

Phy 410
Quiz #1, Jan 23, 2009

a) There are 6 magnets each can point either up or down with equal probability (6 points)

- i) How many possible microstates are there for this system?**
- ii) What is the probability of seeing the microstate ($\uparrow\uparrow\uparrow\uparrow\downarrow\downarrow$)?**
- iii) What is the probability of seeing a macrostate (N,s), $2s$ =spin excess, for $N=6$, $s=0$?**

i) $2^6 = 64$; ii) $1/64$;

iii)

$$P(N,s) = g(N,s) \cdot \frac{1}{2^N} = \frac{N!}{(\frac{N}{2} + s)! (\frac{N}{2} - s)!} \cdot \frac{1}{2^N} = \frac{20}{64} = \frac{5}{16}$$

b) Consider a system consisting of 2 quantum harmonic oscillators ($N=2$). The total energy of the system is 3 (in units of energy quantum hw i.e. $n=3$). (4 points)

- i) How many microstates ($N;s_1,s_2$) correspond to this macrostate (N,n)?**
- ii) Write down these microstates.**

i) $g(N,n) = \frac{(N-1+n)!}{(N-1)!n!} = \frac{(2-1+3)!}{(2-1)!3!} = 4$

ii) $s_1 + s_2 = 3$;

The microstates are:

$(2;0,3), (2;3,0), (2,2,1); (2;1,2)$