

Exercise walk-through

4.5.2

Carbonyl tests, reduction and cyanide addition

Pearson Edexcel · International A-Level · Chemistry

Find the temperature boundary

Your turn

$\Delta H = +36.0 \text{ kJ mol}^{-1}$; $\Delta S(\text{system}) = +120 \text{ J mol}^{-1} \text{ K}^{-1}$. Which condition gives positive total entropy?

- A. T below 300 K
- B. T above 300 K
- C. Every temperature
- D. No temperature

Hydrogen bonds require a donor and acceptor

- 1** Carbonyl O accepts a hydrogen bond from water. Simple aldehydes/ketones lack an O–H donor.
- 2** Acids form hydrogen-bonded associations; compare similar-sized molecules for boiling points.
- 3** A longer non-polar chain can reduce water solubility without removing the polar group.

Independent structural identification

Your turn

$\text{C}_3\text{H}_6\text{O}$ has two carbon-13 signals, gives iodoform and no Tollens' silver. Which structure fits?

- A. Propanal
- B. Propanone
- C. Propan-1-ol
- D. Ethanoic acid

Exercises 2.1·2.3

2.1 Give one test that distinguishes propanal from propanone and both observations. [3]

2.2 Give product and reagent conditions for reduction of propanone. [2]

2.3 State the observation with 2,4-DNPH and explain its identification limit. [2]

3 Exam-style questions

Exercises 2.1·2.3

2.1 Give one test that distinguishes propanal from propanone and both observations. [3]

2.1 Warm Tollens' reagent: propanal gives a silver mirror/grey silver, propanone gives no such change. Accept correct Fehling's/Benedict's alternative.

2.2 Give product and reagent conditions for reduction of propanone. [2]

2.2 Propan-2-ol; LiAlH_4 in dry ether then appropriate work-up.

2.3 State the observation with 2,4-DNPH and explain its identification limit. [2]

3 Exam-style questions

2.3 Yellow/orange precipitate; both aldehydes and ketones respond, so it is not a distinction between them.

Exercises 3.1·3.2

3.1 An unknown $\text{C}_3\text{H}_6\text{O}$ gives 2,4-DNPH and iodoform precipitates, no Tollens' silver and two carbon-13 signals. Identify it, explain all evidence, and predict whether its HCN product is chiral. [5]

3.2 Describe the electron-pair movements for CN^- addition to ethanal and the following proton transfer. State why a racemate results under achiral conditions. [4]

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3.1 Propanone CH_3COCH_3 . Carbonyl gives DNPH; $\text{CH}_3\text{CO}-$ gives iodoform and ketone gives no Tollens' silver. Two equivalent methyl carbons and one carbonyl environment give two signals. HCN product $(\text{CH}_3)_2\text{C}(\text{OH})\text{CN}$ has identical methyl groups, so is achiral.

3.2 Describe the electron-pair movements for CN^- addition to ethanal and the following proton transfer. State why a racemate results under achiral conditions. [4]

3.2 CN^- carbon lone pair $\rightarrow$ carbonyl C; $\text{C}=\text{O}$ π pair $\rightarrow$ O. O^- gains H^+ from HCN,

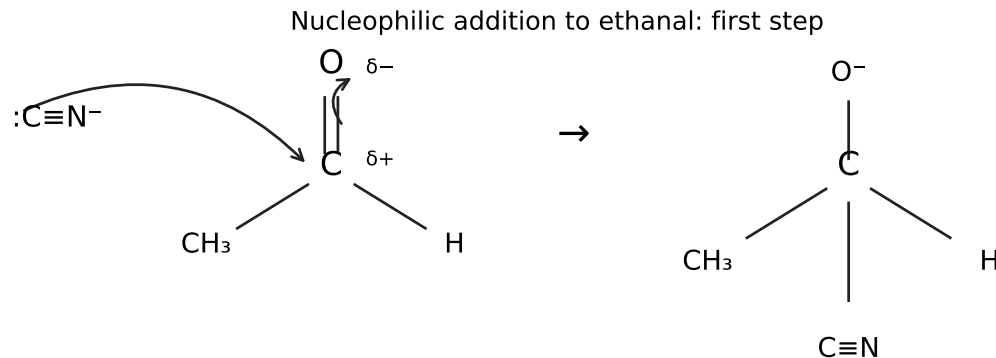
Exercise 3.3

3.3 Draw the first-step electron-pair arrows for CN^- addition to ethanal and the charged intermediate. [4]

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3.3



Then O^- takes H^+ from HCN : $\text{CH}_3\text{CH}(\text{OH})\text{CN} + \text{CN}^-$.
Arrows start at an electron pair; CN^- attacks through carbon.

B1 lone pair on CN carbon to carbonyl carbon; B1 $\text{C}=\text{O}$ π pair to oxygen; B1 correct intermediate connectivity; B1 negative oxygen.