AOSC 431-Atmospheric Physics and Thermodynamics, Fall 2016, Dr. Kleist
Homework #6 – DUE: THURSDAY 8 DECEMBER 2016 (5 PM)
All work needs to be shown for full credit.

1. [20 points] Answer or explain each of the following using a few sentences:
    a. Small droplets of pure water evaporate in air, even when the relative humidity is 100%.
    b. A cupboard may be kept dry by placing a tray of salt in it.
    c. The air must be supersaturated for a cloud to form.
    d. Growth by condensation in warm clouds is too slow to account for the production of raindrops.
    e. Raindrops are more likely to form in marine clouds than in continental clouds of comparable size.
    f. Raindrops reaching the ground do not exceed a certain critical size.
    g. Lightning occurs more frequently over the continents than over the oceans.

2. [5 points] Calculate the relative humidity of the air adjacent to a pure water droplet of 0.5 μm in radius if the temperature is 0 ^{o}C. The surface energy of water at 0 ^{o}C is 0.076 J m^{-2} and the number density of molecules in water at 0 ^{o}C is 3.3 X 10^{28} m^{-3}.

3. [5 points] Use the Kohler curves shown in the Wallace and Hobbs textbook (Fig 6.3) to estimate:
    a. The radius of the droplet that will form on a sodium chloride particle of mass 10^{-18} kg in air that is 0.1 percent supersaturated.
    b. The relative humidity of the air adjacent to a droplet of radius 0.05 μm that contains 10^{-19} kg of dissolved ammonium sulfate.
    c. The critical supersaturation required for an ammonium sulfate particle of mass 10^{-19} kg to grow beyond the haze state.

4. [10 points] A drop with an initial radius of 100 μm falls through a cloud containing 100 droplets per cubic centimeter that it collects in a continuous manner with a collection efficiency of 0.8. If all of the cloud droplets have a radius of 10 μm, how long will it take for the drop to reach a radius of 1 mm. You may assume that for the drops of the size considered in this problem that the terminal fall speed v (in ms^{-1}) of a drop of radius r (in m) is given by $v = 6 \times 10^{3} r$. Assume that the cloud droplets are stationary and that the updraft velocity in the cloud is negligible.