Lagrangian

$$\begin{aligned}\mathcal{L} = &\frac{m\omega_y}{2}\left(-{r_1}^2(t)+{r_2}^2(t)\right)\frac{d}{dt}q(t)+\frac{m}{8}\left({r_1}^2(t)+{r_2}^2(t)\right)\frac{d}{dt}q(t)^2+\frac{m}{2}\frac{d}{dt}r_1(t)^2\\&+\frac{m}{2}\frac{d}{dt}r_2(t)^2+\omega_x\left(\frac{\omega_x}{2}\left(m{r_1}^2(t)\sin^2\left(\frac{1}{2}q(t)\right)+m{r_2}^2(t)\sin^2\left(\frac{1}{2}q(t)\right)\right)\right.\\&\left.+\frac{\omega_z}{2}\left(-m{r_1}^2(t)\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right.\right.\\&\left.\left.+m{r_2}^2(t)\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right)\right)\\&+\frac{\omega_y^2}{2}\left(m\left({r_1}^2(t)\sin^2\left(\frac{1}{2}q(t)\right)+{r_1}^2(t)\cos^2\left(\frac{1}{2}q(t)\right)\right)\right.\\&\left.+m\left({r_2}^2(t)\sin^2\left(\frac{1}{2}q(t)\right)+{r_2}^2(t)\cos^2\left(\frac{1}{2}q(t)\right)\right)\right)\\&+\omega_z\left(\frac{\omega_x}{2}\left(-m{r_1}^2(t)\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right.\right.\\&\left.\left.+m{r_2}^2(t)\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right)\right.\\&\left.+\frac{\omega_z}{2}\left(m{r_1}^2(t)\cos^2\left(\frac{1}{2}q(t)\right)+m{r_2}^2(t)\cos^2\left(\frac{1}{2}q(t)\right)\right)\right)\end{aligned}\tag{1}$$

Hamiltonian

$$\begin{aligned}\mathcal{H} = &J_x\left(\frac{J_x}{2}\left(\frac{\left(-{r_1}^2(t)+{r_2}^2(t)\right)^2\sin^2\left(q(t)\right)}{8m\left({r_1}^2(t)+{r_2}^2(t)\right)\left(\cos\left(q(t)\right)+1\right){r_1}^2(t){r_2}^2(t)\sin^4\left(\frac{1}{2}q(t)\right)}\right.\right.\\&\left.\left.+\frac{2}{m\left({r_1}^2(t)+{r_2}^2(t)\right)\left(-\cos\left(q(t)\right)+1\right)}\right)-\frac{J_z\left(-{r_1}^2(t)+{r_2}^2(t)\right)}{4m{r_1}^2(t){r_2}^2(t)\sin\left(q(t)\right)}\right)\\&+\frac{J_y^2\left({r_1}^2(t)+{r_2}^2(t)\right)}{2m\left(-\left({r_1}^2(t)-{r_2}^2(t)\right)^2+\left({r_1}^2(t)+{r_2}^2(t)\right)^2\right)}+\frac{J_y p(t)}{2m{r_2}^2(t)}-\frac{J_y p(t)}{2m{r_1}^2(t)}\\&+J_z\left(-\frac{J_x\left(-{r_1}^2(t)+{r_2}^2(t)\right)}{4m{r_1}^2(t){r_2}^2(t)\sin\left(q(t)\right)}+\frac{J_z\left({r_1}^2(t)+{r_2}^2(t)\right)}{4m\left(\cos\left(q(t)\right)+1\right){r_1}^2(t){r_2}^2(t)}\right)\\&+\frac{p^2(t)}{2m{r_2}^2(t)}+\frac{p^2(t)}{2m{r_1}^2(t)}+\frac{{p_1}^2(t)}{2m}+\frac{{p_2}^2(t)}{2m}\end{aligned}\tag{2}$$