Physics 220: Problem Set 3
due May 19, 2011.

1. **Kardar, Chapter 6, Problem 3.** The solution is in the book and so will not be graded.
2. **Kardar, Chapter 6, Problem 6.**
3. **High temperature expansion for the O(n) model on the honeycomb lattice:** Consider the partition function defined by

$$Z = \prod_i \int [d\vec{s}_i] \prod_{\langle ij \rangle} [1 + nt\, \vec{s}_i \cdot \vec{s}_j] \,, \tag{1}$$

where $\vec{s}_i$ are n-component spins of unit length $|\vec{s}_i| = 1$ and $t > 0$. The integrals are defined to be uniform over the n-dimensional sphere, i.e. $\int [d\vec{s}_i] = \int ds_i^1 \cdots ds_i^n \delta(\vec{s}_i \cdot \vec{s}_i - 1)$. Take the sites to reside on a honeycomb lattice, which is the two-dimensional lattice composed of hexagons sharing sides (the links), three of which intersect at each vertex i.

   (a) Construct a high temperature expansion for the partition function. What are the diagrams that appear and what is the weight for each diagram?

   (b) Construct an expansion for the spin-spin correlation function, $C_{ij} = \langle \vec{s}_i \cdot \vec{s}_j \rangle$. Show that, in the limit of $n \to 0$, this gives just a sum over configurations of a single self-avoiding polymer.

4. **Karder, Chapter 7, Problem 11.**