SOML MEET
TEAM EVENT

NAME: _____
NAME: _____
NAME: _____
TEAM: _____
SCHOOL: _____

1. [15 Points] BACKGROUND From playing different games, you probably have lots of experience with the likelihood of different sums occurring when you roll two dice, such as:

1. Sums range from 2 to 12.
2. Most frequent sum is 7, with a likelihood of $\frac{6}{36}$.
3. Least frequent sums are 2 and 12, each with a likelihood of $\frac{1}{36}$.
4. All values from 2-12 are possible with the likelihood of a particular sum increasing by $\frac{1}{36}$ th as sums grow from 2 to 7 and decreasing by $\frac{1}{36}$ th as the sums grow beyond 7.
5. A table of values like the one below is frequently used to chart the different possibilities.

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

TEAM PROBLEM This problem asks you to think about rolling three dice. It will help if you think of dice that are distinguishable, e.g. each die being a different color (red, white, and green) or being rolled in a particular order (1st, 2nd, and 3rd). It should be fairly obvious that the possible sums range from 3 to 18. Also, a sum of 3 can only occur in one way, all three dice come up 1s, while a sum of 9 can occur in several ways, both with the same three numbers showing up on different dice (red 3, white 4, green 2; red 2, white 4, green 3) or with different numbers showing up (red 6, white 2, and green 1).

What is the likelihood (probability) of rolling a sum of 9 using exactly three dice? Give an <u>exact</u> answer.

ANS:_____

SOML MEET
TEAM EVENT

NAME:_____Key_____
NAME: _____
TEAM: _____
SCHOOL: _____

1. [15 Points] BACKGROUND From playing different games, you probably have lots of experience with the likelihood of different sums occurring when you roll two dice, such as:

1. Sums range from 2 to 12.
2. Most frequent sum is 7, with a likelihood of $6/36$.
3. Least frequent sums are 2 and 12, each with a likelihood of $1/36$.
4. All values from 2-12 are possible with the likelihood of a particular sum increasing by $1/36$ th as sums grow from 2 to 7 and decreasing by $1/36$ th as the sums grow beyond 7.
5. A table of values like the one below is frequently used to chart the different possibilities.

	1	2	3	4	5	6
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6	7	8	9	10	11	12

TEAM PROBLEM This problem asks you to think about rolling three dice. It will help if you think of dice that are distinguishable, e.g. each die being a different color (red, white, and green) or being rolled in a particular order (1st, 2nd, and 3rd). It should be fairly obvious that the possible sums range from 3 to 18. Also, a sum of 3 can only occur in one way, all three dice come up 1s, while a sum of 9 can occur in several ways, both with the same three numbers showing up on different dice (red 3, white 4, green 2; red 2, white 4, green 3) or with different numbers showing up (red 6, white 2, and green 1).

What is the likelihood (probability) of rolling a sum of 9 using exactly three dice? Give an <u>exact</u> answer.

Solution:

First, there are $6^3 = 216$ different possible rolls of three distinguishable dice.

It remains to count how many of them sum to 9.

One option is just to carefully organize a list of all the possible combinations that total 9. Not my favorite option.

Instead, focus on the last die rolled and subtract its value from 9. Use the table above to determine the number of ways to get the needed difference from the first two dice. For example, if the 3rd die was a 3, then the first two dice would need to sum to 6 and there are 5 combinations of two dice that sum to 6. Repeat for all possible outcomes on the 3rd die and total the possibilities (see table below).

Total the possibilities and you've found the probability of rolling three dice that sum to 9 is exactly $25/216$.

3rd die→	1	2	3	4	5	6
1st two dice must sum to→	8	7	6	5	4	3
Frequency for 1st two dice→	5	6	5	4	3	2

↑ A total of 25 different ways

ANS: $\frac{25}{216}$