AST 105 HW #12 Solution

Week of November 9th, 2015

Note: All Problems are from The Cosmic Perspective (6ed)

Chapter 12

Review Problems

4. What is the difference between a meteor and a meteorite? How can we distinguish a meteorite from a terrestrial rock?

⇒ While the terms meteor and meteorite are often interchanged, they mean different things. A meteor is a piece of debris that is hitting our atmosphere and glowing from the heat of entry. A meteorite is what is left of the debris after it hits the ground. We can identify a meteorite several ways. One is that the crust tends to be pitted in an unusual way due to its entry into our atmosphere. Another feature common to many meteorites is a high metal content that causes them to attract magnets. The ultimate test, however, is a chemical analysis since meteorites tend to be rich in elements that are rare in Earth's crust.

6. What does a comet look like when it is far from the Sun? How does its appearance change when it is near the Sun? What happens to comets that make many passes near the Sun?

⇒ When a comet is far from the Sun, it appears to be a dirty snowball. When the comet is closer to the Sun, it appears to be a bright ball with a long tail. For each time comets pass near the Sun, they lose some ice. After many such passes, they would look like asteroids.

7. What produces the coma and tails of a comet? What is the nucleus? Why do tails point away from the Sun?

⇒ The coma and tails of a comet are produced by ices warming and sublimating off of the surface. As these ices turn to gas, they escape the nucleus (the solid icy part of the comet in the middle), carrying dust with them. The gas that escapes becomes ionized and is carried away from the Sun by the solar wind. The dust that escapes is pushed, more gently, away from the Sun by solar radiation pressure.

9. Describe the Kuiper belt and Oort cloud in terms of their locations and the orbits of comets within them. How did comets come to exist in these two regions?

⇒ There are two reservoirs of comets in our solar system. The first is the Kuiper belt, which is similar to the asteroid belt except that it is beyond the orbit of Neptune and is filled with icy bodies rather than rocky and metallic ones. The other reservoir of comets is the Oort cloud, a spherical halo of comets well outside of the orbits of the planets. While comets in the Kuiper belt have orbits that are nearly in the plane of the solar system and go around the Sun in the "forward" direction, Oort cloud comets often orbit on highly inclined orbits in any direction. Comets that are now in the Oort cloud were probably flung there early in the solar system's life by Jupiter. Comets in the Kuiper belt probably formed in that region of the solar system, or close to it.

10. Briefly describe Pluto and Charon. How do Eris and other large Kuiper belt objects compare to Pluto and Charon?
Pluto’s orbit is more elliptical and more inclined than that any of the planets. It is far smaller than the terrestrial planets and it is ice rich which is different from the composition of other planets.

Charon is a large moon of Pluto’s. It is also made of ice and rocks. The size of Charon is compared to that of Pluto. The diameter of Charon is more than half of Pluto’s. Its mass is about one eighth of Pluto’s. It’s density is slightly lower than that of Pluto.

Test Your Understanding

Suppose someone claimed to make the discoveries described below. (These are not real discoveries.) Decide whether each discovery should be considered reasonable or surprising. Explain clearly; not all these have definitive answers, so your explanation is more important than your chosen answer.

19. Astronomers discover a previously unknown comet that will be brightly visible in our night sky about 2 years from now.
   🔄 It is reasonable. We haven’t yet to discover all comets that passes near the Sun.

23. Astronomers discover three objects with the same average distance from the Sun (and the same orbital period) as Pluto.
   🔄 It is reasonable considering there are already five known moons of Pluto. These moons are clearly the same average distance from the Sun. Also, they have the same orbital period as Pluto.

Investigate Further

42. Comet Tails. Describe in your own words why comets have tails. Why do most comets have two distinct visible tails, and why do the tails go in different directions? Why is the third, invisible tail of small pebbles of interest to us on Earth?
   🔄 Comets have tails due to the sublimation of ice caused by sunlight as they approach the Sun. The ejected gas is ionized and carried away in the ion tail by the solar wind - straight back from the Sun. Small solid particles drift away in the dust tail, which curves slowly away from the comet because the pressure of sunlight is so small compared to that from the solar wind. The third tail of larger particles is of interest because it’s the source of meteor showers.

43. Oort Cloud vs. Kuiper Belt. Explain in your own words how and why there are two different reservoirs of comets. Be sure to discuss where the two groups of comets formed, and what kinds of orbits they travel on.
   🔄 Kuiper belt objects are leftovers from the outer edges of the original solar nebula—they haven’t moved much since their formation, and their (relatively) organized motions around the Sun support this conclusion. Oort cloud comets formed closer in, but were ejected by gravitational encounters with the jovian planets onto random orbits (highly eccentric and highly tilted) well beyond the Kuiper belt.