Astronomy 2110 Homework #10

Spring 2024 Due Thursday, April 18 in class.

For full credit you must write your solutions neatly and include all work. Do not forget the units.

1) A number of storms in the Uranian atmosphere can be seen in Figure 14-2, but none are visible in Figure 14-1. How can you account for the difference?

2) Why are Uranus and Neptune distinctly blue-green in color, while Saturn and Jupiter are not?

3) Briefly describe the evidence supporting the idea that Uranus was struck by a large planet-like object several billion years ago.

4) Uranus's epsilon (ε) ring has a radius of 51,150 km. (a) How long does it take a particle in the ε-ring to make one complete orbit of Uranus? (b) If you were riding on one of the particles in the ε-ring and watching a cloud near Uranus's equator, would the cloud appear to move eastward or westward as Uranus rotates? Explain your answer.

5) Suppose you wanted to search for trans-Neptunian objects. Why might it be advantageous to do your observations in the radio instead of the visible? (Hint: at what wavelengths would you expect distant dwarf planets to emit most strongly?). Could the search be conducted from the ground?

6) The New Horizons spacecraft swung by Jupiter to get a boost from the planet's gravity, enabling it to get to Pluto more quickly. To see what would happen if this technique was not used, consider a spacecraft trajectory that is an elliptical orbit around the Sun. The perihelion is at 1 AU (at Earth) and the aphelion is at 30 AU (at Pluto). Calculate how long it would take a spacecraft in this orbit to make the one-way trip from Earth to Pluto. Based on the information in Section 14-9, how much time was saved by using a gravity assist from Jupiter?

7) If Jupiter was not present in our solar system, would the asteroid belt exist? Why or why not?

8) Suppose that a binary asteroid (two asteroids orbiting each other) is observed in which one member is 16 times brighter than the other. Suppose that they both have the same albedo and that the larger of the two is 120 km in diameter. What is the diameter of the other asteroid?

9) On March 9, 1997, comet Hale-Bopp was 1.39 AU from the Earth and 1.00 AU from the Sun. Use this information and that given in the caption to figure 15-35 to estimate the length of the comet's ion tail on that date. Give your answer in AU.

10) A very crude model of a typical comet nucleus is a cube of ice (density 1000 kg/m^3) 10 km on a side. (a) What is the mass of this nucleus? (b) Suppose 1% of the mass of the nucleus evaporates away to form the comet's tail. Suppose further that this tail is measured to be 100 million km long and 1 million km wide. Estimate the average density of the tail (in kg/m^3) and compare this to the density of air (about 1.2 kg/m^3). (c) In 1910 Earth actually passed through the tail of comet Halley. At the time there was some concern about this from the general public that this could be hazardous. Was this concern justified? Why or why not?