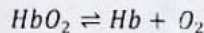


Quiz-1, BT209, Date: 22/02/2024

Q1. Find the first-order rate constant for the disappearance of A in the gas reaction  $A \rightarrow 1.6R$  if the volume of the reaction mixture, starting with pure A increases by 50% in 4 min. The total pressure within the system stays constant at 1.2 atm, and the temperature is 25°C.

Q2. When arterial blood enters a tissue capillary, it exchanges oxygen and carbon dioxide with its environment. The kinetics of deoxygenation of hemoglobin in blood was studied with the aid of a tubular reactor.



Although this is a reversible reaction, measurements were made in the initial phases of the decomposition so that the reverse reaction could be neglected. The solution enters a tubular reactor (radius,  $R = 0.079$  cm) that has oxygen electrodes placed at 5 cm intervals down the tube. The solution flow rate into the reactor is  $19.6 \text{ cm}^3/\text{sec}$ . Assume the initial concentration of  $HbO_2$  to be 150 g/liter and molecular weight of  $HbO_2$  to be 64500 g/mol.

Electrode Position (z, cm)	0	5	10	15	20	25	30
Percent Decomposition of $HbO_2$	0.00	1.93	3.82	5.68	7.48	9.25	11.00

(a) Find the initial concentration of  $HbO_2$  in terms of mol/liter.

(b) Derive the PFR design equation  $-r_A = \frac{F_{A0}}{\pi R^2} \frac{dX_A}{dz}$ , where z is axial distance along the reactor.

(c) Assuming  $\left(\frac{dX_A}{dz}\right)_{z_i} = \frac{X_{A,i} - X_{A,i-1}}{z_i - z_{i-1}}$ , make a table for  $-r_A$  vs  $C_A$  where  $A = HbO_2$ .

(d) Determine the reaction order and the forward specific reaction rate constant  $k$  for the deoxygenation of hemoglobin.

Handwritten calculations on the right margin:  
 $1.9812 \times 10^{-4} \times 10^5$   
 $1.9812 \times 10$   
 $9.812$