

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Semester 2 Autumn 2013

Module Title: Biological Chemistry 2

Module Code: CHEM6009

School: Science and Informatics.

**Programme Title: Bachelor of Science in Applied Biosciences
 Bachelor of Science in Pharmaceutical Biotechnology
 Bachelor of Science in Nutrition and Health Science**

**Programme Code: SBIOS -7 – Y1
 SPHB – 8 - Y1
 SNHS – 8 - Y1
 SHERB – 8 -Y1**

**External Examiner(s): Dr. Carmel Roche
Internal Examiner(s): Dr. Rosamund Hourihane
 Dr. Mary Lehane**

**Instructions: Attempt THREE questions.
 Section A is compulsory. Attempt 8 out of 10 questions from
 Section A.
 Attempt one question each from sections B and C.
 Show all calculations and rough work on the answer book.**

Duration: 2 Hours

Sitting: Autumn 2013

Requirements for this examination: Maths Tables

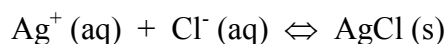
Note to Candidates: Please check the Programme Title and the Module Title to ensure that you have received the correct examination paper.
If in doubt please contact an Invigilator.

Section A

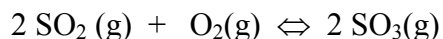
Attempt 8 of the following 10 parts

All parts carry equal marks.

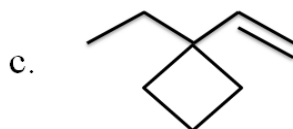
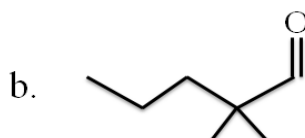
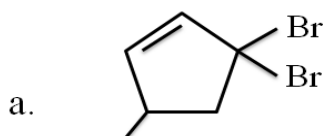
- (i) What is meant by a neutralisation reaction, illustrate with a simple labeled example?
- (ii) Give the Henderson-Hasselbalch equation, label and explain each of the quantities which it contains.
- (iii) State Le Chatelier's Principle. Using the principle predict how the amount of solid silver chloride will change when the following equilibrium is disturbed by the addition of NaCl.



- (iv) What do the following generalisations say regarding the composition of an equilibrium mixture?
(a) $K_c > 10^3$, (b) $K_c < 10^{-3}$, (c) K_c in the range 10^{-3} to 10^{+3}
- (v) An equilibrium mixture of O_2 , SO_2 , and SO_3 contains equal concentrations of SO_2 and SO_3 . Calculate the concentration of O_2 if $K_c = 2.7 \times 10^{-2}$



- (vi) Draw the structures of Z-but-2-ene and E-but-2-ene.
- (vii) Using the IUPAC rules of nomenclature name the following compounds:



- (viii) Distinguish between the terms 'Nucleophile' and 'Electrophile' and give examples of each.

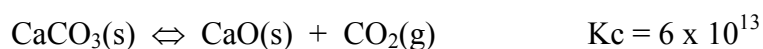
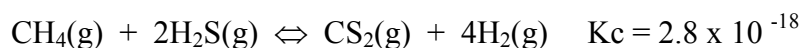
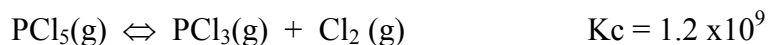
(ix) 'Cyclohexane is often drawn in text books as a perfect hexagon; in fact it exists as two predominant conformers.' Explain **conformational isomerism** in cyclohexane.

(x) Explain what is meant by a substitution reaction in organic chemistry and give an example of such a reaction. (8x5 marks, total 40)

Section B

Attempt any one of the following questions

- Q2. (i) Write the equilibrium constant expression for each of the following processes



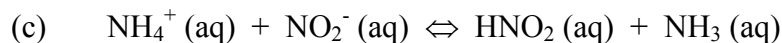
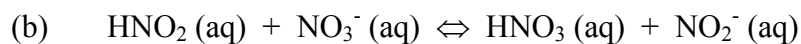
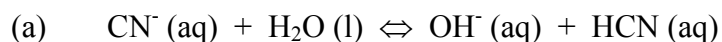
(9 marks)

- (ii) When each of the equilibrium processes described in part (i) above reach equilibrium, on which side does the equilibrium lie, on the left in favor of the reactants or on the right in favor of the products? (6 marks)

- (iii) A sample of hydrogen iodide, (HI) 9.30×10^{-3} mol was placed in an empty 2.00 L container at 1000K. After equilibrium was established, the concentration of iodine, (I_2) was $6.29 \times 10^{-4} \text{ mol dm}^{-3}$. Hydrogen, (H_2) is the other product produced.

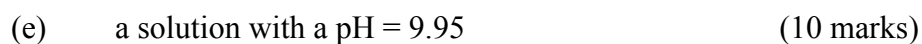
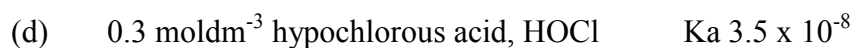
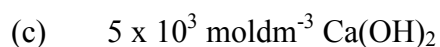
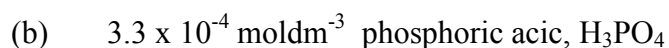
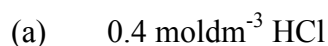
- (a) Write a balanced chemical equation for the process as described above.
(b) Write the equilibrium expression, K_c , that describes this process.
(c) Calculate the value for K_c for the process.
(d) Determine a value for K_c the reverse reaction. (15 marks)

Q3. (i) Identify the acid, base, conjugate acid and conjugate base in each of the following reactions

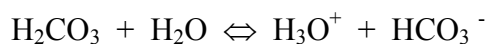


(6 marks)

(ii) Calculate the pH or the hydrogen ion concentration, which ever is appropriate of each of the following solutions



(iii) The reaction illustrated below is an important reaction in maintaining the pH of blood at a constant value of about 7.4.



Predict and explain briefly what happens to

(a) the position of the equilibrium

(b) the concentration of each of the products and reactants

(c) the pH of the blood

when the blood absorbs (i) acid (ii) base.

(14 marks)

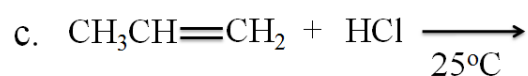
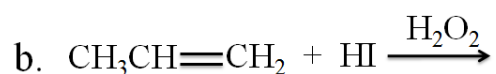
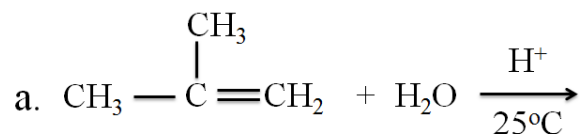
Section C

Attempt any one of the following questions

- Q4. (i) Discuss benzene under the following headings:
- The unique structure of benzene in terms of bonding
 - The unique properties of benzene
 - The effect of substitution on the reactivity of the benzene ring
 - How different substituents on the benzene ring influence the position of electrophilic attack (16 marks)
- (ii) A component of protein called serine has an approximate molar mass of 100 g/mole. If the percent composition is as follows, what is the empirical and molecular formula of serine?
- C = 34.95 % H= 6.844 % O = 46.56 % N= 13.59 % (8 marks)
- (iii) Explain the term 'structural isomerism' drawing some examples to support your answer. (6 marks)

Q5. (i) Explain, with the aid of diagrams, the mechanism for the addition of F_2 to the double bond of an alkene (7 marks)

(ii) Complete the following alkene reactions (provide a written explanation in each case):



(iii) Draw the following organic compounds:

(a) 2-methylbutanal

(b) 2-hydroxy, methyl, cyclohexanol

(c) 2-cyclopropylbutane

(d) Benzaldehyde

(e) 3-hydroxypentanoic acid (10 marks)

(iv) Long-chain hydrocarbons are of limited value in the petrochemical industry discuss the mechanism by which they can be converted into more high value fuels.

(6 marks)