

The odds *against* an event occurring are the odds that the event will *not* occur.

Study Tip

In this text, a *standard deck of cards* always indicates 52 cards in 4 suits of 13 cards each.

Example 3 Odds Against an Event

A card is selected at random from a standard deck of 52 cards. What are the odds against selecting a 3?

There are four 3s in a deck of cards, and there are $52 - 4$ or 48 cards that are not a 3.

odds against a 3 = $\frac{48}{4}$ ← number of ways to *not* pick a 3

The odds against selecting a 3 from a deck of cards are 12:1.

Example 4 Probability and Odds

WEATHER A weather forecast states that the probability of rain the next day is 40%. What are the odds that it will rain?

The probability that it will rain is 40%, so the probability that it will not rain is 60%.

odds of rain = 40:60 or 2:3

The odds that it will rain tomorrow are 2:3.

Check for Understanding

Concept Check

- OPEN ENDED** Give an example of an impossible event, a certain event, and an equally likely event when a die is rolled.
- Describe** how to find the odds of an event occurring if the probability that the event will occur is $\frac{3}{5}$.
- FIND THE ERROR** Mark and Doug are finding the probability of picking a red card from a standard deck of cards.

Mark

$$P(\text{red card}) = \frac{26}{26} \text{ or } \frac{1}{1}$$

Doug

$$P(\text{red card}) = \frac{26}{52} \text{ or } \frac{1}{2}$$

Who is correct? Explain your reasoning.

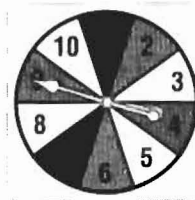
Guided Practice

A card is selected at random from a standard deck of cards. Determine each probability.

- $P(5)$
- $P(\text{red } 10)$
- $P(\text{odd number})$
- $P(\text{queen of hearts or jack of diamonds})$

Find the odds of each outcome if the spinner is spun once.

- multiple of 3
- even number less than 8
- odd number or blue
- red or yellow



Application

NUMBER THEORY One of the factors of 48 is chosen at random.

- What is the probability that the chosen factor is not a multiple of 4?
- What is the probability that the number chosen has 4 and 6 as two of its factors?

Practice and Apply

Homework Help

For Exercises	See Examples
14–35, 51, 54, 56	1
36–47, 52, 53, 55	2, 3
48, 49	4

Extra Practice See page 824.

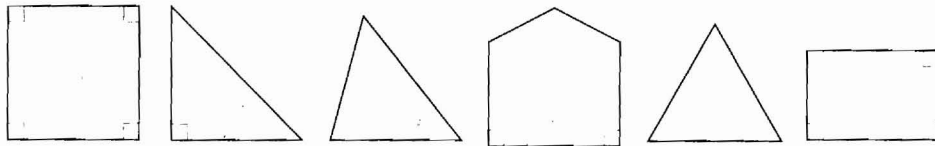
One coin is randomly selected from a jar containing 70 nickels, 100 dimes, 80 quarters, and 50 1-dollar coins. Find each probability.

- | | |
|-----------------------------------------|--------------------------------------------|
| 14. $P(\text{quarter})$ | 15. $P(\text{dime})$ |
| 16. $P(\text{nickel or dollar})$ | 17. $P(\text{quarter or nickel})$ |
| 18. $P(\text{value less than } \$1.00)$ | 19. $P(\text{value greater than } \$0.10)$ |
| 20. $P(\text{value at least } \$0.25)$ | 21. $P(\text{value at most } \$1.00)$ |

Two dice are rolled, and their sum is recorded. Find each probability.

- | | |
|---------------------------------------------------|--------------------------------------------------|
| 22. $P(\text{sum less than } 7)$ | 23. $P(\text{sum less than } 8)$ |
| 24. $P(\text{sum is greater than } 12)$ | 25. $P(\text{sum is greater than } 1)$ |
| 26. $P(\text{sum is between } 5 \text{ and } 10)$ | 27. $P(\text{sum is between } 2 \text{ and } 9)$ |

One of the polygons is chosen at random. Find each probability.



- | | |
|---------------------------------------|-------------------------------------------|
| 28. $P(\text{triangle})$ | 29. $P(\text{pentagon})$ |
| 30. $P(\text{not a triangle})$ | 31. $P(\text{not a quadrilateral})$ |
| 32. $P(\text{more than three sides})$ | 33. $P(\text{more than one right angle})$ |
34. If a person's birthday is in April, what is the probability that it is the 29th?
35. If a person's birthday is in July, what is the probability that it is after the 16th?

Find the odds of each outcome if a computer randomly picks a letter in the name *The United States of America*.

- | | |
|-------------------------|-------------------------|
| 36. the letter <i>a</i> | 37. the letter <i>t</i> |
| 38. a vowel | 39. a consonant |
| 40. an uppercase letter | 41. a lowercase vowel |

More About . . .



Stamp Collecting

Stamp collecting can be a very inexpensive hobby. Most stamp collectors start by saving stamps from letters, packages, and postcards.

Source: United States Postal Service

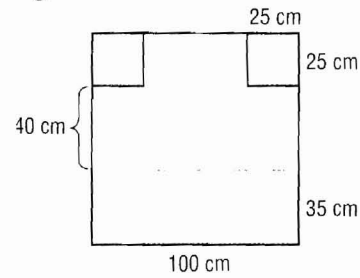
STAMP COLLECTING Lanette collects stamps from different countries. She has 12 from Mexico, 5 from Canada, 3 from France, 8 from Great Britain, 1 from Russia, and 3 from Germany. Find the odds of each of the following if she accidentally loses one stamp.

- | |
|----------------------------------------------------|
| 42. the stamp is from Canada |
| 43. the stamp is from Mexico |
| 44. the stamp is not from France |
| 45. the stamp is not from a North American country |
| 46. the stamp is from Germany or Russia |
| 47. the stamp is from Canada or Great Britain |
48. If the probability that an event will occur is $\frac{3}{7}$, what are the odds that it will occur?
49. If the probability that an event will occur is $\frac{2}{3}$, what are the odds against it occurring?

50. **CONTESTS** Every Tuesday, Mike's Submarine Shop has a business card drawing for a free lunch. Four coworkers from InvoAccounting put their business cards in the bowl for the drawing. If there are 80 cards in the bowl, what are the odds that one of the coworkers will win a free lunch?

GAMES For Exercises 51–53, use the following information.

A game piece is randomly placed on the board shown at the right by blindfolded players.



51. What is the probability that a game piece is placed on a shaded region?
52. What are the odds against placing a game piece on a shaded region?
53. What are the odds that a game piece will be placed within the green rectangle?

BASEBALL For Exercises 54–56, use the following information.

The stem-and-leaf plot shows the number of home runs hit by the top major league baseball players in the 2000 season. **Source:** www.espn.com

Stem	Leaf
3	0 0 0 1 1 1 1 1 1 1 2 2 2 3 3 4 4 4 5 5 5 6 6 6 7 7 8 8 9
4	0 1 1 1 1 2 2 3 3 3 4 4 7 7 9
5	0 3 0 = 30

54. What is the probability that one of these players picked at random hit more than 35 home runs?
55. What are the odds that a randomly selected player hit fewer than 45 home runs?
56. If a player batted 439 times and hit 38 home runs, what is the probability that the next time the player bats he will hit a home run?

WebQuest

You can use real-world data to find the probability that a person will live to be 100. Visit www.khanacademy.com/math/probability to continue work on your WebQuest project.

CONTESTS For Exercises 57 and 58, use the following information.

A fast-food restaurant is holding a contest in which the grand prize is a new sports car. Each customer is given a game card with their order. The contest rules state that the odds of winning the grand prize are 1:1,000,000.

57. For any randomly-selected game card, what is the probability that it is the winning game card for the grand prize?
58. Do your odds of winning the grand prize increase significantly if you have several game cards? Explain.

59. **CRITICAL THINKING** Three coins are tossed, and a tail appears on at least one of them. What is the probability that at least one head appears?

60. **WRITING IN MATH** Answer the question that was posed at the beginning of the lesson.

Why is probability important in sports?

Include the following in your answer:

- examples of two sports in which probability is used and an explanation of each sport's importance, and
- examples of methods other than probability used to show chance.

61. If the probability that an event will occur is $\frac{12}{25}$, what are the odds that the event will *not* occur?
 (A) 12:13 (B) 13:12 (C) 13:25 (D) 25:12
62. What is the probability that a number chosen at random from the domain $\{-6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8\}$ will satisfy the inequality $3x + 2 \leq 17$?
 (A) 20% (B) 27% (C) 73% (D) 80%

Maintain Your Skills

Mixed Review

63. **WEATHER** The following data represents the average daily temperature in Fahrenheit for Sacramento, California, for two weeks during the month of May. Organize the data using a stem-and-leaf plot. (Lesson 2-5)
- | | | | | | | |
|------|------|------|------|------|------|------|
| 58.3 | 64.3 | 66.7 | 65.1 | 68.7 | 67.0 | 69.3 |
| 70.0 | 72.8 | 77.4 | 77.4 | 73.2 | 75.8 | 65.5 |

Evaluate each expression if $a = -\frac{1}{3}$, $b = \frac{2}{5}$, and $c = \frac{1}{2}$. (Lesson 2-4)

64. $b \div c$ 65. $2a \div b$ 66. $\frac{ab}{c}$

Find each sum. (Lesson 2-2)

67. $4.3 + (-8.2)$ 68. $-12.2 + 7.8$ 69. $-\frac{1}{4} + \left(-\frac{3}{8}\right)$ 70. $\frac{7}{12} + \left(-\frac{5}{6}\right)$

Find each absolute value. (Lesson 2-1)

71. $|4.25|$ 72. $|-8.4|$ 73. $\left|-\frac{2}{3}\right|$ 74. $\left|\frac{1}{6}\right|$

Getting Ready for the Next Lesson

PREREQUISITE SKILL Evaluate each expression.

(To review *evaluating expressions*, see Lesson 1-2.)

75. 6^2 76. 17^2 77. $(-8)^2$ 78. $(-11.5)^2$
 79. 1.6^2 80. $\left(\frac{5}{12}\right)^2$ 81. $\left(-\frac{4}{9}\right)^2$ 82. $\left(-\frac{16}{15}\right)^2$

Practice Quiz 2

Lessons 2-4 through 2-6

Find each quotient. (Lesson 2-4)

1. $-136 \div (-8)$ 2. $15 \div \left(-\frac{3}{8}\right)$ 3. $(-46.8) \div 4$

Simplify each expression. (Lesson 2-4)

4. $\frac{3a + 9}{3}$ 5. $\frac{4x + 32}{4}$ 6. $\frac{15n - 20}{-5}$

7. State the scale you would use to make a line plot for the following data. Then draw the line plot. (Lesson 2-5)

1.9 1.1 3.2 5.0 4.3 2.7 2.5 1.1 1.4 1.8 1.8 1.6
 4.3 2.9 1.4 1.7 3.6 2.9 1.9 0.4 1.3 0.9 0.7 1.9

Determine each probability if two dice are rolled. (Lesson 2-6)

8. $P(\text{sum of } 10)$ 9. $P(\text{sum} \geq 6)$ 10. $P(\text{sum} < 10)$