

Study Guide

Midterm 1

AST 308, Fall 2007

The test will cover [CO 24.1, 24.2, 24.3 and all of chapter 25], as well as the parts of [BS] you have been assigned to read, and other material I presented in the lectures (most notably: star-forming regions, the Orion Nebula, and the analysis of emission lines from HII regions). The class notes are all on the course web site (www.pa.msu.edu/courses/ast308). Review them carefully.

There will be 1 or 2 straight-forward derivations or back-of-the-envelope calculations, along the lines of the ones you have done as homework or have seen in [CO].

Anywhere you write down an equation, you can invent your own notation if you don't remember what I used. But **NO MATTER WHOSE NOTATION YOU USE**, briefly describe in words the physical meaning of each constant, variable and term. I want you to show me that you understand what the equation is actually describing.

The other questions will be 1-2 paragraph short essays. For example, "What is the evidence for the existence of dark matter in our own Galaxy?" A bulleted outline and maybe a little sketch would be a fine way to answer, but you need to say enough to demonstrate that you know what the evidence is in some physical terms... a list of buzz words will not be adequate. And I *HAVE* to be able to actually read it!

In the lectures I often have briefly mentioned lots of little details about galactic astronomy. *Examples: curve of growth, forbidden emission lines, details of various coordinate systems, how the extinction curve is used mathematically, etc.* I don't expect you to necessarily remember every single thing, especially if I spent almost no time on it, never used it later for anything and it is not described in [CO] either ... I throw these things in because they are part of how astronomy is actually done and I think it is better for you to have at least heard of them. But the short essay questions are places where you can use such facts to help make your case, and I certainly will give you credit for knowing them.

1. *Your best bet: know everything about everything.*

2. *Failing that, know a lot about the following:*

- Overview of Cosmology: What is the general sequence of events in the the evolution of the universe? What underlying effect drives this progression of events? What is the "scale factor"? What are the relative fractions of normal matter, dark matter and dark energy? I will NOT ask you about the Friedmann equation (this time).

THE TYPES OF GALAXIES

- I might ask you to assign a Hubble class to a galaxy or two, and to tell me the reasons you assigned that classification.

CHEMICAL EVOLUTION

- How do we measure chemical abundances in HII regions?
- Be able to sketch out the equations for HII regions describing ionization balance, size of a Stromgren sphere, and how to determine the mass of line-emitting gas, both in words and in equation form that indicates how the density of the different interacting particles comes into play.
- What physical effects in HII regions let us measure the density and temperature?
- Describe molecular clouds. What are they made of? Where do they form? Why are they important?
- What is the Orion Nebula? Describe its immediate neighborhood, its structure, what powers it, how it is evolving, and what sorts of objects we find within it.

- What sorts of objects produce: H, He, CNO, Fe, elements heavier than Fe?
- What are Populations I and II? Where do we find them?
- Define in equations and words: equivalent width, column density, surface brightness, emission measure. What do these have to do with measuring the results of chemical evolution (in general... I do not expect you to know many details)?

GALAXY STRUCTURE & MASS

- I will expect you to have read the assigned parts of [BS] and have a general overview of what they are talking about, but not to know the equations or other details except as noted below. There may be a specific [BS] question on the test, as opposed to the generalized BS that the other questions are sure to generate.
- What is the general effect of dust on our view of our own Galaxy? At what wavelengths does dust have a big effect, and at what wavelengths does it have a small effect? What *is* dust?
- What are the mathematical forms of the 3D distribution of stars in galaxy disks and halos, and of the projected surface brightness of E galaxies and bulges?
- Describe the relative masses, shapes, extents of the different components of the Milky Way.
- What are Oort's Constants? *Aha!* A likely source for a little problem to work.
- Taylor series expansions were used to derive both Oort's constants and the epicycles for density waves. Be able to write these down, explain what the terms mean, and explain why some terms can be set to zero.
- *Aha²!* How about a simple derivation involving rotation curves, relating to masses? Or perhaps a simple application of the virial theorem?
- How do we measure the rotation curve of the Milky Way?
- Describe four ways that are used to measure distances within our Galaxy.
- What is the evidence (that I have described so far) for the existence of dark matter in our own and other spiral galaxies?
- What are the Inner and Outer Lindblad Resonances and the Co-rotation radius? Why are they important in the study of spiral structure?
- What is the evidence in favor of the existence of density waves? Why do we think they can't last forever?
- What is the Tully-Fisher relation? *Aha³!* Do something similar to the semi-derivation of this relation given by [CO]?
- What are the true shapes of E galaxies? How do we know?
- What is the Faber-Jackson Relation?
- What is the fundamental plane?
- Sketch the Schechter Luminosity Function (assuming that we get to it in class). What is an L* galaxy?
- *ALMOST LEFT OUT:* When we say that the rotation velocity of the Local Standard of Rest is 220 km/sec, what is that relative to? How is that velocity measured

PS. I will *not* ask you to describe the psychedelic barred-spiral movie. None of us are ready for that!