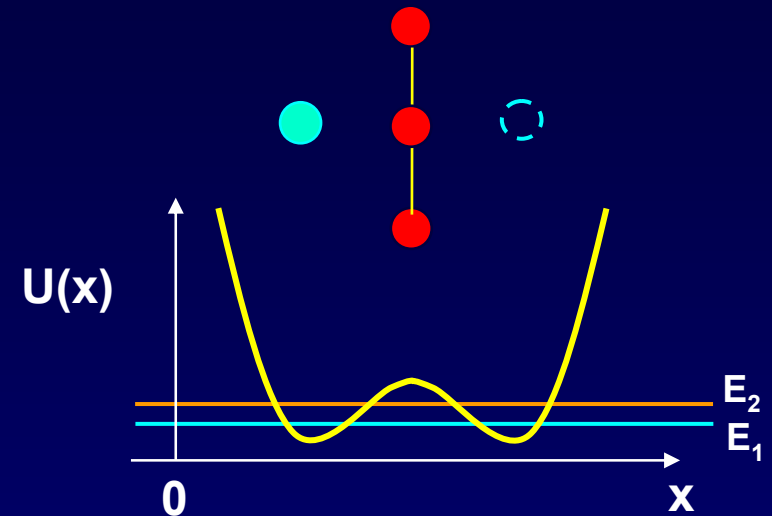


# Example: The Ammonia Molecule (3)

Given the energy difference between the ground and first excited states,  $E_2 - E_1 = 1.8 \times 10^{-4} \text{ eV}$ , estimate how long it takes for the N atom to “tunnel” from one side of the  $\text{NH}_3$  molecule to the other?



This takes a half the oscillation period,  $T = h/(E_2 - E_1)$ :

$$t_o = \frac{T}{2} = \frac{h}{2(E_2 - E_1)} = \frac{4.136 \times 10^{-15} \text{ eV} \cdot \text{sec}}{2(1.8 \times 10^{-4} \text{ eV})} = 1.1 \times 10^{-11} \text{ sec}$$