

ASTR 121: Homework 4

Due Thursday, October 1st, 2009

For problems of a mathematical nature, show all work for full credit (including multiple choice responses).

- (10 pts)** Does the Sun or the Moon have a greater effect in causing the tides on Earth?
 - The Sun, because it exerts a stronger gravitational pull on Earth.
 - The Moon, because it has a stronger gravitational pull on Earth.
 - The Sun, because it has a larger *difference* between pulling on the near side and pulling on the far side of the Earth.
 - The Moon, because it has a larger *difference* between pulling on the near side and pulling on the far side of the Earth.
- (10 pts)** Edmund Halley, one of Newton's friends, discovered that Halley's comet would return to the solar system every 76 years. **(a)** How does the eccentricity of Halley's orbit compare with that of Earth's (qualitatively)? **(b)** Explain, using Kepler's Third Law, why Halley's comet has an orbital period that is much longer than Earth's.
- (15 pts)** Which of the following is one of the reasons that the Ptolemaic System is **NO LONGER ACCEPTED** by scientists?
 - This system requires the solar system to be heliocentric.
 - Planets don't actually experience retrograde motion.
 - The Ptolemaic system was grounded in simple, underlying principles that applied to all of the planets.
 - Orbital paths were characteristically circular.
- (15 pts)** It is thought that half of all stars are found in binary star systems, like *Albeiro*, which is visible from Earth on a clear night. Say two such stars are gravitationally bound somewhere in the Milky Way. Their combined masses amount to 4×10^{30} kg, which is about twice the mass of the Sun. The period of their orbit is observed to be 12 days. What is the semi-major axis of their orbit in meters?
- (25 pts)** Imagine a superior planet that has a synodic period of 500 days (as viewed from Earth). **(a)** What is its sidereal period? **(b)** What is its semi-major axis in AU? (*Hint: remember to convert days to years and give the semi-major axis in units of astronomical units (AU).*)

6. (25 pts) Using Newton's law of universal gravitation, defined as:

$$F = \frac{Gm_1m_2}{r^2}, \quad (1)$$

answer the following:

(a) Say the distance r between objects 1 and 2 suddenly tripled in size, while the object masses remained the same. By what factor would the force F change?

(b) Solve for the algebraic equation of m_1 , the mass of object 1.

(c) If the gravitational force F exerted on object 1 from an object 2 ($m_2 = 600\text{g}$) located a distance $r = 10^3$ m away is 2200N, compute m_1 . (*Note: the constant $G = 6.673 \times 10^{-11} \text{ N m}^2/\text{kg}^2$. Be sure to use the correct units!*)