ASTR 300 Stars and Stellar Systems Spring 2011

Homework Set No. 4 Due March 29, 2011

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, 7th edition*.

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1. Why don't astronomers know the inclination of a spectroscopic binary ? How do they know the inclination of an eclipsing binary ? (Chapter 9, p 190, Review Question 11)

2. If you look only at the brightest stars in the night sky, what kind of stars are you likely to be observing ? Why ? (Chapter 9, Review Question 15)

3. Why are interstellar lines so narrow ? Why do some spectral lines forbidden in spectra on Earth appear in spectra of interstellar clouds and nebulae ? What does that tell you ? (Chapter 10, p 208, Review Question 6)

4. How can the HI clouds and the intercloud medium have similar pressures when their temperatures are so different ? (Chapter 10, Review Question 8)

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/cm^3. 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/cm^3? Give your answer in km. (Hint: The volume of a sphere is $\frac{4}{3}\pi R^3$.) (Chapter 10, Problem 5)

6. If a giant molecular cloud has a diameter of 30 pc and drifts relative to neighboring clouds at 20 km/s, how long will it take to travel its own diameter ? (Chapter 10, Problem 6)

7. How does the geometry of bipolar flows and Herbig-Haro objects support the hypothesis that protostars are surrounded by rotating disks ? (Chapter 11, p 230, Review Question 5)

8. If a giant molecular cloud has a mass of 10^{35} kg and it converts 1 percent of its mass into stars during a single encounter with a shock wave, how many stars can it make ? Assume the stars each contain 1 solar mass. (Chapter 11, Problem 3)

9. The gas in a bipolar flow can travel as fast as 100 km/s. If the length of the jet is 1 ly, how long does it take for a blob of gas to travel from the protostar to the end of the jet ? (Chapter 11, Problem 6)

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 ($\sim$20 million K). By what factor would the energy generation increase if the temperature were to increase from 20 million to 21 million K?