Quick Lab

Entropy and Probability

MATERIALS LIST

- 3 dice
- a sheet of paper
- a pencil

Take two dice from a board game. Record all the possible ways to obtain the numbers 2 through 12 on the sheet of paper. How many possible dice combinations can be rolled? How many combinations of both dice will produce the number 5? the number 8? the number 11? Which number(s) from 2 through 12 is most probable? How many ways out of the total number of ways can this number(s) be rolled? Which number(s) from 2 through 12 is least probable? How many ways out of the total number of ways can this number(s) be rolled?

Repeat the experiment with three dice. Write down all of the possible combinations that will produce the numbers 3 through 18. What number is most probable?

SECTION REVIEW

1. Is it possible to construct a heat engine that doesn't transfer energy to its surroundings? Explain.

2. An engineer claims to have built an engine that takes in 7.5×10^4 J and expels 3.5×10^4 J.
   - **a.** How much energy can the engine provide by doing work?
   - **b.** What is the efficiency of the engine?
   - **c.** Is this efficiency possible? Explain your answer.

3. Of the items listed below, which ones have high entropy?
   - **a.** papers scattered randomly across a desk
   - **b.** papers organized in a report
   - **c.** a freshly opened pack of cards
   - **d.** a mixed deck of cards
   - **e.** a room after a party
   - **f.** a room before a party

4. Some compounds have been observed to form spontaneously, even though they are more ordered than their components. Explain how this is consistent with the second law of thermodynamics.

5. Discuss three common examples of natural processes that involve decreases in entropy. Identify the corresponding entropy increases in the environments of these processes.

6. **Critical Thinking** A steam-driven turbine is one major component of an electric power plant. Why is it advantageous to increase the steam's temperature as much as possible?

7. **Critical Thinking** Show that three purple marbles and three light blue marbles in two groups of three marbles each can be arranged in four combinations: two with only one possible arrangement each and two with nine possible arrangements each.