Module Title: General and Inorganic Chemistry

Module Code:	CHEM6002
School:	Science
Course:	Bachelor of Science in Applied Biosciences & Biotechnology
	Bachelor of Science (Honours) in Herbal Science
	BSc (Hons) Nutrition & Health Science
	BSc (Hons) in Biomedical Science
	BSc in Applied Physics & Instrumentation
	BSc (Honours) in Instrument Engineering
	BSc in Analytical & Pharmaceutical Chemistry
	BSc (Hons) in Analytical Chemistry with Quality Assurance
	BSc (Hons) in Environmental Science & Sustainable Technology

Programme Code:	SBISC-8-Y1
	SBIOS-7-Y1
	SHERB-8-Y1
	SNHSC-8-Y1
	SPHBI-8-Y1
	SPHYS-7-Y1
	SINEN-8-Y1
	SCHEM-7-Y1
	SCHQA-8-Y1
	SESST-8-Y1

External Examiner(s):	Dr. C. Roche.
Internal Examiner(s):	Dr. R. Hourihane, Dr. L. Goold, Dr. M. Lehane
	Ms. C. Griffin.

Instructions:	Attempt 3 three questions.
	Attempt both Sections A and B.
	Show all calculations in the answer book.
Duration:	2 Hours
Sitting:	Autumn 2012

Requirements for this examination:

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you have received the correct examination paper.
If in doubt please contact an Invigilator.

Useful Constants

$R = 8.31 Jmol^{-1}K^{-1}, 0.0821 Latm\ mol^{-1}\ K^{-1}$

Section A

Q1.   Attempt any **10** of the following. All carry equal marks.

(a) Define (i) Mass Number (ii) Atomic Number. Give examples from the periodic table.

(b) Chlorine has two naturally occurring <u>isotopes</u>; $Cl^{35}_{17,}$ which has an <u>abundance</u> of 75.77% and an isotopic mass of 34.969 amu and $Cl^{37}_{17,}$ with an abundance of 24.23% and an <u>isotopic mass</u> of 36.966 amu. What is the atomic mass of Cl?

(c) Explain the underlined terms in part (b) above.

(d) Explain the trend in atomic radius going across a period and down a group in the periodic table?

(e) Name and arrange in order of increasing strength, the different types of intermolecular forces that occur between molecules.

(f) High electrical and thermal conductivity are two of the properties of Alkali metals. Explain these properties, diagrams required.

(g) List three differences between ionic and covalent bonds? Supplement your answer with examples.

(h) What is meant when we say that the half-life of iron-59 is 44.5 days? Give the relationship between a half-life and decay constant.

(i) Define Charles law, in words and by equation.

(j) Complete and balance the following nuclear equations

$$a.\quad ^{126}_{50}Sn \rightarrow\ ^{O}_{-1}e\ \ +\ \ ?$$

$$b.\quad ^{210}_{88}Ra\ \rightarrow\ ^{4}_{2}He\ \ +\ \ ?$$

(k) Define what is meant by the term mole of a chemical substance?

(l) Calculate the concentration in $moldm^{-3}$ of $HClO_4$ when 25g of the solid salt is dissolved in $250cm^3$ of water.

(m) Calculate the number of moles of a 0.1 $moldm^{-3}$ solution of CH_3COOH used in the titration when a $25cm^3$ aliquot is dispensed.   (40 marks)

Section B

Attempt any **2** of the following **3** questions

Q2. (a) Water can exist in any of three physical states. Describe each of these states at the molecular level and indicate the 2 physical conditions which allow these states to interconvert. (5 marks)

(b) State Boyles Law, illustrate it graphically. (5 marks)

(c) Write the equation of state for an ideal gas. Use the equation to demonstrate that the value of the ideal gas constant, R is $8.31 Jmol^{-1}K^{-1}$ from the following information:-

(i) 1 mole of any gas has a volume of .0224 m^3 at STP

(ii) STP = 273K and $1.013 \times 10^5 Nm^{-2}$

(iii) J=Nm (10 marks)

(d) Chlorophyll, the green pigment in leaves, has the chemical formula $C_{55}H_{72}MgN_4O_5$. A sample of chlorophyll was found to contain 0.0022g of Mg. Calculate the mass(g) of the sample of chlorophyll. (10 marks)

Q3. (a) (i) What are quantum numbers? What does each one specify?

(ii) Give all possible quantum numbers associated with the L shell (n=2 level)

(10 marks)

(b) The ground state electron configuration of any multi electron atom is written by following a series of 3 rules.

(i) Define these rules. (10 marks)

(ii) Applying these rules, give the expected ground state electron configuration for the following elements; N^7; Cr^{24}. In each case illustrate the orbital occupancy of the valance shell. (10 marks)

Q4. (a) Use the 'octet rule' to describe (i) the ionic bonding between Al and O in aluminium oxide and (ii) the covalent bonding between H and O in water. In

each case, give the correct chemical formula for the compound based on your description of the bonding. (8 marks)

(b) Define the term 'electronegativity of an element'. Explain how differences in the electronegativity of 2 elements can be used to (i)predict whether the bonding between the elements will be essentially ionic or essentially covalent and (ii) explain the polarity of a covalent bond formed between the elements.

(6 marks)

(c) Compare the physical properties of ionic and covalent compounds.

(8 marks)

(d) What is hydrogen bonding? Briefly explain how hydrogen bonding affects the boiling point of compounds whose molecules hydrogen bond compared with compounds that have a similar molecular weight but whose molecules do not hydrogen bond. (4 marks)

(e) Define the term 'ionization potential of an element' and briefly discuss the significance of the screening effect in explaining the trend in ionization potential values of elements in a group in the periodic table.

(4 marks)