

Celestial Mechanics – Exercises

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Unit 2: The two-body problem

Problem 2.1

Is the barycenter of the Solar System inside the Sun or outside of it? *Hint: to solve this problem, you will need the solar mass and radius, as well as masses and orbital radii of (at least some) planets. These can be found online easily.*

(2 points)

Problem 2.2

Interestingly, the escape velocity from the surface of a body (in meters per second) is roughly equal to the radius of the body (in kilometers). Prove this and give one or two examples.

(1 point)

Problem 2.3

Assume that astronomers have discovered another universe, where the gravitational law is slightly different:

$$\vec{F} = -\frac{GM_1M_2}{r^4}\vec{r} \quad (1)$$

Derive the equation of motion for the two-body problem in that universe. Do the angular momentum and energy integrals exist? **(2 points)**

Bonus: Discuss whether circular orbits are possible or not. **(+2 points)**

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