A-LEVEL CHEMISTRY • HOLIDAY HOMEWORK 假期作业

19 Nitriles – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
nucleophilic substitution	亲核取代			
nitrile	腈			
halogenoalkane	卤代烷			
potassium cyanide	氰化钾			
hydrolysis	水解			
carboxylic acid	羧酸			
reduction	还原			
amine	胺			

Recall

From Part 1 you used a **nucleophilic substitution** 亲核取代 to make an amine. The **cyanide ion** (CN^-) can do the same — and it has a special bonus: it **adds a carbon** to the chain.

- A **nitrile** 腈 has the –CN group.
- Nitriles are a useful "hub" — they convert to acids or amines.

New ideas

Read these first, then do the Practice.

1 Making a nitrile

Heat a **halogenoalkane** 卤代烷 with **potassium cyanide** 氰化钾 (KCN) in ethanol:

$$C_2H_5Br + KCN \rightarrow C_2H_5CN + KBr$$

This is a nucleophilic substitution with $\mathbf{CN^-}$ as the nucleophile. It is useful because it **adds one carbon** to the chain.

2 The nitrile hub

A **nitrile** 腈 can be changed two ways:

- **hydrolysis** 水解 (warm with dilute acid) turns –CN into –COOH → a **carboxylic acid** 羧酸.
- **reduction** 还原 (H_2 and a catalyst) turns –CN into $-CH_2NH_2$ → an **amine** 胺.

3 Two ways cyanide adds a carbon

R–Br + KCN → nitrile (substitution)

C=O + HCN → hydroxynitrile (addition)

- **KCN** + a halogenoalkane → a **nitrile** (substitution).
- **HCN** + an aldehyde/ketone → a **hydroxynitrile** (addition).

Watch out: cyanide adds a carbon two different ways — KCN + a halogenoalkane gives a nitrile by *substitution*; HCN + a carbonyl gives a hydroxynitrile by *addition*. The nitrile is a hub: hydrolyse it to an acid, or reduce it to an amine.

Practice

Try these in order.

19.1 Write the equation for bromoethane reacting with KCN. [2]

19.2 Why is making a nitrile a useful step in organic synthesis? [1]

19.3 Name the product when a nitrile is (a) hydrolysed, (b) reduced. [2]

19.4 State the reagent and the type of mechanism for making a nitrile from a halogenoalkane. [2]

19.5 HCN reacts with a ketone. Name the product and the type of mechanism. [2]

19.6 Challenge. A chemist needs to turn bromoethane (2 carbons) into propanoic acid (3 carbons). Outline a two-step route, naming the reagent for each step. [3]