

HL Questions on Acids & bases calculations

1. Calculate the pH of:

- i. 10.0 cm³ of 1.00 × 10⁻² mol dm⁻³ hydrochloric acid solution.
- ii. 100 cm³ of 1.00 × 10⁻² mol dm⁻³ hydrochloric acid solution.
- iii. 10.0 cm³ of 2.00 × 10⁻⁴ mol dm⁻³ nitric acid solution.
- iv. 10.0 cm³ of 1.00 × 10⁻² mol dm⁻³ sodium hydroxide solution.
- v. 10.0 cm³ of 1.00 × 10⁻³ mol dm⁻³ sulfuric acid solution.
- vi. 20.0 cm³ of 1.00 × 10⁻³ mol dm⁻³ barium hydroxide solution, Ba(OH)₂(aq).

2. A solution has a pH of 3.60. Calculate:

- i. The hydrogen ion concentration.
- ii. The hydroxide ion concentration.
- iii. The pH if the solution is diluted ten times (assume it is a strong acid as the degree of dissociation increases with dilution for weak acids).

3. State the equations for the reaction of i. ethanoic acid and ii. ammonia with water.

4. Calculate the pH of:

- i. 1.00 × 10⁻³ mol dm⁻³ ethanoic acid solution, CH₃COOH(aq). $K_a(\text{CH}_3\text{COOH}) = 1.8 \times 10^{-5}$ at 298 K.
- ii. 3.00 × 10⁻² mol dm⁻³ ammonia solution, NH₃(aq). $K_b(\text{NH}_3) = 1.8 \times 10^{-5}$ at 298 K.

5. Use Section 21 of the IB Chemistry data booklet to calculate:

- i. the pH of 4.00 × 10⁻⁴ mol dm⁻³ propanoic acid solution, C₂H₅COOH(aq).
- ii. the pH of 1.00 × 10⁻⁵ mol dm⁻³ ethylamine (ethanamine) solution, C₂H₅NH₂(aq).

6. Use Section 21 of the IB data booklet to put the following in order of decreasing acid strength: water, ethanoic acid, phenol, chloroethanoic acid, ethanol, propanoic acid, benzoic acid.

7. The graph on the right shows how the ionic product of water changes with temperature.

Use the graph to determine:

- i. the value of K_w at 80 °C.
- ii. the hydrogen ion concentration at 70 °C.
- iii. the hydroxide concentration at 70 °C.
- iv. the pH at 50 °C.
- v. the pOH at 80 °C.

