

Physics 5524
Statistical Mechanics
Problem Set 2

Due: Wednesday Jan 27, 11:50am (in my Keen office)

2.1:

Calculate the work performed by 10grams of oxygen (gas) expanding isothermally at 20°C from 1 to 0.3 atmospheres of pressure. Approximate the gas as ideal and state your answer in Joules (note that 4184Joules corresponds to 1Cal used in US nutrition labels.)

2.2:

- a) What is the heat capacity at constant volume of a (classical) ideal di-atomic gas?
- b) Consider a reversible adiabatic process. If the pressure (P) of such an ideal di-atomic gas decreases by a factor of λ , by what factor does the temperature (T) change?
- c) Considering a column of such a gas in the gravitational field of Earth close to Earth's surface. By mechanically balancing the effects of gravity and pressure changes, find the dependence of dP/dz on P and T , where z is the altitude (height). Express your answer in terms of the Earth's gravitational acceleration g , molar mass of the gas M , and the gas constant R .
- d) Assuming the air changes its pressure and temperature adiabatically, find the rate of change of temperature with the altitude, dT/dz . Using $R = 8.314 \frac{J}{molK}$, $g = 9.8m/s^2$, and the molar mass of air $M = 28g/mol$, express the change of temperature in Kelvin per kilometer. Find the actual data in the literature and compare with your answer.