CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Semester 1 Examinations 2010

Module Title: General & Inorganic Chemistry C/A

Module Code: CHEM 6002

School: School of Science

Programme Title: **Bachelor of Science in Applied Biosciences**
Bachelor of Science in Herbal Science
BSc Hons Nutrition & Health Science
BSc Hons in Biomedical Science
BSc Hons in Pharmaceutical Biotechnology
BSc in Applied Physics & Instrumentation

Programme Code: **SBISC-8-Y1**
SBIOS-7-Y1
SHERB-8-Y1
SNHSC-8-Y1
SPHBI-8-Y1
SPHYS-7-Y1

External Examiner(s): **Dr. G. Keavney.**
Internal Examiner(s): **Dr. R. Hourihane, Dr. L. Goold, Dr. B. Doyle, Mr. D. Spicer**

Instructions: **Attempt All 3 Questions**

Duration: 2 Hours

Sitting: Autumn 2010

Requirements for this examination: Periodic table

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.

Section A

Useful constants: R = 8.31Jmol^{-1}K^{-1}, 0.0821Latm mol^{-1} K $^{-1}$

Q1. Attempt **8** of the following **12** parts.

(i) Predict the trends in the following properties: phase, density, atomic radius and ionisation potential for the halogens, (group VII).

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

(iii) Which sample contains more molecules, 15.0 L of steam (H_2O g) at 123.0 ^oC and 0.93 atm pressure or 10.5 g ice cubes at -5.0 ^oC.

(iv) Explain how electronegativity values may be used to determine bond polarity. Hence or otherwise, indicate which of the following bonds are polar, and why?

B ----- Cl; Cl ----- Cl.

(v) Identify the four quantum numbers by name, symbol and possible values.

(vi) State what is meant by each of the following atomic properties. Identify and explain briefly the trends of each property across a period and down a group in the periodic table? (i) Atomic Radius, (ii) Ionisation Energy, and (iii) Electron Affinity.

(vii) Define hybridisation. Taking carbon as an example apply the method and generate any of the hybrid orbitals.

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

(ix) Complete and balance the following nuclear equations

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

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

(x) Use Valence Shell Electron Pair Repulsion (VSEPR) Theory to predict the shape of the water, H_2O, molecule.

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

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

Section B

Q2. (a) Explain the following properties of an element:- (i) atomic number (ii) mass number and (iii) isotopes.

(b) Boron (B) has 2 isotopes, $^{10}_{5}\mathbf{B}$ and $^{11}_{5}\mathbf{B}$. The relative abundance of each is 18.7% and 81.3% respec. Calculate the relative atomic mass of boron.

(c) Explain what an atomic orbital is and give the orbital electronic configuration of the element chlorine (Cl) which has an atomic number of 17.

(d) Compare and contrast the physical properties of ionic and covalent compounds and, where appropriate, account for differences in properties on the basis of bonding in these 2 types of compound. (30 marks)

Q3. (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.

(b) State Boyles Law and Charles Law, illustrate graphically.

(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

(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. (30 marks)

Periodic Table of Elements

IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIIIA
1 **H** 1.01																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 40.0
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.9	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (99)	44 **Ru** 101	45 **Rh** 103	46 **Pd** 106	47 **Ag** 108	48 **Cd** 112	49 **In** 115	50 **Sn** 119	51 **Sb** 122	52 **Te** 128	53 **I** 127	54 **Xe** 131
55 **Cs** 133	56 **Ba** 137	57 **La** 139	72 **Mf** 179	73 **Ta** 181	74 **W** 184	75 **Re** 186	76 **Os** 190	77 **Ir** 192	78 **Pt** 195	79 **Au** 197	80 **Hg** 201	81 **Tl** 204	82 **Pb** 207	83 **Bi** 209	84 **Po** (210)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (233)	88 **Ra** (226)	89 **Ac** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (264)	108 **Hs** (265)	109 **Mt** (268)	110 (269)	111 (272)	112 (277)		114 (285)		116 (289)		