Hamilton’s Equations:
If a system has generalised coordinates \( q = (q_1, q_2, ..., q_n) \), Lagrangian \( \mathcal{L} \), and generalised momenta \( p_i = \frac{\partial \mathcal{L}}{\partial \dot{q}_i} \), its Hamiltonian is defined as

\[
\mathcal{H} = \sum_{i=1}^{n} p_i \dot{q}_i - \mathcal{L},
\]

and Hamilton’s equations are given by

\[
\dot{q}_i = \frac{\partial \mathcal{H}}{\partial p_i} \quad \text{and} \quad \dot{p}_i = -\frac{\partial \mathcal{H}}{\partial q_i}.
\]

Inertial Forces:

\[
\mathbf{F}_{\text{Coriolis}} = -2 m \mathbf{\Omega} \times \dot{\mathbf{r}}
\]

\[
\mathbf{F}_{\text{cf g}} = -m \mathbf{\Omega} \times (\mathbf{\Omega} \times \mathbf{r})
\]

Central Forces:
For two objects \( m_1 \) and \( m_2 \) under the influence of a central force described by \( F = \gamma/r^2 \), the effective potential energy is given by

\[
U_{\text{eff}}(r) = U(r) + \frac{\ell^2}{2 \mu r^2}
\]

where \( r \) describes the relative coordinate.

The transformed radial equation is given by

\[
u''(\phi) = -u(\phi) - \frac{\mu}{\ell^2 u(\phi)^2} F
\]

where \( u = 1/r \), and has a solution given by

\[
r(\phi) = \frac{c}{1 + \epsilon \cos \phi}
\]

where \( c = \ell^2/(\gamma \mu) \) and \( \epsilon \) is related to the energy by

\[
E = \frac{\gamma^2 \mu}{2 \ell^2} (\epsilon^2 - 1).
\]

For the case where \( \epsilon < 1 \), the trajectories are elliptical with semi-major and semi-minor axes given by:

\[
a = \frac{\gamma}{2E} \quad \text{and} \quad b = \frac{\ell}{2\mu |E|}.
\]