Name: ___________________________________ Date: _________________

BINOMIAL PROBABILITY – DAY #1
ALGEBRA 2 WITH TRIGONOMETRY

Inherent in combinatorial probability is the idea that we sample without replacement. But, there are many probability problems that involve sampling with replacement, or better yet, where each successive event is not affected by the one prior to it. In this case, it will be easier to work with these problems using a fundamental probability law illustrated in *Exercise* #1.

***Exercise* #1:** Consider tossing a standard coin and then rolling a standard six-sided die.

(a) Write the sample space to this experiment using a list of ordered pairs.

(b) Determine the probability of getting a head and a number less than three.

(c) What are the individual probabilities of getting a head and getting a number less than three?

(d) How could your answers in (c) be used to calculate your answer to part (b)?

THE FUNDAMENTAL PROBABILITY PRINCIPLE

Suppose an event, E, can be broken into a sequence of n **independent** sub-events, $E_1, E_2, \ldots, E_n$. The probability that E will occur is given by:

$$P(E) = P(E_1) \cdot P(E_2) \cdot \ldots \cdot P(E_n)$$

This principle can now be applied to what are known as **binomial probability problems**. These occur anytime an event is comprised of repeated trials of the same experiment, where the probability of a successful outcome does not change trial after trial. The formula for this type of probability will be developed in *Exercise* #2.

***Exercise* #2:** On a five question multiple choice test, there are four choices per question. What is the probability of getting exactly three out of the five questions correct?

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BINOMIAL PROBABILITY FORMULA

Suppose an experiment is run with n-trials. If the probability of success for a given trial is p and the probability of failure is q, then the probability of exactly r successes is given by:

$$P = {}_nC_r \cdot p^r \cdot q^{n-r} \quad \text{(where } p + q = 1\text{)}$$

***Exercise* #3:** On an equatorial island, it rains very consistently. If the probability of rain on any given day of the week is $\frac{2}{3}$ then find the following.

(a) The probability it will rain on exactly five out of seven days of a given week.

(b) The probability it will rain on exactly one out of the seven days of a given week.

***Exercise* #4:** Which of the following represents the probability of getting exactly four heads when flipping a fair coin eight times.

(1) $\frac{1}{2}$
(3) $\frac{35}{128}$

(2) $\frac{13}{128}$
(4) $\frac{1}{128}$

____

***Exercise* #5:** Michaela has a probability of making any free-throw in basketball of 80%. If she shoots six free throws in a given game, which of the following is closest to the probability that she will make exactly four out of the six free throws?

(1) 67%
(3) 35%

(2) 12%
(4) 25%

____

***Exercise* #6:** A good hitter in professional baseball will get a hit about $\frac{1}{3}$ of the times he comes up to bat. What is the probability that a good hitter will get a hit each time if he bats four times in a game?

(1) $\frac{3}{4}$
(3) $\frac{1}{81}$

(2) $\frac{4}{81}$
(4) $\frac{4}{9}$

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BINOMIAL PROBABILITY – DAY #1
ALGEBRA 2 WITH TRIGONOMETRY - HOMEWORK

APPLICATIONS

1. If the probability it will rain on Saturday is 25% and the probability it will rain on Sunday is 60%, then which of the following is the probability it will rain both Saturday and Sunday assuming the two events are independent?

(1) 36% (3) 15%

(2) 85% (4) 43% _________

2. The probability that a fair coin will land heads-up on four consecutive tosses is

(1) $\frac{1}{2}$ (3) $\frac{4}{9}$

(2) $\frac{1}{16}$ (4) $\frac{1}{4}$ _________

3. The probability of winning a particular carnival game is $\frac{1}{6}$. If Samuel plays the game five times, which of the following is closest to the probability he will win exactly two of the five games?

(1) 16% (3) 74%

(2) 8% (4) 39% _________

4. Kenyin is taking a short multiple choice quiz with three questions on it. If each question has four choices and Kenyin guess at all the questions, which of the following represents the probability he gets exactly two of the three correct?

(1) $\frac{8}{27}$ (3) $\frac{5}{64}$

(2) $\frac{2}{27}$ (4) $\frac{9}{64}$ _________

5. Jersey is a fantastic goalie who stops three out of every four penalty shots taken on her. In a particularly tough game, she faced five penalty shots. Which of the following represents the probability she let only one of the five shots score?

(1) $\frac{16}{25}$ (3) $\frac{405}{1024}$

(2) $\frac{101}{256}$ (4) $\frac{256}{625}$ _________

6. Harold rolled a standard die four times and recorded the result each time. Determine the probability, in reduced fraction form, that he rolled the following.

(a) Exactly two sixes in the four roles.

(b) Exactly three out of the four roles had numbers greater than four.

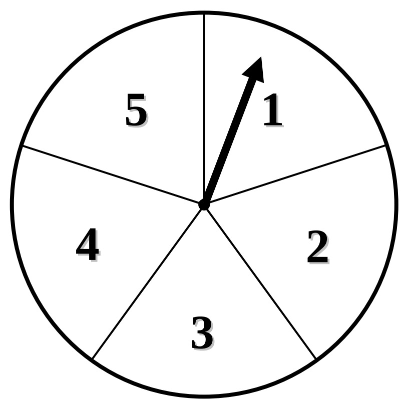
(c) All four of the roles were even numbers.

(d) Exactly one of the four roles was a multiple of three.

7. In a particular game, an arrow is spun around a circle divided into five congruent slices numbered 1 through 5, as shown below. If the arrow is spun exactly three times, do or answer the following.

(a) Fill in the table below for the probability the arrow lands on an even a certain number of times out of the three spins. Express your answers as exact decimals (no rounding).

# of Evens	Calculation	Answer
0	${}_3C_0\left(\frac{2}{5}\right)^0\left(\frac{3}{5}\right)^3$	0.216
1		
2		
3		



(b) What do all of the probabilities sum to in the table in (a)?

(c) Why does your answer to part (b) make sense?

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