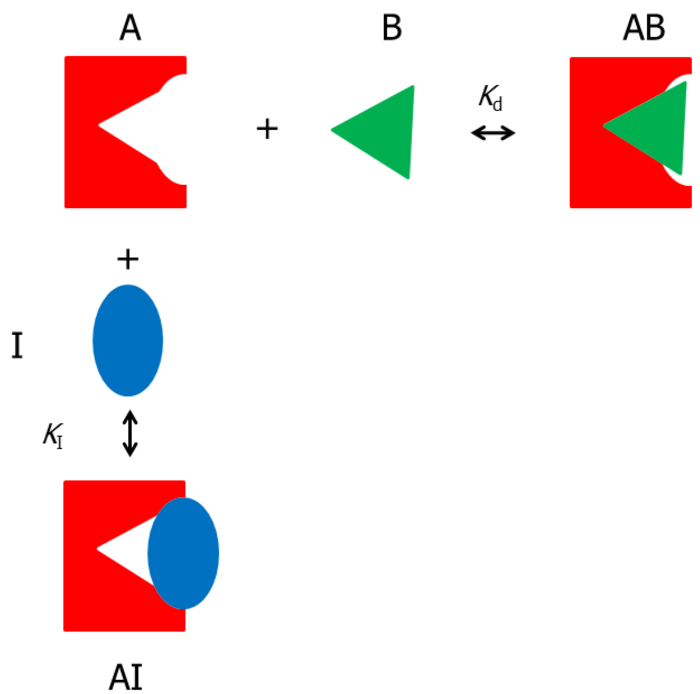
Competitive inhibition model



Reactant B binding to reactant A is competitively inhibited by inhibitor I

K_d = Dissociation constant of A and B binding
K_i = Dissociation constant of A and I binding

In the reaction sample you know…

Total reactant A concentration = A_0
Total reactant B concentration = B_0
Total inhibitor I concentration = I_0

However, you do not know…

Free reactant A concentration
Free reactant B concentration
Free inhibitor I concentration
Free product AI concentration
Free product AB concentration

Suppose you can indirectly determine concentration of product AB by a method which gives you values (activity, optical density, peak height, etc.) proportional to the concentration.

(Activity value) = k1 × [AB] (concentration).

If AI complex also contribute activity values (usually not!), actual activity values are

(Activity value) = *k*1 × [AB] (concentration) + *k*2 × [AI] (concentration)

By performing curve fitting you try to obtain…

K_d, K_i, *k*1, and *k*2 values

In this example (data sets) concentration of A_0 is fixed. Each data set was generated after measuring activity values in the presence of fixed concentration of B_0 after adding various concentration of I_0.

independent variable (x1 values) is I_0
dependent variable (y values) is activity.

There are two equations in each data set (total of four sets).

$$y = \frac{k1 \cdot B_0 \cdot A}{(K_d + A)} + \frac{k2 \cdot I_0 \cdot A}{(K_i + A)}$$

$$A_0 - A - \frac{B_0 \cdot A}{(K_d + A)} - \frac{I_0 \cdot A}{(K_i + A)} = 0$$

(Newton Raphson equation)

Press "**Fill Sheet with selected example data**" button to generate a new sheet filled with example data sets.

Described below are the input texts of equations according to "Curve Fitter Excel Add-in" syntax.

DataSet 1 (A_0 = 20, B_0 = 20)
y=p3*20*n1/(p1+n1)+p4*x1*n1/(p2+n1)
f=20-n1-20*n1/(p1+n1)-x1*n1/(p2+n1)

DataSet 2 (A_0 = 20, B_0 = 40)
y=p3*40*n1/(p1+n1)+p4*x1*n1/(p2+n1)
f=20-n1-40*n1/(p1+n1)-x1*n1/(p2+n1)

DataSet 3 (A_0 = 20, B_0 = 60)
y=p3*60*n1/(p1+n1)+p4*x1*n1/(p2+n1)
f=20-n1-60*n1/(p1+n1)-x1*n1/(p2+n1)

DataSet 4 (A_0 = 20, B_0 = 80)
y=p3*80*n1/(p1+n1)+p4*x1*n1/(p2+n1)
f=20-n1-80*n1/(p1+n1)-x1*n1/(p2+n1)

K_d = p1
K_i = p2
*k*1= p3
*k*2 = P4
free reactant Aconcentration = n1 (determined by Newton Raphson method)

*In reality determine p1 and p3 values by fitting data set in the absence of inhibitor (I) separately. (Also determine p4 by an experiment in the absence of reactant B.) Then plug-in those value to the above equation and obtain p2 value by curve fitting.