Dr. Lankar INTRODUCTION TO ASTRONOMY

ASSIGNMENT T NAME ___________________________

1)

When 2 stars orbit their center of mass we know : M1/M2 = V2/V1
(also called conservation of momentum. It tells you that if one star is twice as massive than the others, it will go half as fast).
and we also know the newton's version of Kepler's law third law (connecting the orbital period p, the average distance a between the 2 stars and the sum of their mass M1+ M2 : **equation A=**

$$(M_1 + M_2) = \frac{4\Pi}{G} \times \frac{a^3}{p^2}$$

How can we measure the masses of stars in binary system ?
Suppose we can compute the speed of 1 star (relative to the other) using the Doppler effect as well as its period.
Then we can compute its distance relative to its companion. a (relative to the other star) this way:
Suppose the orbit is circular and the distance between the stars is a. The distance the star covers during an orbital period is = circumference = 2 π a

So its speed is v1=2 π a /p (speed = distance/time) or **a= p v1 / 2 π** **equation B**

So we have a and p. Using Kepler's law we can find M1+M2 then using **M2/M1 = v1/v2 equation C**
we can find the individual mass. The ratio between the speed of the stars is known thanks to the Doppler effect.

Your turn:
The spectral lines of 2 stars in an eclipsing binary system shift back and forth with a period of 2 years.
(or p = $6.3\ 10^7$ seconds). The lines of 1 star shift twice as far as the lines of the other star (V1/V2=2)
The amount of doppler shift indicates an orbital speed of 100,000 m/s (V1) for star 1 relative to star 2.
What are the masses of the 2 stars M1 + M2 ? Assume that each of the 2 stars traces a circular orbit around their center of mass.

Hint:
first find the relative distance a using equation B. units are in meters

then plug a in equaton A to find M1 + M2

Then use equation C (the ratio is 2).

2 Alpha centauri A lies at a distance of 4.4 light-years and has an apparent brightness in our sky of 2.7 10^{-8} Watt/m^2 . Recall that 1 light year = 9.5 10^{15} m.
A) use the inverse square law ($B = L / 4pi\ d^2$) to calculate the luminosity of Alpha Centauri.

B) Suppose you have a light bulb that emits 100 wattof visible light. How far away would you have to put the light bulb away for it to have the same brightness as Alpha Centauri in our sky ?
Hint: Use 100 Watts as L in the inverse square law for ligh, and use the apparent brightness given above for Alpha Centauri. Then solve for the distance.

3) sky google Mira.
Constellation ? Kind of star ? Distance? Etc.....