

Name _____

Astronomy 161 – Introduction to Solar System Astronomy
Winter Quarter 2010 – 9:30-10:18 M-F – Prof. Martini
Homework #4

Due Friday, March 5 in class

Instructions

Answer the following five questions (and optionally the extra credit questions) by circling the correct answer. Each question has equal weight.

No late homework will be accepted.

1. The Galilean moon Io orbits Jupiter every 1.8 days, while Europa and Ganymede have twice and four times the orbital period, respectively. What is the resonance between Europa and Ganymede? How much further is Ganymede from Jupiter relative to Europa?
 - a) 1:2, 1.6 times farther
 - b) 1:2, 3.2 times farther
 - c) 1:3, 2.4 times farther
 - d) 1:4, 1.6 times farther
 - e) 1:4, 3.2 times farther

2. Which of the following can NOT be explained by a giant impact:
 - a) Retrograde motion of Venus
 - b) Iron core of Mercury
 - c) Atmosphere of Jupiter
 - d) Formation of the Moon
 - e) Extinction of the dinosaurs

3. The Sun contains most of the mass of the Solar System. For example, it is 1000 times more massive than Jupiter, which is the most massive planet. The four Jovian planets contain most of the rest of the mass in the Solar System. What fraction of the total mass in the eight planets is contained in the four Jovian planets?
 - a) 95%
 - b) 98%
 - c) 99%
 - d) 99.5%
 - e) 99.9%

4. We have learned a great deal about the Moon and planets with just observations from the Earth's surface, rather than space missions. Which of the following properties of the planets were NOT known until a space mission visited the Moon or planet:
 - a) Retrograde rotation of Venus
 - b) Mass, radius, and density of the planets
 - c) Chemical composition of meteorites
 - d) Temperature of the surface of Mercury
 - e) Ages of the highlands and maria on the Moon

5. Imagine that a planet with the same mass and size as the Earth had managed to form in the asteroid belt. Below is a list of observed properties for this hypothetical planet. Which of these properties is the most unlikely, given what we know about the other planets in our solar system?
 - a) There are no active volcanoes
 - b) There is a cold, dense atmosphere of primarily CO₂
 - c) The surface temperature is comparable to that of Mars
 - d) The planet has a moon
 - e) The surface of the planet only has a few craters

6. (Extra Credit) The escape velocity from Saturn's giant moon Titan is 2.6 km/s and the surface temperature is 94K. One important constituent of Titan's atmosphere is Methane (CH₄). The characteristic gas velocity is related to temperature T as $v_{\text{gas}} = \sqrt{3kT/m_{\text{gas}}}$, where $k=1.38 \times 10^{-23} \text{ m}^2 \text{ kg s}^{-2} \text{ K}^{-1}$ is Boltzmann's constant, $m_{\text{H}}=1.67 \times 10^{-27} \text{ kg}$, and $m_{\text{C}}=12m_{\text{H}}$ (the mass of a Carbon atom is twelve times greater than a Hydrogen atom). What is the characteristic gas velocity of methane in the atmosphere of Titan?
 - a) 0.22 km/s
 - b) 0.38 km/s
 - c) 0.44 km/s
 - d) 0.76 km/s
 - e) 1.5 km/s

7. (Extra Credit) The most distant moons of Jupiter orbit that planet approximately once every three years, while in contrast the closest giant moon (Io) orbits at a semi-major axis distance of 421,700 km every 1.8 days. Given that Jupiter orbits the Sun at an average distance of 5.2 AU, what is the angular diameter of the orbit of the most distant moons as seen from the Earth (at opposition)?
 - a) 0.05 degrees
 - b) 0.25 degrees
 - c) 0.32 degrees
 - d) 2.3 degrees
 - e) 2.8 degrees