The Solar System – Exercise classes

Problem Set 1

Distributed: 14 Oct 2024, results due: 21 Oct 2024.

Problem 1.1

Consider a pendulum in the belltower of Jena's city church. How far will this pendulum be moved from its vertical resting position because of the JenTower's (or, alternatively, the Hausberg's) gravitational pull? Make estimates for the unknown quantities. *(2 points)*

Figure 1: City church and Hausberg (392 m) in the center, JenTower on the right. (Image credit: Stadt Jena, Jens Hausprung).

Problem 1.2

In opposition, Jupiter is about 4.2 times as far from Earth as Earth from the Sun. Jupiter has got four big moons, called the Galileian Moons. The outermost of the four, Callisto, orbits Jupiter with a period of 17 days. The apparent separation between Callisto and Jupiter reaches a maximum of $10'$ when observed from Earth. What is the mass of Jupiter (in Solar units)? *(2 points)*

Bonus problem 1.3

During the time of their opposition, the outer planets seem to run in the wrong direction (that is, their right ascension decreases). For how many days before and after opposition is this the case for Mars? Assume circular, coplanar orbits with orbital periods of 1 and 1.88 years for Earth and Mars, respectively, with Mars being 1.5 times as far from the Sun as Earth. *(2 points)*

Bonus problem 1.4

Imagine you observe the Moon from somewhere close to Earth's equator during its rise (i. e. close to the horizon) and then again during its culmination (i. e. around its highest point on the sky, near zenith). By how much do

  (a) the speed at which the Moon moves (apparently) relative to the stars and
  (b) the apparent diameter of the Moon

vary between rise and culmination? *(2 points)*