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**Study Guide**

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**Solving Proportions**

An equation stating that two ratios are equal is called a **proportion**.

For example,  $\frac{8}{3} = \frac{16}{6}$  is a proportion. Use the Property of Proportions and other algebraic properties you know to solve proportions.

\*cannot cross cancel with = ; only with x

Property of Proportions	
The cross products of a proportion are equal.	
If $\frac{a}{b} = \frac{c}{d}$ , then $ad = bc$ . If $ad = bc$ , then $\frac{a}{b} = \frac{c}{d}$ .	

**Example 1:** Solve  $\frac{6}{5} = \frac{18}{n}$ .

$$\frac{6}{5} = \frac{18}{n}$$

$$6n = 5(18) \text{ Find the cross products.}$$

$$6n = 90 \text{ Simplify.}$$

$$n = 15$$

Check:  $\frac{6}{5} \stackrel{?}{=} \frac{18}{15}$   
 $6(15) \stackrel{?}{=} 5(18)$   
 $90 = 90 \checkmark$

**Example 2:** Solve  $\frac{p}{12} = \frac{p-4}{6}$ .

$$\frac{p}{12} = \frac{p-4}{6}$$

$$6p = 12(p-4)$$

$$6p = 12p - 48$$

$$-6p = -48$$

$$p = 8$$

Check:  $\frac{8}{12} \stackrel{?}{=} \frac{8-4}{6}$   
 $\frac{8(6)}{12} \stackrel{?}{=} 12(8-4)$   
 $48 = 48 \checkmark$

$\frac{x}{60} = \frac{3}{6}$  Solve each proportion.

1.  $\frac{g}{3} = \frac{12}{4}$

2.  $\frac{7 \times 5}{4 \times 5} = \frac{35}{m}$

3.  $\frac{2}{3} = \frac{a}{60}$

$x = 7.5$   
 $\frac{7.5}{37.5} = \frac{3}{60}$

4.  $\frac{5 \times 7.5}{8 \times 7.5} = \frac{x}{37.5}$

5.  $\frac{5}{b} = \frac{65}{39}$

6.  $\frac{c}{38} = \frac{2 \times 2}{4 \times 2} = \frac{1 \times 19}{2 \times 19}$

7.  $\frac{d \times 2}{2 \times 2} = \frac{2 \div 2}{8 \div 2} = \frac{1}{4}$

8.  $\frac{k}{10} = \frac{1}{1000}$

9.  $\frac{8}{x-2} = \frac{24}{7}$

$\frac{2d}{2} = \frac{1}{4}$   $d = \frac{1}{2} = 0.5$

10.  $\frac{y}{9} = \frac{y+2}{3}$

11.  $\frac{x}{x-3} = \frac{18}{6}$

12.  $\frac{5}{x-2} = \frac{8}{x+1}$

see notes

see notes

4)  $\frac{5}{8} = \frac{x}{60}$

$8 \cdot x = 5 \cdot 60$

$\frac{8x}{8} = \frac{300}{8} \rightarrow$

$x = 37.5$

$8 \overline{) 300.0}$   
 $\underline{-24} \downarrow$   
 $60$   
 $\underline{-56} \downarrow$   
 $40$

$$10) \quad \frac{y}{9} = \frac{(y+2) \times 3}{3 \times 3}$$

$$3y = 9(y+2)$$

$$3y = 9y + 18$$

~~+9y~~   ~~= +9y~~

---


$$\frac{-6y}{-6} = \frac{18}{-6}$$

$$y = -3$$

$$y = 3(y+2)$$

$$y = 3y + 6$$


---


$$\frac{-2y}{-2} = \frac{6}{-2}$$

$$y = -3$$

$$12) \quad \frac{5}{(x-2)} = \frac{8}{(x+1)}$$

$$5(x+1) = 8(x-2)$$

$$5x + 5 = 8x - 16$$

~~+5~~   ~~=~~   ~~+8x~~   ~~-16~~

---


$$x = 8x - 21$$

~~+8x~~   ~~= +8x~~

---


$$\frac{-3x}{-3} = \frac{-21}{-3}$$

$$x = 7$$

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**Solving Proportions**

Solve each proportion.

1. $\frac{1}{7} = \frac{a}{14}$	2. $\frac{8}{2} = \frac{12}{h}$	3. $\frac{5}{b} = \frac{3}{9}$
4. $\frac{9}{6} = \frac{15}{b}$	5. $\frac{3}{y} = \frac{9}{21}$	6. $\frac{21}{24} = \frac{c}{8}$
7. $\frac{8}{3} = \frac{32}{x}$	8. $\frac{4}{5} = \frac{p}{25}$	9. $\frac{24}{g} = \frac{3}{8}$
10. $\frac{5}{2} = \frac{13}{a}$	11. $\frac{1.5}{c} = \frac{15}{5}$	12. $\frac{6}{2.4} = \frac{x}{4}$
13. $\frac{4}{2} = \frac{x+2}{3}$	14. $\frac{c+5}{15} = \frac{8}{6}$	15. $\frac{7}{7} = \frac{10}{b+3}$
16. $\frac{y}{y+3} = \frac{2}{6}$ <i>see notes</i>	17. $\frac{z+6}{12} = \frac{z}{4}$	18. $\frac{5}{4} = \frac{a+4}{2a}$

Convert each measurement as indicated.

19. 5 pounds to ounces <i>see notes</i>	20. 3000 grams to kilograms <i>see notes</i>
21. 7 feet to inches	22. 4 meters to centimeters
23. 6 quarts to gallons	24. 250 centimeters to meters

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16)

$$\frac{y}{y+3} = \frac{2}{5}$$

$$5 \cdot y = 2(y+3)$$

$$+5y = 2y + 6$$

$$+ -2y \quad = \quad + -2y$$


---


$$+3y = 6$$

$$\underline{\quad} \quad = \quad \underline{\quad}$$

$$y = 2$$

$$19) \quad 5 \text{ lbs} \rightarrow \text{oz.}$$

$$\frac{5 \text{ lb}}{x \text{ oz.}} \quad \begin{array}{l} \nearrow 1 \text{ lb} \times 5 \\ \searrow 16 \text{ oz} \times 5 \end{array} \quad x = 16 \cdot 5 = 80$$

$$1 \cdot x = 5 \cdot 16$$

$$x = 80$$

$$\begin{array}{r} 16 \\ \times 5 \\ \hline 80 \end{array}$$

$$x = 80 \text{ oz.}$$

Method 2:

$$\frac{5 \text{ lb}}{1} \times \frac{16 \text{ oz}}{1 \text{ lb}} = \frac{5 \cdot 16}{1} = \frac{80}{1} = 80 \text{ oz.}$$

$$20) \quad 3000 \text{ g} \rightarrow \text{kg}$$

$$\frac{3000 \text{ g}}{x \text{ kg}} = \frac{1000 \text{ g} \times 3}{1 \text{ kg} \times 3}$$

$$x = 1 \cdot 3 = 3 \text{ kg}$$

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Scale Drawings and Models

A scale drawing or scale model is used to represent an object that is too large or too small to be drawn or built at its actual size.

**Example 1:** The Statue of Liberty is about 150 feet tall. A model is 15 inches tall. Find the scale used.

The scale used is the ratio of the length of the model to the actual length, or  $15 \text{ in.} = 150 \text{ feet}$ . Reduce the ratio to get a scale of  $1 \text{ in.} = 10 \text{ feet}$ .

Another method is to convert 150 feet to inches, or  $150 \text{ ft} = 150(12) \text{ in.} = 1800 \text{ in.}$  The scale is  $15 \text{ in.} = 1800 \text{ in.}$  Reduce the ratio to get  $1:120$ . The units do not need to be included if they are the same.

**Example 2:** The scale of a map of Florida is 1 inch = 20 miles. Find the actual distance between Miami and St. Petersburg if the distance between them on the map is 13 inches.

$$\frac{1 \text{ inch}}{20 \text{ miles}} = \frac{13 \text{ inches}}{x \text{ miles}} \quad \text{Use a proportion.}$$

$$1 \cdot x = 20(13)$$

$$x = 260$$

The distance from Miami to St. Petersburg is 260 miles.

Find each scale or distance.

1. On the blueprint of a house, the kitchen is 5 inches long. If the actual kitchen is 20 feet long, find the scale of the blueprint.

2. On a map, the scale is  $1 \text{ inch} = 25 \text{ miles}$ . Find the actual distance for each map distance.

From	To	Map Distance
Portsmouth, OH	Springfield, OH	5.2 inches
Chicago, IL	Lawrenceville, IL	10 inches
Santa Fe, NM	Clovis, NM	$8\frac{2}{5}$ inches

$$\frac{5.2 \text{ in}}{x \text{ mi}} = \frac{1 \text{ in}}{25 \text{ mi}}$$

3. The Sears Tower is 1450 feet tall. If a model is 25 inches tall, find the scale.

4. In an HO scale model of a train, the length of the engine is 6 inches. If the HO scale is  $1:87$ , find the actual length. Write the answer in feet. *see notes*

5. Las Vegas, Nevada, is 445 miles from Reno, Nevada. If the distance on the map is  $11\frac{1}{8}$  inches, find the scale used for the map.

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$$\frac{11\frac{1}{8} \text{ in (map)}}{445 \text{ mi (actual)}} = \frac{1 \text{ in}}{x \text{ mi}}$$

$$445 \div 11\frac{1}{8} = x$$

$$445 \div 11\frac{1}{8} = 40$$

$$\frac{445}{11\frac{1}{8}} = \frac{445 \cdot 8}{11 \cdot 8} = \frac{3560}{88} = 40$$

scale:  $1 \text{ in} = 40 \text{ mi}$

4)  $1:87$

$$\frac{\text{model}}{\text{actual}} = \frac{1 \text{ in}}{87 \text{ in}} \quad \text{or} \quad \frac{1 \text{ ft}}{87 \text{ ft}} \quad \text{or} \quad \frac{1 \text{ mi}}{87 \text{ mi}}$$

model  $\rightarrow$  6 inches

$$\frac{\text{model}}{\text{actual}} = \frac{6 \text{ inches}}{x \text{ in}} = \frac{1 \text{ in}}{87 \text{ in}}$$

$$1 \cdot x = 6 \cdot 87$$

$$x = \frac{522}{1}$$

$$x = 522 \text{ in}$$

$$\frac{522 \text{ in}}{1} \cdot \frac{1 \text{ ft}}{12 \text{ in}} = \frac{522}{12} \text{ ft}$$

$$43\frac{6}{12} = 43\frac{1}{2}$$

$$12 \overline{) 522.0}$$

$$\underline{-48} \phantom{0}$$

$$42 \phantom{0}$$

$$\underline{-36} \phantom{0}$$

$$60$$

actual length

$43.5 \text{ ft}$

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**Scale Drawings and Models**

On a map, the scale is  $1 \text{ inch} = 30 \text{ miles}$ . Find the actual distance for each map distance.

1. Los Angeles, CA, to San Bernardino, CA; 2 inches

2. Kalamazoo, MI, to Chicago, IL; 4.5 inches

3. Nashville, TN, to Union City, TN; 6 inches

4. Springfield, MO, to Joplin, MO; 2.5 inches

5. Albuquerque, NM, to Santa Fe, NM;  $1\frac{3}{4}$  inches

6. Montgomery, AL, to Birmingham, AL; 3 inches

7. Columbus, OH, to Cincinnati, OH; 3.5 inches

8. Des Moines, IA, to Sioux City, IA;  $6\frac{3}{4}$  inches

9. Concord, NH, to Boston, MA;  $2\frac{1}{4}$  inches

10. Providence, RI, to Newport, RI; 1 inch

11. Raleigh, NC, to Wilmington, NC; 4 inches

12. St. Paul, MN, to Minneapolis, MN;  $\frac{1}{4}$  inch

13. Portland, OR, to Seattle, WA;  $5\frac{3}{4}$  inches

*Handwritten notes:*  
 $\frac{1 \text{ in}}{30 \text{ mi}} = \frac{0 \text{ in}}{x \text{ mi}}$   
 $\frac{1 \text{ in} \times 2}{30 \text{ mi} \times 2} = \frac{2 \text{ in}}{x \text{ mi}}$   
 $x = 30 \times 2 = 60 \text{ mi}$

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**The Percent Proportion** "Part is percent of Base"

Percent is a ratio that compares a number to 100. For example, 6 out of 100 can be expressed as  $\frac{6}{100}$ , 6:100, or 6%. Use the percent proportion to find percents.

If  $A$  is the percentage,  $B$  is the base, and  $P$  is the percent, the percent proportion is  $\frac{A}{100} = \frac{P}{B}$ .

**Example 1:** 80% of what number is 336?  
 $\frac{P}{B} = \frac{r}{100}$   
 $\frac{336}{B} = \frac{80}{100}$   
 $336(100) = 80B$   
 $33600 = 80B$   
 $\frac{33600}{80} = \frac{80B}{80}$   
 $420 = B$   
 So, 80% of 420 = 336.

**Example 2:** 75 is what percent of 300?  
 $\frac{P}{B} = \frac{r}{100}$   
 $\frac{75}{300} = \frac{r}{100}$   
 $75(100) = 300r$   
 $7500 = 300r$   
 $\frac{7500}{300} = \frac{300r}{300}$   
 $25 = r$   
 So, 75 is 25% of 300.

*Handwritten notes:*  
 Part is percent of Base  
 Base (Total)  
 Cross multiply.  
 Simplify.

**Use the percent proportion to find each number.**

1.  $\frac{40}{80} = \frac{P}{100}$  40 is what percent of 80?  
 $\frac{4}{8} = \frac{P}{100}$  3. Find 10% of 170.  
 $\frac{1 \times 50}{2 \times 50} = \frac{P}{100}$  30 is what percent of 150?  
 $P = 50\%$

2. 8 is what percent of 25?  
 $\frac{18}{100} = \frac{12}{100}$  18 is 12% of what number?  
 32 is 400% of what number?  
 Find 84% of 500.  
 What number is 15% of 42?  
 Find 140% of 82.  
 Find 0.5% of 8.  
 1 is what percent of 250?

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### The Percent Proportion

Express each fraction or ratio as a percent.

3:4

1.  $\frac{3}{4} \rightarrow 75\%$
2. 4 out of 5  $\rightarrow 80\%$
3. 4 to 10
4. 7 to 4
5.  $\frac{13}{20}$
6. 1 out of 8
7.  $\frac{1}{5}$
8. 2 out of 4
9. 6 to 5
10. Two out of 50 students scored above 98 on a geometry test.
11. At a computer convention, 19 out of 20 people accepted a free mouse pad.
12. In a recent inspection, three-eighths of the apartments at Kendall Heights had fire extinguishers.

Use the percent proportion to find each number.

13. 20 is what percent of 125?
14. Find 30% of 75.
15. 18 is 45% of what number?
16. 85% of what number is 85?
17. 15 is what percent of 50?
18. What number is 3% of 40?
19. 40% of what number is 28?
20. Find 130% of 20.
21. 78 is 65% of what number?
22. What is 10% of 73?
23. 30 is what percent of 150?
24. Find 6% of 15.

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### The Percent Equation

$A = P\% \times B$   
 "Part is percent of Base"

The percent proportion  $\frac{P}{B} = \frac{r}{100}$  can also be written as the equation  $P = RB$ , where  $P$  is the percentage,  $B$  is the base, and  $R$  is the rate expressed as a decimal.

written as decimal

**Example 1:** Find 60% of 225.

$$P = RB$$

$$R = 0.6 \quad \text{Write } R \text{ as decimal.}$$

$$P = 0.6(225)$$

$$P = 135$$

So, 60% of 225 = 135.

**Example 2:** 18 is 40% of what number?

$$P = RB$$

$$R = 0.4$$

$$18 = 0.4(B)$$

$$\frac{18}{0.4} = \frac{0.4B}{0.4} \quad \text{Divide by } 0.4$$

$$45 = B$$

So, 18 is 40% of 45.

Use the percent equation to find each number.

1. 72 is what percent of 90? *see notes*  
 $72 = P \times 90$
2. Find 10% of 240.
3. 90 is what percent of 360?
4. Find 8% of 120.
5. Find 32% of 600.
6. 14% of what number is 9.8?
7. What number is 24% of 90?
8. 150% of 0.6 is what number?
9. 750 is what percent of 150?
10. 48 is 300% of what number?
11. 2 is what percent of 500?
12. Find 0.5% of 12.
13. Find 160% of 85.
14. What number is 265% of 24?
15. 150 is what percent of 25?
16. 98 is 5% of what number?
17. Marcia bought \$80 in groceries. What is her final cost after sales tax of 6.5% is added? *see notes*  
 $\text{What is } 6.5\% \text{ of } *80*$
18. Mr. Perez paid 14% of his income in taxes. If his taxes were \$7686, what was his income? *see notes*

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$$1) \quad \frac{72}{90} = \frac{p \times \cancel{90}}{\cancel{90}}$$

$$\frac{72 \div 6}{90 \div 6} = p$$

$$\frac{12 \div 3}{15 \div 3} = p$$

$$d \text{ to } p \quad \frac{4}{5} = p$$

$$5 \overline{) 4.0} \begin{array}{r} 0.80 \rightarrow 80\% \\ -40 \\ \hline 0 \end{array} \quad p = 80\%$$

17) What is 6.5% of \$80 cost?

$$A = 0.065 \times 80$$

$$A = 0.065 \times 80$$

$$\begin{array}{r} 0.065 \\ \times 80 \\ \hline \$5.200 \end{array}$$

→ Tax = \$5.20

Total Cost = \$80.00 (original)

+ 5.20 (tax)

→ \$85.20



$$18) \quad A = P \times B$$

(tax \$)                      14%                      (income)

$$\frac{\$7686}{0.14} = \frac{0.14}{0.14} \times B$$

$$0.14 \overline{) 7686.00} =$$

$$\begin{array}{r} 3 \times 54900 \\ 14 \overline{) 7686.00} \\ \underline{-70} \phantom{00} \\ 68 \phantom{00} \\ \underline{-56} \phantom{00} \\ 126 \phantom{00} \\ \underline{-126} \phantom{00} \\ 00 \end{array}$$

$$B = \$54,900$$

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### The Percent Equation

*Use the percent equation to find each number.*

1. Find 60% of 150.  3. 21 is 70% of what number?  5. Find 7% of 80.  7. 12 is 30% of what number?  9. What number is 27% of 50?  11. What number is 12% of 85?  13. 26 is 65% of what number?  15. 108 is 90% of what number?  17. 50 is 25% of what number?  19. 21 is 35% of what number?  21. Find 14.5% of 500.	2. What number is 40% of 95?  4. Find 20% of 120.  6. 63 is 60% of what number?  8. 90 is 45% of what number?  10. What number is 70% of 122?  12. Find 14% of 150.  14. What number is 67% of 140?  16. Find 34% of 85.  18. What number is 95% of 90?  20. Find 22% of 55.  22. 4 is 0.8% of what number?
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**Percent of Change**

The median price of a home increased from \$90,600 in 1988 to \$134,600 in 1998. The change in the price can be written as a percent. Since the price increased, it is called the **percent of increase**. Likewise, the percent that an amount decreases is known as the **percent of decrease**.

To find the percent of increase or decrease, write a ratio that compares the amount of increase or decrease to the original amount.

**Example:** Find the percent of increase in the median price of a home.

original price: \$90,600    new price: \$134,600

The amount of increase =  $134,600 - 90,600 = 44,000$ . Substitute the amount of increase for  $P$ . You are comparing it to the original price, so substitute \$90,600 for  $B$ .

**Method 1**

**Method 2**

$\% \text{ change} = \frac{\text{new} - \text{old}}{\text{old}}$

$$\begin{aligned} \frac{P}{B} &= \frac{r}{100} \\ \frac{44,000}{90,600} &= \frac{r}{100} \\ 44,000(100) &= 90,600r \\ 4,400,000 &= 90,600r \\ \frac{4,400,000}{90,600} &= \frac{90,600r}{90,600} \\ 48.6 &= r \end{aligned}$$

$$\begin{aligned} P &= RB \\ 44,000 &= R \cdot 90,600 \\ \frac{44,000}{90,600} &= R \cdot \frac{90,600}{90,600} && \text{Divide each side} \\ 0.486 &= R && \text{by } 90,600. \end{aligned}$$

So the percent of increase was about 49%.

Find the percent of change. Round to the nearest percent.

- original: 25  
new: 26  $\% \text{ change} = \frac{26-25}{25} = \frac{1}{25}$  see notes
- original: \$20,000  
new: \$17,500
- original: 96  
new: 54  $\frac{1 \times 4}{25 \times 4} = \frac{4}{100} = 4\%$  increase
- original: 15  
new: 33
- In January, gasoline cost \$1.05 per gallon. In July, gasoline cost \$1.20 per gallon. Find the percent of increase.
- The original price of a CD player is \$105. A discount of \$21 is given. Find the percent of decrease.
- The original cost of a computer is \$900. If the price is decreased by 15%, what is the sale price?

2) old = \$20,000  
 new = \$17,500 ↓ decrease

$\% \text{ change} = \frac{\text{new} - \text{old}}{\text{old}}$

$$= \frac{17,500 - 20,000}{20,000} = \frac{-2,500}{20,000} = \frac{-25}{200} = \frac{-1}{8}$$

0 → P  
 2 places Right

0.125  
 8 | 1.000  
 - 8  
 ---  
 20  
 - 16  
 ---  
 40  
 - 40  
 ---  
 0

12.5% decrease

3) new (sale) = ?  
 old (original) = \$ 900  
 15% ↓

$$\% \text{ change} = \frac{\text{new} - \text{old}}{\text{old}}$$

$$-15\% = \frac{\text{new} - 900}{900}$$

$$\boxed{-15 \times 9} = \frac{\boxed{\text{new} - 900}}{100 \times 9}$$

$$10 \times 9 = 90$$

$$5 \times 9 = \frac{45}{135}$$

$$-15 \times 9 = \text{new} - 900$$

$$-135 = \text{new} + 900$$

$$+900 = +900$$

$$\begin{array}{r} 89 \\ 900 \\ -135 \\ \hline 765 \end{array}$$

$$+765 = \text{new}$$

Sale price = \$ 765

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**Percent of Change**

Find the percent of increase or decrease. Round to the nearest percent.

1. original: 60 new: 54	2. original: 20 new: 25
3. original: 18 new: 36	4. original: 50 new: 32
5. original: 32 new: 20	6. original: 35 new: 98

The cost of an item and a sales tax rate are given. Find the total price of each item to the nearest cent.

7. guitar: \$120; 5%	8. shirt: \$22.95; 6%
9. shoes: \$49.99; 7%	10. jacket: \$89.95; 6%
11. ruler: \$1.49; 5%	12. weight bench: \$79; 6%

The original cost of an item and a discount rate are given. Find the sale price of each item to the nearest cent.

13. stereo: \$900; 10%	14. jeans: \$54; 25%
15. VCR: \$129.95; 20%	16. golf club: \$69.95; 15%
17. barrette: \$6.99; 15%	18. sweat pants: \$12; 25%

*Handwritten notes:*  
 100% - discount % = cost %  
 100 - 20 = 80% of original  
 see notes 80% of \$129.95

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**Probability and Odds**

You can measure the chances of an event happening with probability, a number that is always between 0 and 1, inclusive. You can express the probability of an event as a fraction, as a decimal, or as a percent, using the following relationship.

The probability of an event is a ratio that compares the number of favorable outcomes to the number of possible outcomes.  

$$P(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}}$$
*want total*

**Example 1:** The spinner at the right is spun. Find the probability of spinning a number greater than 5.  
 There are 3 favorable outcomes, spinning a 6, 7, or an 8. There are 8 possible outcomes.



Therefore  $P(\text{a number greater than 5}) = \frac{3}{8}$ .

Another way to measure the chance of an event is with odds.

The odds of an event is a ratio that compares the number of favorable outcomes to the number of unfavorable outcomes.  

$$\text{Odds} = \frac{\text{number of favorable outcomes}}{\text{number of unfavorable outcomes}}$$
*want don't want*

**Example 2:** Refer to the spinner above. Find the odds of spinning an even number.

There are 4 favorable outcomes: 2, 4, 6, or 8. The number of unfavorable outcomes is  $8 - 4 = 4$ . Therefore the odds of spinning an even number are 4:4 or 1:1.

Refer to the spinner above. Find the probability of each outcome.

- 1. a 3  $\rightarrow \frac{1}{8} = 0.125 = 12.5\%$
- 2. an even number  $\rightarrow \frac{4}{8} = \frac{1}{2} = 50\%$
- 3. a number less than 3  $\rightarrow \frac{2}{8} = \frac{1}{4} = 25\%$
- 4. a number greater than 4  $\rightarrow \frac{4}{8} = \frac{1}{2} = 50\%$

Refer to the spinner above. Find the odds of each outcome.

- 5. an odd number  $\rightarrow 4:4 \rightarrow 1:1$
- 6. a multiple of 3  $\rightarrow 2:6$
- 7. not a 6  $\rightarrow 7:1$
- 8. a number greater than 4  $\rightarrow 4:4 \rightarrow 1:1$

**5-6** NAME \_\_\_\_\_ DATE \_\_\_\_\_ PERIOD \_\_\_\_\_  
**Practice** Student Edition Pages 219-223

**Probability and Odds**

Find the probability of each outcome if a pair of dice are rolled. Refer to the table below, which shows all of the possible outcomes when you roll a pair of dice.

	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)

- 1. an even number on the second die
- 2. a sum of 8  $\rightarrow \frac{18}{36} = \frac{1}{2}$
- 3. a sum of 7  $\rightarrow \frac{6}{36} = \frac{1}{6}$
- 4. an odd sum  $\rightarrow \frac{18}{36} = \frac{1}{2}$
- 5. a sum less than 6
- 6. a sum greater than 7
- 7. both die are the same number
- 8. a sum less than 2  $\rightarrow \frac{0}{36} = 0$

Find the odds of each outcome if a bag contains 7 blue marbles, 3 yellow marbles, and 2 red marbles.

- 9. choosing a blue marble
- 10. choosing a red marble
- 11. choosing a yellow marble
- 12. choosing a yellow or red marble  $\rightarrow 3 + 2 \rightarrow 5:7$
- 13. choosing a yellow or blue marble  $\rightarrow 3 + 7 \rightarrow 10:2$
- 14. choosing a blue or red marble
- 15. not choosing a blue or red marble  $\rightarrow 5:1$
- 16. not choosing a blue marble  $\rightarrow 2 + 3 \rightarrow 5:7$

**Compound Events**

To win a game, you have to roll either an even number or a 3 with one die. What is the probability that you will win? The probability of tossing an even number =  $P(\text{even number}) = \frac{1}{2}$ , and the probability of tossing a 3 is  $P(3) = \frac{1}{6}$ . These events cannot occur at the same time and so they are **mutually exclusive**. This is a compound event because there is more than 1 event occurring. You find the probability of mutually exclusive events by **adding** the probabilities of each event.

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

Compound events are called **independent** if the outcome of one event does not affect the outcome of the other event. For example, if two dice are rolled, rolling an odd number with the first die does not affect rolling a 4 on the second die. You find the probability of two independent events by **multiplying** the probabilities of each event.

$$P(\text{odd number and } 4) = P(\text{odd number}) \cdot P(4) = \frac{1}{2} \cdot \frac{1}{6} = \frac{1}{12}$$

Probability of Mutually-Exclusive Events A and B	$P(A \text{ or } B) = P(A) + P(B)$
Probability of Independent Events A and B	$P(A \text{ and } B) = P(A) \cdot P(B)$

A die is rolled. Find the probability of each compound event.

*mutually exclusive*  
2, 4, 6

- $P(\text{a } 4 \text{ or } 2) = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$
- $P(\text{an odd number or } 6) = \frac{3}{6} + \frac{1}{6} = \frac{4}{6} = \frac{2}{3}$
- $P(\text{a } 2 \text{ or } 3) = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$
- $P(\text{a } 1 \text{ or } 6) = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$
- $P(\text{an even number or } 5) = \frac{3}{6} + \frac{1}{6} = \frac{4}{6} = \frac{2}{3}$
- $P(\text{a } 1 \text{ or a multiple of } 2) = \frac{1}{6} + \frac{2}{6} = \frac{3}{6} = \frac{1}{2}$
- $P(\text{a } 1 \text{ or a number greater than } 4) = \frac{1}{6} + \frac{2}{6} = \frac{3}{6} = \frac{1}{2}$
- $P(\text{an odd number or an even number}) = \frac{6}{6} = 1$

Two dice are rolled. Find the probability of each compound event.

*independent*  
1, 3, 5

- $P(\text{an odd number and } 1) = \frac{3}{6} \cdot \frac{1}{6} = \frac{3}{36} = \frac{1}{12}$
- $P(\text{an odd number and an even number}) = \frac{3}{6} \cdot \frac{3}{6} = \frac{9}{36} = \frac{1}{4}$
- $P(\text{two odd numbers}) = \frac{3}{6} \cdot \frac{3}{6} = \frac{9}{36} = \frac{1}{4}$
- $P(\text{a } 6 \text{ and a number greater than } 4) = \frac{1}{6} \cdot \frac{2}{6} = \frac{2}{36} = \frac{1}{18}$
- $P(\text{two numbers less than } 3) = \frac{2}{6} \cdot \frac{2}{6} = \frac{4}{36} = \frac{1}{9}$
- $P(\text{an even number and } 5) = \frac{3}{6} \cdot \frac{1}{6} = \frac{3}{36} = \frac{1}{12}$

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$$\frac{3}{6} \cdot \frac{3}{6} = \frac{9}{36} \rightarrow \frac{1}{4}$$

$$\frac{1}{6} \cdot \frac{2}{6} = \frac{2}{36} \rightarrow \frac{1}{18}$$

**Compound Events**

Two dice are rolled. Find the probability of each outcome.

- $P(\text{even number and } 2)$
- $P(5 \text{ and } 5)$
- $P(\text{odd number and a number less than } 6)$
- $P(3 \text{ and a number less than } 3)$
- $P(\text{even number and a number greater than } 2)$

6.  $P(6 \text{ and a number greater than } 2)$

*52 total cards 4 suits 13 cards in each suit sample spaces overlap*  
*2 colors (Red/Black)*  
*Text p. 227*  
*out of total*  $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

A card is drawn from a standard deck of cards. Determine whether the events are mutually exclusive or **inclusive**. Then find each probability.

- $P(\text{jack or five})$
- $P(\text{ace or club})$
- $P(\text{red card or four})$
- $P(\text{face card or black card})$

*mutually exclusive*

$$P(\text{spade or diamond}) = \frac{13}{52} + \frac{13}{52} = \frac{26}{52} = \frac{1}{2}$$

13.  $P(\text{heart or black card})$

*inclusive 3, 5, 7, 9 4 suits*

$$P(\text{black card or odd-numbered card}) = \frac{13}{52} + \frac{16}{52} - \frac{8}{52} = \frac{21}{52}$$

14.  $P(\text{heart or even-numbered card})$

*4 suits x 1, 3, 5, 7, 9*

$$P(\text{face card or diamond}) = \frac{12}{52} + \frac{13}{52} - \frac{3}{52} = \frac{22}{52} = \frac{11}{26}$$

16.  $P(\text{red card or black card})$

$$P(\text{red card or heart}) = \frac{13}{52} + \frac{13}{52} - \frac{8}{52} = \frac{18}{52} = \frac{9}{26}$$

