

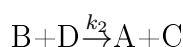
assignment 1

(due before class on 16 Oct 2020)

1. Consider the first-order reversible reaction involving two steps : $A_1 \xrightleftharpoons[k_{-1}]{k_1} A_2 \xrightleftharpoons[k_{-2}]{k_2} A_3$

Assuming that initially at time $t = 0$, $[A_1] = [A_1]_0$ and $[A_2]_0 = [A_3]_0 = 0$, obtain expressions for $[A_1]$, $[A_2]$ and $[A_3]$ and the equilibrium constant for the overall reaction $A_1 \rightleftharpoons A_3$

2. The reaction $A+B \rightarrow C+D$ takes place in two steps, by the following mechanism :



The first step comes to a rapid equilibrium (constant K_1). Obtain rate of formation of C in terms of K_1 , k_2 and $[A]$ and $[B]$.

3. A reaction has the stoichiometry $2A + 2B \rightarrow Y + 2Z$; rate of reaction, $v = k [A]^\alpha [B]^\beta$

Some results for the rate of consumption of A are shown below:

$[A]/\text{mol dm}^{-3}$	$[B]/\text{mol dm}^{-3}$	$v/\text{mol dm}^{-3}\text{s}^{-1}$
1.4×10^{-2}	2.3×10^{-2}	7.4×10^{-9}
2.8×10^{-2}	4.6×10^{-2}	5.92×10^{-8}
2.8×10^{-1}	4.6×10^{-2}	5.92×10^{-6}

Deduce α and β and the rate constant k .

4. (a) Integrate the rate equation for an autocatalytic reaction of the form $A \rightarrow P$, with rate law $v = k[A][P]$, and show that

$$\text{or, } \frac{[P]}{[P]_0} = \frac{(1+b)e^{at}}{1+be^{at}}, \text{ where } a = ([A]_0 + [P]_0)k \text{ and } b = \frac{[P]_0}{[A]_0}$$

- (b) Plot $\frac{[P]}{[P]_0}$ against $a.t$ for several values of b . Discuss the effect of autocatalysis on the shape of a plot of $\frac{[P]}{[P]_0}$ against t by comparing your results with those for a first-order process, (c) Show that the reaction rate reaches a maximum at $t_{\max} = -\frac{1}{a} \ln b$.