▶ Video explanation (YouTube Short)

Aldehyde or Ketone? The Distinguishing Tests

Propanal and propanone are both colourless, both C_3H_6O, and both contain C=O. The only difference is what is attached to the carbonyl carbon, and that one difference changes how they react.

Aldehyde R–C(=O)–H · Ketone R–C(=O)–R′

1. The key idea

- Aldehydes are **easily oxidised** (to carboxylic acids, or carboxylate ions in alkaline reagents).
- Ketones **resist mild oxidation**.
- A mild oxidising agent therefore reacts with an aldehyde and not with a ketone: that is the test.

2. Tollens' test: the silver mirror

Tollens' reagent is ammoniacal silver nitrate, $[Ag(NH_3)_2]^+$. Warmed with an aldehyde, the aldehyde is **oxidised** and Ag^+ is **reduced** to metallic silver, which coats the tube as a **silver mirror**.

$$\mathbf{RCHO + 2[Ag(NH_3)_2]^+ + 3OH^- \rightarrow RCOO^- + 2Ag + 4NH_3 + 2H_2O}$$

Ketones generally give no mirror. Aromatic aldehydes such as benzaldehyde also give the mirror.

3. Fehling's test: blue to brick red

Fehling's solution contains blue Cu^{2+} (complexed with tartrate). **Aliphatic** aldehydes reduce it to a **brick-red precipitate of Cu_2O**.

$$\mathbf{RCHO + 2Cu^{2+} + 5OH^- \rightarrow RCOO^- + Cu_2O + 3H_2O}$$

Ketones and **aromatic aldehydes** (benzaldehyde) generally do not give Fehling's test.

4. Iodoform test: the twist

With I_2 and NaOH, compounds containing a **$CH_3CO–$** group give a **yellow precipitate of iodoform, CHI_3**. Methyl ketones (propanone, acetophenone) are positive, and so is **ethanal**, the only aldehyde with a $CH_3CO–$ group.

5. Strategy table

Compound	Tollens'	Fehling's	Iodoform
Propanal	+	+	–
Benzaldehyde	+	–	–
Ethanal	+	+	+
Propanone	–	–	+

Pentan-3-one	–	–	–
Acetophenone	–	–	+

These are general rules under ordinary test conditions; some special compounds (for example α-hydroxy ketones) also reduce Tollens' and Fehling's reagents.

Solved example

Q. A compound C_3H_6O gives a yellow precipitate with I_2/NaOH but no silver mirror with Tollens' reagent. Identify it.
A. No mirror: not an aldehyde, so a ketone. Iodoform positive: it has CH_3CO–. The C_3H_6O ketone is propanone, CH_3COCH_3.

Key takeaways

- H on the carbonyl carbon → easily oxidised → Tollens' silver mirror.
- Fehling's: aliphatic aldehydes only (brick-red Cu_2O).
- Iodoform: any CH_3CO– group, including ethanal.

Practice questions

1. (MCQ) Which gives a silver mirror? (a) propanone (b) propanal (c) pentan-3-one (d) acetophenone
2. (MCQ) Which aldehyde does not give Fehling's test? (a) ethanal (b) propanal (c) benzaldehyde (d) methanal
3. (Very short) Name the precipitate formed in a positive Fehling's test.
4. (Very short) Which aldehyde gives the iodoform test?
5. (Short) Why do aldehydes give Tollens' test but ketones do not?
6. (Short) In Tollens' test, what is oxidised and what is reduced?
7. (Application) Give one test each to distinguish (i) propanal and propanone, (ii) benzaldehyde and ethanal.
8. (Numerical) How many moles of silver are deposited by 0.5 mol of propanal with excess Tollens' reagent?

Answer key

1. (b) Propanal, an aldehyde.
2. (c) Benzaldehyde, an aromatic aldehyde.
3. Cu_2O, copper(I) oxide (brick red).
4. Ethanal, CH_3CHO.
5. The H on the carbonyl carbon makes aldehydes easy to oxidise; ketones resist mild oxidation.
6. The aldehyde is oxidised (to $RCOO^-$); Ag^+ is reduced (to Ag).
7. (i) Tollens': propanal gives a mirror, propanone does not. (ii) Fehling's (ethanal brick red, benzaldehyde no change) or iodoform (ethanal yellow CHI_3).
8. 2 mol Ag per mol of aldehyde: 0.5 × 2 = 1 mol Ag.

▶ Watch the video explanation