ME B10 – 12

123

Exam.Code:1033
Sub. Code: 35400

2056

M.E. (Bio-Technology) Second Semester

ME-BIO-203: Enzyme Engineering

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section. State clearly your assumptions.

x-x-x

Q. 1) Write briefly: *(2×5 =10)*

a) Effect of substrate concentration on enzyme activity.

b) Define extracellular and intracellular enzyme with examples?

c) What are the functions of amylase, protease and lipase enzyme?

d) Name the various methods of 'Enzyme Immobilization' in Block diagram.

e) In case of immobilized enzymes, the equation $V = K_L(S_b - S_s) = \frac{V_{max}.S}{K_m+S+S^2/K_s}$ represents _____.

SECTION – A

Q. 2. a) The protein catalyzes the reaction:

$$2H_2O_2 \text{----> } 2H_2O + O_2$$

And has a K_m 25 $\times 10^{-3}$ and turn over number 4.0 $\times 10^{7}$ s^{-1}. Calculate the initial velocity of this reaction if the total enzyme concentration is 0.016 $\times 10^{-6}$ and the initial substrate concentration is 4.32 $\times 10^{-4}$M. Calculate V_{max} for this enzyme.

b) Derive a rate of expression (V) for substrate inhibition kinetics and show that at maximum reaction rate of substrate concentration is

$$S_{max} = \sqrt{K_m \times K_S}$$

c) Derive the rate of expression (V) for different type of enzyme inhibitions. *(4, 3, 3)*

Q. 3. a) An enzyme catalyzed reaction (K_m = 2.7x10^{-3} M) is inhibited by a competitive inhibitor I (K_I = 3.1x10^{-5}). Suppose that the substrate concentration is 3.6x10^{-4}. How much the inhibitor is needed for 65% inhibition? How much does the substrate concentration have to be increased to reduce the inhibition to 25%?

b) Defined Biocatalyst and what are differences between Biocatalyst and Chemical catalyst?

c) If Enzyme follows the deactivation kinetics, what will be effect of V_{max} and K_m, explain. *(5, 3, 2)*

Q. 4. a) The enzymatic hydrolization of fish oil extract from crude oil has been carried out using lipase. One of the desired products is docosahexaenic. For the enzyme V_{max} = 0.00266 µmol/min. and K_m 0.052 M. The initial concentration of substrate 0.1M .Calculate the time needed to convert 80% substrate conversion .the reaction is carried out under isothermal conditions. If the enzyme is used as deactivates with half life 4.4hrs, what is the time required for 90% substrate conversion?

b) The given enzymatic reaction scheme:

$$E + S \leftrightarrow ES \leftrightarrow E + P$$

The equilibrium constant for the given reaction is 5. Suppose we have a mixture of

[S] = 2×10^{-4} M and [P] = 3×10^{-4} M.

What initial velocity will the reaction start towards equilibrium? If

K_m^S = 3×10^{-5} M, V_{max}^S = 2 µ moles.$lit^{-1}min.^{-1}$, V_{max}^P = 4 µ moles.$lit^{-1}min.^{-1}$.

(7, 3)

P.T.O.

SECTION – B

Q. 5) Write a critical review on "enzyme immobilization advanced" *(10)*

Q. 6 a) Discuss various idealized enzyme reactor systems. Discuss which you justified to be the best?

b) Immobilized lactose is used to hydrolyze lactose in dairy waste to glucose and galactose. Enzyme is immobilized in resin particles and packed into at 0.05 m^3 Plug – flow column. The total effectiveness factor for the system is close to unity; K_m for the immobilized enzyme is 1.32 kg m^{-3}; V_{max} is 45 kg m^{-3} h^{-1}. The lactose concentration in the feed stream is 9.5 kg m^{-3}; a substrate conversion is 98% is required. At what flow rate should the reactor be operated? *(5, 5)*

Q. 7 a) An enzymatic reaction follows M-M kinetics with V_{max} = 15 mmol m^{-3} s^{-1} and K_m = 5 mM. The reaction was carried out in batch reactor. Starting with an initial substrate concentration of 0.5 M, Calculate the time required for 50% conversion of the substrate?

b) Enzymatic isomerization glucose to fructose can be expressed by reaction mechanism:

$$E + S \leftrightarrow ES \leftrightarrow E + P$$

The kinetic parameter is:

$$\frac{V_{m,s}}{K_{m,s}} = 0.128 \quad , \quad \frac{V_{m,p}}{K_p} = 0.098 \quad , \quad \frac{1}{K_{m,s}} = 0.383 \quad , \quad \frac{1}{K_p} = 0.25$$

If the feed (glucose) concentration is 1.0 kg mole/liter and desired conversion is 40%. Calculate the productivity in above reaction mechanism in CSTR. *(4, 6)*

x-x-x