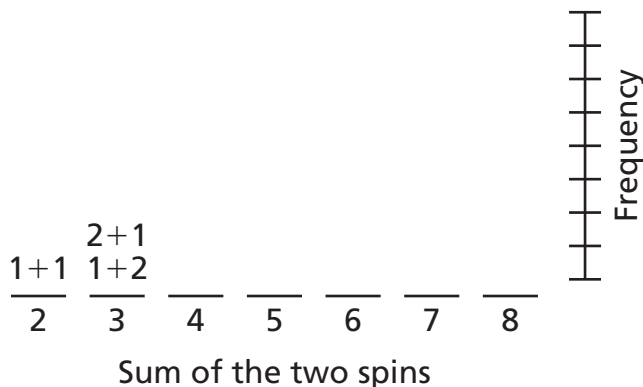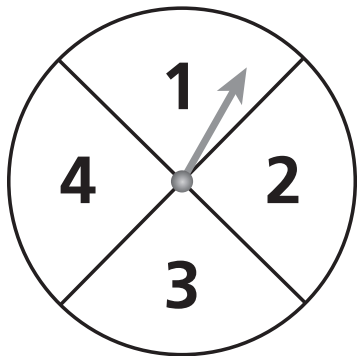## 12.6 Start Thinking

The spinner in the diagram is spun twice. An outcome is identified as the sum of the two spins, so there are seven possible outcomes. Complete the chart to determine the frequency of each outcome. Do you notice a pattern in the chart?

$$\frac{1+1}{2} \quad \frac{\overset{2+1}{1+2}}{3} \quad \frac{\phantom{0}}{4} \quad \frac{\phantom{0}}{5} \quad \frac{\phantom{0}}{6} \quad \frac{\phantom{0}}{7} \quad \frac{\phantom{0}}{8}$$

Sum of the two spins

Frequency

## 12.6 Warm Up

**Evaluate the expression without the use of a calculator.**

**1.** $_4C_2$

**2.** $_7C_1$

**3.** $_5C_0$

**4.** $_9C_4$

**5.** $_8C_8$

**6.** $_{11}C_{10}$

**7.** $_6C_3$

**8.** $_{10}C_2$

## 12.6 Cumulative Review Warm Up

**Identify the amplitude and the period of the function.**

**1.** $y = 2\cos(3x)$

**2.** $y = 3 - \sin\left(\dfrac{\pi x}{4}\right)$

**3.** $y = \dfrac{4}{3}\sin(3x - \pi)$

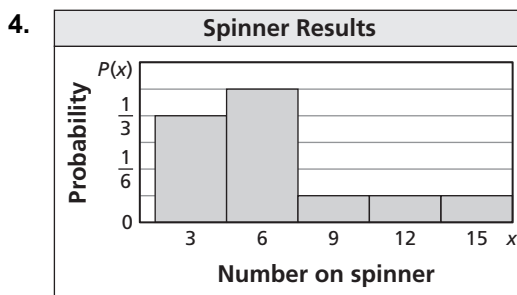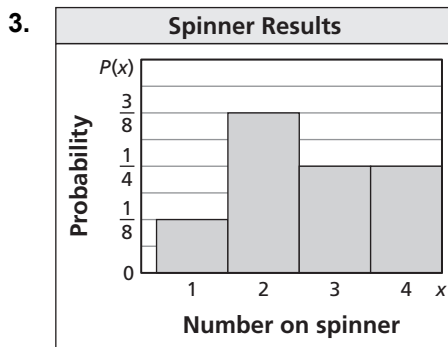**4.** $y = \cos(x) + 8$

**5.** $y = \dfrac{1}{2}\sin(x - 4)$

**6.** $y = 3.8\cos(1.5x + 7)$

## 12.6 Practice A

**In Exercises 1 and 2, make a table and draw a histogram showing the probability distribution for the random variable.**

1. $X =$ the letter that is spun on a wheel that contains 2 sections labeled "A," five sections labeled "B," and 1 section labeled "C."

2. $F =$ the type of fruit randomly chosen from a bowl that contains three apples, four pears, and four oranges.

**In Exercises 3 and 4, use the probability distribution to determine (a) the number that is most likely to be spun on a spinner, and (b) the probability of spinning an even number.**

3.

**Spinner Results**

$P(x)$

Probability

$\frac{3}{8}$

$\frac{1}{4}$

$\frac{1}{8}$

0

1   2   3   4   $x$

**Number on spinner**

4.

**Spinner Results**

$P(x)$

Probability

$\frac{1}{3}$

$\frac{1}{6}$

0

3   6   9   12   15   $x$

**Number on spinner**

**In Exercises 5–7, calculate the probability of flipping a coin 20 times and getting the given number of heads.**

5. 2                    6. 7                    7. 14

8. Describe and correct the error in calculating the probability of rolling a five exactly four times in six rolls of a six-sided number cube.

$$\times \quad P(k = 4) = \ _6C_4\left(\frac{1}{6}\right)^4\left(\frac{5}{6}\right)^6 \approx 0.0039$$

Name _____ Date _____

**In Exercises 1 and 2, make a table and draw a histogram showing the probability distribution for the random variable.**

1. $V = 1$ if a randomly chosen letter consists only of line segments (i.e. A, E, F, …) and 2 otherwise (i.e. B, C, D, G, …).

2. $X = $ the number of digits in a random perfect square from 1 to 1225.

**In Exercises 3–5, calculate the probability of flipping a coin 20 times and getting the given number of heads.**

3. 3                          4. 15                          5. 18

6. According to a survey, 22% of high school students watch at most five movies a month. You ask seven randomly chosen high school students whether they watch at most five movies a month.

   a. Draw a histogram of the binomial distribution for your survey.

   b. What is the most likely outcome of your survey?

   c. What is the probability that at most three people watch at most five movies a month.

7. Describe and correct the error in calculating the probability of rolling a four exactly five times in six rolls of a six-sided number cube.

$$\diagdown\!\!\!\!\diagup \quad P(k = 4) = {}_6C_4\left(\frac{1}{6}\right)^4\left(\frac{5}{6}\right)^{6-4} \approx 0.008$$

8. A cereal company claims that there is a prize in one out of five boxes of cereal.

   a. You purchase 5 boxes of the cereal. You open four of the boxes and do not get a prize. Evaluate the validity of this statement: "The first four boxes did not have a prize, so the next one will probably have a prize."

   b. What is the probability of opening four boxes without a prize and then a box with a prize?

   c. What is the probability of opening all five boxes and not getting a prize?

   d. What is the probability of opening all five boxes and getting five prizes?

## 12.6 Enrichment and Extension

## Binomial Distributions

You can find the mean and standard deviation of a binomial distribution using the following formulas: Mean: $\mu = np$ and Standard Deviation: $\sigma = \sqrt{np(1 - p)}$.

Sometimes the mean is referred to as the average or expected value when referenced in problems.

**Example:** Ninety percent of the people who open a checking account at a particular bank keep the account open at least one year. A random sample of 20 new accounts is taken and the bank looks at how many will be kept open for at least one year. What are the expected value and standard deviation of the distribution?

Mean (expected value): $\mu = np = 20 \bullet 0.90 = 18$

Standard Deviation: $\sigma = \sqrt{np(1 - p)} = \sqrt{20 \bullet 0.90 \bullet 0.10} \approx 1.34$

**Complete the exercises using your knowledge of the binomial distribution.**

1.  An Olympic archer is able to hit the bull's-eye 80% of the time. Assume that each shot is independent of the others. If she shoots six arrows, find the following.

    a.  The mean and standard deviation of the number of bull's-eyes she may get.

    b.  The probability she gets at most four bull's-eyes.

    c.  The probability she gets at least four bull's-eyes.

    d.  The probability she misses the bull's-eye at least once.

2.  It is generally believed that nearsightedness affects about 12% of all children. A school district tests the vision of 169 incoming kindergarten children. How many would you expect to be nearsighted? What is the standard deviation?

3.  At a certain college, 6% of all students come from outside the United States. Incoming students are assigned at random to freshman dorms, where students live in residential clusters of 40 freshmen sharing a common lounge area. How many international students would you expect to find in a typical cluster? What is the standard deviation?

4.  The degree to which democratic and non-democratic countries attempt to control the news media was examined in the *Journal of Peace Research* (Nov. 1997). Between 1948 and 1996, 80% of all democratic regimes allowed a free press. In contrast, over the same time period, 10% of all non-democratic regimes allowed a free press. In a random sample of 50 democratic regimes, how many would you expect to allow a free press? What is the standard deviation?

## 12.6 Puzzle Time

## What Did The Police Do With The Hamburger?

Write the letter of each answer in the box containing the exercise number.

**Use the probability distribution to determine the probability.**

**Number Selected at Random**
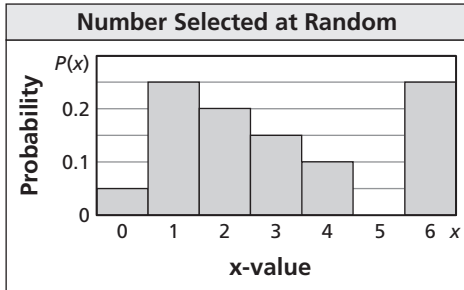


1. What is the most likely number to be selected?

2. What is the probability of selecting an even number?

3. What is the probability of selecting a multiple of three?

4. What is the least likely number to be selected?

5. What is the probability of selecting a number other than two?

6. What is the probability of selecting a three or four?

7. What is the probability of selecting a number that is no greater than four?

8. What is the probability of selecting a five?

9. What is the probability of selecting a three, replacing it, then selecting a four?

10. What is the probability of selecting a number that is not less than zero?

**Answers**

**L.** 80%

**M.** 100%

**I.** 1.5%

**G.** 1 or 6

**I.** 40%

**L.** 5

**E.** 25%

**R.** 60%

**D.** 75%

**H.** 0%

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |  | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|----|
|   |   |   |   |   |   |   |   |   |   |    |