## Guiding Question revisited

What determines the covalent nature and properties of a substance?

In this chapter we have used the covalent model of bonding to show:

- [ ] A covalent bond is formed by the electrostatic attraction between a shared pair of electrons and the positively charged nuclei. Atoms can share one, two or three pairs of electrons to form a single, double or triple bond respectively.
- [ ] A covalent bond in which one atom provides both shared electrons is called a coordination bond.
- [ ] The octet rule is a useful tool for predicting the arrangement of atoms in covalent molecules and network structures but has many exceptions. An atom with less than four valence pairs of electrons has an incomplete octet.
- [ ] Lewis formulas can be used to represent all of the valence electrons in a covalently bonded species.
- [ ] The Valence Shell Electron Pair Repulsion (VSEPR) model can be used to accurately predict the shape of molecules by considering the repulsions between electron domains. These can be bonding domains, containing shared pairs of electrons, or non-bonding domains (lone pairs of electrons).
- [ ] The electron geometry describes the arrangement of electron domains around a central atom:
  - 2 electron domains → linear
  - 3 electron domains → triangular planar
  - 4 electron domains → tetrahedral
- [ ] The molecular geometry describes the position of bonding domains around a central atom. We can predict the bond angles in a molecule knowing its geometry and considering any addition repulsion caused by non-bonding pairs and multiple bonds.
- [ ] Bond polarity results from the difference in electronegativities of the bonded atoms. This causes an unequal distribution of electron density, a bond dipole, which can be represented with partial charges ($\delta+$ and $\delta-$) and/or a vector.
- [ ] Molecular polarity depends on both bond polarity and molecular geometry. If bond dipoles cancel out on a molecule then it will be non-polar. If there is a net dipole across a molecule, then it will be polar.
- [ ] Carbon and silicon are able to form network structures with distinct chemical and physical properties. Examples include silicon, silicon dioxide and the allotropes of carbon.
- [ ] Intermolecular forces are determined by the size and polarity of a molecule. In increasing order of strength, they include London dispersion forces, dipole-induced dipole, dipole–dipole and hydrogen bonding. Intermolecular forces can influence physical properties such as melting and boiling point, volatility, electrical conductivity and solubility.

☐ Paper chromatography and thin layer chromatography are techniques used to separate the components of a mixture based on their relative attractions to the mobile and stationary phases. For a given solvent, the retardation factor value for a component can be calculated using $R_f = \frac{\text{distance moved by component}}{\text{distance moved by solvent}}$. This value is compared to known values in order to identify the compound.