UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualifications:-

B.Eng. *B.Sc.* *M.Eng.*

Biochemical Eng E100: Introduction to Biochemical Engineering

COURSE CODE	:	**BENGE100**
UNIT VALUE	:	**0.50**
DATE	:	**09-MAY-03**
TIME	:	**14.30**
TIME ALLOWED	:	**2 Hours**

TURN OVER

Answer ***THREE QUESTIONS.*** **Only the first three answers given will be marked.**
ALL questions carry a total of ***25 MARKS*** *each, distributed as shown* [ ]

1.

This question relates to the identification and development of a new drug compound for the treatment of AIDS. Answer *one* of the following parts:

a) Outline the life cycle of the HIV virus and explain how this knowledge can be used to identify a potential new drug candidate.

b) Outline the stages involved in the development of a new drug compound giving an indication of the timescales and costs involved. [25]

2.

a) Define the terms "sterilisation" and "disinfection" and give examples of where each operation might be used in an industrial fermentation facility. [4]

b) For a fermentation process involving a recombinant microorganism, outline the potential problems of the fermentation medium becoming contaminated by a microorganism from the surrounding environment. [6]

c) A 150 L batch of a nutrient medium is to be steam sterilised at 121 °C. Exposure to the environment has resulted in it becoming contaminated with spores of two types of microorganism:

	Spore A	**Spore B**
Initial concentration (spores L^{-1})	$1.0x10^{9}$	$1.0x10^{11}$
Activation energy (KJ mol^{-1})	283.6	280.4
Preexponential factor (s^{-1})	$1.58x10^{36}$	$2.50x10^{36}$

For each type of spore calculate the number of viable spores remaining in the medium after 60, 600 and 1200 seconds . After what time would you consider the medium to be sterile and why? Clearly state any assumptions made. [15]

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3.

A microorganism has been grown in a series of batch fermentations using either nutrient medium X or Y under otherwise identical culture conditions. The following data has been obtained:

Nutrient media X			Nutrient media Y		
Time (h)	Biomass ($g\ L^{-1}$)	Product ($mg\ L^{-1}$)	Time (h)	Biomass ($g\ L^{-1}$)	Product ($mg\ L^{-1}$)
0	1.05	0.00	0	1.05	0.00
10	1.86	0.00	10	1.70	0.00
20	3.32	1.00	20	2.90	1.00
30	5.90	1.50	30	4.75	1.50
40	10.50	2.00	40	7.90	2.00
50	18.70	3.00	50	13.00	3.00
60	33.20	3.50	60	21.50	3.50
70	59.00	10.00	70	35.60	5.00
80	60.00	18.00	80	59.00	11.00
90	61.00	24.00	90	60.00	20.00
100	61.00	30.00	100	61.00	25.00
110	62.00	40.00	110	61.00	30.00
120	62.00	40.00	120	62.00	35.00
130	61.00	40.00	130	62.00	40.00
140	60.00	37.00	140	61.00	40.00

i) What type of metabolite is the product likely to be? Give reasons. [8]

ii) Plotting the data in an appropriate graph indicated that there was no significant lag phase in either media and that the exponential growth phase finished at 70 hours (medium X) and 80 hours (medium Y). Estimate the maximum specific growth rate and doubling time for the microorganism grown in each type of medium. [8]

iii) Explain the effect of the different media on growth and product formation. Based solely on the data provided, which media would you recommend to use in a production scale fermentation? Give reasons. [9]

PLEASE TURN OVER

4.

The following data are available from a 30 L working volume fermentation of *Saccharomyces cerevisiae* grown in batch culture under aerobic conditions using glucose and ammonia as sources of nutrients:

Final biomass concentration: 20 g (dry cell weight) L^{-1}
Ash content of biomass: 7.3 % (w/w)
Yield of biomass on substrate: 0.40 g (dry cell weight) g (glucose)$^{-1}$
S. cerevisiae elemental composition: $CH_{1.78}O_{0.60}N_{0.19}$

Your company wants to produce 12 kg (dry cell weight) biomass per batch.

i) Estimate the size (m^3) of the production scale fermenter required. [5]

ii) Write down a general stoichiometric equation for biomass production. Clearly state any assumptions made. [5]

iii) Calculate the total amount (in kg) of glucose and ammonia required. [15]

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

5.

a) Define the terms "volumetric productivity", "specific productivity" and "overall productivity" with regard to batch fermentation process. Explain when each might be used. [13]

b) Outline a typical downstream process sequence for the purification of a therapeutic antibody identifying the types of unit operation employed at each stage. Show how the number of operations employed will affect the overall process yield. [12]

END OF PAPER