Comparing Rate Law, Equilibrium Expression, Acid/Base Equilibrium Expression

and Solubility Product

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| Constant | Expression and Others | What is not in the expression | Factors that affect the constant | Factor that affect the | Manipulating multiple equations |
| Rate | Rate=k[A]a [B]b  (Rate Law)  Exponents need to be determined experimentally | Products | Temperature  Catalyst  (think Arrhenius equation, activation energy and kinetics/ orientation) | **Rate**  Physical state  Concentration  Temperature  Catalyst | Reverse the reaction  =1/k  Add reactions we get a new k |
| Equilibrium constant | Keq  =[C]c [D]d  [A]a [B]b  (Kc or Kp see related equations)  Exponents found by coefficients | Solids and liquids (for aqueous and gas reactions) | Temperature  Not catalyst because equal both directions | **Equilibrium**  Position shifts according to Le Chatelier’s Principle  Temperature  Concentrations  Pressure for gases by changing volume  Not catalyst because effects are equal in both directions | Reverse reaction  = 1/K  Double the all the coefficients K2  Triple K3 etc.  Add reactions multiply K’s |
| Acid/ Base  constant | Ka or Kb =[C]c [D]d  [A]a [B]b  Exponents found by coefficients | Solids and liquids (for aqueous and gas reactions) | Temperature | **Equilibrium**  Position shifts according to Le Chatelier’s Principle  Temperature  Concentrations  Not catalyst because equal effects in both directions |  |

Related Equations for Rate, Equilibrium, and Acid Base Equilibrium

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| Rate  Integrated rate law graphs can determine rate order.  Integrated rate laws are used to determine how concentrations change **with time.** | | | | | | | | |
| **Order** | **Rate Law** | **Integrated Rate Equation** | **Equation in form**  **y=mx+b** | | **Linear Plot** | **Slope** | **Units for *k*** | **Half life** |
| **0** | rate = *k* | [A]0 - [A]t = *k*t | [A]t = -kt + [A]0 | | [A] vs. time | -k | M / s | t½ =  [Ao] / 2k |
| **1** | rate = *k* [A] | ln ([A]t/[A]0) = - *k*t  or [*A*]*t*=[*A*] 0ekt | ln[A]t = -k t + ln[A]0 | | ln [A] vs. time | -*k* | s-1 | t½ = 0.693 / k |
| **2** | rate = k [A]2 | (1/[A]t) - (1/[A]0) = *k*t | 1/[A]t = kt + 1/[A]0 | | (1/[A]) vs. time | k | M-1 s-1 | t½ = 1 / k [Ao] |
| Arrhenius equation  **k = Ae-Ea/RT** | | | | | | | | |
| Equilibrium | | | | Kc  = [C]c [D]d  Kp = Pcc PDd  [A]a [B]b PAa PBb  Kp=Kc(RT)Δn | | Le Chatelier note:  Remember solids or liquids are not in the equilibrium expression and do not affect equilibrium.  Gasses not in reaction do not affect equilibrium at constant volume. | | |
| Acid Base | | | | Kw = 1x10-14  Kw=Ka(Kb)  pH+pOH=14 | |  | | |