Important Equilibrium Constant Formulas PDF

Formulas
Examples
with Units

List of 12
Important Equilibrium Constant Formulas

1) Backward Reaction Rate Constant Formula

Evaluate Formula

Formula

$$K_b = \frac{K_f}{K_c}$$

Example with Units

$$3.3333\,\text{mol/L} = \frac{200\,\text{mol/L}}{60\,\text{mol/L}}$$

2) Change in Number of Moles Formula

Evaluate Formula

Formula

$$\Delta n = n_P - n_R$$

Example with Units

$$10\,\text{mol} = 15\,\text{mol} - 5\,\text{mol}$$

3) Equilibrium Concentration of Substance A Formula

Evaluate Formula

Formula

$$Eq_{conc\ A} = \left(\frac{\left(Eq_{conc\ C}{}^{c} \right) \cdot \left(Eq_{conc\ D}{}^{d} \right)}{K_c \cdot \left(Eq_{conc\ B}{}^{b} \right)} \right)^{\frac{1}{a}}$$

Example with Units

$$5.977\,\text{mol/L} = \left(\frac{\left(30\,\text{mol/L}^{9} \right) \cdot \left(35\,\text{mol/L}^{7} \right)}{60\,\text{mol/L} \cdot \left(0.011\,\text{mol/L}^{3} \right)} \right)^{\frac{1}{17}}$$

4) Equilibrium concentration of Substance B Formula

Evaluate Formula

Formula

$$Eq_{conc\ B} = \frac{Eq_{conc\ C} \cdot Eq_{conc\ D}}{K_c \cdot Eq_{conc\ A}}$$

Example with Units

$$0.0029\,\text{mol/L} = \frac{30\,\text{mol/L} \cdot 35\,\text{mol/L}}{60\,\text{mol/L} \cdot 5.97\,\text{mol/L}}$$

5) Equilibrium Concentration of Substance C Formula

Evaluate Formula

Formula

$$Eq_{conc\ C} = \left(\frac{K_c \cdot \left(Eq_{conc\ A}^{\ a} \right) \cdot \left(Eq_{conc\ B}^{\ b} \right)}{Eq_{conc\ D}^{\ d}} \right)^{\frac{1}{c}}$$

Example with Units

$$29.9335\,\text{mol/L} = \left(\frac{60\,\text{mol/L} \cdot \left(5.97\,\text{mol/L}^{\ 17} \right) \cdot \left(0.011\,\text{mol/L}^{\ 3} \right)}{35\,\text{mol/L}^{\ 7}} \right)^{\frac{1}{9}}$$

6) Equilibrium Concentration of Substance D Formula

Evaluate Formula

Formula

$$Eq_{conc\ D} = \left(\frac{K_c \cdot \left(Eq_{conc\ A}^{\ a} \right) \cdot \left(Eq_{conc\ B}^{\ b} \right)}{Eq_{conc\ C}^{\ c}} \right)^{\frac{1}{d}}$$

Example with Units

$$34.9003\,\text{mol/L} = \left(\frac{60\,\text{mol/L} \cdot \left(5.97\,\text{mol/L}^{\ 17} \right) \cdot \left(0.011\,\text{mol/L}^{\ 3} \right)}{30\,\text{mol/L}^{\ 9}} \right)^{\frac{1}{7}}$$

7) Equilibrium Constant Formula

Evaluate Formula

Formula

$$K_c = \frac{K_f}{K_b}$$

Example with Units

$$60.0601\,\text{mol/L} = \frac{200\,\text{mol/L}}{3.33\,\text{mol/L}}$$

8) Equilibrium Constant with respect to Molar Concentrations Formula

Evaluate Formula

Formula

$$K_c = \frac{\left(Eq_{conc\ C}^{\ c} \right) \cdot \left(Eq_{conc\ D}^{\ d} \right)}{\left(Eq_{conc\ A}^{\ a} \right) \cdot \left(Eq_{conc\ B}^{\ b} \right)}$$

Example with Units

$$61.2105\,\text{mol/L} = \frac{\left(30\,\text{mol/L}^{\ 9} \right) \cdot \left(35\,\text{mol/L}^{\ 7} \right)}{\left(5.97\,\text{mol/L}^{\ 17} \right) \cdot \left(0.011\,\text{mol/L}^{\ 3} \right)}$$

9) Forward Reaction Rate Constant Formula

Evaluate Formula

Formula

$$K_f = K_c \cdot K_b$$

Example with Units

$$199.8\,\text{mol/L} = 60\,\text{mol/L} \cdot 3.33\,\text{mol/L}$$

10) Number of Moles of Gaseous Products Formula

Evaluate Formula

Formula

$$n_P = \Delta n + n_R$$

Example with Units

$$9\,\text{mol} = 4\,\text{mol} + 5\,\text{mol}$$

11) Number of Moles of Gaseous Reactants Formula

Evaluate Formula

Formula

$$n_R = n_P - \Delta n$$

Example with Units

$$11\,\text{mol} = 15\,\text{mol} - 4\,\text{mol}$$

12) Variation of Equilibrium Constant with Temperature at Constant Pressure Formula

Evaluate Formula

Formula

$$K_2 = K_1 \cdot \exp\left(\left(\frac{\Delta H}{[R]}\right) \cdot \left(\frac{T_2 - T_{abs}}{T_{abs} \cdot T_2}\right)\right)$$

Example with Units

$$0.1417 = 0.0260 \cdot \exp\left(\left(\frac{32.4\,\text{KJ/mol}}{8.3145}\right) \cdot \left(\frac{310\,\text{K} - 273.15\,\text{K}}{273.15\,\text{K} \cdot 310\,\text{K}}\right)\right)$$

Variables used in list of Equilibrium Constant Formulas above

- **a** Number of Moles of A
- **b** No. of Moles of B
- **c** No. of Moles of C
- **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_1 Equilibrium constant 1
- K_2 Equilibrium constant 2
- K_b Backward Reaction Rate Constant *(Mole per Liter)*
- K_c Equilibrium Constant *(Mole per Liter)*
- K_f Forward reaction rate constant *(Mole per Liter)*
- n_P Number of moles of products *(Mole)*
- n_R Number of moles of reactants *(Mole)*
- T_2 Absolute temperature 2 *(Kelvin)*
- T_{abs} Absolute Temperature *(Kelvin)*
- **ΔH** Heat of reaction *(KiloJoule Per Mole)*
- **Δn** Change in Number of Moles *(Mole)*

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

- constant(s): **[R]**, 8.31446261815324
  Universal gas constant
- Functions: **exp**, exp(Number)
  n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Amount of Substance** in Mole (mol)
  Amount of Substance Unit Conversion
- Measurement: **Molar Concentration** in Mole per Liter (mol/L)
  Molar Concentration Unit Conversion
- Measurement: **Energy Per Mole** in KiloJoule Per Mole (KJ/mol)
  Energy Per Mole Unit Conversion

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