

Exercise walk-through

Nitriles and hydroxynitriles ■ 19.2

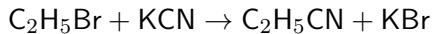
eXercise

You must be able to

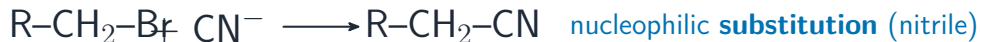
- recall how nitriles are made (halogenoalkane + KCN) and hydroxynitriles (carbonyl + HCN)
- describe the hydrolysis of nitriles to carboxylic acids

Method — Two ways cyanide adds a carbon

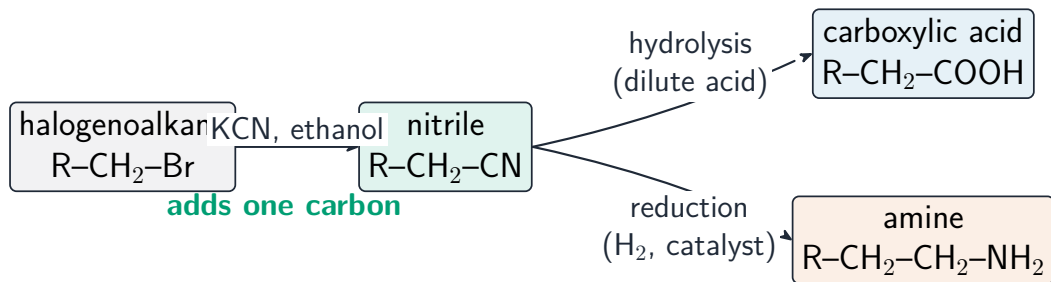
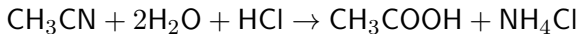
*KCN + halogenoalkane → nitrile (nucleophilic substitution); HCN + carbonyl → hydroxynitrile (nucleophilic addition). Both **add one carbon***



Method — Two ways cyanide adds a carbon



Method — Hydrolysis of nitriles



A halogenoalkane $\rightarrow$ nitrile (KCN) $\rightarrow$ carboxylic acid (hydrolysis) or amine (reduction)

Practice 2.1 ■ 2 marks

State the reagents and conditions to make a nitrile from a halogenoalkane.

Solution 2.1

Worked steps

potassium cyanide (KCN) in ethanol **B1**; and heat **B1**.

Practice 2.2 ■ 1 mark

State what functional group a nitrile is changed into by hydrolysis.

Solution 2.2

Method: Hydrolysis of nitriles

Worked steps

a carboxylic acid ($-\text{COOH}$) **B1**.

Exam-style 3.1 ■ 1 mark

The reaction of KCN with a halogenoalkane is useful in synthesis because it:

- A** removes a carbon
- B** adds one carbon to the chain
- C** forms a double bond
- D** makes an ester

Solution 3.1

- A removes a carbon
- B adds one carbon to the chain**
- C forms a double bond
- D makes an ester



Worked steps

B. KCN adds one carbon to the chain (forming the nitrile).

Exam-style 3.2 ■ 1 mark

Hydrolysis of ethanenitrile, CH_3CN , with dilute acid gives:

- A** ethanol
- B** ethanoic acid
- C** ethylamine
- D** ethanal

Solution 3.2

Method: Hydrolysis of nitriles

- A ethanol
- B ethanoic acid
- C ethylamine
- D ethanal



Worked steps

B. Hydrolysis of a nitrile gives the carboxylic acid (ethanoic acid).

Exam-style 3.3 ■ 1 mark

- (a) Write the equation for the reaction of bromoethane with KCN.
- (b) Describe how the nitrile product can be converted into a carboxylic acid.

Solution 3.3

Method: Hydrolysis of nitriles

Worked steps

(a) $\text{C}_2\text{H}_5\text{Br} + \text{KCN} \rightarrow \text{C}_2\text{H}_5\text{CN} + \text{KBr}$ **B1**.

(b) warm the nitrile with dilute acid (or dilute alkali then acidify) **M1**; the $-\text{CN}$ group is hydrolysed to $-\text{COOH}$ **A1**.

Exam-style 3.4 ■ 2 marks

State the reagent and condition to make a hydroxynitrile from propanone (a ketone), and name the mechanism.

Solution 3.4

Worked steps

HCN with a KCN catalyst (and heat) **B1**; nucleophilic addition **B1**.