UNIVERSITY OF TEESSIDE

School of Science and Technology
Microbial and Enzyme Kinetics

Enzyme Kinetics Tutorial 2b

Background.

Rates of reaction are conventionally expressed in terms of concentration of reactant. However in some cases, it is more convenient to follow the formation of product. In this case, the rate equations need to be modified.

For a first order reaction of the form A -> P, the concentration of reactant at time t is C_A, that of product is C_P. If the stoichiometry is 1:1 and the reaction goes to completion, the concentration of product will be C_{Pf}.

Writing the rate equation gives

$$-r_A = r_P = kC_A = k\left(C_{Pf} - C_P\right) \qquad (1)$$

It can be shown that the concentration of product at any time, t is given by

$$\ln\left(\frac{C_{Pf}}{C_{Pf} - C_P}\right) = kt \qquad (2)$$

Thus a graph of $\ln\{C_{Pf}/(C_{Pf}-C_P)\}$ vs time will give a straight line through the origin.

Problems

1. A reaction of the form A -> B is monitored by following the formation of product. For an initial concentration of reactant of 0.1 M, the following concentrations of product were measured

Time/min	0	5	10	15	20	25	30
Conc^n /M	0.000	0.016	0.031	0.038	0.051	0.057	0.061

Show that the reaction is first order, calculate the rate constant, k and the half life, $t_{½}$.

2. An enzyme catalysed reaction of the form

S ⇔ P

Has a ΔG° value of –2.4 kJ mol^{-1}.

a. Calculate the equilibrium constant at 298 K

b. If we start with a solution containing 0.1 M substrate, what is the concentration at equilibrium?

Universal Gas constant R = 8.314 kJ kmol^{-1}.
Note that 1 kJ mol^{-1} = 1000 kJ kmol^{-1} (1000 J mol^{-1})