

## LECTURE 15 INTERNAL DEGREES OF FREEDOM

### I. Internal Degrees of Freedom

- A. Example 1:  $N_2$
- B. Example 2:  $CO_2$
- C. Example 3:  $H_2O$

### II. Molecular Vibrations

- A. Vibrational quantum number  $v$
- B. Energy of vibrational states
  - 1. Fundamental frequency  $\nu$
  - 2. Force constant  $k$
  - 3. Reduced mass  $\mu$
- C. Vibrational spectra of polyatomic molecules

### III. Molecular Rotations

- A. Rotational quantum number  $J$
- B. Energy of rotational states
- C. Calculating bond length