Week 2 Notes
Astro 1 (Discussion Sections 101 & 102)

Department of Physics: University of California, Santa Barbara

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Administrative Tasks

Sign-in Sheet Pass sign-in sheet around classroom. Roster is as of 10 AM this morning. Those that crashed last week that haven't yet enrolled have been added as "previous crashers." Sign in again by your name. Any new crashers should sign below under "New Crashers." An asterisk in the signature column indicates that a person did not sign in last week and is still on the class roster.

Dropping, Adding, and Switching After class, those that have not signed in yet will be contacted to see if they are still planning on taking the class. Hopefully this will confirm numbers and get students to drop who are no longer taking the class. If there are enough spaces for the crashers still hanging on, all will be given add codes. If there are not enough available spaces, placement will be done by lottery.

Review

Questions from last week?

Concept Review: Motion of the Sun Discuss (and draw) the motion of the sun throughout the year at various latitudes, being sure to clearly define the zenith. Point students towards section 2-5 in the textbook. This material is often very confusing for students.

Concept Review: Heliocentric and Geocentric Models Give some context for the value of the geocentric theory and why scientists did not initially accept Copernicus' heliocentric theory. Mention how awesome Tycho Brahe's eyes were.

Concept Review: Kepler's Laws Review what each of the three laws are:

1. Planets move in ellipses, not circles
2. Orbits sweep out equal areas in equal times
3. Square of a sidereal period is equal to the semimajor axis cubed: $P^2 = a^3$

Note that the second focus in an orbit is nothing special. Perhaps consider the "Planet X" idea. Check comprehension of the second law and perhaps relate to angular momentum conservation. Note the stupidity of the form of the third law (units, anyone?).

Open Forum

Examples

Example 1 (Example from Box 1-1 in textbook) On December 11, 2006, Jupiter was 944 million kilometers from Earth and had an angular diameter of 31.2 arcsec. From this information, calculate the actual diameter of Jupiter in kilometers.

Solution: The small angle formula is

$$D = \frac{\alpha d}{206,265}$$

We know d and α and we wish to find D. Simply plugging in numbers yields

$$D = \frac{\alpha d}{206,265} = \frac{(31.2)(9.44 \times 10^8\,\mathrm{km})}{206265} = 1.42 \times 10^5\,\mathrm{km}$$

Example 2 (Problem 2.42 in textbook) The city of Mumbai (formerly Bombay) in India is 19° north of the equator. On how many days of the year, if any, is the Sun at the zenith at midday as seen from Mumbai? Explain your answer.

Solution There are only two days in which this could happen, and they both happen in the summer. As the solstice approaches, the sun goes higher and higher in the sky at midday until it approaches the zenith. It then continues to move further north until the solstice, when it moves back south, passing again through the zenith.

Example 3 (Problem 3.39 in textbook) The total lunar eclipse of October 28, 2004, was visible from South America. The duration of totality was 1 hour, 21 minutes. Was this total eclipse also visible form Australia, on the opposite side ofEarth? Explain your reasoning.

Solution No, since it was currently night in Australia, and presumably an hour and twenty-one minutes was not a sufficient amount of time to bring Australia into daylight, especially since the shadow typically moves eastward.

Example 4 Super Earth Suppose Earth were twice as massive and its average distance from the sun were doubled to 2 AU. How long would it take to make one full revolution around the sun?

Solution The mass of the earth makes no difference in this calculation. We may simply apply Kepler's Third Law to the system, starting with what we already know, namely that

$$(1\,\mathrm{year})^2 = (1\,\mathrm{AU})^3$$

Doubling the semimajor axis gives

$$(2\,\mathrm{AU})^3 = 8\,\mathrm{AU}^3 = 8(1\,\mathrm{AU})^3 = 8(1\,\mathrm{year})^2 = P^2$$

Taking the square root of both sides yields $P = \sqrt{8}\,\mathrm{year} \approx 2.8\,\mathrm{year}$