UNIVERSITI SAINS MALAYSIA

First Semester Examination
2010/2011 Academic Session

November 2010

IBG 302 – BIOREACTOR OPERATION
[PENGOPERASIAN BIOREAKTOR]

Duration: 3 hours
[Masa: 3 jam]

Please check that this examination paper consists of SEVEN pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi TUJUH muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: Answer ALL questions. You may answer the questions either in Bahasa Malaysia or in English.

*[**Arahan**: Jawab KESEMUA soalan. Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai].

Answer ALL questions.

1. Answer both parts of this question.

   (a) Sketch a diagram of a bioreactor and label at least 8 important parts. State the functions of each of those parts.

   (8 marks)

   (b) Write an essay on the types, operating principles and uses of bioreactors/ fermentors.

   (12 marks)

2. Write short notes on all of the following:

   (a) Design and sterility of a fermentor (6 marks)

   (b) Agitation during fermentation (7 marks)

   (c) Solid state fermentation (7 marks)

3. Answer all parts of this question, based on Fig. 1 (appended) which gives a schematic representation of a type of submerged fermentation.

   (a) Name this mode and type of fermentation. Explain its principles of operation.

   (5 marks)

   (b) What is the component 'A' in the figure? Explain the function/s of 'A' and the characteristics that 'A' should have, to fulfill its role in this case.

   (5 marks)

   (c) What is the component 'B' in the figure? Explain the function/s of 'B' in this type of fermentation.

   (5 marks)

   (d) Draw and briefly explain the fermentation profile that should be obtained in this type of fermentation

   (5 marks)

4. Answer all parts of this question.

   (a) List 8 ancillary equipments in the bioprocess laboratory.

   (4 marks)

   (b) Write short notes on pumps as an ancillary equipment in the bioprocess laboratory.

   (6 marks)

   (c) Explain the kinetics of product formation during fermentation.

   (10 marks)

5. Answer all parts of this question.

   (a) Describe the steps required, and the rationale of these steps, in the sterilization of a 2 litre fermentor.

   (10 marks)

   (b) Calculate K_La based on the data provided in Table 1.

   (10 marks)

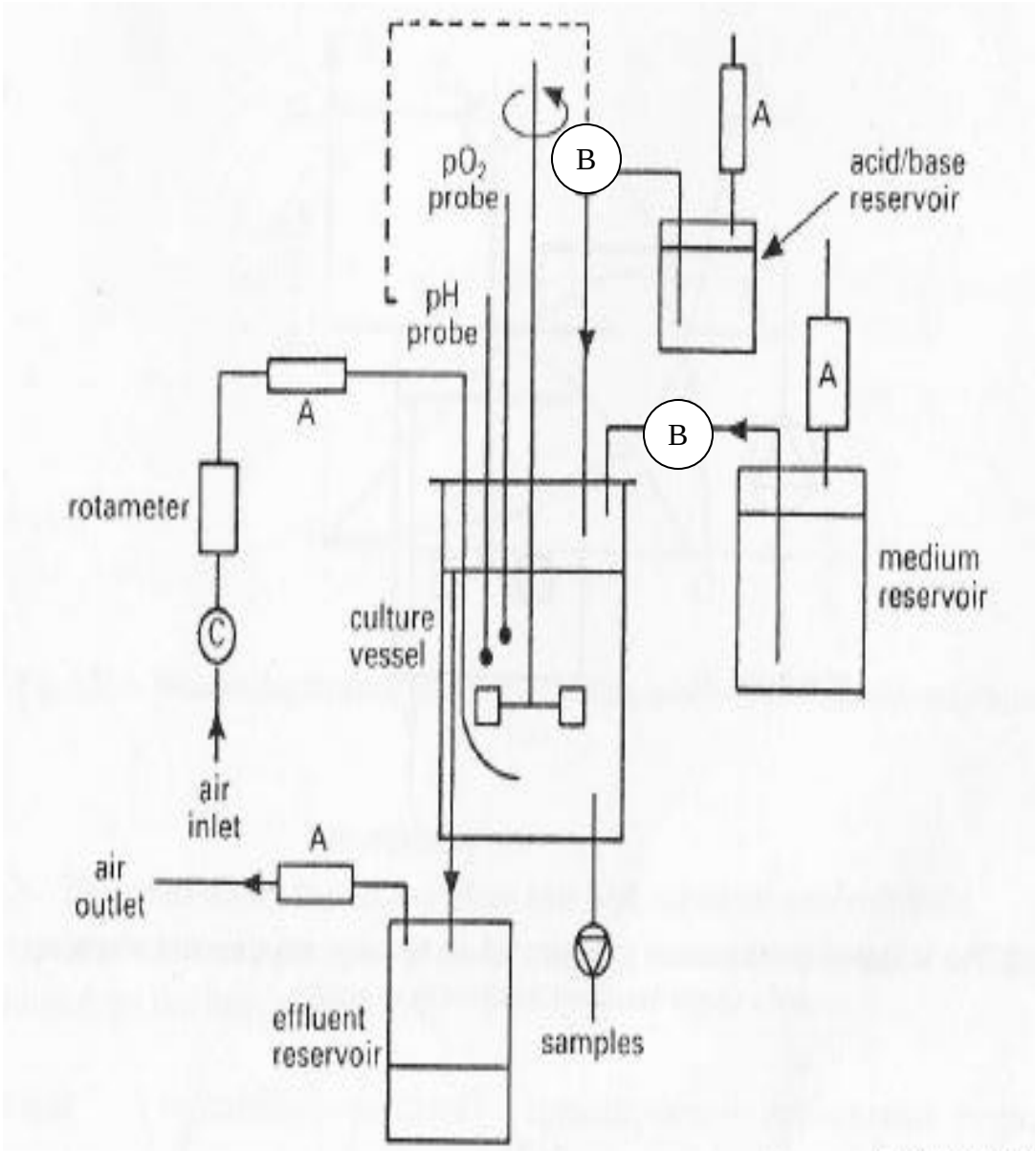

Figure 1. Schematic representation of a type of submerged fermentation

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Table 1.

Data from K_La experiment by the Dynamic Gassing-out method

Agitation speed: 150 rpm

	Time	D.O (% saturation)
	0	88.8
	2	87.4
	4	85.4
	6	83.4
	7	81.1
	9	79.0
	11	76.8
	13	74.8
	15	72.6
	17	70.6
	19	68.3
	21	66.2
	22	65.7
	23	67.1
	24	69.3
	25	72.2
	26.5	76.1
	28	79.2
	31	83.2
	33	84.8
	36	86.0
	38	86.3

Aeration "OFF"

Aeration "ON"

Given: $dC/dt = K_La\ (C^* - C) - rx$

Where,

C - concentration of dissolved oxygen, (d.o.) in the bulk liquid at any time, t (Unit: % saturation d.o or mmol O2/liter)

C* - saturation d.o value. (Unit: % or mmol O2/liter)

r - Specific oxygen uptake rate (Unit: mmol O2/ g cell/h)

x - Concentration of the cell mass, (Unit: g cell/liter)

K_La - volumetric oxygen transfer coefficient

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Jawab SEMUA soalan.

1. *Jawab kedua-dua bahagian dalam soalan ini.*

   (a) Lakarkan gambarajah bioreaktor dan labelkan sekurang-kurangnya 8 bahagian-bahagian penting. Nyatakan fungsi setiap bahagian tersebut.

   (8 markah)

   (b) Tulis satu karangan berkenaan pembangunan, jenis-jenis, prinsip operasi dan kegunaan bioreaktor/fermentor.

   (12 markah)

2. *Tuliskan catatan-catatan ringkas bagi kesemua yang berikut:*

   (a) Rekabentuk dan kesterilan fermentor (6 markah)

   (b) Pengadukan semasa fermentasi (7markah)

   (c) Fermentasi keadaan pepejal (7markah)

3. *Jawab semua bahagian soalan ini berdasarkan rajah 1 yang memaparkan satu jenis mod fermentasi tenggelam secara skematik.*

   (a) Namakan mod dan jenis fermentasi ini. Terangkan prinsip pengoperasiannya.

   (5 markah)

   (b) Apakah komponen 'A' pada rajah tersebut? Terangkan fungsi 'A' dan ciri-ciri yang sepatutnya dipunyai oleh 'A' untuk memenuhi peranannya dalam kes ini?

   (5 markah)

   (c) Apakah komponen 'B' pada rajah tersebut? Terangkan fungsi 'B' dalam pengoperasian fermentasi jenis ini.

   (5 markah)

   (d) Lakarkan dan terangkan secara rinkas profail kultur yang fermentasi yang sepatutnya diperolehi daripada fermentasi jenis ini.

   (5 markah)

4. Jawab semua bahagian dalam soalan ini.

(a) Senaraikan 8 peralatan tambahan dalam makmal bioproses

(4 markah)

(b) Tuliskan nota ringkas berkenaan pam sebagai peralatan tambahan dalam makmal bioproses

(6 markah)

(c) Terangkan kinetic pembentukan produk semasa fermentasi

(10 markah)

5. Jawab semua bahagian dalam soalan ini.

(a) Jelaskan langkah-langkah, dan rasional langkah-langkah tersebut, untuk pensterilan fermentor bersaiz 2 liter

(10 markah)

(b) Kirakan K_La berdasarkan data yang dibekalkan pada jadual 1

(10 markah)

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