Project 3

Please type your responses into a word document, and submit that on UNM Learn. Be sure to number your responses 1, 2(a), etc. so I know which question you're answering, and **show your work** for all questions.

This project consists of four questions. Be careful not to give away answers in the forums, but feel free to ask questions about concepts.

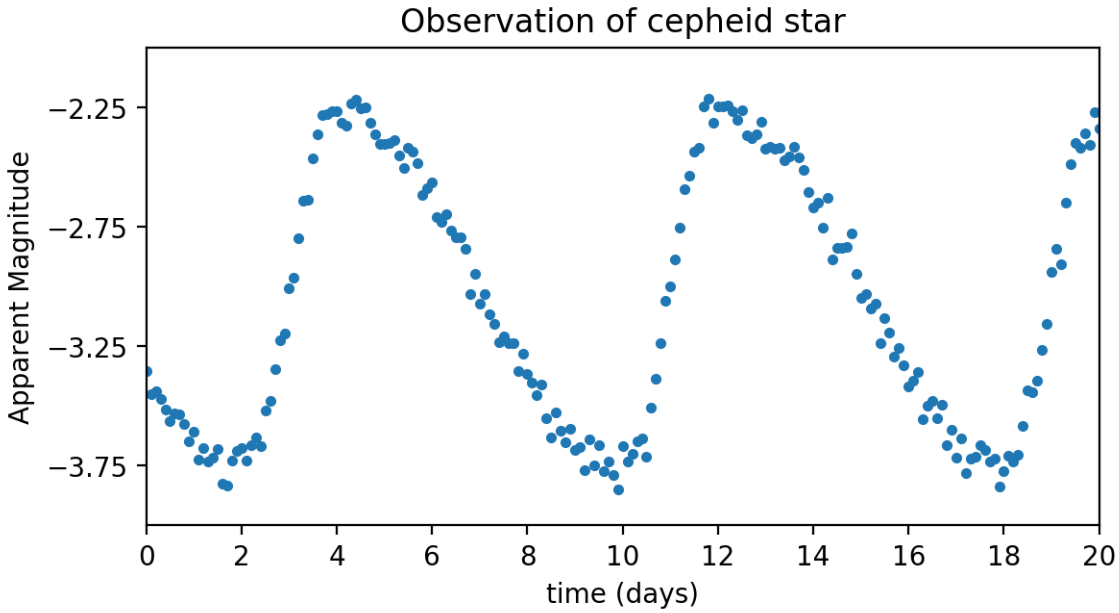

Figure 1: Apparent magnitude of a cepheid star.

1. *(50 points) You observe a star you identify to be a cepheid to have the light curve shown in Figure 1.*

   (a) *(10 points) List the period in days and the average, maximum, and minimum apparent magnitudes. Double-check these, since your work in the next questions will depend on them!*

   (b) *(15 points) By what factor does the brightness change from minimum to maximum brightness? Show your work.*

   (c) *(5 points) Suppose the period-luminosity relation is given by*

   $$M_v = A\,(\log(P) - 1) - B,$$

   where M_v is the absolute magnitude, P is the period in days, and the constants are given by $A = -2.43$ and $B = -4.05$. Using the period you found from analyzing the graph, what is the absolute magnitude of this cepheid star? (Pay attention to significant figures).

   (d) *(20 points) Using the distance modulus equation and the value you found for the average apparent magnitude, find the distance to the cepheid, in AU; show all work and remember significant figures.*

2. *(25 points) Sort all of the methods we've covered for finding distances to celestial objects by the maximum distances they can measure by looking at Tables 19.1 and 26.2. Include a very short description of each (no more than one sentence).*

3. *(40 points) Two binary stars orbit each other such that to an Earthly observer, their orbit is on the same line (they are right in front of each other). Someone has measured the intensity for a wavelength present in the first star, in Figure 2.*

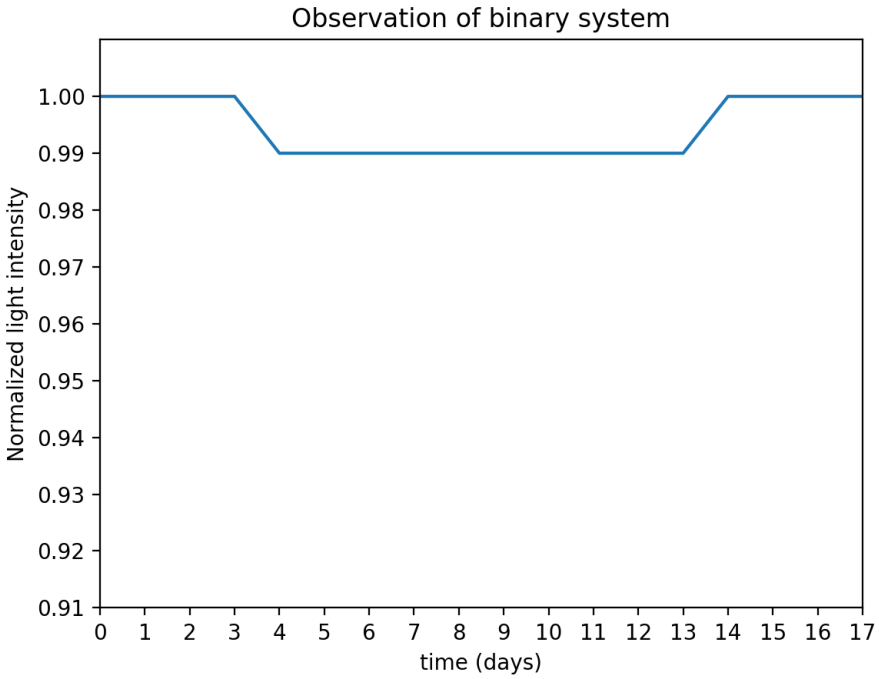

Figure 2: Magnitude of light from a binary star system.

(a) *(5 points) Which star is bigger—the one being eclipsed, or the one eclipsing, or are they the same size? How can you tell?*

(b) *(15 points) Which star is faster? Assuming that the larger star is massive enough that we can approximate it as not moving, what's the faster star's velocity?*

(c) *(10 points) What is the relative radius of the smaller star compared to the larger star?*

(d) *(10 points) What is the relative volume of the smaller star compared to the larger star?*

(e) *(15 points, extra credit) The plot is for a single wavelength emitted by the eclipsed star. Show that the eclipsing star doesn't emit at this wavelength using your previous results.*