

Please type up or print out your homework and staple the pages together. Leave a blank space to write in mathematical equations or diagrams. Make sure you **show your work** for any calculations – “magical” answers will receive no credit. Problems are **due at the beginning of the lecture**.

Review questions, Problems, etc. which have a chapter and number noted are from your text *Stars and Galaxies, 6th edition*.

1. How do the spectra of HII regions differ from the spectra of reflection nebulae? Why? (Chapter 10, Review Question 3)
2. Why do distant stars look redder than their spectral types suggest? (Chapter 10, Review Question 6)
3. Why can the 21-cm radio emission line of neutral hydrogen be observed in the interstellar medium but not in the laboratory? (Chapter 10, Review Question 9)
4. The dust in a molecular cloud has a temperature of about 50 K. At what wavelength does it emit the maximum energy? (Hint: Consider black body radiation, Chapter 7.) (Chapter 10, Problem 2)
5. The density of air in a child’s balloon 20 cm in diameter is roughly the same as the density of air at sea level, 10^{19} particles/cm³. To how large a diameter would you have to expand the balloon to make the gas inside the same density as the interstellar medium, about 1 particle/cm³? Give your answer in km. (Hint: The volume of a sphere is $\frac{4}{3}\pi R^3$.) (Chapter 10, Problem 5)
6. What factors resist the contraction of a cloud of interstellar matter? (Chapter 11, Review Question 1)
7. What evidence is there that (a) star formation has occurred recently? (b) Protostars really exist? (c) The Orion region is actively forming stars? (Chapter 11, Review Question 3)
8. How does the energy of a 0.35 solar mass star reach the surface? What fraction of this star’s hydrogen fuel is available during the star’s lifetime? Why?
9. If a protostellar disk is 200 AU in radius, and the disk plus the forming star contain 2 solar masses, what is the orbital velocity at the outer edge of the disk in kilometers per second? (Chapter 11, Problem 4)
10. The CNO cycle is very sensitive to temperature; the temperature dependence of the CNO energy generation rate is approximately T^{16} for the relevant temperatures (~ 20 million K). By what factor would the energy generation increase if the temperature were to increase from 20 million to 25 million K?