Homework Question Set #3
NATS 101, Section 13
Fall 2010

The following questions cover Lectures 11-14. Provide thorough, complete answers for maximum credit. Three of the following questions will be randomly graded, with equal credit given to each question. Note that the last two questions cover devices or experiments in lecture.

Due Thursday, October 7 by 5pm. Submit completed assignment to D2L as .doc or .pdf file. Scanned copies of handwritten answers are fine, provided the document is neat and clearly legible. For the problems involving calculations, clearly label and provide appropriate accompanying textual description for equations used.

1. Why are atmospheric aerosols necessary for the formation of clouds?

2. Thick fog is very common during winter in the Sacramento in San Joaquin Valleys of central California. What type of fog is this and how does it occur?

3. For each of the clouds that appear on the *Cloudscapes* U.S. postage stamps as shown in class lecture, describe: a) where the cloud fits in terms of the modern cloud classification and b) at least two distinguishing characteristics of the cloud. Which of the clouds on the stamps is associated with the most severe weather and why?

4. Explain how visible and infrared satellite images can be used to distinguish: a) high clouds from low clouds and b) thick clouds from thin clouds.

5. What is an adiabatic process? Why are the moist and dry adiabatic rates of cooling associated with a rising air parcel different?

6. Describe general characteristics of clouds associated with stable and unstable atmospheres? What would the range of environmental lapse rates, or temperature change with change in height as observed from a weather balloon, be for stable and unstable atmospheres? What condition is generally always necessary to make the atmosphere unstable?

7. Why do monsoon thunderstorms in Arizona typically form over the mountains during the afternoon? Why do thunderstorm clouds always have flat bases? Finally, why do the most intense thunderstorms typically have a flat anvil top?

8. If the height of the base of a cumulonimbus cloud is 1000 m above the surface and the dew point temperature on Earth's surface is 20º C, determine the surface air temperature directly beneath the cloud. Explain and show your work.

9. Describe how the process of collision and coalescence produces precipitation. What is the typical timeframe for a cumulonimbus cloud to produce precipitation once this process begins?

10. How does the ice-crystal (Bergeron) process produce precipitation? What is the main premise describing this process?

11. Describe how hail forms. How is this process similar or different from the formation of other forms of frozen precipitation, like freezing rain, sleet, and snow? (Hint: does hail typically occur at the same time of year as these other forms of precipitation?)

12. Explain why, in the Northern Hemisphere, the average height of contour lines on an upper-level isobaric chart tend to decrease northward.

13. The ideal gas law states that pressure is proportional to temperature time density. Use the ideal gas law to explain why a balloon will deflate when placed in a refrigerator and then inflate when removed and placed in a warm room.

14. Explain how a Galileo thermometer works. How are the colored balls in thermometer analogous to stable or unstable parcels of air in atmosphere? This device was shown during class lecture.

15. Describe the cloud in the bottle experiment, as shown in class lecture. Physically explain the reason(s) for the cloud formation in this experiment.