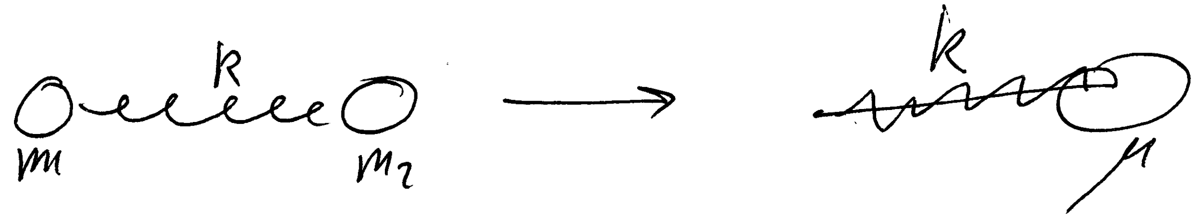
HARMONIC OSCILLATOR



$$\mu = \frac{m_1 m_2}{m_1 + m_2}$$

$$V(x) = \frac{1}{2} k x^2$$

$$\hat{H} = -\frac{\hbar^2}{2\mu} \frac{d^2}{\partial x^2} + \frac{1}{2} k x^2$$

$$\hat{H} \psi_n = -\frac{\hbar^2}{2\mu} \frac{d^2 \psi_n}{\partial x^2} + V(x) \psi_n$$

$$= E_n \psi_n$$

$$\psi_n(x) = A_n \, e^{-\alpha x^2/2} \, H_n(\sqrt{\alpha}\, x)$$

$$E_n = \hbar \sqrt{\frac{k}{\mu}} \left(\frac{1}{2} + n\right) = h\nu \left(\frac{1}{2} + n\right)$$

$$n = 0, 1, 2, \ldots$$

$$\nu = \frac{1}{2\pi} \sqrt{\frac{k}{\mu}}$$

$$\langle \hat{V} \rangle = ?$$

$$\langle \hat{K} \rangle = ?$$

$$\Delta x \, \Delta p \doteq ?$$

$$-\frac{\hbar^2}{2\mu}\frac{1}{R_0}\frac{d^2\Phi}{d\phi^2} = E\Phi$$

$$\Phi \sim e^{\pm im\phi}$$

<u>BC</u> $$e^{\pm im\phi} = e^{\pm im(\phi+2\pi)}$$

$$\Rightarrow e^{\pm i2\pi m} = 1$$

$$\cos(2\pi m) \pm \overset{0}{i\sin(2\pi m)} = 1$$

$$2\pi m \Rightarrow m \in N$$

$$m = 0, \pm 1, \pm 2, \pm 3, \ldots$$

$$E_m = \frac{\hbar^2}{2\mu R_0^2} m^2 = \frac{\hbar^2}{2I} m^2 \qquad m = 0, \pm 1, \ldots$$

$$I = \mu R_0^2$$

$$\boxed{\Phi_m(\phi) = \frac{1}{\sqrt{2\pi}} e^{im\phi}}$$

Review 18.7 Rigid Rotor