

$$\therefore \left\{ \begin{array}{l} \rho^{-1} = \frac{\dot{q} \wedge \ddot{q}}{|\dot{q}|^3} \Rightarrow \rho^{-2} = 9q^2, \\ \dot{q}^2 + \left(k^2 - \frac{1}{2}\right) q^2 = \frac{1}{2}, \\ \sum_{i < j} r_{ij}^2 = 3 \sum_i q_i^2. \end{array} \right.$$