Homework 4 Solutions
Astronomy/EPS 12 – The Planets

Chapter 13, Review and Discussion 4

Uranus and Neptune are both blue due to reflection of sunlight by white clouds and the absorption of sunlight by gaseous methane in their atmsospheres. Neptune is a deeper blue because it has more methane.

Chapter 13, Review and Discussion 12

Triton has a retrograde orbit, which means that tidal forces cause the radius of the orbit to slowly decrease. This means Triton is slowly approaching Neptune and when it crosses Neptune's Roche limit (or tidal stability limit) Triton will be torn apart by tidal forces and will shred into tiny ring particles.

Chapter 13, Problem 10

The moons in Figure 13.8 are Cordelia and Ophelia and their orbital periods are 0.34 and 0.38 days, respectively. Although they look far apart, since they are in the same image, they are actually really close together and we can consider them starting from the same point. What we need to determine is the synodic period of one moon relative to the other. We use the following equation (from p.234 in Chaisson)

$$\frac{1}{S} = \frac{1}{P_1} - \frac{1}{P_2}$$

so the time for Cordelia to lap Ophelia is

$$S = \left(\frac{1}{P_1} - \frac{1}{P_2}\right)^{-1} = \left(\frac{1}{0.34} - \frac{1}{0.38}\right)^{-1} = 3.23\,\text{days}$$

If you mix up P_1 and P_2 you get -3.23 days, which is the synodic period relative to the outside moon, Ophelia.

Chapter 14, Review and Discussion 14

The Kuiper belt and the asteroid belt are both in roughly the same orbital plain as the terrestrial and Jovian planets. They both consist of a large number of small bodies (or minor planets). They are different in that the Kuiper belt is much further away and composed of icy bodies where the asteroid belt is composed of rocky bodies.

Chapter 14, Problem 11

There are $100\,\text{days} \times 24\,\text{hr/day} \times 60\ \text{min/hr} \times 60\ \text{sec/min} = 8.64{\times}10^6$ seconds in the timespan we're considering. And the comet loses $3.5\ {\times}10^5$ kg per second, so that is a total of $3\ {\times}10^{12}$ kg. Which is just under one thousandth of the mass of the comet. This means Hale-Bopp is only coming around another 1,000 times or so.

Chapter 15, Review and Discussion 8

The huge jovian planets would have experienced drag in traversing the outer regions of the early solar nebula. This drag would have resulted in decreased orbital speed, and, therefore, a reduced orbital radius.

Chapter 15, Review and Discussion 11

Earth would not have been able to condense enough water in the early period of formation due to the high temperatures. However, once the planet cooled sufficiently, the temperatures became acceptable for the condensation of water. Now, at this point, there was no longer enough water ice in the vicinity of Earth to account for the amount of water that we see today. Therefore, the water must have been brought in by objects originating in the far regions of the solar system. These objects would be comets.

Chapter 15, Problem 3

From Kepler's third law you can figure out the period of the orbit at at 25 A.U. Specifically,

$$P^2 = a^3 = 25^3$$

so, P= 125 years per orbit. Dividing 1000 years by 125 years per orbit gives 8 orbits.

Chapter 15, Problem 7

If there are 10^{13} kg water per comet and 2×10^{21} kg total, then the total number of comets is:

$$\frac{2 \times 10^{21}}{10^{13}} = 2 \times 10^8 comets$$

In other words, 200 million comets, and over 500 million years, this means 200 million comets / 500 million years = 0.4 comets per year or 1 comets every 2.5 years.