

# What are Acids, Bases, and Buffer Solutions?

## Worksheet

Acids donate protons (H) and have  $\text{pH} < 7$ ; bases accept protons and have  $\text{pH} > 7$ . Buffers contain a weak acid-conjugate base pair (or weak base-conjugate acid pair) and resist pH shifts when small amounts of acid or base are added.

## Questions

1. Which compound is an acid?

- A) NaOH
- B) HCl
- C) NH
- D) NaCl

2. A buffer contains 0.1 M weak acid and 0.1 M its conjugate base. What happens if acid is added?

- A) pH drops drastically
- B) Conjugate base neutralizes the added acid, pH drops slightly
- C) No pH change at all
- D) Buffer becomes stronger

3. Which is true about strong acids?

- A) Only partially ionize
- B) Completely ionize in water
- C) Have  $\text{pH} > 7$
- D) Need a buffer to use

4. A buffer system requires

- A) Two strong acids
- B) A weak acid and its conjugate base
- C) Two bases
- D) Salt only

5. Hydrochloric acid (HCl) is a strong acid. If 0.01 M HCl solution is prepared, what is its approximate pH?

6. A buffer is made with 0.1 M acetic acid ( $\text{CH}_3\text{COOH}$ ) and 0.1 M sodium acetate ( $\text{NaCH}_3\text{COO}$ ). A small amount of HCl is added. Does pH change drastically?

7. Sodium hydroxide (NaOH) is a strong base with concentration 0.001 M. Find  $[\text{OH}^-]$  and  $\text{pOH}$ .

8. Define: What is the main property of a buffer solution?

9. Define: Name one example of a buffer system.

10. Define: Why do bases feel slippery?

## Answer Key

1. B) HCl - HCl is hydrochloric acid-it donates H ions. NaOH is a base, NH is a weak base, NaCl is a salt.
2. B) Conjugate base neutralizes the added acid, pH drops slightly - The conjugate base reacts with added H, limiting pH change. A well-designed buffer minimizes the change.
3. B) Completely ionize in water - Strong acids fully dissociate. Weak acids partially ionize and are buffered by their conjugate bases.
4. B) A weak acid and its conjugate base - A classic buffer: weak acid + its conjugate base (or weak base + conjugate acid).
5.  $[H] = 0.01 \text{ M} = 10^{-2} \text{ M}$   $\text{pH} = -\log[H] = -\log(10^{-2}) = 2$  Solution is strongly acidic
6. The acetate ion ( $\text{CH}_3\text{COO}^-$ ) from the salt neutralizes added H  $\text{CH}_3\text{COO}^- + \text{H}^+ \rightarrow \text{CH}_3\text{COOH}$  pH drops only slightly, not drastically Buffer resists pH change
7.  $[\text{OH}^-] = 0.001 \text{ M} = 10^{-3} \text{ M}$   $\text{pOH} = -\log[\text{OH}^-] = -\log(10^{-3}) = 3$  At 25°C:  $\text{pH} = 14 - 3 = 11$
8. A buffer resists large pH changes when small amounts of acid or base are added.
9. Acetic acid ( $\text{CH}_3\text{COOH}$ ) + sodium acetate ( $\text{NaCH}_3\text{COO}$ ), or ammonia ( $\text{NH}_3$ ) + ammonium chloride ( $\text{NH}_4\text{Cl}$ ).
10. Bases react with oils and proteins on skin, forming slippery soap-like compounds.

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