10.4 Compound Events

Essential Question How can you find the number of possible outcomes of one or more events?

1 ACTIVITY: Comparing Combination Locks

Work with a partner. You are buying a combination lock. You have three choices.

a. This lock has 3 wheels. Each wheel is numbered from 0 to 9.

The least three-digit combination possible is ____.

The greatest three-digit combination possible is ____.

How many possible combinations are there?

b. Use the lock in part (a).

There are ____ possible outcomes for the first wheel.

There are ____ possible outcomes for the second wheel.

There are ____ possible outcomes for the third wheel.

How can you use multiplication to determine the number of possible combinations?

c. This lock is numbered from 0 to 39. Each combination uses three numbers in a right, left, right pattern. How many possible combinations are there?

d. This lock has 4 wheels.

Wheel 1: 0–9

Wheel 2: A–J

Wheel 3: K–T

Wheel 4: 0–9

How many possible combinations are there?

e. For which lock is it most difficult to guess the combination? Why?

Common Core

Probability and Statistics

In this lesson, you will

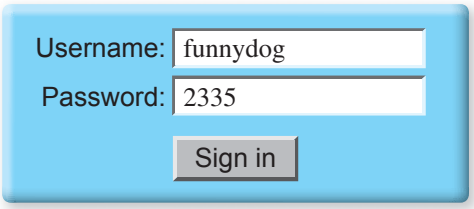
- use tree diagrams, tables, or a formula to find the number of possible outcomes.
- find probabilities of compound events.

Learning Standards
7.SP.8a
7.SP.8b

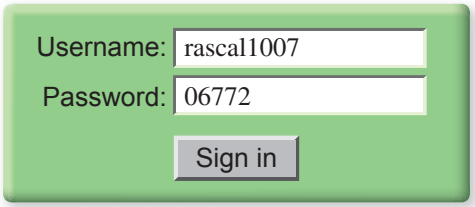
2 ACTIVITY: Comparing Password Security

Work with a partner. Which password requirement is most secure? Explain your reasoning. Include the number of different passwords that are possible for each requirement.

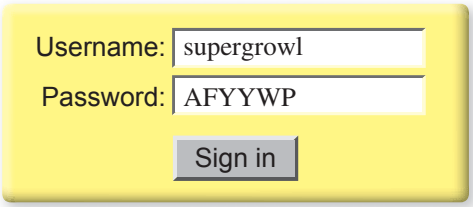
a. The password must have four digits.



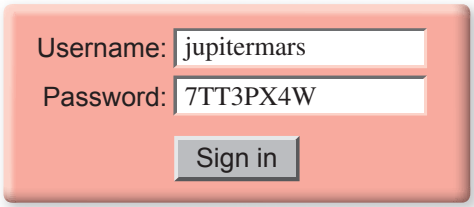
b. The password must have five digits.



c. The password must have six letters.



d. The password must have eight digits or letters.



Math Practice 7

View as Components

What is the number of possible outcomes for each character of the password? Explain.

What Is Your Answer?

3. **IN YOUR OWN WORDS** How can you find the number of possible outcomes of one or more events?

4. **SECURITY** A hacker uses a software program to guess the passwords in Activity 2. The program checks 600 passwords per minute. What is the greatest amount of time it will take the program to guess each of the four types of passwords?

Practice Use what you learned about the total number of possible outcomes of one or more events to complete Exercise 5 on page 425.

10.4 Lesson

Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Vocabulary
sample space, *p. 422*
Fundamental Counting Principle, *p. 422*
compound event, *p. 424*

The set of all possible outcomes of one or more events is called the **sample space**.

You can use tables and tree diagrams to find the sample space of two or more events.

EXAMPLE 1 Finding a Sample Space

You randomly choose a crust and style of pizza. Find the sample space. How many different pizzas are possible?

Use a tree diagram to find the sample space.

Crust	*Style*	*Outcome*
Thin	Hawaiian	Thin Crust Hawaiian
	Mexican	Thin Crust Mexican
	Pepperoni	Thin Crust Pepperoni
	Veggie	Thin Crust Veggie
Stuffed	Hawaiian	Stuffed Crust Hawaiian
	Mexican	Stuffed Crust Mexican
	Pepperoni	Stuffed Crust Pepperoni
	Veggie	Stuffed Crust Veggie

∴ There are 8 different outcomes in the sample space. So, there are 8 different pizzas possible.

On Your Own

Now You're Ready
Exercises 6 and 7

1. **WHAT IF?** The pizza shop adds a deep dish crust. Find the sample space. How many pizzas are possible?

Another way to find the total number of possible outcomes is to use the **Fundamental Counting Principle**.

Study Tip
The Fundamental Counting Principle can be extended to more than two events.

Key Idea

Fundamental Counting Principle

An event M has m possible outcomes. An event N has n possible outcomes. The total number of outcomes of event M followed by event N is $m \times n$.

EXAMPLE 2 Finding the Total Number of Possible Outcomes

Find the total number of possible outcomes of rolling a number cube and flipping a coin.

Method 1: Use a table to find the sample space. Let H = heads and T = tails.

	1	2	3	4	5	6
	1H	2H	3H	4H	5H	6H
	1T	2T	3T	4T	5T	6T

∴ There are 12 possible outcomes.

Method 2: Use the Fundamental Counting Principle. Identify the number of possible outcomes of each event.

Event 1: Rolling a number cube has 6 possible outcomes.

Event 2: Flipping a coin has 2 possible outcomes.

$6 \times 2 = 12$ Fundamental Counting Principle

∴ There are 12 possible outcomes.

EXAMPLE 3 Finding the Total Number of Possible Outcomes

How many different outfits can you make from the T-shirts, jeans, and shoes in the closet?

Use the Fundamental Counting Principle. Identify the number of possible outcomes for each event.

Event 1: Choosing a T-shirt has 7 possible outcomes.

Event 2: Choosing jeans has 4 possible outcomes.

Event 3: Choosing shoes has 3 possible outcomes.

$7 \times 4 \times 3 = 84$ Fundamental Counting Principle

∴ So, you can make 84 different outfits.

On Your Own

Now You're Ready
Exercises 8–11

2. Find the total number of possible outcomes of spinning the spinner and choosing a number from 1 to 5.
3. How many different outfits can you make from 4 T-shirts, 5 pairs of jeans, and 5 pairs of shoes?

A **compound event** consists of two or more events. As with a single event, the probability of a compound event is the ratio of the number of favorable outcomes to the number of possible outcomes.

EXAMPLE 4 Finding the Probability of a Compound Event

In Example 2, what is the probability of rolling a number greater than 4 and flipping tails?

There are two favorable outcomes in the sample space for rolling a number greater than 4 and flipping tails: 5T and 6T.

$$P(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}}$$

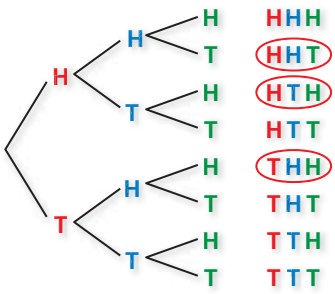
$$P(\text{greater than 4 and tails}) = \frac{2}{12} \quad \text{Substitute.}$$

$$= \frac{1}{6} \quad \text{Simplify.}$$

∴ The probability is $\frac{1}{6}$, or $16\frac{2}{3}\%$.

EXAMPLE 5 Finding the Probability of a Compound Event

You flip three nickels. What is the probability of flipping two heads and one tails?



Use a tree diagram to find the sample space. Let H = heads and T = tails.

There are three favorable outcomes in the sample space for flipping two heads and one tails: HHT, HTH, and THH.

$$P(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}}$$

$$P(\text{2 heads and 1 tails}) = \frac{3}{8} \quad \text{Substitute.}$$

∴ The probability is $\frac{3}{8}$, or 37.5%.

On Your Own

Now You're Ready
Exercises 15–24

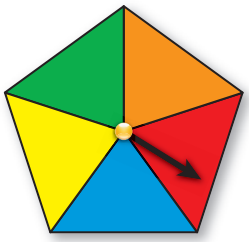
4. In Example 2, what is the probability of rolling at most 4 and flipping heads?
5. In Example 5, what is the probability of flipping at least two tails?
6. You roll two number cubes. What is the probability of rolling double threes?
7. In Example 1, what is the probability of choosing a stuffed crust Hawaiian pizza?

10.4 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

Vocabulary and Concept Check

1. **VOCABULARY** What is the sample space of an event? How can you find the sample space of two or more events?
2. **WRITING** Explain how to use the Fundamental Counting Principle.
3. **WRITING** Describe two ways to find the total number of possible outcomes of spinning the spinner and rolling the number cube.
4. **OPEN-ENDED** Give a real-life example of a compound event.



Practice and Problem Solving

5. **COMBINATIONS** The lock is numbered from 0 to 49. Each combination uses three numbers in a right, left, right pattern. Find the total number of possible combinations for the lock.

Use a tree diagram to find the sample space and the total number of possible outcomes.

1

6.

Birthday Party	
Event	Miniature golf, Laser tag, Roller skating
Time	1:00 P.M.–3:00 P.M., 6:00 P.M.–8:00 P.M.

7.

New School Mascot	
Type	Lion, Bear, Hawk, Dragon
Style	Realistic, Cartoon

Use the Fundamental Counting Principle to find the total number of possible outcomes.

2

8.

Beverage	
Size	Small, Medium, Large
Flavor	Milk, Orange juice, Apple juice, Iced tea, Lemonade, Water, Coffee

9.

MP3 Player	
Memory	2 GB, 4 GB, 8 GB, 16 GB
Color	Silver, Green, Blue, Pink, Black

3

10.

Clown	
Suit	Dots, Stripes, Checkers board
Wig	One color, Multicolor
Talent	Balloon animals, Juggling, Unicycle, Magic

11.

Meal	
Appetizer	Nachos, Soup, Spinach dip, Salad, Applesauce
Entrée	Chicken, Beef, Spaghetti, Fish
Dessert	Yogurt, Fruit, Ice cream

12. **NOTE CARDS** A store sells three types of note cards. There are three sizes of each type. Show two ways to find the total number of note cards the store sells.

13. **ERROR ANALYSIS** A true-false quiz has five questions. Describe and correct the error in using the Fundamental Counting Principle to find the total number of ways that you can answer the quiz.

✗ $2 + 2 + 2 + 2 + 2 = 10$

You can answer the quiz in 10 different ways.

14. **CHOOSE TOOLS** You randomly choose one of the marbles. Without replacing the first marble, you choose a second marble.

   a. Name two ways you can find the total number of possible outcomes.

   b. Find the total number of possible outcomes.

You spin the spinner and flip a coin. Find the probability of the compound event.

4 15. Spinning a 1 and flipping heads

16. Spinning an even number and flipping heads

17. Spinning a number less than 3 and flipping tails

18. Spinning a 6 and flipping tails

19. *Not* spinning a 5 and flipping heads

20. Spinning a prime number and *not* flipping heads

You spin the spinner, flip a coin, then spin the spinner again. Find the probability of the compound event.

5 21. Spinning blue, flipping heads, then spinning a 1

22. Spinning an odd number, flipping heads, then spinning yellow

23. Spinning an even number, flipping tails, then spinning an odd number

24. *Not* spinning red, flipping tails, then *not* spinning an even number

25. **TAKING A TEST** You randomly guess the answers to two questions on a multiple-choice test. Each question has three choices: A, B, and C.

   a. What is the probability that you guess the correct answers to both questions?

   b. Suppose you can eliminate one of the choices for each question. How does this change the probability that your guesses are correct?

26. PASSWORD You forget the last two digits of your password for a website.

a. What is the probability that you randomly choose the correct digits?

b. Suppose you remember that both digits are even. How does this change the probability that your choices are correct?

27. COMBINATION LOCK The combination lock has 3 wheels, each numbered from 0 to 9.

a. What is the probability that someone randomly guesses the correct combination in one attempt?

b. Explain how to find the probability that someone randomly guesses the correct combination in five attempts.

28. TRAINS Your model train has one engine and eight train cars. Find the total number of ways you can arrange the train. (The engine must be first.)

29. REPEATED REASONING You have been assigned a 9-digit identification number.

a. Why should you use the Fundamental Counting Principle instead of a tree diagram to find the total number of possible identification numbers?

b. How many identification numbers are possible?

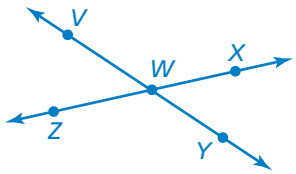
c. RESEARCH Use the Internet to find out why the possible number of Social Security numbers is not the same as your answer to part (b).

30. Problem Solving From a group of 5 candidates, a committee of 3 people is selected. In how many different ways can the committee be selected?

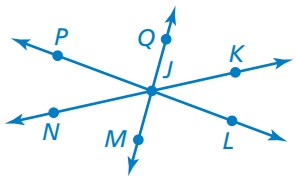
Fair Game Review What you learned in previous grades & lessons

Name two pairs of adjacent angles and two pairs of vertical angles in the figure. *(Section 7.1)*

31.



32.



33. MULTIPLE CHOICE A drawing has a scale of 1 cm : 1 m. What is the scale factor of the drawing? *(Section 7.5)*

(A) 1 : 1 (B) 1 : 100 (C) 10 : 1 (D) 100 : 1