

8.2 pH and pOH of Strong Acids and Bases

Name: _____ Class: _____ Date: _____ **Total: 12 marks****KEY WORDS** strong base 强碱 • pH 值 • acid 酸 • strong acid 强酸 • base 碱

Objective

Build the skills to answer exam questions on **pH** and **pOH** of strong acids and bases.**You must be able to:**

- use $\text{pH} = -\log[\text{H}^+]$ and $\text{pOH} = -\log[\text{OH}^-]$
- use $\text{pH} + \text{pOH} = 14$ and $[\text{H}^+][\text{OH}^-] = 1 \times 10^{-14}$
- find pH for a strong acid or base of known concentration

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.

■ The definitions

$$\text{pH} = -\log[\text{H}^+], \quad \text{pOH} = -\log[\text{OH}^-].$$

At 25°C, $\text{pH} + \text{pOH} = 14$ and $[\text{H}^+][\text{OH}^-] = 1 \times 10^{-14}$.

■ Strong acid pH

A strong acid ionizes completely, so $[\text{H}^+]$ equals its concentration. For 0.010 M HCl: $\text{pH} = -\log(0.010) = 2$.

■ Strong base pH

A strong base gives $[\text{OH}^-]$ equal to its concentration. For 0.010 M NaOH: $\text{pOH} = 2$, so $\text{pH} = 14 - 2 = 12$.

■ Finding $[\text{H}^+]$ back from pH

Reverse with $[\text{H}^+] = 10^{-\text{pH}}$. A pH of 3 means $[\text{H}^+] = 1 \times 10^{-3}$ M.

2 Practice

Now apply the methods above.

2.1 Find the pH of 0.001 M HCl. [2]

2.2 Find the pOH of 0.010 M NaOH, then the pH. [2]

2.3 Find $[\text{H}^+]$ for a solution of $\text{pH} = 4$. [1]

3 Exam-style questions

3.1 At 25°C, $\text{pH} + \text{pOH} =$ [1]

- **A** 7
- **B** 10
- **C** 14
- **D** 1

3.2 A 0.0050 M solution of HNO_3 (a strong acid).(a) State $[\text{H}^+]$. [1]

(b) Find the pH. [2]

3.3 A 0.020 M solution of NaOH.

(a) Find the pOH.

[2]

(b) Find the pH.

[1]

Solutions

2.1 $\text{pH} = -\log(0.001) = 3.$

2.2 $\text{pOH} = -\log(0.010) = 2$; $\text{pH} = 14 - 2 = 12.$

2.3 $[\text{H}^+] = 10^{-4} = 1 \times 10^{-4} \text{ M}.$

3.1 **C** — 14.

3.2 (a) $[\text{H}^+] = 0.0050 \text{ M}.$ (b) $\text{pH} = -\log(0.0050) = 2.30.$

3.3 (a) $\text{pOH} = -\log(0.020) = 1.70.$ (b) $\text{pH} = 14 - 1.70 = 12.30.$