Homework # 3 3760

Pr#1

K 6.11 (also Schroeder 1.40)

Convective isentropic equilibrium of the atmosphere.

The lower 10-15 km of the atmosphere – troposphere – is often in a convective steady state at constant entropy, not constant temperature. In such equilibrium PV^{γ} is independent of altitude, where $\gamma = C_p / C_V$.

(a) Use the condition of mechanical equilibrium in a uniform gravitational field to show that $dT / dz = const$, where z is the altitude. This quantity important for meteorology is called the dry adiabatic lapse rate.

(b) Estimate dT / dz in ^{0}C per km. Take $\gamma = 7/5$.

(c) Show that $P \propto \rho^{\gamma}$, where ρ is the mass density.

Problem #2

A penny is tossed 400 times. Find the probability of getting 215 heads. (Suggestion: use Gaussian approximation. Do not directly use the Gaussian distribution with the spin excess that we have in lecture notes. It has to be modified to be applicable to this problem).

Problem#3

A) In how many possible ways may 4 different balls (red, blue, yellow and green) be distributed between 3 baskets (1, 2, 3)? What is the probability of particular distribution? (Suggestion: use a method of symbolic multiplication)

B) Five balls (two red, one blue, and two yellow balls) are randomly distributed between 3 baskets. What is the probability of the following distribution: red is in the first basket, blue is in the second basket, one yellow in the second basket, and the other yellow and red are in the third basket?

Problem#4

Using binominal distribution, compute an average value of a square of a spin excess $\langle S^2 \rangle$ for a system of 10 spins in *zero* magnetic field.