

PHYS 328

IN - CLASS DISCUSSION 13 SEPT. 2013

When you flip a coin, there are two possible outcomes, H or T. If you flip n coins, there are a total of 2^n possible microstates. So in the case where you flip 20 coins, there are a total of 2^{20} microstates (outcomes). Numerically, this is 1,048,576.

The probability of a specific sequence is :

$$\text{probability} = \frac{\text{total ways of getting the sequence}}{\text{total microstates}} = \frac{1}{2^{20}} = 2^{-20}$$

There is only one way of getting the specific sequence indicated in the text, and we just calculated the total number of microstates.

The probability of getting 12 heads in any sequence can be written as :

$$\text{Prob}(12) = \frac{\Omega(12)}{\Omega(\text{all})} = \binom{20}{12} / 2^{20} = \left(\frac{20!}{12! \times 8!} \right) / 2^{20} = 0.120$$

We could write a short Mathematica program to compute combinations and the probability of obtaining a certain macrostate :

```
Clear[comb, totalstates]
n = 20;
comb[n_, m_] := n! / (m! (n - m)!)
prob = comb[20, 12] / 2^n;
Print[prob // N]

0.120134
```