Recitation Problems for Week 14, Tuesday

9.C4. You are carrying out experiments in rolling dice, where each of the outcomes of a single roll has the same probability. If you roll three dice, the numbers on the dice can add up to all numbers from 3 to 18. How many ways can you get each of these totals from the three dice?

9.C8. A composite system has a total volume V and 25 particles in it. It is divided into two subsystems, where subsystem one has 1/5 of the total volume. The system starts out with 15 particles in sybsystem one and 10 in subsystem two. (a) What is the initial entropy of the system? (b) A small hole is punched between the two subsystems, and after some length of time, you find 5 particles in subsystem one and 20 in subsystem two. What is the change in entropy of the system?

9.C11. A composite system can have between 0 and 6 particles in subsystem one. The probabilities of each of these seven outcomes are given in Table 1. (a) What is the average number of particles in subsystem one? (b) What is the variance in the number of particles in subsystem one?

N_1	0	1	2	3	4	5	6
$P(N_1)$	0.02	0.10	0.15	0.20	0.25	0.20	0.08

Table 1: Data for problem 9.C11.

9.S40. A composite system of total volume V is composed of two subsystems of volumes V_1 and V_2 and a total of N particles are split between the them, with N_1 in subsystem one and N_2 in subsystem two. We are told that he entropy of the the two subsystems are given as

$$\begin{aligned} S_1(N_1, V_1) &= \alpha\, k_B\, N_1 \ln\left(\frac{V_1}{N_1}\right) + \alpha\, k_B\, N_1 \\ S_2(N_2, V_2) &= \beta\, k_B\, N_2 \ln\left(\frac{V_2}{N_2}\right) + \beta\, k_B\, N_2\,. \end{aligned}$$

where α and β are positive constants. (a) Under what conditions would there be a net movement of particles from one subsystem to the other? (b) If $V_1 = V_2$ and $\alpha = 2\beta$, and the particles can move between the two subsystems, what fraction of all the particles in the system would we expect to find in subsystem one?