

1.1: Introduction to Symmetry

You will already be familiar with the concept of symmetry in an everyday sense. If we say something is ‘symmetrical’, we usually mean it has mirror symmetry, or ‘left-right’ symmetry, and would look the same if viewed in a mirror. Symmetry is also very important in chemistry. Some molecules are clearly ‘more symmetrical’ than others, but what consequences does this have, if any?

The aim of this course is to provide a systematic treatment of symmetry in chemical systems within the mathematical framework known as *group theory* (the reason for the name will become apparent later on). Once we have classified the symmetry of a molecule, group theory provides a powerful set of tools that provide us with considerable insight into many of its chemical and physical properties.

Some applications of group theory that will be covered in this course include:

1. Predicting whether a given molecule will be chiral, or polar.
2. Examining chemical bonding and visualising molecular orbitals.
3. Predicting whether a molecule may absorb light of a given polarisation, and which spectroscopic transitions may be excited if it does.
4. Investigating the vibrational motions of the molecule.

You may well meet some of these topics again, possibly in more detail, in later courses. However, they will be introduced here to give you a fairly broad introduction to the capabilities and applications of group theory once we have worked through the basic principles and ‘machinery’ of the theory.

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