

2 Lewis diagrams and molecular shapes – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Lewis diagram	路易斯结构	_____
lone pairs	孤对电子	_____
octet	八隅体	_____
VSEPR	价层电子对互斥	_____

Recall

In Part A you met covalent bonds, where atoms share electrons. Now draw molecules and predict their shapes:

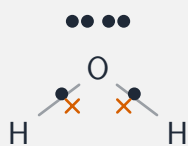
- You have drawn simple dot-and-cross diagrams before.
- Molecules are not flat blobs –they have definite 3-D shapes.

Each idea has a worked example before the Practice.

New ideas

■ 1 Lewis diagrams

A **Lewis diagram** 路易斯结构 shows an atom's outer electrons as shared **bonding pairs** and unshared **lone pairs** 孤对电子. Most atoms want a full **octet** 八隅体—eight outer electrons (hydrogen wants just two).



H₂O: 2 bonding pairs
+ 2 lone pairs



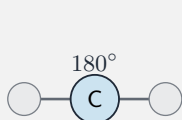
N₂: triple bond
(3 shared pairs)

● electron from one atom
× electron from the other

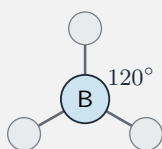
Worked example. In carbon dioxide CO₂, carbon shares **two** pairs with each oxygen (two double bonds, O = C = O), so every atom reaches an octet.

■ 2 Molecule shapes

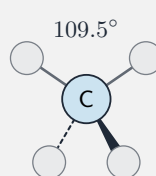
VSEPR 价层电子对互斥 theory predicts shape with one simple rule: the electron pairs around a central atom spread out **as far apart as possible**.



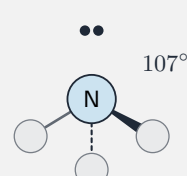
linear
CO₂



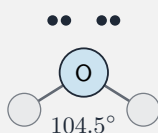
trigonal planar
BF₃



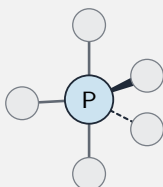
tetrahedral
CH₄



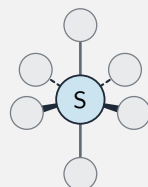
pyramidal
NH₃



bent
H₂O



trig. bipyramidal
PF₅, 120° & 90°



octahedral
SF₆, 90°

- 2 pairs → linear; 3 pairs → flat triangle; 4 pairs → tetrahedral.

Worked example. Methane CH₄ has four bonding pairs around carbon, so they point to the corners of a **tetrahedron** (angles 109.5°).

■ 3 Lone pairs bend the shape

Lone pairs take up space too, and they push the bonds a little closer together, bending the shape.

Worked example. Water H₂O has two bonding pairs and two lone pairs; the lone pairs push the two O–H bonds down to a **bent** shape (about 104.5°).

■ 4 Polar molecules

If a molecule's shape leaves its bond dipoles unbalanced, the whole molecule is **polar** (like water). If they cancel by symmetry, it is non-polar (like CO₂).

Watch out: a molecule can have polar bonds but still be non-polar overall –if its symmetric shape makes the dipoles cancel. CO_2 is the classic example.

Practice

Try these in order. The methods are all above.

2.1 State how many outer electrons most atoms want (the octet rule), and the exception for hydrogen. [2]

2.2 State the shape and bond angle of methane CH_4 (four bonding pairs). [2]

2.3 Explain why water is a bent shape rather than straight. [2]

2.4 A molecule of CO_2 has polar bonds but is non-polar overall. Explain why. [2]

2.5 State the VSEPR rule that decides the shape of a molecule. [1]
