Introduction to Meteorology
ATMS 103 – Fall 2022
Study Guide for Exam II

The following is not intended to be a comprehensive list of everything that may appear on the second exam, but I have tried to put together some questions that will guide you toward an understanding of the subjects we've covered so far this semester. All of the information from the first exam is fair game for the second exam, particularly the more difficult concepts that are necessary to understand interesting weather processes. It would be a very good idea to look over the homework assignments and previous study guide, read the book, and of course review the class notes. I expect that you will have attended class and/or viewed all of the class lecture videos. **This is a closed-book exam.** You may use a calculator, but do *not* use a cell phone, the Internet (except to access only the exam via Moodle), books, or friends. Do not memorize equations, but do know how to use them. You will receive an equation sheet similar to the one at the end of this study guide. This is now available via Moodle and you may print it beforehand and use it during the exam. The exam will take place via Moodle on **20 October 2022 at 1:20 p.m. during your regular class time**. As always, ask questions and good luck!

1. How does a Doppler radar work and how do you calculate the distance to a reflective object? What is the Doppler effect and how do we use it in meteorology? What is a WSR-88D and where might you see data from its measurements?
2. What is the difference between visible, infrared, and water vapor satellite imagery? What are we seeing in each image?
3. What is a lapse rate? What are the standard, dry adiabatic, moist adiabatic, and environmental lapse rates and how do you use them?
4. What is atmospheric stability and what does it have to do with thunderstorms?
5. Which processes are diabatic and which are adiabatic processes?
6. What causes stable (unstable) air?
7. What are the LCL and LFC?
8. Given an environmental lapse rate (or an observed sounding), how do you tell if the atmosphere is stable, unstable, or conditionally unstable?
9. What happens to an air parcel when it sinks (rises)?
10. What is the ideal gas law? Which variables depend on each other when governed by this law?
11. What is hydrostatic balance?
12. How might latent heating in mid-levels lead to lower pressure at the surface? How might radiational cooling lead to higher pressure at the surface?
13. What is the relationship between jet streaks and midlatitude cyclones (i.e., at the surface)? How does a jet streak affect upper-level vertical motion?
14. Why do pressure systems dissipate?
15. What is an air mass and what are source regions?
16. How are air masses classified?
17. Know the difference between each type of front, how it's drawn on a weather map, and what weather is typically associated with each type of front before, during, and after its passage.
18. Identify a cold front from a meteorogram.
19. What are three types of thunderstorms and what are the typical characteristics of each?
20. How does the NWS define a severe thunderstorm?
21. Define each stage in the life cycle of an ordinary thunderstorm.
22. What are different lifting mechanisms that may initiate thunderstorms?
23. List the necessary atmospheric ingredients for thunderstorms.
24. Define and understand the structure of each of the following: MCC, MCV, MCS, bow echo, squall line, and derecho.
25. What is a gust front, how does it form, and what clouds are associated with it?
26. What is special about a supercell compared with other thunderstorms?
27. How are supercells classified (three types)?
28. What is the horizontal and vertical structure of a supercell?

Some potentially useful equations and constants:

$F = ma$

$\frac{\partial p}{\partial z} = -\rho g$

$\Gamma = -\frac{\Delta T}{\Delta z}$

$p = \rho R_d T$

$p\alpha = R_d T$

$C = 2\Omega v \sin\phi$

$\frac{\partial \rho}{\partial t} = -\vec{\nabla} \cdot \rho\vec{V}$

$KE = \frac{1}{2}mv^2$

$\Phi = g\Delta z$

$^\circ C = \frac{5}{9}\left(^\circ F - 32^\circ\right)$

$K = ^\circ C + 273.15$

$c = f\lambda$

$Z = 300R^{1.4}$

$\theta = T\left(\frac{p_0}{p}\right)^{\kappa}$

$\lambda_{max} = \frac{2897\ \mu mK}{T}$ T in Kelvin

$E = \varepsilon\sigma T^4$

$2d = ct$

$\Gamma_d = 9.8^\circ C/km$

$\Gamma_m \approx 6.0^\circ C/km$

$\sigma = 5.67 \times 10^{-8}\ \frac{W}{m^2\ K^4}$

$c = 2.9979 \times 10^8\ \frac{m}{s}$

$RH = \frac{e}{e_s} \times 100\%$

$c_p = 1005\ \frac{J}{kg\ K}$

$S_o = 1367\ \frac{W}{m^2}$

$^\circ F = \left(\frac{9}{5}{}^\circ C\right) + 32$

$\Omega = 7.292 \times 10^{-5}\ s^{-1}$

$V_1 r_1 = V_2 r_2$