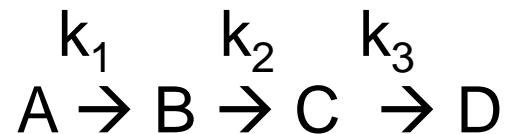


# Steady-state approximation

Consider a general reaction shown in the rate scheme:

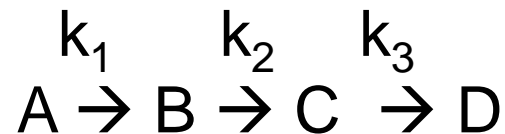


Express the rate scheme in terms of kinetic equations.

Assuming that  $k_2 \gg k_1$  and  $k_3 \gg k_2$  determine an expression for the rate of formation of product D as a function of the concentration of the starting compound A.

# Steady-state approximation

Consider a general reaction shown in the rate scheme:



Express the rate scheme in terms of kinetic equations.

**Solution:** First we express the mechanistic rate scheme in terms of kinetic equations.

$$\begin{aligned}\frac{d[A]}{dt} &= -k_1[A] \\ \frac{d[B]}{dt} &= k_1[A] - k_2[B] \\ \frac{d[C]}{dt} &= k_2[B] - k_3[C] \\ \frac{d[D]}{dt} &= k_3[C]\end{aligned}$$

# Steady-state approximation

Assuming that  $k_2 \gg k_1$  and  $k_3 \gg k_2$  determine an expression for the rate of formation of product D as a function of the concentration of the starting compound A.

$$\frac{d[B]}{dt} = k_1[A] - k_2[B] \approx 0$$

Therefore,

$$k_1[A] = k_2[B]$$

$$\frac{d[C]}{dt} = k_2[B] - k_3[C] \approx 0$$

Therefore,

$$k_1[A] = k_2[B] = k_3[C]$$

# Steady-state approximation

Since

$$k_1[A] = k_2[B] = k_3[C]$$

Finally, we can write

$$\frac{d[D]}{dt} = k_1[A]$$