

What is Spontaneity and Equilibrium?

Worksheet

Spontaneity is the tendency of a reaction to proceed naturally; equilibrium is the state where forward and reverse reaction rates are equal. $G < 0$ means spontaneous; $G = 0$ means equilibrium.

$$\Delta G = \Delta H - T\Delta S$$

Questions

1. A reaction with $G = -50$ kJ/mol is

- A) Non-spontaneous
- B) Spontaneous
- C) At equilibrium
- D) Reversible but slow

2. At equilibrium, what is G ?

- A) Positive
- B) Zero
- C) Negative
- D) Undefined

3. Which increases spontaneity most?

- A) Large H (exothermic)
- B) Large S (entropy gain)
- C) High temperature
- D) Both a and b

4. A reaction is non-spontaneous at 298 K but spontaneous at 600 K. S must be

- A) Negative
- B) Zero
- C) Positive
- D) Decreasing

5. At 298 K, a reaction has $H = -60$ kJ/mol and $S = 150$ J/(molK). Is it spontaneous?

6. A reaction with $H = 80$ kJ/mol and $S = -50$ J/(molK) at 300 K. Spontaneous?

7. Find the temperature at which $H = 40$ kJ/mol and $S = 100$ J/(molK) reach equilibrium.

8. Define: What is a spontaneous reaction?

9. Define: What is chemical equilibrium?

10. Define: What does $G = H - TS$ mean?

Answer Key

1. B) Spontaneous - $G < 0$ always means spontaneous.
2. B) Zero - $G = 0$ defines the equilibrium state.
3. D) Both a and b - Negative H and positive S both favour spontaneity; high T amplifies S effect.
4. C) Positive - Positive S makes TS dominate at high T, overcoming positive H.
5. $G = H - TS$
 $G = -60 - 298 (150/1000)$
 $G = -60 - 44.7 = -104.7 \text{ kJ/mol}$
 $G < 0$, so the reaction IS spontaneous.
6. $G = 80 - 300 (-50/1000)$
 $G = 80 + 15 = 95 \text{ kJ/mol}$
 $G > 0$, so the reaction is NOT spontaneous.
7. At equilibrium, $G = 0$
 $0 = 40 - T (100/1000)$
 $T = 40 / 0.1 = 400 \text{ K}$
8. One that occurs naturally without external energy; $G < 0$.
9. The state where forward and reverse reaction rates are equal; $G = 0$.
10. Gibbs free energy depends on enthalpy, entropy, and temperature.

Bounlu

All cards, step-by-step solutions and an AI tutor are in the Notek app.
Promy turns exam dates into automatic reminders.