

CONCEPT: EQUILIBRIUM CONSTANT (K)

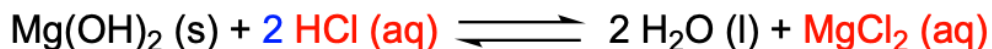
- Equilibrium constant (K) specifies the favored _____ of a reaction while rate constant (k) deals with _____.
 - **K**: concentration units; **k**: concentration and time units ($M \cdot \text{time}^{-1}$)

Equilibrium Constant Expressions

- **Equilibrium Constant (K or Keq)** is a _____ of product to reactant concentrations at equilibrium.
 - Equilibrium Constant is temperature _____: change in temperature changes the _____ of K.

Equilibrium Constant Expression (Formula)		
$aA + bB \rightleftharpoons cC + dD$ □ a, b, c, d = coefficients	$K = \frac{[\text{products}]}{[\text{reactants}]} = \frac{[C]^c [D]^d}{[A]^a [B]^b}$	□ K = Kp or Kc - Kp used when []s are in _____ - Kc used when []s are in _____

- Solids and pure liquids are _____ from K expressions
 - adding a solid (s) or pure liquid (l) does _____ change their concentrations



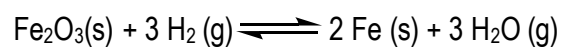
$$K = \frac{[\text{products}]}{[\text{reactants}]} = \text{_____}$$

EXAMPLE: What is the equilibrium constant expression for the following reaction:



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PRACTICE: Provide K expression for the reverse of the following reaction:



a) $\mathbf{K} = \frac{[\text{Fe}]^2 [\text{H}_2\text{O}]^3}{[\text{Fe}_2\text{O}_3] [\text{H}_2]^3}$

c) $\mathbf{K} = \frac{[\text{Fe}_2\text{O}_3] [\text{H}_2]^3}{[\text{Fe}]^2 [\text{H}_2\text{O}]^3}$

b) $\mathbf{K} = \frac{[\text{H}_2\text{O}]^3}{[\text{H}_2]^3}$

d) $\mathbf{K} = \frac{[\text{H}_2]^3}{[\text{H}_2\text{O}]^3}$

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Magnitude of Equilibrium Constant

- Magnitude of **K** indicates how far _____ or _____ a reaction lies at equilibrium, at a given temperature.

Magnitude of Equilibrium Constant	
K > 1: _____ and _____ reaction are favored.	$K = \frac{10}{2} = 5$
K < 1: _____ and _____ reaction are favored.	$K = \frac{2}{10} = 0.2$
K = 1: _____ direction is favored.	$K = \frac{10}{10} = 1$

- Magnitude of K can also be determined from rate constants of forward and reverse reactions.

$K = \frac{k_{\text{forward}}}{k_{\text{reverse}}}$	<ul style="list-style-type: none">□ K = Equilibrium Constant□ k = Rate Constant
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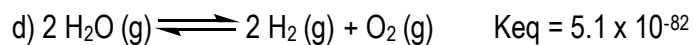
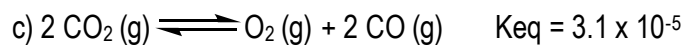
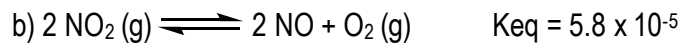
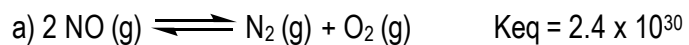
EXAMPLE: When this reaction comes to an equilibrium, which will be higher in pressure, reactants or products?



- a) reactants b) products c) neither d) impossible to estimate

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PRACTICE: Which of the reactions is likely to produce more O₂ at equilibrium at 25°C?



PRACTICE: Consider the reaction $\text{A (g)} \rightleftharpoons \text{B (g)} + \text{C (g)}$, with k_{forward} of 5.7×10^{-2} and k_{reverse} of 3.8×10^{-4} .

Which would be greater at equilibrium, partial pressure of A or partial pressures of B and C?

a) partial pressure of A

b) partial pressure of B & C

c) partial pressures will be equal