CHAPTER 12

Solutions Key

Probability

ARE YOU READY? PAGE 665

1. whole; part

2. equivalent

3. ratio

4. frequency

5. percent

6. $\frac{3}{4}$

7. $\frac{2}{7}$

8. $\frac{1}{2}$

9. $\frac{9}{10} = 0.9$

10. $\frac{1}{2} = \frac{5}{10} = 0.5$

11. $\frac{12}{25} = \frac{48}{100} = 0.48$

12. $\frac{11}{20} = \frac{55}{100} = 0.55$

13. $0.35 \blacksquare 0.4$
$0.35 < 0.4$

14. $25\% \blacksquare 0.25$
$0.25 = 0.25$, so $0.25 = 25\%$.

15. $\frac{3}{5} \blacksquare 0.7$
$\frac{3}{5} = 0.6$
$0.6 < 0.7$, so $\frac{3}{5} < 0.7$.

16. $0.5 \blacksquare \frac{23}{50}$
$\frac{23}{50} = \frac{46}{100} = 0.46$
$0.5 > 0.46$, so $0.5 > \frac{23}{50}$.

17. There are 3 blue circles out of 7 total circles.
3 : 7

18. There are 5 squares and 4 triangles.
5 : 4

12-1, PAGE 669

Think and Discuss

1. Possible answer: playing a board game

2. Impossible: a cat will fly; likely: I will get an A on my report card; as likely as not: I flip a coin and it lands heads up; unlikely: it will snow in Florida; certain: the sun will rise tomorrow.

Exercises

1. certain

2. unlikely

3. $40\% = 0.4$
$40\% = \frac{40}{100} = \frac{2}{5}$

4. compare: $25\% < 50\%$
It is more likely that one child is a boy and one child is a girl.

5. likely

6. impossible

7. unlikely

8. likely

9. $\frac{3}{10} = 3 \div 10 = 0.3$
30%

10. $0.20 = \frac{20}{100} = \frac{1}{5}$
$0.20 = 20\%$

11. compare: $20\% > 15\%$
It is less likely that you will choose a cashew.

12. likely

13. unlikely

14. as likely as not

15. unlikely

16. There are 7 days in a week so Saturday has to be one of them.

17. unlikely; 3 people out of 100 could have AB positive blood.

18. O positive

19. AB negative

20. $6\% = 0.06$
$6\% = \frac{6}{100} = \frac{3}{50}$

21. Possible answer: All types that are not O positive or A positive, because when needed, these would be the hardest to locate.

22. A person with AB positive blood can safely receive O, A, B, AB blood. Since these are all of the possible blood types, this means that this person could safely receive all blood types. The sum of all probabilities of all blood types is 100%, which is equal to 1, so there is a probability of 1 that a person with AB positive blood can receive blood from a random donor.

23. C; $\frac{9}{20} = \frac{45}{100} = 45\%$

24. $0.7 = \frac{7}{10}$

25. 76
19×4
$19 \times 2 \times 2$
$2^2 \times 19$

26. 12
4×3
$2 \times 2 \times 3$
$2^2 \times 3$

27. 16
4×4
$2 \times 2 \times 2 \times 2$
2^4

28. 18
2×9
$2 \times 3 \times 3$
2×3^2

29. 128
8×16
$2 \times 4 \times 4 \times 4$
$2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$
2^7

30. $C = \pi \cdot d$
$C = 3.14 \cdot 2$
$C = 6.28$ in.

31. $C = 2 \cdot \pi \cdot r$
$C = 2 \cdot 3.14 \cdot 5$
$C = 31.4$ cm

32. $C = \pi \cdot d$
$28.26 = 3.14d$
$9 \text{ m} = d$

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Think and Discuss

1. Possible answer: Not necessarily: even though the outcomes have the same chances of happening, they may not occur the same number of times.

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2. Possible answer: Each time you repeat the experiment you will probably get slightly different results. The more times you repeat the experiment, the closer your experiment's probability will get to the actual probability.

Exercises

1. Outcome shown; 6

2. $P(\text{one hit}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{8}{15}$

3. $P(\text{two hits}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{2}{15}$

$P(\text{no hits}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{4}{15}$

The player is more likely to get no hits in a game.

$P(\text{one hit}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{1}{15}$

$\frac{1}{15} < \frac{2}{15} < \frac{4}{15} < \frac{8}{15}$

The player will most likely get 1 hit in a game.

4. Outcome shown: 4

5. HTH

6. $P(\text{red}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{3}{25}$

7. $P(\text{not black}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{5 + 3 + 5}{25} = \frac{13}{25}$

8. $P(\text{white}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{5}{25}$

$P(\text{Red}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{3}{25}$

$P(\text{Yellow}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{5}{25}$

$P(\text{Black}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{12}{25}$

$\frac{3}{25} < \frac{5}{25} < \frac{12}{25}$

It is most likely that she will select a black marble.

9. yellow

10. 4

11. There are 31 days in January.

$P(\text{day in January warmer than } 55°\text{F}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{1}{31}$

It is unlikely.

12. a. There are a total of 100 trials.

$P(\text{red}) = \frac{25}{100} = 25\%$

$P(\text{blue}) = \frac{19}{100} = 19\%$

$P(\text{green}) = \frac{56}{100} = 56\%$

b. Green; the probability of landing on green is greatest.

13. The coin should land heads about half of the time.

14. With two number cubes, the most likely sum is 7 because there are more ways of obtaining 7 by adding the numbers on the cube.

15. D; yellow.

16. H; $\frac{5}{10} = \frac{1}{2}$

17. $x + 7$
$5 + 7 = 12$

18. $4x$
$4(5) = 20$

19. $3x + 6$
$3(5) + 6$
$15 + 6 = 21$

20. $x + 5$
$5 + 5 = 10$

21. $2x - 7$
$2(5) - 7$
$10 - 7 = 3$

22. $93\% > 91\%$
Lance has a better chance.

HANDS-ON LAB 12-2, PAGE 676

Activity 1

Think and Discuss

1. 1 or 6; since 1 and 6 were each rolled only once, and the simulation is complete after all the numbers have been rolled, then either 1 or 6 was the last number rolled.

2. Possible answer: 15

3. Possible answer: 15; every simulation will have a different result, so even if you use results from your experiment to estimate the number of boxes you should buy, you can never be sure that you will win.

Try This

1. Answers will vary. Repeated simulations will not always give the same results.

2. Possible answer:
$\frac{9 + 12 + 15 + 6 + 13 + 17}{6} = 12$

3. Possible answer: 12; yes, the results of my first two simulations were 15 and 9.

Activity 2

Think and Discuss

1. Each trial represents one game, and Amy makes 20 shots in a game.

2. Possible answer: yes; 4

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3. Possible answer: 4; every simulation will have different results, and the actual game results depend on outside factors that the experiment does not account for. So even if you use the results from your experiment to estimate the number of baskets in a row that she will make, there is no guarantee that this will occur in every game.
4. Possible answer: $\frac{4}{10} = 0.4$
5. No, because the probability of a coin landing on a particular side is $\frac{1}{2}$; there is no way to simulate $\frac{1}{3}$ with a coin.

Try This

1. Answers will vary. The most likely results are 4 families and 3 families.
2. Answers will vary. Divide the number of families that have two boys and two girls by the total number of families, 10.
3. Answers will vary.

12-3, PAGE 679

Think and Discuss

1. Possible answer: When you make an organized list, you are less likely to forget information or leave anything out.
2. Possible answer: Organize the list in a different way, listing the information in a different order. Compare the lists to see whether they have the same items.

Exercises

1. Turkey and fruit, turkey and salad, taco and fruit, taco and salad, pasta and fruit, pasta and salad.
2. First, find all the combinations that are possible with Patrice playing the doctor:
   doctor: Patrice, teacher: Jason
   doctor: Patrice, teacher: Kenya
   doctor: Jason, teacher: Patrice
   doctor: Jason, teacher: Kenya
   doctor: Kenya, teacher: Patrice
   doctor: Kenya, teacher: Jason
   There are 2 combinations possible when Patrice plays the doctor and another person plays the teacher. The same is true when Jason and Kenya play the doctor.
   $2 + 2 + 2 = 6$
   There are 6 different ways the roles can be assigned.
3. Monday before school, Monday during lunch, Monday after school
   Tuesday before school, Tuesday during lunch, Tuesday after school
   Thursday before school, Thursday during lunch, Thursday after school.
   Mr. Li can give his make-up test 9 different times.
4. Saturday: foot race
   Saturday: hike
   Saturday: bicycle race
   Saturday: swimming race
   Saturday: scavenger hunt
   Sunday: foot race
   Sunday: hike
   Sunday: bicycle race
   Sunday: swimming race
   Sunday: scavenger hunt
   There are 10 different combinations for the day and activity.
5. First, find all the pass codes that begin with 1.
   List all possible codes that begin with 1: 123, 132.
   List all possible codes that begin with 2: 213, 231.
   List all possible codes that begin with 3: 312, 321.
   There are 6 possible codes.
6. There are 26 letters possible. There are 10 numbers possible.
   $26 \cdot 10 = 260$.
   There are 260 different combinations.
7. **a.** She has 3 shirts, 3 pants, and 3 skirts, so she has 3 tops and 6 bottoms. Each shirt can be matched with any of the 6 bottoms, so there are $6 + 6 + 6 = 18$ combinations.
   b. She had 7 skirts, 5 pants, and 3 skirts, so she has 7 tops and 8 bottoms. Each top can be matched with any of the following 8 bottoms, so there are $8 + 8 + 8 + 8 + 8 + 8 + 8 = 56$ combinations.
8. **a.** For each brush, there are two borders from which to choose and three colors from which to choose. So for each brush, there are 6 options. Because there are 2 brushes, there are $6 + 6 = 12$.
   b. For each brush, there are still two borders and three colors from which to choose so there are still 6 options for each brush. Because he now has 3 brushes from which to choose, there are now $6 + 6 + 6 = 18$ different combinations.
9. The possible combinations are:
   gu-gu, gu-pa, gu-choki
   pa-gu, pa-pa, pa-choki
   choki-gu, choki-pa, choki-choki
   There are 9 different outcomes possible in this game.

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10. In a group of 2 people there will be 1 handshake, in a group of 3 people there will be 3 handshakes, and in a group of 4 people there will be 6 handshakes. Identify a pattern in the number of handshakes, and continue the pattern to find how many people it will take to have 28 handshakes.

People	Handshakes
1	0
2	0 + 1 = 1
3	1 + 2 = 3
4	3 + 3 = 6
5	6 + 4 = 10
6	10 + 5 = 15
7	15 + 6 = 21
8	21 + 7 = 28

A group of 8 people will shake hands 28 times, so there were 8 people in the meeting.

11. You can make a tree diagram. Start with all the boys' names and match them with each of the girls' names.

12. The possible flag combinations are:
blue, green, red
blue, green, orange
blue, green, yellow
blue, red, orange
blue, red, yellow
blue, yellow, orange
green, red, orange
green, red, yellow
green, orange, yellow
red, orange, yellow
There are 10 different combinations of flags.

13. C; $3 \cdot 2 = 6$

14. $5 \cdot 2 \cdot 4 = 40$
40 different combinations

15. $\frac{1}{3} + \frac{3}{4} = \frac{4}{12} + \frac{9}{12} = \frac{13}{12} = 1\frac{1}{12}$

16. $\frac{3}{8} + \frac{2}{5} = \frac{15}{40} + \frac{16}{40} = \frac{31}{40}$

17. $\frac{7}{8} - \frac{1}{4} = \frac{7}{8} - \frac{2}{8} = \frac{5}{8}$

18. $\frac{5}{6} - \frac{1}{2} = \frac{5}{6} - \frac{3}{6} = \frac{2}{6} = \frac{1}{3}$

19. **Height of Sunflowers (in.)**

Stems	Leaves
1	5 6 7 8 8
2	0 1 2

Key: 2\|0 means 20

12-4, PAGE 683

Think and Discuss

1. Possible answers: You pull a tile from a bag with 5 red, 5 green, 5 blue, and 5 white tiles. You spin a spinner that is $\frac{3}{5}$ yellow and $\frac{2}{5}$ pink.

2.
$$\begin{aligned} P(\text{snow}) + P(\text{sleet}) + P(\text{no snow/sleet}) &= 100\% \\ 50\% + 10\% + P(\text{no snow/sleet}) &= 100\% \\ 60\% + P(\text{no snow/sleet}) &= 100\% \\ P(\text{no snow/sleet}) &= 40\% \end{aligned}$$

Exercises

1. There are two possible outcomes when flipping a coin, heads or tails. Both are equally likely because the coin is fair. There is only one way for the coin to land tails up.
$$P(\text{tails}) = \frac{\text{1 way event can occur}}{\text{2 possible outcomes}} = \frac{1}{2}$$

2. There are 5 possible outcomes when choosing from the letters *A*, *B*, *C*, *D*, and *E*. All are equally likely. There are 2 vowels, *A* and *E*, so there are two ways that a vowel can be chosen.
$$P(\text{vowel}) = \frac{\text{2 ways even can occur}}{\text{5 possible outcomes}} = \frac{2}{5}$$

3.
$$\begin{aligned} P(\text{blue}) + P(\text{red}) &= 100\% \\ 26\% + P(\text{not blue}) &= 100\% \\ -26\% \qquad\qquad\quad & \quad -26\% \\ \hline P(\text{not blue}) &= 74\% \end{aligned}$$

4.
$$\begin{aligned} P(2) + P(\text{not } 2) &= 1 \\ 0.7 + P(\text{not } 2) &= 1.0 \\ -0.7 \qquad\qquad & \quad -0.7 \\ \hline P(\text{not } 2) &= 0.3 \end{aligned}$$

5. There are six possible outcomes when a fair number cube is rolled: 1, 2, 3, 4, 5, or 6. All are equally likely. There is only one way to roll the number 3.
$$P(\text{rolling number } 3) = \frac{\text{1 way event can occur}}{\text{6 possible outcomes}} = \frac{1}{6}$$

6. There are six possible outcomes when a fair number cube is rolled: 1, 2, 3, 4, 5, or 6. All are equally likely. There are two multiplies of 3: 3 and 6.
$$P(\text{multiple of } 3) = \frac{\text{2 ways the event can occur}}{\text{6 possible outcomes}} = \frac{2}{6} = \frac{1}{3}$$

7. There are $3 + 2 + 4 = 9$ total marbles in the bag. All are equally likely to be chosen. There are four yellow marbles.
$$P(\text{yellow marbles}) = \frac{\text{4 ways event can occur}}{\text{9 possible outcomes}} = \frac{4}{9}$$

8.
$$\begin{aligned} P(\text{snow}) + P(\text{not snow}) &= 100\% \\ 81\% + P(\text{not snow}) &= 100\% \\ -81\% \qquad\qquad & \quad -81\% \\ \hline P(\text{not snow}) &= 19\% \end{aligned}$$

9.
$$\begin{aligned} P(\text{winning color}) + P(\text{not winning color}) &= 1 \\ 0.04 + P(\text{not wining color}) &= 1.00 \\ -0.04 \qquad\qquad & \quad -0.04 \\ \hline P(\text{not winning color}) &= 0.96 \end{aligned}$$

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10. There are six possible outcomes when a standard number cube is rolled: 1, 2, 3, 4, 5, or 6. There is only one way to roll the number 4.

$$P(4) = \frac{\text{1 way event can occur}}{\text{6 possible outcomes}} = \frac{1}{6}$$

11. There are six possible outcomes when a standard number cube is rolled: 1, 2, 3, 4, 5, or 6. There are five ways of not rolling the number 3: 1, 2, 4, 5, or 6.

$$P(\text{not } 3) = \frac{\text{5 ways event can occur}}{\text{6 possible outcomes}} = \frac{5}{6}$$

12. There are six possible outcomes when a standard number cube is rolled: 1, 2, 3, 4, 5, or 6. There are three ways of rolling a 1, 2, or 3.

$$P(1, 2, \text{or } 3) = \frac{\text{3 ways event can occur}}{\text{6 possible outcomes}} = \frac{3}{6} = \frac{1}{2}$$

13. There are six possible outcomes when a standard number cube is rolled: 1, 2, 3, 4, 5, or 6. There are six ways of rolling a number greater than 0: 1, 2, 3, 4, 5, or 6.

$$P(\text{number greater than } 0) = \frac{\text{6 ways event can occur}}{\text{6 possible outcomes}} = \frac{6}{6} = 1$$

14. There are six possible outcomes when a standard number cube is rolled: 1, 2, 3, 4, 5, or 6. There are three ways of a rolling an odd number: 1, 3, or 5.

$$P(\text{odd number}) = \frac{\text{3 ways event can occur}}{\text{6 possible outcomes}} = \frac{1}{2}$$

15. There are six possible outcomes when a standard number cube is rolled: 1, 2, 3, 4, 5, or 6. There is only one way to roll a number divisible by 5: 5.

$$P(\text{number divisible by } 5) = \frac{\text{1 way event can occur}}{\text{6 possible outcomes}} = \frac{1}{6}$$

16. There are six possible outcomes when a standard number cube is rolled: 1, 2, 3, 4, 5, or 6. There are three ways of rolling a prime number: 2, 3, or 5.

$$P(\text{prime number}) = \frac{\text{3 ways event can occur}}{\text{6 possible outcomes}} = \frac{3}{6} = \frac{1}{2}$$

17. There are six possible outcomes when a standard number cube is rolled: 1, 2, 3, 4, 5, or 6. There is no way to roll a negative number.

$$P(\text{negative number}) = \frac{\text{0 ways event can occur}}{\text{6 possible outcomes}} = \frac{0}{6} = 0$$

18. There are 8 possible outcomes: 1, 2, 3, 4, 5, 6, 7, or 8. Each number can be rolled one way.

$$P(\text{each number}) = \frac{\text{1 way event can occur}}{\text{8 possible outcomes}} = \frac{1}{8}$$

19. There are 12 possible outcomes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, or 12. There are 6 ways of rolling a factor of 12: 1, 2, 3, 4, 6, or 12.

$$P(\text{factor of } 12) = \frac{\text{6 ways event can occur}}{\text{12 possible outcomes}} = \frac{6}{12} = \frac{1}{2} = 50\%$$

20. The probability that an eligible person voted is 45%. So, the probability that an eligible person did not vote is 100% − 45%, or 55%. 55% > 45% so it is more likely that an eligible person did not vote.

21.
$$\begin{aligned} P(\text{A}) + P(\text{not A}) &= 100\% \\ 47\% + P(\text{not A}) &= 100\% \\ 47\% + P(\text{not A}) - 47\% &= 100\% - 47\% \\ P(\text{not A}) &= 53\% \end{aligned}$$

22.
$$\begin{aligned} P(\text{A}) + P(\text{not A}) &= 1 \\ 0.9 + P(\text{not A}) &= 1 \\ 0.9 + P(\text{not A}) - 0.9 &= 1 - 0.9 \\ P(\text{not A}) &= 0.1 \end{aligned}$$

23.
$$\begin{aligned} P(\text{A}) + P(\text{not A}) &= 1 \\ \frac{7}{12} + P(\text{not A}) &= 1 \\ \frac{7}{12} + P(\text{not A}) - \frac{7}{12} &= 1 - \frac{7}{12} \\ P(\text{not A}) &= \frac{12}{12} - \frac{7}{12} \\ P(\text{not A}) &= \frac{5}{12} \end{aligned}$$

24.
$$\begin{aligned} P(\text{A}) + P(\text{not A}) &= 1 \\ \frac{5}{8} + P(\text{not A}) &= 1 \\ \frac{5}{8} + P(\text{not A}) - \frac{5}{8} &= 1 - \frac{5}{8} \\ P(\text{not A}) &= \frac{8}{8} - \frac{5}{8} \\ P(\text{not A}) &= \frac{3}{8} \end{aligned}$$

25.
$$\begin{aligned} P(\text{A}) + P(\text{not A}) &= 1 \\ 0.23 + P(\text{not A}) &= 1 \\ 0.23 + P(\text{not A}) - 0.23 &= 1 - 0.23 \\ P(\text{not A}) &= 0.77 \end{aligned}$$

26.
$$\begin{aligned} P(\text{A}) + P(\text{not A}) &= 100\% \\ 100\% + P(\text{not A}) &= 100\% \\ 100\% + P(\text{not A}) - 100\% &= 100\% - 100\% \\ P(\text{not A}) &= 0\% \end{aligned}$$

27. There are 144 tiles. 16 of the tiles are Wind tiles.

$$P(\text{Wind tile}) = \frac{\text{16 ways event can occur}}{\text{144 possible outcomes}} = \frac{16}{144} = \frac{1}{9}$$

28. There are 9 possible outcomes: 1, 2, 2, 3, 4, 4, 5, 6, and 6.

$$P(1) = \frac{\text{1 way event can occur}}{\text{9 possible outcomes}} = \frac{1}{9}$$

$$P(5) = \frac{\text{1 way event can occur}}{\text{9 possible outcomes}} = \frac{1}{9}$$

$\frac{1}{9} = \frac{1}{9}$, so $P(1) = P(5)$

29. There are 9 possible outcomes: 1, 2, 2, 3, 4, 4, 5, 6, and 6.

$$P(3) = \frac{\text{1 way event can occur}}{\text{9 possible outcomes}} = \frac{1}{9}$$

$$P(2) = \frac{\text{2 ways event can occur}}{\text{9 possible outcomes}} = \frac{2}{9}$$

$\frac{1}{9} < \frac{2}{9}$, so $P(3) < P(2)$.

30. There are 9 possible outcomes: 1, 2, 2, 3, 4, 4, 5, 6 and 6.

$$P(4) = \frac{\text{2 ways event can occur}}{\text{9 possible outcomes}} = \frac{2}{9}$$

$$P(6) = \frac{\text{2 ways event can occur}}{\text{9 possible outcomes}} = \frac{2}{9}$$

$\frac{2}{9} = \frac{2}{9}$, so $P(4) = P(6)$.

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31. There are 9 possible outcomes: 1, 2, 2, 3, 4, 4, 5, 6 and 6.

$$P(4) = \frac{\text{2 ways event can occur}}{\text{9 possible outcomes}} = \frac{2}{9}$$

$$P(5) = \frac{\text{1 way event can occur}}{\text{9 possible outcomes}} = \frac{1}{9}$$

$$P(6) = \frac{\text{2 ways event can occur}}{\text{9 possible outcomes}} = \frac{2}{9}$$

$\frac{2}{9} < \frac{2}{9} + \frac{1}{9} = \frac{3}{9}$, so $P(4) < P(5) + P(6)$

32. There are 9 possible outcomes: 1, 2, 2, 3, 4, 4, 5, 6 and 6.

$$P(3) = \frac{\text{1 way event can occur}}{\text{9 possible outcomes}} = \frac{1}{9}$$

$$P(5) = \frac{\text{1 way event can occur}}{\text{9 possible outcomes}} = \frac{1}{9}$$

$$P(6) = \frac{\text{2 ways event can occur}}{\text{9 possible outcomes}} = \frac{2}{9}$$

$\frac{1}{9} + \frac{1}{9} = \frac{2}{9} = \frac{2}{9}$, so $P(3) + P(5) = P(6)$

33. There are 9 possible outcomes: 1, 2, 2, 3, 4, 4, 5, 6 and 6.

$$P(\text{Less than 3}) = \frac{\text{3 ways event can occur}}{\text{9 possible outcomes}} = \frac{3}{9}$$

$$P(6) = \frac{\text{2 ways event can occur}}{\text{9 possible outcomes}} = \frac{2}{9}$$

$\frac{3}{9} > \frac{2}{9}$, so $P(\text{Less than 3}) > P(6)$

34. The error is that landing on its top, bottom, or side are not equally likely.

35. Check students' work. The theoretical probability is $P(\text{tails}) = \frac{\text{1 way event can occur}}{\text{2 possible outcomes}} = \frac{1}{2}$. Through the experiment, the student should find their probability is close to $\frac{1}{2}$, and it should become closer to $\frac{1}{2}$ the more times the coin is flipped.

36. $P(\text{heads}) = \frac{\text{1 way event can occur}}{\text{2 possible outcomes}} = \frac{1}{2}$

$$P(3) = \frac{\text{1 way event can occur}}{\text{6 possible outcomes}} = \frac{1}{6}$$

Multiply the probabilities.

$\frac{1}{2} \cdot \frac{1}{6} = \frac{1}{12}$

37. C;

$$\begin{aligned} P(\text{snow}) + P(\text{no snow}) &= 100\% \\ 25\% + P(\text{no snow}) &= 100\% \\ -25\% \qquad\qquad &\quad -25\% \\ \hline P(\text{no snow}) &= 75\% \end{aligned}$$

38. There are a total of 20 socks.

$$P(\text{blue}) = \frac{\text{6 ways event can occur}}{\text{20 possible outcomes}} = \frac{6}{20} = \frac{3}{10}$$

$$P(\text{brown}) = \frac{\text{4 ways event can occur}}{\text{20 possible outcomes}} = \frac{4}{20} = \frac{1}{5}$$

$$P(\text{white}) = \frac{\text{10 ways event can occur}}{\text{20 possible outcomes}} = \frac{10}{20} = \frac{1}{2}$$

$P(\text{brown}) < P(\text{blue}) < P(\text{white})$

39. $84 \div 4 = 21$

40. $-25 \div 5 = -5$

41. $-60 \div (-20) = 3$

42. $-55 \div 5 = -11$

43. $15 \div 1.2 = 12$

READY TO GO ON ? PAGE 686

1. Impossible

2. As likely as not

3. $0.15 = \frac{15}{100} = \frac{3}{20}$

4. Compare: $45\% > 35\% > 33\%$
It is most likely to rain on Wednesday.

5. Outcome shown: 1

6. Outcome shown: yellow

7. There was a total of $7 + 12 + 6 = 25$ spins.

$$P(1) = \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{7}{25}$$

$$P(2) = \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{12}{25}$$

$$P(3) = \frac{\text{number of times the event occurs}}{\text{total number of trials}} = \frac{6}{25}$$

The spinner is most likely to land on 2.

8. Possible outcomes:
spaghetti and tomato
spaghetti and pesto
fettuccine and tomato
fettuccine and pesto
bow tie and tomato
bow tie and pesto

9. There are 2 choices of pants. There are 3 choices of shirts.
$2 \cdot 3 = 6$
There are 6 combinations she can choose.

10. There are four possible outcomes for the spinner: 1, 2, 3, or 4. There is one way the spinner will land on 2.

$$P(2) = \frac{\text{1 way event can occur}}{\text{4 possible outcomes}} = \frac{1}{4}$$

11. There are six possible outcomes when a fair number cube is rolled: 1, 2, 3, 4, 5, or 6. There are 2 numbers less than 3 : 1 and 2.

$$P(\text{rolling number less than 3}) = \frac{\text{2 ways event can occur}}{\text{6 possible outcomes}} = \frac{2}{6} = \frac{1}{3}$$

12.

$$\begin{aligned} P(\text{Kirk will score}) + P(\text{Kirk will not score}) &= 100\% \\ 33\% + P(\text{Kirk will not score}) &= 100\% \\ -33\% \qquad\qquad &\quad -33\% \\ \hline P(\text{Kirk will not score}) &= 67\% \end{aligned}$$

FOCUS ON PROBLEM SOLVING, PAGE 687

1. For each customer, there are only three possible colors he or she could get. So 2,100 is too large to be the correct answer. The correct answer is that there are 3 possible outcomes.

2. The numbers 100 and 20 are not divisible by 3, and the probability of drawing a blue marble is 3 out of 8, which means that the number of blue marbles must be divisible by 3. There are 45 blue marbles and 75 red marbles.

3. 350 divided by 10 is much larger than 3, since
$3 \times 10 = 30$
$350 \div 10 = 35$
So, out of 350 shoppers, 35 shoppers were surveyed.

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4. There is only 1 dime that is older than 1932, and a 50% probability would suggest that half of the time, or 6 out of 12 times, you would draw the same dime. The correct answer is:

$$P(\text{older than 1932}) = \frac{\text{1 way event can occur}}{\text{12 possible outcomes}} = \frac{1}{12}$$

12-5, PAGE 689

Think and Discuss

1. Possible answer: rolling a number cube and pulling a marble out of a bag.

2. Possible answer: Multiply the number of possible outcomes for each independent to find the number of possible outcomes for the compound event.

Exercises

1.

Roll 2 \ Roll 1	1	2	3	4	5	6
1	1, 1	1, 2	1, 3	1, 4	1, 5	1, 6
2	2, 1	2, 2	2, 3	2, 4	2, 5	2, 6
3	3, 1	3, 2	3, 3	3, 4	3, 5	3, 6
4	4, 1	4, 2	4, 3	4, 4	4, 5	4, 6
5	5, 1	5, 2	5, 3	5, 4	5, 5	5, 6
6	6, 1	6, 2	6, 3	6, 4	6, 5	6, 6

Nine of the outcomes have two even numbers: 2, 2; 2, 4; 2, 6; 4, 2; 4, 4; 4, 6; 6, 2; 5, 4; and 6, 6.

$$P(\text{even, even}) = \frac{\text{9 ways event can occur}}{\text{36 possible outcomes}} = \frac{9}{36} = \frac{1}{4}$$

2. Let the boy's coin be the first one in the pair, and let the girl's coin be the second one in the pair. There are 4 possible outcomes: HH, HT, TH, and TT. Only one outcome has heads on the boy's coin and tails on the girl's coin: HT.

$$P(\text{heads on boy's coin, tails on girl's coin}) = \frac{\text{1 way event can occur}}{\text{4 possible outcomes}} = \frac{1}{4}$$

3. Let green be G, purple be P, and yellow be Y. There are 9 possible outcomes: GG, GP, GY, PG, PP, PY, YG, YP, and YY. Only one outcome has green on the first spin and purple on the second spin: GP.

$$P(\text{green, purple}) = \frac{\text{1 way event can occur}}{\text{9 possible outcomes}} = \frac{1}{9}$$

4. Let green be G, purple be P, and yellow be Y. There are 9 possible outcomes: GG, GP, GY, PG, PP, PY, YG, YP, and YY. Two of the outcomes have green or purple on the first spin and yellow on the second spin: GY and PY.

$$P(\text{green or purple, yellow}) = \frac{\text{2 ways event can occur}}{\text{9 possible outcomes}} = \frac{2}{9}$$

5. Let green be G, purple be P, and yellow be Y. There are 9 possible outcomes: GG, GP, GY, PG, PP, PY, YG, YP, and YY. Three of the outcomes have the same color twice in a row: GG, PP, and YY.

$$P(\text{same color twice in a row}) = \frac{\text{3 ways event can occur}}{\text{9 possible outcomes}} = \frac{3}{9} = \frac{1}{3}$$

6. There are 12 possible outcomes: 1, 4; 1, 5; 1, 6; 1, 7; 2, 4; 2, 5; 2, 6; 2, 7; 3, 4; 3, 5; 3, 6; and 3, 7. Only one outcome has 2 on spinner 1 and 5 on spinner 2: 2, 5.

$$P(\text{2 on spinner 1 and 5 on spinner 2}) = \frac{\text{1 way event can occur}}{\text{12 possible outcomes}} = \frac{1}{12}$$

7. There are 12 possible outcomes: 1, 4; 1, 5; 1, 6; 1, 7; 2, 4; 2, 5; 2, 6; 2, 7; 3, 4; 3, 5; 3, 6; and 3, 7. Six of the outcomes do not have 1 on spinner 1 and not 7 on spinner 2: 2, 4; 2, 5; 2, 6; 3, 4; 3, 5; and 3, 6.

$$P(\text{not 1 spinner 1 and not 7 on spinner 2}) = \frac{\text{6 ways event can occur}}{\text{12 possible outcomes}} = \frac{6}{12} = \frac{1}{2}$$

8. There are 12 possible outcomes: 1, 4; 1, 5; 1, 6; 1, 7; 2, 4; 2, 5; 2, 6; 2, 7; 3, 4; 3, 5; 3, 6; and 3, 7. Two of the outcomes have even numbers on both spinners: 2, 4 and 2, 6.

$$P(\text{even number on both spinners}) = \frac{\text{2 ways event can occur}}{\text{12 possible outcomes}} = \frac{1}{6}$$

9. There are 12 possible outcomes: 1, 4; 1, 5; 1, 6; 1, 7; 2, 4; 2, 5; 2, 6; 2, 7; 3, 4; 3, 5; 3, 6; and 3, 7. Four of the outcomes have an odd number on spinner 1 and even number on spinner 2: 1, 4; 1, 6; 3, 4; and 3, 6.

$$P(\text{odd number on spinner 1 and even number on spinner 2}) = \frac{\text{4 ways event can occur}}{\text{12 possible outcomes}} = \frac{4}{12} = \frac{1}{3}$$

10. There are 12 possible outcomes: 1, 4; 1, 5; 1, 6; 1, 7; 2, 4; 2, 5; 2, 6; 2, 7; 3, 4; 3, 5; 3, 6; and 3, 7. All of the outcomes have the number on spinner 2 greater than the number on spinner.

$$P(\text{number on spinner 2 is greater than the number on spinner 1}) = \frac{\text{12 ways event can occur}}{\text{12 possible outcomes}} = \frac{12}{12} = 1$$

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11. There are 12 possible outcomes: 1, 4; 1, 5; 1, 6; 1, 7; 2, 4; 2, 5; 2, 6; 2, 7; 3, 4; 3, 5; 3, 6; and 3, 7. None of the outcomes have the same number on both spinners.

$P(\text{same number on both spinner})$

$$= \frac{\text{0 ways event can occur}}{\text{12 possible outcomes}}$$

$$= 0$$

12. There are 12 possible outcomes: 1, 4; 1, 5; 1, 6; 1, 7; 2, 4; 2, 5; 2, 6; 2, 7; 3, 4; 3, 5; 3, 6; and 3, 7. Only one outcome has a multiple of 3 on both spinners: 3, 6.

$P(\text{a multiple of 3 on both spinners})$

$$= \frac{\text{1 way event can occur}}{\text{12 possible outcomes}}$$

$$= \frac{1}{12}$$

13. There are 12 possible outcomes: 1, 4; 1, 5; 1, 6; 1, 7; 2, 4; 2, 5; 2, 6; 2, 7; 3, 4; 3, 5; 3, 6; and 3, 7. All of the outcomes have different numbers on each spinner.

$P(\text{different number on each spinner})$

$$= \frac{\text{12 ways event can occur}}{\text{12 possible outcomes}}$$

$$= \frac{12}{12}$$

$$= 1$$

14. There are 25 possible outcomes: 1, 2; 1, 2; 1, 3; 1, 4; 1, 5; 2, 1; 2, 2; 2, 3; 2, 4; 2, 5; 3, 1; 3, 2; 3, 3; 3, 4; 3, 5; 4, 1; 4, 2; 4, 3; 4, 4; 4, 5; 5, 1; 5, 2; 5, 3; 5, 4; and 5, 5.. Five of the outcomes have the same number on both tiles: 1, 2; 2, 2; 3, 3; 4, 4; and 5, 5.

$P(\text{same number on both tiles})$

$$= \frac{\text{5 ways event can occur}}{\text{25 possible outcomes}}$$

$$= \frac{5}{25}$$

$$= \frac{1}{5}$$

15. There are 12 possible outcomes: 1, T; 2, T; 3, T; 4, T; 5, T; 6, T; 1, H; 2, H; 3, H; 4, H; 5, H; and 6, H. Only one outcome is 3 and tails: 3, T.

$$P(\text{3 and tails}) = \frac{\text{1 way event can occur}}{\text{12 possible outcomes}}$$

$$= \frac{1}{12}$$

Only one outcome is 5 and heads; 5, H.

$$P(\text{5 and heads}) = \frac{\text{1 way event can occur}}{\text{12 possible outcomes}}$$

$$= \frac{1}{12}$$

$\frac{1}{12} = \frac{1}{12}$, so $P(\text{3 and tails}) = P(\text{5 and heads})$.

16. There are 12 possible outcomes: 1, T; 2, T; 3, T; 4, T; 5, T; 6, T; 1, H; 2, H; 3, H; 4, H; 5, H; and 6, H. Three of the outcomes have an even number and tails: 2, T; 4, T; and 6, T.

$$P(\text{even number and tails}) = \frac{\text{3 ways event can occur}}{\text{12 possible outcomes}}$$

$$= \frac{3}{12}$$

Three of the outcomes have an odd number and heads: 1, H; 3, H; and 5, H.

$P(\text{odd number and heads})$

$$= \frac{\text{3 ways event can occur}}{\text{12 possible outcomes}}$$

$$= \frac{3}{12}$$

$\frac{3}{12} = \frac{3}{12}$, so $P(\text{even number and tails}) = P(\text{odd number and heads})$.

17. There are 12 possible outcomes: 1, T; 2, T; 3, T; 4, T; 5, T; 6, T; 1, H; 2, H; 3, H; 4, H; 5, H; and 6, H. Two of the outcomes have a number less than 3 and tails: 1, T and 2, T.

$P(\text{number less than 3 and tails})$

$$= \frac{\text{2 ways event can occur}}{\text{12 possible outcomes}}$$

$$= \frac{2}{12}$$

Three of the outcomes have an odd number and tails: 1, T; 3, T; and 5, T.

$$P(\text{odd number and tails}) = \frac{\text{3 ways event can occur}}{\text{12 possible outcomes}}$$

$$= \frac{3}{12}$$

$\frac{2}{12} < \frac{3}{12}$, so $P(\text{number less than 3 and tails}) < P(\text{odd number and tail})$.

18. There are 12 possible outcomes: 1, T; 2, T; 3, T; 4, T; 5, T; 6, T; 1, H; 2, H; 3, H; 4, H; 5, H; and 6, H. One of the outcomes is a number greater than 5 and heads: 6, H.

$P(\text{number greater than 5 and heads})$

$$= \frac{\text{1 way event can occur}}{\text{12 possible outcomes}}$$

$$= \frac{1}{12}$$

Three of the outcomes have a prime number and tails: 2, T; 3, T; and 5, T.

$P(\text{prime number and tails})$

$$= \frac{\text{3 ways event can occur}}{\text{12 possible outcomes}}$$

$$= \frac{3}{12}$$

$\frac{1}{12} < \frac{3}{12}$, so $P(\text{number greater than 5 and heads}) < P(\text{prime number and tails})$.

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19. There are 32 possible outcomes:
All male or female: MMMMM, FFFFF
1 female, 4 males: FMMMM, MFMMM, MMFMM, MMMFM, MMMMF
2 females, 3 males: FFMMM, MFFMM, MMFFM, MMMFF, FMFMM, FMMFM, FMMMF, MFMFM, MMFMF, MFMMF.
3 females, 2 males: MMFFF, FMMFF, FFMMF, FFFMM, MFMFF, MFFMF, MFFFM, FMFMF, FFMFM, FMFFM.
4 females, 1 male: MFFFF, FMFFF, FFMFF, FFFMF, FFFFM
Only one outcome would be 5 female kittens: FFFFF.

$$P(\text{all female}) = \frac{\text{1 way event can occur}}{\text{32 possible outcomes}} = \frac{1}{32}$$

Only one outcome would be 5 male kittens: MMMMM.

$$P(\text{all male}) = \frac{\text{1 way event can occur}}{\text{32 possible outcomes}} = \frac{1}{32}$$

20. Find the ID numbers that start with 1: 11, 12, 13, 14, 15, and 16.
There are 6 numbers that start with 1. Similarly, there are 6 numbers that start with 2, 3, 4, 5, and 6.
$6 + 6 + 6 + 6 + 6 + 6 = 36$
There are 36 possible ID numbers. One of them is Jared's ID number. So, there are $36 - 1 = 35$ outcomes that are not Jared's ID number.

$$P(\text{not Jared's ID number}) = \frac{\text{35 ways event can occur}}{\text{36 possible outcomes}} = \frac{35}{36}$$

21. The classmate added; should have multiplied.

22. Possible answer: Rolling a fair number cube and flipping a coin.

23. The probability of getting a 1 on the first roll is $\frac{1}{6}$, 2 on the second roll is $\frac{1}{6}$, 3 on the third roll is $\frac{1}{6}$, 4 on the fourth roll is $\frac{1}{6}$, 5 on the fifth roll is $\frac{1}{6}$, and 6 on the sixth roll is $\frac{1}{6}$.

$$= \frac{1}{6} \cdot \frac{1}{6} \cdot \frac{1}{6} \cdot \frac{1}{6} \cdot \frac{1}{6} \cdot \frac{1}{6} = \frac{1}{46{,}656}$$

24. B; There are 36 possible outcomes: 1, 1; 1, 2; 1, 3; 1, 4; 1, 5; 1, 6; 2, 1; 2, 2; 2, 3; 2, 4; 2, 5; 2, 6; 3, 1; 3, 2; 3, 3; 3, 4; 3, 5; 3, 6; 4, 1; 4, 2; 4, 3; 4, 4; 4, 5; 4, 6; 5, 1; 5, 2; 5, 3; 5, 4; 5, 5; 5, 6; 6, 1; 6, 2; 6, 3; 6, 4; 6, 5 and 6, 6.
There are 9 possible outcomes with an even number on the first roll and an odd number on the second roll: 2, 1; 2, 3; 2, 5; 4, 1; 4, 3; 4, 5; 6, 1; 6, 3; and 6, 5.
P(even number on first roll and odd number on the second roll)

$$= \frac{\text{9 ways event can occur}}{\text{36 possible outcomes}} = \frac{9}{36} = \frac{1}{4}$$

25. J; There are 12 possible outcomes: 1, T; 2, T; 3, T; 4, T; 5, T; 6, T; 1, H; 2, H; 3, H; 4, H; 5, H; and 6, H. Only one outcome has a 5 on the number cube and heads on the coin: 5, H.

$$P(\text{5 and head}) = \frac{\text{1 way event can occur}}{\text{12 possible outcomes}} = \frac{1}{12}$$

26. 0.445, 0.9, 1.06, 1.2

27. 2.007, 2.02, 2.45, 2.678

28. 7.09, 7.9, 7.99, 7.999

29.
$$\begin{aligned} P(\text{will finish work}) + P(\text{will not finish work}) &= 100\% \\ 15\% \quad + P(\text{will not finish work}) &= 100\% \\ -15\% \qquad\qquad\qquad\qquad & \quad -15\% \\ \hline P(\text{will not finish work}) &= 85\% \end{aligned}$$

HANDS-ON LAB 12-5, PAGE 692

Activity 1

Think and Discuss

1. Possible answer: The order is important when conducting a systematic sample in which every third person will be surveyed. Even if the first three people through the door are the same in each case, the order in which they enter affects the survey results. The order is not important in a situation in which the first three people into a store win a prize. All three people win, regardless of who was first, second or third to enter.

Try This

1. Let C represent Cindy, L represent Laurie, M represent Marty, and J represent Joel. The possible election results are: CLMJ, CLJM, CMLJ, CMJL, CJLM, CJML, LCMJ, LCJM, LMCJ, LMJC, LMJC, LJCM, LJMC, MCLJ, MCJL, MLCJ, MLJC, MJCL, MJLC, JCLM, JCML, JLCM, JLMC, JMCL, JMLC. Thus, there are 24 different ways the election can turn out.

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Activity 2

Think and Discuss

1. Permutation; order is important.
2. Combination; order is not important.
3. Combination; order is not important.
4. Permutation; order is important.

Try This

1. Represent the movies by the letters A, B, C, D, E, and F. The possibilities are: AB, AC, AD, AE, AF, BC, BD, BE, BF, CD, CE, CF, DE, DF, and EF. There are 15 ways the club members can choose 2 movies from a list of 6 possibilities.
2. Choosing three equal team members is a combination problem and results in 10 possible teams; choosing a captain, assistant captain, and a secretary is a permutation problem and results in 60 possible teams. The permutation problem has more possible teams because the order in which team members are chosen is important.

12-6, PAGE 695

Think and Discuss

1. No; a prediction, by definition, is just a guess and a sample is also a prediction as to the makeup of a population. So you can not expect a guess based on a prediction to be exact.

Exercises

1. You can write a proportion. Remember that *percent* means "per hundred."

$$\frac{12}{100} = \frac{x}{5{,}000}$$
$$100 \cdot x = 12 \cdot 5{,}000$$
$$100x = 60{,}000$$
$$\frac{100x}{100} = \frac{60{,}000}{100}$$
$$x = 600$$

You can predict that 600 residents will volunteer.

2. $P(\text{multiple of } 3) = \frac{2}{6}$

$$\frac{2}{6} = \frac{x}{30}$$
$$6 \cdot x = 2 \cdot 30$$
$$6x = 60$$
$$\frac{6x}{6} = 60$$
$$x = 10$$

You can expect to roll a multiple of 3 about 10 times.

3. The airlines want to fill all 186 seats. But, on average, only 93% of ticket holders will show up for their flight. So 93% of ticket holders must equal 186. You can write an equation to find this number.

$$\frac{93}{100} = \frac{186}{x}$$
$$100 \cdot 186 = 93 \cdot x$$
$$18{,}600 = 93x$$
$$\frac{18{,}600}{93} = \frac{93x}{93}$$
$$x = 200$$

The airline should sell 200 tickets.

4. $$\frac{64}{100} = \frac{x}{15{,}000}$$
$$100 \cdot x = 64 \cdot 15{,}000$$
$$100x = 960{,}000$$
$$\frac{100x}{100} = \frac{960{,}000}{100}$$
$$x = 9{,}600$$

You can predict that 9,600 households receive the paper.

5. $P(\text{tails}) = \frac{1}{2}$

$$\frac{1}{2} = \frac{x}{64}$$
$$2 \cdot x = 1 \cdot 64$$
$$2x = 64$$
$$\frac{2x}{2} = \frac{64}{2}$$
$$x = 32$$

You can expect the coin to show tails about 32 times.

6. $P(\text{red chip}) = \frac{5}{11}$

$$\frac{5}{11} = \frac{x}{99}$$
$$11 \cdot x = 5 \cdot 99$$
$$11x = 495$$
$$\frac{11x}{11} = \frac{495}{11}$$
$$x = 45$$

You can expect to remove a red chip from the bag about 45 times.

7. $$\frac{7}{100} = \frac{9}{x}$$
$$100 \cdot 9 = 7 \cdot x$$
$$900 = 7x$$
$$\frac{900}{7} = \frac{7x}{7}$$
$$128.6 = x$$

The director needs to find 129 donors each day.

8. **a.** $$\frac{10}{50} = \frac{x}{5{,}500}$$
$$50 \cdot x = 10 \cdot 5{,}500$$
$$50x = 55{,}000$$
$$\frac{50x}{50} = \frac{55{,}000}{50}$$
$$x = 1{,}100$$

You would expect about 1,100 residents to know the name of the mayor of the neighboring city.

b. $$\frac{40}{50} = \frac{x}{600}$$
$$50 \cdot x = 40 \cdot 600$$
$$50x = 24{,}000$$
$$\frac{50x}{50} = \frac{24{,}000}{50}$$
$$x = 480$$

You can predict that 480 residents do not know the name of the mayor of the neighboring city.

9. No; they were only surveying people who like frozen yogurt.

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10. $\frac{108}{400} = \frac{x}{75}$

$400 \cdot x = 108 \cdot 75$

$400x = 8{,}100$

$\frac{400x}{400} = \frac{8{,}100}{400}$

$x = 20.25$

You can predict that about 20 Canadians are of French origin.

11. $\frac{80}{400} = \frac{18}{x}$

$400 \cdot 18 = 80 \cdot x$

$7{,}200 = 80x$

$\frac{7{,}200}{80} = \frac{80x}{80}$

$90 = x$

You can predict that about 90 Canadians are in the group.

12. The students should have said 20%, not 20, of the group will be native Canadians.

13. First find what percent of the Canadians in the sample group are of French origin. Then find what percent of the Canadians in the sample group are of native Canadian origin. Multiply both percents by 150 and add the products.

14. $\frac{6}{400} = \frac{15}{x}$

$400 \cdot 15 = 6 \cdot x$

$6{,}000 = 6x$

$\frac{6{,}000}{6} = \frac{6x}{6}$

$1{,}000 = x$

There are 1,000 total people in the group, so there are $1{,}000 - 15 = 985$ Canadians not in the Other European origin category.

15. B; $\frac{24}{100} = 24\%$, which can be estimated to 25%.

16. H; $\frac{1}{6} = \frac{x}{36}$

$6 \cdot x = 1 \cdot 36$

$6x = 36$

$\frac{6x}{6} = \frac{36}{6}$

$x = 6$

17. $x + 10 = -2$

$x + 10 - 10 = -2 - 10$

$x = -12$

18. $x - 20 = -5$

$x - 20 + 20 = -5 + 20$

$x = 15$

19. $-9x = 45$

$\frac{-9x}{-9} = \frac{45}{-9}$

$x = -5$

20. $x \div (-2) = -5$

$x \div (-2) \cdot (-2) = -5 \cdot (-2)$

$x = 10$

21. $P(5) = \frac{\text{1 way event can occur}}{\text{6 possible outcomes}}$

$P(5) = \frac{1}{6}$

22. $P(\text{not } 2) = \frac{\text{5 ways event can occur}}{\text{6 possible outcomes}}$

$P(\text{not } 2) = \frac{5}{6}$

23. $P(3 \text{ or } 4) = \frac{\text{2 ways event can occur}}{\text{6 possible outcomes}}$

$P(3 \text{ or } 4) = \frac{2}{6} = \frac{1}{3}$

24. $P(\text{divisible by } 3) = \frac{\text{2 ways event can occur}}{\text{6 possible outcomes}}$

$P(\text{divisible by } 3) = \frac{1}{3}$

READY TO GO ON? PAGE 698

1. There are 12 possibilities: 1, T; 2, Y; 3, T; 4, T; 5, T; 6, T; 1, H; 2, H; 3, H; 4, H; 5, H; and 6. H. There are three possible outcomes that have and even number and a tail: 2, T; 4, T; and 6, T.

$P(\text{even number and tail}) = \frac{\text{3 ways event can occur}}{\text{12 possible outcomes}}$

$P(\text{even number and tail}) = \frac{3}{12} = \frac{1}{4}$.

2. There are 12 possibilities: 1, T; 2, Y; 3, T; 4, T; 5, T; 6, T; 1, H; 2, H; 3, H; 4, H; 5, H; and 6. H. Only one outcome is 6 and tails: 6, T.

$P(6 \text{ and tails}) = \frac{\text{1 way event can occur}}{\text{12 possible outcomes}}$

$P(6 \text{ and tails}) = \frac{1}{12}$.

3. There are 12 possibilities: 1, T; 2, Y; 3, T; 4, T; 5, T; 6, T; 1, H; 2, H; 3, H; 4, H; 5, H; and 6. H. Only one outcome has 4 and heads: 4, H.

$P(4 \text{ and heads}) = \frac{\text{1 way event can occur}}{\text{12 possible outcomes}}$

$P(4 \text{ and heads}) = \frac{1}{12}$

Three outcomes have an odd number and heads: 1, H; 3, H; and 5, H.

$P(\text{odd number and heads}) = \frac{\text{3 ways event can occur}}{\text{12 possible outcomes}}$

$P(\text{odd number and heads}) = \frac{3}{12}$

$\frac{1}{12} < \frac{3}{12}$, so $P(4 \text{ and heads}) < P(\text{odd number and heads})$.

4. $P(\text{spinning red}) = \frac{\text{2 ways event can occur}}{\text{5 possilble outcomes}}$

$P(\text{spinning red}) = \frac{2}{5}$

$P(\text{red marble}) = \frac{\text{4 ways the event can occur}}{\text{8 possible outcomes}}$

$P(\text{red marble}) = \frac{4}{8}$

$P(\text{red marble}) = \frac{1}{2}$

$P(\text{spinning red and red marble}) = \frac{2}{5} \cdot \frac{1}{2}$

$P(\text{spinning red and red marble}) = \frac{2}{10}$

So, $P(\text{spinning red and red marble}) = \frac{1}{5}$.

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5. $P(\text{spinning yellow}) = \dfrac{\text{1 way event can occur}}{\text{5 possible outcomes}}$

$P(\text{spinning yellow}) = \dfrac{1}{5}$

$P(\text{not a yellow marble}) = \dfrac{\text{6 ways event can occur}}{\text{8 possible outcomes}}$

$P(\text{not a yellow marble}) = \dfrac{6}{8}$

$P(\text{not a yellow marble}) = \dfrac{3}{4}$

$P(\text{spinning yellow and not a yellow marble}) = \dfrac{1}{5} \cdot \dfrac{3}{4}$

So, $P(\text{spinning yellow and not a yellow marble}) = \dfrac{3}{20}$.

6. $P(\text{spinning not blue}) = \dfrac{\text{3 ways event can occur}}{\text{5 possible outcoms}}$

$P(\text{spinning not blue}) = \dfrac{3}{5}$

$P(\text{not a blue marble}) = \dfrac{\text{6 ways event can occur}}{\text{8 possible outcomes}}$

$P(\text{not a blue marble}) = \dfrac{6}{8}$

$P(\text{not a blue marble}) = \dfrac{3}{4}$

So, $P(\text{spinning not blue and not a blue marble}) = \dfrac{3}{5} \cdot \dfrac{3}{4}$

$P(\text{spinning not blue and not a blue marble}) = \dfrac{9}{20}$.

7. $\dfrac{26}{100} = \dfrac{x}{600}$

$100 \cdot x = 26 \cdot 600$

$100x = 15{,}600$

$\dfrac{100x}{100} = \dfrac{15{,}600}{100}$

$x = 156$

You can predict that 156 people have a dog.

8. $P(\text{less than 3}) = \dfrac{2}{6} = \dfrac{1}{3}$

$\dfrac{1}{3} = \dfrac{x}{54}$

$3 \cdot x = 1 \cdot 54$

$3x = 54$

$\dfrac{3x}{3} = \dfrac{54}{3}$

$x = 18$

You can expect to roll a number less than 3 about 18 times.

9. $\dfrac{90}{100} = \dfrac{450}{x}$

$90 \cdot x = 100 \cdot 450$

$90x = 45{,}000$

$\dfrac{90x}{90} = \dfrac{45{,}000}{90}$

$x = 500$

The managers should sell 500 tickets.

10. $\dfrac{45}{100} = \dfrac{x}{45{,}000}$

$100 \cdot x = 45 \cdot 45{,}000$

$100x = 2{,}025{,}000$

$\dfrac{100x}{100} = \dfrac{2{,}025{,}000}{100}$

$x = 20{,}250$

$45{,}000 - 20{,}250 = 24{,}750$

You can predict that 24,750 people are not getting enough sleep.

MULTI-STEP TEST PREP, PAGE 699

1. $P(\text{A on Big Wheel}) = \dfrac{1}{4}$

$P(\text{even number on Lucky Circle}) = \dfrac{2}{5}$

$\dfrac{1}{4} < \dfrac{2}{5}$, so the guest is more likely to win a prize by spinning the Lucky Circle.

2. There are 20 possible outcomes: A, 1; A, 2; A, 3; A, 4; A, 5; B, 1; B, 2; B, 3; B, 4; B, 5; C, 1; C, 2; C, 3; C, 4; C, 5; D, 1, D, 2; D, 3; D, 4; and D, 5.

3. There are 2 outcomes that have an A and an even number: A, 2 and A, 4.

$P(\text{A and an even number}) = \dfrac{\text{2 ways event can occur}}{\text{20 possible outcomes}}$

$P(\text{A and an even number}) = \dfrac{2}{20} = \dfrac{1}{10}$

4. $\dfrac{1}{4} \cdot \dfrac{1}{4} = \dfrac{1}{16}$

5. $\dfrac{1}{4} = \dfrac{x}{160}$

$4 \cdot x = 1 \cdot 160$

$4x = 160$

$\dfrac{4x}{4} = \dfrac{160}{4}$

$x = 40$

You can predict the Big Wheel will have 40 winners.

$\dfrac{2}{5} = \dfrac{x}{125}$

$5 \cdot x = 2 \cdot 125$

$5x = 250$

$\dfrac{5x}{5} = \dfrac{250}{5}$

$x = 50$

You can predict the Lucky Circle will have 50 winners.

So, you can predict that the Lucky Circle will have the greatest number of winners.

GAME TIME, PAGE 702

1. None; the people were chosen from the phone book, which is make up of listed numbers.

2. There are only two different colors of socks in the drawer. If the first two socks she pulls out of the drawer are different colors, then the third sock she pulls out must be the same color as one of the socks she has already pulled out. So, she needs to pull out only 3 socks to be certain that she will have two of the same color.

3. The probability is 0; if 3 boys got the correct food, then so did the 4th boy.

STUDY GUIDE: REVIEW, PAGE 704

1. Equally likely

2. Experiment; outcome

3. Probability

4. Theoretical probability

5. Sample space

6. Certain

7. $75\% = 0.75$

$75\% = \dfrac{3}{4}$

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8. Compare: $50\% > 30\%$
He is more likely to pick a white sock.

9. $P(\text{juice}) \approx \dfrac{\text{number of times the event occurs}}{\text{total number of trials}}$
$= \dfrac{20}{75}$
$= \dfrac{4}{15}$

10. soup, turkey, juice
soup, turkey, milk
soup, turkey, iced tea
soup, roast beef, juice
soup, roast beef, milk
soup, roast beef, iced tea
soup, ham, juice
soup, ham, milk
soup, ham, iced tea
salad, turkey, juice
salad, turkey, milk
salad, turkey, iced tea
salad, roast beef, juice
salad, roast beef, milk
salad, roast beef, iced tea
salad, ham, juice
salad, ham, milk
salad, ham, iced tea
There are 18 lunch combinations.

11. There are 4 possible outcomes: red, blue, yellow, and green. All are equally likely because the colored regions have the same areas.
$P(\text{yellow}) = \dfrac{\text{1 way event can occur}}{\text{4 possible outcomes}}$
$= \dfrac{1}{4}$

12. There are 6 possible outcomes when a standard number cube is rolled: 1, 2, 3, 4, 5, or 6. There are three ways a number greater than 3 can be rolled: 4, 5, or 6.
$P(\text{number greater than 3}) = \dfrac{\text{3 ways event can occur}}{\text{6 possible outcomes}}$
$= \dfrac{3}{6}$
$= \dfrac{1}{2}$

13.
$$\begin{aligned} P(\text{purple}) + P(\text{not purple}) &= 100\% \\ 25\% + P(\text{not purple}) &= 100\% \\ -25\% \qquad\qquad\quad & \quad -25\% \\ \hline P(\text{not purple}) &= 75\% \end{aligned}$$

14. Let B represent the blue marbles, W represent the white marbles, H and T represent heads and tails on the first coin, and h and t represent heads and tails on the second coin. There are 24 possible outcomes, which are:
BHh, BHt, BTh, BTt
BHh, BHt, BTh, BTt
BHh, BHt, BTh, BTt
BHh, BHt, BTh, BTt
WHh, WHt, WTh, WTt
WHh, WHt, WTh, WTt
A blue marble, heads on the first coin, and tails on the second coin is represented by BHt, which appears 4 times.
$P(\text{blue, heads, tails}) = \dfrac{\text{4 ways event can occur}}{\text{24 possible outcomes}}$
$= \dfrac{4}{24}$
$= \dfrac{1}{6}$

15. Let H and T represent heads and tails on the penny, and h and t represent heads and tails on the quarter. There are 24 possible outcomes: 1Hh, 2Hh, 3Hh, 4Hh, 5Hh, 6Hh, 1Ht, 2Ht, 3Ht, 4Ht, 5Ht, 6Ht, 1Th, 2Th, 3Th, 4Th, 5Th, 6Th, 1Tt, 2Tt, 3Tt, 4Tt, 5Tt, 6Tt. An even number on the number cube and both coins landing on heads occurs 3 times: 2Hh, 4Hh, and 6Hh.
P(even number, heads, heads)
$= \dfrac{\text{3 ways event can occur}}{\text{24 possible outcomes}}$
$= \dfrac{3}{24}$
$= \dfrac{1}{8}$

16. $\dfrac{2}{100} = \dfrac{x}{5{,}000}$
$100 \cdot x = 2 \cdot 5{,}000$
$100x = 10{,}000$
$\dfrac{100x}{100} = \dfrac{10{,}000}{100}$
$x = 100$
You can predict that there will be 100 defective items.

17. $P(\text{even number}) = \dfrac{3}{6}$
$\dfrac{3}{6} = \dfrac{x}{50}$
$6 \cdot x = 3 \cdot 50$
$6x = 150$
$\dfrac{6x}{6} = \dfrac{150}{6}$
$x = 25$
You can expect to roll an even number about 25 times.

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18. $\frac{175}{500} = \frac{x}{4{,}500}$

$500 \cdot x = 175 \cdot 4{,}500$

$500x = 787{,}500$

$\frac{500x}{500} = \frac{787{,}500}{500}$

$x = 1{,}575$

You can predict that 1,575 teenagers use their computers regularly.

19. $\frac{20}{100} = \frac{x}{500}$

$100 \cdot x = 20 \cdot 50$

$100x = 10{,}000$

$\frac{100x}{100} = \frac{10{,}000}{100}$

$x = 100$

You can predict that 100 students take music lessons.

CHAPTER TEST, PAGE 707

1. Unlikely

2. Likely

3. $12\% = 0.12$

$12\% = \frac{12}{100} = \frac{3}{25}$

4. $0.8 = 80\%$

$0.8 = \frac{8}{10} = \frac{4}{5}$

5. There are 60 students. Twenty-four go to bed at 8:30 P.M.

$P(8{:}30 \text{ P.M.}) \approx \frac{\text{number of times the event occurs}}{\text{total number of trials}}$

$= \frac{24}{60}$

$= \frac{2}{5}$

6. There are 60 students. Twelve go to bed before 8:30 P.M.

$P(\text{before } 8{:}30 \text{ P.M.})$

$\approx \frac{\text{number of times the event occurs}}{\text{total number of trials}}$

$= \frac{12}{60}$

$= \frac{1}{5}$

7. There are 10 darts. One dart is in the center circle.

$P(\text{dart lands in center circle})$

$\approx \frac{\text{number of times the event occurs}}{\text{total number of trials}}$

$= \frac{1}{10}$

8. There are six possible outcomes when a fair number cube is rolled: 1, 2, 3, 4, 5, or 6. There are 2 even numbers greater than 2: 4 and 6.

$P(\text{even number greater than 2})$

$= \frac{\text{2 ways event can occur}}{\text{6 possilble outcomes}}$

$= \frac{2}{6}$

$= \frac{1}{3}$

9. $P(\text{being rained out}) + P(\text{not being rained out}) = 100\%$

$64\% + P(\text{not being rained out}) = 100\%$

$-64\% \qquad\qquad -64\%$

$P(\text{not being rained out}) = 36\%$

10. Let A, B, C, and D represent the 4 photos. The possible arrangements are: ABCD, ABDC, ACBD, ACDB, ADBC, ADCB, BACD, BADC, BCAD, BCDA, BDAC, BDCA, CABD, CADB, CBAD, CBDA, CDAB, CDBA, DABC, DACB, DBAC, DBCA, DCAB, DCBA. There are 24 possible arrangements.

11. The possible outfits that Marsha can make are: jeans and red shirt, jeans and blue shirt, jeans and white shirt, black pants and red shirt, black pants and blue shirt, black pants and white shirt. Marsha can choose from 6 different outfits.

12. $P(\text{even number}) = \frac{3}{6} = \frac{1}{2}$

$\frac{1}{12} = \frac{x}{36}$

$2 \cdot x = 1 \cdot 36$

$2x = 36$

$\frac{2x}{2} = \frac{36}{2}$

$x = 18$

You can expect to roll an even number about 18 times.

13. $P(\text{blue marble from first bag}) = \frac{2}{4} = \frac{1}{2}$

$P(\text{blue marble from second bag}) = \frac{3}{9} = \frac{1}{3}$

$P(\text{spinner landing on blue}) = \frac{1}{4}$

Multiply the probabilities $= \frac{1}{2} \cdot \frac{1}{3} \cdot \frac{1}{4} = \frac{1}{24}$

PROBLEM SOLVING ON LOCATION, PAGE 710

See Appendix.

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Miniature Golf Tournaments

1. Make a table is a possible strategy to solve this problem.
First, find how many eruptions occur in 1 hour. If the volcano erupts every 20 minutes, then it erupts 3 times every hour.

Hour	Times of eruptions	Number of eruptions
9 a.m. to 10 a.m.	9:15; 9:35; 9:55	3
10 a.m. to 11 a.m.	10:15; 10:35; 10:55	3
11 a.m. to 12 noon	11:15; 11:35; 11:55	3
12 noon to 1 p.m.	12:15; 12:35; 12:55	3
1 p.m. to 2 p.m.	1:15; 1:35; 1:55	3
2 p.m. to 3 p.m.	2:15; 2:35; 2:55	3
3 p.m. to 4 p.m.	3:15; 3:35; 3:55	3
4 p.m. to 5 p.m.	4:15; 4:35; 4:55	3
5 p.m. to 6 p.m.	5:15; 5:35; 5:55	3
6 p.m. to 7 p.m.	6:15; 6:35; 6:55	3
7 p.m. to 8 p.m.	7:15; 7:35; 7:55	3
8 p.m. to 9 p.m.	8:15; 8:35; 8:55	3

The golf course is open for 12 hours and each hour the volcano erupts 3 times. The volcano erupts 36 times each day.

2. *Guess and test* is a possible strategy to solve this problem.
Create an equation using the area of a rectangle.

$$A = \cdot w$$
$$240 \text{ ft}^2 = \cdot w$$
$$240 = (w + 22) \cdot w$$

Choose a width to begin the guess and test process. Consider a width of 10. The length would be 32 and the area 320. That area is greater than 240. so test a value less than 10

Width, w	Length, $w + 22$	Area, $w \cdot$
10	32	320
5	27	135
7	29	203
8	30	240

The length of the green is 30 ft.

3. *Use logical reasoning* is a possible strategy to solve this problem.
$C = \pi d$
$C \approx 3.14 \cdot 7$
$C \approx 21.98$ meters
Because the circumference is approximately 22 meters and the lights are evenly spaced 2 meters apart, 22 divided by 2 will give the number of lights.
$22 \div 2 = 11$
There should be 11 lights.

4. *Draw a diagram* is a possible strategy to solve this problem.
Step 1:
Find the area of the putting surface.
Left rectangle: $15 \cdot 5 = 75 \text{ ft}^2$
Right rectangle: $15 \cdot 5 = 75 \text{ ft}^2$
Middle rectangle: $5 \cdot 5 = 25 \text{ ft}^2$
Add the left, middle, and right areas.
$75 + 75 + 25 = 175 \text{ ft}^2$
Step 2:
Find the cost of the replacement green.
$175 \cdot 1.80 = 315$
It will cost \$315 to replace the green.

CHAPTER 12, PAGES 710-711

Shipwreck Diving

1. *Use logical reasoning* is a possible strategy to solve this problem.
First, find the depth of the U-869.
$3 \cdot -80 =$ depth of U-869
$3 \cdot -80 = -240$
The depth of the U-869 is -240 feet.
Next, divide 240 by 20.
$240 \div 20 = 12$
Because there are 12 sections of 20 feet to reach the U-869, she will check her equipment 11 times *before* reaching the U-869.

2. *Solve a simpler problem* is a possible strategy to solve this problem.
Step 1:
Divide the total depth into 5 equal parts.
$-95 \div 5 = -19$
Carlos dove -19 feet to watch a school of fish.
Step 2:
Add -19 to -30 to find his current location.
$-19 + -30 = -49$
Carlos dove -49 feet to stop and rest.
Subtract -49 feet from -95 feet to find how many more feet he needs to descend to reach the *Tolten*.
$-95 - (-49) = -95 + 49 = -46$
Carlos needs to descend 46 feet to reach the *Tolten*.

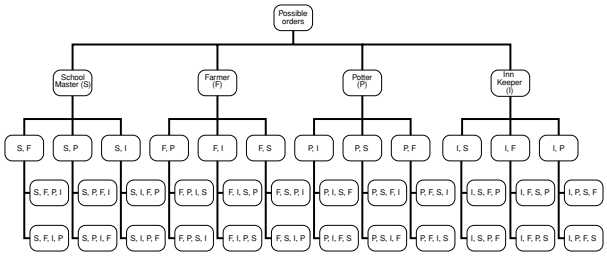
3. First, find the depth of the *Eureka*.
depth of the *Resor* $+ 15 =$ depth of the *Eureka*
$-125 + 15 = -110$
The depth of the *Eureka* is -110 feet.
Next, find the depth of the *Eagle*.
$-110 \cdot \frac{1}{2} =$ depth of the *Eagle*
$-110 \cdot \frac{1}{2} = -55$
The depth of the *Eagle* is -55 feet.

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Historic Cold Spring Village

1. *Use logical reasoning* is a possible strategy to solve this problem.
Each video takes 7 minutes, plus 30 seconds between shows.
Knowing that 60 seconds equals 1 minute, each orientation takes 7.5 minutes.
Because 60 minutes equals 1 hour, divide 60 by 7.5 minutes.
$60 \div 7.5 = 8$
The video plays 8 times in 1 hour, so 8 times 8 equals how many times it plays in an 8-hour period.
$8 \cdot 8 = 64$
The video plays 64 times in an 8-hour period.

2. *Make a table* is a possible strategy to solve this problem.



The residents can line up in 24 different ways.

3. *Make a model* is a possible strategy to solve this problem.
Number of private homes · number of barns · number of meeting halls = possible number of tours
$5 \cdot 2 \cdot 2 = 20$
There are 20 possible different tours.

4. *Make an organized* list is a possible strategy to solve this problem.
Let 1, 2, 3, 4, 5, and 6 represent the 6 different shops.
The different ways are:
1, 2, 3, 4, 5
1, 3, 4, 5, 6
1, 2, 4, 5, 6
1, 2, 3, 5, 6
1, 2, 3, 4, 6
2, 3, 4, 5, 6
There are 6 different ways she can choose a set of 5 shops.

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