# Outline

#### 1. Symmetry elements and point groups

1.1.Symmetry elements and operations

1.2. Group concepts

1.3. Classification of point groups, incuding the Platonic Solids

1.4.Finding the point group that a molecule belongs to

## 2. Group representations

2.1.An intuitive approach

2.2. The great orthogonality theorem (GOT)

2.3. Theorems about irreducible representations

2.4.Basis functions

2.5.Relation between representation theory and quantum mechanics

2.6.Character tables and how to use them

2.7.Examples: symmetry of physical properties, tensor symmetries

## 3. Molecular Orbitals and Group Theory

3.1. Elementary representations of the full rotation group

3.2.Basics of MO theory

3.3. Projection and Transfer Operators

3.4.Symmetry of LCAO orbitals

3.5.Direct product groups, matrix elements, selection rules

3.6.Correlation diagrams

## 4.Vibrations in molecules

4.1.Number and symmetry of normal modes in molecules4.2.Vibronic wave functions4.3.IR and Raman selection rules

#### **5.**Electron bands in solids

5.1.Symmetry properties of solids5.2.Wave functions of energy bands5.3.The group of the wave vector5.4.Band degeneracy, compatibility

#### 6.The full rotation group

6.1.Atomic wave functions6.2.The spherical harmonics6.3.Selection rules for electron states6.4.Crystal field splitting