# Enzyme Inhibition: Competitive, Non-Competitive and Uncompetitive

Reaction rate of an enzyme with an inhibitor for competitive, non-competitive or uncompetitive inhibition, with the apparent K_m and V_max and the inhibition.

**Method:** Michaelis–Menten kinetics with reversible inhibition

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Kind of inhibition | Competitive | |
| Maximum rate without inhibitor | 10.000 | mmol/L |
| Michaelis constant | 2.0000 | mmol/L |
| Substrate concentration | 5.0000 | mmol/L |
| Inhibitor concentration | 1.0000 | mmol/L |
| Inhibition constant | 0.50000 | mmol/L |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Rate without inhibitor (per unit time) | 7.1429 | mmol/L |
| Rate with inhibitor (per unit time) | 4.5455 | mmol/L |
| Apparent Michaelis constant | 6.0000 | mmol/L |
| Apparent maximum rate | 10.000 | mmol/L |
| Inhibition | 36.364 | % |

**Notes for this case**

• A competitive inhibitor competes for the active site: K_m rises by (1 + I/K_i) and V_max is unchanged, so plenty of substrate overcomes it. A non-competitive inhibitor (equal binding to enzyme and complex) lowers V_max by that factor and leaves K_m. An uncompetitive inhibitor binds only the enzyme–substrate complex and lowers both K_m and V_max by the same factor. Rates are in the concentration unit per the time unit of V_max.

## Formula and method

$$v = \frac{V_{max}^{app} S}{K_m^{app} + S}, \quad \text{competitive}: \; K_m^{app} = K_m \left(1 + \frac{I}{K_i}\right), \quad \text{non-competitive}: \; V_{max}^{app} = \frac{V_{max}}{1 + I/K_i}$$

### Variables

| | | |
|---|---|---|
| $\text{type}$ | Kind of inhibition | - |
| $V_{max}$ | Maximum rate without inhibitor | mol/m³ |
| $K_m$ | Michaelis constant | mol/m³ |
| $S$ | Substrate concentration | mol/m³ |
| $I$ | Inhibitor concentration | mol/m³ |
| $K_i$ | Inhibition constant | mol/m³ |
| $v_0$ | Rate without inhibitor (per unit time) | mol/m³ |
| $v$ | Rate with inhibitor (per unit time) | mol/m³ |
| $K_m^{app}$ | Apparent Michaelis constant | mol/m³ |
| $V_{max}^{app}$ | Apparent maximum rate | mol/m³ |
| $1 - v/v_0$ | Inhibition | - |

### Method and standards

Enzyme inhibition.

### Assumptions and limits

- Rapid-equilibrium Michaelis–Menten kinetics; one inhibitor.

### References

Michaelis–Menten kinetics with reversible inhibition

## Report details

| | |
|---|---|
| Report reference | FCC-WH0D-YAAJ (the same inputs always give the same reference) |
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| Release checks | 3 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/chemical/bioprocess/enzyme-inhibition-kinetics

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.