

# 8.6 Molecular Structure of Acids and Bases

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

Total: 10 marks

## Objective

Build the skills to answer exam questions on the **molecular structure of acids and bases** —what makes an acid strong.

**You must be able to:**

- link acid strength to bond **polarity** and bond **strength**
- compare **oxoacid** 含氧酸 strength (more O atoms → stronger)
- explain trends down a group (binary acids)

## 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.

### ■ What makes an acid ionize

An acid ionizes more easily when the bond to H is **weaker** or **more polar**, so  $\text{H}^+$  leaves readily, and when the resulting anion is **stable**.

### ■ Binary acids down a group

Down a group the H–X bond gets **weaker** (larger atom), so the acid is **stronger**:  $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$ . Bond strength wins over polarity here.

### ■ Oxoacids: more oxygens = stronger

For oxoacids, more **electronegative O atoms** pull electron density away from the O–H bond, making it more polar and stabilizing the anion. So  $\text{HClO}_4 > \text{HClO}_3 > \text{HClO}_2 > \text{HClO}$ .

### ■ Central atom electronegativity

A more electronegative central atom also strengthens an oxoacid:  $\text{HClO} > \text{HBrO} > \text{HIO}$ .

## 2 Practice

Now apply the methods above.

2.1 Which is the stronger acid, HCl or HI? [1]

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2.2 Which is stronger, HClO<sub>4</sub> or HClO? [1]

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2.3 What two bond properties make an acid ionize more easily? [2]

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### 3 Exam-style questions

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3.1 Among oxoacids of the same central atom, more oxygen atoms make the acid [1]

- A weaker
  - B stronger
  - C neutral
  - D basic
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3.2 Rank HClO, HClO<sub>2</sub>, HClO<sub>3</sub> from weakest to strongest acid, with a reason. [3]

3.3 Explain why HI is a stronger acid than HF, even though F is more electronegative. [2]

### 4 Go further

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You are now ready for the real exam questions on this subtopic:

- work through the **8.6 Molecular Structure of Acids and Bases** lesson on the **Learn** page;

- read the **Molecular Structure of Acids and Bases** section of the AP Chemistry handout on the **Know** page.

## Solutions

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**2.1** HI.

**2.2** HClO<sub>4</sub>.

**2.3** A weaker H–X bond; a more polar H–X bond.

**3.1 B** —stronger.

**3.2** HClO < HClO<sub>2</sub> < HClO<sub>3</sub>; more oxygen atoms pull electron density from the O–H bond and stabilize the anion, increasing acid strength.

**3.3** The H–I bond is much weaker than H–F (I is a large atom), so H<sup>+</sup> is released more easily; the weaker bond outweighs F's higher electronegativity.