What is Weak Acid and Weak Base Equilibrium?

Worksheet

Weak acids: HA H + A, with Ka = [H][A]/[HA]. Weak bases: B + HO BH + OH, with Kb = [BH][OH]/[B]. Small Ka/Kb means weak ionization; large values mean stronger ionization.

Questions

1. A weak acid has Ka = 0.001. Does it ionize significantly?

A) Yes, 100%
B) Yes, moderately
C) No, very weakly
D) Cannot tell from Ka alone

2. Hydrochloric acid (HCl) is strong; acetic acid (CHCOOH) is weak. Why?

A) HCl is more concentrated
B) HCl fully dissociates; acetic acid reaches equilibrium with mostly molecules
C) Acetic acid has more atoms
D) pH difference

3. For weak acid HA with Ka = 10, the equilibrium has mostly

A) H and A
B) HA molecules
C) Strong acid
D) Base form only

4. Ammonia (NH) is a weak base. Its conjugate acid (NH) is

A) Also weak
B) Strong
C) Neutral
D) Not defined

5. Acetic acid (CHCOOH) is weak with Ka = 1.8 10. If [CHCOOH]initial = 0.1 M, estimate [H] at equilibrium.

6. Ammonia (NH) is a weak base with Kb = 1.8 10. Compare to acetic acid's Ka.

7. For a weak acid, why is [H] less than the initial concentration?

8. Define: Difference: strong vs weak acid?

9. Define: What does Ka tell us?

10. Define: Example of a weak acid?

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Answer Key

1. B) Yes, moderately - Ka = 0.001 = 10 is moderate. Very small Ka (< 10) = very weak; Ka > 0.1 = much stronger.

2. B) HCl fully dissociates; acetic acid reaches equilibrium with mostly molecules - Strong acids dissociate 100%; weak acids establish equilibrium, staying mostly molecular.

3. B) HA molecules - Very small Ka means little ionization; HA molecules dominate the equilibrium.

4. A) Also weak - Weak bases have weak conjugate acids; strong bases have weak conjugate acids (and vice versa).

5. Setup equilibrium: CHCOOH H + CHCOO Ka = [H][CHCOO]/[CHCOOH] = 1.8 10 If x = [H]: Ka = x/(0.1 x) x/0.1 (since Ka is small) x = 1.8 10 x = [H] 1.34 10 M

6. Ammonia: NH + HO NH + OH, Kb = 1.8 10 Acetic acid: Ka = 1.8 10 Same Kb as Ka? Not quite-but both are weak (Ka, Kb < 10)

7. Weak acids only partially ionize. If initial [HA] = 0.1 M, only a fraction (e.g. 1%) ionizes. [H] from ionization << [HA]initial This is why we can use approximation Ka x/[HA]initial

8. Strong acids: 100% ionize; weak acids: only partially ionize and reach equilibrium.

9. Ka is the equilibrium constant. Small Ka = weak acid (little ionization); large Ka = stronger acid.

10. Acetic acid (CHCOOH), formic acid (HCOOH), carbonic acid (HCO).

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