

ASTR 311 STELLAR ASTROPHYSICS
Problem Set #1
(due 31 Aug 11)

There will be frequent problem sets assigned this semester. In many cases, the problems will be from LeBlanc. You should get in the habit of writing up complete, legible solutions. You should state the problem, perhaps including a sketch. Then you should briefly but clearly describe how you get from one step to the next. If there is a final, numerical answer, draw a box around it. Whenever appropriate, make sure you provide correct units.

- 1) List the right ascension and declination of the Sun when it is located at the vernal equinox, the summer solstice, the autumnal equinox, and the winter solstice.
- 2) Provide diagrams illustrating your calculations: (a) Calculate the altitude of the Sun when it crosses the meridian on the first day of summer ("the summer solstice") for an observer at a latitude of 33° North. (b) Calculate the maximum altitude of the Sun on the first day of winter (the "winter solstice") at the same latitude? (c) What is the angular separation along the meridian between the summer and winter solstice points? (d) What is the significance of this angular separation? (e) What is the angular separation on the meridian between the summer and winter solstice points for an observer at a latitude of 45° South?
- 3) For an observer anywhere on Earth (other than the poles) there will be 3 parts of the sky: 1) the stars never set below the horizon, 2) stars rise and set each day, 3) stars never rise above the horizon. (a) Derive a formula providing the declination ranges for these 3 parts of the sky for any given latitude, L . (b) At what latitude(s) on Earth will the Sun not set below the horizon on the summer solstice? (c) Is there any latitude on Earth where the Sun will never set when it is at the vernal equinox? If so, where?
- 4) The coordinates of Vega are $\alpha=18^h 37^m$ and $\delta=+39^\circ$. Like everything else, Vega makes a complete circle around the sky as the Earth rotates in about 24 hours. What fraction of the time (it may be up in the daytime, too) is Vega "above" the horizon for each of the following: (a) an observer at a latitude of 60° South; (b) an observer at 38° South; (c) an observer on the equator; (d) an observer at 38° North; (e) an observer at 60° North. [Hint: You should be able to estimate this to within an hour or so, but explain your reasoning. For extra credit, check your answers with a planetarium program or some on-line resource].