A9 · Molecular shapes · Worked examples and practice

Name: _____ Date: _____

Worked examples

Read these first. There is one for each kind of question in this lesson.

Example 1 · Predict the shape of a molecule

Use the four steps to find the shape of phosphine, PH_3.

1. Draw the electron dot diagram: phosphorus is in the middle, with 3 single bonds and 1 lone pair.
2. Count the groups around the centre atom: 3 bonds and 1 lone pair are 4 groups.
3. Count how many groups are lone pairs: 1.
4. Name the shape from the table: 4 groups with 1 lone pair is trigonal pyramidal.

Answer: PH_3 is trigonal pyramidal.

Example 2 · Predict the shape of an ion

In the carbonate ion, CO_3^{2-}, carbon has 2 single bonds and 1 double bond, and no lone pairs. Find its shape.

1. Count the groups around the centre atom: each bond is 1 group, so there are 3 groups.
2. Count how many groups are lone pairs: none.
3. Name the shape from the table: 3 groups with no lone pairs is trigonal planar.
4. Check: the double bond counted as 1 group.

Answer: CO_3^{2-} is trigonal planar.

Practice

Questions 1 to 4 are easy. Questions 5 to 8 are medium. Questions 9 and 10 are harder.

EASY

1. What does VSEPR say about the groups of electrons around a centre atom?

EASY

2. A centre atom has 1 double bond and 2 single bonds, and no lone pairs. How many groups are around it?

EASY

3. A centre atom has 4 groups, and none is a lone pair. Name the shape.

EASY

4. In a drawing of a molecule, which kind of line shows a bond that points toward you? Which shows a bond that points away?

MEDIUM

5. In HCN, carbon has 1 single bond and 1 triple bond, and no lone pairs. Name the shape.

MEDIUM

6. In OCl_2, oxygen has 2 single bonds and 2 lone pairs. Name the shape.

MEDIUM

7. In the nitrate ion, NO_3^-, nitrogen has 2 single bonds and 1 double bond, and no lone pairs. Name the shape.

MEDIUM

8. Use the four steps to find the shape of the phosphonium ion, PH_4^+.

HARDER

9. Methanol, CH_3OH, has two centre atoms. Carbon has 4 single bonds. Oxygen has 2 single bonds and 2 lone pairs. Name the shape around each centre atom.

HARDER

10. NH_3 and CH_4 each have 4 groups around the centre atom. Explain why their shapes have different names.