Classical Mechanics

Phase Diagrams

Problem 1.- Sketch the phase diagram of a particle of mass *m* moving in a central gravitational potential:

$$V = -G\frac{Mm}{r}$$

Assume the total energy is positive.

Solution: The total energy is given by:

$$E = \frac{1}{2}mv^2 - G\frac{Mm}{r} = \frac{p^2}{2m} - G\frac{Mm}{r}$$

Since the total energy is positive this is an unbound state and the momentum can be calculated for any value of *r* using the equation:

$$p = \sqrt{2mE + 2G\frac{Mm^2}{r}}$$