ASTR 300 Stars and Stellar Systems Fall 2009

Homework Set No. 3 **Solutions**

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1. For which stars does absolute visual magnitude differ least from absolute bolometric magnitude? Why? (Chapt. 9, Review Question 5)

   For stars with spectral types or surface temperatures similar to the sun.

2. The parallax of the bright star Sirius is 0.375 seconds of arc. By how much, during the year, does the position of Sirius shift relative to distant background stars? If an astronomer were observing from the surface of Mars, by how much would Sirius shift during the Martain year?

   A parallax of 0.375 means that when the observer moves 1 AU, the star shifts 0.375 arcsec. Since the *diameter* of the Earth's orbit is 2 AU, the shift seen during the year will be $2 \times 0.375 = 0.75$ arcsec.

   The radius of Mars' orbit is 1.5237 AU (p 440) so the diameter of its orbit is 3.0474 AU. Thus the astronomer on Mars sees a shift of $3.0474 \times 0.375 = 1.14$ arcsec.

3. A binary star system contains one star of mass 0.8 $M_\odot$ and another of mass 2.2 $M_\odot$. They are in circular orbits and the distance between the centers of the stars is 1.5 AU.

   (a) What is the period P of the binary?
   Kepler's third law is $(M_1+M_2)P^2 = a^3$. In this case $M_1+M_2 = 2.2+0.8 = 3$ and $a = 1.5$, so $P^2 = (1.5^3)/3 = 1.125$. Thus the period is $P = \sqrt{1.125} = 1.06066$ years.

   (b) Find the location of the center of mass (i.e., how far is it from the center of the more massive star?).

   (c) Compare the gravitational force of the two stars on a small mass m located at the center of mass. Are the forces equal?

4. A double-lined spectroscopic binary has a period of 30 days and the velocities of the two stars are 70 km/s and 200 km/s.

   (a) What is the ratio of the masses of the stars?

   (b) Assume we are in the plane of the orbit. What is the total separation of the stars? What is the total mass and the individual masses of the stars?

   (c) If instead, the orbit is inclined at an angle of 45 degrees, what are the true velocities of the stars? In this case, what is their separation? What is the total mass and the individual masses?

5. Problem 14, chapter 9 of the text.