Classical Mechanics 2, Spring 2023 CMI

Assignment 6

Due by 6pm, Saturday Apr 15, 2023

Kepler problem

1. $\langle \mathbf{8} \rangle$ Given that the radius of the Sun is $r_s \approx 7 \times 10^5$ km, make order of magnitude estimates to find whether the CM of the Sun-Earth system and the orbit of the Sun lie within the solar interior. Recall that 1 AU $\approx 1.5 \times 10^8$ km, $m_e \approx 6 \times 10^{24}$ kg and $m_s \approx 2 \times 10^{30}$ kg. Draw a figure to roughly illustrate the situation showing the orbits of the Sun and Earth, CM etc. Hint: The eccentricity of the orbit is very small.

2. $\langle \mathbf{4} + \mathbf{3} \rangle$ (a) For bound elliptical orbits of the Kepler problem, express the time period $T(E)$ as a function of relative energy E and physical constants. Give an explicit formula, not just an integral representation. (b) What happens to $T(E)$ as $E \to 0^-$ and why is this physically reasonable based on properties of the effective potential? Hint: You do not need to evaluate any new integrals if you use the techniques developed in the lecture.