/AIDS: Homework
#1
Astronomy
101

Due: Tuesday, October 20

Please answer the questions below as fully as you can. Showing your work or drawing a picture often helps and could result in partial credit.

1. Two Martian astronomers are located due north and south of each other on the day of the Martian equinox. Marvin is on the Equator and sees no shadows cast at Noon (the Sun is directly overhead). Marvina is 667 Selim (a Martian unit of length) north of the Equator and sees a 6-degree shadow at Noon. (Hint: look at the diagram of the method Erathosthenes used to estimate the circumference of the Earth in the class notes. Drawing a picture may help)
   a. What is the circumference of Mars in Selim? (10 pts)
   b. The actual circumference of Mars is 4289 miles. How many miles are in a Selim? (5 pts)

2. An Apollo astronaut dressed in his Moon suit had a total mass of 162 kilograms on Earth; this is the equivalent of weighing 360 pounds. The Moon’s gravity is 1/6th that of Earth’s. While standing on the Moon’s surface, what is the astronaut’s mass and weight (in kilograms and pounds, respectively)? (5 pts)

3. You note that the Moon is full on a given night. What time did the Moon rise that night? (Hint: answer in terms of the time the Sun rose or set) (10 pts)

4. At sunset you notice that the planet Jupiter appears high in the sky. Draw a sketch of the configuration of the Earth, Sun, and Jupiter as viewed from above. (5 pts)

5. You observe the full Moon one night and think you see Venus just beside the Moon in the sky. Are you correct? Why? (5 pts)

6. During a total solar eclipse you observe Jupiter just beside the Moon in the sky. How far away is Jupiter from the Earth? (10 pts)

7. How far do you have to be from the Sun in AU in order for the gravitational force from the Sun on you to be 100 times smaller than the Sun’s gravitational force on you right now? (5 pts)

8. Two identical robotic spacecraft are launched by NASA. The first is inserted into a circular orbit 20000 km from the center of the Earth, while the second flies to the planet Mongo and is inserted into a circular orbit that is 20000 km from the center of Mongo. However, the spacecraft orbiting Mongo has an orbital period exactly ¼ the period of the spacecraft orbiting Earth. What is the mass of Mongo in units of the mass of the Earth? (15 pts) (Hint: you do not need to know G or the mass of the Earth to do this problem and you can assume the masses of both spacecraft are negligibly small compared to the masses of both Earth and Mongo)

9. The planet Mongo emits a continuous blackbody spectrum with a maximum brightness occurring at a wavelength of 30,000 nm (in the infrared).
   a. Using Wien’s Law, what is Mongo’s approximate surface temperature? (5 pts)
   b. Using Stefan-Boltzmann’s Law, how much more energy is emitted per second per area by Mongo compared to the Earth? (5 pts) (Hint: the surface temperature of the Earth is about 300 K)

10. A new comet has been discovered far out in the Solar System. The semimajor axis of its long elliptical orbit around the Sun is 100 AU; the semiminor axis is only 1 AU. (Hint: use Kepler’s Laws and Newton’s version of Kepler’s 2nd Law in particular)
    a. How long will this comet take to complete one orbit around the Sun? (10 pts)
    b. How much faster does the comet move when it is at its closest approach to the Sun compared to when it is at its furthest? (10 pts)