

PHY422/820: Classical Mechanics

FS 2020

Exam Preparation

December 1, 2020

Problem P7 – Stability of Circular Orbits

In class, we discussed the possible trajectories for an object with energy E that is moving in a central potential $V(r)$.

1. Under which condition(s) do we obtain a circular orbit?
2. Determine the equations of motion in polar coordinates for a general potential $V(r)$. What condition does the radial equation of motion have to satisfy for a circular orbit?
3. Now consider a circular trajectory with an added perturbation:

$$r(t) = R + \epsilon(t), \quad R = \text{const.} \quad (1)$$

Expand the equation of motion through linear order in ϵ to find an ODE for the perturbation. Which condition does $V(r)$ have to satisfy to ensure that the orbit will be stable?