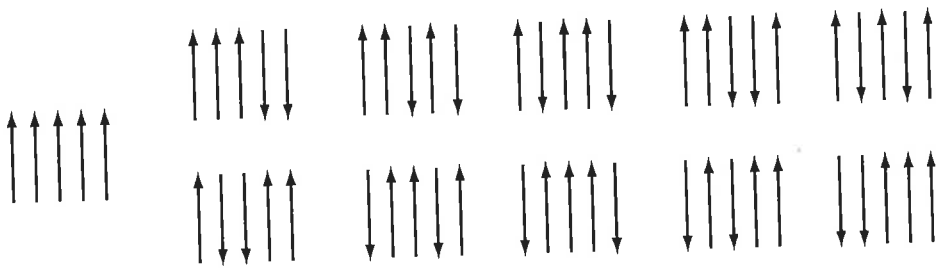
Seminar 4

Warmup Problems

Warmup Problem 1 G & T Problem 4.1

$N = 5$ distinguishable spins ... $E = -\mu B$. There two variables specify macrostate. There are ten microstates which you see in Fig. 4.1



(a) (b)

Figure 4.1. (a) Example of an inaccessible microstate corresponding to the macrostate specified by $E = -\mu B$ and $N = 5$. (b) The ten accessible microstates. Spin 1 is the leftmost spin.

(a) What is mean value of spin "2"?

This is mean value of any single spin.

We just look at picture:

$$\overline{S_2} = \frac{1}{2}\left(\frac{1+1+-1+1+-1+-1+1+1+1+-1}{10}\right)$$

spin of any individual s_i is $\pm\frac{1}{2}$

$$= \frac{1}{2}\left(\frac{6-4}{10}\right) = \frac{1}{2}\cdot\frac{2}{10} = +\frac{1}{10}$$

Note... if you solved this like example at bottom of page 181, you used $s_i = \pm 1$ so your answer would be $1/5$

These are not $\emptyset$ b/c the macrostate of $E = -\mu B$ biases the spins so they are more likely to be positive, making $E = -\mu B \sum_{i=1}^{5} s_i = -\mu B$.

(b) Prob spin (say 2) points up is

$$p = \frac{\#\text{ states where 2 is up}}{\text{total \# states}} = \frac{6}{10} = \frac{3}{5}$$

(c) Given spin 1 is up, what is prob spin 2 is up?

To solve, we restrict ourself to the 6 microstates where spin 1 is up. Of those, there are 3 where spin 2 is up.

Thus $p(\text{spin 1 up} \mid \text{2 is up}) = 3/6 = 1/2$