ASTRONOMY 150 – FINAL Name: _____

December 15, 2004 – Autumn 2004 TA's Name & Section: _____

Answer all questions in the space provided. If you have any questions, raise your hand. 100 points possible. No calculators.

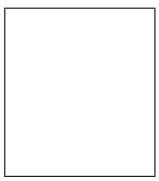
1 (6 pts) Describe how the (a) internal mass distribution and (b) moment-of-inertia factor change as a planet *differentiates*.

2 (6 pts) Explain why there are very few Kuiper Belt objects with orbits that cross the orbit of Neptune.

3 (4 pts) Explain what it means to be in a 2:3 resonance orbit with Neptune.

4 (9 pts) Other than shape, color, or density, list three (3) differences between a typical carbonaceous chondrite meteorite and a typical piece of Earth basalt.

5 (6 pts) I said that (practically) every rock on the surface of the Earth is an Achondrite. Explain what I meant by that statement.



6 (6 pts) Explain how we know some asteroids **have** differentiated.

7 (5 pts) Explain why it is difficult to detect an **Earth-sized** planet around another star.

8 (8 pts) In the space below, sketch the visible reflectance spectrum of a typical Saturn ring particle. Make sure to label the axes.

9 (4 pts) Liquid water probably exists below the surface of Jupiter's moon Europa. Explain why liquid water cannot exist in large seas on the **surface** of Europa. [There are two reasons, give them both]

10 (8 pts) Which of Jupiter's moons, Io or Callisto, has more volatile material on its surface? Explain your answer. [Hint: Write down the definition of a volatile substance, then answer the question.]

11 (3 pts) The inner planets of our solar system are mostly made of rock and iron because:

(a) lighter materials cannot orbit the Sun; they would fall in immediately
(b) the Sun is made mostly of rock and iron and the inner planets are closest to the Sun.
(c) Jupiter's large mass immediately attracted most of the light material so there is little left to make the inner planets.
(d) rock and iron are the most abundant material in the solar system.
(e) low density materials such as ice are not solid close to the Sun where the inner planets formed.

At least two worlds in our solar system show unambiguous evidence for currently active volcanoes: **Earth**, and Jupiter's moon **Io**. For each of these worlds, describe the energy source that drives these volcanoes (6 pts) and the duration of this energy source (*i.e.,* how long will it last?) (2 pt).

12 (8 pts) Earth

13 (8 pts) Io

14 (3 pts) I said that the surface of Uranus' moon Oberon is about 3.8 billion years old because it has about the same crater density as the highlands of the Earth's Moon. Why might this statement be completely wrong.

(a) Oberon is smaller than the Moon and therefore a smaller target
(b) Oberon is a tidally heated world so geological activity removes most craters
(c) Oberon may not have been hit by the same number and size of impactors as the Moon.
(d) Crater density has no relation to the age of a planetary surface
(e) Uranus' rings have shielded Oberon from all but the largest impacts

15 (8 pts) The Cassini mission is just starting to reveal the surface of Saturn's moon Titan from below its thick atmosphere. In the space below, sketch the most probable crater density distribution of Titan's surface. Make sure to label your axes.

16 (6 pts) List the three properties a planet needs to generate a magnetic field.

17 (2 pts) And finally, list the top 100 objects in the solar system.