Wavenumbers and Frequencies

The relation between wavelength and frequency for electromagnetic radiation is

$$\lambda \nu = c$$

In the SI system of units the wavelength λ is measured in meters (m) and since wavelengths are usually very small one often uses the nano meter (nm) which is 10^{-9} m.

The frequency ν in the SI system is measured in reciprocal seconds s^{-1} which is called a Hertz and represented by Hz.

Often in Chemistry one will use the reciprocal of the wavelength in centimeters as a measure of the frequency of radiation. This unit is called a wavenumber and is represented by $\tilde{\nu}$ and is defined by

$$\tilde{\nu} = \frac{1}{\lambda} = \frac{\nu}{c}$$

Example:
The wavelength of the red line in the Hydrogen spectrum is approximately 656.5 nm. This corresponds to 656.5 x 10^{-9} m x 10^2 cm/m or 656.5 x 10^{-7} cm or 1.523x10^4 cm^{-1}.
We can convert this to Hz by multiplying by the speed of light which is 2.99792458 x 10^{10} cm s^{-1} resulting in 4.566 x 10^{14} Hz.