

**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

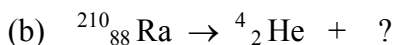
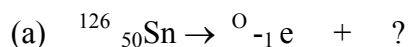
Useful constants: $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$, $0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$

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 ($\text{H}_2\text{O g}$) at 123.0°C and 0.93 atm pressure or 10.5 g ice cubes at -5.0°C .
- (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?



- (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



- (x) Use Valence Shell Electron Pair Repulsion (VSEPR) Theory to predict the shape of the water, H_2O , molecule.
- (xi) Calculate the concentration in mol dm^{-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 mol dm^{-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, $^{10}_5\text{B}$ and $^{11}_5\text{B}$. 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 $8.31\text{Jmol}^{-1}\text{K}^{-1}$ from the following information:-
- (i) 1 mole of any gas has a volume of $.0224\text{ m}^3$ at STP
 - (ii) $\text{STP} = 273\text{K}$ and $1.013 \times 10^5 \text{Nm}^{-2}$
 - (iii) $\text{J} = \text{Nm}$
- (d) Chlorophyll, the green pigment in leaves, has the chemical formula $\text{C}_{55}\text{H}_{72}\text{MgN}_4\text{O}_5$. A sample of chlorophyll was found to contain 0.0022g of Mg. Calculate the mass(g) of the sample of chlorophyll. (30 marks)

IA											VIII										
1 H 1.01	IIA										He 4.00										
3 Li 6.94	4 Be 9.01																			9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3																			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)	110 110 (269)	111 111 (272)	112 112 (277)										
												114 (285)			116 (289)						