1. Consider the η Cas binary star system in Cassiopeia, which is a nice target for observing with the SFSU telescopes. The brighter component of the binary (η Cas A) has a spectral type of G0V and has an apparent magnitude of $m_V = 3.45$. Its companion (η Cas B) is a K7V star of magnitude $m_V = 7.51$. The system is at a distance of 19.4 ly, and the mean separation of the stars is 71 AU.

(i) Which of these stars is most similar to the Sun? (Look up the spectral type of the Sun if you need to, and state it here.)

(ii) By what factor is the V-band flux of η Cas A greater than the V-band flux of η Cas B?

(iii) What is the angular separation between η Cas A and η Cas B as seen from Earth?

2. Consider the binary star system Albireo, also known as β Cyg, and sometimes called “the eye of the swan” for its location in the constellation Cygnus. Its brighter component is a K3III star of magnitude $m_V = 3.2$. Its fainter component is about 11 times fainter than β Cyg A and is of spectral type B0V. The two stars are about 390 ly away and are separated on the sky by 35″.

(i) What is the V magnitude of β Cyg B?

(ii) What is the (minimum) physical separation between the two components of β Cyg?

(iii) To the unaided eye, β Cyg looks like a single star. By what factor is the combined flux of the two stars greater than the flux of β Cyg A alone? Using this result, compute the combined V magnitude of the β Cyg binary system.
3. With Hubble Space Telescope it is possible to observe stars with V ("visual band") magnitudes of 27 in a matter of minutes. The star Vega has an apparent V magnitude of 0.0. How does the flux from a $m_V = 27$ star compare to the flux from Vega?

4. Jupiter and Venus are both visible in the night sky this fall. Right now, Jupiter is rising at about 10am, while Venus rises about 3 hours before dawn. Jupiter’s magnitude is currently $-2.5$. It will be even brighter at the end of the month. Venus’ magnitude is currently $-4.1$.

(i) Which planet appears brighter?

(ii) By what factor is the brighter planet’s flux greater than that of the fainter planet?

(iii) By what factor is each planet’s flux greater or less than that of Vega, which has $m_V = 0.0$?

5. Short essay (< 1 page, typed): Describe in detail what factors you can think of that would contribute to how bright a planet appears from Earth. What makes a planet shine? Would you expect a planet to always appear the same brightness from Earth? Why or why not. Give as much detail as you can.