29:52 Exploration of the Solar System
Homework Assignment # 9
Quiz must be completed on ICON by 8 AM, Monday, April 12

1. How far from the center of Jupiter is its *Roche Distance*, or tidal disruption radius?
   (a) 357,000 km
   (b) 750 million kilometers
   (c) 0.45 astronomical units
   (d) 2,500,000 km
   (e) 179,000 km

2. How does the tidal disruption radius calculated in problem (1) compare with the semimajor axis of the orbit of Io around Jupiter?
   (a) Io is outside the tidal disruption radius by about a factor of 2.4
   (b) Io is outside the tidal disruption radius by about a factor of 7.5
   (c) Io is at the tidal disruption radius
   (d) Io is at a distance from the center of Jupiter equal to 38 % of the Roche Distance
   (e) Io is at a distance from the center of Jupiter equal to 83 % of the Roche Distance

3. What can you deduce from the numbers for the mean densities of Jupiter's moons Io and Callisto?
   (a) Callisto has a higher proportion of rock than Io
   (b) Callisto is an object with higher albedo (reflectivity)
   (c) Io has a higher proportion of rock to ice in its composition
   (d) Of the two, Callisto must be mainly composed of hydrogen
   (e) Of the two, only Callisto has an atmosphere

4. What is the basis of the statement that, 500 million years ago, Saturn did not possess a ring?
   (a) The solar system had not formed 500 million years ago, so Saturn did not exist
   (b) ring particles move out of the ring (in or out) on timescales of a few hundred million years
   (c) Saturn itself did not form until 249 million years ago
   (d) At times prior to 500 million years ago, Saturn had a much stronger magnetic field than now, which impeded formation of a ring

(e) According to our current theories of rings, they occur in an outward sequence among the planets, with each planet having a ring for about 200 million years

5. What is the principal difference in the internal structures of Uranus and Jupiter?
   (a) Uranus does not contain liquid metallic hydrogen
   (b) Jupiter does not contain hydrogen, whereas this is the principal element in Uranus
   (c) Uranus has a solid surface only about 150 km below the cloud layers
   (d) Jupiter does not contain liquid metallic hydrogen

6. Voyager 2 is now about 100 au out from the Sun, and is moving out into space at a speed of 3 au/year. The nearest star is 4.3 light years away. If this star were in the same direction as Voyager 2 is moving, approximately how long would it take to get there?
   (a) 85 years
   (b) 470 years
   (c) 100,000 years
   (d) 4.2 million years
   (e) 780 million years

7. What is the temperature in the atmosphere of Uranus at a point where the pressure is 1 atmosphere? How does this compare with (a) a temperature at which you are comfortable (assuming you are not an alien from the outer solar system), and (b) the temperature of liquid nitrogen?
   (a) 3 K (3 degrees Kelvin, or degrees above absolute zero)
   (b) 293 K
   (c) 40 degrees C
   (d) 80 K
   (e) 200 degrees Fahrenheit

8. Which of the following statements about the orbits of Neptune and Pluto is correct? Hint: "perihelion" means point on an orbit when a planet is closest to the Sun. "Aphelion" is the point on an orbit when the planet is furthest from the Sun.
   (a) The aphelion distance of Neptune is larger than the aphelion distance of Pluto.
   (b) The perihelion distance of Pluto is smaller than the aphelion distance of Neptune.

(c) Pluto is always farther from the Sun than Neptune.
(d) The eccentricity of the orbit of Neptune is larger than that of Pluto.