where $K_m = \dfrac{k_{-1} + k_2}{k_1}$ and $K_p = \dfrac{k_{-1} + k_2}{k_{-2}}$ and $V_s = k_2[E_0]$, $V_p = k_{-1}[E_0]$ ·

3.3. The enzyme, fumarase, has the following kinetic constants:

$$S + E \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_2} P + E$$

where $k_1 = 10^9\ M^{-1}\ s^{-1}$
$k_{-1} = 4.4 \times 10^4\ s^{-1}$
$k_2 = 10^3\ s^{-1}$

a. What is the value of the Michaelis constant for this enzyme?

b. At an enzyme concentration of $10^{-6}\ M$, what will be the initial rate of product formation at a substrate concentration of $10^{-3}\ M$?

[Courtesy of D. J. Kirwan from "Collected Coursework Problems in Biochemical Engineering" compiled by H. W. Blanch for 1977 Am. Soc. Eng. Educ. Summer School.]

3.4. The hydration of CO_2 is catalyzed by carbonic anhydrase as follows:

$$H_2O + CO_2 \overset{E}{\rightleftharpoons} HCO_3^- + H^+$$

The following data were obtained for the forward and reverse reaction rates at pH 7.1 and an enzyme concentration of $2.8 \times 10^{-9}\ M$.

Hydration		Dehydration	
$1/v$, M^{-1} ($s \times 10^{-3}$)	$[CO_2]$ ($M \times 10^3$)	$1/v$, M^{-1} ($s \times 10^{-3}$)	$[HCO_3^-]$ ($M \times 10^3$)
36	1.25	95	2
20	2.5	45	5
12	5	29	10
6	20	25	15

v is the *initial* reaction rate at the given substrate concentration. Calculate the forward and reverse catalytic and Michaelis constants.
[Courtesy of D. J. Kirwan from "Collected Coursework Problems in Biochemical Engineering" compiled by H. W. Blanch for 1977 Am. Soc. Eng. Educ. Summer School.]

3.5. An inhibitor (I) is added to the enzymatic reaction at a level of 1.0 g/l. The following data were obtained for $K_m = 9.2$ g S/l.

v	S
0.909	20
0.658	10
0.493	6.67
0.40	5
0.333	4
0.289	3.33
0.227	2.5