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Important Formulas on Enzyme Kinetics

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List of 26 Important Formulas on Enzyme Kinetics

Important Formulas on Enzyme Kinetics

1) Catalytic Rate Constant from Michaelis Menten Kinetics Equation

Open Calculator

fx $$k_{cat\_MM} = \frac{V_0 \cdot (K_M + S)}{([E_0]) \cdot S}$$

ex $$0.0135s^{-1} = \frac{0.45mol/L*s \cdot (3mol/L + 1.5mol/L)}{100mol/L \cdot 1.5mol/L}$$

2) Catalytic Rate Constant if Substrate Concentration is higher than Michaelis Constant

Open Calculator

fx $$k_{cat} = \frac{V_{max}}{[E_0]}$$

ex $$0.4s^{-1} = \frac{40mol/L*s}{100mol/L}$$

3) Dissociation Constant of Enzyme given Modifying Factor of Enzyme

Open Calculator

fx $$K_{ei} = \frac{I}{\alpha - 1}$$

ex $$2.25mol/L = \frac{9mol/L}{5 - 1}$$

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4) Dissociation Rate Constant in Enzymatic Reaction Mechanism

Open Calculator

fx $$K_D = \frac{k_r}{k_f}$$

ex $$2.898551\text{mol/L} = \frac{20\text{mol/L*s}}{6.9\text{s}^{-1}}$$

5) Enzyme Catalyst Concentration given Forward, Reverse, and Catalytic Rate Constants

Open Calculator

fx $$E = \frac{(k_r + k_{cat}) \cdot ES}{k_f \cdot S}$$

ex $$19.3243\text{mol/L} = \frac{(20\text{mol/L*s} + 0.65\text{s}^{-1}) \cdot 10\text{mol/L}}{6.9\text{s}^{-1} \cdot 1.5\text{mol/L}}$$

6) Enzyme Concentration from Michaelis Menten Kinetics equation

Open Calculator

fx $$([E_i]) = \frac{V_0 \cdot (K_M + S)}{k_{cat} \cdot S}$$

ex $$2.076923\text{mol/L} = \frac{0.45\text{mol/L*s} \cdot (3\text{mol/L} + 1.5\text{mol/L})}{0.65\text{s}^{-1} \cdot 1.5\text{mol/L}}$$

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7) Enzyme Substrate Complex Concentration for Competitive Inhibition of Enzyme Catalysis

Open Calculator

$$ES = \frac{S \cdot ([E_0])}{K_M \cdot \left(1 + \left(\frac{I}{K_i}\right)\right) + S}$$

$$25.33333\text{mol/L} = \frac{1.5\text{mol/L} \cdot 100\text{mol/L}}{3\text{mol/L} \cdot \left(1 + \left(\frac{9\text{mol/L}}{19\text{mol/L}}\right)\right) + 1.5\text{mol/L}}$$

8) Final Rate Constant for Competitive Inhibition of Enzyme Catalysis

Open Calculator

$$k_{final} = \frac{V_0 \cdot \left(K_M \cdot \left(1 + \left(\frac{I}{K_i}\right)\right) + S\right)}{([E_0]) \cdot S}$$

$$0.017763\text{s}^{-1} = \frac{0.45\text{mol/L*s} \cdot \left(3\text{mol/L} \cdot \left(1 + \left(\frac{9\text{mol/L}}{19\text{mol/L}}\right)\right) + 1.5\text{mol/L}\right)}{100\text{mol/L} \cdot 1.5\text{mol/L}}$$

9) Forward Rate Constant given Dissociation Rate Constant

Open Calculator

$$k_f = \left(\frac{k_r}{K_D}\right)$$

$$3.508772\text{s}^{-1} = \left(\frac{20\text{mol/L*s}}{5.7\text{mol/L}}\right)$$

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10) Inhibitor Concentration for Competitive Inhibition of Enzyme Catalysis

Open Calculator

fx $$I_{IEC} = \left(\left(\frac{\left(\frac{k_2 \cdot ([E_0]) \cdot S}{V_0} \right) - S}{K_M} \right) - 1 \right) \cdot K_i$$

ex $$48527.06\text{mol/L} = \left(\left(\frac{\left(\frac{23\text{s}^{-1} \cdot 100\text{mol/L} \cdot 1.5\text{mol/L}}{0.45\text{mol/L*s}} \right) - 1.5\text{mol/L}}{3\text{mol/L}} \right) - 1 \right) \cdot 19\text{mol/L}$$

11) Inhibitor Concentration given Apparent Initial Enzyme Concentration

Open Calculator

fx $$I_{CI} = \left(\left(\frac{[E_0]}{E0^{app}} \right) - 1 \right) \cdot K_i$$

ex $$31647.67\text{mol/L} = \left(\left(\frac{100\text{mol/L}}{0.06\text{mol/L}} \right) - 1 \right) \cdot 19\text{mol/L}$$

12) Inhibitor Concentration given Enzyme Substrate Modifying Factor

Open Calculator

fx $$I = \left(\alpha' - 1 \right) \cdot (K_i')$$

ex $$15\text{mol/L} = (2 - 1) \cdot 15\text{mol/L}$$

13) Inhibitor Concentration in Competitive Inhibition given Maximum Rate of System

Open Calculator

fx $$I_{max} = \left(\left(\frac{\left(\frac{V_{max} \cdot S}{V_0}\right) - S}{K_M}\right) - 1\right) \cdot K_i$$

ex $$815.9444\text{mol/L} = \left(\left(\frac{\left(\frac{40\text{mol/L*s} \cdot 1.5\text{mol/L}}{0.45\text{mol/L*s}}\right) - 1.5\text{mol/L}}{3\text{mol/L}}\right) - 1\right) \cdot 19\text{mol/L}$$

14) Initial Concentration of Enzyme in presence of Inhibitor by Enzyme Conservation Law

Open Calculator

fx $$([E_{initial}]) = (E + ES + EI)$$

ex $$64\text{mol/L} = (25\text{mol/L} + 10\text{mol/L} + 29\text{mol/L})$$

15) Initial Enzyme Concentration if Substrate Concentration is Higher than Michaelis Constant

Open Calculator

fx $$([E_{initial}]) = \frac{V_{max}}{k_{cat}}$$

ex $$61.53846\text{mol/L} = \frac{40\text{mol/L*s}}{0.65\text{s}^{-1}}$$

16) Initial Enzyme Concentration given Dissociation Rate Constant

Open Calculator

$$([E_{initial}]) = \frac{ES \cdot (K_D + S)}{S}$$

$$48mol/L = \frac{10mol/L \cdot (5.7mol/L + 1.5mol/L)}{1.5mol/L}$$

17) Initial Rate in Competitive Inhibition given Maximum Rate of system

Open Calculator

$$V_{CI} = \frac{V_{max} \cdot S}{K_M \cdot \left(1 + \left(\frac{I}{K_i}\right)\right) + S}$$

$$10.13333mol/L*s = \frac{40mol/L*s \cdot 1.5mol/L}{3mol/L \cdot \left(1 + \left(\frac{9mol/L}{19mol/L}\right)\right) + 1.5mol/L}$$

18) Initial Rate of System given Rate Constant and Enzyme Substrate Complex Concentration

Open Calculator

$$V_{RC} = k_2 \cdot ES$$

$$230mol/L*s = 23s^{-1} \cdot 10mol/L$$

19) Initial Reaction Rate given Dissociation Rate Constant

Open Calculator

$$V_{DRC} = \frac{V_{max} \cdot S}{K_D + S}$$

$$8.333333mol/L*s = \frac{40mol/L*s \cdot 1.5mol/L}{5.7mol/L + 1.5mol/L}$$

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20) Maximum Rate given Dissociation Rate Constant

Open Calculator

$$V_{max\_DRC} = \frac{V_0 \cdot (K_D + S)}{S}$$

$$2.16\text{mol/L*s} = \frac{0.45\text{mol/L*s} \cdot (5.7\text{mol/L} + 1.5\text{mol/L})}{1.5\text{mol/L}}$$

21) Maximum Rate if Substrate Concentration is Higher than Michaelis Constant

Open Calculator

$$V_{max} = k_{cat} \cdot ([E_0])$$

$$65\text{mol/L*s} = 0.65\text{s}^{-1} \cdot 100\text{mol/L}$$

22) Maximum Rate in presence of Noncompetitive Inhibitor

Open Calculator

$$V_{max} = \left(Vmax^{app} \cdot \left(1 + \left(\frac{I}{K_i}\right)\right)\right)$$

$$30.94737\text{mol/L*s} = \left(21\text{mol/L*s} \cdot \left(1 + \left(\frac{9\text{mol/L}}{19\text{mol/L}}\right)\right)\right)$$

23) Michaelis Constant given Forward, Reverse, and Catalytic Rate Constants

Open Calculator

$$K_M = \frac{k_r + k_{cat}}{k_f}$$

$$2.898645\text{mol/L} = \frac{20\text{mol/L*s} + 0.65\text{s}^{-1}}{6.9\text{s}^{-1}}$$

24) Michaelis Constant in Competitive Inhibition given Enzyme Substrate Complex Concentration

Open Calculator

fx $$K_M = \frac{\left(\frac{([E_0])\cdot S}{ES}\right) - S}{1 + \left(\frac{I}{K_i}\right)}$$

ex $$9.160714\text{mol/L} = \frac{\left(\frac{100\text{mol/L}\cdot 1.5\text{mol/L}}{10\text{mol/L}}\right) - 1.5\text{mol/L}}{1 + \left(\frac{9\text{mol/L}}{19\text{mol/L}}\right)}$$

25) Modifying Factor of Enzyme Substrate Complex

Open Calculator

fx $$\alpha' = 1 + \left(\frac{I}{K_i'}\right)$$

ex $$1.6 = 1 + \left(\frac{9\text{mol/L}}{15\text{mol/L}}\right)$$

26) Substrate Concentration given Catalytic Rate Constant and Initial Enzyme Concentration

Open Calculator

fx $$S_o = \frac{K_M \cdot V_0}{(k_{cat} \cdot ([E_0])) - V_0}$$

ex $$0.020914\text{mol/L} = \frac{3\text{mol/L} \cdot 0.45\text{mol/L*s}}{(0.65\text{s}^{-1} \cdot 100\text{mol/L}) - 0.45\text{mol/L*s}}$$

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Variables Used

- **$[E_0]$** Initial Enzyme Concentration *(Mole per Liter)*
- **$[E_i]$** Initial Concentration of Enzyme *(Mole per Liter)*
- **$[E_{initial}]$** Enzyme Concentration Initially *(Mole per Liter)*
- **E** Catalyst Concentration *(Mole per Liter)*
- **$E0^{app}$** Apparent Initial Enzyme Concentration *(Mole per Liter)*
- **EI** Enzyme Inhibitor Complex Concentration *(Mole per Liter)*
- **ES** Enzyme Substrate Complex Concentration *(Mole per Liter)*
- **I** Inhibitor Concentration *(Mole per Liter)*
- **I_{CI}** Inhibitor Concentration for CI *(Mole per Liter)*
- **I_{IEC}** Inhibitor Concentration given IEC *(Mole per Liter)*
- **I_{max}** Inhibitor Concentration given Max Rate *(Mole per Liter)*
- **k_2** Final Rate Constant *(1 Per Second)*
- **k_{cat}** Catalytic Rate Constant *(1 Per Second)*
- **k_{cat_MM}** Catalytic Rate Constant for MM *(1 Per Second)*
- **K_D** Dissociation Rate Constant *(Mole per Liter)*
- **K_{ei}** Enzyme Inhibitor Dissociation Constant given MF *(Mole per Liter)*
- **k_f** Forward Rate Constant *(1 Per Second)*
- **k_{final}** Final Rate Constant for Catalysis *(1 Per Second)*
- **K_i** Enzyme Inhibitor Dissociation Constant *(Mole per Liter)*
- **K_i'** Enzyme Substrate Dissociation Constant *(Mole per Liter)*
- **K_M** Michaelis Constant *(Mole per Liter)*
- **k_r** Reverse Rate Constant *(Mole per Liter Second)*
- **S** Substrate Concentration *(Mole per Liter)*

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- S_o Concentration of Substrate *(Mole per Liter)*
- V_0 Initial Reaction Rate *(Mole per Liter Second)*
- V_{CI} Initial Reaction Rate in CI *(Mole per Liter Second)*
- V_{DRC} Initial Reaction Rate given DRC *(Mole per Liter Second)*
- V_{max} Maximum Rate *(Mole per Liter Second)*
- V_{max_DRC} Maximum Rate given DRC *(Mole per Liter Second)*
- V_{RC} Initial Reaction Rate given RC *(Mole per Liter Second)*
- $Vmax^{app}$ Apparent Maximum Rate *(Mole per Liter Second)*
- α Enzyme Modifying Factor
- α' Enzyme Substrate Modifying Factor

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Constants, Functions, Measurements used

- Measurement: **Molar Concentration** in Mole per Liter (mol/L)
  Molar Concentration Unit Conversion
- Measurement: **Reaction Rate** in Mole per Liter Second (mol/L*s)
  Reaction Rate Unit Conversion
- Measurement: **First Order Reaction Rate Constant** in 1 Per Second (s^{-1})
  First Order Reaction Rate Constant Unit Conversion

Check other formula lists

- Collision Theory Formulas
- Collision Theory and Chain Reactions Formulas
- Enzyme Kinetics Formulas
- First Order Reaction Formulas
- Important formulae on Reversible Reaction Formulas
- Important Formulas on Enzyme Kinetics
- Second Order Reaction Formulas
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