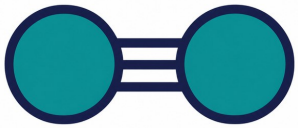
Nitrogen and Sulfur Map

Cambridge International AS & A Level Chemistry · Topic 12 Nitrogen and sulfur

1 Unreactive nitrogen

12.1.1

- N≡N: 944 kJ mol^{-1}
- Bond is very strong
- Molecule is **non-polar**
- No δ+ site to attack



2 Ammonia as a base

12.1.2

- Accepts a proton
- Lone pair forms NH_4^+
- NH_4^+ is tetrahedral
- Alkali displaces NH_3

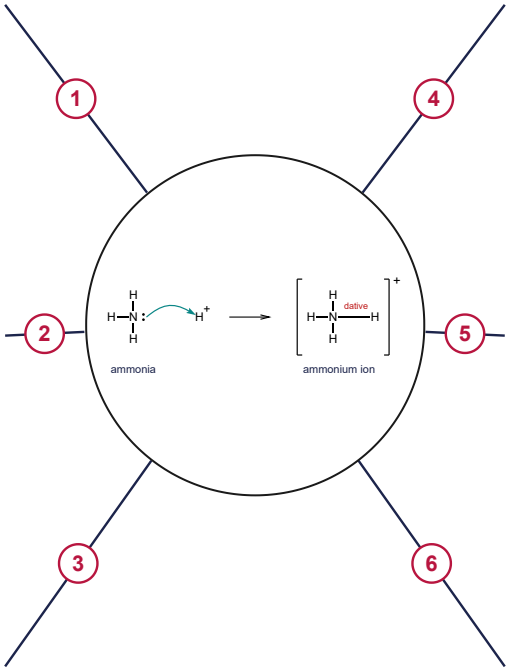


3 Oxides of nitrogen

12.1.3

- Lightning: $N_2 + O_2$
- Engines: high temperature
- $2NO + O_2 \rightarrow 2NO_2$
- Natural and man-made

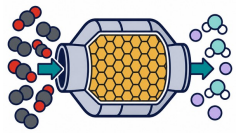




4 Catalytic removal

12.1.3

- Pt, Pd, Rh on a mesh
- $2CO + 2NO \rightarrow 2CO_2 + N_2$
- NO_x to N_2
- Harmless gases



5 PAN and smog

12.1.4

- NO_x + hydrocarbons
- Forms **PAN**
- Photochemical smog
- Irritates eyes, lungs



6 Acid rain

12.1.5

- NO_2 gives HNO_3
- NO_2 oxidises SO_2
- NO_2 regenerated
- SO_3 gives H_2SO_4



Key equations

what each one shows

Change	Equation	Type
Protonating NH_3	$NH_3 + H^+ \rightarrow NH_4^+$	Acid–base
Displacing NH_3	$NH_4Cl + NaOH \rightarrow NaCl + NH_3 + H_2O$	Acid–base
Forming NO	$N_2 + O_2 \rightarrow 2NO$	Redox
Oxidising SO_2	$NO_2 + SO_2 \rightarrow NO + SO_3$	Redox
Regenerating NO_2	$2NO + O_2 \rightarrow 2NO_2$	Redox

Worked examples

Bond energy

- N≡N 944 kJ mol^{-1}
- N–N about 160
- **Almost 6 times stronger**

Moles of ammonia

- 5.35 g NH_4Cl (Mr 53.5)
- 0.100 mol NH_3
- **2.4 dm³ at r.t.p.**

Natural rain

- Dissolved CO_2
- Weakly acidic
- **pH about 5.6**

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