Main Idea
Find the probability of a simple event.

New Vocabulary
- outcome
- simple event
- probability
- random
- complementary event

Math Online
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- Concepts In Motion
- Extra Examples
- Personal Tutor
- Self-Check Quiz

Food
A cheesecake has four slices of each type as shown.

1. What fraction of the cheesecake is chocolate? Write in simplest form.
2. Suppose your friend gives you the first piece of cheesecake without asking which type you prefer. Are your chances of getting original the same as getting raspberry?

An outcome is any one of the possible results of an action. A simple event is one outcome or a collection of outcomes. For example, getting a piece of chocolate cheesecake is a simple event. The chance of that event happening is called its probability.

Probability

**Key Concept**

**Words**
If all outcomes are equally likely, the probability of a simple event is a ratio that compares the number of favorable outcomes to the number of possible outcomes.

**Symbols**

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

**Example**
Find Probability

1. What is the probability of rolling an even number on a number cube marked with 1, 2, 3, 4, 5, and 6 on its faces?

\[
P(\text{even number}) = \frac{\text{even numbers possible}}{\text{total numbers possible}} = \frac{3}{6} = \frac{1}{2} \]

The probability of rolling an even number is \( \frac{1}{2} \), 0.5, or 50%.

Use the number cube above to find each probability. Write as a fraction in simplest form.

a. \( P(\text{odd number}) \)

b. \( P(\text{5 or 6}) \)

c. \( P(\text{prime number}) \)
Outcomes occur at **random** if each outcome occurs by chance. For example, rolling a number on a number cube occurs at random.

**TALENT COMPETITION** Simone and her three friends were deciding how to pick the song they will sing for their school’s talent show. They decide to roll a number cube. The person with the lowest number chooses the song. If her friends rolled a 6, 5, and 2, what is the probability that Simone will get to choose the song?

The possible outcomes of rolling a number cube are 1, 2, 3, 4, 5, and 6. In order for Simone to be able to choose the song, she will need to roll a 1.

Let \( P(A) \) be the probability that Simone chooses the song.

\[
P(A) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}} = \frac{1}{6}
\]

There are 6 possible outcomes, and 1 of them is favorable.

The probability that Simone will choose the song is \( \frac{1}{6} \), or about 17%.

**CHECK Your Progress**

**MUSIC** The table shows the numbers of brass instrument players in the New York Philharmonic. Suppose one brass instrument player is randomly selected to be a featured performer. Find the probability of each event. Write as a fraction in simplest form.

<table>
<thead>
<tr>
<th>New York Philharmonic Brass Instrument Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horn 6</td>
</tr>
<tr>
<td>Trombone 4</td>
</tr>
<tr>
<td>Trumpet 3</td>
</tr>
<tr>
<td>Tuba 1</td>
</tr>
</tbody>
</table>

Source: New York Philharmonic

d. \( P(\text{trumpet}) \)  
e. \( P(\text{brass}) \)  
f. \( P(\text{flute}) \)  
g. \( P(\text{horn or tuba}) \)

The probability that an event will happen can be any number from 0 to 1, including 0 and 1, as shown on the number line below. Notice that probabilities can be written as fractions, decimals, or percents.
Either Simone will go first or she will not go first. These two events are **complementary events**. The sum of the probabilities of an event and its complement is 1 or 100%. In symbols, \( P(A) + P(\text{not } A) = 1 \).

**Complementary Events**

**TALENT COMPETITION** Refer to Example 2. Find the probability that Simone will not choose the song.

The probability that Simone will not choose the song is the complement of the probability that Simone will choose the song.

\[
P(A) + P(\text{not } A) = 1 \quad \text{Definition of complementary events}
\]

\[
\frac{1}{6} + P(\text{not } A) = 1 \quad \text{Replace } P(A) \text{ with } \frac{1}{6},
\]

\[
\frac{1}{6} \quad \text{Subtract } \frac{1}{6} \text{ from each side.}
\]

\[
P(\text{not } A) = \frac{5}{6}
\]

The probability that Simone will not choose the song is \( \frac{5}{6} \), or about 83%.

**SCHOOL** Ramón’s teacher uses a spinner similar to the one shown at the right to determine the order in which each group will make their presentation. Use the spinner to find each probability. Write as a fraction in simplest form.

**Example 1** (p. 460)

Use the spinner to find each probability. Write as a fraction in simplest form.

1. \( P(M) \)
2. \( P(Q \text{ or } R) \)
3. \( P(\text{vowel}) \)

**Examples 2, 3** (pp. 461–462)

**MARBLES** Robert has a bag that contains 7 blue, 5 purple, 12 red, and 6 orange marbles. Find each probability if he draws one marble at random from the bag. Write as a fraction in simplest form.

4. \( P(\text{purple}) \)
5. \( P(\text{red or orange}) \)
6. \( P(\text{green}) \)
7. \( P(\text{not blue}) \)
8. \( P(\text{not red or orange}) \)
9. \( P(\text{not yellow}) \)

**Example 3** (p. 462)

10. **SURVEYS** Shanté asked her classmates how many pets they own. The responses are in the table. If a student in her class is selected at random, what is the probability that the student does not own 3 or more pets?
A set of 20 cards is numbered 1, 2, 3, \ldots, 20. Suppose you pick a card at random without looking. Find the probability of each event. Write as a fraction in simplest form.

11. \( P(1) \)
12. \( P(3 \text{ or } 13) \)
13. \( P(\text{multiple of } 3) \)
14. \( P(\text{even number}) \)
15. \( P(\text{not } 20) \)
16. \( P(\text{not a factor of } 10) \)

**RAFFLE** The table shows those students in seventh grade who entered in the school drawing to win lunch with the principal. Suppose that only one student is randomly selected to win. Find the probability of each event. Write as a fraction in simplest form.

17. \( P(\text{girl}) \)
18. \( P(\text{boy}) \)
19. \( P(\text{Room } 12) \)
20. \( P(\text{Room } 10) \)
21. \( P(\text{girl or boy}) \)
22. \( P(\text{Room } 11) \)
23. \( P(\text{not Room } 10) \)
24. \( P(\text{Room } 10 \text{ or } 11) \)

25. **SOUP** A cupboard contains 20 soup cans. Seven are tomato, 4 are cream of mushroom, 5 are chicken, and 4 are vegetable. If one can is chosen at random from the cupboard, what is the probability that it is neither cream of mushroom nor vegetable soup? Write as a percent.

26. **VIDEOS** In a drawing, one name is randomly chosen from a jar of 75 names to receive free video rentals for a month. If Enola entered her name 8 times, what is the probability that she is not chosen to receive the free rentals? Write as a fraction in simplest form.

27. **PETS** The graph shows the last 33 types of pets that were purchased at a local pet store. Based on this, what is the probability that the next pet purchased will be a dog? Write as a fraction in simplest form.

28. **GAMES** For a certain game, the probability of choosing a card with the number 13 is 0.008. What is the probability of not choosing card 13?

29. **WEATHER** The forecast for tomorrow says that there is a 37% chance of rain. Describe the complementary event and predict its probability.

30. **ANNOUNCEMENTS** There are 90 students in the seventh grade. Fifty-two of those students are girls. If one student will be chosen at random to read the morning announcements for the week, what is the probability that the student is a boy?
31. **REASONING** A leap year has 366 days and occurs in non-century years that are evenly divisible by 4. The extra day is added as February 29th. Determine whether each probability is 0 or 1. Explain your reasoning.
   a. \( P(\text{there will be 29 days in February in 2032}) \)
   b. \( P(\text{there will be 29 days in February in 2058}) \)

32. **CHALLENGE** A bag contains 6 red marbles, 4 blue marbles, and 8 green marbles. How many marbles of each color should be added so that the total number of marbles is 27, but the probability of randomly selecting one marble of each color remains unchanged? Explain your reasoning.

33. **Which One Doesn’t Belong?** Identify the pair of probabilities that does not represent probabilities of complementary events. Explain your reasoning.

   \[
   \frac{3}{5}, \frac{2}{5} \quad 0.625, \frac{3}{8} \quad \frac{6}{8}, \frac{1}{4} \quad 0.33, 0.44
   \]

34. **WRITING IN MATH** Marissa has 5 black T-shirts, 2 purple T-shirts, and 1 orange T-shirt. Without calculating, determine whether each of the following probabilities is reasonable if she randomly selects one T-shirt. Explain your reasoning.
   a. \( P(\text{black T-shirt}) = \frac{1}{3} \)
   b. \( P(\text{orange T-shirt}) = \frac{4}{5} \)
   c. \( P(\text{purple T-shirt}) = \frac{1}{4} \)

35. A bag contains 8 blue marbles, 15 red marbles, 10 yellow marbles, and 3 brown marbles. If a marble is randomly selected, what is the probability that it will be brown?
   A 0.27       C 0.083
   B 11%        D \( \frac{3}{8} \)

36. What is the probability of the spinner landing on a number less than 3?
   F 25%       H 50%
   G 37.5%     J 75%

37. **RAIN** The scatter plot shows the relationship between rainfall and lawn growth. Why might the graph be misleading? (Lesson 8-9)

38. **PARKS** A researcher randomly selected 100 households near a city park. Of these, 26% said they visit the park daily. If there are 500 households near the park, about how many visit it daily? (Lesson 8-8)

39–33. See margin.

34. See Ch. 9 Answer Appendix.

**Spiral Review**

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**GET READY for the Next Lesson**

**PREREQUISITE SKILL** Write each fraction in simplest form. (Lesson 4-4)

39. \( \frac{2}{6} \)
40. \( \frac{6}{8} \)
41. \( \frac{15}{30} \)
42. \( \frac{6}{16} \)
43. \( \frac{18}{32} \)