

Stuff for Thursday/Friday, May 24/25, 2012

- Quiz #8 Friday on T4–T6. Extra final review sheets online.
- Plan for next week (Monday is an OSU holiday)
 - PS #17 due Tuesday; PS #18 due Friday
 - 1094 Session 9 on Wednesday and quiz #9 on Friday

T6, T7 stuff:

- Entropy $S = k_b \ln \Omega$, so $\Omega = e^{S/k_b}$; $\partial S / \partial U \equiv 1/T$ defines temperature
- Boltzmann factor: small quantum system in thermal contact with large heat reservoir \implies energy exchange at same T

$$\text{Prob}(E) = \frac{1}{Z} e^{-E/k_B T} = \frac{e^{-E/k_B T}}{\sum_i e^{-E_i/k_B T}} \implies \frac{\text{Pr}(E_2)}{\text{Pr}(E_1)} = e^{-(E_2 - E_1)/k_B T} = e^{-\Delta E/k_B T}$$

- Maxwell-Boltzmann: Probability of molecule speed v is $\propto e^{-E/k_B T} = e^{-mv^2/2k_B T}$

$$\text{Pr}(\text{speed } v \pm dv/2) = \frac{4}{\sqrt{\pi}} \left(\frac{v}{v_P} \right)^2 e^{-(v/v_P)^2} \frac{dv}{v_P} \quad \text{where} \quad v_P \equiv \left(\frac{2k_B T}{m} \right)^{1/2}$$

- Average energy of a quantum system

$$E_{\text{avg}} = \sum_n E_n \text{Pr}(E_n) = \sum_n E_n e^{-E_n/k_B T} / \sum_n e^{-E_n/k_B T}$$

StatMech

A Atoms: 100 Total U: 200 Table Graph

B Atoms: 100 Max Rows: 200

Number of atoms in System A = 100
 Number of atoms in System B = 100
 Total combined system energy = 200 units.

U(A)	U(B)	Omega(A)	Omega(B)	Omega(AB)	Fraction of states
0	200	1	3.033e+144	3.033e+144	5.23e-50
1	199	300	1.216e+144	3.647e+146	6.29e-48
2	198	45,150	4.858e+143	2.193e+148	3.79e-46
3	197	4,545,100	1.935e+143	8.796e+149	1.52e-44
4	196	344,291,325	7.686e+142	2.646e+151	4.57e-43
5	195	2,093e+10	3.043e+142	6.371e+152	1.10e-41
6	194	1.064e+12	1.201e+142	1.278e+154	2.21e-40
7	193	4.652e+13	4.727e+141	2.199e+155	3.80e-39
8	192	1.785e+15	1.854e+141	3.310e+156	5.71e-38
9	191	6.109e+16	7.252e+140	4.430e+157	7.65e-37
10	190	1.888e+18	2.827e+140	5.336e+158	9.21e-36
11	189	5.320e+19	1.098e+140	5.843e+159	1.01e-34
12	188	1.379e+21	4.254e+139	5.864e+160	1.01e-33
13	187	3.309e+22	1.642e+139	5.433e+161	9.38e-33
14	186	7.398e+23	6.318e+138	4.674e+162	8.07e-32
15	185	1.549e+25	2.423e+138	3.752e+163	6.48e-31
16	184	3.049e+26	9.262e+137	2.824e+164	4.87e-30
17	183	5.667e+27	3.528e+137	2.000e+165	3.45e-29
18	182	9.980e+28	1.340e+137	1.337e+166	2.31e-28
19	181	1.670e+30	5.069e+136	8.467e+166	1.46e-27
20	180	2.664e+31	1.911e+136	5.092e+167	8.79e-27
21	179	4.060e+32	7.182e+135	2.916e+168	5.03e-26
22	178	5.924e+33	2.690e+135	1.593e+169	2.75e-25
23	177	8.293e+34	1.004e+135	8.324e+169	1.44e-24
24	176	1.116e+36	3.732e+134	4.166e+170	7.19e-24
25	175	1.446e+37	1.383e+134	2.000e+171	3.45e-23
26	174	1.808e+38	5.106e+133	9.231e+171	1.59e-22
27	173	2.183e+39	1.878e+133	4.100e+172	7.08e-22
28	172	2.550e+40	6.884e+132	1.755e+173	3.03e-21
29	171	2.884e+41	2.514e+132	7.249e+173	1.25e-20
30	170	3.162e+42	9.146e+131	2.892e+174	4.99e-20
31	169	3.366e+43	3.315e+131	1.116e+175	1.93e-19
32	168	3.482e+44	1.197e+131	4.169e+175	7.20e-19

StatMech

A Atoms: 100 Total U: 200 Table Graph

B Atoms: 100 Max Rows: 200

84	116	1.556e+86	2.671e+105	4.157e+191	0.00717*
85	115	7.030e+86	7.466e+104	5.249e+191	0.00906*
86	114	3.147e+87	2.074e+104	6.527e+191	0.01127*
87	113	1.396e+88	5.724e+103	7.994e+191	0.01380*
88	112	6.141e+88	1.570e+103	9.642e+191	0.01664*
89	111	2.677e+89	4.278e+102	1.145e+192	0.01977*
90	110	1.157e+90	1.158e+102	1.340e+192	0.02313*
91	109	4.959e+90	3.115e+101	1.545e+192	0.02666*
92	108	2.108e+91	8.323e+100	1.754e+192	0.03028*
93	107	8.884e+91	2.208e+100	1.962e+192	0.03386*
94	106	3.714e+92	5.820e+99	2.162e+192	0.03731*
95	105	1.540e+93	1.523e+99	2.347e+192	0.04050*
96	104	6.338e+93	3.959e+98	2.509e+192	0.04331*
97	103	2.588e+94	1.022e+98	2.644e+192	0.04563*
98	102	1.048e+95	2.618e+97	2.744e+192	0.04736*
99	101	4.214e+95	6.659e+96	2.806e+192	0.04843*
100	100	1.681e+96	1.681e+96	2.827e+192	0.04879*
101	99	6.659e+96	4.214e+95	2.806e+192	0.04843*
102	98	2.618e+97	1.048e+95	2.744e+192	0.04736*
103	97	1.022e+98	2.588e+94	2.644e+192	0.04563*
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113	87	5.724e+103	1.396e+88	7.994e+191	0.01380*
114	86	2.074e+104	3.147e+87	6.527e+191	0.01127*
115	85	7.466e+104	7.030e+86	5.249e+191	0.00906*
116	84	2.671e+105	1.556e+86	4.157e+191	0.00717*
117	83	9.997e+105	3.413e+85	3.241e+191	0.00559*
118	82	3.356e+106	7.416e+84	2.489e+191	0.00430*
119	81	1.179e+107	1.596e+84	1.882e+191	0.00325*
120	80	4.116e+107	3.402e+83	1.400e+191	0.00242*
121	79	1.429e+108	7.181e+82	1.026e+191	0.00177*
122	78	4.930e+108	1.501e+82	7.400e+190	0.00128*
123	77	1.692e+109	3.105e+81	5.253e+190	0.00091*

