AST 250 Spring 2009
EXAM #1

Please write answers on these pages.

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(1) (a) In submillimeter astronomy, we rarely observe objects below an elevation of 20 degrees due to the opacity of the Earth's atmosphere. For a radio telescope atop the 13,700 foot Mauna Kea in Hawaii (latitude = 19^d), what is the southernmost declination that can be observed using this criterion? Prove your answer.

(b) If the local siderial time at the Prime Meridian in Greenwich, England is $12^h\ 30^m$, what is the LST for an observer at a longitude of $+180^d$, on the opposite side of the Earth at that instant?

(c) If the constellation Orion ($\alpha = 5^h$ $\delta = 0^d$) is setting for an observer at the Earth's equator, what is the hour angle of Orion? What is the LST for the observer?

(2) (a) What are the cgs units of monochromatic specific intensity, total flux density, flux, and luminosity ? Hint: cgs units are: energy (erg), length (cm), time (s).

(b) The luminosity of the sun is 3.862×10^{33} erg/s and the radius of the sun is 6.960×10^{10} cm. What is the emergent flux density from the surface of the sun?

(3) (a) A star with twice the luminosity of the sun is twice as far away as another star with half the luminosity of the sun. What is the difference in the stars' apparent magnitudes?

(b) The bright star Betelgeuse in Orion has luminosity that is 100,000 times the luminosity of the sun and a radius that is 1000 times the radius of the sun. What is the effective blackbody temperature of Betelgeuse ? At what wavelength does its blackbody spectrum (B_λ) peak? Based on that information, can you estimate the apparent color to the naked eye? (Hint: the effective blackbody temperature of the sun is ~ 6000 K).

(4) (a) Assume the absorption coefficient, α_ν, is the same for two dark nebula (zero emission) and does not depend on position within the nebula. If one nebula is twice as long as the other nebula, what is the ratio in the optical depth through each nebula? Prove your answer.

(b) If the ratio of observed intensity to initial intensity at a frequency, ν, is $I_\nu/I_{\nu,0} = 0.5$ through one nebula, how large is the ratio of observed intensity to initial intensity through the nebula that is twice as long ?