Name _____

Astronomy 161 – Introduction to Solar System Astronomy
Winter Quarter 2010 – 9:30-10:18 M-F – Prof. Martini
Homework #2

Due Friday, February 5 in class

Instructions

Answer the following five questions (and optionally the extra credit questions) by circling the correct answer or filling in T (true) or F (false), as appropriate. Each question has equal weight.

No late homework will be accepted.

To the Planet Ecliptica! You are part of a futuristic interstellar exploration team that has reached the far off planet Ecliptica, a planet that appears identical to the Earth in many respects. In fact, the only important differences are:

Ecliptica's rotation axis is exactly perpendicular to its orbit about its sun

Ecliptica's moon, Plana, orbits Ecliptica in the same plane that Ecliptica orbits its sun

Use these differences to answer the first two questions:

1. You quickly realize that Ecliptica's orbit about its sun has some obvious implications: *Label each of the following statements as either True (T) or False (F), 1/2 point each*

   _____ The amount of insolation does not vary during the course of a year.

   _____ The Eclipticans would have also celebrated Quarter and Cross-Quarter Days defined by the Equinoxes and Solstices.

2. *Ecliptica's and Plana's orbits have some interesting implications for eclipses: Label each of the following statements as either True (T) or False (F), 1/2 point each*

   _____ Solar eclipses would be visible everywhere on the planet's surface every New Moon.

   _____ Lunar eclipses must have occurred every Full Moon.

3. Copernicus developed a heliocentric model primarily because: *(circle one)*

   a) His careful observations had convincingly shown the geocentric model was incorrect
   b) He was a devoted follower of Aristarchus of Samos
   c) There was no observational evidence at the time that the Earth was moving
   d) He did not think epicycles were a correct physical description of the orbits of planets
   e) Ptolemy's model deviated too much from his Aristotelean ideals about circular motion

4. *Newton's cannon* is a useful thought experiment to picture how a sufficiently fast projectile could actually go into a circular orbit, but the drawback is that air resistance due to the Earth's atmosphere will slow the cannonball down. This is not true on the surface of the Moon, where a sufficiently fast cannonball could go in a circle completely around the lunar surface and smack into the cannon from behind (if it didn't hit a lunar mountain). How fast would you need to shoot the cannonball to make this happen (in km/s)? Note: the mass of the Moon is 7.35×10^{22} kg and the radius of the Moon is 1737 km.

   a) 1.7 km/s
   b) 2.4 km/s
   c) 3.4 km/s
   d) 8.4 km/s
   e) 11.2 km/s

5. *Phases of Mars:* Which of the following correctly lists the phase and apparent size of Mars at Opposition, Quadrature, and Conjunction, respectively, as seen from the surface of the Earth?

   a) The phase is always full, the apparent size increases
   b) The phase is always gibbous, the apparent size does not change
   c) The phase changes from full to quarter to new, the apparent size increases
   d) The phase changes from full to gibbous to full, the apparent size decreases
   e) The phase changes from full to crescent to full, the apparent size decreases

6. *Extra Credit: Center of Mass:* The Earth and the Moon orbit around their center of mass. What is the distance between their center of mass and the center of the Earth? Note that the Earth's mass is 5.97×10^{24} kg, the Moon's mass is 7.35×10^{22} kg, and the average distance between them is 384,400 km.

   a) 4671 km
   b) 4728 km
   c) 6404 km
   d) 192,200 km
   e) 384,400 km

7. *Extra Credit:* A solar-powered geostationary satellite was launched into orbit around the Earth directly above the Earth's equator. Unfortunately, the batteries failed shortly after launch and the satellite does not work when it is in the Earth's shadow. How many minutes per day is the satellite without power? *Hint: Use Aristarchus' method.*

   a) 15 min
   b) 34 min
   c) 69 min
   d) 720 min
   e) It does not pass though the Earth's shadow