NAME _____ DATE _____ PERIOD ____

# 6-1 Study Guide and Intervention

## Solving Inequalities by Addition and Subtraction

**Solve Inequalities by Addition** Addition can be used to solve inequalities. If any number is added to each side of a true inequality, the resulting inequality is also true.

| Addition Property of Inequalities | For all numbers $a$, $b$, and $c$, if $a > b$, then $a + c > b + c$, and if $a < b$, then $a + c < b + c$. |
|---|---|

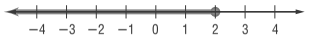
The property is also true when $>$ and $<$ are replaced with $\geq$ and $\leq$.

**Example 1** **Solve $x - 8 \leq -6$. Then graph it on a number line.**

| | |
|---|---|
| $x - 8 \leq -6$ | Original inequality |
| $x - 8 + 8 \leq -6 + 8$ | Add 8 to each side. |
| $x \leq 2$ | Simplify. |

The solution in set-builder notation is $\{x \mid x \leq 2\}$.

Number line graph:

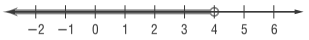



**Example 2** **Solve $4 - 2a > -a$. Then graph it on a number line.**

| | |
|---|---|
| $4 - 2a > -a$ | Original inequality |
| $4 - 2a + 2a > -a + 2a$ | Add $2a$ to each side. |
| $4 > a$ | Simplify. |
| $a < 4$ | $4 > a$ is the same as $a < 4$. |

The solution in set-builder notation is $\{a \mid a < 4\}$.

Number line graph:

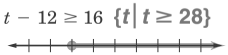



Lesson 6-1

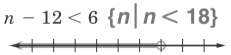
### Exercises

**Solve each inequality. Then check your solution, and graph it on a number line.**

1. $t - 12 \geq 16$ $\{t \mid t \geq 28\}$

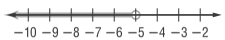



2. $n - 12 < 6$ $\{n \mid n < 18\}$

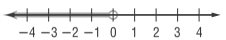



3. $6 \leq g - 3$ $\{g \mid g \geq 9\}$

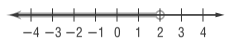

4. $n - 8 < -13$ $\{n \mid n < -5\}$




5. $-12 > -12 + y$ $\{y \mid y < 0\}$




6. $-6 > s - 8$ $\{s \mid s < 2\}$




**Solve each inequality. Then check your solution.**

7. $-3x \leq 8 - 4x$ $\{x \mid x \leq 8\}$

8. $0.6n \geq 12 - 0.4n$ $\{n \mid n \geq 12\}$

9. $-8k - 12 < -9k$ $\{k \mid k < 12\}$

10. $-y - 10 > 15 - 2y$ $\{y \mid y > 25\}$

11. $z - \frac{1}{3} \leq \frac{4}{3}$ $\left\{z \mid z \leq 1\frac{2}{3}\right\}$

12. $-2b > -4 - 3b$ $\{b \mid b > -4\}$

**Define a variable, write an inequality, and solve each problem. Then check your solution.** 13–15. Sample answer: Let $n$ = the number.

13. A number decreased by 4 is less than 14. $n - 4 < 14$; $\{n \mid n < 18\}$

14. The difference of two numbers is more than 12, and one of the numbers is 3. $n - 3 > 12$; $\{n \mid n > 15\}$

15. Forty is no greater than the difference of a number and 2. $40 \leq n - 2$; $\{n \mid n \geq 42\}$



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# 6-1 Study Guide and Intervention (continued)

## Solving Inequalities by Addition and Subtraction

**Solve Inequalities by Subtraction** Subtraction can be used to solve inequalities. If any number is subtracted from each side of a true inequality, the resulting inequality is also true.

| Subtraction Property of Inequalities | For all numbers $a$, $b$, and $c$, if $a > b$, then $a - c > b - c$, and if $a < b$, then $a - c < b - c$. |
|---|---|

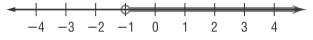
The property is also true when $>$ and $<$ are replaced with $\geq$ and $\leq$.

**Example** **Solve $3a + 5 > 4 + 2a$. Then graph it on a number line.**

| | |
|---|---|
| $3a + 5 > 4 + 2a$ | Original inequality |
| $3a + 5 - 2a > 4 + 2a - 2a$ | Subtract $2a$ from each side. |
| $a + 5 > 4$ | Simplify. |
| $a + 5 - 5 > 4 - 5$ | Subtract 5 from each side. |
| $a > -1$ | Simplify. |

The solution is $\{a \mid a > -1\}$.

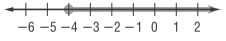
Number line graph:



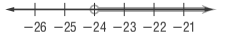

### Exercises

**Solve each inequality. Then check your solution, and graph it on a number line.**

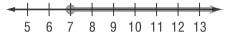
1. $t + 12 \geq 8$ $\{t \mid t \geq -4\}$



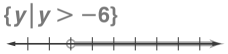

2. $n + 12 > -12$ $\{n \mid n > -24\}$




3. $16 \leq h + 9$ $\{h \mid h \geq 7\}$




4. $y + 4 > -2$ $\{y \mid y > -6\}$




5. $3r + 6 > 4r$ $\{r \mid r < 6\}$


6. $\frac{3}{2}q - 5 \geq \frac{1}{2}q$ $\{q \mid q \geq 5\}$


**Solve each inequality. Then check your solution.**

7. $4p \geq 3p + 0.7$ $\{p \mid p \geq 0.7\}$

8. $r + \frac{1}{4} > \frac{3}{8}$ $\left\{r \mid r > \frac{1}{8}\right\}$

9. $9k + 12 > 8k$ $\{k \mid k > -12\}$

10. $-1.2 > 2.4 + y$ $\{y \mid y < -3.6\}$

11. $4y < 5y + 14$ $\{y \mid y > -14\}$

12. $3n + 17 < 4n$ $\{n \mid n > 17\}$

**Define a variable, write an inequality, and solve each problem. Then check your solution.** 13–15. Sample answer: Let $n$ = the number.

13. The sum of a number and 8 is less than 12. $n + 8 < 12$; $\{n \mid n < 4\}$

14. The sum of two numbers is at most 6, and one of the number is $-2$. $n + (-2) \leq 6$; $\{n \mid n \leq 8\}$

15. The sum of a number and 6 is greater than or equal to $-4$. $n + 6 \geq -4$; $\{n \mid n \geq -10\}$





Glencoe Algebra 1

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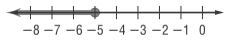
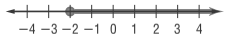
# 6-1 Skills Practice

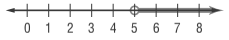
## Solving Inequalities by Addition and Subtraction

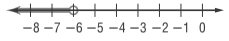
**Match each inequality with its corresponding graph.**

1. $x + 11 > 16$ **c**
2. $x - 6 < 1$ **e**
3. $x + 2 \leq -3$ **a**
4. $x + 3 \geq 1$ **b**
5. $x - 1 < -7$ **d**

a. 

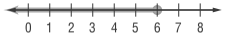

b. 

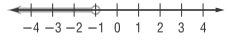

c. 

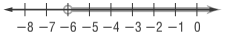

d. 

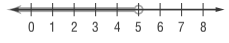

e. 

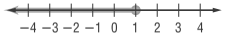

**Solve each inequality. Then check your solution, and graph it on a number line.**

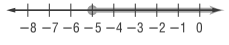
6. $d - 5 \leq 1$ $\{d \mid d \leq 6\}$


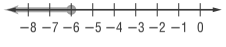

7. $s + 9 < 8$ $\{s \mid s < -1\}$


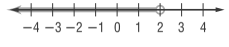

8. $a - 7 > -13$ $\{a \mid a > -6\}$



9. $w - 1 < 4$ $\{w \mid w < 5\}$



10. $4 \geq k + 3$ $\{k \mid k \leq 1\}$



11. $-9 \leq b - 4$ $\{b \mid b \geq -5\}$



12. $-2 \geq x + 4$ $\{x \mid x \leq -6\}$



13. $2y < y + 2$ $\{y \mid y < 2\}$



**Define a variable, write an inequality, and solve each problem. Then check your solution.** 14–18. Sample answer: Let $n$ = the number.

14. A number decreased by 10 is greater than −5. $n - 10 > -5$; $\{n \mid n > 5\}$
15. A number increased by 1 is less than 9. $n + 1 < 9$; $\{n \mid n < 8\}$
16. Seven more than a number is less than or equal to −18. $n + 7 \leq -18$; $\{n \mid n \leq -25\}$
17. Twenty less than a number is at least 15. $n - 20 \geq 15$; $\{n \mid n \geq 35\}$
18. A number plus 2 is at most 1. $n + 2 \leq 1$; $\{n \mid n \leq -1\}$





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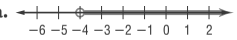
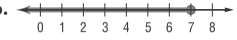
# 6-1 Practice (Average)

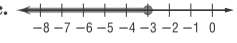
## Solving Inequalities by Addition and Subtraction

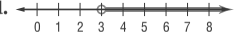
**Match each inequality with its corresponding graph.**

1. $-8 \geq x - 15$ **b**
2. $4x + 3 < 5x$ **d**
3. $8x > 7x - 4$ **a**
4. $12 + x \leq 9$ **c**

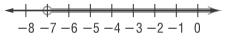
a. 

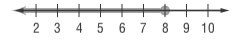

b. 


c. 


d. 

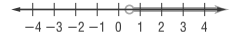

**Solve each inequality. Then check your solution, and graph it on a number line.**

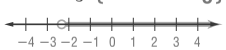
5. $r - (-5) > -2$ $\{r \mid r > -7\}$


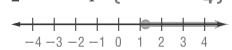

6. $3x + 8 \geq 4x$ $\{x \mid x \leq 8\}$



7. $n - 2.5 \geq -5$ $\{n \mid n \geq -2.5\}$



8. $1.5 < y + 1$ $\{y \mid y > 0.5\}$



9. $z + 3 > \frac{2}{3}$ $\left\{z \mid z > -2\frac{1}{3}\right\}$



10. $\frac{1}{2} \leq c - \frac{3}{4}$ $\left\{c \mid c \geq 1\frac{1}{4}\right\}$



**Define a variable, write an inequality, and solve each problem. Then check your solution.** 11–14. Sample answer: Let $n$ = the number.

11. The sum of a number and 17 is no less than 26.
$n + 17 \geq 26$; $\{n \mid n \geq 9\}$

12. Twice a number minus 4 is less than three times the number.
$2n - 4 < 3n$; $\{n \mid n > -4\}$

13. Twelve is at most a number decreased by 7.
$12 \leq n - 7$; $\{n \mid n \geq 19\}$

14. Eight plus four times a number is greater than five times the number.
$8 + 4n > 5n$; $\{n \mid n < 8\}$

15. **ATMOSPHERIC SCIENCE** The troposphere extends from the earth's surface to a height of 6–12 miles, depending on the location and the season. If a plane is flying at an altitude of 5.8 miles, and the troposphere is 8.6 miles deep in that area, how much higher can the plane go without leaving the troposphere? **no more than 2.8 mi**

16. **EARTH SCIENCE** Mature soil is composed of three layers, the uppermost being topsoil. Jamal is planting a bush that needs a hole 18 centimeters deep for the roots. The instructions suggest an additional 8 centimeters depth for a cushion. If Jamal wants to add even more cushion, and the topsoil in his yard is 30 centimeters deep, how much more cushion can he add and still remain in the topsoil layer? **no more than 4 cm**







Answers

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# 6-1 Reading to Learn Mathematics

## *Solving Inequalities by Addition and Subtraction*

**Pre-Activity** **How are inequalities used to describe school sports?**

Read the introduction to Lesson 6-1 at the top of page 318 in your textbook.

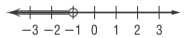
- Use the information in the graph to write an inequality statement about participation in two sports. **Sample answer: For softball and track and field, 13,009 < 14,587**

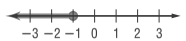
- Rewrite your inequality statement to show that 40 schools added both of the sports. Is the statement still true? **Sample answer: 13,049 < 14,627; yes**

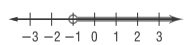
### Reading the Lesson

**Write the letter of the graph that matches each inequality.**

1. $x \leq -1$ **b**
2. $x \geq -1$ **d**
3. $x < -1$ **a**
4. $x > -1$ **c**

**a.**



**b.**



**c.**



**d.**



5. Use the chart to write a sentence that could be described by the inequality $3n \geq 2n + 7$. Then solve the inequality.

| Inequalities | | | |
|---|---|---|---|
| < | > | ≤ | ≥ |
| less than<br>fewer than | greater than<br>more than | at most<br>no more than<br>less than or equal to | at least<br>no less than<br>greater than or equal to |

**Sample answer: Three times a number is at least two times the number plus 7; $n \geq 7$**

### Helping You Remember

6. Teaching someone else can help you remember something. Explain how you would teach another student who missed class to solve the inequality $2x + 4 \leq 3x$.

**Subtract $2x$ from each side. Simplify.**



Lesson 6-1

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# 6-1 Enrichment

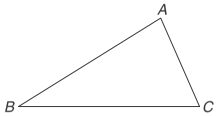
## *Triangle Inequalities*

Recall that a line segment can be named by the letters of its endpoints. Line segment $AB$ (written as $\overline{AB}$) has points $A$ and $B$ for endpoints. The *length* of $AB$ is written without the bar as $AB$.

$$AB < BC \qquad m\angle A < m\angle B$$

The statement on the left above shows that $\overline{AB}$ is shorter than $\overline{BC}$. The statement on the right above shows that the measure of angle $A$ is less than that of angle $B$.

These three inequalities are true for any triangle $ABC$, no matter how long the sides.



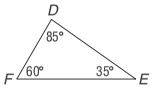

**a.** $AB + BC > AC$

**b.** If $AB > AC$, then $m\angle C > m\angle B$.

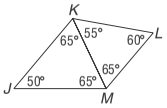
**c.** If $m\angle C > m\angle B$, then $AB > AC$.

**Use the three triangle inequalities for these problems.**

1. List the sides of triangle $DEF$ in order of increasing length.
**$\overline{DF}$, $\overline{DE}$, $\overline{EF}$**




2. In the figure at the right, which line segment is the shortest?
**$\overline{LM}$**

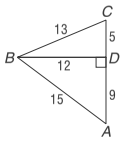



3. Explain why the lengths 5 cm, 10 cm, and 20 cm could not be used to make a triangle. **5 + 10 is not greater than 20.**

4. Two sides of a triangle measure 3 in. and 7 in. Between which two values must the third side be? **4 in. and 10 in.**

5. In triangle $XYZ$, $XY = 15$, $YZ = 12$, and $XZ = 9$. Which is the greatest angle? Which is the least? **$\angle Z$; $\angle Y$**

6. List the angles $\angle A$, $\angle C$, $\angle ABC$, and $\angle ABD$, in order of increasing size.
**$\angle ABD$, $\angle A$, $\angle ABC$, $\angle C$**



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# 6-2 Study Guide and Intervention

## Solving Inequalities by Multiplication and Division

**Solve Inequalities by Multiplication** If each side of an inequality is multiplied by the same positive number, the resulting inequality is also true. However, if each side of an inequality is multiplied by the same negative number, the direction of the inequality must be reversed for the resulting inequality to be true.

| | |
|---|---|
| **Multiplication Property of Inequalities** | For all numbers $a$, $b$, and $c$, with $c \neq 0$,<br>**1.** if $c$ is positive and $a > b$, then $ac > bc$;<br>if $c$ is positive and $a < b$, then $ac < bc$;<br>**2.** if $c$ is negative and $a > b$, then $ac < bc$;<br>if $c$ is negative and $a < b$, then $ac > bc$. |

The property is also true when $>$ and $<$ are replaced with $\geq$ and $\leq$.

**Example 1** **Solve $-\frac{y}{8} \geq 12$.**

$-\frac{y}{8} \geq 12$ Original equation

$(-8)\left(-\frac{y}{8}\right) \leq (-8)12$ Multiply each side by $-8$; change $\geq$ to $\leq$.

$y \leq -96$ Simplify.

The solution is $\{y \mid y \leq -96\}$.

**Example 2** **Solve $\frac{3}{4}k < 15$.**

$\frac{3}{4}k < 15$ Original equation

$\left(\frac{4}{3}\right)\frac{3}{4}k < \left(\frac{4}{3}\right)15$ Multiply each side by $\frac{4}{3}$.

$k < 20$ Simplify.

The solution is $\{k \mid k < 20\}$.

**Exercises**

**Solve each inequality. Then check your solution.**

**1.** $\frac{y}{6} \leq 2$ $\{y \mid y \leq 12\}$

**2.** $-\frac{n}{50} > 22$ $\{n \mid n < -1100\}$

**3.** $\frac{3}{5}h \geq -3$ $\{h \mid h \geq -5\}$

**4.** $-\frac{p}{6} < -6$ $\{p \mid p > 36\}$

**5.** $\frac{1}{4}n \geq 10$ $\{n \mid n \geq 40\}$

**6.** $-\frac{2}{3}b < \frac{1}{3}$ $\left\{b \mid b > -\frac{1}{2}\right\}$

**7.** $\frac{3m}{5} < -\frac{3}{20}$ $\left\{m \mid m < -\frac{1}{4}\right\}$

**8.** $-2.51 \leq -\frac{2h}{4}$ $\{h \mid h \leq 5.02\}$

**9.** $\frac{g}{5} \geq -2$ $\{g \mid g \geq -10\}$

**10.** $-\frac{3}{4} > -\frac{9p}{5}$ $\left\{p \mid p > \frac{5}{12}\right\}$

**11.** $\frac{n}{10} \geq 5.4$ $\{n \mid n \geq 54\}$

**12.** $\frac{2a}{7} \geq -6$ $\{a \mid a \geq -21\}$

**Define a variable, write an inequality, and solve each problem. Then check your solution.** 13–15. Sample answer: Let $n$ = the number.

**13.** Half of a number is at least 14. $\frac{1}{2}n \geq 14$; $\{n \mid n \geq 28\}$

**14.** The opposite of one-third a number is greater than 9. $-\frac{1}{3}n > 9$; $\{n \mid n < -27\}$

**15.** One fifth of a number is at most 30. $\frac{1}{5}n \leq 30$; $\{n \mid n \leq 150\}$





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# 6-2 Study Guide and Intervention *(continued)*

## Solving Inequalities by Multiplication and Division

**Solve Inequalities by Division** If each side of a true inequality is divided by the same positive number, the resulting inequality is also true. However, if each side of an inequality is divided by the same negative number, the direction of the inequality symbol must be reversed for the resulting inequality to be true.

| | |
|---|---|
| **Division Property of Inequalities** | For all numbers $a$, $b$, and $c$ with $c \neq 0$,<br>**1.** if $c$ is positive and $a > b$, then $\frac{a}{c} > \frac{b}{c}$; if $c$ is positive and $a < b$, then $\frac{a}{c} < \frac{b}{c}$;<br>**2.** if $c$ is negative and $a > b$, then $\frac{a}{c} < \frac{b}{c}$; if $c$ is negative and $a < b$, then $\frac{a}{c} > \frac{b}{c}$. |

The property is also true when $>$ and $<$ are replaced with $\geq$ and $\leq$.

**Example** **Solve $-12y \geq 48$.**

$-12y \geq 48$ Original inequality

$\frac{-12y}{-12} \leq \frac{48}{-12}$ Divide each side by $-12$ and change $\geq$ to $\leq$.

$y \leq -4$ Simplify.

The solution is $\{y \mid y \leq -4\}$.

**Exercises**

**Solve each inequality. Then check your solution.**

**1.** $25g \geq -100$ $\{g \mid g \geq -4\}$

**2.** $-2x \geq 9$ $\left\{x \mid x \leq -4\frac{1}{2}\right\}$

**3.** $-5c > 2$ $\left\{c \mid c < -\frac{2}{5}\right\}$

**4.** $-8m < -64$ $\{m \mid m > 8\}$

**5.** $-6k < \frac{1}{5}$ $\left\{k \mid k > -\frac{1}{30}\right\}$

**6.** $18 < -3b$ $\{b \mid b < -6\}$

**7.** $30 < -3n$ $\{n \mid n < -10\}$

**8.** $-0.24 < 0.6w$ $\{w \mid w > -0.4\}$

**9.** $25 \geq -2m$ $\left\{m \mid m \geq -12\frac{1}{2}\right\}$

**10.** $-30 > -5p$ $\{p \mid p > 6\}$

**11.** $-2n \geq 6.2$ $\{n \mid n \leq -3.1\}$

**12.** $-35 < 0.05h$ $\{h \mid h > -700\}$

**13.** $-40 > 10h$ $\{h \mid h < -4\}$

**14.** $-\frac{2}{3}n \geq 6$ $\{n \mid n \leq -9\}$

**15.** $-3 < \frac{p}{4}$ $\{p \mid p > -12\}$

**Define a variable, write an inequality, and solve each problem. Then check your solution.** 16–18. Sample answer: Let $n$ = the number.

**16.** Four times a number is no more than 108. $4n \leq 108$; $\{n \mid n \leq 27\}$

**17.** The opposite of three times a number is greater than 12. $-3n > 12$; $\{n \mid n < -4\}$

**18.** Negative five times a number is at most 100. $-5n \leq 100$; $\{n \mid n \geq -20\}$







Answers

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# 6-2 Skills Practice

## Solving Inequalities by Multiplication and Division

**Match each inequality with its corresponding statement.**

| | |
|---|---|
| **1.** $3n < 9$ **d** | **a.** Three times a number is at most nine. |
| **2.** $\frac{1}{3}n \geq 9$ **f** | **b.** One third of a number is no more than nine. |
| **3.** $3n \leq 9$ **a** | **c.** Negative three times a number is more than nine. |
| **4.** $-3n > 9$ **c** | **d.** Three times a number is less than nine. |
| **5.** $\frac{1}{3}n \leq 9$ **b** | **e.** Negative three times a number is at least nine. |
| **6.** $-3n \geq 9$ **e** | **f.** One third of a number is greater than or equal to nine. |

**Solve each inequality. Then check your solution.**

| | | | |
|---|---|---|---|
| **7.** $14g > 56$ $\{g \mid g > 4\}$ | **8.** $11w \leq 77$ $\{w \mid w \leq 7\}$ | **9.** $20b \geq -120$ $\{b \mid b \geq -6\}$ | **10.** $-8r < 16$ $\{r \mid r > -2\}$ |
| **11.** $-15p \leq -90$ $\{p \mid p \geq 6\}$ | **12.** $\frac{s}{4} < 9$ $\{s \mid s < 36\}$ | **13.** $\frac{a}{9} \geq -15$ $\{a \mid a \geq -135\}$ | **14.** $-\frac{p}{7} > -9$ $\{p \mid p < 63\}$ |
| **15.** $-\frac{t}{12} \geq 6$ $\{t \mid t \leq -72\}$ | **16.** $5z < -90$ $\{z \mid z < -18\}$ | **17.** $-13m > -26$ $\{m \mid m < 2\}$ | **18.** $\frac{k}{5} \leq -17$ $\{k \mid k \leq -85\}$ |
| **19.** $-y < 36$ $\{y \mid y > -36\}$ | **20.** $-16c \geq -224$ $\{c \mid c \leq 14\}$ | **21.** $-\frac{h}{10} \leq 2$ $\{h \mid h \geq -20\}$ | **22.** $12 > \frac{d}{12}$ $\{d \mid d < 144\}$ |

**Define a variable, write an inequality, and solve each problem. Then check your solution.** 23–27. Sample answer: Let $n$ = the number.

**23.** Four times a number is greater than −48. $4n > -48$; $\{n \mid n > -12\}$

**24.** One eighth of a number is less than or equal to 3. $\frac{1}{8}n \leq 3$; $\{n \mid n \leq 24\}$

**25.** Negative twelve times a number is no more than 84. $-12n \leq 84$; $\{n \mid n \geq -7\}$

**26.** Negative one sixth of a number is less than −9. $-\frac{1}{6}n < -9$; $\{n \mid n > 54\}$

**27.** Eight times a number is at least 16. $8n \geq 16$; $\{n \mid n \geq 2\}$





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# 6-2 Practice (Average)

## Solving Inequalities by Multiplication and Division

**Match each inequality with its corresponding statement.**

| | |
|---|---|
| **1.** $-4n \geq 5$ **d** | **a.** Negative four times a number is less than five. |
| **2.** $\frac{4}{5}n > 5$ **f** | **b.** Four fifths of a number is no more than five. |
| **3.** $4n \leq 5$ **e** | **c.** Four times a number is fewer than five. |
| **4.** $\frac{4}{5}n \leq 5$ **b** | **d.** Negative four times a number is no less than five. |
| **5.** $4n < 5$ **c** | **e.** Four times a number is at most five. |
| **6.** $-4n < 5$ **a** | **f.** Four fifths of a number is more than five. |

**Solve each inequality. Then check your solution.**

| | | | |
|---|---|---|---|
| **7.** $-\frac{a}{5} < -14$ $\{a \mid a > 70\}$ | **8.** $-13h \leq 52$ $\{h \mid h \geq -4\}$ | **9.** $\frac{s}{16} \geq -6$ $\{s \mid s \geq -96\}$ | **10.** $39 > 13p$ $\{p \mid p < 3\}$ |
| **11.** $\frac{2}{3}n > -12$ $\{n \mid n > -18\}$ | **12.** $-\frac{5}{9}t < 25$ $\{t \mid t > -45\}$ | **13.** $-\frac{3}{5}m \leq -6$ $\{m \mid m \geq 10\}$ | **14.** $\frac{10}{3}k \geq -10$ $\{k \mid k \geq -3\}$ |
| **15.** $-3b \leq 0.75$ $\{b \mid b \geq -0.25\}$ | **16.** $-0.9c > -9$ $\{c \mid c < 10\}$ | **17.** $0.1x \geq -4$ $\{x \mid x \geq -40\}$ | **18.** $-2.3 < \frac{j}{4}$ $\{j \mid j > -9.2\}$ |
| **19.** $-15y < 3$ $\left\{y \mid y > -\frac{1}{5}\right\}$ | **20.** $2.6v \geq -20.8$ $\{v \mid v \geq -8\}$ | **21.** $0 > -0.5u$ $\{u \mid u > 0\}$ | **22.** $\frac{7}{8}f \leq -1$ $\left\{f \mid f \leq -\frac{8}{7}\right\}$ |

**Define a variable, write an inequality, and solve each problem. Then check your solution.** 23–25. Sample answer: Let $n$ = the number.

**23.** Negative three times a number is at least 57. $-3n \geq 57$; $\{n \mid n \leq -19\}$

**24.** Two thirds of a number is no more than −10. $\frac{2}{3}n \leq -10$; $\{n \mid n \leq -15\}$

**25.** Negative three fifths of a number is less than −6. $-\frac{3}{5}n < -6$; $\{n \mid n > 10\}$

**26. FLOODING** A river is rising at a rate of 3 inches per hour. If the river rises more than 2 feet, it will exceed flood stage. How long can the river rise at this rate without exceeding flood stage? no more than 8 h

**27. SALES** Pet Supplies makes a profit of $5.50 per bag on its line of natural dog food. If the store wants to make a profit of no less than $5225, how many bags of dog food does it need to sell? at least 950 bags

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# 6-2 Reading to Learn Mathematics

## *Solving Inequalities by Multiplication and Division*

**Pre-Activity** **Why are inequalities important in landscaping?**

Read the introduction to Lesson 6-2 at the top of page 325 in your textbook.

- Would a wall 6 bricks high be lower than a wall 6 blocks high? Why?
  **yes; $6(3) < 6(12)$**
- Would a wall $n$ bricks high be lower than a wall $n$ blocks high? Explain.
  **yes; When one quantity is less than another quantity, multiplying both quantities by the same positive number does not change the truth of the inequality.**

### Reading the Lesson

**1.** Write an inequality that describes each situation.

**a.** A number $n$ divided by 8 is greater than 5. $n \div 8 > 5$

**b.** Twelve times a number $k$ is at least 7. $12k \geq 7$

**c.** A number $x$ divided by $-10$ is less than or equal to 50. $x \div (-10) \leq 50$

**d.** Three fifths of a number $n$ is at most 13. $\frac{3}{5}n \leq 13$

**e.** Nine is greater than or equal to one half of a quantity $m$. $9 \geq \frac{1}{2}m$

**2.** Use words to tell what each inequality says.

**a.** $12 < 6n$ **12 is less than 6 times a number *n*.**

**b.** $\frac{t}{-3} \geq 14$ **A number *t* divided by $-3$ is greater than or equal to 14.**

**c.** $11x \leq 32$ **11 times a number *x* is at most 32.**

### Helping You Remember

**3.** In your own words, write a rule for multiplying and dividing inequalities by positive and negative numbers.

**Sample answer: When you multiply or divide each side of a true inequality by a positive number, the result is true. When you multiply or divide a true inequality by a negative number, you must reverse the direction of the inequality sign.**





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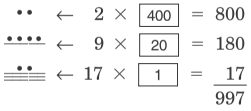
# 6-2 Enrichment

## *The Maya*

The Maya were a Native American people who lived from about 1500 B.C. to about 1500 A.D. in the region that today encompasses much of Central America and southern Mexico. Their many accomplishments include exceptional architecture, pottery, painting, and sculpture, as well as significant advances in the fields of astronomy and mathematics.

The Maya developed a system of numeration that was based on the number twenty. The basic symbols of this system are shown in the table at the right. The places in a Mayan numeral are written vertically—the bottom place represents *ones*, the place above represents *twenties*, the place above that represents $20 \times 20$, or *four hundreds*, and so on. For instance, this is how to write the number 997 in Mayan numerals.




| | | | |
|---|---|---|---|
| 0 | ◎ | 10 | ═ |
| 1 | • | 11 | ═ • |
| 2 | •• | 12 | ═ •• |
| 3 | ••• | 13 | ═ ••• |
| 4 | •••• | 14 | ═ •••• |
| 5 | — | 15 | ═ ═ |
| 6 | — • | 16 | ═ ═ • |
| 7 | — •• | 17 | ═ ═ •• |
| 8 | — ••• | 18 | ═ ═ ••• |
| 9 | — •••• | 19 | ═ ═ •••• |

**Evaluate each expression when $v =$ —•—, $w =$ ═══, $x =$ ••••, $y =$ ◎, and $z =$ ═══. Then write the answer in Mayan numerals. Exercise 5 is done for you.**

**1.** $\frac{z}{w}$ •••

**2.** $\frac{v + w + z}{x}$ ••••

**3.** $xv$ •<br>••••

**4.** $vxy$ ◎

**5.** $wx - z$ •••<br>◎

**6.** $vz + xy$ •••<br>••

**7.** $w(v + x + z)$ •••••<br>•

**8.** $vwz$ •••<br>••••<br>•

**9.** $z(wx - x)$ ••<br>◎<br>•

**Tell whether each statement is *true* or *false*.**

**10.** ═══ + —•— = —•— + ═══ **true**

**11.** ═══ / • = • / ═══ **false**

**12.** ═══ / ═══ = ═══ / ═══ **false**

**13.** (••• + ——) + ═══ = ••• + (—— + ═══) **true**

**14.** How are Exercises 10 and 11 alike? How are they different?

**Both involve changing the order of the symbols. Exercise 10 involves changing the order of the addends in an addition problem. Exercise 11 involves changing the order of the digits in a numeral.**

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# 6-3 Study Guide and Intervention

## Solving Multi-Step Inequalities

**Solve Multi-Step Inequalities** To solve linear inequalities involving more than one operation, undo the operations in reverse of the order of operations, just as you would solve an equation with more than one operation.

**Example 1** **Solve $6x - 4 \le 2x + 12$.**

| | |
|---|---|
| $6x - 4 \le 2x + 12$ | Original inequality |
| $6x - 4 - 2x \le 2x + 12 - 2x$ | Subtract $2x$ from each side. |
| $4x - 4 \le 12$ | Simplify. |
| $4x - 4 + 4 \le 12 + 4$ | Add 4 to each side. |
| $4x \le 16$ | Simplify. |
| $\frac{4x}{4} \le \frac{16}{4}$ | Divide each side by 4. |
| $x \le 4$ | Simplify. |

The solution is $\{x \mid x \le 4\}$.

**Example 2** **Solve $3a - 15 > 4 + 5a$.**

| | |
|---|---|
| $3a - 15 > 4 + 5a$ | Original inequality |
| $3a - 15 - 5a > 4 + 5a - 5a$ | Subtract $5a$ from each side. |
| $-2a - 15 > 4$ | Simplify. |
| $-2a - 15 + 15 > 4 + 15$ | Add 15 to each side. |
| $-2a > 19$ | Simplify. |
| $\frac{-2a}{-2} < \frac{19}{-2}$ | Divide each side by $-2$ and change $>$ to $<$. |
| $a < -9\frac{1}{2}$ | Simplify. |

The solution is $\left\{a \mid a < -9\frac{1}{2}\right\}$.

**Exercises**

**Solve each inequality. Then check your solution.**

1. $11y + 13 \ge -1$
   $\left\{y \mid y \ge -1\frac{3}{11}\right\}$
2. $8n - 10 < 6 - 2n$
   $\left\{n \mid n < 1\frac{3}{5}\right\}$
3. $\frac{q}{7} + 1 > -5$
   $\{q \mid q > -42\}$
4. $6n + 12 < 8 + 8n$
   $\{n \mid n > 2\}$
5. $-12 - d > -12 + 4d$
   $\{d \mid d < 0\}$
6. $5r - 6 > 8r - 18$
   $\{r \mid r < 4\}$
7. $\frac{-3x + 6}{2} \le 12$
   $\{x \mid x \ge -6\}$
8. $7.3y - 14.4 > 4.9y$
   $\{y \mid y > 6\}$
9. $-8m - 3 < 18 - m$
   $\{m \mid m > -3\}$
10. $-4y - 10 > 19 - 2y$
    $\left\{y \mid y < -14\frac{1}{2}\right\}$
11. $9n - 24n + 45 > 0$
    $\{n \mid n < 3\}$
12. $\frac{4x - 2}{5} \ge -4$
    $\left\{x \mid x \ge -4\frac{1}{2}\right\}$

**Define a variable, write an inequality, and solve each problem. Then check your solution.** 13–15. Sample answer: Let $n$ = the number.

13. Negative three times a number plus four is no more than the number minus eight.
    $-3n + 4 \le n - 8$; $\{n \mid n \ge 3\}$
14. One fourth of a number decreased by three is at least two.
    $\frac{1}{4}n - 3 \ge 2$; $\{n \mid n \ge 20\}$
15. The sum of twelve and a number is no greater than the sum of twice the number and $-8$.
    $12 + n \le 2n + (-8)$; $\{n \mid n \ge 20\}$





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# 6-3 Study Guide and Intervention *(continued)*

## Solving Multi-Step Inequalities

**Solve Inequalities Involving the Distributive Property** When solving inequalities that contain grouping symbols, first use the Distributive Property to remove the grouping symbols. Then undo the operations in reverse of the order of operations, just as you would solve an equation with more than one operation.

**Example** **Solve $3a - 2(6a - 4) > 4 - (4a + 6)$.**

| | |
|---|---|
| $3a - 2(6a - 4) > 4 - (4a + 6)$ | Original inequality |
| $3a - 12a + 8 > 4 - 4a - 6$ | Distributive Property |
| $-9a + 8 > -2 - 4a$ | Combine like terms. |
| $-9a + 8 + 4a > -2 - 4a + 4a$ | Add $4a$ to each side. |
| $-5a + 8 > -2$ | Combine like terms. |
| $-5a + 8 - 8 > -2 - 8$ | Subtract 8 from each side. |
| $-5a > -10$ | Simplify. |
| $a < 2$ | Divide each side by $-5$ and change $>$ to $<$. |

The solution in set-builder notation is $\{a \mid a < 2\}$.

**Exercises**

**Solve each inequality. Then check your solution.**

1. $2(t + 3) \ge 16$
   $\{t \mid t \ge 5\}$
2. $3(d - 2) - 2d > 16$
   $\{d \mid d > 22\}$
3. $4h - 8 < 2(h - 1)$
   $\{h \mid h < 3\}$
4. $6y + 10 > 8 - (y + 14)$
   $\left\{y \mid y > -2\frac{2}{7}\right\}$
5. $4.6(x - 3.4) > 5.1x$
   $\{x \mid x < -31.28\}$
6. $-5x - (2x + 3) \ge 1$
   $\left\{x \mid x \le -\frac{4}{7}\right\}$
7. $3(2y - 4) - 2(y + 1) > 10$
   $\{y \mid y > 6\}$
8. $8 - 2(b + 1) < 12 - 3b$
   $\{b \mid b < 6\}$
9. $-2(k - 1) > 8(1 + k)$
   $\left\{k \mid k < -\frac{3}{5}\right\}$
10. $0.3(y - 2) > 0.4(1 + y)$
    $\{y \mid y < -10\}$
11. $m + 17 \le -(4m - 13)$
    $\left\{m \mid m \le -\frac{4}{5}\right\}$
12. $3n + 8 \le 2(n - 4) - 2(1 - n)$
    $\{n \mid n \ge 18\}$
13. $2(y - 2) > -4 + 2y$
    $\varnothing$
14. $k - 17 \le -(17 - k)$
    $\{k \mid k \text{ is a real number}\}$
15. $n - 4 \le -3(2 + n)$
    $\left\{n \mid n \le -\frac{1}{2}\right\}$

**Define a variable, write an inequality, and solve each problem. Then check your solution.** 16–18. Sample answer: Let $n$ = the number.

16. Twice the sum of a number and 4 is less than 12. $2(n + 4) < 12$; $\{n \mid n < 2\}$
17. Three times the sum of a number and six is greater than four times the number decreased by two. $3(n + 6) > 4n - 2$; $\{n \mid n < 20\}$
18. Twice the difference of a number and four is less than the sum of the number and five.
    $2(n - 4) < n + 5$; $\{n \mid n < 13\}$

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# 6-3 Skills Practice

## *Solving Multi-Step Inequalities*

**Justify each indicated step.**

**1.** $\frac{3}{4}t - 3 \geq -15$

$\frac{3}{4}t - 3 + 3 \geq -15 + 3$ **a.** ?

$\frac{3}{4}t \geq -12$

$\frac{4}{3}\left(\frac{3}{4}\right)t \geq \frac{4}{3}(-12)$ **b.** ?

$t \geq -16$

a. Add 3 to each side.
b. Multiply each side by $\frac{4}{3}$.

**2.** $5(k + 8) - 7 \leq 23$

$5k + 40 - 7 \leq 23$ **a.** ?

$5k + 33 \leq 23$

$5k + 33 - 33 \leq 23 - 33$ **b.** ?

$5k \leq -10$

$\frac{5k}{5} \leq \frac{-10}{5}$ **c.** ?

$k \leq -2$

a. Distributive Property
b. Subtract 33 from each side.
c. Divide each side by 5.

**Solve each inequality. Then check your solution.**

**3.** $-2b + 4 > -6$ $\{b \mid b < 5\}$

**4.** $3x + 15 \leq 21$ $\{x \mid x \leq 2\}$

**5.** $\frac{d}{2} - 1 \geq 3$ $\{d \mid d \geq 8\}$

**6.** $\frac{2}{5}a - 4 < 2$ $\{a \mid a < 15\}$

**7.** $-\frac{t}{5} + 7 > -4$ $\{t \mid t < 55\}$

**8.** $\frac{3}{4}j - 10 \geq 5$ $\{j \mid j \geq 20\}$

**9.** $-\frac{2}{3}f + 3 < -9$ $\{f \mid f > 18\}$

**10.** $2p + 5 \geq 3p - 10$ $\{p \mid p \leq 15\}$

**11.** $4k + 15 > -2k + 3$ $\{k \mid k > -2\}$

**12.** $2(-3m - 5) \geq -28$ $\{m \mid m \leq 3\}$

**13.** $-6(w + 1) < 2(w + 5)$ $\{w \mid w > -2\}$

**14.** $2(q - 3) + 6 \leq -10$ $\{q \mid q \leq -5\}$

**Define a variable, write an inequality, and solve each problem. Then check your solution.** 15–20. Sample answer: Let $n$ = the number.

**15.** Four more than the quotient of a number and three is at least nine. $\frac{n}{3} + 4 \geq 9$; $\{n \mid n \geq 15\}$

**16.** The sum of a number and fourteen is less than or equal to three times the number. $n + 14 \leq 3n$; $\{n \mid n \geq 7\}$

**17.** Negative three times a number increased by seven is less than negative eleven. $-3n + 7 < -11$; $\{n \mid n > 6\}$

**18.** Five times a number decreased by eight is at most ten more than twice the number. $5n - 8 \leq 2n + 10$; $\{n \mid n \leq 6\}$

**19.** Seven more than five sixths of a number is more than negative three. $\frac{5}{6}n + 7 > -3$; $\{n \mid n > -12\}$

**20.** Four times the sum of a number and two increased by three is at least twenty-seven. $4(n + 2) + 3 \geq 27$; $\{n \mid n \geq 4\}$





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# 6-3 Practice (Average)

## *Solving Multi-Step Inequalities*

**Justify each indicated step.**

**1.** $x > \frac{5x - 12}{8}$

$8x > (8)\frac{5x - 12}{8}$ **a.** ?

$8x > 5x - 12$

$8x - 5x > 5x - 12 - 5x$ **b.** ?

$3x > -12$

$\frac{3x}{3} > \frac{-12}{3}$ **c.** ?

$x > -4$

a. Multiply each side by 8.
b. Subtract $5x$ from each side.
c. Divide each side by 3.

**2.** $2(2h + 2) < 2(3h + 5) - 12$

$4h + 4 < 6h + 10 - 12$ **a.** ?

$4h + 4 < 6h - 2$

$4h + 4 - 6h < 6h - 2 - 6h$ **b.** ?

$-2h + 4 < -2$

$-2h + 4 - 4 < -2 - 4$ **c.** ?

$-2h < -6$

$\frac{-2h}{-2} > \frac{-6}{-2}$ **d.** ?

$h > 3$

a. Distributive Property
b. Subtract $6h$ from each side.
c. Subtract 4 from each side.
d. Divide each side by $-2$ and change $<$ to $>$.

**Solve each inequality. Then check your solution.**

**3.** $-5 - \frac{t}{6} \geq -9$ $\{t \mid t \leq 24\}$

**4.** $4u - 6 \geq 6u - 20$ $\{u \mid u \leq 7\}$

**5.** $13 > \frac{2}{3}a - 1$ $\{a \mid a < 21\}$

**6.** $\frac{w + 3}{2} < -8$ $\{w \mid w < -19\}$

**7.** $\frac{3f - 10}{5} > 7$ $\{f \mid f > 15\}$

**8.** $h \leq \frac{6h + 3}{5}$ $\{h \mid h \geq -3\}$

**9.** $3(z + 1) + 11 < -2(z + 13)$ $\{z \mid z < -8\}$

**10.** $3e + 2(4e + 2) \leq 2(6e + 1)$ $\{e \mid e \geq 2\}$

**11.** $5n - 3(n - 6) \geq 0$ $\{n \mid n \geq -9\}$

**Define a variable, write an inequality, and solve each problem. Then check your solution.** 12–13. Sample answer: Let $n$ = the number.

**12.** A number is less than one fourth the sum of three times the number and four. $n < \frac{3n + 4}{4}$; $\{n \mid n < 4\}$

**13.** Two times the sum of a number and four is no more than three times the sum of the number and seven decreased by four. $2(n + 4) \leq 3(n + 7) - 4$; $\{n \mid n \geq -9\}$

**14. GEOMETRY** The area of a triangular garden can be no more than 120 square feet. The base of the triangle is 16 feet. What is the height of the triangle? no more than 15 ft

**15. MUSIC PRACTICE** Nabuko practices the violin at least 12 hours per week. She practices for three fourths of an hour each session. If Nabuko has already practiced 3 hours in one week, how many sessions remain to meet or exceed her weekly practice goal? at least 12 sessions





Answers

NAME _____ DATE _____ PERIOD ____

# 6-3 Reading to Learn Mathematics

## *Solving Multi-Step Inequalities*

**Pre-Activity** **How are linear inequalities used in science?**

Read the introduction to Lesson 6-3 at the top of page 332 in your textbook. Then write an inequality that could be used to find the temperatures in degrees Celsius for which each substance is a gas.

Argon: $\frac{9}{5}C + 32 > -303$ Bromine: $\frac{9}{5}C + 32 > 138$

### Reading the Lesson

1. What does the phrase "undoing the operations in reverse of the order of operations" mean?

   **Sample answer: First add or subtract to undo subtraction or addition, then multiply or divide to undo division or multiplication.**

2. Describe how checking the solution of an inequality is different from checking the solution of an equation.

   **Sample answer: Instead of substituting one value for the variable, there are infinitely many values that can be used to check. It is a good idea to use a value that is less than, the value equal to, and a value greater than the number in the solution to check an inequality.**

3. Describe how the Distributive Property can be used to remove the grouping symbols in the inequality $4x - 7(2x + 8) \leq 3x - 5$.

   **Multiply $-7$ by both $2x$ and 8.**

4. Is it possible to have no solution when you solve an inequality? Explain your answer and give an example.

   **Sample answer: Yes; if solving results in an inequality that is never true (and the signs have been reversed if necessary), then there is no solution. Example: $3(t - 4) - 8 > 3(t + 4) - 8$**

### Helping You Remember

5. Make a checklist of steps you can use when solving inequalities.

   **(1) Use the Distributive Property to remove any grouping symbols.**
   **(2) Combine any like terms.**
   **(3) Add or subtract the same variable terms or constants on both sides.**
   **(4) Multiply or divide to undo operations.**
   **(5) Reverse the direction of the inequality symbol if both sides were multiplied or divided by a negative number.**
   **(6) Be sure the variable is by itself on one side of the final inequality.**





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# 6-3 Enrichment

## *Carlos Montezuma*

During his lifetime, Carlos Montezuma (1865?–1923) was one of the most influential Native Americans in the United States. He was recognized as a prominent physician and was also a passionate advocate of the rights of Native American peoples. The exercises that follow will help you learn some interesting facts about Dr. Montezuma's life.

**Solve each inequality. The word or phrase next to the equivalent inequality will complete the statement correctly.**

**1.** $-2k > 10$
Montezuma was born in the state of ___?___.

| | | |
|---|---|---|
| (a.) | $k < -5$ | Arizona |
| b. | $k > -5$ | Montana |
| c. | $k > 12$ | Utah |

**2.** $5 \geq r - 9$
He was a Native American of the Yavapais, who are a ___?___ people.

| | | |
|---|---|---|
| a. | $r \leq -4$ | Navajo |
| b. | $r \geq -4$ | Mohawk |
| (c.) | $r \leq 14$ | Mohave-Apache |

**3.** $-y \leq -9$
Montezuma received a medical degree from ___?___ in 1889.

| | | |
|---|---|---|
| (a.) | $y \geq 9$ | Chicago Medical College |
| b. | $y \geq -9$ | Harvard Medical School |
| c. | $y \leq 9$ | Johns Hopkins University |

**4.** $-3 + q > 12$
As a physician, Montezuma's field of specialization was ___?___.

| | | |
|---|---|---|
| a. | $q > -4$ | heart surgery |
| (b.) | $q > 15$ | internal medicine |
| c. | $q < -15$ | respiratory diseases |

**5.** $5 + 4x - 14 \leq x$
For much of his career, he maintained a medical practice in ___?___.

| | | |
|---|---|---|
| a. | $x \leq 9$ | New York City |
| (b.) | $x \leq 3$ | Chicago |
| c. | $x \geq -9$ | Boston |

**6.** $7 - t < 7 + t$
In addition to maintaining his medical practice, he was also a(n) ___?___.

| | | |
|---|---|---|
| a. | $t > 7$ | director of a blood bank |
| (b.) | $t > 0$ | instructor at a medical college |
| c. | $t < -7$ | legal counsel to physicians |

**7.** $3a + 8 \geq 4a - 10$
Montezuma founded, wrote, and edited ___?___, a monthly newsletter that addressed Native American concerns.

| | | |
|---|---|---|
| a. | $a \leq -2$ | Yavapai |
| b. | $a \geq 18$ | Apache |
| (c.) | $a \leq 18$ | Wassaja |

**8.** $6n > 8n - 12$
Montezuma testified before a committee of the United States Congress concerning his work in treating ___?___.

| | | |
|---|---|---|
| (a.) | $n < 6$ | appendicitis |
| b. | $n > -6$ | asthma |
| c. | $n > -10$ | heart attacks |

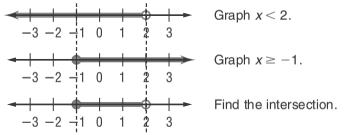
NAME _____ DATE _____ PERIOD ____

# 6-4 Study Guide and Intervention

## Solving Compound Inequalities

**Inequalities Containing *and*** A compound inequality containing *and* is true only if both inequalities are true. The graph of a compound inequality containing *and* is the **intersection** of the graphs of the two inequalities. Every solution of the compound inequality must be a solution of both inequalities.

**Example 1** **Graph the solution set of $x < 2$ and $x \geq -1$.**



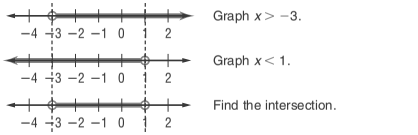

The solution set is $\{x \mid -1 \leq x < 2\}$.

**Example 2** **Solve $-1 < x + 2 < 3$ using *and*. Then graph the solution set.**

$-1 < x + 2$ and $x + 2 < 3$

$-1 - 2 < x + 2 - 2$ $x + 2 - 2 < 3 - 2$

$-3 < x$ $x < 1$

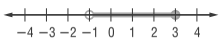



The solution set is $\{x \mid -3 < x < 1\}$.

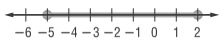
**Exercises**

**Graph the solution set of each compound inequality.**

**1.** $b > -1$ and $b \leq 3$

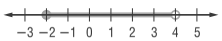


**2.** $2 \geq q \geq -5$



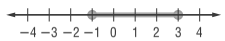
**3.** $x > -3$ and $x \leq 4$

**4.** $-2 \leq p < 4$



**5.** $-3 < d$ and $d < 2$

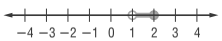
**6.** $-1 \leq p \leq 3$



**Solve each compound inequality. Then graph the solution set.**

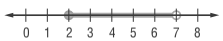
**7.** $4 < w + 3 \leq 5$

$\{w \mid 1 < w \leq 2\}$



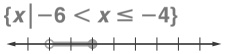
**8.** $-3 \leq p - 5 < 2$

$\{p \mid 2 \leq p < 7\}$



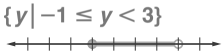
**9.** $-4 < x + 2 \leq -2$

$\{x \mid -6 < x \leq -4\}$



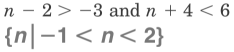
**10.** $y - 1 < 2$ and $y + 2 \geq 1$

$\{y \mid -1 \leq y < 3\}$



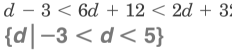
**11.** $n - 2 > -3$ and $n + 4 < 6$

$\{n \mid -1 < n < 2\}$



**12.** $d - 3 < 6d + 12 < 2d + 32$

$\{d \mid -3 < d < 5\}$







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# 6-4 Study Guide and Intervention *(continued)*

## Solving Compound Inequalities

**Inequalities Containing *or*** A compound inequality containing *or* is true if one or both of the inequalities are true. The graph of a compound inequality containing *or* is the **union** of the graphs of the two inequalities. The union can be found by graphing both inequalities on the same number line. A solution of the compound inequality is a solution of either inequality, not necessarily both.

**Example** **Solve $2a + 1 < 11$ or $a > 3a + 2$.**

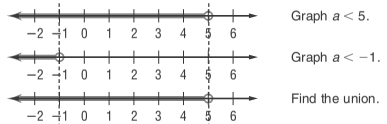
$2a + 1 < 11$ or $a > 3a + 2$

$2a + 1 - 1 < 11 - 1$ $a - 3a > 3a - 3a + 2$

$2a < 10$ $-2a > 2$

$\frac{2a}{2} < \frac{10}{2}$ $\frac{-2a}{-2} < \frac{2}{-2}$

$a < 5$ $a < -1$

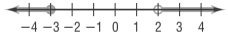



The solution set is $\{a \mid a < 5\}$.

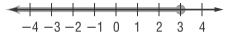
**Exercises**

**Graph the solution set of each compound inequality.**

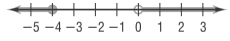
**1.** $b > 2$ or $b \leq -3$



**2.** $3 \geq q$ or $q \leq 1$

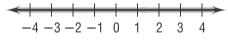


**3.** $y \leq -4$ or $y > 0$

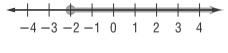


**4.** $4 \leq p$ or $p < 8$

**5.** $-3 < d$ or $d < 2$



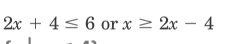
**6.** $-2 \leq x$ or $3 \leq x$



**Solve each compound inequality. Then graph the solution set.**

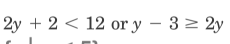
**7.** $3 < 3w$ or $3w \geq 9$

$\{w \mid 1 < w\}$



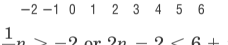
**8.** $-3p + 1 \leq -11$ or $p < 2$

$\{p \mid p \geq 4 \text{ or } p < 2\}$



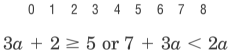
**9.** $2x + 4 \leq 6$ or $x \geq 2x - 4$

$\{x \mid x \leq 4\}$



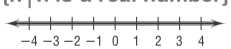
**10.** $2y + 2 < 12$ or $y - 3 \geq 2y$

$\{y \mid y < 5\}$



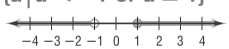
**11.** $\frac{1}{2}n > -2$ or $2n - 2 < 6 + n$

$\{n \mid n \text{ is a real number}\}$



**12.** $3a + 2 \geq 5$ or $7 + 3a < 2a + 6$

$\{a \mid a < -1 \text{ or } a \geq 1\}$









Answers

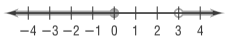
NAME _____ DATE _____ PERIOD ____

# 6-4 Skills Practice

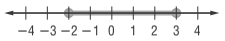
## Solving Compound Inequalities

**Graph the solution set of each compound inequality.**

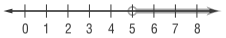
**1.** $b > 3$ or $b \leq 0$



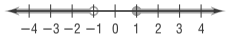

**2.** $z \leq 3$ and $z \geq -2$




**3.** $k > 1$ and $k > 5$

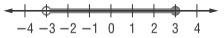



**4.** $y < -1$ or $y \geq 1$



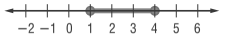

**Write a compound inequality for each graph.**

**5.**




$-3 < x \leq 3$

**6.**

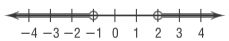



$1 \leq x \leq 4$

**7.**


$x < -2$ or $x \geq 1$

**8.**

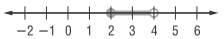



$x < -1$ or $x > 2$

**Solve each compound inequality. Then graph the solution set.**

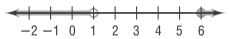
**9.** $m + 3 \geq 5$ and $m + 3 < 7$

$\{m \mid 2 \leq m < 4\}$



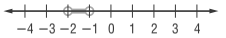

**10.** $y - 5 < -4$ or $y - 5 \geq 1$

$\{y \mid y < 1$ or $y \geq 6\}$



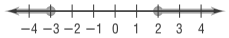

**11.** $4 < f + 6$ and $f + 6 < 5$

$\{f \mid -2 < f < -1\}$



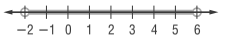

**12.** $w + 3 \leq 0$ or $w + 7 \geq 9$

$\{w \mid w \leq -3$ or $w \geq 2\}$



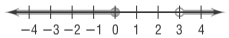

**13.** $-6 < b - 4 < 2$

$\{b \mid -2 < b < 6\}$




**14.** $p - 2 \leq -2$ or $p - 2 > 1$

$\{p \mid p \leq 0$ or $p > 3\}$




**Define a variable, write an inequality, and solve each problem. Then check your solution.** 15–17. Sample answer: Let $n$ = the number.

**15.** A number plus one is greater than negative five and less than three.

$-5 < n + 1 < 3$; $\{n \mid -6 < n < 2\}$

**16.** A number decreased by two is at most four or at least nine.

$n - 2 \leq 4$ or $n - 2 \geq 9$; $\{n \mid n \leq 6$ or $n \geq 11\}$

**17.** The sum of a number and three is no more than eight or is more than twelve.

$n + 3 \leq 8$ or $n + 3 > 12$; $\{n \mid n \leq 5$ or $n > 9\}$





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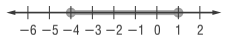
# 6-4 Practice (Average)

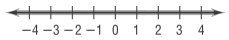
## Solving Compound Inequalities

**Graph the solution set of each compound inequality.**

**1.** $-4 \leq e \leq 1$




**2.** $x > 0$ or $x < 3$

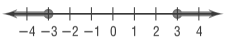



**3.** $g < -3$ or $g \geq 4$


**4.** $-4 \leq p \leq 4$


**Write a compound inequality for each graph.**

**5.**

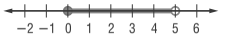



$x \leq -3$ or $x \geq 3$

**6.**

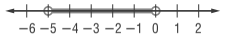

$x < 2$ or $x \geq 3$

**7.**




$0 \leq x < 5$

**8.**




$-5 < x < 0$

**Solve each compound inequality. Then graph the solution set.**

**9.** $k - 3 < -7$ or $k + 5 \geq 8$

$\{k \mid k < -4$ or $k \geq 3\}$


**10.** $-n < 2$ or $2n - 3 > 5$

$\{n \mid n > -2\}$


**11.** $5 < 3h + 2 \leq 11$

$\{h \mid 1 < h \leq 3\}$




**12.** $2c - 4 > -6$ and $3c + 1 < 13$

$\{c \mid -1 < c < 4\}$




**Define a variable, write an inequality, and solve each problem. Then check your solution.** 13–14. Sample answer: Let $n$ = the number.

**13.** Two times a number plus one is greater than five and less than seven.

$5 < 2n + 1 < 7$; $\{n \mid 2 < n < 3\}$

**14.** A number minus one is at most nine, or two times the number is at least twenty-four.

$n - 1 \leq 9$ or $2n \geq 24$; $\{n \mid n \leq 10$ or $n \geq 12\}$

**METEOROLOGY For Exercises 15 and 16, use the following information.**

Strong winds called the prevailing westerlies blow from west to east in a belt from 40° to 60° latitude in both the Northern and Southern Hemispheres.

**15.** Write an inequality to represent the latitude of the prevailing westerlies.

$\{w \mid 40 \leq w \leq 60\}$

**16.** Write an inequality to represent the latitudes where the prevailing westerlies are *not* located. $\{w \mid w < 40$ or $w > 60\}$

**17. NUTRITION** A cookie contains 9 grams of fat. If you eat no fewer than 4 and no more than 7 cookies, how many grams of fat will you consume? between 36 g and 63 g inclusive

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6-4

# Reading to Learn Mathematics

## *Solving Compound Inequalities*

**Pre-Activity** **How are compound inequalities used in tax tables?**

Read the introduction to Lesson 6-4 at the top of page 339 in your textbook.

- Explain why it is possible that Mr. Kelly's income is $41,370.
  **$41,370 is greater than or equal to $41,350 and less than $41,400.**

- Explain why it is *not* possible that Mr. Kelly's income is $41,400.
  **$41,400 is not less than $41,400.**

### Reading the Lesson

1. When is a compound inequality containing *and* true?
   **It is true when both inequalities are true.**

2. The graph of a compound inequality containing *and* is the ___intersection___ of the graphs of the two inequalities.

3. When is a compound inequality containing *or* true?
   **It is true when one or both of the inequalities is true.**

4. The graph of a compound inequality containing *or* is the ___union___ of the graphs of the two inequalities.

5. Suppose you use yellow to show the graph of Inequality #1 on the number line. You use blue to show the graph of Inequality #2. Write *and* or *or* in each blank to complete the sentence.

   a. The part that is green is the graph of Inequality #1 ___and___ Inequality #2.

   b. All colored parts form the graph of Inequality #1 ___or___ Inequality #2.

### Helping You Remember

6. One way to remember something is to connect it to something that is familiar to you. Write two *true* compound statements about yourself, one using the word *and* and the other using the word *or*.
   **Sample answer: I am 14 and I am a freshman in high school. After school, I will go to football practice or I will go home.**





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6-4

# Enrichment

## *Some Properties of Inequalities*

The two expressions on either side of an inequality symbol are sometimes called the *first* and *second* members of the inequality.

If the inequality symbols of two inequalities point in the same direction, the inequalities have the same sense. For example, $a < b$ and $c < d$ have the same sense; $a < b$ and $c > d$ have opposite senses.

In the problems on this page, you will explore some properties of inequalities.

**Three of the four statements below are true for all numbers $a$ and $b$ (or $a$, $b$, $c$, and $d$). Write each statement in algebraic form. If the statement is true for all numbers, prove it. If it is not true, give an example to show that it is false.**

1. Given an inequality, a new and equivalent inequality can be created by interchanging the members and reversing the sense.
   **If $a > b$, then $b < a$.**
   **$a > b$, $a - b > 0$, $-b > -a$, $(-1)(-b) < (-1)(-a)$, $b < a$**

2. Given an inequality, a new and equivalent inequality can be created by changing the signs of both terms and reversing the sense.
   **If $a > b$, then $2a < 2b$.**
   **$a > b$, $a - b > 0$, $-b > -a$, $-a < -b$**

3. Given two inequalities with the same sense, the sum of the corresponding members are members of an equivalent inequality with the same sense.
   **If $a > b$ and $c > d$, then $a + c > b + d$.**
   **$a > b$ and $c > d$, so $(a - b)$ and $(c - d)$ are positive numbers, so the sum $(a - b) + (c - d)$ is also positive.**
   **$a - b + c - d > 0$, so $a + c > b + d$.**

4. Given two inequalities with the same sense, the difference of the corresponding members are members of an equivalent inequality with the same sense.
   **If $a > b$ and $c > d$, then $a - c > b - d$. The statement is false. $5 > 4$ and $3 > 2$, but $5 - 3 \not> 4 - 2$.**

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# 6-5 Study Guide and Intervention

## Solving Open Sentences Involving Absolute Value

**Absolute Value Equations** When solving equations that involve absolute value, there are two cases to consider.

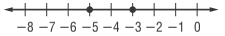
**Case 1:** The value inside the absolute value symbols is positive.
**Case 2:** The value inside the absolute value symbols is negative.

**Example 1** **Solve $|x + 4| = 1$. Then graph the solution set.**

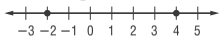
Write $|x + 4 = 1|$ as $x + 4 = 1$ or $x + 4 = -1$.

| | | |
|---|---|---|
| $x + 4 = 1$ | or | $x + 4 = -1$ |
| $x + 4 - 4 = 1 - 4$ | | $x + 4 = -1$ |
| $x = -3$ | | $x + 4 - 4 = -1 - 4$ |
| | | $x = -5$ |

The solution set is $\{-5, -3\}$.
The graph is shown below.




**Example 2** **Write an inequality involving absolute value for the graph.**



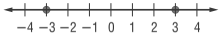

Find the point that is the same distance from $-2$ as it is from 4.


The distance from 1 to $-2$ is 3 units. The distance from 1 to 4 is 3 units.
So, $|x - 1| = 3$.

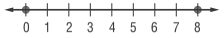
### Exercises

**Solve each open sentence. Then graph the solution set.**

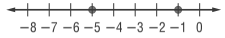
1. $|y| = 3$ $\{-3, 3\}$



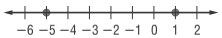

2. $|x - 4| = 4$ $\{0, 8\}$



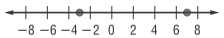

3. $|y + 3| = 2$ $\{-5, -1\}$



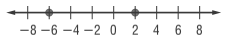

4. $|b + 2| = 3$ $\{-5, 1\}$



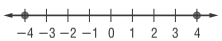

5. $|w - 2| = 5$ $\{-3, 7\}$




6. $|t + 2| = 4$ $\{-6, 2\}$

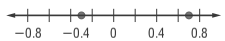



7. $|2x| = 8$ $\{-4, 4\}$



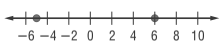

8. $|5y - 2| = 7$ $\left\{-1, 1\frac{4}{5}\right\}$


9. $|p - 0.2| = 0.5$ $\{-0.3, 0.7\}$




10. $|d - 100| = 50$ $\{50, 150\}$

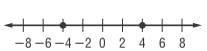

11. $|2x - 1| = 11$ $\{-5, 6\}$




12. $\left|3x + \frac{1}{2}\right| = 6$ $\left\{-2\frac{1}{6}, 1\frac{5}{6}\right\}$

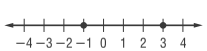

**For each graph, write an open sentence involving absolute value.**

13.



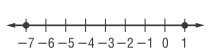

$|x| = 4$

14.




$|x - 1| = 2$

15.




$|x + 3| = 4$

Lesson 6-5



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# 6-5 Study Guide and Intervention *(continued)*

## Solving Open Sentences Involving Absolute Value

**Absolute Value Inequalities** When solving inequalities that involve absolute value, there are two cases to consider for inequalities involving $<$ (or $\leq$) and two cases to consider for inequalities involving $>$ (or $\geq$).

If $|x| < n$, then $x > -n$ and $x < n$.
If $|x| > n$, then $x > n$ or $x < -n$.

Remember that inequalities with *and* are related to intersections, while inequalities with *or* are related to unions.

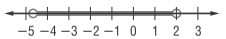
**Example** **Solve $|3a + 4| < 10$. Then graph the solution set.**

Write $|3a + 4| < 10$ as $3a + 4 < 10$ and $3a + 4 > -10$.

| | | |
|---|---|---|
| $3a + 4 < 10$ | and | $3a + 4 > -10$ |
| $3a + 4 - 4 < 10 - 4$ | | $3a + 4 - 4 > -10 - 4$ |
| $3a < 6$ | | $3a > -14$ |
| $\frac{3a}{3} < \frac{6}{3}$ | | $\frac{3a}{3} > \frac{-14}{3}$ |
| $a < 2$ | | $a > -4\frac{2}{3}$ |

The solution set is $\left\{a \mid -4\frac{2}{3} < a < 2\right\}$.

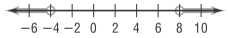
Now graph the solution set.



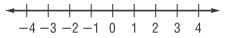

### Exercises

**Solve each open sentence. Then graph the solution set.**

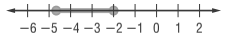
1. $|c - 2| > 6$
$\{c \mid c < -4 \text{ or } c > 8\}$



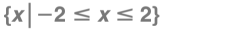

2. $|x - 9| < 0$
$\varnothing$




3. $|3f + 10| \leq 4$
$\left\{f \mid -4\frac{2}{3} \leq f \leq -2\right\}$



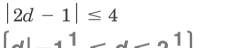

4. $|x| \leq 2$
$\{x \mid -2 \leq x \leq 2\}$



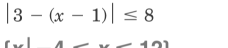

5. $|x| \geq 3$
$\{x \mid x \leq -3 \text{ or } x \geq 3\}$


6. $|2x + 1| \geq -2$
$\{x \mid x \text{ is a real number}\}$

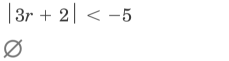

7. $|2d - 1| \leq 4$
$\left\{d \mid -1\frac{1}{2} \leq d \leq 2\frac{1}{2}\right\}$




8. $|3 - (x - 1)| \leq 8$
$\{x \mid -4 \leq x \leq 12\}$

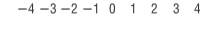



9. $|3r + 2| < -5$
$\varnothing$




**For each graph, write an open sentence involving absolute value.**

10.




$|x| > 1$

11.


$|x - 2| > 1$

12.


$|x - 1| \leq 3$

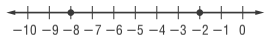
NAME _____ DATE _____ PERIOD ____

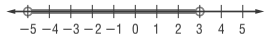
# 6-5 Skills Practice

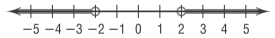
## *Solving Open Sentences Involving Absolute Value*

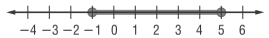
**Match each open sentence with the graph of its solution set.**

1. $|x| > 2$ **c**
2. $|x + 5| = 3$ **a**
3. $|x - 2| \leq 3$ **d**
4. $|x + 1| < 4$ **b**

**a.**



**b.**


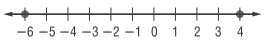

**c.**


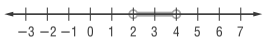

**d.**


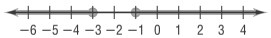

**Express each statement using an inequality involving absolute value. Do *not* solve.**

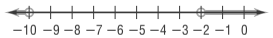
5. The weatherman predicted that the temperature would be within 3° of 52°F.
   $|t - 52| \leq 3$
6. Serena will make the B team if she scores within 8 points of the team average of 92.
   $|p - 92| \leq 8$
7. The dance committee expects attendance to number within 25 of last year's 87 students.
   $|a - 87| \leq 25$

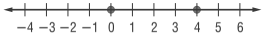
**Solve each open sentence. Then graph the solution set.**

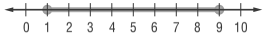
8. $|s + 1| = 5$ $\{-6, 4\}$



9. $|c - 3| < 1$ $\{c \mid 2 < c < 4\}$


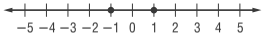

10. $|n + 2| \geq 1$ $\{n \mid n \leq -3 \text{ or } n \geq -1\}$



11. $|t + 6| > 4$ $\{t \mid t < -10 \text{ or } t > -2\}$


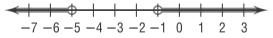

12. $|w - 2| = 2$ $\{0, 4\}$



13. $|k - 5| \leq 4$ $\{k \mid 1 \leq k \leq 9\}$


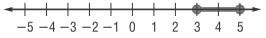

**For each graph, write an open sentence involving absolute value.**

14.


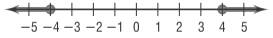
$|x| = 1$

15.


$|x + 3| > 2$

16.


$|x - 4| \leq 1$

17.


$|x| \geq 4$

Lesson 6-5



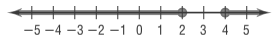
NAME _____ DATE _____ PERIOD ____

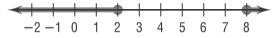
# 6-5 Practice (Average)

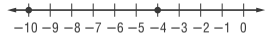
## *Solving Open Sentences Involving Absolute Value*

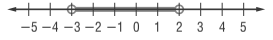
**Match each open sentence with the graph of its solution set.**

1. $|x + 7| = 3$ **c**
2. $|x - 3| \geq 1$ **a**
3. $|2x + 1| < 5$ **d**
4. $|5 - x| \geq 3$ **b**

**a.**



**b.**


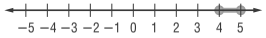

**c.**


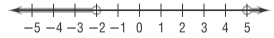

**d.**



**Express each statement using an inequality involving absolute value. Do *not* solve.**

5. The height of the plant must be within 2 inches of the standard 13-inch show size.
   $|h - 13| \leq 2$
6. The majority of grades in Sean's English class are within 4 points of 85.
   $|g - 85| \leq 4$

**Solve each open sentence. Then graph the solution set.**

7. $|2z - 9| \leq 1$ $\{z \mid 4 \leq z \leq 5\}$



8. $|3 - 2r| > 7$ $\{r \mid r < -2 \text{ or } r > 5\}$



9. $|3t + 6| < 9$ $\{t \mid -5 < t < 1\}$



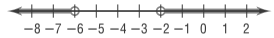
10. $|2g - 5| \geq 9$ $\{g \mid g \leq -2 \text{ or } g \geq 7\}$



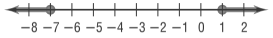
**For each graph, write an open sentence involving absolute value.**

11.

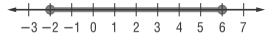

$|x - 6| < 5$

12.


$|x + 4| > 2$

13.


$|x + 3| \geq 4$

14.


$|x - 2| \leq 4$

15. **FITNESS** Taisha uses the elliptical cross-trainer at the gym. Her general goal is to burn 280 Calories per workout, but she varies by as much as 25 Calories from this amount on any given day. What is the range of the number of Calories burned for Taisha's cross-trainer workout? $\{c \mid 255 \leq c \leq 305\}$

16. **TEMPERATURE** A thermometer is guaranteed to give a temperature no more than 1.2°F from the actual temperature. If the thermometer reads 28°F, what is the range for the actual temperature? $\{t \mid 26.8 \leq t \leq 29.2\}$







Answers

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# 6-5 Reading to Learn Mathematics

## *Solving Open Sentences Involving Absolute Value*

**Pre-Activity** **How is absolute value used in election polls?**

Read the introduction to Lesson 6-5 at the top of page 345 in your textbook.

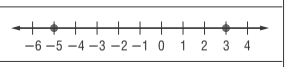
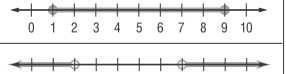
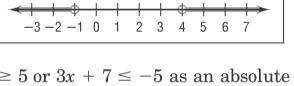
- What does the phrase margin of error mean to you?

  **Sample answer: The number of points a reported result may be off from the exact result.**

- In this poll, the number of people opposed to the tax levy may be as high as **48%** or as low as **42%**. This can be written as the inequality $|x - $ **45** $| \leq 3$.

### Reading the Lesson

**Complete each compound sentence by writing *and* or *or* in the blank. Use the result to help you graph the absolute value sentence.**

| | Absolute Value Sentence | Compound Sentence | Graph |
|---|---|---|---|
| 1. | $\|2x + 2\| = 8$ | $2x + 2 = 8$ **or** $2x + 2 = -8$ |  |
| 2. | $\|x - 5\| \leq 4$ | $x - 5 \leq 4$ **and** $x - 5 \geq -4$ |  |
| 3. | $\|2x - 3\| > 5$ | $2x - 3 > 5$ **or** $2x - 3 < -5$ |  |

4. How would you write the compound sentence $3x + 7 \geq 5$ or $3x + 7 \leq -5$ as an absolute value sentence? $|3x + 7| \geq 5$

### Helping You Remember

5. Recall that $|x|$ tells you how many units the number $x$ is from zero on the number line. Explain the meaning of $|x| = n$, $|x| < n$, and $|x| > n$ by using the idea of the distance from $x$ to zero.

   **$|x| = n$ means $x$ is exactly $n$ units from zero. $|x| < n$ means $x$ is less than $n$ units from zero. $|x| > n$ means $x$ is more than $n$ units from zero.**





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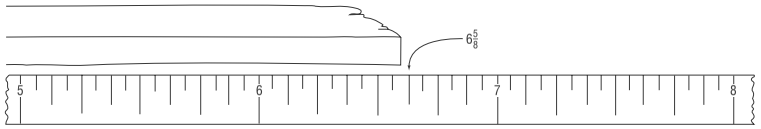
# 6-5 Enrichment

## *Precision of Measurement*

The precision of a measurement depends both on your accuracy in measuring and the number of divisions on the ruler you use. Suppose you measured a length of wood to the nearest one-eighth of an inch and got a length of $6\frac{5}{8}$ in.




The drawing shows that the actual measurement lies somewhere between $6\frac{9}{11}$ in. and $6\frac{11}{16}$ in. This measurement can be written using the symbol $\pm$, which is read *plus or minus*. It can also be written as a compound inequality.

$$6\frac{5}{8} \pm \frac{1}{16} \text{ in.} \qquad 6\frac{9}{16} \text{ in.} \leq m \leq 6\frac{11}{16} \text{ in.}$$

In this example, $\frac{1}{16}$ in. is the absolute error. The absolute error is one-half the smallest unit used in a measurement.

**Write each measurement as a compound inequality. Use the variable m.**

1. $3\frac{1}{2} \pm \frac{1}{4}$ in.
   **$3\frac{1}{4}$ in. $\leq m \leq 3\frac{3}{4}$ in.**

2. $9.78 \pm 0.005$ cm
   **9.775 cm $\leq m \leq$ 9.785 cm**

3. $2.4 \pm 0.05$ g
   **2.35 g $\leq m \leq$ 2.45 g**

4. $28 \pm \frac{1}{2}$ ft
   **$27\frac{1}{2}$ ft $\leq m \leq 28\frac{1}{2}$ ft**

5. $15 \pm 0.5$ cm
   **14.5 cm $\leq m \leq$ 15.5 cm**

6. $\frac{11}{16} \pm \frac{1}{64}$ in.
   **$\frac{43}{64}$ in. $\leq m \leq \frac{45}{64}$ in.**

**For each measurement, give the smallest unit used and the absolute error.**

7. $12.5 \text{ cm} \leq m \leq 13.5$ cm
   **1 cm, 0.5 cm**

8. $12\frac{1}{8}$ in. $\leq m \leq 12\frac{3}{8}$ in.
   **$\frac{1}{4}$ in., $\frac{1}{8}$ in.**

9. $56\frac{1}{2}$ in. $\leq m \leq 57\frac{1}{2}$ in.
   **1 in., $\frac{1}{2}$ in.**

10. $23.05 \text{ mm} \leq m \leq 23.15$ mm
    **0.1 mm, 0.05 mm**

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# 6-6 Study Guide and Intervention

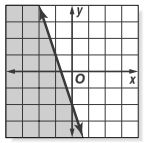
## Graphing Inequalities in Two Variables

**Graph Linear Inequalities** The solution set of an inequality that involves two variables is graphed by graphing a related linear equation that forms a boundary of a **half-plane**. The graph of the ordered pairs that make up the solution set of the inequality fill a region of the coordinate plane on one side of the half-plane.

**Example** **Graph $y \leq -3x - 2$.**

Graph $y = -3x - 2$.

Since $y \leq -3x - 2$ is the same as $y < -3x - 2$ and $y = -3x - 2$, the boundary is included in the solution set and the graph should be drawn as a solid line.




Select a point in each half plane and test it. Choose (0, 0) and (−2, −2).

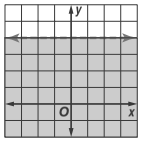
| | |
|---|---|
| $y \leq -3x - 2$ | $y \leq -3x - 2$ |
| $0 \leq -3(0) - 2$ | $-2 \leq -3(-2) - 2$ |
| $0 \leq -2$ is false. | $-2 \leq 6 - 2$ |
| | $-2 \leq 4$ is true. |

The half-plane that contains (−2, −2) contains the solution. Shade that half-plane.

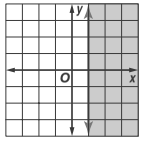
**Exercises**

**Graph each inequality.**

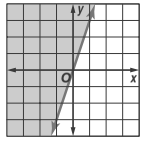
**1.** $y < 4$



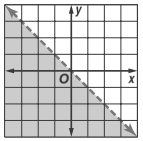

**2.** $x \geq 1$



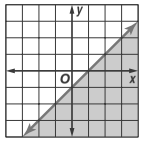

**3.** $3x \leq y$



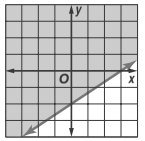

**4.** $-x > y$



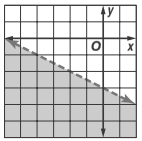

**5.** $x - y \geq 1$



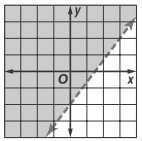

**6.** $2x - 3y \leq 6$



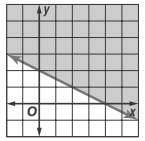

**7.** $y < -\frac{1}{2}x - 3$




**8.** $4x - 3y < 6$




**9.** $3x + 6y \geq 12$









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# 6-6 Study Guide and Intervention *(continued)*

## Graphing Inequalities in Two Variables

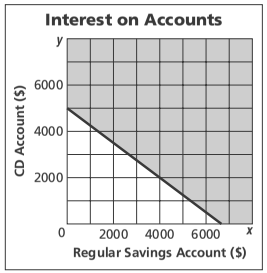
**Solve Real-World Problems** When solving real-life inequalities, the domain and range of the inequality are often restricted to nonnegative numbers or to whole numbers.

**Example** **BANKING A bank offers 4.5% annual interest on regular savings accounts and 6% annual interest on certificates of deposit (CD). If Marjean wants to earn at least $300 interest per year, how much money should she deposit in each type of account?**

Let $x$ = the amount deposited in a regular savings account.

Let $y$ = the amount deposited in a CD.

Then $0.045x + 0.06y \geq 300$ is an open sentence representing this situation.




Solve for $y$ in terms of $x$.

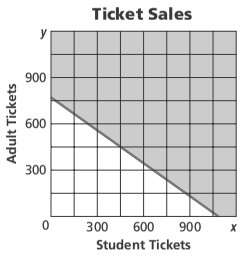
| | |
|---|---|
| $0.045x + 0.06y \geq 300$ | Original inequality |
| $0.06y \geq -0.045x + 300$ | Subtract $0.045x$ from each side. |
| $y \geq -0.75x + 5000$ | Divide each side by 0.06. |

Graph $y \geq -0.75x + 5000$ and test the point (0, 0). Since $0 \geq -0.75(0) + 5000$ is false, shade the half-plane that does not contain (0, 0).

One solution is (4000, 2000). This represents $4000 deposited at 4.5% and $2,000 deposited at 6%.

**Exercises**

**1. SOCIAL EVENTS** Tickets for the school play cost $5 per student and $7 per adult. The school wants to earn at least $5,400 on each performance.




**a.** Write an inequality that represents this situation. $5x + 7y \geq 5400$

**b.** Graph the solution set.

**c.** If 500 adult tickets are sold, what is the minimum number of student tickets that must be sold? 380

**2. MANUFACTURING** An auto parts company can produce 525 four-cylinder engines or 270 V-6 engines per day. It wants to produce up to 300,000 engines per year.

**a.** Write an inequality that represents this situation. $525f + 270s \leq 300000$

**b.** Are there restrictions on the domain or range? Neither $f$ nor $s$ is negative.

**3. GEOMETRY** The perimeter of a rectangular lot is less than 800 feet. Write an inequality that represents the amount of fencing that will enclose the lot. $2\ell + 2w \leq 800$

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# 6-6 Skills Practice

## Graphing Inequalities in Two Variables

**Determine which ordered pairs are part of the solution set for each inequality.**

1. $y > 3x$, {(1, 5), (1, 0), (−1, 0), (5, 1)} **{(1, 5), (−1, 0)}**

2. $y \geq x + 3$, {(2, −3), (−2, −1), (1, 6), (3, 4)} **{(1, 6)}**

3. $y < x - 1$, {(3, 1), (−2, −4), (4, −2), (−3, 3)} **{(3, 1), (−2, −4), (4, −2)}**

**Match each inequality with its graph.**

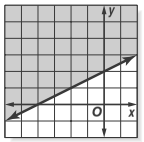
4. $y - 2x < 2$ **b**

5. $y \leq -3x$ **d**

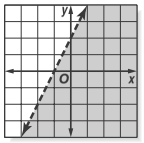
6. $2y - x \geq 4$ **a**

7. $x + y > 1$ **c**

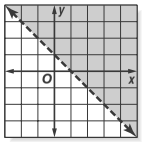
a.



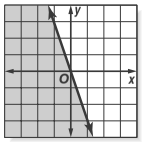
b.



c.

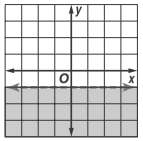


d.

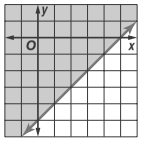


**Graph each inequality.**

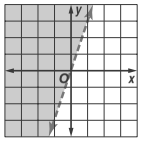
8. $y < -1$



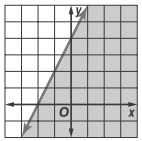
9. $y \geq x - 5$



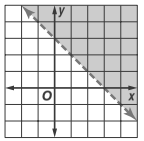
10. $y > 3x$



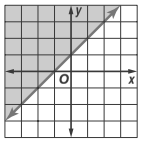
11. $y \leq 2x + 4$



12. $y + x > 3$



13. $y - x \geq 1$





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# 6-6 Practice (Average)

## Graphing Inequalities in Two Variables

**Determine which ordered pairs are part of the solution set for each inequality.**

1. $3x + y \geq 6$, {(4, 3), (−2, 4), (−5, −3), (3, −3)} **{(4, 3), (3, −3)}**

2. $y \geq x + 3$, {(6, 3), (−3, 2), (3, −2), (4, 3)} **{(−3, 2)}**

3. $3x - 2y < 5$, {(4, −4), (3, 5), (5, 2), (−3, 4)} **{(3, 5), (−3, 4)}**

**Match each inequality with its graph.**

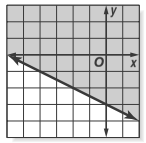
4. $5y - 2x \leq 10$ **d**

5. $3y > 3x + 9$ **c**

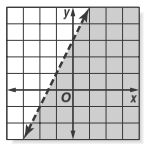
6. $y - 2x < 3$ **b**

7. $x + 2y \geq -6$ **a**

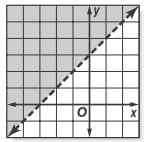
a.



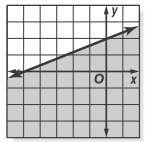
b.



c.

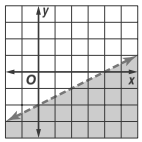


d.

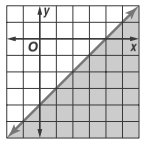


**Graph each inequality.**

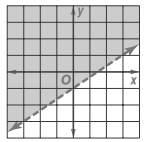
8. $2y - x < -4$



9. $2x - 2y \geq 8$



10. $3y > 2x - 3$



11. **MOVING** A moving van has an interior height of 7 feet (84 inches). You have boxes in 12 inch and 15 inch heights, and want to stack them as high as possible to fit. Write an inequality that represents this situation. **$12x + 15y \leq 84$**

**BUDGETING For Exercises 12 and 13, use the following information.**

Satchi found a used bookstore that sells pre-owned videos and CDs. Videos cost $9 each, and CDs cost $7 each. Satchi can spend no more than $35.

12. Write an inequality that represents this situation. **$9x + 7y \leq 35$**

13. Does Satchi have enough money to buy 2 videos and 3 CDs?
**No, the purchases will be $39, which is greater than $35.**

NAME _____ DATE _____ PERIOD ____

6-6

# Reading to Learn Mathematics

## *Graphing Inequalities in Two Variables*

**Pre-Activity** **How are inequalities used in budgets?**

Read the introduction to Lesson 6-6 at the top of page 352 in your textbook.

What do 3 and 4 represent in the terms $3x$ and $4y$?

**the average amount spent on a cafeteria lunch and a fast-food lunch**

### Reading the Lesson

**1.** Complete the chart to show which type of line is needed for each symbol.

| Symbol | Type of Line | Boundary Part of Solution? |
|---|---|---|
| $<$ | dashed | no |
| $>$ | dashed | no |
| $\leq$ | solid | yes |
| $\geq$ | solid | yes |

**2.** If a test point results in a false statement, what do you know about the graph?

**The half-plane containing the test point is not part of the solution and is not shaded.**

**3.** If a test point results in a true statement, what do you know about the graph?

**The half-plane containing the test point is part of the solution and is shaded.**

**4.** When can the origin *not* be used as a test point?

**The origin cannot be used as a test point when it is on the boundary.**

### Helping You Remember

**5.** The two-variable inequalities in this lesson can be solved for $y$ in terms of $x$ to get a sentence in slope-intercept form. It looks much like a slope-intercept equation, but it has an inequality symbol instead of an equals sign. For example, $4x + 2y \leq 5$ can be written as $y \leq -2x + \frac{5}{2}$. Explain how to graph an inequality once it is written in slope-intercept form. Use the idea that *greater* can mean *above* and *less* can mean *below*.

**Draw the boundary line. If the inequality symbol is $>$ or $<$, make the boundary dashed. If the symbol is $\geq$ or $\leq$, make the boundary line solid. If the symbol in the slope-intercept inequality is $<$ or $\leq$, shade below the boundary to indicate smaller values of $y$. If the symbol is $>$ or $\geq$, shade above the boundary to indicate greater values of $y$.**





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6-6

# Enrichment

## *Using Equations: Ideal Weight*

You can find your ideal weight as follows.

A woman should weigh 100 pounds for the first 5 feet of height and 5 additional pounds for each inch over 5 feet (5 feet = 60 inches). A man should weigh 106 pounds for the first 5 feet of height and 6 additional pounds for each inch over 5 feet. These formulas apply to people with normal bone structures.

To determine your bone structure, wrap your thumb and index finger around the wrist of your other hand. If the thumb and finger just touch, you have normal bone structure. If they overlap, you are small-boned. If they don't overlap, you are large-boned. Small-boned people should decrease their calculated ideal weight by 10%. Large-boned people should increase the value by 10%.

**Calculate the ideal weights of these people.**

**1.** woman, 5 ft 4 in., normal-boned
**120 lb**

**2.** man, 5 ft 11 in., large-boned
**189.2 lb**

**3.** man, 6 ft 5 in., small-boned
**187.2 lb**

**4.** you, if you are at least 5 ft tall
**Answers will vary.**

**For Exercises 5–9, use the following information.**

Suppose a normal-boned man is $x$ inches tall. If he is at least 5 feet tall, then $x - 60$ represents the number of inches this man is over 5 feet tall. For each of these inches, his ideal weight is increased by 6 pounds. Thus, his proper weight ($y$) is given by the formula $y = 6(x - 60) + 106$ or $y = 6x - 254$. If the man is large-boned, the formula becomes $y = 6x - 254 + 0.10(6x - 254)$.

**5.** Write the formula for the weight of a large-boned man in slope-intercept form. $y = 6.6x - 279.4$

**6.** Derive the formula for the ideal weight ($y$) of a normal-boned female with height $x$ inches. Write the formula in slope-intercept form. $y = 5x - 200$

**7.** Derive the formula in slope-intercept form for the ideal weight ($y$) of a large-boned female with height $x$ inches. $y = 5.5x - 220$

**8.** Derive the formula in slope-intercept form for the ideal weight ($y$) of a small-boned male with height $x$ inches. $y = 5.4x - 228.6$

**9.** Find the heights at which normal-boned males and large-boned females would weigh the same. **68 in., or 5 ft 8 in.**







**Answers**