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Aldehydes, Ketones and Carboxylic Acids: Chapter Introduction

Vanilla's smell, cinnamon's smell, vinegar's sour taste and the solvent in nail-polish remover all come from compounds that contain one group: the **carbonyl group, C=O**. This chapter is about the three families built on it.

1. The carbonyl group

A carbon joined to an oxygen by a **double bond**: C=O. What else is attached to the carbonyl carbon decides the family.

2. Three families

Family	On the carbonyl carbon	General formula	Everyday example
Aldehyde	at least one H (the other group H or carbon)	R–CHO	vanillin (vanilla), cinnamaldehyde (cinnamon)
Ketone	two carbon groups	R–CO–R′	acetone (propanone), the solvent in common nail-polish removers
Carboxylic acid	an –OH group	R–COOH	acetic (ethanoic) acid in vinegar

Methanal (HCHO) is the aldehyde with two hydrogens on the carbonyl carbon.

3. What the chapter covers

1. How aldehydes, ketones and carboxylic acids are made.
2. Why the polar C=O undergoes **nucleophilic addition**.
3. Tests that tell an aldehyde from a ketone (Tollens', Fehling's).
4. Why carboxylic acids are acidic.

Solved example

Q. Classify CH_3CHO, CH_3COCH_3 and CH_3COOH.
A. CH_3CHO has an H on the carbonyl carbon: an **aldehyde** (ethanal). CH_3COCH_3 has two CH_3 groups on it: a **ketone** (propanone). CH_3COOH has an –OH on it: a **carboxylic acid** (ethanoic acid).

Key takeaways

- All three families contain C=O, the carbonyl group.
- H on the carbonyl C: aldehyde; two carbon groups: ketone; –OH: carboxylic acid.
- They give smells (vanillin, cinnamaldehyde), solvents (acetone) and acids (acetic acid).

Practice questions

1. (MCQ) The functional group common to aldehydes, ketones and carboxylic acids is: (a) –OH (b) C=O (c) $–NH_2$ (d) C=C
2. (MCQ) Acetone is: (a) an aldehyde (b) a ketone (c) a carboxylic acid (d) an alcohol
3. (MCQ) The acid in vinegar is: (a) formic acid (b) acetic acid (c) citric acid (d) benzoic acid
4. (Very short) Which family has at least one hydrogen on the carbonyl carbon?
5. (Very short) Name the aldehyde responsible for the smell of cinnamon.
6. (Short) How does a ketone differ from an aldehyde in structure?
7. (Short) Classify HCHO, C_6H_5COOH and $CH_3COCH_2CH_3$.
8. (Application) A compound C_3H_6O has its carbonyl carbon in the middle of the chain. Is it an aldehyde or a ketone? Name it.

Answer key

1. (b) C=O.
2. (b) a ketone.
3. (b) acetic acid.
4. Aldehydes.
5. Cinnamaldehyde.
6. In a ketone the carbonyl carbon carries two carbon groups; in an aldehyde it carries at least one hydrogen.
7. HCHO: aldehyde (methanal); C_6H_5COOH: carboxylic acid (benzoic acid); $CH_3COCH_2CH_3$: ketone (butanone).
8. A ketone: CH_3COCH_3, propanone (acetone).

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