

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Autumn 2013

Module Title: Biological Chemistry 1
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Module Code: CHEM6011

School: Science

**Bachelor of Science in Applied Biosciences
Bachelor of Science in Herbal Science
BSc Hons Nutrition & Health Science**

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

External Examiner(s): Dr. C. Roche.

Internal Examiner(s): Dr. L. Goold, Dr. R. Hourihane, Dr. M. Sheahan.

Instructions: Attempt **both** Sections A and B.
Show all calculations in the answer book.

Duration: 2 Hours

Sitting: Autumn 2013

Requirements for this examination: Periodic Table, Standard Enthalpy Tables

Useful Constants $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$, $0.0821 \text{ Latm mol}^{-1} \text{ K}^{-1}$

<p>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.</p>
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Section A

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

- (i) Write the ground state electronic configuration for ^{15}P and ^{29}Cu . Illustrate the detail of the configuration/orbital occupancy of the valance shell in both cases.
- (ii) What is an atomic orbital? Name two types of orbitals. What characteristics may be used to distinguish between different orbitals?
- (iii) List all sub atomic particles. Give the mass, charge and location of each particle within the atom.
- (iv) In each of the following pairs of ions, name and give the chemical formula for the ionic compound formed:
 - (a) Cd^{2+} and Cl^{-}
 - (b) Fe^{3+} and O^{2-}
 - (c) Ca^{2+} and OH^{-}
- (v) Describe through the application of valence shape electron pair repulsion theory (VSEPR) the shape of the NH_3 molecule.
- (vi) Balance the following chemical equations
 - (a) $\text{ZnS (s)} + \text{O}_2 \text{ (g)} \rightarrow \text{ZnO (s)} + \text{SO}_2 \text{ (g)}$
 - (b) $\text{MgCl}_2 \text{ (s)} + \text{AgNO}_3 \text{ (s)} \rightarrow \text{Mg(NO}_3)_2 \text{ (s)} + \text{AgCl (s)}$
- (vii) Calculate the molarity of a solution of sodium acetate (CH_3COONa), which was prepared by dissolving 12g of CH_3COONa in water and diluting to a total volume of 500cm^3 .
- (viii) Calculate the number of moles of pentane (C_5H_{12}), in 36g of pentane. What is the percentage carbon in pentane?
- (ix) What mass of solid sodium chloride (NaCl), is required to prepare 250cm^3 of a 0.1mol dm^{-3} NaCl solution?
- (x) What volume of the solution described in (ix) above is required to prepare 100cm^3 of a 0.005mol dm^{-3} solution?

Section B

Attempt any **TWO** questions

Q2.

- (a) Define (i) Mass Number (ii) Atomic Number.

Give the mass and atomic number for silicon, Si, from the periodic table.

(5 marks)

- (b) Distinguish between an isotope and isotopic abundance. Give an example of an element, other than B, which exists in isotopic form. (5 marks)

- (c) Naturally occurring boron consists of two isotopes ^{10}B (19.9%) with an isotopic mass of 10.0129amu and ^{11}B (80.1%) with an isotopic mass of 11.00931 amu.

What is the atomic mass of boron?

(6 marks)

- (d) State what is meant by each of the following atomic properties.

(i) Atomic Radius

(ii) Ionisation Energy

(iii) Electron Affinity

(iv) Electronegativity

Identify and explain briefly the trends in any three of the listed properties, across a period and down a group in the periodic table (14 marks)

Q3.

- (a) State the First Law of Thermodynamics in words and by equation. (6 marks)

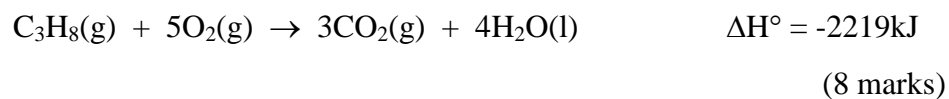
- (b) When 50cm^3 of 1.0 mol dm^{-3} HCl is added to 50mL of 1.0 mol dm^{-3} NaOH in a calorimeter, the temperature of the aqueous solution increases from 25 to 33.9°C . Assuming that the calorimeter absorbs only a negligible quantity of heat and that the specific heat capacity and density of the final solution is the same as that of pure water, calculate enthalpy of neutralisation, $\Delta H_{\text{neutralisation}}$ (in kJ mol^{-1}) for the reaction: $\text{HCl (aq)} + \text{NaOH (aq)} \rightarrow \text{NaCl (aq)} + \text{H}_2\text{O(l)}$

Specific Heat Capacity $\text{H}_2\text{O} = 4.18\text{ J g}^{-1}\text{K}^{-1}$

Density $\text{H}_2\text{O} = 1\text{ g cm}^{-3}$

(8 marks)

- (c) Using the table of standard enthalpy of formation data attached, calculate the enthalpy of formation of propane, C₃H₈(g)



- (d) Define the underlined terms in parts (b) and (c) above. (8 marks)

Q4.

- (a) Which groups from the periodic table typically form (i) ionic (ii) covalent bonds, hence or otherwise describe the bonding in NaCl(s) and HCl (g). (10 marks)
- (b) List three differences between ionic and covalent compounds. (6 marks)
- (c) What are intermolecular forces, IMF? Identify three types listing them in order of increasing strength? (8 marks)
- (d) Discuss briefly the effect(s) IMF's have on the following physical properties of molecules:
- (i) solubility
 - (ii) melting point
 - (iii) boiling point
- (6 marks)