The Rules: As before, the full rules are in the day-one lecture notes (posted on the website). But the important stuff is:

- Each student can bring one and a half pages (or three half pages) of hand-written cheat sheet to the exam.
- You won’t need a calculator—in fact, you won’t be allowed a calculator. The same goes for cell phones, iPods/iPhones/iPads, Kindles, Tarot cards, Google Glass, robotic test takers (RTTs), etc.

What’ll Be Covered?: The exam is comprehensive, so anything we’ve covered this semester is fair game. But since you already have reviews for the older material, this one will be just for the new stuff (since exam 2). In terms of chapters, that includes the latter part of Chapter 8 (effects of friction), parts of Chapter 10 (jet streams) and 11 (fronts), most of Chapters 12 (cyclones) and 6 (stability), and the beginning of Chapter 14 (thunderstorms). As always, refer to the website for the specific page ranges and list of topics:

http://atmo.tamu.edu/epifanio/ATMO201

The Exam Breakdown: I haven’t made it yet, so I don’t know for sure. But I’ll aim for something like 60% new material (since the second exam) and 40% old stuff.

Chapter 8: We had a bit of left over material on basic forces and circulations, particularly the stuff on the effects of friction. For example:

- Where in the atmosphere is friction important? And what does friction do to the wind?
- Suppose the figure at right represents the height contours on an upper-level surface (say, the 500 mb surface). What would the PGF, Coriolis force, and wind look like?
- Now suppose the figure shows pressure contours at the ground. What do the forces and wind look like in this case?
- Why do low pressure systems tend to be cloudy, while high pressure brings clear skies? And what does this have to do with friction?

Chapter 10: We covered part of Chapter 10, specifically the part on jet streams. Some of the key ideas include:

Jet streams: Be familiar with the idea of jet streams and why we have them. Things like:

- Towards which direction does a westerly wind blow? A northerly wind?
- This was on the last review, but it’s relevant here also. Take a look at the figures below (next page) and convince yourself they show the same thing, just from different perspectives.
• If the PGF points poleward, toward which direction is the Coriolis force? And the wind?
• On a typical day, how is the jet stream pattern related to the temperature distribution in the lower troposphere (at least roughly)?
• Over what latitude range and at what height (again roughly) is the jet stream strongest?
• Wait, weren’t there two jet streams (i.e., two in each hemisphere)? What’s up with that?

Chapters 11 and 12: I’ll group the fronts and cyclones into one category, since they’re pretty closely related. Key ideas here include:

Basic weather map symbols: I won’t explicitly test you on this, but it’s still good stuff to know. So I’m puttin’ it on the review anyway. For instance, for the figure at right:

- Which direction is the wind, and what’s the wind speed?
- Suppose the air were cooled without changing the amount of vapor. At what temperature would the air become saturated (i.e., what’s the dew point temperature)?
- What’s the cloud cover? And is it raining?

Fronts: Know your types of fronts and some of the key properties of each type. For instance:

- What are the four main types of fronts and how is each defined?
- Sketch a cold front that’s propagating to the east. Which side of the front has cold air?
- Satellite images show that fronts are often associated with precipitation. Why might that be?
- Which is faster: a cold front or a warm front? And broadly speaking, why?
- Which type of front has cold air on both sides? And what happened to the warm air in this case?

Cyclones: Mid-latitude cyclones can be a little bit complicated, but they also account for most of our weather in mid-latitudes. So you can expect them to feature prominently on the exam. Some key ideas include:
In the big picture, what role do mid-latitude cyclones play in the distribution of warm and cold air in the atmosphere? And why do cyclones form in zones of north-south temperature gradient?

Ok, so why are cyclones usually below the jet stream?

Name and draw the five basic stages in the Norwegian Cyclone Model (aka the polar front theory).

In the figure at right, why is the upper-level trough shifted westward from the low pressure at the ground? And what effect does this have on the surface pressure?

When does a cyclone eventually die off?

Step through the stages of cyclone development in the notes a few times (slides 20-28 under Upper-level processes and cyclone amplification), until all the steps make sense. Rinse and repeat.

Chapters 4 and 6: The last of the basic physics concepts in the course was the idea of stability, which is closely related to clouds. Some of the key ideas include:

**Dew point temperature:** We introduced the dew point temperature kind of informally, but that should still be enough to get the basic idea. For example:

- How is the dew point temperature defined? (*Hint:* it’s actually defined earlier in the review sheet.)
- Suppose the properties of the air are as indicated by the ‘x’ in the figure at right. What’s the corresponding dew point temperature? (*Hint:* In the definition of the dew point, what changes and what stays fixed?)

**Rising air and clouds:** We discussed how relative humidity (RH) varies with temperature, and how rising air can lead to clouds. For example:

- Suppose we decrease the temperature, without changing the vapor content of the air. How does this affect the amount of vapor needed for saturation?
- And so how does the RH change?
- It’s a cold winter day in Beulah, ND. (Aren’t they all.) If I bring a cold air mass inside and warm it up, will the RH of the air mass increase or decrease? (And now you know why our houses are dry in the winter.)
- Why does rising air lead to clouds?

**Stability:** Know how lapse rates are defined and how the lapse rates relate to stability classes. For instance:

- What’s the lapse rate (i.e., the rate of temperature decrease) for an ascending dry air mass? A saturated air mass? Why are they different?
- What does stability have to do with rising air?
• Suppose the environmental temperature decreases by 12 °C over 1 km of height. Is the environment stable or unstable?
• Suppose the atmosphere is conditionally unstable. Under what condition is it stable, and what condition unstable?
• What types of clouds form in conditionally unstable environments? In stable environments?

Chapter 14: The overview of stability led to a somewhat truncated discussion of thunderstorms. Some key ideas from as far as we covered:

Thunderstorm classification and structure: Be familiar with the basic structure of thunderstorms and how they’re classified:

• What ingredients are needed to get a thunderstorm going?
• A mature thunderstorm cell has both an updraft and a downdraft. What drives the updraft? And the downdraft?
• What’s a cold pool? A gust front?
• What are the three basic thunderstorm types?
• Which property of the environment has the most influence on determining the storm type?
• What’s a mesoscale convective system (MCS)? And what are the two main categories of MCS?