

ASTR1050
Fall 2025

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Due Date: 24 October, 11:59 PM

1. A stove burner is heated from room temperature (300 K) to operational temperature (800 K). Find the peak wavelength of thermal emission for both cases. How can we see the burner glow when it is hot if its peak wavelength is not in the visible (300–700 nm)?
2. Star ζ Ophiuchi has a radius of 8.5 times that of the Sun and temperature 32,000 K. Find its luminosity, in solar luminosity units (L_{\odot}). The Sun has radius $R_{\odot} = 6.957 \times 10^8$ m and luminosity $L_{\odot} = 3.828 \times 10^{26}$ W.
3. The star Sirius is actually a binary star system where the brighter (primary) star, Sirius A, has apparent magnitude -1.5, and the dimmer (secondary) star, Sirius B, is 10,000 times less bright than Sirius A. What is the apparent magnitude of Sirius B?
4. Alpha Centauri, the second nearest star, is similar to our Sun and has an apparent magnitude of 0 from Earth. Estimate the distance in AU to Alpha Centauri. The Sun is 1 AU from Earth and has apparent magnitude -26.7 mag. Hint: assume the Sun and Alpha Centauri have the same luminosity.
5. The spectrum of the Sun has hundreds of strong lines from nonionized iron but only a few, very weak lines from helium. A B-type star has very strong hydrogen lines but very weak iron lines. Do these differences mean that the Sun has more iron and less helium than the B-type star? Explain.
6. The star Betelgeuse has temperature 3400 K and a luminosity of 13,200 L_{\odot} . Calculate the radius of Betelgeuse, relative to the Sun.
7. Sirius A is 91 times larger than its companion Sirius B. If Sirius A has temperature 10,000 K and luminosity 23 L_{\odot} , find
 - (a) The radius of Sirius A, in R_{\odot} .
 - (b) The radius of Sirius B, in R_{\odot} .
8. The Sun has absolute magnitude of $M = +4.83$. Find the apparent magnitude of the Sun from our nearest stellar neighbor Proxima Centauri, at a distance of 1.30 parsecs away.
9. If a planetary nebula is 2.6 light years in diameter, and the ejecta is moving at a constant speed of 40 km s⁻¹, how long ago, in years, the progenitor star undergo a supernova?

10. Our star will eventually evolve into a red supergiant. If Betelgeuse, another red supergiant star, has radius $\sim 5 \times 10^{11}$ m, which planets can we expect to survive this phase? Remember, there are 1.5×10^{11} m in 1 AU. Use the following table of orbital parameters.

Table 1. Planetary data.

| Planet | Semimajor axis (AU) |
|---------|---------------------|
| Mercury | 0.39 |
| Venus | 0.72 |
| Earth | 1.00 |
| Mars | 1.52 |
| Jupiter | 5.20 |
| Saturn | 9.54 |
| Uranus | 19.2 |
| Neptune | 30.1 |
| Pluto | 39.5 |