Name: ____________________________________ Date: __________________

Sets and Probability
Common Core Algebra II

Since the basic calculation within probability involves counting the number of **outcomes** that fit into a particular **event**, it makes sense to have a tool to visualize and keep track of all of the outcomes in a **sample space**. We will do this by using sets. Recall the basic definition of a set:

SET DEFINITION

A **set** is simply a collection of things (numbers, objects, etcetera) that satisfy a well-defined criteria. The things that are contained in the set are called the **elements** of the set

***Exercise* #1:** The set A is defined as the collection of all integers that are greater than 0 and less than 10.

(a) Write out set A in **roster form**.

(b) Show set A in **Venn Diagram** form. This will be a very simple Venn Diagram.

(c) A **subset** is any set whose elements are all contained within another set. Give two possible rules that could define subsets of A and then write the sets as B and C in roster form. Do sets B and C have any elements in common?

Set B's Definition: ____________________________________ $B =$

Set C's Definition: ____________________________________ $C =$

Let's get back to a bit of probability.

***Exercise* #2:** Consider an experiment where we first toss a coin and note the outcome and then roll a six-sided die and note the outcome.

(a) Write a set of ordered pairs, such as $(H, 4)$, that represents all outcomes for this experiment. Recall that this is called the **sample space**. We will generally call this set S.

(b) Write a set of ordered pairs that represents the event of getting a tail and an even number. Call this set A.

(c) The complement of a set A will be all of the events in the sample space S that do not fall into set A. Write out the complement of set A. We'll call this set B.

(d) Find $P(A)$ and $P(B)$.

A set and its complement are important when we look at probability because all outcomes either fall into an event or into its complement, but not both. Different textbooks use different notations to denote complements. Since the notation is not universal, we will simply refer to complements by name instead of by symbol.

***Exercise* #3:** Consider rolling a single six-sided die and recording the result. Let set A be the event of rolling a number greater than 4 and let set B be the complement of set A.

(a) Draw a Venn Diagram that illustrates the sample space, S, and sets A and B.

(b) Find $P(A)$ and $P(B)$.

(c) What is true of the sum $P(A)+P(B)$?

(d) Prove that the sum of the probability of an event with the probability of its complement will always be 1.

We use the relationship developed in (d) all the time without even thinking about it. Try the following.

***Exercise* #4:** Answer each of the following problems by using the relationship developed in Exercise #3(d).

(a) If the probability I will draw a red marble from a bag is $\frac{3}{17}$, what is the probability that I won't draw a red marble from a bag?

(b) If the probability that it will rain tomorrow is 20%, what is the probability that it won't rain tomorrow?

In theoretical probability calculations, the sets that make up the sample spaces can get difficult to write out. It is good to remember things like tree diagrams to help.

***Exercise* #5:** Two four-sided die are rolled and the number on each is noted.

(a) Draw a tree diagram that represents all outcomes in the sample space. How many are there?

(b) What is the probability that you don't get two of the same number?

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SETS AND PROBABILITY
COMMON CORE ALGEBRA II HOMEWORK

APPLICATION

1. Consider the experiment of picking one of the 12 months at random.

   (a) Write down that sample space, S, for this experiment. What is the value of $n(S)$?

   (b) Let E be the event (set) of picking a month that begins with the letter J. Write out the elements of E.

   (c) What is the probability of E, i.e. $P(E)$?

   (d) What is the probability of picking a month that does *not* start with the letter J?

2. Consider the set, A, of all integers from 1 to 10 inclusive (that means the 1 and the 10 are included in this set). Give a set B that is a subset of A. State its definition and list its elements in roster form. Then give a set C that is the complement of B.

   Set B's Definition: ______________________________ Set B:

   Set C:

3. If A and B are complements, then which of the following is true about the probability of B based on the probability of A?

   (1) $P(B)=P(A)+1$

   (3) $P(B)=\dfrac{1}{P(A)}$

   (2) $P(B)=1-P(A)$

   (4) $P(B)=P(A)-1$

   ____

4. If a fair coin is flipped three times, the probability it will land heads up all three times is $\frac{1}{8}$. Which of the following is the probability that when a coin is flipped three times at least one tail will show up?

   (1) $\frac{7}{8}$

   (3) $\frac{3}{2}$

   (2) $\frac{1}{8}$

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

   ____

5. A four-sided die, in the shape of a tetrahedron, is rolled twice and the number rolled is recorded each time.

(a) Draw a tree-diagram that shows the sample space, S, of this experiment. How many elements are in S?

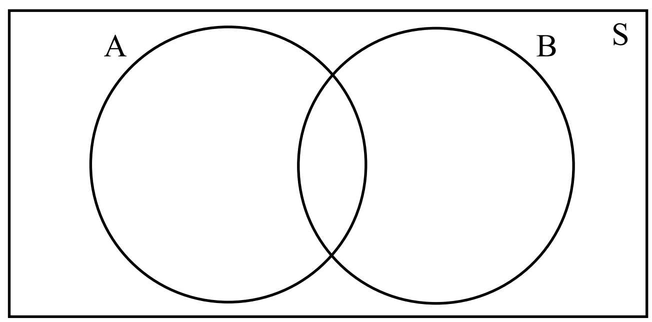
(b) Let E be the event of rolling two numbers that have an odd product. List all of the elements of E as ordered pairs.

(c) What is the probability that the two rolled numbers have a product that is odd?

(d) What is the probability that the two rolled numbers have a product that is even?

Reasoning

6. Consider the set of all integers from 1 to 10, i.e. $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$, to be our sample space, S. Let A be the set of all integers in S that are even and let B be the set of all integers in S that are multiples of 3. Fill in the circles of the Venn diagram with elements from S. If an element lies in both sets, place it in the overlapping region.



7. Find in the following:

$n(A) =$ $\qquad$ $n(B) =$

8. Why is the following equation *not* true? Explain.

$$n(S) = n(A) + n(B)$$