Week 4 Notes
Astro 1 (Discussion Sections 101 & 102)

Department of Physics: University of California, Santa Barbara

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Administrative Tasks

Stargazing Sign-In Pass sign-up sheet for stargazing night (March 3, 2011) around class, explaining that there is a 50 person limit, and that if that limit is breached, a second night will take place on March 8, 2011.

Add Codes Also pass sign-in sheet around meant only for those who are trying to get add codes.

Website Announce website, which is `www.physics.ucsb.edu/∼wmwolf`. Relevant files are under the "teaching" tab.

Questions from Test

A2/B18 Two very bright fireworks are exploded at the same time during the July 4^{th} celebrations, one in Los Angeles, the other in Seattle (1000 miles apart). How far apart in angle will these flashes appear to astronauts on the moon, who are 400,000 km from Earth?

This is a simple small-angle formula problem. The only caveat is that the units are not uniform. In this case

$$d = 400,000km$$

and

$$D = 1000\,\text{miles} \times \frac{1.6\,\text{km}}{1\,\text{mile}} = 1,600\,\text{km}$$

after rearranging the small angle formula, we get

$$\alpha = \frac{206,265D}{d} = \frac{(206,265)(1,600\,\text{km})}{400,000\,\text{km}} = 825'' = 13.7'$$

A5/B4 How much of the total surface of Venus is illuminated by the Sun when it is at crescent phase?

Consider the exact wording of the question. Half of any given planet is always illuminated by the sun.

A9/B10 If you drop an object near Earth's surface it will have an acceleration of 9.8 m/s^2. If, instead, you throw the object downward its acceleration (after it leaves your hand) will be:

Acceleration tells us the *change* in velocity. Throwing the eraser downwards merely adds an additional initial velocity initially (though it had to accelerate to obtain this velocity). After the "throwing" is complete, no more forces act on the eraser except gravity, so by Newton's second law, the acceleration will remain at 9.8 m/s^2.

A13/B16 The gravitational acceleration on the Earth's surface is 9.8m/s^2. What would it be on the surface of a planet with the same size but twice the mass?

Newton's second law states that $F = ma$, so combined with his law of universal gravitation, we get

$$ma = G\frac{Mm}{r^2}$$

$$a = G\frac{M}{r^2}$$

where now a is the acceleration due to gravity, and r is the distance from the center of the earth. We see then that doubling the mass simply doubles the acceleration, or

$$a' = G\frac{(2M)}{r^2} = 2\left(G\frac{M}{r^2}\right) = 2\left(9.8\,\mathrm{m/s}^2\right) = 19.6\,\mathrm{m/s}^2$$

A15/B22 Captain Picard wishes to send a message to a Ferenghi ship, which is located behind a large dust cloud. In order to ensure the best possible transmission he sends:

There's no math here, it's just a fact that radio waves travel best through interstellar medium.

A17/B3 What is the distance to Sirius? The parallax is 0.337".

This question probes your understanding of parallax and parsecs. In your textbook, the definition of a parsec is given to be the distance at which 1 AU subtends 1" in the sky. This is rarely a useful definition in practice, since we don't really care about objects of the order of 1 AU. However, when viewing Earth's orbit from far away, the angle it subtends over a quarter of a year is then roughly equivalent to a distance of 1 AU. This angle is *exactly* what parallax angle is! Thus, we can compare an arbitrary parallaax angle to 1arcsec/AU to find a distance.

$$1AU = \frac{(1\,\mathrm{pc})(1'')}{206,265} = \frac{d}{\alpha}206,265$$
$$\frac{1\,\mathrm{pc}}{d} = \frac{\alpha}{1''}$$

here, we see that d *must* be measured in pc, so plugging in .337" yields $d = 2.97$ pc.

A23/B27 If a large cloud of gas and dust is initially rotating, and it begins to expand without losing any mass, it will rotate:

Due to Kepler's second law, it must move *slower* in order to sweep out the same area in the same time.

A24/B28 If one of the three wisemen lit a candle at the moment of Christ's birth in Nazareth approximately how far out in space has some of the light now reached?

This is just a rate-time problem.

$$d = vt = 3\times10^8\,\mathrm{m/s}\times 2011\,\mathrm{years} = 2\times10^{19}\,\mathrm{m}$$

A25/B29 According to Kepler's law, the approximated period of an asteroid moving around the Sun in the asteroid belt is:

You are not explicitly given what the distance to the asteroid belt is from the sun. However, you could find one number in one of the homework questions, or you could just look up in the appendix the distance to Mars or Jupiter and take some distance in between. As it turns out, for the asteroid belt, $a \approx 2.8$ AU. So using Kepler's third law,

$$p^2 = a^3$$
$$p = a^{3/2} = (2.8)^3/2 = 4.68\,\mathrm{years}$$

A26/B24 As Venus orbits the Sun, by what factor, as viewed from Earth, does its angular size change from smallest to largest?

The easy way to do this problem is to see the two values for Venus' angular size as seen from earth and take their ratio (5.8). Otherwise, you can look at two triangles formed by the distance from Earth to each of Venus' edges and its diameter at both conjunction and disjunction and compare the angles. Knowing Venus' distance from Earth and the Sun is crucial here.

Other Questions

Review

Concept Review: Energy of a Photon Review the difference between intensity and energy of a photon, referencing lecture example of baseballs.

Concept Review: Transmission spectra and Absorption spectra Note that Transmission spectra and Absorption spectra are complementary; that is, the two "added together" give a continuous spectra. One comes from the material absorbing the "right" photons, and one comes from emitting the "right" photons.