

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Autumn Examinations 2016

Module Title: Biological Chemistry 1 (CA)

Module Code: **CHEM 6011**

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. M. Geary**

Internal Examiners: **Dr. W. Doherty, Dr. M. Sheahan, Dr. C O Sullivan,**
 Dr. R. O Connor

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 2016

Requirements for this examination: Periodic Table

<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

Question 1. Attempt any eight of the following. *All parts carry 5 marks*

- (i) Write a brief note on the Millikan Oil drop experiment.
- (ii) Describe two types of atomic orbitals; hence state the characteristics which may be used to distinguish between different orbitals.
- (iii) Name three subatomic particles. Give their respective mass, charge and location within the atom.
- (iv) If a given atom contains 24 electrons and 28 neutrons;
 - i. How many protons are in the atom?
 - ii. Give its mass number
 - iii. Is it a metal or a non-metal?
 - iv. Give its symbol?
 - v. How many electrons are in the trivalent cation of this element?
- (v) In each of the following pairs of ions, name and give the chemical formula for the ionic compound formed:
 - (a) K^+ and NO_3^-
 - (b) Na^+ and PO_4^{3-}
 - (c) Al^{3+} and Cl^-
- (vi) Complete and balance the following equation: $\text{NaOH(aq)} + \text{H}_2\text{SO}_4(\text{l}) \rightarrow$
- (vii) What volume of a 100ppm saline (sodium chloride) solution is required to prepare 750cm^3 of a 5ppm solution? Give answer in L
- (viii) What mass of sodium carbonate (Na_2CO_3), is required to prepare 50cm^3 of a 0.25M solution?
- (ix) Calculate the molarity of a solution of potassium hydrogen phthalate (KHP, $\text{C}_8\text{H}_5\text{KO}_4$), prepared by dissolving 5.1g of KHP in water and diluting to a total volume of 500cm^3 .
- (x) Calculate the number of moles of paracetamol ($\text{C}_8\text{H}_9\text{NO}_2$), in a 50g sample. What is the percentage nitrogen in paracetamol?
- (xi) Assign 4 quantum numbers to each of the 2p electrons in the carbon atom to show that each electron has a unique set of quantum numbers.

Section B

Attempt any **TWO** questions

Question 2.

- (a) Distinguish by definition between the mass number and the atomic number of an atom. Select any element from the periodic table and give its mass and atomic numbers respectively. (5 marks)
- (b) Write the electron configuration for sulfur. (2 marks)
- (c) What is the difference between an isotope and isotopic abundance? Other than Pb, give an example of an element, which exists in isotopic form. (5 marks)
- (d) Use the following data to calculate the average atomic mass of lead in amu: ^{204}Pb (203.97 a.m.u) has an abundance of 1.4%, ^{206}Pb (205.97 a.m.u) has an abundance of 24.1%, ^{207}Pb (206.97 a.m.u) has an abundance of 22.1%, and ^{208}Pb (207.97 a.m.u) has an abundance of 52.4%. (7 marks)
- (e) What is understood by each of the following atomic properties:
- (i) Atomic radius
 - (ii) Ionization energy
 - (iii) Electron affinity.

State and explain briefly the trends in the listed properties, across a period and down a group in the periodic table (11 marks)

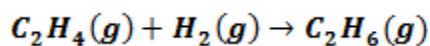
Question 3.

- (a) Identify the type of intermolecular force prevalent in the molecules listed; NaCl, CH₄, CH₃NH₂, N₂, SO₂, CH₃Cl. Explain your choice in each case (4 marks)
- (b) With the aid of relevant examples, explain how intermolecular forces influence the physical state of a substance at room temperature. (4 marks)

- (c) What is understood by the term '*electronegativity*'? State the trend observed in electronegativity values in the periodic table? (5 marks)
- (d) 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)
- (e) Write a detailed note which clearly highlights the differences between ionic and covalent compounds (9 marks)

Question 4.

- (a) State *Hess's Law*. Applying the principles of this law and using the thermochemical equations provided, determine the enthalpy change (ΔH) for the hydrogenation of ethane (C_2H_4) gas as follows:



1. $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$ $\Delta H = -1410.9 kJ$
2. $2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l)$ $\Delta H = -3119.4 kJ$
3. $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ $\Delta H = -571.6 kJ$

(9 marks)

- (b) What do you understand by *standard state* in thermodynamic; hence give the temperature and pressure which correspond to standard state conditions. (3 marks)
- (c) Differentiate between *heat capacity* and *specific heat capacity* by defining both terms. Give units for both terms (6 marks)
- (d) 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)