

What is the Equilibrium Constant?

Worksheet

The equilibrium constant $K = \frac{[\text{products}]}{[\text{reactants}]}$ (each raised to stoichiometric coefficients) at equilibrium. Its value is fixed for a given reaction at a specific temperature and determines which side the reaction favors.

$$K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

Questions

- For $A \rightleftharpoons 2B$, $K_c = [B]/[A]$. At equilibrium, $[A] = 0.2 \text{ M}$ and $[B] = 0.8 \text{ M}$. Calculate K_c .
 - 3.2
 - 0.25
 - 1.6
 - 6.4
- Which statement is true about K_c ?
 - It changes with concentration
 - It depends on temperature
 - It depends on the amount of catalyst
 - It is always greater than 1
- A reaction has $K_c = 0.1$. At equilibrium, are products or reactants favored?
 - Products
 - Reactants
 - Both equally
 - Cannot determine
- If $K_c = 100$, the equilibrium position favors:
 - Reactants
 - Products
 - Neither
 - Formation of catalyst
- For the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$, equilibrium concentrations are $[N_2] = 0.5 \text{ M}$, $[H_2] = 1.5 \text{ M}$, $[NH_3] = 2 \text{ M}$. Calculate K_c .
- A reaction $A \rightleftharpoons B$ has $K_c = 4$ at 25°C . If at equilibrium $[A] = 0.1 \text{ M}$, find $[B]$.
- For $2A \rightleftharpoons B + C$, $K_c = 9$ at 300K . At equilibrium $[A] = 1 \text{ M}$, $[B] = 1.5 \text{ M}$. Find $[C]$.
- Define: What is the equilibrium constant?
- Define: Is K_c temperature-dependent?
- Define: What does a large K_c mean?

Answer Key

1. D) $K_c = (0.8) / 0.2 = 0.64 / 0.2 = 3.2$. Wait, recalculate: $(0.8)^2 = 0.64$; $0.64/0.2 = 3.2$. The index should be 0 but let me verify: $(0.8)^2 = 0.64$, divided by $0.2 = 3.2$. Correct answer is 3.2, index 0.
2. B) It depends on temperature - K_c is temperature-dependent. It does not change with concentration, catalyst, or pressure (for gases).
3. B) Reactants - $K_c < 1$ means reactants are favored; very little product forms.
4. B) Products - $K_c > 1$ means products are strongly favored at equilibrium.
5. $K_c = \frac{[NH]}{[N][H]}$ $K_c = (2) / (0.5 (1.5))$ $K_c = 4 / (0.5 \cdot 3.375) = 4 / 1.6875 = 2.37$
6. $K_c = \frac{[B]}{[A]}$ $4 = \frac{[B]}{0.1}$ $[B] = 0.4 \text{ M}$
7. $K_c = \frac{[B][C]}{[A]}$ $9 = (1.5)[C] / (1)$ $[C] = 9 / 1.5 = 6 \text{ M}$
8. A numerical value that expresses the ratio of products to reactants at equilibrium for a specific reaction.
9. Yes, each reaction has a unique K_c value at each temperature.
10. The reaction strongly favors products at equilibrium.

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