

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 : 08-MAY-03

TIME : 10.00

TIME ALLOWED : 3 Hours

Answer **FIVE** questions only. Only the first **FIVE** answers will be marked.
Each question carries a total of **20** marks distributed as shown []

- 1 The stability of aromatic compounds may be accounted for by the Hückel “(4n+2)” theory of π -electrons. Describe the basis of the theory as applied to cyclic conjugated molecules. [5]

Show how the theory applies to the following and indicate which would be predicted to be aromatic and which non-aromatic:

- (i) the cyclopentadienyl anion [5]
(ii) the cycloheptatrienyl cation [5]
(iii) 14-annulene [5]

- 2 Describe the differences between optical, geometric and conformational isomers. [6]

List the assumptions on which the R-S system of nomenclature for chiral atoms is based and indicate the structural designation of each chiral atom in the following molecules.

- (a) $(\text{CH}_3)\text{CH}(\text{OH})\text{CH}_2\text{OH}$
(b) $(\text{CH}_2\text{OH})\text{CH}(\text{OH})\text{CH}(\text{OH})(\text{CH}_2\text{OH})$ [14]

- 3 Describe the general mechanism of electrophilic substitution reactions of aromatic compounds and indicate which step 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]

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

The Diels-Alder reaction between a diene and a dienophile 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]

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- 5 Describe the chemical structures of the main components of crude oil. [6]
- How are the following defined: (a) the octane number of gasoline and (b) the cetane number of diesel oil. [4]
- The octane number of naphtha may be increased by the process of catalytic reforming using a platinum-on-alumina catalyst. Describe the molecular mechanism of the process and show why the addition of halogens to the catalyst enhances its activity. [10]
- 6 Describe the mechanism of the chain reactions involved in the production of (a) chain growth polymers such as polypropene and (b) step growth polymers such as the polyamides. [10]
- Use molecular diagrams to show the difference between isotactic, syndiotactic and atactic polymers. [5]
- Describe the structures of the three main types of polyethene – low density, high density and linear low density – and outline their methods of manufacture. [5]
- 7 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]

END OF PAPER