Acid Strength

Steps To Follow For Determining Relative Acidities

1. Look for the most electronegative element which can lose a H^+. We will primarily be concerned with C, N, and O.

2. Write the structure of the conjugate base (it will usually carry a negative charge). At this point the following broad classification can be made

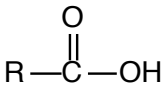
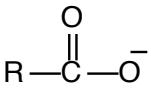
INCREASING STRENGTH OF ACID ⟶

Acid	C–H	N–H	O–H
Conjugate base	C^-	N^-	O^-

INCREASING STRENGTH OF BASE ⟵

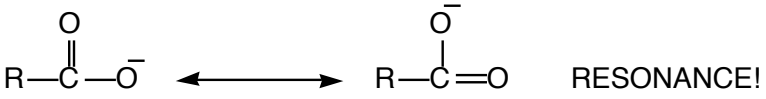
3. Look for resonance stabilization of the conjugate base. Factors stabilizing the conjugate base increase the acidity (i.e., lower the pK_a).

example:

Acids	Conjugate base
	
$R–CH_2–OH$	$R–CH_2–O^-$

From 1 and 2 above - these two acids should be stronger than their C and N analogs.

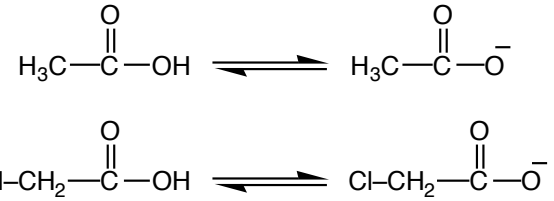
$R–CH_2–O^-$ NO RESONANCE



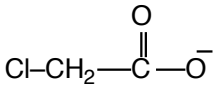
RESONANCE!
(Stronger Acid)

4. Look for inductive stabilization. Again charge dispersal stabilizes the conjugate base, and increases the acidity.

example:



Both conjugate bases are stabilized by resonance.



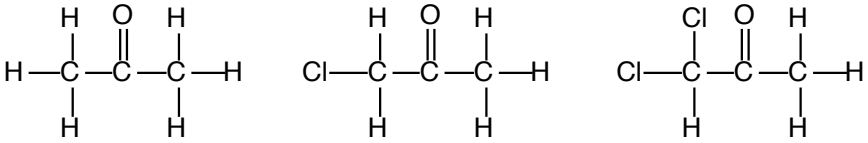
Cl withdraws e^-; it inductively stabilizes the conjugate base
$\therefore$ <u>stronger acid</u>

5. Look at the hybridization of the atom losing H^+ (primarily with carbanions). The more s-character in the orbital containing the extra electron, the more stable the conjugate base.

Acid strength $sp > sp^2 > sp^3$

	H-C≡C-H	$H_2C{=}CH_2$	$CH_3{-}CH_3$
pK_a =	25	42	48

Look at the following examples, write structures for the conjugate bases, and rationalize their pK_a using steps 1-5 (Draw resonance structures where possible).



	Acetone	Chloroacetone	Dichloroacetone
pK_a =	20	16.5	14.9

	$CH_3CH_2CH_3$	$CH_3CH{=}CH_2$
	Propane	Propene
pK_a =	49	40

	CH_3NO_2	$O_2N{-}CH_2{-}NO_2$
	Nitromethane	Dinitromethane
pK_a =	11	4