

## Past-paper walk-through

Covalent bonding and coordinate (dative covalent) bonding ■ 3.4

eXercise

## Questions in this set

- 9701/11 N25 Q6 ■ 1 mark
- 9701/11 N25 Q24 ■ 1 mark

## Question 6

9701/11 N25 ■ Q6 ■ 1 mark

- 6  $\text{NH}_3$  and  $\text{HCN}$  react together to form  $\text{NH}_4\text{CN}$ , an ionic compound.

Which row states the number of coordinate bonds and the number of  $\pi$  bonds in one formula unit of  $\text{NH}_4\text{CN}$ ?

|          | number of<br>coordinate bonds | number of<br>$\pi$ bonds |
|----------|-------------------------------|--------------------------|
| <b>A</b> | 0                             | 2                        |
| <b>B</b> | 1                             | 2                        |
| <b>C</b> | 0                             | 3                        |
| <b>D</b> | 1                             | 3                        |

## Solution 6

Answer: **B**

### Why

- In  $\text{NH}_4^+$  the nitrogen's lone pair forms the fourth N–H bond, so that is one coordinate bond.
- The cyanide ion holds a  $\text{C}\equiv\text{N}$  triple bond: one  $\sigma$  and two  $\pi$ .
- So one coordinate bond and two  $\pi$  bonds.

## Question 24

9701/11 N25 ■ Q24 ■ 1 mark

- 24** When dry ammonia and hydrogen chloride gases are mixed, a solid white ionic compound is formed.

Two statements are listed.

- 1 The formation of the ionic compound is a redox reaction.
- 2 During the formation of the ionic compound, the H–N–H bond angle increases.

Which statements are correct?

- A** both 1 and 2  
**B** 1 only  
**C** 2 only

## Question 24

**D** neither 1 nor 2

## Solution 24

Answer: **C**

### Why

- No element changes oxidation number, so it is not a redox reaction – statement 1 fails.
- $\text{NH}_3$  has a lone pair, which squeezes the H–N–H angle to about  $107^\circ$ .
- In  $\text{NH}_4^+$  that lone pair becomes a bond, so the angle opens to  $109.5^\circ$  – statement 2 holds.