You may find it helpful to consult a galactic astronomy text, such as Binney & Merrifield's *Galactic Astronomy*, to determine certain stellar values for this problem set.

- 1. A nearby galaxy is observed with both a direct imaging camera and an optical spectrograph over the wavelength range 3500 8500Å.
  - (a) How would you use the broad band images to determine the galaxy type? Describe the particular features and band-passes which would identify each type (elliptical, lenticular, spiral, irregular). Be thorough, and include sketches.
    (8 pts)
  - (b) How would you use the optical spectrum to determine the galaxy type? Describe the particular spectral features and wavelengths which would identify each type (elliptical, lenticular, spiral, irregular). Be thorough, and include sketches. (8 pts)
  - (c) Name one property of the galaxy, which depends upon our viewing angle, which could have a significant effect in your assessment. (2 pts)
  - (d) Describe, in broad terms, how to adapt your analysis technique for a galaxy at a redshift z of 0.8. (5 pts)
- 2. Consider a  $10^{10}$  M<sub> $\odot$ </sub> elliptical galaxy made up entirely of M0 V stars.
  - (a) What would be the observed mass to light ratio, and how many stars would there be? (You may assume values of  $M = 0.60 M_{\odot}$  and  $L = 7.2 \times 10^{-2} L_{\odot}$  for the M0 dwarfs.) (3 pts)
  - (b) How many B0 V stars would you need to add to reduce the mass to light ratio to 2? (You may assume values of  $M = 17.50 M_{\odot}$  and  $L = 5.25 \times 10^4 L_{\odot}$  for the B0 dwarfs.) (3 pts)
- 3. You determine a period of 30 days for a Type I Cepheid variable, with apparent magnitude 18.7.
  - (a) What is the absolute magnitude of this star? (3 pts)
  - (b) How far away is this star? (3 pts)
  - (c) Where is this star probably located? (2 pts)
  - (d) If you had misidentified this star as a Type II Cepheid, by how much would your distance estimate be in error? (5 pts)
- 4. Use LaTeX to formally present your solution to Problem 3. Adopt the conventions and style used in the homework assignments to date, when uncertain. To get you started, I have included a portion of the LaTeX file used to create the solution set to Homework #6 (back of page, also lecture 23, slide 2); you may also wish to examine the sample LaTeX file and output discussed in Lecture #1. The following UNIX environment commands will enable you to process, view, and print out a LaTeX file named prob4.tex. (20 pts)

latex prob4 dvips -o prob4.ps prob4 ghostview prob4.ps lp -ddown prob4.ps

<pre>\left(\frac{r_m}{R_{em}} \right)^2 \frac{fac{A_m}{2}} .ight] \\ &amp; = &amp; \left(\frac{r_e}{2}_{es}) \right)^2 L_{(\odot)} 1.25 \times 10^{-4} + 7.16 \times 10^{-7} \right] \\ \end{array}\end{center} where the first term in brackets is due to the change in position of the Earth, and the second term is due to the radiation reflected and emitted the Moon. We take the ratio of these two terms and observe that \begin(displaymath) \frac{lopla E_{(pos)} (Earth)}{\tend{desth}} {Delta E_{ref} (Earth)} = \frac{lopla E_{(pos)} (Earth)}{\tend{displaymath}} so the effect of the movement of the Earth around the center of mass of the Earth-Moon system is {\bf much} larger than the effect of the reflection light from the full Moon. \end{document}</pre>	<pre>Earth lies between the center of mass of the Earth-Moon system and the Sun. The figure below illustrates the full Moon phase. % Negin(figure)[h] Negetin(figure)[h] Negfig(file=sample_fig.eps, height=1.50in, clip=) Negfig(file=sample_fig.eps, height=1.50in, clip=] Negfig(file=sample_fig.eps, height=1.50in, clip=] Negfig(file=sample_fig.eps,</pre>
<pre>We use a Taylor series expansion to re-express the first two terms, that \begin{displaymath} \left(1 + \delta \right)^{-2} = 1 - 2 \delta - \ldots, \mbc \end{displaymath} As \$S_e \ll R_{se}\$, \begin{center}\begin{array}{lcl} \begin{center}\begin{array}{lcl} \begin{center}\begin{array}{lcl} \begin{center}\frac{r_e}{2} R_{se}} \right)^2 L_{ \left(1 + \frac{s_e}{r_e}} r_{se}} \right)^{-2} \times</pre>	at a full Moon compared to a new Moon (neglecting eclipses). Which effect is larger, the change in position of the Earth or the radiation reflected and emutted from the Moon? (10-pts)) (end(enumerate) % 1,2, Consider the illumination of the Earth. We will be comparing the effect of two factors: (1) the amount of sunlight reflected off of the Moon onto the Earth, and (2) the change in the direct amount of sunlight due to the Earth's rotation about the center of mass of the Earth-Moon system. During the (\it new) Moon, the Moon reflects no light onto the Earth, and the Earth full) Moon, the Moon reflects a maximum amount of light onto the Earth, and the
<pre>that the 24 hour Deriod of rotation of the Earth is much less than orbital period of rotation of the Earth is much less than incident on the Earth between the new and the full Moon phases. \begin{center}\begin{array}{lclcll} \Delta F (Earth between the new and the full Moon phases. \Delta F (Earth &amp; Carth between the new and the full Moon phases. \Left(1 - \frac{S_e}{F_c}R_{c}) \right)^{-2} L_(' \left(1 - \frac{S_e}{R_c}R_{c}) \right)^{-2} + \left(1 + \frac{S_e}{R_c}R_{c}) \right)^{-2} \times \left(1 + \frac{S_m}{R_c}R_{c}) \right)^{-2} \times \left(1 + \frac{T_m}{R_c}R_{c}) \right)^{-2} \times \times \times \time</pre>	<pre>Vbegin(center) Vbegin(center) Vrenewcomman(fboxsep{8pt}) Vframebox((textbf(Astronomy 505: Homework \$^{\\#}6\$ (Planets)}) Vend(center) Vend(center) Vskip 0.15truein Vskip 0.15truein Vbegin(enumerate} % 1,2,3, Vsetcounter(enumi){3} Vitem {\bframebox} Vitem V</pre>
At the full Moon, the Earth lies between the center of mass of the system and the Sun, and the Moon reflects light back onto the Earth calculate the flux accordingly. Nbegin(displaymath) F_(FM) (Earth) = \frac(L_{\odot})}{4 \pi (R_{se} - S_e)^2  \pi \frac(L_{\odot})}{4 \pi (R_{se} + S_m)^2  \pi \frac(L_{\odot}) \{4 \pi R_{(em}^2 + S_m)^2  \pi \frac(L_{\odot}) \\frac(L_{\odot}) \\	\documentclass[notitlepage]{article}    % no title page      \usepackage(graphicx)    % no page numbers      \pagestyle(empty)    % no page numbers      \textwidth    9.50in    % normal width of text on page      \textwidth    -0.35in    % normal height of text on page      \textwidth    -0.35in    % RHP edge to left margin, minus one in      \textwident    0.00in    % edge to top margin, minus one in      \usepackage(epsfig)    \usepackage(epsfig)