LESSON MAKER PRO

The pH Puzzle

Use ion concentrations to compare solutions.

HIGH SCHOOL · CHE.6

CHE.6 "Make qualitative and quantitative claims, based on ion concentration, about the acidic, basic, or neutral characteristics of a solution. a. Obtain, evaluate, and communicate information concerning the properties of acids and bases. b..."

NAME _____ **DATE** _____

POWERS OF TEN

At 25°C, if $[H_3O^+] = 1 \times 10^{-n}$ mol/L, then pH = n. If $[OH^-] = 1 \times 10^{-n}$ mol/L, then pOH = n. Use pH + pOH = 14: a pH below 7 is acidic, 7 is neutral, and above 7 is basic.

WORKED EXAMPLE

At 25°C, a solution has $[H_3O^+] = 1 \times 10^{-6}$ mol/L. Find its pH and pOH.

1. The exponent gives pH = 6.
2. Use pH + pOH = 14.
3. pOH = 14 - 6 = 8.

Answer: pH = 6; pOH = 8

PRACTICE 6 problems

1 A solution has $[H_3O^+] = 1 \times 10^{-3}$ mol/L. Find its pH.

ANSWER _____

2 A solution has $[OH^-] = 1 \times 10^{-2}$ mol/L. Find its pOH and pH.

ANSWER _____

3 A solution has a pH of 9. Find $[H_3O^+]$ in mol/L.

ANSWER _____

4 A solution has a pH of 4. Find $[OH^-]$ in mol/L.

ANSWER _____

5 A solution has $[OH^-] = 1 \times 10^{-7}$ mol/L. Find its pH and classify it as acidic, basic, or neutral.

ANSWER _____

6 A solution has a pH of 13. Find its pOH and $[OH^-]$ in mol/L.

ANSWER _____

APPLY IT Show your work

1 Two sports drinks have pH values of 3 and 4. Find $[H_3O^+]$ in each drink. How many times greater is the hydronium ion concentration in one drink than in the other?

WORK SPACE

ANSWER _____

2 A liquid hand soap has a pH of 10, while tap water has a pH of 7. Find $[OH^-]$ in each. How many times greater is the hydroxide ion concentration in the soap?

WORK SPACE

ANSWER _____

CHALLENGE One step up

Use the measured concentrations in the table to find the pH of each sample. Which sample has the greater hydronium ion concentration, and by what factor?

TWO UNKNOWN SAMPLES

Sample	Measured ion concentration (mol/L)
A	$[H_3O^+] = 1 \times 10^{-2}$
B	$[OH^-] = 1 \times 10^{-3}$

WORK SPACE AND ANSWER

The pH Puzzle

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A solution has $[H_3O^+] = 1 \times 10^{-3}$ mol/L. Find its pH.	**pH = 3**
2	A solution has $[OH^-] = 1 \times 10^{-2}$ mol/L. Find its pOH and pH.	**pOH = 2; pH = 12**
3	A solution has a pH of 9. Find $[H_3O^+]$ in mol/L.	**$[H_3O^+] = 1 \times 10^{-9}$ mol/L**
4	A solution has a pH of 4. Find $[OH^-]$ in mol/L.	**$[OH^-] = 1 \times 10^{-10}$ mol/L**
5	A solution has $[OH^-] = 1 \times 10^{-7}$ mol/L. Find its pH and classify it as acidic, basic, or neutral.	**pH = 7; neutral**
6	A solution has a pH of 13. Find its pOH and $[OH^-]$ in mol/L.	**pOH = 1; $[OH^-] = 1 \times 10^{-1}$ mol/L**

PART 2 · APPLY IT

1. **pH 3: 1×10^{-3} mol/L; pH 4: 1×10^{-4} mol/L. The pH 3 drink has 10 times the hydronium ion concentration.** Each pH gives the exponent of its hydronium ion concentration. The concentrations differ by one power of ten.
2. **Soap: 1×10^{-4} mol/L; tap water: 1×10^{-7} mol/L. The soap has 1,000 times the hydroxide ion concentration.** Subtract each pH from 14 to get pOH values of 4 and 7. The resulting hydroxide ion concentrations differ by three powers of ten.

CHALLENGE

Sample A has pH 2. Sample B has pOH 3, so its pH is 11. Sample A has 1×10^9 times the hydronium ion concentration of sample B.

Accept equivalent decimal or power-of-ten forms for concentrations and factors. All calculations assume 25°C.