▶ Video explanation (YouTube Short)

Why Aldehydes Are More Reactive than Ketones

In **nucleophilic addition**, an electron-rich nucleophile (Nu^-) attacks the δ+ carbonyl carbon. The attack is easier when that carbon is **more positive** and **less crowded**. Aldehydes win on both counts (NCERT 8.4).

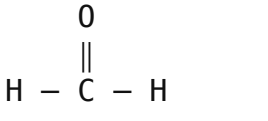
1. Electronic reason: electron push (+I)

Alkyl groups such as CH_3 release electrons towards the carbonyl carbon (+I effect) and lower its δ+. An aldehyde has one alkyl group (and an H); a ketone has two. So the ketone's carbonyl carbon is **less electrophilic** and pulls the nucleophile less.

2. Steric reason: crowding

In an aldehyde the carbonyl carbon carries a small H; in a ketone it carries two relatively large groups, which **hinder the approach** of the nucleophile.

Expanded structural formulas

Methanal (HCHO)	Ethanal (CH_3CHO)	Propanone (CH_3COCH_3)
		
two H: least crowded, most δ+	one CH_3, one H	two CH_3: most crowded, least δ+

Order of reactivity (nucleophilic addition): HCHO > CH_3CHO > CH_3COCH_3.

Solved example

Q. Arrange in increasing order of reactivity towards HCN: acetone, formaldehyde, acetaldehyde.
A. Acetone < acetaldehyde < formaldehyde. Each extra methyl group adds +I electron release and crowding at the carbonyl carbon.

Key takeaways

- More alkyl groups on C=O: less δ+ (electronic) and more crowding (steric).
- So aldehydes are generally more reactive than ketones in nucleophilic addition.
- Methanal, with two H, is the most reactive.

Practice questions

1. (MCQ) Most reactive towards nucleophilic addition: (a) acetone (b) ethanal (c) methanal (d) butanone
2. (MCQ) Alkyl groups lower the reactivity of the carbonyl carbon because they: (a) withdraw electrons (b) release electrons (+I) (c) form H-bonds (d) add a π bond

3. (MCQ) Which effect is described by "two large groups block the nucleophile"? (a) inductive (b) resonance (c) steric (d) hydrogen bonding
4. (Very short) How many alkyl groups are attached to the carbonyl carbon in propanone?
5. (Very short) Name the two reasons why aldehydes are more reactive than ketones.
6. (Short) Why is methanal more reactive than ethanal?
7. (Short) Benzaldehyde is less reactive than ethanal in nucleophilic addition. Suggest a reason.
8. (Application) Arrange in increasing reactivity towards HCN: CH_3CHO, CH_3COCH_3, HCHO, $C_2H_5COCH_3$.

Answer key

1. (c) methanal.
2. (b) release electrons (+I).
3. (c) steric.
4. Two (two CH_3 groups).
5. Electronic (+I effect of alkyl groups lowers δ+) and steric (larger groups hinder the approach).
6. Methanal has two H on the carbonyl carbon: no +I alkyl group and the least crowding; ethanal has one CH_3.
7. The benzene ring's resonance with the C=O spreads the positive charge and lowers the carbonyl carbon's δ+.
8. $C_2H_5COCH_3 < CH_3COCH_3 < CH_3CHO < HCHO$.

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