UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For the following qualifications :-

B.Eng.   M.Eng.

Chemical Eng E846: Chemistry I

COURSE CODE   : **CENGE846**

UNIT VALUE   : **0.50**

DATE   : **03-MAY-02**

TIME   : **14.30**

TIME ALLOWED   : **3 hours**

Answer FIVE questions only.
Each question carries a total of 20 marks distributed as shown [ ]

1. The most common reactions of aromatic compounds are electrophilic substitutions. Describe the general mechanism of these reactions and indicate which step in the sequence is rate determining. [5]

   Taking benzene as a typical aromatic compound write down the chemical equations for its nitration, bromination and Friedel-Crafts alkylation. [9]

   Describe the process chemistry in the Friedel-Crafts production of phenol (hydroxybenzene), acetone (propanone) and anthraquinone. [6]

2. Discuss the mechanism of the electrophilic addition of halogen acids such as hydrobromic acid to (a) unsymmetrical mono-alkenes (b) conjugated dienes. [10]

   The Diels-Alder reaction between a diene and a dieneophile is thought to proceed via a "concerted" mechanism. Describe the nature of this mechanism and distinguish between those reactions that are symmetry allowed and those that are symmetry forbidden. [10]

3. Williamson's synthesis of ethers involves the reaction between an alcohol and an alkyl halide in basic solution. Show how this may be modified to produce a crown ether such as 18-crown-6 and indicate why it is necessary to carry out such a reaction in high dilution. [10]

   Outline the application of compounds such as the crown ethers in the technique of phase transfer catalysis. [10]

TURN OVER

4. Outline the methods available for the production of (a) chain growth polymers such as polypropene (b) step growth polymers such as the polyamides. [5]

Use molecular diagrams to show the difference between isotactic, syndiotactic and atactic polymers. [5]

A blend is made as follows from seven fractions of polyethene each with a different relative molar mass (RMM):

RMM	12000	15000	25000	35000	60000	100000	120000
Mass/g	0.10	0.15	0.18	0.25	0.22	0.07	0.03

Calculate the number average, M_n, and the mass average, M_m, relative molar mass of the blend given:

$$M_n = \frac{\Sigma M_i N_i}{\Sigma N_i}; M_m = \frac{\Sigma M_i^2 N_i}{\Sigma M_i N_i}$$

where M_i is the molar mass of the ith species and N_i is the number of moles of the ith species. [10]

5. Write notes on ONE of the following:
   i)   the role of RNA and DNA in the synthesis of proteins [20]
   ii) modern theories of the structure and function of acids and bases [20]
   iii) the "greenhouse effect" and global warming [20]

6. Write mechanisms for the following reactions:
   i)   The nucleophilic addition of hydroxylamine to ethanal [4]
   ii) The aldol condensation between two molecules of ethanal in basic solution [4]
   iii) The formation of a hemiacetal from an aldehyde and an alcohol in acid solution [4]

Discuss the evidence for the (a) linear and (b) cyclic structure of glucose and describe how the α and β forms of glucose undergo mutarotation. [8]

7. List with typical examples the principal chemical components of crude oil. [5]

What are the essential properties that distinguish gasoline from diesel fuel and how are the two rated (ie describe the octane and cetane scales). [5]
Discuss the chemistry of the catalytic reforming of naphtha to gasoline. What is the role of the platinum-on-alumina catalyst and how may its activity be increased. [10]

END OF EXAM