

## Exercise walk-through

Introduction to Acid-Base Reactions ■ 4.8

eXercise

## You must be able to

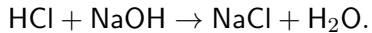
- identify **Brønsted-Lowry** 布朗斯特-劳里 acids (proton donors) and bases (proton acceptors)
- write **neutralization** 中和 as acid + base  $\rightarrow$  salt + water
- identify **conjugate acid-base pairs** 共轭酸碱对

## Method — Brønsted-Lowry definition

An **acid** donates a proton ( $\text{H}^+$ ); a **base** accepts one. In  $\text{HCl} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$ , HCl donates ( $\rightarrow$  acid), water accepts ( $\rightarrow$  base).

## Method — Neutralization

Acid + base  $\rightarrow$  **salt** + **water**:



The net ionic form is  $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$ .

## Method — Conjugate pairs

When an acid donates its proton, what remains is its **conjugate base**.  $\text{HCl}$  (acid)  $\rightarrow$   $\text{Cl}^-$  (conjugate base).  $\text{H}_2\text{O}$  (base)  $\rightarrow$   $\text{H}_3\text{O}^+$  (conjugate acid). A pair differs by **one  $\text{H}^+$** .

## Method — Identifying pairs

Look for two species that differ by a single proton on each side of the equation.

## Practice 2.1 ■ 1 mark

Define a Brønsted-Lowry acid.

## Solution 2.1

Method: Brønsted-Lowry definition

### Worked steps

A proton ( $\text{H}^+$ ) donor **B1**.

## Practice 2.2 ■ 2 marks

Write the products of  $\text{HNO}_3 + \text{KOH}$ .

## Solution 2.2

### Worked steps

$\text{KNO}_3 + \text{H}_2\text{O}$  (salt + water) **M1** **A1**.

## Practice 2.3 ■ 1 mark

What is the conjugate base of HF?

## Solution 2.3

Method: Conjugate pairs

### Worked steps

$F^-$  **B1**.

## Exam-style 3.1 ■ 1 mark

A Brønsted-Lowry base is a

- A** proton donor
- B** proton acceptor
- C** electron donor
- D** hydroxide only

## Solution 3.1

Method: Brønsted-Lowry definition

- A proton donor
- B proton acceptor**
- C electron donor
- D hydroxide only



### Worked steps

**B** — a proton acceptor.

## Exam-style 3.2 ■ 2 marks

Consider  $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$ .

- (a) Identify the acid and base on the left.
- (b) Identify the conjugate acid-base pairs.

## Solution 3.2

Method: Conjugate pairs

### Worked steps

(a)  $\text{H}_2\text{O}$  is the acid (donates  $\text{H}^+$ );  $\text{NH}_3$  is the base (accepts) **M1** **A1**. (b)  $\text{NH}_3/\text{NH}_4^+$  and  $\text{H}_2\text{O}/\text{OH}^-$  **M1** **A1**.

## Exam-style 3.3 ■ 3 marks

Write the balanced molecular equation for the neutralization of sulfuric acid  $\text{H}_2\text{SO}_4$  with sodium hydroxide.

## Solution 3.3

Method: Neutralization

### Worked steps

