Astro 121, Fall 2005
Important topics for midterm exam

This list is not necessarily complete, but it is my attempt to list the most important things we've discussed. Feel free to ask me about anything not listed here.

- Coordinate systems, angular distance, equinox, epoch.
- Time: local sidereal time, universal time, equation of time.
- Astronomical nomenclature.
- Error analysis; propagation of errors, basic probabilities; Poisson and Gaussian statistics; χ^2; reduced χ^2;
- Telescope designs, aberrations, focal plane scale (a.k.a. plate scale), focal ratio, telescope "speed" (fast vs. slow designs), Nyquist or critical sampling, spatial resolution, diffraction limit.
- CCDs: characteristics, basic functionality, major noise sources, calibration observations, basic data reduction, how to calculate noise (and signal-to-noise) in a CCD observation.
- Photometry: observational techniques, data reduction, instrumental magnitudes, photometric systems, extinction correction, use of IRAF for photometry.

Here are some practice problems. These certainly don't cover all of the concepts above, but they will give you practice with *some* of the concepts.

1. Suppose you take a CCD image (1° x 1°) of the north galactic pole. You then divide the image into ten equal subareas and count the number of galaxies in each, as listed below.

Area 1	10
Area 2	5
Area 3	9
Area 4	12
Area 5	9
Area 6	12
Area 7	22
Area 8	11
Area 9	7
Area 10	8

a) Suppose that you make the hypothesis that the parent distribution of galaxies on the sky is random with a mean surface density of 100 galaxies per square degree. Write a precise analytic expression for the probability distribution describing the number of galaxies in a subarea.

b) Based on the above data, what would you conclude about the spatial distribution of galaxies in the Universe? Explain your reasoning and be quantitative in your analysis.

2. At what time of year do local sidereal time and local solar time agree with each other?

3. Explain how you could measure local sidereal time at a given location, equipped only with a catalog of stars' equatorial coordinates.

4. Star A has a right ascension of 4^h; star B has a right ascension of 2^h; both have a declination of 40°. Which star will rise earlier? Which star is farther to the east in the sky when both are up? What is the angular separation between the stars?

5. It is routine to observe stars that are between airmasses of 1 and 2, and not so unusual to observe stars at slightly greater than 2 airmasses. However, it is rare to observe a star at much more than 3 airmasses. Given that the ratio 3/2 is less than the ratio 2/1, why the reluctance to observe at 3 airmasses? Why might you observe a star at three airmasses (or even more)?

6. What are the tradeoffs involved in building a long-focal-length vs. short-focal-length telescope, for a given primary mirror aperture diameter and a given detector?

7. Two astronomers measure the brightness of a star to be 350 ± 50 photons/sec and 320 ± 20 photons/sec, respectively. What is the likelihood that the star is variable?

8. Imagine an Earth-like planet orbiting a Sun-like star in another solar system. If the equation of time on that planet is always zero, in what way(s) must that solar system be different from our own? For each difference you give, explain why it must be the way it is in order to give zero equation of time.