

Exercise walk-through

2.7

VSEPR and Bond Hybridization

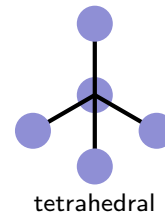
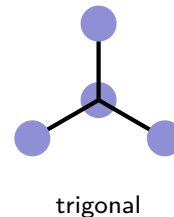
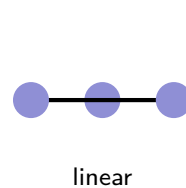
AP Chemistry

VSEPR and hybridization

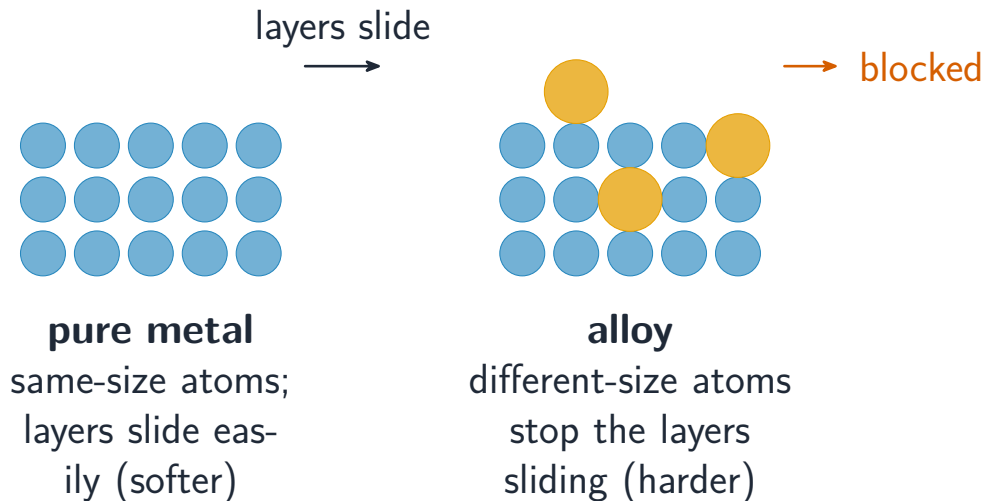
VSEPR : electron domains push as far apart as possible.

- 2 domains – sp – linear
- 3 – sp^2 – trigonal planar
- 4 – sp^3 – tetrahedral

Lone pairs bend the shape; geometry decides **polarity**.

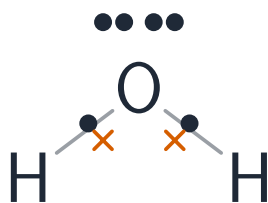


Structure of Metals and Alloys



Different-sized atoms in an alloy stop the layers sliding, so it is harder

Lewis Diagrams



H₂O: 2 bonding pairs
+ 2 lone pairs

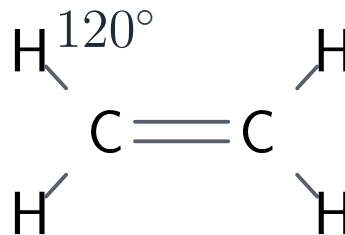
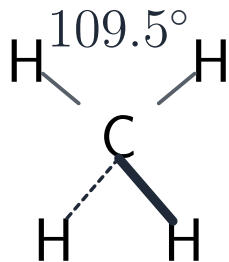


N₂: triple bond
(3 shared pairs)

• electron from one atom
x electron from the other

Dot-and-cross diagrams show the bonding pairs and lone pairs in a molecule

VSEPR and Bond Hybridization



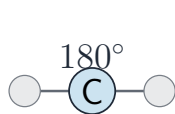
sp^3 : 4 single bonds
tetrahedral

sp^2 : 1 double + 2 single
planar (flat)

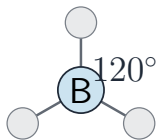
sp : 1 triple bond
linear

Hybridisation and shape: sp^3 tetrahedral, sp^2 planar, sp linear

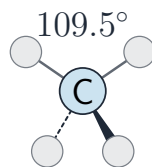
The common VSEPR shapes and their bond angles



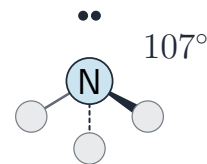
linear
CO2



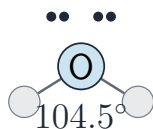
trigonal planar
BF3



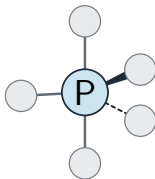
tetrahedral
CH4



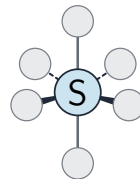
pyramidal
NH3



bent
H2O



trig. bipyramidal
PF5, 120° & 90°



octahedral
SF6, 90°

The common VSEPR shapes and their bond angles

Exercises 2.1-2.3

2.1 How many electron domains are around C in CH_4 ? [1]

2.2 State the shape and bond angle of CH_4 . [2]

2.3 State the hybridization of carbon in CO_2 . [1]

Exercises 2.1-2.3

2.1 How many electron domains are around C in CH_4 ? [1]

2.1

- 4
-

2.2 State the shape and bond angle of CH_4 . [2]

2.2

- Tetrahedral, 109.5°
-

2.3 State the hybridization of carbon in CO_2 . [1]

2.3

- sp

Exercise 3.1

3.1 A central atom with 3 electron domains and no lone pairs has the shape [1]

☐

A linear

B trigonal planar

C tetrahedral

D bent

Exercise 3.1

3.1 A central atom with 3 electron domains and no lone pairs has the shape [1]

☐

A linear

B trigonal planar

C tetrahedral

D bent

3.1 B

- 3 domains with no lone pairs is trigonal planar

Exercise 3.2 (a)

3.2 Consider H_2O .

(a) Count the electron domains on oxygen.

[1]

Exercise 3.2 (a)

3.2 Consider H_2O .

(a) Count the electron domains on oxygen.

[1]

(a)

- 4 (2 bonds + 2 lone pairs)

Exercise 3.2 (b)

3.2 Consider H_2O .

(b) State the molecular shape and approximate bond angle.

[2]

Exercise 3.2 (b)

3.2 Consider H_2O .

(b) State the molecular shape and approximate bond angle.

[2]

(b)

- Bent, $\approx 104.5^\circ$

Exercise 3.2 (c)

3.2 Consider H_2O .

(c) State the hybridization of oxygen.

[1]

Exercise 3.2 (c)

3.2 Consider H_2O .

(c) State the hybridization of oxygen.

[1]

(c)

- sp^3

Exercise 3.3

3.3 Explain why the bond angle in NH_3 (107°) is smaller than in CH_4 (109.5°). [2]

Exercise 3.3

3.3 Explain why the bond angle in NH_3 (107°) is smaller than in CH_4 (109.5°). [2]

3.3

- NH_3 has one lone pair, which repels more strongly than a bonding pair and pushes the N–H bonds closer together, reducing the angle below the tetrahedral 109.5°