Week 2 Notes
Astro 1 (Discussion Section 105)

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 12 PM today. 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: 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?).

Concept Review: Newton's Laws of Motion and Gravity List the three laws, paying special attention to the second law. Do mention the consequences of the third law with gravity. State the law of gravitation and its consequences on orbit.

Open Forum

Examples

Example 1: Super Earth Suppose Earth were twice as massive, twice as wide, 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? How heavy would a 180 pound person be?

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

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

Doubling the semimajor axis gives

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

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

For the second part of the question, we require Newton's gravitational law:

$$F_{12} = G\frac{Mm}{R^2}$$

Originally, $F = 150$ pounds. Now we double M and R to yield

$$F = G\frac{2Mm}{(2r)^2} = \frac{1}{2}G\frac{Mm}{r^2} = 75\,\text{pounds}$$

Example 2: Box 4-4(?)