1. When a hot and cold object are placed in contact heat is observed to flow from the hot object to the cold one. The reason the reverse process is not observed is

   (a) It is impossible for a molecule in the cold object to lose energy to a molecule in the hot object.

   (b) Moving heat from a cold object to a hot object results in the loss of energy, which violates the first law of thermodynamics.

   (c) Moving heat from a cold object to a hot object causes the entropy of both objects to decrease, thus violating the second law of thermodynamics.

   (d) Moving heat from a cold object to a hot object causes the total entropy of both objects to decrease, thus violating the second law of thermodynamics.

2. Which system has greater entropy, a puddle of water on a table next to a disorderly scattering of salt crystals, or the same amount of salt dissolved in a homogeneous solutions with the sane amount of water.

   (a) The puddle and the crystals.

   (b) The solution in the glass.

   (c) They both have the same entropy.

   (d) It depends on the nature of the salt crystals.

3. A hot object is brought into contact with a cold object the cold object's entropy increases by 2.5 J/K as it comes into equilibrium with the hot object. By how much does the entropy of the hot object change?

   (a) It decreases by more than 2.5 J/K.

   (b) It decreases by less than 2.5 J/K.

   (c) It increases by 2.5 J/K.

   (d) It decreases by 2.5 J/K.

4. Each of the following processes happens spontaneously, yet appeasers to result in a decrease in entropy (or increase in order). Discuss each item with your group and explain how total entropy has in fact increased in each case.

   (a) An egg which is initially albumen and yolk, develops into a highly structured chick.

   (b) When you wear a wet T-shirt on a hot but windy day your body is cooled down, and hence loses entropy.

   (c) When a grain of sugar is placed in a super-saturated solution of sugar water, sugar crystalizes out of the solution creating an ordered structure out of a homogeneous solution.

5. If we think of a solid as being a collection of oscillators that can oscillate at discrete energy levels, then we can draw an analogy between a solid and a box with bins. Each bin corresponds to an oscillator. Adding discrete units of energy to an oscillator corresponds to adding discrete balls to a bin. The temperature of a solid (the average energy per oscillator), corresponds to the average number of balls per bin in a box. The entropy of the solid corresponds to the information needed to determine the arrangement of balls that are randomly distributed in the bins.

   (a) Consider a box with 2 bins and 1 ball placed in a random location. How many different ways can you arrange the balls in the bins? What is the 'entropy' and 'temperature' of this 'solid'?

   (b) Consider a second box with 2 bin and 3 balls distributed randomly. What is the 'entropy' and 'temperature' of this 'solid'?

   (c) If we now allow the two boxes to come into 'thermal contact' (ie allow the balls two distribute themselves randomly between them), how many different ways are their to arrange the four balls in the four bins (Hint: draw them all out)? How many of those arrangements correspond to possible arrangements of the original boxes? What is the 'entropy' and 'temperature' of the new 'solid'? How do your answers compare to the total 'entropy' and the 'temperatures' of each of the separate 'solids'?