19 Nitriles – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	**Write it 3 times** (English)		
nucleophilic substitution			
nitrile			
halogenoalkane			
potassium cyanide			
hydrolysis			
carboxylic acid			
reduction			
amine			

Recall

From Part 1 you used a **nucleophilic substitution** 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** has the –CN group.
- Nitriles are a useful "hub" – they convert to acids or amines.

New ideas

Read these first, then do the Practice.

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1 Making a nitrile

Heat a **halogenoalkane** with **potassium cyanide** (KCN) in ethanol:

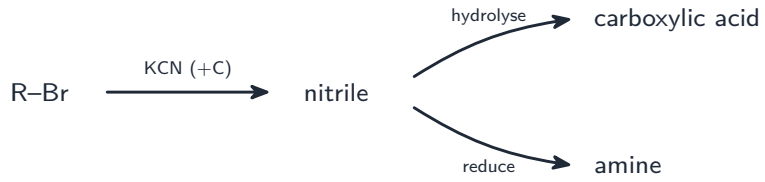
$$C_2H_5Br + KCN \rightarrow C_2H_5CN + KBr$$

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

2 The nitrile hub

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

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



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]