

8.2: Covalent Compounds and Intermolecular Forces

The ionic compounds are almost all solids with melting temperatures above 600°C. By contrast, most substances which contain simple molecules are either gases or liquids at room temperature. They can only be persuaded to solidify at rather low temperatures. The reason for this contrasting behavior is easily explained on the microscopic level. Oppositely charged ions attract each other very strongly and usually require energies of 400 kJ mol⁻¹ or more in order to be separated. On the other hand, molecules are electrically neutral and scarcely attract each other at all. The energy needed to separate two simple molecules is usually less than a hundredth of that needed to separate ions.

For example, only 1.23 kJ mol⁻¹ is needed to separate two molecules of methane, CH₄. At room temperature virtually all molecules are moving around with energies in excess of this, so that methane is ordinarily a gas. Only if we cool the gas to quite a low temperature can we slow down the molecules to a point where they find it difficult to acquire an energy of 1.23 kJ mol⁻¹. At such a temperature, the molecules will be difficult to separate and the substance will become a liquid or a solid. Experimentally, we find that methane condenses to a liquid at -162°C, and this liquid freezes at -182°C.

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