Solutions

Each answer shows the steps, then the **result**.

2.1

- the N≡N triple bond is very strong (high bond energy); the molecule is non-polar / symmetrical

2.2

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

2.3

- about **107°** (three bonding pairs and one lone pair, which repels more strongly)

2.4

- burning fossil fuels that contain sulfur

3.1 B

- The lone pair on nitrogen accepts a proton

3.2 B

- $2NO + 2CO \rightarrow N_2 + 2CO_2$

3.3

(a)

- the high temperature in the engine makes nitrogen and oxygen from the air react; $N_2 + O_2 \rightarrow 2NO$

(b)

- directly: NO_2 dissolves in rain to form nitric acid; as a catalyst: NO_2 catalyses the oxidation of SO_2 to SO_3, which forms sulfuric acid in the rain

3.4

- warm the salt with sodium hydroxide; ammonia gas is given off – sharp smell and damp red litmus turns blue

3.5

(a)

- $SO_2 + NO_2 \rightarrow SO_3 + NO$
- $NO + \frac{1}{2}O_2 \rightarrow NO_2$

(b)

- the NO_2 used in the first step is made again in the second, so it is not used up overall

3.6

- dense white smoke (of ammonium chloride) forms
- $NH_3 + HCl \rightarrow NH_4Cl$