Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

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

2.1

NH_3: trigonal pyramidal, 107°; CO_2: linear, 180°

2.2

oxygen is more electronegative than C and H, so each bond is polar; CO_2 is linear, so the two bond dipoles cancel; H_2O is bent, so the dipoles do not cancel

2.3

water molecules form hydrogen bonds (H bonded to O, the very electronegative O with lone pairs); H_2S has only dipole–dipole and London forces; hydrogen bonds are stronger, so more energy is needed to separate water molecules

2.4

5 σ and 1 π; sp^2

2.5

three resonance structures can be drawn with the double bond in different places; the π electrons are delocalized over all three bonds, so they are identical (bond order $1\frac{1}{3}$); the length is between that of a C–O single bond and a C=O double bond

3.1

(a) $R_F = \dfrac{3.6}{8.0} = \mathbf{0.45}$

(b) components have different attractions to the paper (stationary phase) and the solvent (mobile phase); so they move up the paper at different rates and separate

(c) ink would dissolve in the solvent and move up the paper / pencil (graphite) is insoluble

3.2

(a) layers of carbon atoms in hexagons, each carbon covalently bonded to three others; weak London forces between the layers

(b) in graphite one electron per carbon is delocalized and can move along the layers; in diamond all four outer electrons are in covalent bonds, so none are free

(c) many strong covalent bonds must be broken

(d) a giant covalent lattice; each Si bonded to four O, and each O bonded to two Si

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