

UNIT 8 • ALDEHYDES, KETONES AND CARBOXYLIC ACIDS

Acidity of Carboxylic Acids

Understanding dissociation, resonance stabilization,
and the quantitative scales of acid strength.

Core Concept Vocabulary

[resonance-stabilised carboxylate anion]

The conjugate base formed when a carboxylic acid loses a proton, uniquely stabilized by electron delocalization.

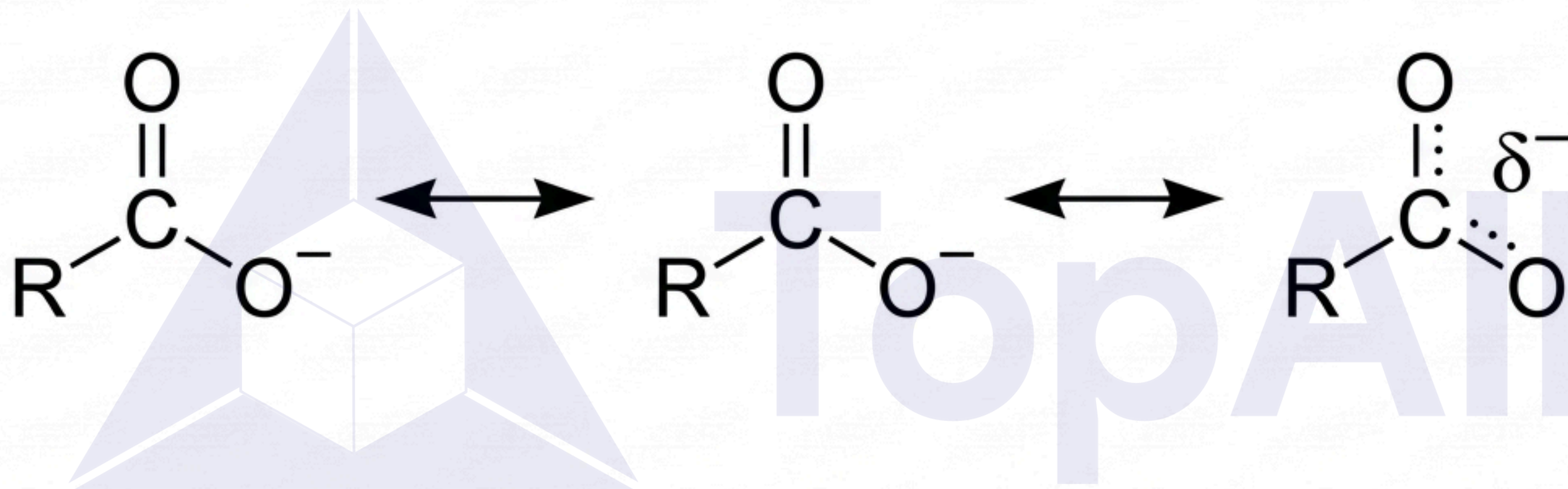
[dissociation constant (K_a)]

The equilibrium constant measuring the exact extent to which the acid breaks down into ions in water.

[pK_a]

The negative base-10 logarithm of the acid dissociation constant, serving as a shorthand to rank and compare acid strength.

The Secret to Strength: Equivalent Resonance



The negative charge is perfectly delocalized across both highly electronegative oxygen atoms.

Unlike phenoxide ions—where the charge is forced onto less electronegative carbon atoms—the carboxylate anion boasts two equivalent resonance structures, offering superior stability.



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$$E=mc^2$$



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The pKa Gradient: Benchmarking Acid Strength

Formula Bank:
 $\text{pKa} = -\log K_a$



Lab Diagnostics: The Bicarbonate Test

-COOH Group

Reaction: Reacts with NaHCO_3 or Na_2CO_3

Result: Brisk effervescence (Evolves CO_2 gas).

-OH Group (Phenol)

Reaction: Reacts with NaHCO_3

Result: Inert (No gas evolved).

Carboxylic acids are strong enough to displace carbonic acid from its salts; phenols are not.

Watch for this: The Inverse Rule

It is easy to intuitively assume that a larger number means a stronger acid. Always flip the logic: because $pK_a = -\log K_a$, a **SMALLER** pK_a = **STRONGER** acid.

Trifluoroacetic acid (pK_a 0.23) is mathematically and **practically** a much **stronger acid** than **acetic acid** (pK_a 4.76).

Module Summary

- Carboxylic acids derive their high acidity from the equivalent resonance structures of the carboxylate anion, cleanly distributing the negative charge across two highly electronegative oxygen atoms.
- Remember the inverse rule (Smaller pK_a = Stronger acid) and use the Bicarbonate Test (CO_2 evolution) as your definitive lab evidence to distinguish true carboxylic acids from phenols.



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