

# 8.1 Introduction to Acids and Bases

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

**Total: 10 marks****KEY WORDS** acid 酸 • base 碱 • weak 弱 • weak acid 弱酸 • strong 强

## Objective

Build the skills to answer exam questions on **acids and bases** — the basic definitions.**You must be able to:**

- use the **Brønsted-Lowry** definitions (proton donor / acceptor)
- distinguish **strong** 强 from **weak** 弱 acids and bases
- write the ionization of an acid in water

## 1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

### ■ Brønsted-Lowry

An **acid** donates  $\text{H}^+$ ; a **base** accepts  $\text{H}^+$ . In water an acid produces  $\text{H}_3\text{O}^+$  (hydronium); a base produces  $\text{OH}^-$ .

### ■ Strong vs weak

- A **strong** acid/base ionizes **completely** ( $\text{HCl}$ ,  $\text{NaOH}$ ) — a single arrow.
- A **weak** acid/base ionizes **partially** ( $\text{CH}_3\text{COOH}$ ,  $\text{NH}_3$ ) — an equilibrium arrow.

### ■ A worked ionization

Strong:  $\text{HCl} \rightarrow \text{H}^+ + \text{Cl}^-$  (complete). Weak:  $\text{CH}_3\text{COOH} \rightleftharpoons \text{H}^+ + \text{CH}_3\text{COO}^-$  (partial, so a small  $K_a$ ).

### ■ Recognising strong acids

The common strong acids are  $\text{HCl}$ ,  $\text{HBr}$ ,  $\text{HI}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HClO}_4$ . Assume other acids are weak.

## 2 Practice

Now apply the methods above.

**2.1** Define a Brønsted-Lowry base. [1]**2.2** Write the ionization of the strong acid  $\text{HNO}_3$  in water. [1]**2.3** Why is a weak acid written with an equilibrium arrow? [1]

## 3 Exam-style questions

**3.1** A strong acid in water [1]

- **A** ionizes completely
- **B** ionizes partially
- **C** does not ionize
- **D** forms  $\text{OH}^-$

**3.2** Compare  $\text{HCl}$  and  $\text{CH}_3\text{COOH}$  (acetic acid) at the same concentration.

(a) Which ionizes more? [1]

(b) Which has the higher  $[\text{H}^+]$ ? Explain. [2]
**3.3** Write the equilibrium for the weak base ammonia  $\text{NH}_3$  reacting with water. [3]

## Solutions

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**2.1** A proton ( $\text{H}^+$ ) acceptor.

**2.2**  $\text{HNO}_3 \rightarrow \text{H}^+ + \text{NO}_3^-$ .

**2.3** It only ionizes partially, so an equilibrium exists between the molecule and its ions.

**3.1 A** — ionizes completely.

**3.2** (a) HCl. (b) HCl — it is strong and ionizes completely, giving a higher  $[\text{H}^+]$  than the partially-ionized weak acetic acid.

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