

Name: _____

ERTH 1 – Planets
Instructor – Memorie Yasuda
Assigned – May 30, 2007
Due – June 8, 2007

Homework 6 – The outer planets (100 points total)

- Answers must be typed, double-spaced, and printed. Except equations and hand-drawn illustrations.
- All papers must be stapled together. Name on front with initials at top right-hand side of each page.
- You will need to use the following resources as you see fit:
 1. Resources on the Web (you may want to look at the posted websites for ideas first, although you will need to look beyond that)
 2. Your textbook and any other printed materials you want to use.
 3. Notes
- You are encouraged to confer with other students, but individual answers must be original, i.e. crafted and written by individuals. No credit will be given for unusually similar responses.
- Homework is due at the start of class. No late work accepted.

A. Short answer (40 points)

1. What are the two ways in which rings (such as the ones around Saturn) could have formed?
Changed this question. Please take note.
2. What is the Roche limit and how is it related to the geometry of the rings around a planet?
3. If you were to touch down on the “surface” of Jupiter, how would it differ from the surface of the Earth?
4. The flow of “air” around the planets is strong in the east-west direction, along lines of latitude. It is particularly visually striking around Jupiter, and notable with respect to its velocity on Saturn (Fig. 13.15, page 346 of your text). While distinct latitudinal winds exist on Earth too, winds on Earth also circulate in the north-south direction across lines of latitude.

http://aquarius.nasa.gov/images/six_cell_lg.jpg (this website was down on Monday, the other one below should work.)

http://wps.prenhall.com/wps/media/tmp/labeling/2131555_dyn.jpg

Why might the winds on Jupiter and Saturn be so much more confined to east-west trending bands than on Earth?

5. Why is it said that it's “raining diamonds on Uranus”?
<http://www.berkeley.edu/news/berkeleyan/1999/1006/diamonds.html>
6. What is unusual about the orientation of the rotational axis of **Uranus** ~~Neptune~~ and what might have caused this? **Changed this question. Please take note.**

http://www.windows.ucar.edu/tour/link=/our_solar_system/planets_table.html

7. What's your favorite photo of the gaseous giants – Jupiter and Saturn? (10 points)

<http://sse.jpl.nasa.gov/planets/profile.cfm?Object=Jupiter&Display=Gallery>

B. Essay questions (60 points)

8. Composition of the Gas Giants

Based on the overall density of planets such as Jupiter, the relative abundance of elements we see around us in the galaxy, and what we now know about the surface composition of Jupiter, we assume that a significant portion of Jupiter is composed of the elements hydrogen and helium.

Depending on the temperature and pressures at which the hydrogen and helium mixture exists, the atoms and electrons configure or arrange themselves differently in three-dimensional space, giving the resulting material at any depth within the planet different properties and behaviors.

- a. Do volcanoes on Earth emit hydrogen and helium to the atmosphere? If so, what is their relative abundance within the gas mixture?
<http://volcanoes.usgs.gov/Hazards/What/VolGas/volgas.html>
- b. Does the Earth's atmosphere contain the same proportion of molecular hydrogen (H₂) as in the gas emitted out of volcanoes?
<http://www.physicalgeography.net/fundamentals/7a.html>
- c. Why does the Earth's atmosphere have so much less H₂?
- d. Why does Jupiter's atmosphere have so much H₂?
- d. The cutaway diagrams of Jupiter and Saturn on page 337 of your text show that the outermost layers of these planets are composed of molecular hydrogen and underlain by a layer of metallic hydrogen. What's the difference between molecular hydrogen and metallic hydrogen?
<http://access.ncsa.uiuc.edu/Stories/MetalHydrogen/Hydrogen.html#top>
- e. What conditions cause the change in structure from molecular to metallic hydrogen at depth?
- f. On page 335 of your text, it mentions that - "A basic problem in constructing such models of the giant planets is our limited knowledge of the behavior of the planets' principle constituents, hydrogen and helium, at appropriately high pressures and temperatures."

How might we guess about what happens to these materials at high pressures and temperatures?
- g. If hydrogen is so rare, where do we get the H₂ we use in balloons?
- h. Why do we think that there is helium in Jupiter?
- i. How is it possible for Jupiter and Saturn to generate and release more energy to space than they receive from the Sun?

