

Homework 7

Astro 1

Due Friday, November 22 by 4:30 pm

1. (U11.20.17) The Ring Nebula is a planetary nebula in the constellation Lyra. It has an angular size of $1.4 \text{ arcmin} \times 1.0 \text{ arcmin}$ and is expanding at the rate of about 20 km/s. Approximately how long ago did the central star shed its outer layers? Assume that the nebula is 2700 ly from Earth.
2. (U11.20.26) A white dwarf has a greater mass than either a red dwarf or a brown dwarf. Yet a white dwarf has a smaller radius than either a red dwarf or a brown dwarf. Explain why, in terms of the types of pressure that keep the different kinds of dwarfs from collapsing under their own gravity.
3. (U11.20.41) The supergiant star depicted in Figure 20-13 is actually one member of a binary star system. The masses of the two stars are $18 M_{\odot}$ and $34 M_{\odot}$, and the orbital period is 19.56 days. **(a)** What is the average separation between the two stars? Give your answer in au. **(b)** Compare your answer in part (a) to the sizes of the orbits of Mercury, Venus, and Earth around the Sun.
4. (U11.20.62) Suppose that the red supergiant star Betelgeuse, which lies some 425 ly from Earth, becomes a Type II supernova. **(a)** At the height of the outburst, how bright would it appear in the sky? Give your answer as a fraction of brightness of the Sun (b_{\odot}). **(b)** How would it compare with the brightness of Venus (about $10^{-9} b_{\odot}$)?