

Problems for Tutorial Week #2
The Celestial Sphere & Time

Remember to use degrees (not hours) with trigonometric functions. **Do not over-round-off, but do not carry excessive decimal places either.** Express answers in degrees, arcminutes, and arcseconds or hours, minutes and seconds as appropriate. (*Some problems based on Eric Jensen's.*)

Chromey: Chapter 3: 1, 3, 8, 9

1. With [online planetarium](#): Set sliders as follows: date to Sept. 30, 2017, time to 20:00, field of view to 120°. Click and drag in the star field until you are facing “East.” Defaults for other parameters are fine.
 - a) Slowly slide the **date** slider forward in time from September 30 to November 15 (shown in the readout box in the lower right) and describe what happens. Return to September 30.
 - b) Slowly slide the **time** slider forward from 20:00 to 23:00 and describe what happens.
 - c) Compare your answers to a) and b) and explain the comparison.

2. a) An optically observed G dwarf star has galactic coordinates $\ell = 283^\circ$ and $b = -2^\circ$. What can you conclude regarding whether it is located in the disk or halo of the Galaxy?
 - b) Same as (a), but for $\ell = 32^\circ$ and $b = +87^\circ$.
 - c) A radio source has galactic coordinates $\ell = 202^\circ$ and $b = +3^\circ$. What can you conclude regarding its distance from the galactic center compared to the Sun's distance from the galactic center?
 - d) Same as (c), but for $\ell = 15^\circ$ and $b = -2^\circ$.

3. We refer to the units of Right Ascension (RA, or α) as hours, minutes and seconds of *time* to distinguish them from arcminutes and arcseconds.
 - a) Why is RA given in *hours* rather than *degrees*? (It certainly can be given in degrees, and sometimes is, but usually is not.)
 - b) What *kind* of time is RA? That is, is one second of RA a solar second or a sidereal second?
 - c) How is the zero point of RA defined? At what time(s) of year could you observe an object with RA=0 at optical wavelengths?

4. Explain why there is one more sidereal day than solar day in a year.

5. I was once at a meeting at a midwestern university that was also attended by an eminent astronomer, a theorist. At one point this astronomer asked the assembled colleagues why they had never observed the Magellanic Clouds from their on-campus observatory. What answer did they give?

6. a) Derive the relation between a fixed RA interval (e.g., 1^h) and the amount of arc it corresponds to. What are these values at declinations of 0°, 30°, 45°, 60° and 75°?
 - b) The field of view of our 24-inch telescope's CCD is 1200 arcseconds on a side. At the celestial equator, $\delta=0^\circ$, this corresponds to 1^m20^s of RA. Calculate the corresponding RA intervals when we observe at the following declinations: 20°, 40°, 60°, 70°, 80°, and 85°.

7. Assuming you can observe between roughly 7:30 PM and 5:30 AM on November 1, what is the approximate range of RA that will cross the meridian during this time?