



UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF CHEMICAL AND BIO-ENGINEERING TECHNOLOGY

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE : CPB30103
COURSE TITLE : BIOCHEMICAL ENGINEERING
PROGRAMME NAME : BACHELOR OF CHEMICAL ENGINEERING TECHNOLOGY
(PROCESS) WITH HONOURS
DATE : 29 JANUARY 2026
TIME : 2:00PM - 5:00PM
DURATION : 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☒ *Tick if applicable*

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

Question 1

Answer the following questions.

- (a) Define a cell.
(2 marks)
- (b) Describe the structure of the plasma membrane.
(4 marks)
- (c) Describe the structure of cytoskeleton.
(4 marks)
- (d) Differentiate between plant and animal cells in terms of their energy-producing organelles.
(10 marks)

Question 2

Answer the following questions.

- (a) Describe downstream processing in biochemical engineering.
(3 marks)
- (b) State **THREE (3)** examples of downstream recovery process.
(3 marks)
- (c) List the major steps involved in downstream processing.
(6 marks)
- (d) Explain how centrifugation is applied in downstream recovery of biological products.
(8 marks)

SECTION B (Total: 60 marks)

Answer **THREE (3)** questions only.

Please use the answer booklet provided.

Question 1

Pressure-driven membrane processes were widely applied in the downstream processing of bio-based products. With the use of appropriate labelled diagrams, compare dead-end filtration and cross-flow filtration.

(20 marks)

Question 2

Answer the following questions.

- (a) Pour plate and spread plate are two techniques in microbiology to facilitate the enumeration of microbial cells in a sample. Both methods measure the viable cells. Contrast the key differences between pour plate and spread plate methods.

(12 marks)

- (b) Two fermenters (G and H) are supplied with the same media in a fermentation process. G is supplied with 1 liter media and H is supplied with 5000 liter media. Given that $k_d t = 20$ and initial concentration of spores is 10^6 spores/L. Calculate the probability of unsuccessful sterilization for fermenter G and H.

(8 marks)

Question 3

Answer the following questions.

- (a) Rearrange the Michaelis-Menten equation to give a Hanes-Woolf equation. (4 marks)
- (b) Relate the Hanes-Woolf plot (slope, y-intercept, and x-intercept) to the two important parameters of enzyme activity: the Michaelis-Menten constant and the maximum reaction rate. (6 marks)
- (c) An enzyme-catalyzed reaction follows Michaelis-Menten kinetics. The following data were obtained at 25°C.
Refer Below - Table1 : Enzyme-catalyzed reaction .

Table 1: Enzyme-catalyzed reaction

Substrate concentration, [S] (mM)	Initial velocity, v ($\mu\text{mol min}^{-1}$)
1.0	20
2.0	33
5.0	55
10.0	67
20.0	67

- i. Determine V_{max} and K_m for the enzyme. (6 marks)
- ii. When the experiment was repeated in the presence of an inhibitor, the maximum velocity remained unchanged, but a higher substrate concentration was required to reach half of the maximum velocity. Analyze the type of inhibition, justifying your answer using kinetic principles. (4 marks)

Question 4

Answer the following questions.

- (a) The following figure shows the comparison of pH change between a buffer solution and deionized water when small amount of HCl was added to these solutions. Analyze the trend of these curves.

Refer Below - Figure1 : Comparison of pH change with added HCl.

(12 marks)

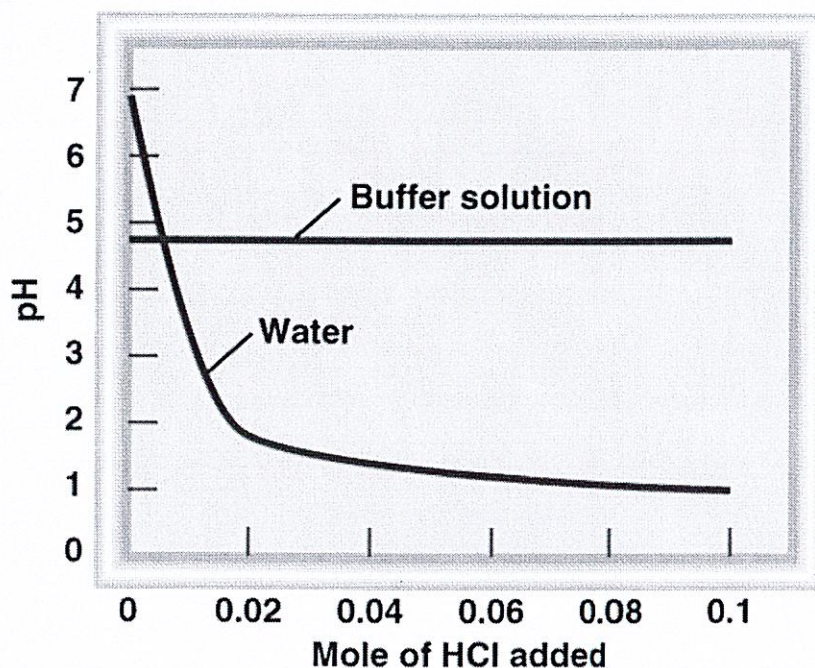


Figure 1: Comparison of pH change with added HCl

- (b) As a plant design engineer, one of the tasks given to Joseph is to design a stirred tank fermenter. Analyze the mechanical design (dimension) considerations for designing/deciding the impellers of a stirred tank fermenter.

(8 marks)

END OF EXAMINATION PAPER

APPENDIX

Michaelis-Menten equation:	$V_o = \frac{V_{\max} \cdot [S]}{[S] + K_m}$
Number of generations:	$n = (\log N - \log N_o) / \log 2$
Generation time:	$t_d = \ln 2 / \mu$
Total number cells:	$N = N_o \times 2^n$
Universal growth equation:	$X / X_o = e^{\mu t}$
Monod equation:	$\mu = \mu_{\max} \left(\frac{S}{S + K_s} \right)$
Biomass concentration:	$x_t = x_o + Y(S_R - s)$ $x_{\max} = Y \cdot S_R$
Probability of extinction:	$P_o(t) = [1 - p(t)]^{N_o}$ $p(t) = e^{-k_d t}$
Specific death rate:	$k_d = \alpha e^{\frac{-E_{od}}{R \cdot T}}$
Decimal reduction time:	$N(t) = N_o e^{-k_d t}$ $D = 2.303 / k_d$
Oxygen uptake rate:	$\text{OUR} = X \times q_{O_2}$
Oxygen transfer rate:	$\text{OTR} = k_L a (C^* - C_L)$

