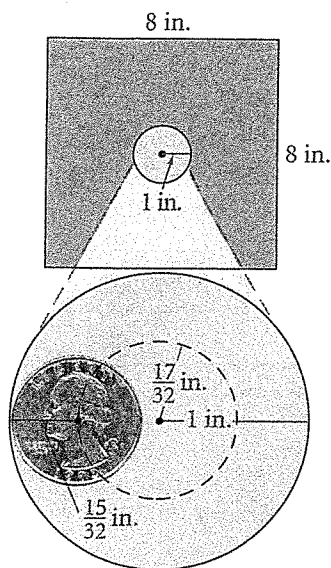As Example 3 suggests, you can apply geometric probability to some games. This can help you decide how easy or difficult it may be to win such games.

4 EXAMPLE Real-World Connection

8 in.

8 in.

1 in.

$\frac{17}{32}$ in.

1 in.

$\frac{15}{32}$ in.

Coin Toss To win a prize in a carnival game, you must toss a quarter so that it lands entirely within the circle as shown at the left. Find the probability of this happening on one toss. Assume that the center of a tossed quarter is equally likely to land at any point within the 8-in. square.

The radius of the circle is 1 in. The radius of a quarter is $\frac{15}{32}$ in. The favorable points are those that are less than $\frac{17}{32}$ in. from the center of the circle. They are the points within the dashed circle.

$P(\text{quarter landing in circle}) = \dfrac{\text{area of dashed circle}}{\text{area of square}}$

$$= \frac{\pi\left(\frac{17}{32}\right)^2}{8^2} \approx 0.014, \text{ or } 1.4\%$$

● The probability of a quarter landing in the circle is about 1.4%.

✓ Quick Check ❹ **Critical Thinking** Suppose you toss 100 quarters. Would you expect to win a prize? Explain.

EXERCISES

For more exercises, see *Extra Skill, Word Problem, and Proof Practice.*
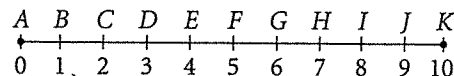
Practice and Problem Solving

Ⓐ Practice by Example

Example 1 (page 582)

GO for Help

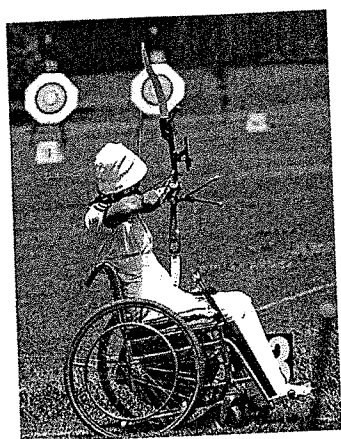Find the probability that a point chosen at random from $\overline{AK}$ is on the given segment.

A   B   C   D   E   F   G   H   I   J   K
+---+---+---+---+---+---+---+---+---+---+
0   1   2   3   4   5   6   7   8   9 10

1. $\overline{CH}$ 2. $\overline{FG}$ 3. $\overline{DJ}$ 4. $\overline{EI}$ 5. $\overline{AK}$

6. Points M and N are on $\overline{ZB}$ with $ZM = 5$, $NB = 9$, and $ZB = 20$. A point is chosen at random from $\overline{ZB}$. What is the probability that the point is on $\overline{MN}$?

Example 2 (page 583)

7. **Transportation** A rapid transit line runs trains every 10 minutes. Draw a geometric model and find the probability that randomly arriving passengers will not have to wait more than 4 minutes.

Traffic Patterns Main Street intersects each street below. The traffic lights on Main follow the cycles shown. As you travel along Main and approach the intersection, what is the probability that the first color you see is green?

8. Durham Avenue: green 30 s, yellow 5 s, red 25 s

9. Martin Luther King Boulevard: green 20 s, yellow 5 s, red 50 s

10. Yonge Street: green 40 s, yellow 5 s, red 25 s

11. International Drive: green 25 s, yellow 5 s, red 45 s

12. Tamiami Trail: green 35 s, yellow 8 s, red 32 s

13. Flutie Pass: green 50 s, yellow 4 s, red 26 s

14. During May, a certain drawbridge over the Intracoastal Waterway is raised every half hour to allow boats to pass. It remains open for 5 min. What is the probability that a motorist arriving at the bridge in May will find it raised?

Target Games Darts are thrown at each of the boards shown below. A dart hits the board at a random point. Judging by appearances, find the probability that it will land in the shaded region.
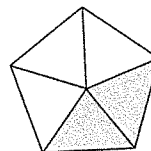
15.
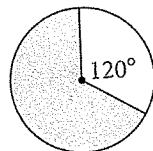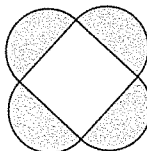
16.

17.

18. 120°

19.

20.

Real-World Connection

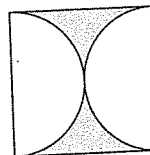An archer receives from 1 to 10 points for an arrow that hits the target. A hit in the center zone is worth 10 points.
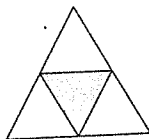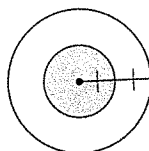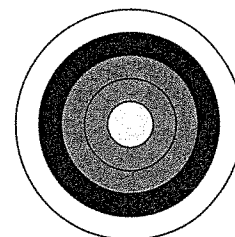
21. Archery An archery target with a radius of 61 cm has 5 scoring zones formed by concentric circles. The colors of the zones are yellow, red, blue, black, and white. The radius of the yellow circle is 12.2 cm. The width of each ring is also 12.2 cm. If an arrow hits the target at a random point, what is the probability that it hits the center yellow zone?
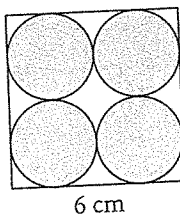
B **Apply Your Skills**

22. $\overline{BZ}$ contains $\overline{MN}$ and $BZ = 20$. A point is chosen at random from $\overline{BZ}$. The probability that the point is also on $\overline{MN}$ is 0.3, or 30%. Find MN.

Target Games A dart hits each square dartboard at a random point. Find the probability that the dart lands inside a circle. Leave your answer in terms of π.
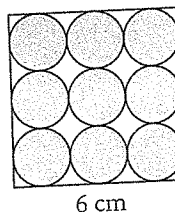
23.
6 cm

24.
6 cm

25.
6 cm
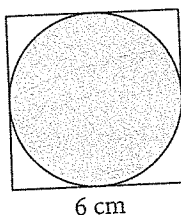
26. A dartboard is a square of radius 10 in. You throw a dart and hit the target. Find the probability that the dart lies within $\sqrt{10}$ in. of the center of the square.

27. Critical Thinking Use the information given in Example 4.
  a. For each 1000 quarters tossed, about how many prizes would be won?
  b. Suppose the game prize costs the carnival $10. About how much profit would the carnival expect for every 1000 quarters tossed?

28. Commuting Suppose a bus arrives at a bus stop every 25 min and waits 5 min before leaving. Sketch a geometric model. Use it to find the probability that a person has to wait more than 10 min for a bus to leave.

29. Traffic Patterns The traffic lights at Fourth and Commercial Streets repeat themselves in 60-second cycles. Ms. Li regularly has students drive on Fourth Street through the Commercial Street intersection. By experience, she knows that they will face a red light 60% of the time. Use this information to estimate how long the Fourth Street light is red during each 1-min cycle.