What is Chemical Equilibrium?

Worksheet

Chemical equilibrium is the dynamic state of a reversible reaction where the forward and reverse rates are equal, so concentrations of reactants and products stay constant over time.

$$K_c = \frac{[C][D]}{[A][B]}$$

Questions

1. At equilibrium, the forward reaction rate is __ the reverse reaction rate.

A) greater than
B) less than
C) equal to
D) unrelated to

2. For 2A B, the Kc expression is:

A) [B]/[A]
B) [B]/[A]^2
C) [A]^2/[B]
D) [A]/[B]

3. If Q < Kc, the reaction will:

A) shift toward reactants
B) shift toward products
C) stay unchanged
D) stop completely

4. Increasing pressure on a gaseous equilibrium shifts it toward the side with:

A) more moles of gas
B) fewer moles of gas
C) equal moles of gas
D) no effect, always

5. For the reaction A B, at equilibrium [A] = 0.40 M and [B] = 1.60 M. Find Kc.

6. For N2(g) + 3H2(g) 2NH3(g), at equilibrium [N2] = 0.50 M, [H2] = 0.30 M, [NH3] = 0.20 M. Find Kc.

7. For A + B C + D, Kc = 10. At a given moment Q = [C][D]/([A][B]) = 4. Which way does the reaction shift?

8. Define: What is chemical equilibrium?

9. Define: What does Keq measure?

10. Define: What is Le Chatelier's Principle?

Answer Key

1. C) equal to - Equilibrium is defined by equal forward and reverse rates - that's why concentrations stop changing.

2. B) [B]/[A]^2 - Coefficients become exponents, so Kc = [B]/[A]^2.

3. B) shift toward products - Q < Kc means not enough product has formed yet, so the reaction shifts forward.

4. B) fewer moles of gas - By Le Chatelier's Principle, the system shifts to reduce gas moles and relieve the added pressure.

5. Kc = [B]/[A] Kc = 1.60 / 0.40 Kc = 4.0

6. Kc = [NH3]^2 / ([N2][H2]^3) Kc = (0.20)^2 / (0.50 (0.30)^3) Kc = 0.04 / (0.50 0.027) = 0.04 / 0.0135 Kc 2.96

7. Compare Q to Kc Q = 4 < Kc = 10 Since Q < Kc, the reaction shifts forward (toward products) until Q rises to equal Kc

8. The state where forward and reverse reaction rates are equal, so concentrations stay constant.

9. The ratio of product to reactant concentrations, each raised to its stoichiometric power, at equilibrium.

10. If a system at equilibrium is disturbed (concentration, pressure, temperature), it shifts to counteract the change.