ANSWER KEY.

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8.6 Molecular Structure of Acids and Bases

AP Chemistry | ANSWER KEY

Answer in complete sentences. Use bond strength, polarity, and conjugate base stability in your explanations.

1. Rank the hydrohalic acids HF, HCl, HBr, and HI from weakest to strongest. Explain the trend in terms of bond strength.

HF < HCl < HBr < HI

Going down Group 17 the halogen atom gets larger, so the H-X bond gets longer and weaker. A weaker bond releases H^+ more easily, so the acid is stronger. HF has the strongest bond and is the only weak acid of the four.

2. Rank HClO, $HClO_2$, $HClO_3$, and $HClO_4$ from weakest to strongest. Explain using the number of oxygen atoms.

HClO < $HClO_2$ < $HClO_3$ < $HClO_4$

More oxygen atoms (very electronegative) pull electron density away from the O-H bond, which makes the H easier to release. They also help spread out the negative charge on the conjugate base, which makes it more stable.

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3. Acetic acid, CH_3COOH, has $K_a = 1.8 \times 10^{-5}$. Chloroacetic acid, $CH_2ClCOOH$, has $K_a = 1.4 \times 10^{-3}$. Explain why chloroacetic acid is the stronger acid.

The electronegative Cl atom pulls electron density toward itself, away from the O-H bond. That makes the H easier to release and stabilizes the negative charge on CH_2ClCOO^-. A more stable conjugate base means a stronger acid (larger K_a).

4. The compounds CH_4, NH_3, H_2O, and HF are all in Period 2. Which is the strongest acid? Explain using electronegativity.

HF is the strongest acid.

Fluorine is the most electronegative of the four atoms, so the H-F bond is the most polar. F also holds the negative charge in F^- best, so the conjugate base is the most stable. Acid strength increases from left to right across a period.

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