

OpenStax Astronomy, Ch.18: WS Problems (Apr-2021)

Review Questions

1. How does the mass of the Sun compare with that of other stars in our local neighborhood?
2. Name and describe the three types of binary systems.
3. Describe two ways of determining the diameter of a star.
4. What are the largest- and smallest-known values of the mass, luminosity, surface temperature, and diameter of stars (roughly)?
5. Sketch an H-R diagram. Label the axes. Show where cool supergiants, white dwarfs, the Sun, and main-sequence stars are found.
6. Describe what a typical star in the Galaxy would be like compared to the Sun.
7. How do we distinguish stars from brown dwarfs? How do we distinguish brown dwarfs from planets?
8. Describe how the mass, luminosity, surface temperature, and radius of main-sequence stars change in value going from the “bottom” to the “top” of the main sequence.
9. Why do most known visual binaries have relatively long periods and most spectroscopic binaries have relatively short periods?
10. Review this spectral data for five stars.

Star	Spectrum
1	G, main sequence
2	K, giant
3	K, main sequence
4	O, main sequence
5	M, main sequence

Which is the hottest? Coolest? Most luminous? Least luminous? In each case, give your reasoning.

11. Which changes by the largest factor along the main sequence from spectral types O to M—mass or luminosity?
12. Suppose you want to search for brown dwarfs using a space telescope. Will you design your telescope to detect light in the ultraviolet or the infrared part of the spectrum? Why?
13. An astronomer discovers a type-M star with a large luminosity. How is this possible? What kind of star is it?
14. Approximately 6000 stars are bright enough to be seen without a telescope. Are any of these white dwarfs? Use the information given in this chapter to explain your reasoning.
15. If you were to compare three stars with the same surface temperature, with one star being a giant, another a supergiant, and the third a main-sequence star, how would their radii compare to one another?

16. It is possible that stars as much as 200 times the Sun's mass or more exist. What is the luminosity of such a star based upon the mass-luminosity relation?

17. The lowest mass for a true star is $1/12$ the mass of the Sun. What is the luminosity of such a star based upon the mass-luminosity relationship?

18. How much would you weigh if you were suddenly transported to the white dwarf Sirius B? You may use your own weight (or if don't want to own up to what it is, assume you weigh 70 kg or 150 lb). In this case, assume that the companion to Sirius has a mass equal to that of the Sun and a radius equal to that of Earth. Remember Newton's law of gravity: $F = GM_1M_2/R^2$ and that your weight is proportional to the force that you feel. What kind of star should you travel to if you want to *lose* weight (and not gain it)?

19. The star Betelgeuse has a temperature of 3400 K and a luminosity of $13,200 L_{\text{Sun}}$. Calculate the radius of Betelgeuse relative to the Sun.

20. Confirm that the angular diameter of the Sun of $1/2^\circ$ corresponds to a linear diameter of 1.39 million km. Use the average distance of the Sun and Earth to derive the answer. (Hint: This can be solved using a trigonometric function.)