

19.2 Nitriles and hydroxynitriles

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS hydrolysis 水解 • nitrile 腈 • carboxylic acid 羧酸 • hydroxynitrile 羟基腈 • nitriles and hydroxynitriles 腈和羟基腈

Objective

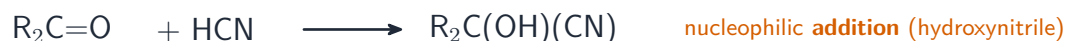
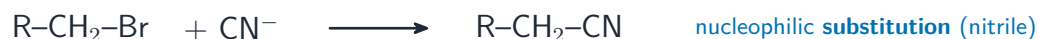
Build the skills to answer exam questions on **nitriles and hydroxynitriles** 腈和羟基腈 — making them and the **hydrolysis** 水解 of nitriles.

You must be able to:

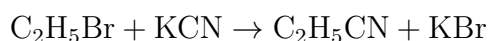
- recall how nitriles are made (halogenoalkane + KCN) and hydroxynitriles (carbonyl + HCN)
- describe the hydrolysis of nitriles to carboxylic acids

1 Worked examples

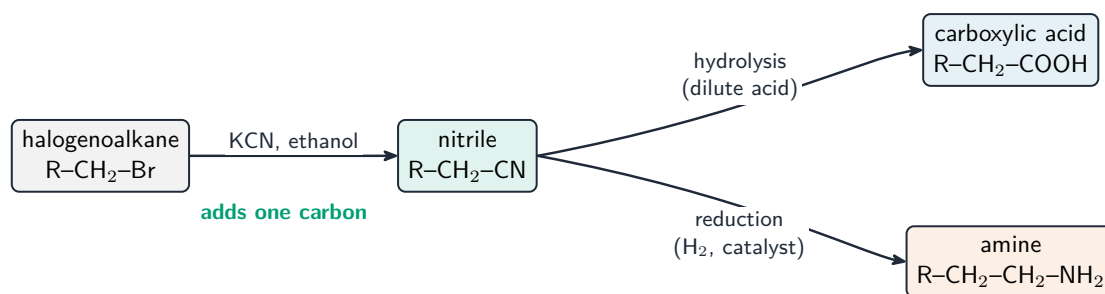
■ Two ways cyanide adds a carbon



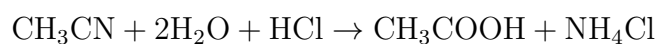
*KCN + halogenoalkane → nitrile (nucleophilic substitution); HCN + carbonyl → hydroxynitrile (nucleophilic addition). Both **add one carbon***



■ Hydrolysis of nitriles



A nitrile hydrolyses to a carboxylic acid (dilute acid or alkali, then acidify) or reduces to an amine



2 Practice

2.1 State the reagents and conditions to make a nitrile from a halogenoalkane. [2]

2.2 State what functional group a nitrile is changed into by hydrolysis. [1]

3 Exam-style questions

3.1 The reaction of KCN with a halogenoalkane is useful in synthesis because it: [1]

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

3.2 Hydrolysis of ethanenitrile, CH_3CN , with dilute acid gives: [1]

- **A** ethanol
 - **B** ethanoic acid
 - **C** ethylamine
 - **D** ethanal
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3.3 (a) Write the equation for the reaction of bromoethane with KCN. [1]

(b) Describe how the nitrile product can be converted into a carboxylic acid. [2]

3.4 State the reagent and condition to make a hydroxynitrile from propanone (a ketone), and name the mechanism. [2]

Solutions

2.1 potassium cyanide (KCN) in ethanol; and heat.

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

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

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

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

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

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