

**AOSC 431-Atmospheric Physics and Thermodynamics, Fall 2016, Dr. Kleist**  
**Homework #1 (45 Points) – DUE: 13 September 2016 (5 PM)**  
**Each question is worth 5 points. All work needs to be shown for full credit.**

1. Despite what certain map projections may lead one to believe, exactly half of the earth's surface area is contained between  $30^{\circ}\text{S}$  and  $30^{\circ}\text{N}$ . Assuming that the earth is a perfect sphere, show that this is true.
2. Let's assume that the mid-latitude jet stream was constant around the earth at a particular latitude ( $55^{\circ}\text{N}$ ) and wind speed ( $60\text{ ms}^{-1}$ ). If a weather balloon got trapped within this jet stream, how long would it take before it traveled completely around the planet?
3. If your new smart watch is rated at 5 atm, how deep can you dive while wearing it without damaging it? Note that 1 atm is about 1013.25 mb.
4. Describe in words what is mean by "scale height" for the atmosphere. Starting from a surface pressure of 1013 hPa, what is the pressure that corresponds to the e-folding distance/altitude above the surface?
5. Using your answer from question (4), what is the total mass of the atmosphere contained **above** the pressure value for the altitude that is one scale height above the surface? Based on the computation in class for the total mass of the atmosphere, what percentage of the atmosphere's mass is contained within one scale height of the surface? Explain how this is or is not consistent with the definition of e-folding distance and scale height?
6. Using the University of Wyoming sounding page, extract data from a radiosonde of your choice:
  - a. <http://weather.uwyo.edu/upperair/sounding.html>
  - b. Keep "Text:List" as the type of plot
  - c. Select Day/Time of Interest
  - d. Click on a stationCompute the observed lapse rate for three isobaric layers (850:700 hPa, 700:500 hPa, 500:250 hPa). Show your work. Please make a note of the station, day, and time for your computation. Please also copy and paste the data in some format (word, excel) to be turned in with your assignment.
7. Using the same Day/Time/Station from (6), go back to the sounding selection page above and actually plot the data. Please select "Gif: Stuve" for type of plot. Print out or save a copy of the image. From the image and focusing on the right-most solid line (temperature), please identify
  - a. Pressure level for the tropopause
  - b. Any temperature inversions (if any)
  - c. Any isothermal layers (if any)
8. Assume you are in a classroom that is 10m x 15m x 3m in dimension. Let's say that someone brings a 2 liter bottle containing a harmless gas not normally found in air at room temperature and pressure. If the gas is released into the classroom and becomes well mixed throughout, what is the final concentration of that gas in parts per million by volume?
9. Why does density decrease exponentially with height in the atmosphere but is nearly uniform in the ocean?