Lagrangian

$$\begin{aligned}
&\frac{m\omega_y}{2}\left(-r_1^2+r_2^2\right)\frac{d}{dt}q(t)+0.125m\left(r_1^2+r_2^2\right)\frac{d}{dt}q(t)^2\\
&+\omega_x\left(0.5\omega_x\left(mr_1^2\sin^2\left(\frac{1}{2}q(t)\right)+mr_2^2\sin^2\left(\frac{1}{2}q(t)\right)\right)\right.\\
&+0.5\omega_z\left(-mr_1^2\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right.\\
&\left.\left.+mr_2^2\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right)\right)\\
&+0.5\omega_y^2\left(m\left(r_1^2\sin^2\left(\frac{1}{2}q(t)\right)+r_1^2\cos^2\left(\frac{1}{2}q(t)\right)\right)\right.\\
&\left.+m\left(r_2^2\sin^2\left(\frac{1}{2}q(t)\right)+r_2^2\cos^2\left(\frac{1}{2}q(t)\right)\right)\right)\\
&+\omega_z\left(0.5\omega_x\left(-mr_1^2\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right.\right.\\
&\left.+mr_2^2\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right)\\
&+0.5\omega_z\left(mr_1^2\cos^2\left(\frac{1}{2}q(t)\right)+mr_2^2\cos^2\left(\frac{1}{2}q(t)\right)\right)\Bigg)
\end{aligned}\tag{1}$$

Hamiltonian

$$\begin{aligned}
&J_x\left(0.5J_x\left(\frac{1}{m\left(r_1^2+r_2^2\right)\sin^2\left(\frac{1}{2}q(t)\right)}\right.\right.\\
&\left.+\frac{\left(-mr_1^2\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)+mr_2^2\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right)^2}{4m^3r_1^2r_2^2\left(r_1^2+r_2^2\right)\sin^4\left(\frac{1}{2}q(t)\right)\cos^2\left(\frac{1}{2}q(t)\right)}\right)\\
&-\frac{0.125J_z}{m^2r_1^2r_2^2\sin^2\left(\frac{1}{2}q(t)\right)\cos^2\left(\frac{1}{2}q(t)\right)}\left(-mr_1^2\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right.\\
&\left.\left.+mr_2^2\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right)\right)\\
&+\frac{0.5J_y^2\left(r_1^2+r_2^2\right)}{m\left(-\left(r_1^2-r_2^2\right)^2+\left(r_1^2+r_2^2\right)^2\right)}-\frac{J_yp\left(-r_1^2+r_2^2\right)}{2mr_1^2r_2^2}\\
&+J_z\left(-\frac{0.125J_x}{m^2r_1^2r_2^2\sin^2\left(\frac{1}{2}q(t)\right)\cos^2\left(\frac{1}{2}q(t)\right)}\left(-mr_1^2\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right.\right.\\
&\left.\left.+mr_2^2\sin\left(\frac{1}{2}q(t)\right)\cos\left(\frac{1}{2}q(t)\right)\right)+\frac{0.125J_z\left(r_1^2+r_2^2\right)}{mr_1^2r_2^2\cos^2\left(\frac{1}{2}q(t)\right)}\right)+\frac{0.5p^2\left(r_1^2+r_2^2\right)}{mr_1^2r_2^2}
\end{aligned}\tag{2}$$