Unit 3 ATM401, ATM601 and CHEM601

Application, analysis, and evaluation

1. Express the first law of thermodynamics as a function of the specific heat capcity at (a) constant volume, and (b) at constant pressure. How would the first law of thermodynamics look like for an adiabatic process?

2. A parcel of dry air located at $1013.25hPa$ receives $10^7 J$ of heat by solar radiation. Thus, its volume increases by $22m^3$. Assume the center of the air parcel's mass remains in place. Determine the change in the internal energy of the air parcel. Calculate the increase in temperature of the air parcel under the assumption that the air molecules do not exert forces on each other for an air parcel mass of $8000kg$.

3. Assume a change in kinetic energy caused by a change in velocity $\Delta v = 1m/s$ for a weak wind ($v = 3m/s$) and a typhoon ($25m/s$). Calculate the change in kinetic energy assuming a unit mass of air $m = 1kg$. Comment on the results.

4. Determine the change in air pressure if air temperature decreases by 5%, and entropy decreases by $50J/(kgK)$.

5. In a high pressure system, a $100hPa$ thick layer between $100hPa$ and $200hPa$ having a potential temperature of $315K$ and $295K$ at the top and bottom of the layer, respectively sinks adiabatically under conservation of mass. Discuss what this means for the pressure difference between the top and bottom layer and potential temperature. Determine the actual temperature difference between the top and bottom of the layer and discuss the temperature gradiend in that layer. Determine at which pressure levels (top and bottom), the lapse rate becomes isothermal. What are the temperatures at the top and bottom of the layer once it is located between $900hPa$ and $1000hPa$? What does this process yield? Comment on the pressure difference and potential temperature.