Name: _____ Date: _____

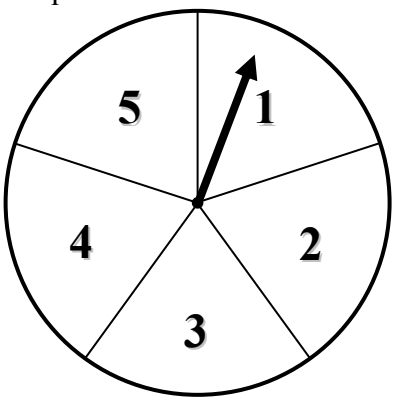
INTRODUCTION TO PROBABILITY
COMMON CORE ALGEBRA II

Mathematics seeks to quantify and model just about everything. One of the greatest challenges is to try to quantify chance. But that is exactly what probability seeks to do. With probability, we attempt to assign a number to how likely an **event** is to occur. Terminology in probability is important, so we introduce some basic terms here:

BASIC PROBABILITY TERMINOLOGY

1. **Experiment:** Some process that occurs with well defined outcomes.
2. **Outcome:** A result from a single **trial** of the experiment.
3. **Event:** A collection of one or more outcomes.
4. **Sample Space:** A collection of all of the outcomes of an experiment.

***Exercise* #1:** An experiment is run whereby a spinner is spun around a circle with 5 equal sectors that have been marked off as shown.



(a) What is the **experiment**?

(b) Give one outcome of the experiment.

(c) What is the probability of spinning the spinner and landing on an odd number? What is the event here? What outcomes fall into the event?

The answer from (c) helps us to define the basic formula that dictates all probability calculations:

THE BASIC DEFINITION OF PROBABILITY

The probability of an event E occurring is given by the ratio: $P(E)=\dfrac{n(E)}{n(S)}$, where:

$n(E)$ is the number of outcomes that fall into the event E

$n(S)$ is the number of outcomes that fall into the sample space

***Exercise* #2:** Given the above definition, between what two numbers must ALL probabilities lie? Explain.

When we deal with **theoretical probability** we don't actually have to run the experiment to determine the probability of an event. We simply have to know the number of outcomes in the sample space and the number of outcomes that fall into our event. Let's take a look at a slightly more challenging scenario.

***Exercise* #3:** A fair coin is flipped three times and the result is noted each time. The sample space consists of **ordered triples** such as (H, H, T), which would represent a head on the first toss, a head on the second toss, and a tail on the third toss.

(a) Draw a **tree diagram** to show all of the different outcomes in the sample space.

(b) List all of the outcomes as ordered triples. How many of them are there?

(c) Find each of the following probabilities based on your answers from (a) and (b):

(i) $P(\text{all heads})$ (ii) $P(\text{exactly 2 heads})$ (iii) $P(\text{all heads or all tails})$

Sometimes we have to quantify chance by using observations that have been made in the real-world. In this case we talk about **empirical probability**. The fundamental equation for probability still stands.

***Exercise* #4:** A survey was done by a marketing company to determine which of three sodas was preferred by people in a blind taste test. The results are shown below.

Soda	Number who Preferred
A	18
B	24
C	11
Total	53

(a) Find the empirical probability that a person selected at random from this group would prefer soda B. Express your answer as a fraction and as a decimal accurate to two decimal places (the standard).

(b) Find the empirical probability that a person selected at random from this group would *not* prefer soda A. Again, express your answer as a fraction and as a decimal accurate to two decimal places.

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INTRODUCTION TO PROBABILITY
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FLUENCY

1. Which of the following could *not* be the value of a probability? Explain your choice.

   (1) 53% (3) $\frac{5}{4}$

   (2) 0.78 (4) $\frac{3}{4}$

_____

2. If a month is picked at random, which of the following represent the probability its name will begin with the letter J?

   (1) 0.08 (3) 0.12

   (2) 0.25 (4) 0.33

_____

3. If a coin is tossed twice, which of the following gives the probability that it will land both times heads up or both times tails up?

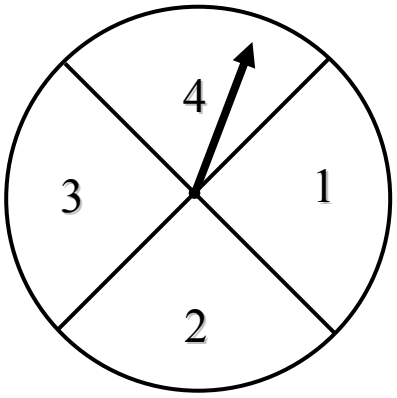
   (1) 0.75 (3) 0.25

   (2) 0.67 (4) 0.50

_____

4. A spinner is now created with four equal sized sectors as shown. An experiment is run where the spinner is spun twice and the outcome is recorded each time.

   (a) Create a sample space list of ordered pairs that represent the outcomes, such as $(4, 2)$, which represent spinning a 4 on the first spin and a 2 on the second spin.



   (b) Using your answer from (a), determine the probability of obtaining two numbers with a sum of 4.

APPLICATIONS

5. Samuel pulls two coins out of his pocket randomly without replacement. If his pocket contains one nickel, one dime, and one quarter, what is the probability that he pulled more than 20 cents out of his pocket? Justify your work by creating a tree diagram or a sample space.

6. Janice, Tom, John, and Tamara are trying to decide on who will make dinner and who will wash the dishes afterwards. They randomly pull two names out of a hat to decide, where the first name drawn will make dinner and the second will do the dishes. Determine the probability that the two people pulled will have first names beginning with the same letter. Assume the same person cannot be picked for both.

7. A blood collection agency tests 50 blood samples to see what type they are. Their results are shown in the table below.

Blood Type	Number of Samples
O	18
A	22
B	7
AB	3
Total	50

(a) If a blood sample is picked at random, what is the probability it will be type B?

(b) If a blood sample is picked at random, what is the probability it will not be type O?

(c) Are the two probabilities you calculated in (a) and (b) **theoretical** or **empirical**? Explain your choice.