerium	58,693 palladium 46 Pd 106,42 platinum 78 Pt 195,08 ununnilium 110	63,546 silver 47 Ag 107,87 gold 79 Au 196,97 unununium	65.39 cadmium 48 Cd 112.41 mercury 80 Hg 200.59 ununbium 112	69,723 indium 49 In 114.82 thailium 81	72.61 tin 50 Sn 118.71 lead 82 Pb 207.2 ununquadium	74.922 antimony 51 Sb 121.76 bismuth 83 Bi	78.96 tellurium 52 Te 127.60 polonium 84 Po	79,904 iodine 53 126,90 astatine 85 At	83.80 xenon 54 Xe 131.29 radon 86 Rn

*Lanthanide series

**Actinide series

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

THIS PAGE HAS BEEN DELIBERATELY LEFT BLANK.

Student Personal Identification Number (SPIN)									

Tonga National Form Seven Certificate 2015

CHEMISTRY

(For Markers Use Only)

QUESTIONS	MARK	CHECK MARKER	TOTAL
1			10
2			10
3			10
4			10
5			10
6			10
7			10
8			10
9			10
10			10
TOTAL MARKS			100