

UNIVERSITY OF LONDON

Biochemical Engineering

E100

Introduction to Biochemical Engineering

Answer **THREE** questions.

Marks distributed as shown []

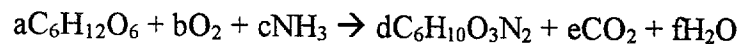
1. a) Outline the advantages of biocatalyst immobilisation and describe the principles behind each of the main immobilisation techniques. [15]
b) With reference to a particular industrial process describe the factors influencing the choice of immobilisation technique and support material. [10]

2. a) Describe the operating principle of polarographic electrodes and their use for the measurement of dissolved oxygen concentrations in fermentation broths. [9]
b) Describe, in detail, a method for the quantification of oxygen mass transfer coefficients in a stirred tank fermenter. Clearly state any assumptions made. [11]
c) Briefly explain how the design and operation of the fermenter will influence the measured oxygen mass transfer coefficient. [5]

3. a) The maximum specific growth rate (μ_{\max}) for a microorganism grown in batch culture in complex media is 1.7 h^{-1} . Calculate the doubling time (t_d) for the microorganism under such conditions. Give typical t_d values for bacteria and mammalian cells in culture. [10]
b) Describe the various modes of operation of cell culture processes. [7]
c) Describe the various patterns of growth and product formation for cultured microorganisms. Explain why this information is important for process design. [8]

TURN OVER

4. Given the following general stoichiometric equation for the growth of a microorganism in culture:



- a) Write down the elemental mass balances. Clearly state any assumptions made. [8]
- b) Under the conditions used the yield of biomass on substrate is typically 0.4 (on a mass basis). Considering 3000 litres of medium with a biomass concentration of 5g/l and an ash content of 3.8% (w/w), calculate the amount (in kg) of glucose and ammonia that were required. [9]
- c) Define respiratory quotient (RQ). What process parameters would you use to calculate RQ? [8]

Atomic weights: H=1; C=12; N=14; O=16

5. Recent developments in molecular genetics and diagnostics are set to have a major impact on human health care. For each of the following briefly outline the basis of the technology and describe the factors that need to be considered before implementation.

- a) The production of human therapeutic antibodies in plants. [13]
- b) The screening of humans for genetic diseases. [12]

END OF PAPER