1. The normal modes of ethylene are shown below. What is the point group of ethylene and what are the irreducible representations for these normal modes?

![Normal modes of ethylene](image)

2. Use the Hückel theory to calculate the $\pi$-electron energy of cyclobutadiene (see below). Draw the molecular orbital diagram and indicate which $\pi$ orbitals are occupied.

![Cyclobutadiene](image)

3. $C_{2v}$ point group has the following symmetry operations: $E$, $C_2$, $\sigma_v$, and $\sigma'_v$. Derive the group multiplication table for this group.