Important Properties of Equilibrium Constant Formulas PDF

Formulas
Examples
with Units

List of 21
Important Properties of Equilibrium Constant Formulas

1) Active Mass Formula

Evaluate Formula

Formula	Example with Units
$M = \frac{w}{MW}$	$0.0002\,\text{mol/L} = \frac{21\,\text{g}}{120\,\text{g}}$

2) Equilibrium Constant for Reaction when Multiplied with Integer Formula

Evaluate Formula

Formula	Example with Units
$K''_c = \left(K_c^{\,n}\right)$	$3600 = \left(60\,\text{mol/L}^{\,2}\right)$

3) Equilibrium Constant for Reverse Reaction Formula

Evaluate Formula

Formula	Example with Units
$K'_c = \frac{\left(Eq_{\text{conc A}}^{\,a}\right)\cdot\left(Eq_{\text{conc B}}^{\,b}\right)}{\left(Eq_{\text{conc C}}^{\,c}\right)\cdot\left(Eq_{\text{conc D}}^{\,d}\right)}$	$1.6\text{E+}8\,\text{mol/L} = \frac{\left(45\,\text{mol/L}^{\,17}\right)\cdot\left(25\,\text{mol/L}^{\,3}\right)}{\left(30\,\text{mol/L}^{\,9}\right)\cdot\left(35\,\text{mol/L}^{\,7}\right)}$

4) Equilibrium Constant for Reverse Reaction given Constant for Forward Reaction Formula

Evaluate Formula

Formula	Example with Units
$K'_c = \frac{1}{K_c}$	$0.0167\,\text{mol/L} = \frac{1}{60\,\text{mol/L}}$

5) Equilibrium Constant for Reversed Reaction when Multiplied with Integer Formula

Evaluate Formula

Formula	Example with Units
$K''_c = \frac{1}{K_c^{\,n}}$	$0.0003 = \frac{1}{60\,\text{mol/L}^{\,2}}$

6) Equilibrium Constant with respect to Mole Fraction Formula

Evaluate Formula

Formula

$$K_\chi = \frac{\left(\chi_C^{\ c}\right)\cdot\left(\chi_D^{\ d}\right)}{\left(X_A^{\ a}\right)\cdot\left(\chi_B^{\ b}\right)}$$

Example with Units

$$20.0122\,\text{mol/L} = \frac{\left(8\,\text{mol/L}^{\ 9}\right)\cdot\left(10\,\text{mol/L}^{\ 7}\right)}{\left(0.6218\,\text{mol/L}^{\ 17}\right)\cdot\left(6\,\text{mol/L}^{\ 3}\right)}$$

7) Equilibrium Constant with respect to Partial Pressure Formula

Evaluate Formula

Formula

$$K_p = \frac{\left(p_C^{\ c}\right)\cdot\left(p_D^{\ d}\right)}{\left(P_A^{\ a}\right)\cdot\left(p_B^{\ b}\right)}$$

Example with Units

$$149.6158\,\text{mol/L} = \frac{\left(80\,\text{Bar}^{\ 9}\right)\cdot\left(40\,\text{Bar}^{\ 7}\right)}{\left(0.77\,\text{Bar}^{\ 17}\right)\cdot\left(50\,\text{Bar}^{\ 3}\right)}$$

8) Equilibrium Mole Fraction of Substance A Formula

Evaluate Formula

Formula

$$X_A = \left(\frac{\left(\chi_C^{\ c}\right)\cdot\left(\chi_D^{\ d}\right)}{K_\chi\cdot\left(\chi_B^{\ b}\right)}\right)^{\frac{1}{a}}$$

Example with Units

$$0.6218\,\text{mol/L} = \left(\frac{\left(8\,\text{mol/L}^{\ 9}\right)\cdot\left(10\,\text{mol/L}^{\ 7}\right)}{20\,\text{mol/L}\cdot\left(6\,\text{mol/L}^{\ 3}\right)}\right)^{\frac{1}{17}}$$

9) Equilibrium Mole Fraction of Substance B Formula

Evaluate Formula

Formula

$$\chi_B = \left(\frac{\left(\chi_C^{\ c}\right)\cdot\left(\chi_D^{\ d}\right)}{K_\chi\cdot\left(X_A^{\ a}\right)}\right)^{\frac{1}{b}}$$

Example with Units

$$6.0012\,\text{mol/L} = \left(\frac{\left(8\,\text{mol/L}^{\ 9}\right)\cdot\left(10\,\text{mol/L}^{\ 7}\right)}{20\,\text{mol/L}\cdot\left(0.6218\,\text{mol/L}^{\ 17}\right)}\right)^{\frac{1}{3}}$$

10) Equilibrium Mole Fraction of Substance C Formula

Evaluate Formula

Formula

$$\chi_C = \left(\frac{K_\chi\cdot\left(X_A^{\ a}\right)\cdot\left(\chi_B^{\ b}\right)}{\chi_D^{\ d}}\right)^{\frac{1}{c}}$$

Example with Units

$$7.9995\,\text{mol/L} = \left(\frac{20\,\text{mol/L}\cdot\left(0.6218\,\text{mol/L}^{\ 17}\right)\cdot\left(6\,\text{mol/L}^{\ 3}\right)}{10\,\text{mol/L}^{\ 7}}\right)^{\frac{1}{9}}$$

11) Equilibrium Mole Fraction of Substance D Formula

Evaluate Formula

Formula

$$\chi_D = \left(\frac{K_\chi \cdot \left({X_A}^a \right) \cdot \left({\chi_B}^b \right)}{{\chi_C}^c} \right)^{\frac{1}{d}}$$

Example with Units

$$9.9991\,\text{mol/L} = \left(\frac{20\,\text{mol/L} \cdot \left({0.6218\,\text{mol/L}}^{17} \right) \cdot \left({6\,\text{mol/L}}^3 \right)}{{8\,\text{mol/L}}^9} \right)^{\frac{1}{7}}$$

12) Equilibrium Partial Pressure of Substance A Formula

Evaluate Formula

Formula

$$P_A = \left(\frac{\left({p_C}^c \right) \cdot \left({p_D}^d \right)}{K_p \cdot \left({p_B}^b \right)} \right)^{\frac{1}{a}}$$

Example with Units

$$0.7699\,\text{Bar} = \left(\frac{\left({80\,\text{Bar}}^9 \right) \cdot \left({40\,\text{Bar}}^7 \right)}{150\,\text{mol/L} \cdot \left({50\,\text{Bar}}^3 \right)} \right)^{\frac{1}{17}}$$

13) Equilibrium Partial Pressure of Substance B Formula

Evaluate Formula

Formula

$$p_B = \left(\frac{\left({p_C}^c \right) \cdot \left({p_D}^d \right)}{K_p \cdot \left({P_A}^a \right)} \right)^{\frac{1}{b}}$$

Example with Units

$$49.9573\,\text{Bar} = \left(\frac{\left({80\,\text{Bar}}^9 \right) \cdot \left({40\,\text{Bar}}^7 \right)}{150\,\text{mol/L} \cdot \left({0.77\,\text{Bar}}^{17} \right)} \right)^{\frac{1}{3}}$$

14) Equilibrium Partial Pressure of Substance C Formula

Evaluate Formula

Formula

$$p_C = \left(\frac{K_p \cdot \left({P_A}^a \right) \cdot \left({p_B}^b \right)}{{p_D}^d} \right)^{\frac{1}{c}}$$

Example with Units

$$80.0228\,\text{Bar} = \left(\frac{150\,\text{mol/L} \cdot \left({0.77\,\text{Bar}}^{17} \right) \cdot \left({50\,\text{Bar}}^3 \right)}{{40\,\text{Bar}}^7} \right)^{\frac{1}{9}}$$

15) Equilibrium Partial Pressure of Substance D Formula

Evaluate Formula

Formula

$$p_D = \left(\frac{K_p \cdot \left({P_A}^{a} \right) \cdot \left({p_B}^{b} \right)}{{p_C}^{c}} \right)^{\frac{1}{d}}$$

Example with Units

$$40.0147\,\text{Bar} = \left(\frac{150\,\text{mol/L} \cdot \left({0.77\,\text{Bar}}^{17} \right) \cdot \left({50\,\text{Bar}}^{3} \right)}{{80\,\text{Bar}}^{9}} \right)^{\frac{1}{7}}$$

16) Molar Concentration of Substance A Formula

Evaluate Formula

Formula

$$C_A = \left(\frac{\left({C_C}^{c} \right) \cdot \left({C_D}^{d} \right)}{Q \cdot \left({C_B}^{b} \right)} \right)^{\frac{1}{a}}$$

Example with Units

$$1.619\,\text{mol/L} = \left(\frac{\left({18\,\text{mol/L}}^{9} \right) \cdot \left({22\,\text{mol/L}}^{7} \right)}{50 \cdot \left({14\,\text{mol/L}}^{3} \right)} \right)^{\frac{1}{17}}$$

17) Molar Concentration of Substance B Formula

Evaluate Formula

Formula

$$C_B = \left(\frac{\left({C_C}^{c} \right) \cdot \left({C_D}^{d} \right)}{Q \cdot \left({C_A}^{a} \right)} \right)^{\frac{1}{b}}$$

Example with Units

$$13.9496\,\text{mol/L} = \left(\frac{\left({18\,\text{mol/L}}^{9} \right) \cdot \left({22\,\text{mol/L}}^{7} \right)}{50 \cdot \left({1.62\,\text{mol/L}}^{17} \right)} \right)^{\frac{1}{3}}$$

18) Molar Concentration of Substance C Formula

Evaluate Formula

Formula

$$C_C = \left(\frac{Q \cdot \left({C_A}^{a} \right) \cdot \left({C_B}^{b} \right)}{{C_D}^{d}} \right)^{\frac{1}{c}}$$

Example with Units

$$18.0216\,\text{mol/L} = \left(\frac{50 \cdot \left({1.62\,\text{mol/L}}^{17} \right) \cdot \left({14\,\text{mol/L}}^{3} \right)}{{22\,\text{mol/L}}^{7}} \right)^{\frac{1}{9}}$$

19) Molar Concentration of Substance D Formula

Evaluate Formula

Formula

$$C_D = \left(\frac{Q \cdot \left({C_A}^{a} \right) \cdot \left({C_B}^{b} \right)}{{C_C}^{c}} \right)^{\frac{1}{d}}$$

Example with Units

$$22.034\,\text{mol/L} = \left(\frac{50 \cdot \left({1.62\,\text{mol/L}}^{17} \right) \cdot \left({14\,\text{mol/L}}^{3} \right)}{{18\,\text{mol/L}}^{9}} \right)^{\frac{1}{7}}$$

20) Reaction Quotient Formula

Evaluate Formula

Formula

$$Q = \frac{\left({C_C}^{c} \right) \cdot \left({C_D}^{d} \right)}{\left({C_A}^{a} \right) \cdot \left({C_B}^{b} \right)}$$

Example with Units

$$49.462 = \frac{\left({18\,\text{mol/L}}^{9} \right) \cdot \left({22\,\text{mol/L}}^{7} \right)}{\left({1.62\,\text{mol/L}}^{17} \right) \cdot \left({14\,\text{mol/L}}^{3} \right)}$$

21) Weight of Reactant given Active Mass Formula

Evaluate Formula

Formula

$$w = M \cdot MW$$

Example with Units

$$21\,\text{g} = 0.000175\,\text{mol/L} \cdot 120\,\text{g}$$

Variables used in list of Properties of Equilibrium Constant Formulas above

- **a** Number of Moles of A
- **b** No. of Moles of B
- **c** No. of Moles of C
- C_A Concentration of A *(Mole per Liter)*
- C_B Concentration of B *(Mole per Liter)*
- C_C Concentration of C *(Mole per Liter)*
- C_D Concentration of D *(Mole per Liter)*
- **d** No. of Moles of D
- $Eq_{conc\ A}$ Equilibrium Concentration of A *(Mole per Liter)*
- $Eq_{conc\ B}$ Equilibrium Concentration of B *(Mole per Liter)*
- $Eq_{conc\ C}$ Equilibrium Concentration of C *(Mole per Liter)*
- $Eq_{conc\ D}$ Equilibrium Concentration of D *(Mole per Liter)*
- K_c Equilibrium Constant *(Mole per Liter)*
- K'_c Reverse Equilibrium Constant *(Mole per Liter)*
- K''_c Equilibrium Constant Multiplied
- K_p Equilibrium Constant for Partial Pressure *(Mole per Liter)*
- K_X Equilibrium Constant for Mole Fraction *(Mole per Liter)*
- **M** Active mass *(Mole per Liter)*
- **MW** Molecular Weight *(Gram)*
- **n** Number
- P_A Equilibrium Partial Pressure A *(Bar)*
- p_B Equilibrium Partial Pressure B *(Bar)*
- p_C Equilibrium Partial Pressure C *(Bar)*
- p_D Equilibrium Partial Pressure D *(Bar)*
- **Q** Reaction Quotient
- **w** Weight of Solute *(Gram)*
- X_A Equilibrium Mole Fraction A *(Mole per Liter)*

Constants, Functions, Measurements used in list of Properties of Equilibrium Constant Formulas above

- Measurement: **Weight** in Gram (g)
  Weight Unit Conversion
- Measurement: **Pressure** in Bar (Bar)
  Pressure Unit Conversion
- Measurement: **Molar Concentration** in Mole per Liter (mol/L)
  Molar Concentration Unit Conversion

- X_B Equilibrium Mole Fraction B *(Mole per Liter)*
- X_C Equilibrium Mole Fraction C *(Mole per Liter)*
- X_D Equilibrium Mole Fraction D *(Mole per Liter)*

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