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Lewis Acids and Bases

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How did Lewis define an acid and a base?

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Lewis Acids and Bases

According to Gilbert Lewis, an acid accepts a pair of electrons and a base donates a pair of electrons during a reaction.

- This definition is more general than those offered by Arrhenius or by Brønsted and Lowry.

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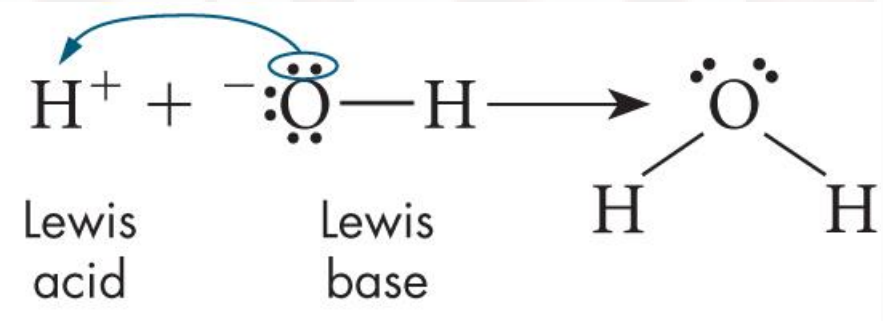
Lewis Acids and Bases

- A **Lewis acid** is a substance that can accept a pair of electrons to form a covalent bond.
- A **Lewis base** is a substance that can donate a pair of electrons to form a covalent bond.
  - The Lewis definitions include all the Brønsted-Lowry acids and bases.

Lewis Acids and Bases

Consider the reaction of H^+ and OH^-.

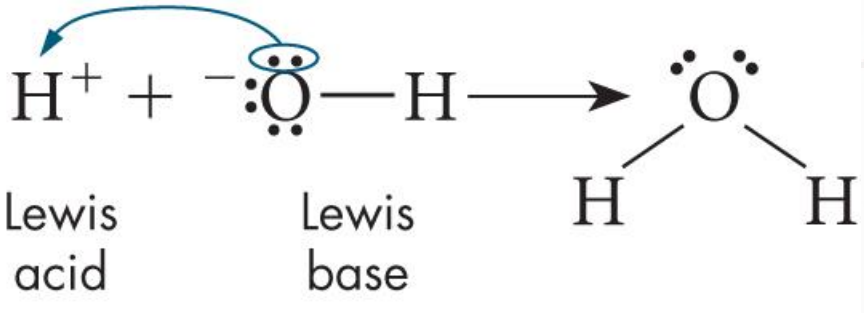
- The hydrogen ion donates itself to the hydroxide ion.
  - H^+ is a Brønsted-Lowry acid, and OH^- is a Brønsted-Lowry base.



Lewis Acids and Bases

Consider the reaction of H^+ and OH^-.

- The hydroxide ion can bond to the hydrogen ion because it has an unshared pair of electrons.
  - OH^- is also a Lewis base, and H^+, which accepts the pair of electrons, is a Lewis acid.



Lewis Acids and Bases

A second example of a reaction between a Lewis acid and a Lewis base is what happens when ammonia dissolves in water.

- Hydrogen ions from the dissociation of water are the electron-pair acceptor and the Lewis acid.
- Ammonia is the electron-pair donor and the Lewis base.

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This table compares the definitions of acids and bases.

Acid-Base Definitions		
Type	**Acid**	**Base**
Arrhenius	H^+ producer	OH^- producer
Brønsted-Lowry	H^+ donor	H^+ acceptor
Lewis	electron-pair acceptor	electron-pair donor

- The Lewis definition is the broadest.
- It extends to compounds that the Brønsted-Lowry theory does not classify as acids and bases.

Identifying Lewis Acids and Bases

Identify the Lewis acid and the Lewis base in this reaction between ammonia and boron trifluoride.

$$NH_3 + BF_3 \rightarrow NH_3BF_3$$

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Analyze **Identify the relevant concepts.**

When a Lewis acid reacts with a Lewis base, the base donates a pair of electrons and the acid accepts the donated pair.

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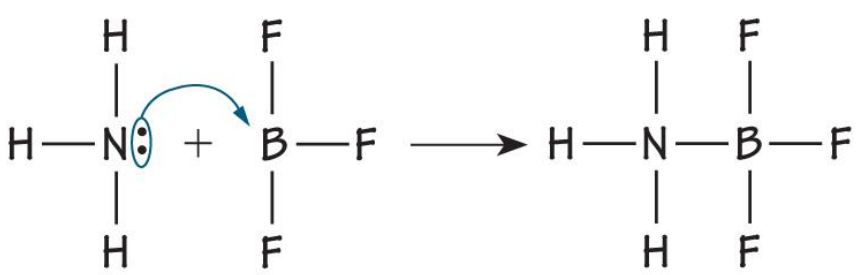
Solve **Apply concepts to this problem.**

Identify the reactant with the unshared pair of electrons and the reactant that can accept the pair of electrons.



Draw electron dot structures to identify which reactant has an unshared pair of electrons.

- Ammonia has an unshared pair of electrons to donate.
- The boron atom can accept the donated electrons.

2 Solve **Apply concepts to this problem.**

Classify the reactants based on their behavior.

- Lewis bases donate a pair of electrons, so ammonia is the Lewis base.
- Lewis acids accept a pair of electrons, so boron trifluoride is the Lewis acid.

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Checkpoint

Are hydrogen-ion donors also electron-pair acceptors?

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Checkpoint

Are hydrogen-ion donors also electron-pair acceptors?

Yes. All substances defined as acids by the Brønsted-Lowry definition (an acid is a hydrogen-ion donor) are also defined as acids by the Lewis definition (an acid is an electron-pair acceptor). That means that these substances are both hydrogen-ion donors and electron-pair acceptors.

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