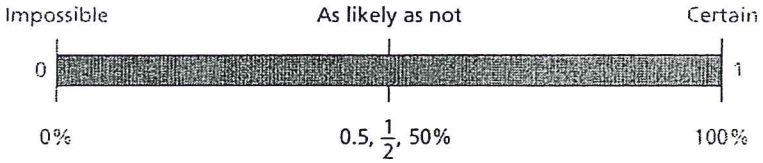
Theoretical and Experimental Probability

Probability is the measure of how likely an event is to occur. Each possible result of an experiment or situation is called an **outcome**. The **sample space** is the set of all possible outcomes.

Probabilities are written as fractions or decimals from 0 to 1, or as percents from 0% to 100%.



Theoretical Probability

$$P(event) = \frac{number\ of\ favorable\ outcomes}{number\ of\ outcomes\ in\ the\ sample\ space}$$

Example #1

A CD has 5 rap songs and 7 country songs. What is the probability that a randomly selected song is a rap song?

$$P(rap\ song) = \frac{5}{12} = 41.7\%$$

Now let's look at a probability problem that uses Permutations/Combinations.

Example #2

Each student received a 4-digit code to use the library computers, with no digit repeated. Manu received the code 7654. What was the probability that he would receive a code of consecutive numbers?

Step 1: Does this problem use Permutations or Combinations?
Does the order of the numbers matter? Yes or No? Yes

Step 2: Since order is important we will use Permutations.

There are 10 different digits and we are picking 4 of them. Let's find out what our total sample space will be.

$${}_{10}P_4 = \frac{10!}{6!} \rightarrow \frac{10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1} \rightarrow 10 * 9 * 8 * 7 = 5{,}040$$

Step 3: Find the number of favorable outcomes.

The favorable outcomes would be 0123, 1234, 2345, 3456, 4567, 5678, 6789, and the reverse order of each of those. That is a total of 14 favorable outcomes.

Step 4: Find the probability.

$$P(\text{consecutive numbers}) = \frac{14}{5040} = \frac{1}{360}$$

Experimental Probability

$$\text{experimental probability} = \frac{\textit{number of times the event occurs}}{\textit{number of trials}}$$

We often use experimental probability to estimate theoretical probability and to make predictions about real world events.

Example #1

The table below shows the results of choosing one card from a deck of cards, recording the suit, and then replacing the card.

Card Suit	Hearts	Diamonds	Clubs	Spades
Number	5	9	7	5

Find the experimental probability of choosing a diamond. 9/26

Find the experimental probability of choosing a card that is not a club. 19/26

You should now be able to do the following things:

- I can distinguish between theoretical and experimental probability.
- I can find theoretical and experimental probabilities.
- I can define and interpret commonly used expressions of probability.
- I can understand and construct sample spaces.

Assignment: Practice B Worksheet + Practice C Worksheet

Name Mr. Ward Date _____ Class _____

LESSON 11-2

Practice B

Theoretical and Experimental Probability

Solve.

1. A fruit bowl contains 4 green apples and 7 red apples. What is the probability that a randomly selected apple will be green? $4/11$

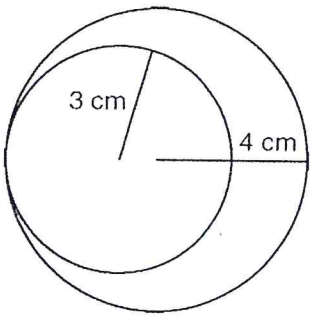
2. When two number cubes labeled 1–6 are rolled, what is the probability that the result will be two 4's? $\frac{1}{6} \cdot \frac{1}{6} = 1/36$

3. Joanne is guessing which day in November is Bess's birthday. Joanne knows that Bess's birthday does not fall on an odd-numbered day. What is the probability that Joanne will guess the correct day on her first try? $1/15$

4. Tom has a dollar's worth of dimes and a dollar's worth of nickels in his pocket. (10) (20)
   a. What is the probability he will randomly select a nickel from his pocket? $20/30 = 2/3$
   b. What is the probability he will randomly select a dime from his pocket? $10/30 = 1/3$

5. Clarice has 7 new CDs; 3 are classical music and the rest are pop music. If she randomly grabs 3 CDs to listen to in the car on her way to school, what is the probability that she will select only classical music? $\frac{3}{7} \cdot \frac{2}{6} \cdot \frac{1}{5} = 1/35$

6. Find the probability that a point chosen at random inside the larger circle shown here will also fall inside the smaller circle.



Area $= \pi r^2$

$\frac{\pi(3)^2}{\pi(4)^2}$

$9/16$

Frank is playing darts. The results of his throws are shown in the table below. Assume that his results continue to follow this trend.

Color Hit	Number of Throws
Blue	12
Red	5
White	2

Find the experimental probability of each event.

7. Frank's next throw will hit white. $2/19$
8. Frank's next throw will hit blue. $12/19$
9. Frank's next throw will hit either red or white. $7/19$
10. Frank's next throw will NOT hit red. $14/19$

Name Mr. Ward Date _____ Class _____

LESSON 11-2

Practice C

Theoretical and Experimental Probability

Solve.

1. A bowl contains 36 blue, 75 green, and 19 yellow jelly beans. What is the probability of randomly selecting a green jelly bean?

$75/130 = 15/26$

2. Two spinners numbered 1–6 are spun. If all numbers are equally likely, what is the probability that the result will be two even numbers?

$\frac{3}{6} \cdot \frac{3}{6} = 1/4$

3. Four quilters are preparing patches for a quilt. When finished, the quilt will contain 200 patches. The quilters' contributions thus far are in the table below.

Name	Number of Patches
Lia	65
Brian	17
Elle	88
Len	6

176

a. What is the probability that a randomly chosen patch will have been sewn by Elle?

$88/176 = 1/2$

b. What is the probability that a randomly chosen patch will not have been sewn by Lia?

$111/176$

c. What is the probability that a randomly chosen patch will have been sewn by Brian or Len?

$23/176$

A hacker is trying to break into his school's computer system to change his F's to A's. The computer system access password is 5 digits.

4. If digits in the password are allowed to repeat, what is the probability that the hacker will guess the password correctly on the first try?

$\frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10} = 1/100,000$

5. The hacker learns that the password does not contain any repeated digits. What is the new probability that he will randomly guess the password correctly?

$\frac{1}{10} \cdot \frac{1}{9} \cdot \frac{1}{8} \cdot \frac{1}{7} \cdot \frac{1}{6} = 1/30,240$

6. If the password contains no repeated digits, what is the probability that the digits in the school password have a sum less than 10?

0 $(0+1+2+3+4 = 10$ not $< 10)$

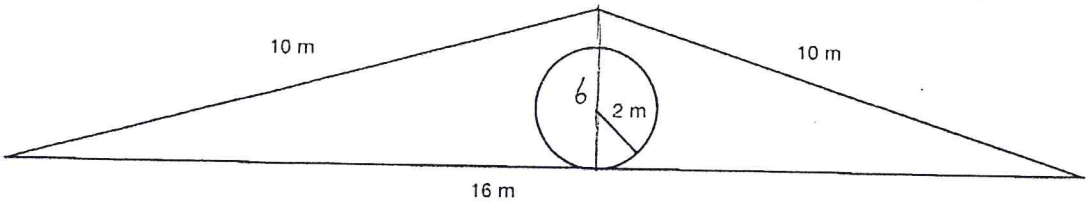
Use the diagram to find each probability.

7. That a random point is within the circle in the triangle

$4\pi/48 = \pi/12$

8. That a random point is NOT within the circle in the triangle

$1 - \pi/12$



Area of $\Delta = \frac{1}{2} \cdot b \cdot h$

$= \frac{1}{2} \cdot 16 \cdot 6$

$= 48_m{}^2$

Area of $\bigcirc = \pi r^2$

$= \pi (2)^2$

$= 4\pi_m{}^2$