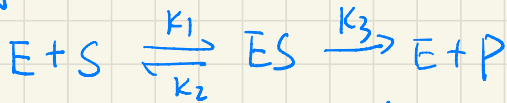


① Enzyme Kinetics: Rates of change.



Four equations for the rate of changes (E, S, ES, P):

$$\frac{d(E)}{dt} = (k_2 + k_3)(ES) - k_1(S)(E)$$

$$\frac{d(S)}{dt} = k_2(ES) - k_1(S)(E)$$

$$\frac{d(ES)}{dt} = k_1(E)(S) - (k_2 + k_3)(ES)$$

$$\frac{d(P)}{dt} = k_3(ES)$$

② $E = 1 \mu M$ $S = 10 \mu M$ $ES = P = 0$.

$k_1 = 100/\mu M/min$ $k_2 = 600/\mu M/min$ $k_3 = 150/\mu M/min$.

$$\frac{d(E)}{dt} = (600 + 150) \times 0 - 100(10)(1) = -1000$$

$$\frac{d(S)}{dt} = 600 \times 0 - 100(10)(1) = -1000$$

$$\frac{d(ES)}{dt} = 100(10)(1) - (600 + 150)(0) = 1000$$

$$\frac{d(P)}{dt} = 150(0) = 0$$

③ steady-state approximation:

$$\frac{d(ES)}{dt} = 0$$

$$\text{since } E_0 = E + ES$$

$$\therefore \text{we have } E = E_0 - ES$$

$$K_1(S)(E) = K_2(ES)$$

$$K_1(S)(E_0 - ES) = K_2 ES$$

$$K_1(S)(ES) = K_1(S)(E_0) - K_2 ES$$

$$(K_1(S) + K_2)(ES) = K_1(S)(E_0)$$

$$ES = \frac{K_1(S)(E_0)}{K_1(S) + K_2} = \frac{K_1 S(E_0) \div K_1}{(K_1(S) + K_2) \div K_1} = \frac{S(E_0)}{S + K_2/K_1}$$

since V is the rate of change of the product P .

$$V = \frac{d(P)}{dt} = K_3(ES) \\ = K_3 \cdot \frac{S(E_0)}{S + K_2/K_1}$$

$$\text{Let } V_{\max} = K_3(E_0)$$

$$V = V_{\max} \cdot \frac{S}{S + K_2/K_1}$$

Plot: V

