12-1 Probability Events

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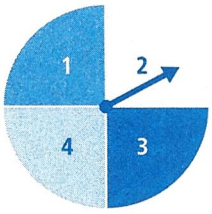
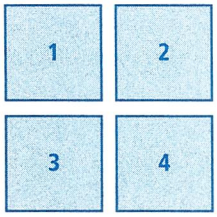
EXPLORE & REASON

Allie spins the spinner and draws one card without looking. She gets a 3 on the spinner and the 3 card. Then she sets the card aside, spins again, and draws another card.





A. Is it possible for Allie to get a 3 on her second spin? On her second card? Explain.

B. **Construct Arguments** How does getting the 3 card on her first draw affect the probability of getting the 2 card on her second draw? Explain.

HABITS OF MIND

Look for Relationships How are the results from the spinner related to the results from the cards? Explain.

EXAMPLE 1 Try It! Find Probabilities of Mutually Exclusive Events

1. A box contains 100 balls. Thirty of the balls are purple and 10 are orange. If you select one of the balls at random, what is the probability of each of the following events?

   a. The ball is purple or orange.

   b. The ball is not purple and not orange.

EXAMPLE 2 Try It! Find the Probabilities of Non-Mutually Exclusive Events

2. A video game is played on a 34 cm by 20 cm rectangular computer screen. A starship is represented by two overlapping circles of radius 6 cm whose area of overlap is 20 cm^2. A black hole is equally likely to appear at any point on the screen. To the nearest whole percent, what is the probability that the point will appear within the starship?

HABITS OF MIND

Generalize Explain in your own words the meaning of mutually exclusive events. Include examples.

EXAMPLE 3 Try It! Identify Independent Events

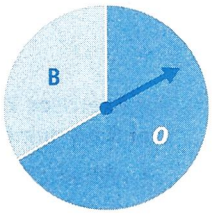
3. There are 10 cards in a box, 5 black and 5 red. Two cards are selected from the box, one at a time.

a. A card is chosen at random and then replaced. Another card is chosen. Does the color of the first card chosen affect the possibilities of the second card chosen? Explain.

b. A card is chosen at random and *not* replaced. Another card is chosen. Does the color of the first card chosen affect the possibilities of the second card chosen? Explain

EXAMPLE 4 Try It! Find Probabilities of Independent Events

4. You spin the spinner two times. Assume that the probability of Blue each spin is $\frac{1}{3}$ and the probability of Orange each spin is $\frac{2}{3}$. What is the probability of getting the same color both times? Explain.



HABITS OF MIND

Make Sense and Persevere Explain the difference between mutually exclusive events and independent events.

Do You UNDERSTAND?

1. ESSENTIAL QUESTION How does describing events as independent or mutually exclusive affect how you find probabilities?

2. **Reason** Two marbles are chosen, one at a time, from a bag containing 6 marbles, 4 red marbles and 2 green marbles. Suppose the first marble chosen is green. Is the probability that the second marble will be red greater if the first marble is returned to the bag or if it is not returned to the bag? Explain.

3. **Error Analysis** The probability that Deshawn plays basketball (event B) after school is 20%. The probability that he talks to friends (event T) after school is 45%. He says that $P(B \text{ or } T)$ is 65%. Explain Deshawn's error.

4. **Vocabulary** What is the difference between mutually exclusive events and independent events?

Do You KNOW HOW?

5. A bag contains 40 marbles. Eight are green and 2 are blue. You select one marble at random. What is the probability of each event?
   a. The marble is green or blue.

   b. The marble is not green and not blue.

6. A robot at a carnival booth randomly tosses a dart at a square target with 8 inch sides and a circle with a 3 inch radius in the middle. To the nearest whole percent, what is the probability that the dart will land in the circle?

For Exercises 7 and 8, assume that you roll a standard number cube two times.

7. What is the probability of rolling an even number on the first roll and a number less than 3 on the second roll?

8. What is the probability of rolling an odd number on the first roll and a number greater than 3 on the second roll?

PRACTICE & PROBLEM SOLVING

UNDERSTAND

9. Construct Arguments Let S be a sample space for an experiment in which every outcome is both equally likely and mutually exclusive. What can you conclude about the sum of the probabilities for all of the outcomes? Give an example.

10. Error Analysis At Lincoln High School, 6 students are members of both the Chess Club and the Math Club. There are 20 students in the Math Club, 12 students in the Chess Club, and 400 students in the entire school.

Danielle calculated the probability that a student chosen at random belongs to the Chess Club or the Math Club. Explain her error.

Event C: Student is in Chess Club
Event M: Student is in Math Club

$$P(C \text{ or } M) = P(C) + P(M)$$
$$= \frac{12}{400} + \frac{20}{400}$$
$$= \frac{32}{400} = 0.08$$

✗

11. Higher Order Thinking Murphy's math teacher sometimes wears scarves to class. Murphy has been documenting the relationship between his teacher wearing a scarf and when the class has a math quiz. The probabilities are as follows:

- P(wearing a scarf) = 10%
- P(math quiz) = 15%
- P(wearing a scarf and math quiz) = 5%

Are the events "the teacher is wearing a scarf" and "there will be a quiz" independent events? Explain.

Reason **A card is drawn from a box containing 5 cards, each showing a different number from 1 to 5. Consider the events "even number," "odd number," "less than 3," and "greater than 3." Determine whether each pair of events mutually exclusive.**

12. $< 3, > 3$

13. even, > 3

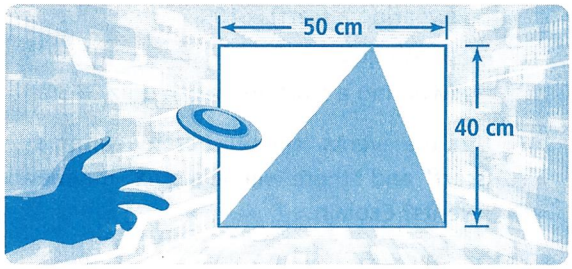
14. odd, > 3

15. odd, even

PRACTICE & PROBLEM SOLVING

PRACTICE

16. Hana is playing a virtual reality game in which she must toss a disc to land on the largest triangular section of the board. If the disc is equally likely to land anywhere on the board, what is the probability that she will succeed? Explain. SEE EXAMPLE 1



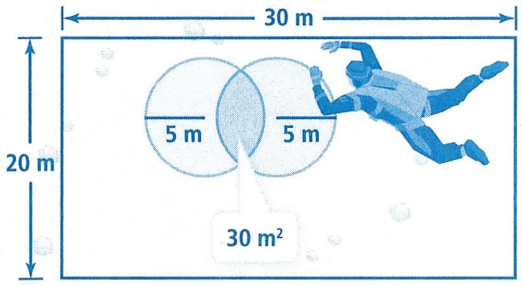
In a class of 25 students, 8 students have heights less than 65 inches and 10 students have heights of 69 inches or more. For Exercises 17–19, find the probabilities described. SEE EXAMPLE 1

17. P(less than 65 inches or greater than 69 inches)

18. P(greater than or equal to 65 inches)

19. P(greater than or equal to 65 inches and less than or equal to 69 inches)

20. A skydiver is equally likely to land at any point on a rectangular field. Two overlapping circular targets of radius 5 meters are marked on the field. To the nearest percent, what is the probability that the sky diver will land in one or both of the circles? SEE EXAMPLE 2



21. Two marbles are chosen at random, one at a time from a box that contains 7 marbles, 5 red and 2 green. SEE EXAMPLES 3 AND 4

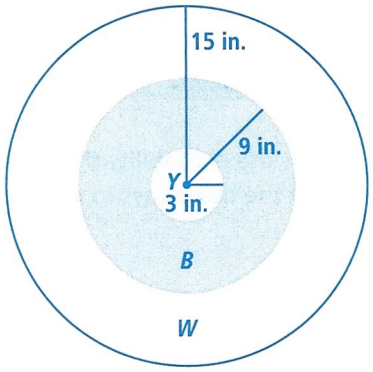
a. Find the probability of drawing 2 red marbles when the first marble is replaced before the second marble is chosen.

b. Determine whether the situation described is independent.

PRACTICE & PROBLEM SOLVING

APPLY

22. Mathematical Connections For a science fair project, Paige wants to test whether ants prefer certain colors. She releases ants on the surface shown, where the circle marked *Y* is yellow, the circle marked *B* is blue, and the circle marked *W* is white. If the ants are randomly distributed across the entire surface, what is the probability that any given ant will be within the blue circle, but not within the yellow circle? Round to the nearest whole percent.



23. Use Structure A city issues 3-digit license plates for motorized scooters. The digits 0–9 are chosen at random by a computer program. What is the probability that a license plate issued meets each set of criteria?

a. The three-digit number formed is even.

b. The first number is not 7.

c. The first two digits are the same.

d. All three digits are the same.

24. Model With Mathematics During a football game, a kicker is called in twice to kick a field goal from the 30 yard line. Suppose that for each attempt, the probability that he will make the field goal is 0.8.

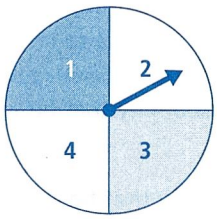
a. What is the probability that he will make both field goals?

b. What is the probability that he will make neither field goal?

ASSESSMENT PRACTICE

25. The probability of events A and B both occurring is 15%. The probability of event A or B occurring is 60%. The probability of B occurring is 50%. What is the probability of A occurring?

26. SAT/ACT A robot spins the spinner shown twice. Assume that the outcomes 1, 2, 3, and 4 are equally likely for each spin. What is the probability that the sum of the two outcomes will be 6?



Ⓐ $\frac{1}{16}$

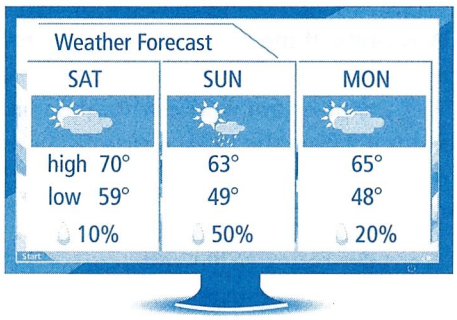
Ⓑ $\frac{1}{8}$

Ⓒ $\frac{3}{16}$

Ⓓ $\frac{1}{4}$

Ⓔ $\frac{3}{4}$

27. Performance Task Paula is packing to visit a friend in another city for a long weekend. She looks at the weather forecast shown below to find the chance of rain. Assume that whether it rains on each day is independent of whether it rains on any other day.



Part A What is the probability that it will not rain on any of the three days to the nearest percent?

Part B What is the probability that it will rain at least one of the three days to the nearest percent?

Part C Do you think Paula should pack an umbrella? Explain.