UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualifications:-

B.Eng.   *M.Eng.*

Chemical Eng E875: Advanced Material Processes and Product Engineering

COURSE CODE   :   **CENGE875**

UNIT VALUE   :   **0.50**

DATE   :   **06–MAY–05**

TIME   :   **10.00**

TIME ALLOWED   :   **3 Hours**

TURN OVER

Please answer question 1 (Part A), one question from Part B, question 4 (Part C) and one question from Part D; in total four questions. Total maximum: 80 marks

*Graph paper is needed.*

PART A

1.

The rate of removal of a microlithographic resist film (s), i.e. dissolution rate,

was found to obey the following empirical equation:

$$-(ds/dt) = qM^{-2}$$

where M is the number average molar mass of the resist after the lithographic treatment and q an experimentally obtainable constant.

The 1/M vs. D plot for this resist is given in the attached figure, where D is the radiation dose in $\mu C/cm^2$ (μC=microcoulomb).

Use the above relationship and data to find an equation between the fraction of the remaining film and dose. Using this equation, construct the sensitivity curve and from this estimate the contrast of the resist.

[25]
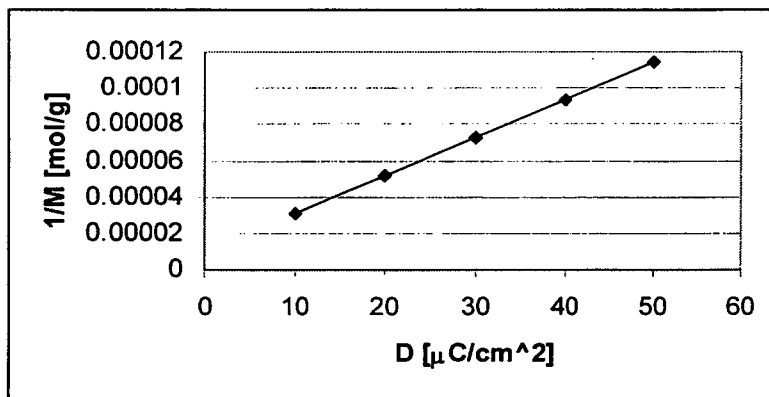
PART B

2.

Develop a process model for supercritical extraction of a solid component (A) from a solid matrix in a column.

Making reasonable assumptions solve the model equations for the concentration of the extracted solid A in the supercritical fluid phase and its concentration in the solid matrix.

Draw qualitative diagrams of the profile of the former concentration along the column at various flows. Draw qualitative diagrams of the profile of the latter concentration along the column at various times.

Is a tubular column a good equipment to measure the solubility of A? Why? If not suggest a more suitable alternative and justify your answer. [25]

3.

Describe, drawing a qualitative diagram, the dependence of the solubility of solids in supercritical fluids. Explain this behaviour. [4]

Draw a flow diagram of a typical supercritical fluid extraction process and describe it. Explain why this is not followed in a decaffeination process using supercritical CO_2, giving the new flow diagram. Why is decaffeination of coffee or tea an established industrial supercritical extraction process, while ethanol-water separation using supercritical CO_2 is not, although it is technically possible? [12]

In flame retardant chemistry, describe referring to the combustion cycle the terms solid phase inhibition and vapour phase inhibition. How do red phosphorous and phosphorous compounds act as flame retardants. [9]

PART C.

4.

Explain and discuss the reasons for the success of the following products:

- Philips' disposable fluorescent bulb
- Swatch's watches

Explain and discuss the reasons the following products have been unsuccessful although they were very advanced technologically:

- Motorola's Iridium mobile phone
- Monsanto's genetically modified food products

Currently there is a similar debate regarding acceptance of nanotechnology products by the public. What strategy should nanotechnology companies follow in order to ensure success of their products? [15]

PLEASE TURN OVER

PART D

5.

a)   Name and discuss the four steps of establishing target specifications for a new
      product.   [7]

b)   Name and discuss the steps for establishing product architecture.   [8]

6.

a)   Name and discuss the aspects to assess the need for industrial design.   [5]

b)   Name and discuss the six phases of industrial design.   [10]

END OF PAPER