

Exercise walk-through

pH and pOH of Strong Acids and Bases ■ 8.2

eXercise

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

Method — The definitions

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

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

Method — Strong acid pH

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

Method — Strong base pH

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

Method — Finding $[H^+]$ back from pH

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

Practice 2.1 ■ 2 marks

Find the pH of 0.001 M HCl.

Solution 2.1

Worked steps

$$\text{pH} = -\log(0.001) = 3 \quad \text{M1} \quad \text{A1}.$$

Practice 2.2 ■ 2 marks

Find the pOH of 0.010 M NaOH, then the pH.

Solution 2.2

Method: Strong base pH

Worked steps

$$\text{pOH} = -\log(0.010) = 2; \text{pH} = 14 - 2 = 12 \quad \text{M1} \quad \text{A1}.$$

Practice 2.3 ■ 1 mark

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

Solution 2.3

Worked steps

$$[\text{H}^+] = 10^{-4} = 1 \times 10^{-4} \text{ M} \quad \text{B1}.$$

Exam-style 3.1 ■ 1 mark

At 25°C, $\text{pH} + \text{pOH} =$

A 7

B 10

C 14

D 1

Solution 3.1

Method: The definitions

A 7

B 10

C 14



D 1

Worked steps

C — 14.

Exam-style 3.2 ■ 1 mark

A 0.0050 M solution of HNO_3 (a strong acid).

- (a) State $[\text{H}^+]$.
- (b) Find the pH.

Solution 3.2

Method: Strong acid pH

Worked steps

(a) $[\text{H}^+] = 0.0050 \text{ M}$ **B1**. (b) $\text{pH} = -\log(0.0050) = 2.30$ **M1** **A1**.

Exam-style 3.3 ■ 2 marks

A 0.020 M solution of NaOH.

- (a) Find the pOH.
- (b) Find the pH.

Solution 3.3

Method: Strong base pH

Worked steps

(a) $\text{pOH} = -\log(0.020) = 1.70$ **M1** **A1**. (b) $\text{pH} = 14 - 1.70 = 12.30$ **B1**.