Ions in Disguise

Use equal-concentration data to compare acid and base strength.

CHE.9.2 "Enrichment: Analyze and interpret data to identify differences between strong and weak acids and bases (i.e., dissociation)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the sentence that explains how strength differs from concentration. Circle the percentages in the table, then number each acid and base pair from more to less ion formation.

Four Beakers, Different Particles

1 Four clear liquids look alike in beakers, but their particles behave differently in water. Each solution starts with 0.10 mole of dissolved substance per liter. The table reports pH and the percentage of formula units or molecules that yield ions. This percentage can describe an ionic solid separating or a molecule reacting with water.

FOUR SOLUTIONS AT 0.10 MOL/L

Solution	Type	Particles yielding ions	pH
Hydrochloric acid	Acid	About 100%	1.0
Acetic acid	Acid	About 1.3%	2.9
Sodium hydroxide	Base	About 100%	13.0
Ammonia	Base	About 1.3%	11.1

2 Acids supply hydronium ions, H_3O^+, when they react with water. For acids that donate one proton per molecule, lower pH at equal starting concentration generally signals more ion formation. Bases supply hydroxide ions, OH^-, by separating into ions or reacting with water. At equal starting concentration, higher pH generally signals more hydroxide formation.

3 Strong acids and bases produce ions from nearly all starting particles; weak ones produce ions from only a small fraction. Strength is not concentration: every solution here starts at the same concentration. Compare acids with acids and bases with bases when using pH as evidence. A pH reading alone cannot reveal strength if the starting concentration is unknown.

2 ANSWER WITH EVIDENCE

Use the passage

1. Which acid is stronger? Use both its percentage and its pH to support your answer.

2. Which base is weaker? Use both its percentage and its pH to support your answer.

3. Which acid and base have the same percentage of particles yielding ions? What does their pH difference show?

4. In one liter of each acid solution, about how many moles of starting particles yield ions? Show your calculations.

3 YOUR TURN

Your own words

A new 0.10 mol/L acid donates one proton per molecule and has a pH of 2.5. Write three sentences comparing its likely ion formation with both acids in the table, judging whether it is likely strong or weak, and explaining why equal starting concentrations matter.

Ions in Disguise

PART 1 · READ AND MARK

Underline the sentence that explains how strength differs from concentration. Circle the percentages in the table, then number each acid and base pair from more to less ion formation. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Which acid is stronger? Use both its percentage and its pH to support your answer.	**Hydrochloric acid is stronger. About 100% of its particles yield ions, compared with about 1.3% for acetic acid, and its pH is lower, 1.0 versus 2.9.**
2	Which base is weaker? Use both its percentage and its pH to support your answer.	**Ammonia is weaker. About 1.3% of its molecules yield ions, compared with about 100% for sodium hydroxide, and its pH is lower, 11.1 versus 13.0.**
3	Which acid and base have the same percentage of particles yielding ions? What does their pH difference show?	**Acetic acid and ammonia both have about 1.3% yielding ions. Their pH values differ because one is an acid that supplies hydronium ions and the other is a base that supplies hydroxide ions.**
4	In one liter of each acid solution, about how many moles of starting particles yield ions? Show your calculations.	**Hydrochloric acid: 0.10 mol × 1.00 = about 0.10 mol. Acetic acid: 0.10 mol × 0.013 = about 0.0013 mol.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The new acid's pH of 2.5 falls between the pH values of hydrochloric acid and acetic acid. Because all three acids start at the same concentration and donate one proton per molecule, the new acid likely yields more ions than acetic acid but fewer than hydrochloric acid. It is likely weak because its ion formation appears much closer to acetic acid's small fraction than to hydrochloric acid's nearly complete ion formation.

Accept approximate mole values in question 4. For the open response, accept a supported weak-acid judgment; pH alone does not establish an exact percentage of ion formation.