Name: _____

Entry no: _____

QUIZ-03

ENZYME SCIENCE AND ENGINEERING

DEPARTMENT OF BIOCHEMICAL ENGG AND BIOTECHNOLOGY-IIT DELHI

21/3/2023 5 x 1 marks

1. Invertase (b-fructofuranosidase, EC 3.2.1.26) catalyzes the inversion of sucrose, according to:

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + H_2O \rightarrow \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6}$$

A CPBR operates with Saccharomyces cerevisiae invertase immobilized in the surface of chitin flakes. The catalyst has a specific activity of 800 IU/g (1 IU is defined as the amount of enzyme hydrolyzing 1µmol of sucrose per minute at reaction conditions). The enzyme is inhibited by glucose. The Michaelis constant is 30mM and the inhibition constant is 150 mM. Determine the mass of catalyst required to process 450 L/h of sugarcane molasses containing 171 g/L of sucrose (S) if 90% steady-state sucrose conversion into glucose plus fructose is required in order to prepare invert sugar for confectionery. Solve assuming that glucose is a competitive inhibitor of invertase.

Remember $V_{max} = K_{cat}.e$, where e is enzyme loading per unit volume of reactor.

Product inhibition → competitive / Non-competitive.

$a_{sp} = 0.8 \text{ m mol/min/g} = 48 \text{ mmol } h^{-1} g^{-1}$

$S_i = 171 \text{ g/L} = 500 \text{ mM}$

$K_m = 30 \text{ mM}$

$K_i = 150 \text{ mM}$

$F = 450 \text{ L/h}$

[1]

① Rate law. [1]

② Integrate for mass balance. [1]

Competitive inhibition

$$\frac{K_{cat} \cdot E}{K_m \cdot F} = S_i \cdot X\left[\frac{1}{K_m} - \frac{K}{K_i}\right] - \left[1 + \frac{S_i}{K_i}\right] \ln(1-X)$$

[4]

Non-competitive inhibition

$$\frac{E \cdot 48}{30 \cdot 450} = 21.98$$

$E = 6181.8 \text{ g}$

[5]