Solutions

Each answer shows the steps, then the **result**.

2.1

- 4

2.2

- Tetrahedral, 109.5°

2.3

- *sp*

3.1 B

- 3 domains with no lone pairs is trigonal planar

3.2

(a)

- 4 (2 bonds + 2 lone pairs)

(b)

- Bent, ≈ 104.5°

(c)

- sp^3

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°

3.4

(a)

- CO_2: two electron domains on C and no lone pairs, so **linear** (180°)
- SO_2: three electron domains on S, one a lone pair, so **bent** (≈ 119°)

(b)

- in linear CO_2 the two equal C=O bond dipoles point in opposite directions and cancel
- in bent SO_2 the S–O bond dipoles do not cancel, leaving a net dipole toward the oxygen side

(c)

- *sp* (two electron domains)

3.5

- bond orders: CO triple bond, order 3; CO_2 double bonds, order 2; CO_3^{2-} resonance spreads one double and two single bonds over three bonds, order $\frac{4}{3} \approx 1.33$
- a higher bond order holds the atoms closer, so shortest to longest: $CO < CO_2 < CO_3^{2-}$