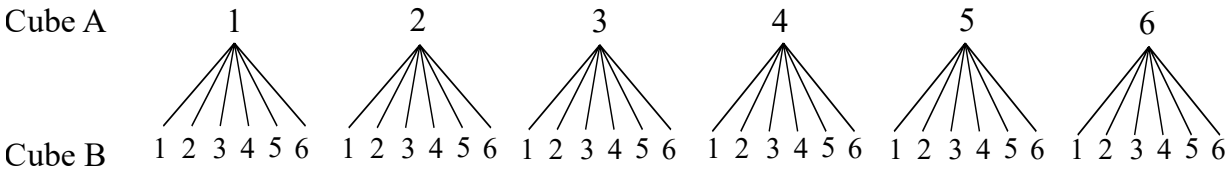
# Problem of the Week
## Problem B and Solution
## Single, Double, Triple Trouble

### Problem

In Monopoly$^{TM}$, you get to roll again if you roll doubles (the same number on two six-sided number cubes).

a) What is the theoretical probability of rolling doubles? (You may find it helpful to complete the tree diagram below.)




b) What is the theoretical probability of rolling two doubles in a row? (Think about what you would have to add to your tree diagram in part a) in order to determine the number of possible outcomes. Then deduce an easy way to get the desired probability as a simple product.)

c) If you get three doubles in a row, you go to the "Jail" space on the board. What are the chances of rolling three doubles in a row?

## Solution

a) From the completed tree diagram shown above, we see that there are 36 possible pairs which could occur in a roll of two number cubes. Of these, only 6 are doubles. Thus, the theoretical probability of rolling doubles is $\frac{1}{6}$.

b) To adapt the tree diagram to a second roll would require adding six branches to EACH of the 36 numbers in the second row of part a) to represent the value on the first cube of the second roll, resulting in $6 \times 36 = 216$ branches and thus 216 numbers in the third row. Then, 6 branches would need to be added to EACH of the 216 numbers on the third row to represent the value on the second cube of the second roll, resulting in $6 \times 216 = 1296$ numbers in the fourth row. Thus, there are 1296 possible pair combinations for the two rolls.

Now, for each of the six possible doubles on the first roll, there are 6 possible doubles for the second roll (1 and 1, 2 and 2, 3 and 3, 4 and 4, 5 and 5, and 6 and 6). Thus, there are $6 \times 6 = 36$ ways to get doubles on the first and second rolls, out of a total of 1296 possible pairs. Thus, the probability of rolling two doubles in a row is $\frac{36}{1296} = \frac{1}{36}$.

The easy way to calculate this is to note that it is equal to the product of the probability of getting a double in each of the two rolls, namely $\frac{1}{6} \times \frac{1}{6} = \frac{1}{36}$.

c) The chances of rolling three doubles in a row is similarly found to be $\frac{1}{6} \times \frac{1}{6} \times \frac{1}{6} = \frac{1}{216}$.