Acids, bases and pH

Chemistry · Class 10 Acids, Bases and Salts; Class 11 Chemistry: Equilibrium (ionic equilibrium, pH)

The trap

✗ Most students think

~~In chuna water, $Ca(OH)_2$, the OH^- concentration is the same as the $Ca(OH)_2$ concentration.~~

✓ Actually

Each $Ca(OH)_2$ gives **two** OH^-: **$[OH^-] = 2 \times [Ca(OH)_2]$**. Forget the 2 and every pH and Ksp answer goes wrong.

The concept in 5 lines

1. An **indicator** changes colour with acid or base: turmeric (curcumin) is yellow in acid and water, **red-brown above about pH 8.5**.
2. In water an acid gives **H^+** and a base gives **OH^-**; chuna is **$Ca(OH)_2 \rightarrow Ca^{2+} + 2OH^-$**.
3. **$pH = -\log_{10}[H^+]$**; at 25 °C, **$pH + pOH = 14$** and pH 7 is neutral.
4. Each pH step is **10×**: lemon (pH 2) has **100,000×** the H^+ of water (pH 7).
5. **Neutralization:** $H^+ + OH^- \rightarrow H_2O$ (acid + base → salt + water). That is why lemon juice turns the red cloth yellow again.

Remember

$$pH = -\log_{10}[H^+] \cdot pH + pOH = 14$$

Why it matters

Equilibrium (Class 11) gave NEET **1, 2, 2, 3 and 3 questions** from 2021 to 2025, plus **27 JEE Main 2025** questions across shifts.

Previous-year question, solved

NEET 2019

The pH of a saturated solution of $Ca(OH)_2$ is 9. The solubility product (Ksp) of $Ca(OH)_2$ is:

(A) 0.125×10^{-15}

(B) 0.5×10^{-10}

(C) 0.5×10^{-15}

(D) 0.25×10^{-10}

Answer: (C) 0.5×10^{-15}

1. pOH = 14 − 9 = 5, so **$[OH^-] = 10^{-5}$ M**.
2. $Ca(OH)_2 \rightleftharpoons Ca^{2+} + 2OH^-$. If the solubility is S, $[Ca^{2+}] = S$ and $[OH^-] = 2S$, so $S = 0.5 \times 10^{-5}$ M.
3. $Ksp = [Ca^{2+}][OH^-]^2 = (0.5 \times 10^{-5})(10^{-5})^2 = \mathbf{0.5 \times 10^{-15}}$.

The trap: $[Ca^{2+}]$ is only half of $[OH^-]$, because each $Ca(OH)_2$ releases two OH^-.

Practice: try each one before you check the answers

Q1 Class 10 A solution turns red litmus blue. Its pH is most likely: (a) 1 (b) 4 (c) 7 (d) 10

Q2 Class 10–11 Solution A has pH 3 and solution B has pH 6. How many times greater is the H^+ concentration in A?

Q3 NEET / JEE Find the pH of 0.01 M NaOH at 25 °C.

Q4 NEET / JEE Chuna water is made with 0.005 M $Ca(OH)_2$. Assuming complete dissociation, find its pH at 25 °C.

Q5 NEET / JEE What volume of 0.05 M NaOH exactly neutralizes 10 mL of 0.1 M HCl?

Answers

1. **(d) 10.** Red litmus turning blue means a base, and bases have pH above 7.
2. **1,000 times.** 10^(6 − 3) = 10^3.
3. NaOH is a strong base, so $[OH^-] = 0.01 = 10^{-2}$ M. pOH = 2, so **pH = 14 − 2 = 12**.
4. Each $Ca(OH)_2$ gives 2 OH^-, so $[OH^-] = 2 \times 0.005 = 0.01$ M. pOH = 2, so **pH = 12**: the "about 12" from the story.
5. HCl = 0.1 × 10 = 1 mmol, so you need 1 mmol of NaOH. Volume = 1 ÷ 0.05 = **20 mL**.

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