MARKER CODE

Student Personal Identification Number

South Pacific Form Seven Certificate

CHEMISTRY

2017

QUESTION and ANSWER BOOKLET

Time allowed: Three hours

(An extra 10 minutes is allowed for reading this paper.)

INSTRUCTIONS

Write your **Student Personal Identification Number (SPIN)** in the space provided on the top right hand corner of this page.

Answer **ALL QUESTIONS**. Write your answers in the spaces provided in this booklet.

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.

Major Learning Outcomes (Achievement Standards)	Skill Level & Number of Questions				Weight/ Time
	Level 1 *Uni-structural*	Level 2 *Multi-structural*	Level 3 *Relational*	Level 4 *Extended Abstract*	
Strand 1: Atomic Structure, Bonding and Related Properties Interpret information about selected properties of elements and compounds in relation to atomic structure	**8**	**5**	**1**	**1**	25% 64 min
Strand 2: Energy Changes in Chemical and Physical Processes Use thermochemical data to determine energy changes in chemical and physical processes	**3**	**2**	-	**1**	11% 28 min
Strand 3: Aqueous Equilibrium Systems Relate the properties of aqueous solutions to the nature and concentration of dissolved species	**3**	**2**	**1**	-	10% 26 min
Strand 4: Oxidation – Reduction Reactions Apply oxidation-reduction principles to electrochemical cells and compare the relative strength of oxidants and reductants and deduce the direction of spontaneous reactions	**2**	**2**	**1**	-	9% 23 min
Strand 5: Organic Chemistry Use information about the structure and reactions of organic molecules to solve problems in organic chemistry	**3**	**1**	**2**	**1**	15% 39 min
TOTAL	**19**	**12**	**5**	**3**	**70% 180 min**

Check that this booklet contains pages 2-14 in the correct order and that none of these pages is blank.

HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION

STRAND 1: ATOMIC STRUCTURE AND BONDING AND RELATED PROPERTIES

Assessor's use only

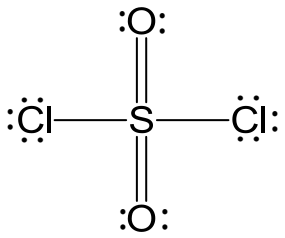
1.1a	Define **electron configuration**. _____ _____	**Unistructural** 1 0 NR
1.1b	Write the electron configuration using *s, p* and *d* notation for the following: Se _____ Zn^{2+} _____	**Multistructural** 2 1 0 NR
1.2a	Describe how 'electronegativity' changes across the period from Si to Cl. _____ _____ _____	**Multistructural** 2 1 0 NR
1.2b	Methane, CH_4, ammonia, NH_3, and water, H_2O have the same number of valence electrons and all form intramolecular covalent bonds. Discuss the factors and relationships that result in methane having the lowest boiling point and water having the highest boiling point. _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	**Extended Abstract** 4 3 2 1 0 NR

Assessor's use only

1.3 Draw the Lewis structure of phosphorus oxychloride, $POCl_3$, in the box below. P is the central atom.

Relational	
3	
2	
1	
0	
NR	

1.4a The Lewis structure for the molecule SO_2Cl_2 (Sulphuryl Chloride) is given below.



State the shape of SO_2Cl_2

Unistructural	
1	
0	
NR	

1.4b Identify the type of intermolecular force that holds the molecules together in the liquid.

Unistructural	
1	
0	
NR	

1.5a The ionization energy of an atom increases as the number of valence electrons increase.

Write the electron configuration using *s, p* and *d* notation for N and O.

N _____

O _____

Unistructural	
1	
0	
NR	

1.5b Describe the difference between ionisation energy and valence electrons of nitrogen and oxygen atoms.

Multistructural	
2	
1	
0	
NR	

Assessor's use only

1.6a	Define **nuclear fusion**. _____ _____	**Unistructural** 1 0 NR
1.6b	Uranium is a radioactive element. Name the radioactive particles given out by uranium as shown in the equation given below. $^{238}_{92}U \longrightarrow {}^{234}_{90}Th + X$ Name: _____	**Unistructural** 1 0 NR
1.6c	Describe the properties of radioactive particles. _____ _____ _____ _____	**Multistructural** 2 1 0 NR
1.7a	When an excess amount of aqueous solution of ammonia, NH_4OH, is added to a clear blue solution of copper sulphate, $CuSO_4$, a complex ion is formed. Name this complex ion. _____	**Unistructural** 1 0 NR
1.7b	Write the balanced equation for this reaction in Question 1.7a. _____	**Multistructural** 2 1 0 NR
1.8	Name the transition metal complex ion given below: $[FeSCN]^{2+}$ _____	**Unistructural** 1 0 NR

STRAND 2: ENERGY CHANGES IN CHEMICAL AND PHYSICAL PROCESSES

Assessor's use only

2.1	Define **Ionisation Enthalpy**. _____ _____	**Unistructural** 1 0 NR
2.2	State a factor that determines the ionization enthalpy of an atom. _____ _____	**Unistructural** 1 0 NR
2.3	Name the enthalpy change at constant pressure, and give the symbol, for the process shown below: $H_2O_{(s)} \longrightarrow H_2O_{(l)}$ _____	**Unistructural** 1 0 NR
2.4	Write a thermochemical equation to represent the enthalpy of formation of ammonia as -46 kJ mol^{-1}. _____ _____ _____	**Multistructural** 2 1 0 NR
2.5	Calculate the enthalpy change when 100cm^3 of water raises its temperature from 27°C to 52°C. Specific heat capacity of water is 4.2Jg^{-1} °C _____ _____ _____ _____	**Multistructural** 2 1 0 NR

Assessor's use only

2.6 Ethanol is a fuel that is easily handled and burns cleanly, because it produces less carbon monoxide.

Calculate the enthalpy change in the reaction for the combustion of ethanol, C_2H_5OH.

$$C_2H_5OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(l)$$

Use the thermochemical equations and data below.

$$2C(s) + 3H_2(g) + \tfrac{1}{2} O_2(g) \longrightarrow C_2H_5OH(l) \quad \Delta_f H = -278 \text{ kJmol}^{-1}$$

$$C(s) + O_2(g) \longrightarrow CO_2(g) \quad \Delta_f H = -394 \text{ kJmol}^{-1}$$

$$H_2(g) + \tfrac{1}{2} O_2(g) \longrightarrow H_2O(g) \quad \Delta_f H = -286 \text{ kJmol}^{-1}$$

Extended Abstract	
4	
3	
2	
1	
0	
NR	

STRAND 3: AQUEOUS EQUILIBRIUM SYSTEMS

Assessor's use only

3.1a

In human beings, one buffer system in blood involves the hydrogen carbonate ion, HCO_3^{-1}, and carbonic acid, H_2CO_3, which is formed when carbon dioxide dissolves in water.

Define '**buffer solution**'.

Unistructural	
1	
0	
NR	

3.1b

Calculate the pH of blood which contains a composition of 0.001 mol l^{-1} H_2CO_3 and 0.0117 mol l^{-1} HCO_3^{-1} molar concentration.

$Ka\ (H_2CO_3) = 4.5 \times 10^{-7}$

Multistructural	
2	
1	
0	
NR	

3.1c

Explain using equations how the buffer in human blood maintains its pH, even when small amounts of acid enter the bloodstream.

Relational	
3	
2	
1	
0	
NR	

Assessor's use only

A solution of vinegar contains the weak acid, ethanoic acid (CH_3COOH). The equation for the dissociation of ethanoic acid at equilibrium is

$$CH_3COOH(l) + H_2O(aq) \rightleftharpoons CH_3COO^{-1}(aq) + H_3O^{+}(aq)$$

3.2a Write the expression for the equilibrium constant, K_a, of ethanoic acid.

Unistructural	
1	
0	
NR	

3.2b If the K_a value of ethanoic acid is 1.74×10^{-5}, determine the relative equilibrium concentrations of a 0.1 mol l^{-1} ethanoic acid sample.

Multistructural	
2	
1	
0	
NR	

3.2c State the effect of an increase in the concentration of ethanoic acid on the value of the equilibrium constant, K_a.

Unistructural	
1	
0	
NR	

STRAND 4: OXIDATION-REDUCTION REACTIONS

Assessor's use only

Use the information below to answer Questions 4.1a - 4.1c

The Daniell Cell is an example of a galvanic cell. It is set up with two half-cells linked with a salt bridge. The equation for each half cell is:

$Cu^{2+}(aq) + 2e \rightarrow Cu(s)$ $\quad E^o = 0.34$ V

$Zn^{2+}(aq) + 2e \rightarrow Zn(s)$ $\quad E^o = -0.76$ V

The following chemicals are used to construct the Daniell Cell:

Copper (Cu) and Zinc (Zn) electrodes

0.1 mol L^{-1} solutions of $CuSO_4$ and $ZnSO_4$

4.1a Define **galvanic cell**.

Unistructural	
1	
0	
NR	

4.1b Write the cell notation for the Daniell Cell mentioned above.

Multistructural	
2	
1	
0	
NR	

4.1c In a Daniell Cell, electrons flow from zinc to copper. Give a reason for this.

Unistructural	
1	
0	
NR	

Assessor's use only

A lead-acid battery in a car provides electric energy for its needs. The two half –cells of this battery are given below.

$PbO_2(s) + 4H^+(aq) + O_4^{2-}(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$ $E^o = 1.69V$

$PbSO_4(s) + 2e^- \rightarrow Pb(s) + SO_4^{2-}(aq)$ $E^o = -0.36V$

4.2 Using the information above, explain whether the reaction is spontaneous or not.

Relational	
3	
2	
1	
0	
NR	

4.3 Some batteries can be recharged by having their spontaneous reaction reversed. While a battery is delivering current, it is an **electrochemical cell**. While a battery is being recharged, it behaves as an **electrolytic cell**.

Describe **two** differences between an electrochemical cell and an electrolytic cell.

Multistructural	
2	
1	
0	
NR	

STRAND 5: ORGANIC CHEMISTRY

Assessor's use only

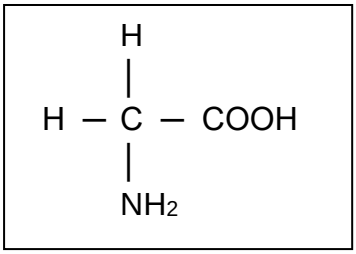
Use the information below to answer Questions 5.1a - 5.1c

Polymers exist both in natural and synthetic forms, and have revolutionized the production of consumer goods.

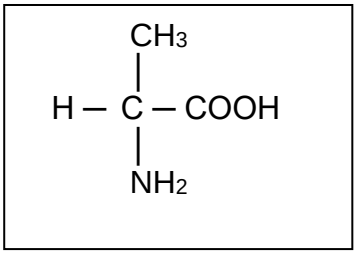
Proteins are a natural polymer formed from amino acids.

Below are two monomers that, when combined, form a section of a single protein chain.

i.



ii.



5.1a In the space provided, draw a section of the polymer formed when the above two monomers are combined.

Multistructural	
2	
1	
0	
NR	

5.1b Use the diagram you have drawn in Question 5.1a to name the functional group formed as a result of the combination.

Name:_____

Unistructural	
1	
0	
NR	

5.1c A protein molecule could be described as a condensation polymer.

Define **condensation polymer**.

_____

_____

_____

Unistructural	
1	
0	
NR	

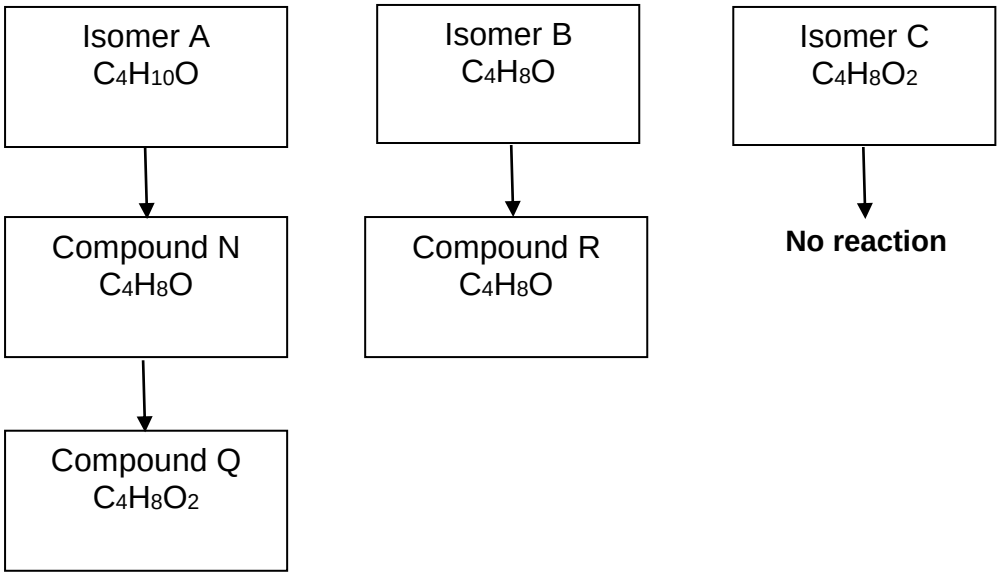
Assessor's use only

Use the information below to answer Questions 5.2a - 5.2c

Alcohols with the molecular formulae, $C_4H_{10}O$ exist as several structural isomers. Each isomer reacts differently with the same reagent under the same special conditions.

The reaction sequence and molecular formula of the products are given below.

Reagent: Warm acidified potassium dichromate solution



5.2a Draw the structural formula, and state the IUPAC names of Isomers **A** and **B**.

Isomer A

Name A_____

Isomer B

Name B: _____

Relational	
3	
2	
1	
0	
NR	

Assessor's use only

5.2b	State the visible evidence that indicates that the reaction was an oxidation reaction. _____ _____ _____ _____	**Unistructural** 1 0 NR
5.2c	Identify, with an explanation, the isomer that is optically active. _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	**Relational** 3 2 1 0 NR

Assessor's use only

5.3 Chlorofluorocarbons (CFCs) are a current topic of concern for environmentalists. Many are substituted methane, ethane and propane compounds.

Name **two** examples of CFCs, and discus their formation and uses, providing suitable balanced equations with necessary conditions where appropriate. In your discussion include the reasons for their use and any negative impact that they can have on the environment.

Two examples of CFCs:

i. _____

ii. _____

Discussion on the formation and uses of CFCs:

Extended Abstract	
4	
3	
2	
1	
0	
NR	

THE END