Ay 10 - Problem Set #6
Due: October 18, 11am

Please write your full name, section number, and GSI's name at the top of your homework. Also, be sure to put your homework in the correct box in the basement of Campbell Hall. There is a 20% penalty per day for the late submission of assignments, however you do get one "freebie" (see course syllabus for more info).

Remember to always show your work; no credit will be given for just a final answer. However, if you get most of the question right but get the final answer wrong, you will get most of the points. Use a calculator where necessary and dont forget units if the answer requires them.

If you use any resource besides the textbook, lecture, or section (*e.g.* a web site), be sure to include proper attribution for the reference. Feel free to work with other students in the class, but remember that all work turned in must be your own (*i.e.* don't just copy the work of another student).

1. **(5 points)** Assume that a distant solar system has a star like our Sun (same size and mass) and a planet that has the the orbit, mass, and size of Jupiter. Assume that from Earth we see this solar system edge-on.
   (a) Given the ratio of the Sun's radius and Jupiter's radius, by how much (in percentage) will the star's light be dimmed when the planet is transiting in front of the star?
   (b) Does the percentage of dimming depend on the distance from Earth to this other solar system? Explain. (A diagram might be helpful.)

2. **(8 points)** Compare and contrast the three major techniques of exoplanet discovery: astrometric, Doppler, and transit. (Cite any sources you use other than the textbook.) On parts b, c, d, and e, you just need to name the technique.
   (a) What is the astrometric technique? What is the Doppler technique? What is the transit technique? (In other words, state how each technique works.)
   (b) Which technique(s) can work well even with small telescopes?
   (c) Which technique(s) are most sensitive to finding solar systems that appear face on to Earth?
   (d) Which technique(s) are more sensitive to edge on solar systems?
   (e) Name and describe at least one alternative techniques besides these three.

3. **(5 points)** Suppose a new star cluster is born with 1 O-type star, 10 A stars, 100 G stars, and 1000 M stars.

(a) Which stellar type dominates the light output (ie. total luminosity) of the cluster?

(b) What would the color of this star cluster appear to be if you observed it from a distance so large that you could not make out the individual stars?

4. **(12 points)** In the bottom left corner of the picture on the next page are three prominent stars of roughly equal brightness. The colors of the stars are red, yellow, and blue. The red star has a peak wavelength of 900 nanometers. The yellow star has a peak wavelength of 500 nanometers. The blue star has a peak wavelength of 290 nanometers. Assume that all three stars are main sequence stars.

   (a) What are the surface temperatures of the three stars?

   (b) Look at the H-R diagrams on pages 453 and 457 of your textbook. Based on the graph, give the approximate luminosity of each of the three stars in terms of solar luminosity (i.e. solar units).

   (c) Recall that the stars are of approximately equal brightness. Rank the three stars in order of increasing distance from us. (You do not need to give the numerical distances, just rank the distances.)

   (d) Look at the diagrams on page 461. Using the luminosities you estimated in part (b), rank the masses of the three stars from least massive to most massive.

   (e) Using page 461 and part (d), rank the radii of the three stars from smallest to largest.

5. **(5 points)** You determine the distance to a star as 43 parsecs using the Inverse Square Law and the fact that the star has been classified as a type F star. You later discover that the star has been misclassified and is actually a type G star. Is the actual distance to the star greater than or less than 43 parsecs? Why?