14.5 (a) # microstates = $6^4 = 1296$

(b) totals range from 4 to 24

most probable is center of distribution:

$\frac{4+24}{2} = 14$

least probable is at either end: 4 & 24

14.6 (c) # microstates = $6^{10^{10}} \Rightarrow$ huge!

(d) most probable is the middle of the distribution. anything else will be an effectively non-zero probability. All of them being 1 or 6 is well-nigh improbable.

(e) both are governed by statistics: effectively, only combinations very close to the most probable distribution have nonzero probability.

14.7 microscopic disorder is $S = k_B \ln W$.

The more ways a system can disperse its energy internal modes, the greater is the entropy. A spontaneous process occurs in the direction of greater global disorder.

14.8 Work is organized, heat is not.

14.9 see above. To transform heat to work, we must create disorder elsewhere in the form of new heat.

14.11 we always lose energy when converting heat to work.

14.12 To generate necessary energy, Billy must convert carbohydrates into CO_2 & H_2O & release heat as a product of the exothermic combustion rxns.