BIOPROCESS & PROCESS INSTRUMENTATION
(BIOT 3133)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

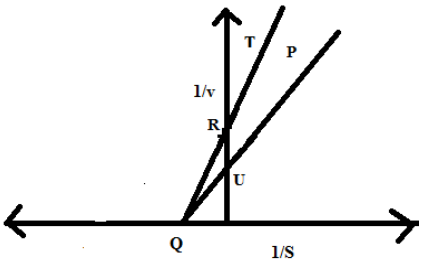
Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) What is the recommended unit of enzyme activity?
(a) Katal (b) mM (c) mM/h (d) All the above

(ii) Which of the following is used as indication instrument in a liquid expansion system?
(a) Bellows (b) Bourdon tube (c) Ammeter (d) Thermometer

(iii) Identify Q, R, U, P and T respectively from the graph below.



(a) $-1/K_m$, $-1/V_{m,app}$, $1/V_{max}$, [I]=0, [I]>0
(b) $-1/K_{m,app}$, $-1/K_m$, $1/V_{max}$, [I]=0, [I]>0
(c) $-1/K_{m,app}$, $-1/K_m$, $1/V_{max}$, [I]>0, [I]=0
(d) , $1/V_{max}$, , $1/V_{max,app}$, $-1/K_m$, [I]=0, [I]>0

(iv) The phenomenon in which substrates are used in a sequential manner is known as
(a) trans-substrate genesis (b) dialism
(c) diauxic (d) multiplicity

(v) An example of an unsteady state reactor is
(a) Fed batch reactor (b) Continuous reactor
(c) Batch reactor (d) All of the above

(vi) Wash out in steady state fermentation occurs when
(a) dilution rate is less than maximum specific growth rate
(b) dilution rate is higher than the maximum specific growth rate
(c) cell concentration reaches the maximum
(d) specific growth rate is maximum

(vii) The maximum specific growth rate of an organism depends on
(a) medium composition (b) temperature
(c) pH (d) All of these

(viii) In sterilization process, spore of which of the following organism is considered as control?
(a) Bacillus subtilis (b) Clostridium botulinum
(c) Bacillus stearothermophilus (d) Aspergillusniger

(ix) Stationary phase is described as
(a) no further increase in the cell population after a maximum value
(b) deceleration of growth and division rate after the growth rate reaches a maximum
(c) acceleration of growth and division rate after the growth rate reaches a maximum
(d) deceleration of growth and division rate after the growth rate reaches a minimum

(x) The hydrogen ion content in water goes from 0.203 g/l he hydrogen ion content in water goes from 0.203 g/l to 0.0032 g/l. How much does the pH change?
(a) 1.805 (b) -1.805 (c) 0.9 (d) -0.9

Group- B

2. (a) Derive a batch kinetic mathematical model for enzyme substrate reaction. [(CO1) (Understand/LOCQ)]

(b) Compare different types of enzyme inhibition graphically while explaining the differences explicitly. [(CO1) (Understand/LOCQ)]

6 + 6 = 12

3. An inhibitor I is added to the enzymaztic reaction at a level of 1.0g/l. The following data were obtained for K_m= 9.2g/l. Identify the type of inhibition and find K_I .

v, g/(L.min)	0.909	0.658	0.493	0.4	0.333	0.289	0.227
S, g/L	20	10	6.67	5	4	3.33	2.5

[(CO1)(Analyse/IOCQ)]

12

Group - C

4. (a) Mathematically prove that as time approaches to infinity , the number of viable organism approaches to zero in a liquid media during heat sterilisation. [(CO3) (Critique/HOCQ)]

   (b) State the advantages of batch sterilisation method. [(CO3) (Remember/LOCQ)]

6 + 6 =12

5. A medium containing vitamin is to be sterilised. Assume the number of spores initially present is 1,00,000/litre. The initial concentration of vitamin is 15 mg/L. What is the amount of active vitamin in the sterile medium of 10 litre when sterilised at 121°C, if probability of unsuccessful sterilisation is 0.001. Ignore the effect of heat up and cool-down periods.

   Data: Activation energy (E) and Arrhenius constant (A) are as follows
   For inactivation of spores:
   E= 65 Kcal/gmol
   $A = 1 \times 10^{36}$ min^{-1}

   For inactivation of vitamin:
   E= 20 Kcal/gmol
   $A = 1 \times 10^{4}$ min^{-1}. [(CO3) (Evaluate/HOCQ)]

12

Group - D

6. Derive an equation for optimum dilution rate based on cell productivity. [(CO4) (Analysis/IOCQ)]

12

7. A simple, batch fermentation of an aerobic bacterium growing on methanol gave the results shown in the table. Calculate:
   (a) Maximum growth rate(μ_{max}) (b) Yield on substrate ($Y_{x/s}$)
   (c) Mass doubling time (d) Specific growth rate at t=10h

Time, h	0	2	4	8	10	12	14	16	18
X, g/L	0.2	0.211	0.305	0.98	1.77	3.2	5.6	6.15	6.2
S, g/L	9.23	9.21	9.07	8.03	6.8	4.6	0.92	0.077	0

[(CO1)(Evaluate/IOCQ)]

12

Group - E

8. (a) Explain the principle of thermistor. [(CO6) (Understand/IOCQ)]

   (b) Why is mercury used in glass thermometer? [(CO6) (Remember/LOCQ)]

6 + 6 = 12

9. (a) Explain the principle of bellow resistance pressure sensors. [(CO6) (Critique/HOCQ)]

(b) What is radiation pyrometer? State the advantages of radiation method for temperature measurement? [(CO6) (Analysis/IOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	25%	50%	25%

Course Outcome (CO):

At the end of this course students will be able to:

1. Understand the mechanism of enzyme action on a substrate explicitly.
2. Apply the above concepts to solve problems in the enzyme technology field.
3. Comprehend and solve any problem regarding sterilization of the medium used in fermentation.
4. Compare between a batch process and a continuous process regarding microbial growth.
5. Classify a microbial product and determine its productivity.
6. Appreciate the operation of different process instruments used for measuring various operating parameters of a bioprocess.

LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
BT	https://classroom.google.com/c/NDU0OTAyODgxNTQw/a/NDU0OTAyODgxNTc3/details