

Transition-Metal Ions as Brønsted Acids

Nahkleh Group

Robinson Group

Weaver Group

Bodner Group

Acids and Bases

Definitions of Acids and Bases and the Role of Water

Acid-Base Pairs, Strength of Acids and Bases, and pH

Factors that Control the Relative Strengths of Acids and Bases

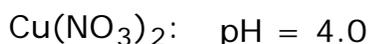
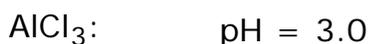
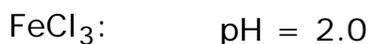
Brønsted Acids and Bases

Transition Metal Ions as Brønsted Acids

The Lewis Definitions of Acids and Bases

Transition-Metal Ions as Brønsted Acids

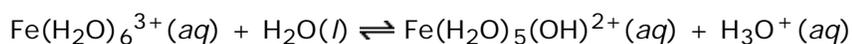
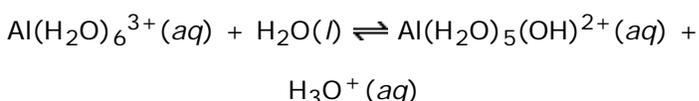
It is easy to understand why aqueous solutions of HCl or CH₃CO₂H are acidic. The following data for the pH of 0.1 M solutions of transition-metal ions are a bit harder to explain.



We can't attribute the acidity of these solutions to the Cl⁻ or NO₃⁻ ions because these ions are weak bases. The acidity of these solutions must result from the behavior of the Fe³⁺, Al³⁺, and Cu²⁺ ions.

The Fe³⁺, Al³⁺, and Cu²⁺ ions can't be Brønsted acids by themselves. They can only act as proton donors by influencing the ability of the neighboring water molecules to give up H⁺ ions. They do this by first forming covalent bonds to six water molecules to form a **complex ion**.

Water molecules covalently bound to one of these metal ions are more acidic than normal. Thus, reactions such as the following occur.



These reactions give rise to a net increase in the H₃O⁺ ion concentration in these solutions, thereby making the solutions acidic.

Practice Problem 8:

As many as 25% of the books in the Library of Congress are in brittle condition, in part because of the acidity of the paper on

which they were printed. Explain how adding aluminum sulfate to paper when it is manufactured makes paper acidic.

[Click here to check your answer to Practice Problem 8](#)

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