Physics 704   **HOMEWORK ASSIGNMENT #1**   Fall 2011

Study: P&B 1.3, 1.8, 2.4, 2.6, 3.1–3.3, 3.5, 3.7–3.11, 4.1,5.2, 5.4

Skim: P&B 3.4, 5.1, 5.3, 5.5

Postponed (till before 6.1): 3.6

Due date for problems on Thursday, Feb. 15 [deadline on Feb. 17].

Warning: P&B problem numbers refer to the 3rd edition and are generally not the same as in the second edition. If you are relying on the latter, check with a classmate who has the third.

1. P&B problem 3.1 You do not need to turn this problem into an integral. It can be done with a discrete sum using the Riemann zeta function!

2. P&B problem 3.9.

3. P&B problem 3.10 a and bii: Show $\alpha_t = 1/2$.

4. P&B problem 3.15.

5. Consider an Ising model (eq. 3.3) in 1D which also includes a 3-spin term $-J_t \Sigma_{<ijk>} \sigma_i \sigma_j \sigma_k$ where i,j, and k are consecutive sites along the chain. Convert this Hamiltonian to the lattice gas model $\mathcal{H} = E_t \Sigma_{<ijk>} n_i n_j n_k + E\Sigma_{<ij>} n_i n_j + h \Sigma_i n_i + const.$, and find the relationship between J_t/J and E_t/E, showing that they are not simply proportional to each other. (This recognition has eluded some researchers in the field!)

Added note: If you like, you can add second-neighbor terms $E_2\Sigma_{<ij>_2} n_i n_j$ and $-J_2\Sigma_{<ij>_2}\sigma_i \sigma_j$ where the sum is over second-neighbor rather than nearest-neighbor pairs. This is not necessary to do the original problem. You will find that J_2/J is similar to E_2/E for $|E_t/E|$ less than 1/4, in contrast to the comparable ratios for the trio interaction.