Atmospheric Sciences 5300
Study Guide

You should be able to use following equations and definitions to solve problems similar to those on the HW exercises. Bring your skew T-log p chart, your calculator, and one page of notes. Values of physical constants will be provided.

- Dry and moist adiabatic process.
- Reversible and pseudo-adiabatic ascent and descent.
- All moisture variables listed in the Thermodynamics Notes, including liquid water mixing ratio, w_l, and how to determine them using skew T-log p diagram. (See below for more.)
- How to use skew T-log p diagram to obtain temperature, water vapor mixing ratio, and liquid water mixing ratio during dry and moist adiabatic processes, including reversible and pseudo-adiabatic ascent and descent. (See below for more.)
- The hydrostatic equation.
- The dry and moist adiabatic lapse rates, Γ_d and Γ_s: numerical value for Γ_d; how Γ_s compares to Γ_d and how it qualitatively changes with temperature and pressure (this is evident on the skew T-log p diagram).
- Stability criteria: the parcel method. Buoyancy oscillations (how frequency and period depend on environmental lapse rate, γ).
- CAPE, NA, PA, LFC, LNB. Maximum updraft speed implied by CAPE. Lifted Index.
- DCAPE and implied maximum downdraft speed.
- **liquid water mixing ratio (w_l):** The mass of liquid water (droplets) per unit mass of dry air.
- **total water mixing ratio (w_t):** The mass of water vapor plus liquid water (droplets) per unit mass of dry air: $w_t = w + w_l$.
- During a *reversible* process, the total water mixing ratio ($w_t = w + w_l$) in a parcel remains constant. During a *pseudo-adiabatic* process, any condensed water immediately falls out of the parcel (as precipitation) so that the liquid water mixing ratio (w_l) is always zero.

  Naturally occurring processes are usually neither reversible nor pseudo-adiabatic, but somewhere in between: some, but not all, of the condensed water falls out of the parcel as precipitation so that the liquid water mixing ratio may be greater than zero, but the total water mixing ratio is reduced by the loss due to precipitation.

  We assume that a parcel is either exactly saturated: $w = w_s(T, p)$, or else unsaturated with no liquid water: $w_l = 0$. Given the total water mixing ratio, one can then determine the remaining unknown mixing ratio: if saturated, $w_l = w_t - w_s(T, p)$, and if unsaturated, $w = w_t$.