12 Nitrogen and its compounds – Part 1

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)		
nitrogen	氮			
ammonia	氨			
lone pair	孤对电子			
triple bond	三键			
bond energy	键能			
non-polar	非极性			
base	碱			
proton	质子			
coordinate bond	配位键			
ammonium ion	铵离子			

Recall

At IGCSE you learned that air is mostly **nitrogen** 氮, and you met **ammonia** 氨 (NH_3). Now we explain why nitrogen barely reacts, and why ammonia is a base.

- Nitrogen gas is N_2 —two atoms joined by a strong bond.
- Ammonia has a **lone pair** 孤对电子 that makes it a base.

Nothing here is harder than IGCSE —it just adds the reasons.

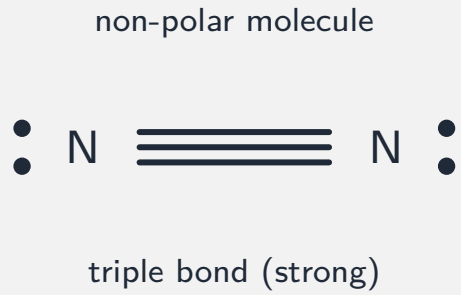
New ideas

Read these first, then do the Practice.

1 Why nitrogen is unreactive

N_2 makes up most of the air but reacts with very little, for two reasons:

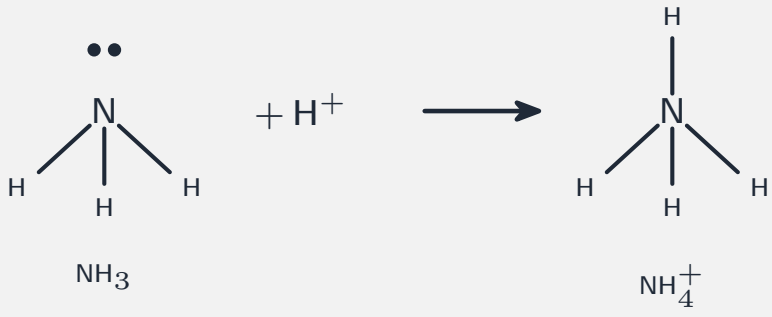
- the atoms are joined by a **triple bond** 三键 with a very high **bond energy** 键能—hard to break.
- the molecule is symmetrical and **non-polar** 非极性, so nothing attracts other molecules to it.



2 Ammonia as a base

Ammonia is a **base** 碱 because the **lone pair** 孤对电子 on its nitrogen can accept a **proton** 质子 (H^+):

$$NH_3 + H^+ \rightarrow NH_4^+$$



The new bond is a **coordinate bond** 配位键 (both electrons came from nitrogen). The **ammonium ion** 铵离子 NH_4^+ has four identical N–H bonds.

3 Test for an ammonium salt

Warm an ammonium salt with sodium hydroxide to push out ammonia gas:

$$NH_4Cl + NaOH \rightarrow NaCl + NH_3 + H_2O$$

The sharp smell, and **damp red litmus turning blue**, confirms an ammonium salt.

Watch out: ammonia is a base because of its lone pair, which accepts an H^+ to form a coordinate bond. Once the ammonium ion has formed, all four N–H bonds are identical —you cannot tell the coordinate one apart.

Practice

Try these in order.

12.1 State the two reasons nitrogen gas is unreactive. [2]

12.2 What feature of ammonia allows it to act as a base? [1]

12.3 Write the equation for ammonia accepting a proton. [1]

12.4 The fourth N–H bond in the ammonium ion is a coordinate bond. Explain what this means. [2]

12.5 Describe the test for an ammonium salt and its result. [2]

12.6 Challenge. Ammonia (NH_3) can act as a base, but the ammonium ion (NH_4^+) cannot. Explain why, in terms of the lone pair. [2]