## Solutions

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

**2.1**

- tetrahedral; 109.5°

**2.2**

- 1 $\sigma$ bond and 1 $\pi$ bond

**2.3**

- **sp**

**2.4**

- **$sp^3$**: four single bonds

**3.1 B**

- Ethene's carbons are $sp^2$ hybridised and the molecule is planar

**3.2 C**

- Methane's bond angle is 109.5°

**3.3**

(a)

- linear; 180°

(b)

- the carbons are $sp^2$ hybridised with 120° bond angles; all the atoms lie in one plane around the C=C double bond, so it is planar

**3.4**

- five $\sigma$ bonds (4 C–H and 1 C–C) formed by direct overlap; one $\pi$ bond from sideways overlap of p orbitals above and below the C=C

**3.5**

(a)

- the $CH_3$ carbon is $sp^3$
- the two carbons of the C=C are $sp^2$

(b)

- **8** $\sigma$ bonds: two C–C and six C–H
- **1** $\pi$ bond, in the C=C

**3.6**

- rotation would break the $\pi$ bond, which is formed by the sideways overlap of p orbitals above and below the plane