T5S.3: (a) $N_A = 100$ $N_B = 100$ $U = 200\varepsilon$

i. 2.8271E+192/3.0330E+144=0.9321134E+48

ii. 70–130 include 0.99983854 of states

iii. 3.6469E+146/3.0330E+144=1.202407E+2

(b) $N_A = 1000$ $N_B = 1000$ $U = 2000\varepsilon$ (request 2001 rows)

i. 6.748E+1949/1.844E+1459=3.659436E490

ii. 904–1096 include 0.99981572 of states

iii. 2.213E+1462/1.844E+1459=1.200109E3

much increased relative probability of being in central state; likely spread δU_A increased on an absolute basis, but not on relative basis.

(c) $N_A = 1000$ $N_B = 1000$ $U = 200\varepsilon$ (request 201 rows)

i. 7.9768E+380/2.2201E+323=3.592991E57

ii. 73–127 include 0.99988206 of states

iii. 4.1639E+325/2.2201E+323=1.875546E2

modest changes toward more central probability

(d) $N_A = 100$ $N_B = 100$ $U = 2000\varepsilon$ (request 2001 rows)

i. 3.5051E+605/1.9303E+384=1.815832E221

ii. 828–1172 include 0.999805788 of states

iii. 5.0377E+386/1.9303E+384=2.609802E2

much increased relative probability of being in central state; likely spread δU_A increased on an absolute basis, but not on relative basis.

Note the online error list `http://www.physics.pomona.edu/sixideas/errfiles/sierrt3.html` suggests doing all these problems with MaxRow 200, but I've followed the instructions as given in the hard copy. Below are the results for the default MaxRows (201)

(b) $N_A = 1000$ $N_B = 1000$ $U = 2009\varepsilon$ (request 201 rows)

i. 1.722E+1956/1.020E+1485=1.688235E471

ii. 0.4552–0.5448 include 0.9997597 of states

iii. 1.964E+1504/1.020E+1485=1.92549E19

(d) $N_A = 100$ $N_B = 100$ $U = 2009\varepsilon$ (request 201 rows)

i. 3.6635E+607/1.2200E+401=3.002869E206

ii. 0.4154– 0.5846 include 0.9998342 of states

iii. 8.5681E+413/1.2200E+401=7.023033E12

T5S.8: (a) $\Delta S = 0.00000001$ J/K $= k_B \ln(\Omega_1/\Omega_2)$

$$\begin{aligned}
\ln(\Omega_1/\Omega_2) &= 0.00000001/k_B = 7.2429 \times 10^{14} \\
\log_{10}(\Omega_1/\Omega_2) &= 7.2429 \times 10^{14}/\ln(10) = 3.1456 \times 10^{14} \\
\Omega_1/\Omega_2 &= 10^{3.1456\times 10^{14}}
\end{aligned}$$

(b) I'm willing to bet that I'll never see something with those odds happen.

T5R.1: Call space alien object A (so Ω_A increases if U_A decreases) and normal object B (so Ω_B increases if U_B increases). Both Ω_A and Ω_B will increase (so then $\Omega_{AB} = \Omega_A\Omega_B$ will also increase) if energy flows from A to B. So as long as the hypothesis hold, less energy in A (and hence more in B) will increase increase total entropy—hence A will reach 'equilibrium' (i.e., steady state) only after it has expelled all of its energy into B. It doesn't matter if B is a flame or an ice bath—both are 'normal' cases where Ω_B will increase if U_B increases. A might be said to have an infinite temperature (since heat will flow from it into any normal body) but in fact the usual definition of temperature will find a negative value (so $\Delta S = Q/T$ is positive for $Q < 0$).