

HW #5

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2.23) (a) $\Omega_{\text{total}} = 2^{10^{23}}$

(b) $10^{10} \cdot 60 \cdot 60 \cdot 24 \cdot 365 \cdot 10^{10} = 3.1536 \times 10^{27} \ll 2^{10^{23}}$

(c) If you had unlimited time to wait then yes
but it would take an incomprehensible amount of time.

2.27) If $N=100$ $P = 0.91^{100}$
 $= 0.366$

If $N=1000$ $P = 0.91^{1000}$
 $= 0.000432$

If $N=10000$ $P = 0.91^{10000}$
 $= 2.25 \times 10^{-44}$

2.28) $\Omega = 52!$
 $= 8.067 \times 10^{67}$

$S = k \ln 52!$
 $\approx k (52 \ln 52 - 52)$
 $= 153.46 k$
 $= 153.46 \cdot 1.38 \times 10^{-23} \text{ J/K}$
 $= 2.1178 \times 10^{-21}$

2.33) $S = N k \left[\ln \left(\frac{V}{N} \left(\frac{4\pi m U}{3N h^2} \right)^{3/2} \right) + \frac{5}{2} \right]$

$N = N_A$

$N_A k = R$

$V = \frac{RT}{P} = \frac{8.31 \cdot 300}{101300}$
 $= 0.0246 \text{ m}^3$

$U = \frac{3}{2} RT$
 $= \frac{3}{2} \cdot 8.31 \text{ J/K} \cdot 300$
 $= 3739.5 \text{ J}$

$S = 8.31 \left[\ln \left(\frac{0.0246}{6.02 \times 10^{23}} \left(\frac{4\pi \cdot 0.0375 \cdot 3739.5}{3 \cdot 6.62 \times 10^{-34} \cdot (6.626 \times 10^{-34})^2} \right)^{3/2} \right) + \frac{5}{2} \right]$
 $= 816.4$

2.40) (a) The salt is distributed through the pot and so has many more available states.

(b) The proteins are denatured.

(c) Humpty Dumpty is in pieces and so there are many more arrangements than as a solid whole.

(d) The sand is scattered instead of in a particular arrangement

(e) The tree can fall in any direction.

(f) The constituents of the gasoline are now many H_2O and CO_2 molecules that are also gas instead of liquid.