CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Autumn Examinations 2015

Module Title: Biological Chemistry 1 (CA)

Module Code: CHEM6011

School : Science

Programme Titles: BSc in Applied Biosciences – Stage 1
BSc (Hons) in Biomedical Sciences – Stage 1
BSc (Hons) in Herbal Science – Stage 1
BSc (Hons) Nutrition & Health Science – Stage 1
BSc (Hons) Pharmaceutical Biotechnology – Stage 1

Programme Codes: SBIOS_7_Y1
SBISC_8_Y1
SHERB_8_Y1
SNHSC_8_Y1
SPHBI_8_Y1

External Examiner: Dr. C. Roche
Internal Examiners: Dr. W. Doherty, Dr. M. Sheahan

Instructions: Answer **THREE** questions as follows:
Question 1 in sections A is compulsory.
Attempt any two questions in section B.
Show all calculations in your answer book

Duration: 2 Hours

Sitting: Autumn 2015

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

Q1. Attempt any **eight** of the following. *All parts carry 5 marks*

(i) A given atom contains 9 protons and 10 neutrons;

i. How many electrons are in the atom?
ii. Give its mass number
iii. State the group and period to which it belongs
iv. Is it a metal or a non-metal?
v. Give its symbol?

(ii) Identify three subatomic particles. Give their respective mass, charge and location within the atom.

(iii) Write a brief note on Bohr's model of the atom

(iv) Describe two types of atomic orbitals; hence state the characteristics which may be used to distinguish between different orbitals

(v) In each of the following pairs of ions, name and give the chemical formula for the ionic compound formed:

(a) Ba^{2+} and SO_4^{2-}
(b) H^+ and PO_4^{3-}
(c) Ca^{2+} and OH^-

(vi) Complete and balance the following equation: $Na_2CO_3(s) + HCl(g) \rightarrow$

(vii) Calculate the molarity of a solution of potassium hydrogen phthalate (KHP, $C_8H_5KO_4$), which was prepared by dissolving 5.1g of KHP in water and diluting to a total volume of $250cm^3$.

(viii) Calculate the number of moles of aspirin ($C_9H_8O_4$), in a 50g sample. What is the precentage carbon in aspirin?

(ix) What mass of sodium hydroxide (NaOH), is required to prepare 0.1L of a 0.5M solution?

(x) What volume of a 30ppm sucrose solution is required to prepare $250cm^3$ of a 3ppm solution? Express answer in L

Section B

Attempt any **TWO** questions

Q2.

(a) Distinguish by definition between the mass number and the atomic number of an atom. Give the mass and atomic number for phosphorus (5 marks)

(b) What is the difference between an isotope and isotopic abundance? Give an example of an element, other than Cu, which exists in isotopic form (5 marks)

(c) Write the electron configuration for copper. (2 marks)

(d) Copper has 2 naturally occurring isotopes; Cu-63 has a natural abundance of 69.17% and an isotopic mass of 62.94 a.m.u. while the abundance of Cu-65 is 30.83% and its isotopic mass of 64.93 a.m.u. Calculate the average atomic mass of copper (7 marks)

(e) State what is meant by each of the following atomic properties: (i) atomic radius, (ii) ionization energy and (iii) electron affinity. Identify and explain briefly the trends in the listed properties, across a period and down a group in the periodic table (11 marks)

Q3.

(a) State Hess's Law (3 marks)

(b) Write an equation for the formation of diborane gas, $B_2H_6(g)$ from its elements (3 marks)

(c) Calculate the standard molar enthalpy of formation ($\Delta H_f^{\ominus}$) of $B_2H_6(g)$ using the following thermochemical information

$4\ B(s) + 3\ O_2(g)$	$\rightarrow 2\ B_2O_3(s)$	$\Delta H^{\ominus}$	=	$-2509.1\ kJ\ mol^{-1}$
$2\ H_2(g) + O_2(g)$	$\rightarrow 2\ H_2O(l)$	$\Delta H^{\ominus}$	=	$-571.7\ kJ\ mol^{-1}$
$B_2H_6(g) + 3\ O_2(g)$	$\rightarrow B_2O_3(s) + 3H_2O(l)$	$\Delta H^{\ominus}$	=	$-2147.5\ kJ\ mol^{-1}$

(6 marks)

(d) Explain or define standard enthalpy of formation ($\Delta H_f^{\ominus}$) 3 marks)

(e) What do you understand by standard state in thermodynamic; hence give the temperature and pressure which correspond to standard state conditions (3 marks)

(f) Describe, with the aid of diagrams, an experiment which could be carried out to determine the heat of reaction (e.g. the heat of neutralization of acid-base reaction). Identify the precautions which should be taken to minimize errors and thus ensure reasonable results

(12 marks)

Q4.

(a) Write a detailed note which clearly highlights the differences between ionic and covalent compounds (9 marks)

(b) Identify the type of intermolecular force prevalent in the molecules listed; HCl, C_2H_6, CH_3NH_2, O_2, H_2O, $CHCl_3$. Give a reason for your choice in each case (4 marks)

(c) Explain how intermolecular forces influence the physical state of a substance at room temperature and comment briefly on the importance of hydrogen bonding in biological molecules (4 marks)

(d) What is understood by the term '*electronegativity*'? State the trend observed in electronegativity values in the periodic table? (5 marks)

(e) With the aid of appropriate examples, distinguish between pure covalent and polar covalent bonds. Explain how electronegativity values may be used to determine if a bond is covalent, polar covalent or ionic? (8 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)		