

Exercise walk-through

Dot-and-cross diagrams ■ 3.7

eXercise

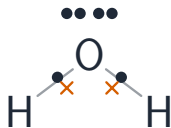
You must be able to

- draw dot-and-cross diagrams for ionic, covalent and coordinate bonding
- include molecules with an expanded octet or an odd number of electrons

Method — Drawing dot-and-cross diagrams

Use **dots** for one atom's outer electrons and **crosses** for the other, so you can see where each bonding electron came from. Show **lone pairs** too. For ionic bonds, draw the ions in brackets with their charge.

Method — Drawing dot-and-cross diagrams



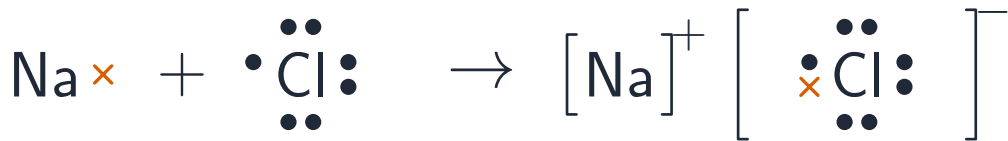
H₂O: 2 bonding pairs
+ 2 lone pairs



N₂: triple bond
(3 shared pairs)

- electron from one atom
- × electron from the other

Method — Drawing dot-and-cross diagrams



sodium gives its outer electron ($\times$) to chlorine

Practice 2.1 ■ 1 mark

State what dots and crosses represent in a dot-and-cross diagram.

Solution 2.1

Method: Drawing dot-and-cross diagrams

Worked steps

the outer (valence) electrons of each of the two atoms **B1**.

Practice 2.2 ■ 1 mark

State how many lone pairs are on the oxygen atom in a water molecule.

Solution 2.2

Method: Drawing dot-and-cross diagrams

Worked steps

2 lone pairs **B1**.

Exam-style 3.1 ■ 1 mark

In a dot-and-cross diagram of methane, CH_4 , how many shared (bonding) pairs are shown around the carbon?

A 1

B 2

C 4

D 8

Solution 3.1

Method: Drawing dot-and-cross diagrams

A 1

B 2

C 4



D 8

Worked steps

C. Methane has four shared pairs (four C–H bonds).

Exam-style 3.2 ■ 2 marks

Draw a dot-and-cross diagram for a molecule of ammonia, NH_3 (show the bonding pairs and the lone pair on nitrogen).

Solution 3.2

Method: Drawing dot-and-cross diagrams

Worked steps

three N–H bonding pairs, each one dot + one cross **B1**; one lone pair shown on the nitrogen **B1**.

Exam-style 3.3 ■ 2 marks

Draw a dot-and-cross diagram for carbon dioxide, CO (show the two double bonds).

Solution 3.3

Method: Drawing dot-and-cross diagrams

Worked steps

carbon in the centre with two double bonds to the oxygens (two shared pairs each) **B1**; two lone pairs shown on each oxygen **B1**.

Exam-style 3.4 ■ 2 marks

Draw a dot-and-cross diagram for the ammonium ion, NH_4^+ , showing the coordinate bond.

Solution 3.4

Method: Drawing dot-and-cross diagrams

Worked steps

four N–H bonds around nitrogen **B1**; one shown as a coordinate bond (both electrons from N), with the whole ion in brackets and a + charge **B1**.