Chapter 5 Solving and Graphing Linear Inequalities

Prerequisite Skills for the chapter "Solving and Graphing Linear Inequalities"

1. *Sample answer:* (1, 2)

$$8x - 5y = -2$$
$$8(1) - 5(2) \stackrel{?}{=} -2$$
$$8 - 10 \stackrel{?}{=} -2$$
$$-2 = -2 \checkmark$$

2. $7x - 4 = 10$

$$7x = 14$$
$$x = 2$$

No; because the solution of $7x - 4 = 10$ is $x = 2$, the two equations do not have the same solution.

3. The absolute value of a number a is the distance between a and 0 on a number line.

4. $m + 8 = -20$

$$m = -28$$

5. $7x + 3 = 38$

$$7x = 35$$
$$x = 5$$

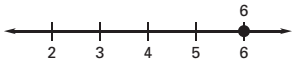
6. $-9r - 4 = 25$

$$-9r = 29$$
$$r = -\frac{29}{9}$$

7. $4t - 7t = 9$

$$-3t = 9$$
$$t = \frac{9}{-3}$$
$$t = -3$$

8.



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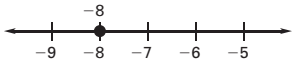

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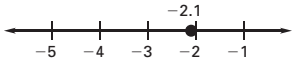

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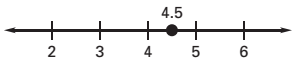


12. $21.7 \stackrel{?}{} 21$

$21.7 > 21$

13. $13.08 \stackrel{?}{} 13.2$

$13.08 < 13.2$

14. $0.1 \stackrel{?}{} 0.04$

$0.1 > 0.04$

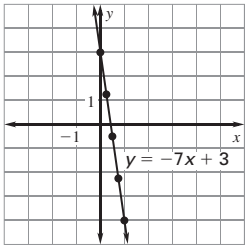
15. $0.517 \stackrel{?}{} 0.52$

$0.517 < 0.52$

16. $y = -7x + 3$

Make a table of values.

x	0	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	1
y	3	$\frac{5}{4}$	$-\frac{1}{2}$	$-\frac{9}{4}$	-4

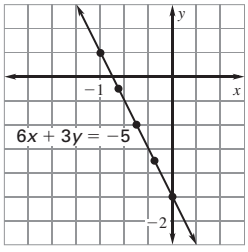


17. $6x + 3y = -5$

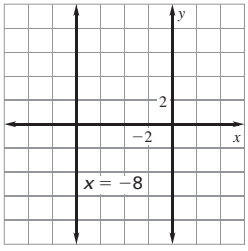
$$3y = -6x - 5$$
$$y = -2x - \frac{5}{3}$$

Make a table of values.

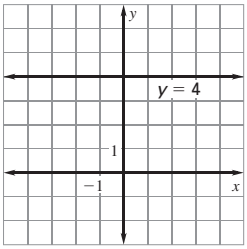
x	-1	$-\frac{3}{4}$	$-\frac{1}{2}$	$-\frac{1}{4}$	0
y	$\frac{1}{3}$	$-\frac{1}{6}$	$-\frac{2}{3}$	$-\frac{7}{6}$	$-\frac{5}{3}$



18. For every value of y, the value of x is -8. The graph of the equation $x = -8$ is a vertical line 8 units to the left of the y-axis.



19. For every value of x, the value of y is 4. The graph of the equation $x = 4$ is a horizontal line 4 units above the x-axis.

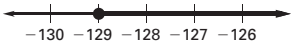


Lesson 5.1 Solve Inequalities Using Addition and Subtraction

Guided Practice for the lesson "Solve Inequalities Using Addition and Subtraction"

1. Let x = temperature in Antarctica

$x \geq -129$

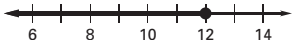


2. $x < 8$

3. $x \geq -2.5$

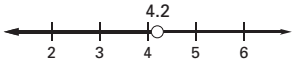
4. $x - 9 \leq 3$

$x \leq 12$



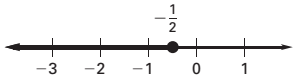
5. $p - 9.2 < -5$

$p < 4.2$



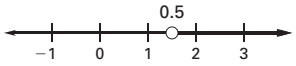
6. $-1 \geq m - \frac{1}{2}$

$-\frac{1}{2} \geq m$



7. $y + 5.5 > 6$

$y > 0.5$



8. $29.1 + w \leq 50$

$w \leq 20.9$

You can add no more than 20.9 pounds to the bag.

Exercises for the lesson "Solve Inequalities Using Addition and Subtraction"

Skill Practice

1. To graph $x < -8$, you draw an *open* circle at -8, and you draw an arrow to the *left* of -8.

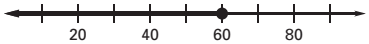
2. By solving the inequality $x + 7 \geq 18$ using subtraction, you see that,

$x + 7 - 7 \geq 18 - 7$

$x \geq 11$

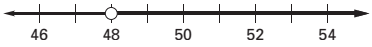
So, $x + 7 \geq 18$ is not equivalent to $x \geq 25$.

3. $x \leq 60$



4. $x \geq 16$

5. $x > 48$



6. $x \leq -4$

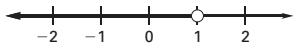
7. $x < 10$

8. $x > 4$

9. $x \geq -2$

10. $x + 4 < 5$

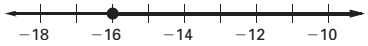
$x < 1$



11. $-8 \leq 8 + y$

$-16 \leq y$

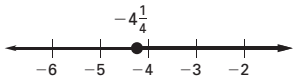
$y \geq -16$



12. $-1\frac{1}{4} \leq m + 3$

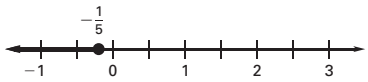
$-4\frac{1}{4} \leq m$

$m \geq -4\frac{1}{4}$



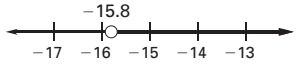
13. $n + 17 \leq 16\frac{4}{5}$

$n \leq -\frac{1}{5}$



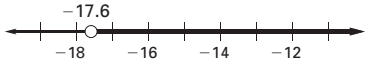
14. $8.2 + v > -7.6$

$v > -15.8$



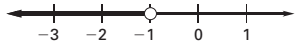
15. $w + 14.9 > -2.7$

$w > -17.6$



16. $r - 4 < -5$

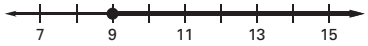
$r < -1$



17. $1 \leq s - 8$

$9 \leq s$

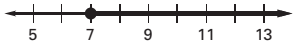
$s \geq 9$



18. $-1\frac{1}{3} \leq p - 8\frac{1}{3}$

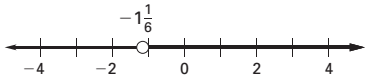
$7 \leq p$

$p \geq 7$



19. $q - 1\frac{1}{3} > -2\frac{1}{2}$

$q > -1\frac{1}{6}$



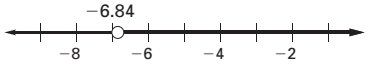
20. $2.1 \geq c - 6.7$

$8.8 \geq c$

$c \leq 8.8$

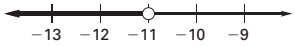
21. $d - 1.92 > -8.76$

$d > -6.84$



22. In order to solve the inequality, 8 needed to be subtracted from both sides. It was mistakenly added to the right side.

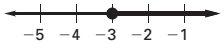
$x + 8 < -3$



$x + 8 - 8 < -3 - 8$

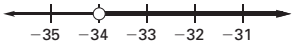
$x < -11$

23. The solution is $-3 \leq x$ or $x \geq -3$, so the graph should be shaded to the right, not the left.



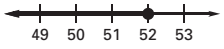
24. $m + 11 > -23$

$m > -34$



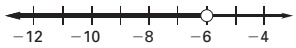
25. $n - 15 \leq 37$

$n \leq 52$



26. $c - 13 < -19$

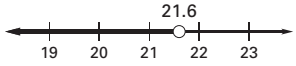
$c < -6$



27. $14.2 + 15.5 + x < 51.3$

$29.7 + x < 51.3$

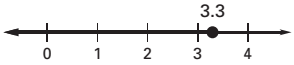
$x < 21.6$



28. $4.9 + 6.4 + x + 4.1 \leq 18.7$

$15.4 + x \leq 18.7$

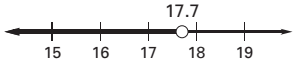
$x \leq 3.3$



29. It is not possible to check all the numbers that are solutions of an inequality because there are an infinite number of real number solutions. Checking one solution does not guarantee you have solved an inequality correctly because that solution could satisfy many inequalities, so you cannot be sure that your solution is correct based on one correct solution.

30. $x - 12 \geq 5.7$

$x \geq 17.7$



Not solutions:

$x < 17.7$

Problem Solving

31. Let x = points before redemption

$x - 2350 > 6000$

$x > 8350$

You must have more than 8350 points before making a redemption.

32. Goals so far + Additional goals ≥ Gretzky's record

$59 + x \geq 92$

$x \geq 33$

The player must make at least 33 more goals in order to match or break Wayne Gretzky's records.

33. a. Your first score + Your second score > Competitor's first score + Competitor's second score

$129.49 + x > 127.04 + 129.98$

$129.49 + x > 257.02$

$x > 127.53$

You must score more than 127.53.

b. If you earn 128.13 points, you will win since $128.13 > 127.53$. If you earn 126.78 points, you will not win since $126.78 \not> 127.53$. If you earn 127.53 points, you will not win, rather you will be tied with your competitor.

34. C; $p - 3 \leq 30$

35. Answers will vary.

36. 2 axles: $w + 14{,}200 \leq 34{,}000$

$w \leq 19{,}800$

3 axles: $w + 14{,}200 \leq 54{,}000$

$w \leq 39{,}800$

4 axles: $w + 14{,}200 \leq 69{,}000$

$w \leq 54{,}800$

5 axles: $w + 14{,}200 \leq 80{,}000$

$w \leq 65{,}800$

A vehicle with 2 axles weighing 20,000 pounds cannot carry 14,200 pounds of contents because the total weight of 34,200 pounds would be greater than the maximum weight allowed, 34,000 pounds.

37. a.

Original Price ($)	Final Price ($)
19,459	16,459
19,989	16,989
20,549	17,549
22,679	19,679
23,999	20,999

b. $x - 3000 \leq 17{,}000$

$x \leq 20{,}000$

Your friend will consider buying cars originally priced up to $20,000.

38. a. last year's time:

$3(60) + 41.1 = 221.1$

$53.34 + 56.38 + 57.46 + x \leq 221.1$

$167.18 + x \leq 221.1$

$x \leq 53.92$

The last athlete must run 400 meters in no more than 53.92 seconds.

b. The team could fail to meet their goal. The last athlete has to run at least as fast as his average speed of 53.92 seconds. If his average speed is 53.92 seconds, that means his slowest speed is slower than 53.92 seconds. So running faster than his slowest speed could still be slower than the speed necessary for the team to win.

39. $3(5953) + 3(6153) + x \geq 72{,}000$

$36{,}318 + x \geq 72{,}000$

$x \geq 35{,}682$

The station needs to raise at least another $35,682 to meet their goal.

Investigating Algebra Activity for the lesson "Solve Inequalities Using Multiplication and Division"

1. Divide both sides by 4.

$4x \geq 8$

$\frac{4x}{4} \geq \frac{8}{4}$

$x \geq 2$

2.

$-4x \geq 8$	Write original inequality.
$-4x + 4x \geq 8 + 4x$	Add $4x$ to each side.
$-8 \geq 8 + 4x - 8$	Subtract 8 from each side.
$-\frac{8}{4} \geq \frac{4x}{4}$	Divide each side by 4.
$x \leq -2$	Rewrite inequality with x on the left side.

3. It does not give the solution found in Exercise 2. You must also change the direction of the inequality symbol.

4. You do not need to change the direction of the inequality symbol when you divide by a positive number, but you do need to change it when you divide by a negative number.

5. $20x \geq 5$

$x \geq \frac{1}{4}$

6. $-9x \leq 45$

$x \geq -5$

7. $-8x > 40$

$x < -5$

8. $7x < 21$

$x < 3$

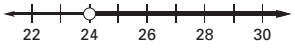
Lesson 5.2 Solve Inequalities Using Multiplication and Division

Guided Practice for the lesson "Solve Inequalities Using Multiplication and Division"

1. $\frac{x}{3} > 8$

$3 \cdot \frac{x}{3} > 8 \cdot 3$

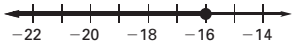
$x > 24$



2. $\frac{m}{8} \leq -2$

$8 \cdot \frac{m}{8} \leq 8 \cdot (-2)$

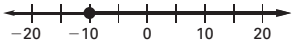
$m \leq -16$



3. $\frac{y}{2.5} \geq -4$

$2.5 \cdot \frac{y}{2.5} \geq 2.5(-4)$

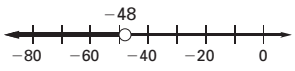
$y \geq -10$



4. $\frac{x}{-4} > 12$

$-4 \cdot \frac{x}{-4} < -4(12)$

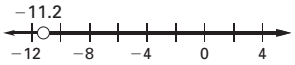
$x < -48$



5. $\frac{m}{-7} < 1.6$

$-7 \cdot \frac{m}{-7} > -7(1.6)$

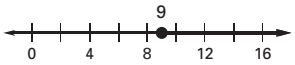
$m > -11.2$



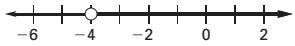
6. $5v \geq 45$

$\frac{5v}{5} \geq \frac{45}{5}$

$v \geq 9$



7. $-6n < 24$



$\frac{-6n}{-6} > \frac{24}{-6}$

$n > -4$

8. $90r \leq 6300$

$\frac{90r}{90} \leq \frac{6300}{90}$

$r \leq 70$

The student can afford to pay no more than \$70 per hour.

Exercises for the lesson "Solve Inequalities Using Multiplication and Division"

Skill Practice

1. You would use the *division property of inequality* to solve $-5x \geq 30$.

2. $\frac{x}{-4} < -9$

$-4 \cdot \frac{x}{-4} > -4(-9)$

$x > 36$

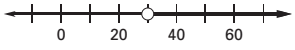
They are not equivalent inequalities because $\frac{x}{-4} < -9$ simplifies to $x > 36$, not $x < 36$. When you multiply each side of an inequality by a negative number, you must reverse the direction of the inequality symbol.

3. $2p \geq 14$

$\frac{2p}{2} \geq \frac{14}{2}$

$p \geq 7$

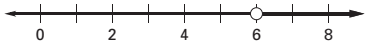
4. $\frac{x}{-3} < -10$



$-3 \cdot \frac{x}{-3} > -3 \cdot -10$

$x > 30$

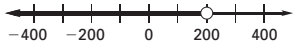
5. $-6y < -36$



$\frac{-6y}{-6} > \frac{-36}{-6}$

$y > 6$

6. $40 > \frac{w}{5}$

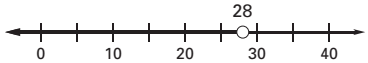


$5(40) > 5 \cdot \frac{w}{5}$

$200 > w$

$w < 200$

7. $\frac{q}{4} < 7$



$4 \cdot \frac{q}{4} < 4 \cdot 7$

$q < 28$

8. $72 \leq 9r$

$\frac{72}{9} \leq \frac{9r}{9}$

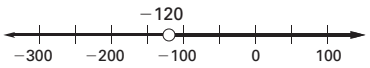
$8 \leq r$

$r \geq 8$

9. $\frac{g}{6} > -20$

$6 \cdot \frac{g}{6} > 6(-20)$

$g > -120$



10. $-11m \leq -22$

$\frac{-11m}{-11} \geq \frac{-22}{-11}$

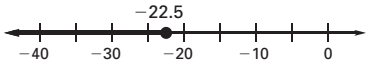
$m \geq 2$

11. $-90 \geq 4t$

$\frac{-90}{4} \geq \frac{4t}{4}$

$-22.5 \geq t$

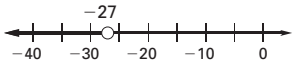
$t \leq -22.5$



12. $\frac{n}{3} < -9$

$3 \cdot \frac{n}{3} < 3 \cdot (-9)$

$n < -27$

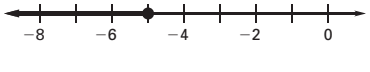


13. $60 \leq -12s$

$\frac{60}{-12} \geq \frac{-12s}{-12}$

$-5 \geq s$

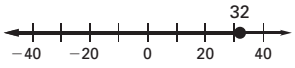
$s \leq -5$



14. $\frac{v}{-4} \geq -8$

$-4 \cdot \frac{v}{-4} \leq -4 \cdot -8$

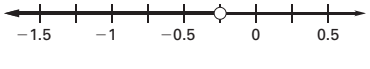
$v \leq 32$



15. $-8.4f > 2.1$

$\frac{-8.4f}{-8.4} < \frac{2.1}{-8.4}$

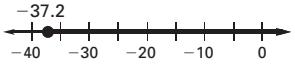
$f < -0.25$



16. $\frac{d}{-2} \leq 18.6$

$-2 \cdot \frac{d}{-2} \geq -2(18.6)$

$d \geq -37.2$

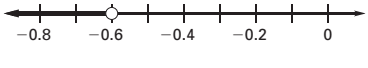


17. $9.6 < -16c$

$\frac{9.6}{-16} > \frac{-16c}{-16}$

$-0.6 > c$

$c < -0.6$

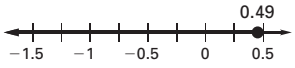


18. $0.07 \geq \frac{k}{7}$

$7(0.07) \geq 7 \cdot \frac{k}{7}$

$0.49 \geq k$

$k \leq 0.49$

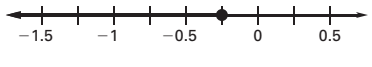


19. $-1.5 \geq 6z$

$\frac{-1.5}{6} \geq \frac{6z}{6}$

$-0.25 \geq z$

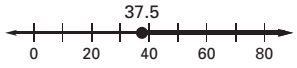
$z \leq -0.25$



20. $\frac{x}{-5} \leq -7.5$

$-5 \cdot \frac{x}{-5} \geq -5(-7.5)$

$x \geq 37.5$

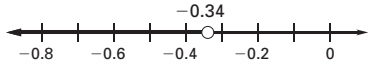


21. $1.02 < -3j$

$\frac{1.02}{-3} > \frac{-3j}{-3}$

$-0.34 > j$

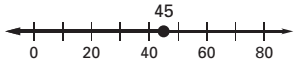
$j < -0.34$



22. $\frac{y}{-4.5} \geq -10$

$-4.5 \cdot \frac{y}{-4.5} \leq -4.5(-10)$

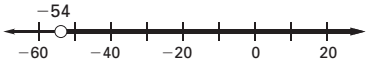
$y \leq 45$



23. $\frac{r}{-30} < 1.8$

$-30 \cdot \frac{r}{-30} > -30(1.8)$

$r > -54$

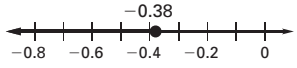


24. $1.9 \leq -5p$

$\frac{1.9}{-5} \geq \frac{-5p}{-5}$

$-0.38 \geq p$

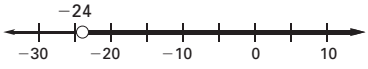
$p \leq -0.38$



25. $\frac{m}{0.6} > -40$

$0.6 \cdot \frac{m}{0.6} > 0.6(-40)$

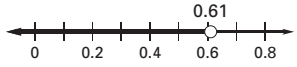
$m > -24$



26. $-2t > -1.22$

$\frac{-2t}{-2} < \frac{-1.22}{-2}$

$t < 0.61$



27. It is similar because you have to divide both sides by a in both inequalities. It is different because, when $a < 0$, you also have to reverse the direction of the inequality symbol.

28. Because you have to divide each side by a negative number, the direction of the inequality sign needed to be reversed (division property of inequality).

$-15x > 45$

$\frac{-15x}{-15} < \frac{45}{-15}$

$x < -3$

29. The error is that the inequality sign did not need to be reversed because both sides of the inequality were multiplied by a positive, not a negative, number.

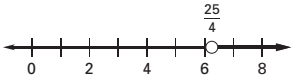
$\frac{x}{9} \le -7$

$9 \cdot \frac{x}{9} \le 9 \cdot (-7)$

$x \le -63$

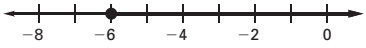
30. $8x > 50$

$\frac{8x}{8} > \frac{50}{8}$



$x > \frac{25}{4}$

31. $-15y \le 90$



$\frac{-15y}{-15} \ge \frac{90}{-15}$

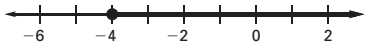
$y \ge -6$

32. $\frac{v}{-9} < -18$

$-9 \cdot \frac{v}{-9} > -9 \cdot (-18)$

$v > 162$

33. $\frac{w}{24} \ge -\frac{1}{6}$



$24 \cdot \frac{w}{24} \ge 24\left(-\frac{1}{6}\right)$

$w \ge -4$

34. *Sample answer:* $-3x < -12$

35. **a.** $a < 0, b > 0$

$-ax > b$

$x < -\frac{b}{a}$

Because x is less than a negative number, the solution consists of only negative numbers.

b. $a > 0, b > 0$

$ax > b$

$x > \frac{b}{a}$

Because x is greater than a positive number, the solution consists of only positive numbers.

c. $a > 0, b < 0$

$ax > -b$

$x > -\frac{b}{a}$

Because x is greater than a negative number, the solution consists of both positive and negative numbers, as well as zero.

d. $a < 0, b < 0$

$-ax > -b$

$x < \frac{b}{a}$

Because x is less than a positive number, the solution consists of both positive and negative numbers, as well as zero.

Problem Solving

36. Cost of a CD $\cdot$ Number of CDs $\le$ Total amount

$18x \le 90$

$\frac{18x}{18} \le \frac{90}{18}$

$x \le 5$

You can buy no more than 5 CDs.

37. $\frac{\text{Total words}}{\text{Time (min)}} \ge$ words per minute

$\frac{x}{5} \ge 40$

$5 \cdot \frac{x}{5} \ge 5(40)$

$x \ge 200$

You must type at least 200 words in 5 minutes.

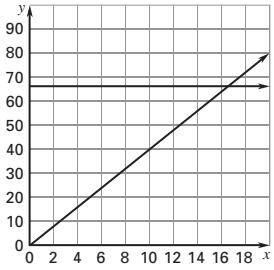
38. **a.** 16 books

b. $4x \le 66$

$x \le 16.5$

You can stack a maximum of 16 books on the shelf.

c. $y = 4x, y = 66$



d. Answers will vary.

39. $48 \le 15w$

$3.2 \le w$

The width must be at least 3.2 inches.

40. 45 minutes $\rightarrow$ 0.75 hours

$d < 18(0.75)$

$d < 13.5$

A beginner water skier can travel a distance of less than 13.5 miles.

41. a. $\frac{\text{length} \cdot \text{width}}{\text{number of horses}} \geq$ Area reserved per horse

$$\frac{80 \cdot 82}{h} \geq 400$$

$$h \cdot \frac{6560}{h} \geq 400h$$

$$\frac{6560}{400} \geq \frac{400h}{400}$$

$$16.4 \geq h$$

$$h \leq 16.4$$

The corral can hold no more than 16 horses.

b. Increasing the length and width by 20 feet each will increase the total area by more than 400 square feet, so the corral will be able to hold more than one more horse.

c. New area =

(original length + 15)(original width + 15)

$A = (80 + 15)(82 + 15)$

$= 95(97)$

$= 9215$ square feet

After finding the new area, use the verbal model from part (a) to create a new inequality to represent the new corral size.

$$\frac{9215}{h} \geq 400$$

$$h \cdot \frac{9215}{h} \geq 400h$$

$$\frac{9215}{400} \geq \frac{400h}{400}$$

$$23.04 \geq h$$

$$h \leq 23.04$$

The corral can hold up to 23 horses.

42. Let $x =$ sale price of the laptop

$$x - 0.05x \leq 900$$

$$0.95x \leq 900$$

$$\frac{0.95x}{0.95} \leq \frac{900}{0.95}$$

$$x \leq 947.37$$

$1050 - 947.37 = 102.63$

The laptop must be decreased in price at least $102.63.

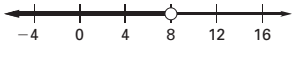
Quiz for the lessons "Solve Inequalities Using Addition and Subtraction" and "Solve Inequalities Using Multiplication and Division"

1. $x + 8 \geq -5$

$x \geq -13$

2. $y + 6 < 14$

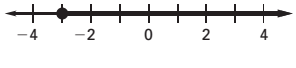
$y < 8$



3. $-8 \leq v - 5$

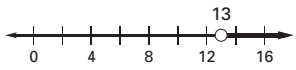
$-3 \leq v$

$v \geq -3$



4. $w - 11 > 2$

$w > 13$



5. $-40 < -5r$

$\frac{-40}{-5} > \frac{-5r}{-5}$

$8 > r$

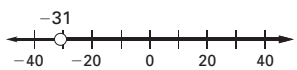
$r < 8$

6. $-93 < 3s$

$\frac{-93}{3} < \frac{3s}{3}$

$-31 < s$

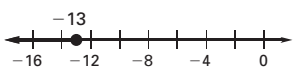
$s > -31$



7. $-2m \geq 26$

$\frac{-2m}{-2} \leq \frac{26}{-2}$

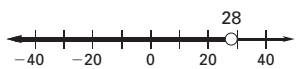
$m \leq -13$



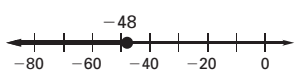
8. $\frac{n}{-4} > -7$

$-4 \cdot \frac{n}{-4} < -4(-7)$

$n < 28$



9. $\frac{c}{6} \leq -8$



$6 \cdot \frac{c}{6} \leq 6(-8)$

$c \leq -48$

10. Sandwiches per minute $\cdot$ Time (minutes) $\geq$ Total number of sandwiches

$3t \geq 150$

$t \geq 50$

It will take you at least 50 minutes to make the number of sandwiches you need.

Lesson 5.3 Solve Multi-Step Inequalities

Guided Practice for the lesson "Solve Multi-Step Inequalities"

1. $2x - 5 \leq 23$

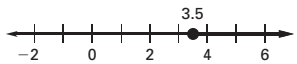
$2x \leq 28$

$x \leq 14$

2. $-6y + 5 \leq -16$

$-6y \leq -21$

$y \geq 3.5$

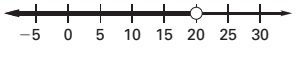


3. $-\frac{1}{4}(p - 12) > -2$

$-\frac{1}{4}p + 3 > -2$

$-\frac{1}{4}p > -5$

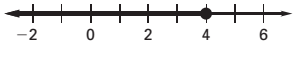
$p < 20$



4. $5x - 12 \leq 3x - 4$

$2x \leq 8$

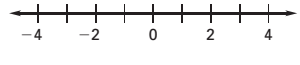
$x \leq 4$



5. $5(m + 5) < 5m + 17$

$5m + 25 < 5m + 17$

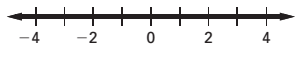
$25 < 17$; False



6. $1 - 8s \leq -4(2s - 1)$

$1 - 8s \leq -8s + 4$

$1 \leq 4$; True



7. $\$2.19 - 0.10 = \$2.09$

$2.09g + 9 \le 20$

$2.09g \le 11$

$g \le 5.26$

You can buy up to 5.26 gallons of gasoline.

8. Weeks saving • Amount saved per week + Amount already saved ≥ Total cost

$14x + 500 \ge 1800$

$14x \ge 1300$

$x \ge 92.86$

You must save, at least, \$92.86 per week.

Skill Practice

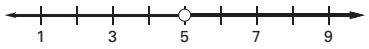
1. The inequalities $3x - 1 < 11$, $3x < 12$, and $x < 4$ are called *equivalent inequalities*.

2. When you solve the inequality and all variables are eliminated, if you end up with a true statement, the solution is all real numbers. If, however, you end up with a false statement, the inequality has no solution.

3. $2x - 3 > 7$

$2x > 10$

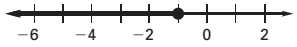
$x > 5$



4. $5y + 9 \le 4$

$5y \le -5$

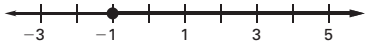
$y \le -1$



5. $8v - 3 \ge -11$

$8v \ge -8$

$v \ge -1$

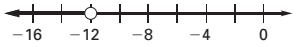


6. $3(w + 12) < 0$

$3w + 36 < 0$

$3w < -36$

$w < -12$

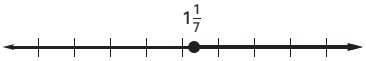


7. $7(r - 3) \ge -13$

$7r - 21 \ge -13$

$7r \ge 8$

$r \ge 1\frac{1}{7}$

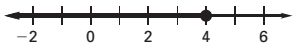


8. $2(s + 4) \le 16$

$2s + 8 \le 16$

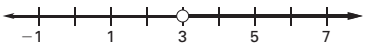
$2s \le 8$

$s \le 4$



9. $4 - 2m > 7 - 3m$

$m > 3$

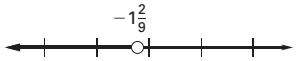


10. $8n - 2 > 17n + 9$

$-11 > 9n$

$-1\frac{2}{9} > n$

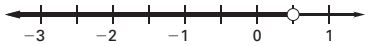
$n < -1\frac{2}{9}$



11. $-10p > 6p - 8$

$-16p > -8$

$p < \frac{1}{2}$

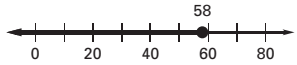


12. $4 - \frac{1}{2}q \le 33 - q$

$4 + \frac{1}{2}q \le 33$

$\frac{1}{2}q \le 29$

$q \le 58$



13. $-\frac{2}{3}d - 2 < \frac{1}{3}d + 8$

$-d - 2 < 8$

$-d < 10$

$d > -10$

14. $8 - \frac{4}{5}f > -14 - 2f$

$8 + \frac{6}{5}f > -14$

$\frac{6}{5}f > -22$

$f > -18\frac{1}{3}$

15. The error is that the inequality symbol was not reversed when dividing each side by -3.

$17 - 3x \ge 56$

$-3x \ge 39$

$x \le -13$

16. The distributive property was not used properly. In step 2, $-4(-3)$ should have given a positive 12.

$-4(2x - 3) < 28$

$-8x + 12 < 28$

$-8x < 16$

$x > -2$

17. $3p - 5 > 2p + p - 7$

$3p - 5 > 3p - 7$

$-5 > -7$

The statement is true, so the solutions are all real numbers.

18. $5d - 8d - 4 \le -4 + 3d$

$-3d - 4 \le -4 + 3d$

$-6d - 4 \le -4$

$-6d \le 0$

$d \ge 0$

19. $3(s - 4) \ge 2(s - 6)$

$3s - 12 \ge 2s - 12$

$s - 12 \ge -12$

$s \ge 0$

20. $2(t - 3) > 2t - 8$

$2t - 6 > 2t - 8$

$-6 > -8$

The statement is true so, the solutions are all real numbers.

21. $5(b + 9) \leq 5b + 45$

$5b + 45 \leq 5b + 45$

$45 \leq 45$

The statement is true, so the solutions are all real numbers.

22. $2(4c - 7) \geq 8(c - 3)$

$8c - 14 \geq 8c - 24$

$-14 \geq -24$

The statement is true, so the solutions are all real numbers.

23. $6(x + 3) < 5x + 18 + x$

$6x + 18 < 6x + 18$

$18 < 18$

The statement is false, so the inequality has no solution.

24. $4 + 9y - 3 \geq 3(3y + 2)$

$1 + 9y \geq 9y + 6$

$1 \geq 6$

The statement is false, so the inequality has no solution.

25. $2.2h + 0.4 \leq 2(1.1h - 0.1)$

$2.2h + 0.4 \leq 2.2h - 0.2$

$0.4 \leq -0.2$

The statement is false, so the inequality has no solution.

26. $9.5j - 6 + 5.5j \geq 3(5j - 2)$

$15j - 6 \geq 15j - 6$

$-6 \geq -6$

The statement is true, so the solutions are all real numbers.

27. $\frac{1}{5}(4m + 10) < \frac{4}{5}m + 2$

$\frac{4}{5}m + 2 < \frac{4}{5}m + 2$

$2 < 2$

The statement is false, so the inequality has no solution.

28. $\frac{3}{4}(8n - 4) < -3(1 - 2n)$

$6n - 3 < -3 + 6n$

$-3 < -3$

The statement is false, so the inequality has no solution.

29. $3x + 4 < 40$

$3x < 36$

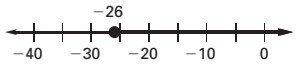
$x < 12$

30. $2(x + 8) \geq -36$

$2x + 16 \geq -36$

$2x \geq -52$

$x \geq -26$



31. $5x + 2x > 9x - 4$

$7x > 9x - 4$

$-2x > -4$

$x < 2$

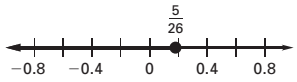
32. $6(6x - 3) \leq -2(4 + 8x)$

$36x - 18 \leq -8 - 16x$

$52x - 18 \leq -8$

$52x \leq 10$

$x \leq \frac{5}{26}$



33. If $a > 0, b > 0$

$ax + b > 0$

$ax > -b$

$x > -\frac{b}{a}$

If $a < 0, b < 0$

$-ax - b > 0$

$-ax > b$

$x < \frac{b}{-a}$

If $a > 0, b < 0$

$ax - b > 0$

$ax > b$

$x > \frac{b}{a}$

C; $a > 0, b < 0$

34. $9(x + 2) > 81$

$9x + 18 > 81$

$9x > 63$

$x > 7$

x is greater than 7 feet.

35. $\frac{1}{2} \cdot 8(x + 1) \leq 44$

$4(x + 1) \leq 44$

$4x + 4 \leq 44$

$4x \leq 40$

$x \leq 10$

x is less than or equal to 10.

36. $2(x - 5) \geq 3x + a$

$2x - 10 \geq 3x + a$

$-x - 10 \geq a$

$-x \geq 10 + a$

$x \leq -10 - a$

$5 = -10 - a$

$15 = -a$

$-15 = a$

All solutions are less than or equal to 5 when $a = -15$.

Problem Solving

37. Minutes per song $\cdot$ Number of songs $+$ Minutes already burned $>$ Total minutes

$4n + 25 \leq 70$

$4n \leq 45$

$n \leq 11.25$

You cannot burn more than 11 additional songs.

38. Price per ornament $\cdot$ Number of ornaments $-$ Cost of supplies $>$ Zero

$8.50n - 46 > 0$

$8.50n > 46$

$n > 5.41$

The woodworker must sell more than 5 ornaments to make a profit.

39. a. Area for first 2 swans $+$ Area for each additional swan $\cdot$ Number of swans $\leq$ Area of habitat

$500 + 125n \leq 20(50)$

$500 + 125n \leq 1000$

$125n \leq 500$

$n \leq 4$

By solving the inequality for n, we find that the zookeeper can have up to 4 additional swans after the first 2, so the habitat can hold a total of 6 swans.

b. $500 + 125n \leq 40(70)$

$500 + 125n \leq 2800$

$125n \leq 2300$

$n \leq 18.4$

$18 + 2 = 20$

$20 - 6 = 14$

The habitat can now hold up to 14 more swans than the original habitat.

40. C; $3(x - 50) < 100$

41. a.

Average Pitches per Inning (p)	Total Pitches (t)
15	98
16	101
17	104
18	107
19	110

b. Average pitches per inning $\cdot$ 3 innings $+$ Pitches in first 4 innings $\leq$ Maximum pitches allowed

$p \cdot 3 + 53 \leq 105$

$3p \leq 52$

$p \leq 17.33$

The pitcher can make no more than an average of 17 pitches per inning in the next 3 innings.

42. a. $6.25 = (300 - 175)x$

$6.25 = 125x$

$0.05 = x$

The tax rate is 5%. This result was obtained by first finding the difference of the price and 175. This is the taxable amount. We know that whatever the tax rate is, the amount paid on tax is \$6.25. From here an equation can be set up and solved to find the tax rate.

b. $p + (p - 175)(0.05) \leq 400$

$p + 0.05p - 8.75 \leq 400$

$1.05p \leq 408.75$

$p \leq 389.29$

The price of the coat must be no more than \$389.29.

c. $p + 0.04p < p + (p - 175)(0.05)$

$1.04p < p + 0.05p - 8.75$

$1.04p < 1.05p - 8.75$

$8.75 < 0.01p$

$875 < p$

The 4% tax rate would be cheaper for items more than \$875.

Test: $p = \$900$

$900 + 0.04(900) \stackrel{?}{<} 900 + (900 - 175)(0.05)$

$936 < 936.25$ ✓

43. $\frac{\text{Scores from each game}}{\text{Number of games}} \geq$ League Average

$\frac{157 + 161 + 149 + 172 + x}{5} \geq 167$

$639 + x \geq 835$

$x \geq 196$

You must score no less than 196 on your next game.

Problem Solving Workshop for the lesson "Solve Multi-Step Inequalities"

1.

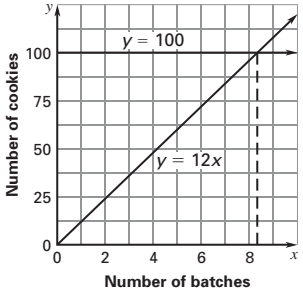
Number of batches	Number of cookies
3	36
4	48
5	60
6	72
7	84
8	96
9	108

You must bake at least 9 batches of cookies.

Total number of cookies = Cookies per batter • Number of batters

$y = 12x$

$y = 100$



You must bake at least 9 batches of cookies.

2.

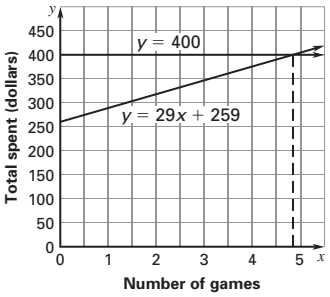
Games	Amount of money left ($)
0	141
1	112
2	83
3	54
4	25

You can buy up to 4 games.

Total cost = Cost per game • Number of games + Cost of console

$y = 29x + 259$

$y = 400$



You can buy up to 4 games.

3.

Games	Amount of money left ($)
0	201
1	172
2	143
3	114
4	85
5	56
6	27

You can buy up to 6 games.

4.

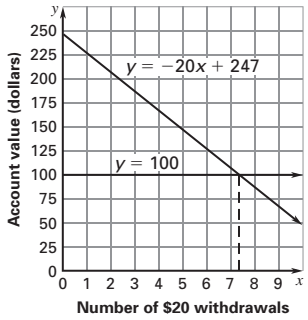
Games	Amount of money left ($)
0	247
1	227
2	207
3	187
4	167
5	147
6	127
7	107

You can withdraw money for up to 7 weeks.

Total left in account = Original amount in account − Amount withdrawn per week • Number of weeks

$y = 247 - 20x$

$y = 100$



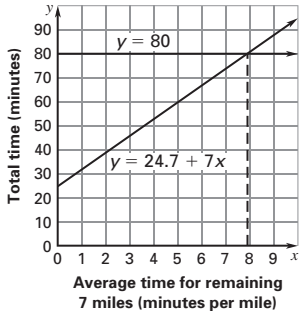
You can withdraw money for up to 7 weeks.

5. 1 h 20 min = 80 min

Total time	=	Time for first 3 miles	+	Time for remaining 7 miles

$y = 24.7 + 7x$

$y = 80$



Your average running time for the remaining miles must be slightly less than 8 minutes per mile in order to have a total time of less than 1 hour and 20 minutes.

Chapter Extension for the extension "Solve Linear Inequalities by Graphing"

1. $2x + 5 > 11$

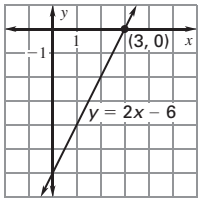
$2x - 6 > 0$

$y = 2x - 6$

So, $x > 3$.

Check: $2(5) + 5 \stackrel{?}{>} 11$

$15 > 11$ ✓



2. $\frac{1}{2}x + 6 \leq 13$

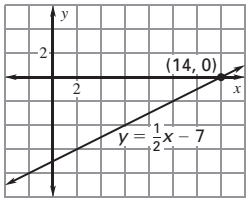
$\frac{1}{2}x - 7 \leq 0$

$y = \frac{1}{2}x - 7$

So, $x \leq 14$.

Check: $\frac{1}{2}(10) + 6 \stackrel{?}{\leq} 13$

$11 \leq 13$ ✓



3. $0.2x - 15.75 < 27$

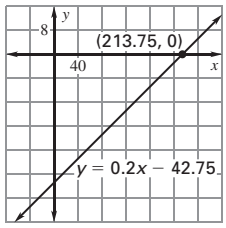
$0.2x - 42.75 < 0$

$y = 0.2x - 42.75$

So, $x < 213.75$

Check: $0.2(200) - 15.75 \stackrel{?}{<} 27$

$24.25 < 27$ ✓



4.

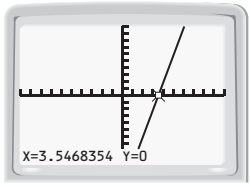
Cost of a PPV movie ($)	•	Number of PPV movies	+	Cable TV package cost ($)	≤	Amount budgeted ($)

$3.95x + 40.99 \leq 55$

$3.95x - 14.01 \leq 0$

$y = 3.95x - 14.01$

Graph on a graphing calculator.



Trace to find the x-intercept.

x-intercept ≈ 3.55

You can afford up to 3 pay-per-view movies per month.

Investigating Algebra Activity for the lesson "Solve Compound Inequalities"

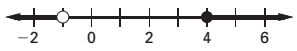
1–6. Answers will vary.

7. True **8.** False

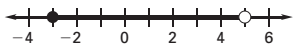
Lesson 5.4 Solve Compound Inequalities

Guided Practice for the lesson "Solve Compound Inequalities"

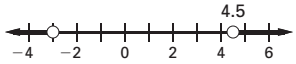
1. $x < -1$ or $x \geq 4$



2. $-3 \leq x < 5$



3. $c < -3$ or $c > 4.5$

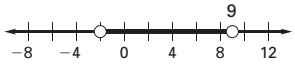


4. $-7 < x - 5 < 4$

$-7 < x - 5$ and $x - 5 < 4$

$-2 < x$ and $x < 9$

$-2 < x < 9$



5. $10 \leq 2y + 4 \leq 24$

$10 \leq 2y + 4$ and $2y - 4 \leq 24$

$6 \leq 2y$ and $2y \leq 20$

$3 \leq y$ and $y \leq 10$

$3 \leq y \leq 10$

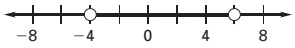
6. $-7 < -z - 1 < 3$

$-7 < -z - 1$ and $-z - 1 < 3$

$-6 < -z$ and $-z < 4$

$6 > z$ and $z > -4$

$-4 < z < 6$



7. $-14 < x - 8 < -1$

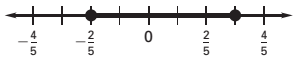
$-6 < x < 7$

8. $-1 \le -5t + 2 \le 4$

$-3 \le -5t \le 2$

$\frac{3}{5} \ge t \ge -\frac{2}{5}$

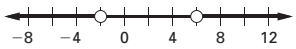
$-\frac{2}{5} \le t \le \frac{3}{5}$



9. $3h + 1 < -5$ or $2h - 5 > 7$

$3h < -6$ or $2h > 12$

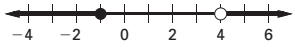
$h < -2$ or $h > 6$



10. $4c + 1 \le -3$ or $5c - 3 > 17$

$4c \le -4$ or $5c > 20$

$c \le -1$ or $c > 4$

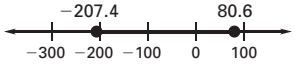


11. $-133 \le C \le 27$

$-133 \le \frac{5}{9}(F - 32) \le 27$

$-239.4 \le F - 32 \le 48.6$

$-207.4 \le F \le 80.6$



Possible temperatures include −100°F, 0°F, 25°F (examples will vary).

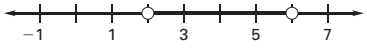
Exercises for the lesson "Solve Compound Inequalities"

Skill Practice

1. A *compound inequality* is an inequality that consists of two inequalities joined by *and* or *or*.

2. The graph of $-6 \le x \le -4$ is shaded between −6 and −4. The graph of $x \le -6$ or $x \ge -4$ is shaded to the left of −6 and to the right of −4.

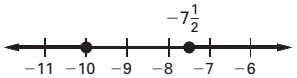
3. $2 < x < 6$



4. $x \le -8$ or $x > 12$

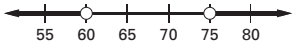
5. $-1.5 \le x < 9.2$

6. $x \ge -7\frac{1}{2}$ or $x \le -10$



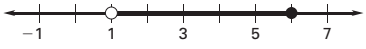
7. $40 \le x \le 60$

8. $x < 60$ or $x > 75$



9. $6 < x + 5 \le 11$

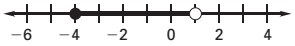
$1 < x \le 6$



10. $-7 > y - 8 \ge -12$

$1 > y \ge -4$

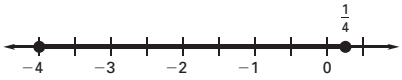
$-4 \le y < 1$



11. $-1 \le -4m \le 16$

$\frac{1}{4} \ge m \ge -4$

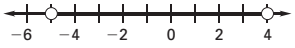
$-4 \le m \le \frac{1}{4}$



12. $-6 < 3n + 9 < 21$

$-15 < 3n < 12$

$-5 < n < 4$

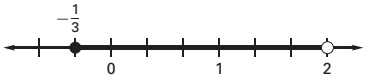


13. $-15 \le 5(3p - 2) < 20$

$-15 \le 15p - 10 < 20$

$-5 \le 15p < 30$

$-\frac{1}{3} \le p < 2$



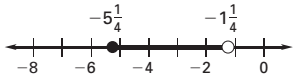
14. $7 > \frac{2}{3}(6q + 18) \ge -9$

$7 > 4q + 12 \ge -9$

$-5 > 4q \ge -21$

$-\frac{5}{4} > q \ge -5\frac{1}{4}$

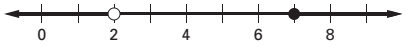
$-5\frac{1}{4} \le q < -1\frac{1}{4}$



15. $2r + 3 < 7$ or $-r + 9 \le 2$

$2r < 4$ or $-r \le -7$

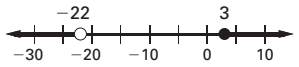
$r < 2$ or $r \ge 7$



16. $16 < -s - 6$ or $2s + 5 \geq 11$

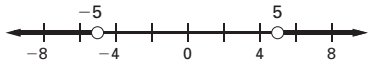
$22 < -s$ or $2s \geq 6$

$-22 > s$ or $s \geq 3$



17. $v + 13 < 8$ or $-8v < -40$

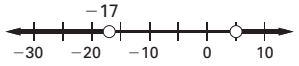
$v < -5$ or $v > 5$



18. $-14 > w + 3$ or $5w - 13 > w + 7$

$-17 > w$ or $4w > 20$

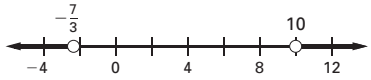
$w < -17$ or $w > 5$



19. $9g - 6 > 12g + 1$ or $4 > -\frac{2}{5}g + 8$

$-3g > 7$ or $-4 > -\frac{2}{5}g$

$g < -\frac{7}{3}$ or $10 < g$

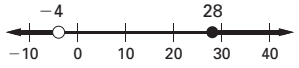


20. $-2h - 7 > h + 5$ or $\frac{1}{4}(h + 8) \geq 9$

$-3h > 12$ or $\frac{1}{4}h + 2 \geq 9$

$h < -4$ or $\frac{1}{4}h \geq 7$

$h < -4$ or $h \geq 28$



21. In Step 2, 3 should have been subtracted from all three expressions of the inequality.

$4 < -2x + 3 < 9$

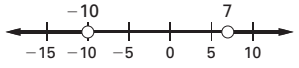
$1 < -2x < 6$

$-\frac{1}{2} > x > -3$

22. The graph should be shaded to the left of -10 and to the right of 7.

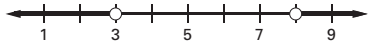
$x - 2 > 5$ or $x + 8 < -2$

$x > 7$ or $x < -10$



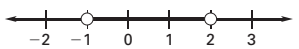
23. $x + 5 < 8$ or $x - 3 > 5$

$x < 3$ or $x > 8$



24. $-4 < x - 3 < -1$

$-1 < x < 2$



25. $-8 \leq 3(x - 4) \leq 10$

$-8 \leq 3x - 12 \leq 10$

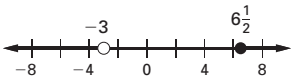
$4 \leq 3x \leq 22$

$1\frac{1}{3} \leq x \leq 7\frac{1}{3}$

26. $-2x + 8 \leq -5$ or $6 < -2x$

$-2x \leq -13$ or $-3 > x$

$x \geq 6\frac{1}{2}$ or $x < -3$



27. C; 23

$a > 3x + 8$ or $a > -4x - 1$

Try 16: $16 > 3x + 8$ or $16 > -4x - 1$

$8 > 3x$ or $17 > -4x$

$\frac{8}{3} > x$ or $-\frac{17}{4} < x$

Try 19: $19 > 3x + 8$ or $19 > -4x - 1$

$11 > 3x$ or $20 > -4x$

$\frac{11}{3} > x$ or $-5 < x$

Try 23: $23 > 3x + 8$ or $23 > -4x - 1$

$15 > 3x$ or $24 > -4x$

$5 > x$ or $-6 < x$

$-6 < x < 5$

28. The statement is false. A counterexample is -5 because it is not greater than or equal to -4.

29. The statement is true.

30. The converse is true. If a is a solution of $x < 5$ and $x \geq -4$, then a is also a solution of $x < 5$.

31. The converse is false. For example, -4 is a solution of $x > 5$ or $x \leq -4$, but it is not a solution of $x > 5$.

32. **a.** $x < 7 + 5$ $5 < x + 7$ $7 < x + 5$

$x < 12$ $-2 < x$ $2 < x$

b. $2 < x < 12$

c. 5, 8, 10 (Examples will vary.)

33. $-18 < x - 23$ and $x - 16 < -22$

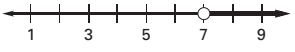
$5 < x$ and $x < -6$

This inequality has no solution because no numbers are less than -6 and greater than 5.

34. $-3y + 7 \leq 11$ and $y + 4 > 11$

$-3y \leq 4$ and $y > 7$

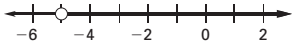
$y \geq -\frac{4}{3}$ and $y > 7$



35. $2m - 1 \geq 5$ or $5m > -25$

$2m \geq 6$ or $m > -5$

$m \geq 3$ or $m > -5$



36. $n + 19 \geq 10$ or $-5n + 3 > 33$

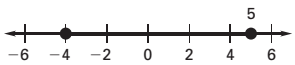
$n \geq -9$ or $-5n > 30$

$n \geq -9$ or $n < -6$

Problem Solving

37. $-2600 \leq x \leq -100$

38. $-20 \leq C \leq -15$



$-20 \leq \frac{5}{9}(F - 32) \leq -15$

$-36 \leq F - 32 \leq -27$

$-4 \leq F \leq 5$

39. B; euro was worth:

$1.0361 \leq v \leq 1.2579$

$v < 1.0361$ or $v > 1.2579$

40. $5319 \leq p \leq 73{,}486$

41. $0.02 \leq p \leq 0.04$

$0.02 \leq \frac{f}{160} \leq 0.04$

$3.2 \leq f \leq 6.4$

A 160 pound deer can eat 3.2 to 6.4 pounds of food per day.

42. $1.16h < 150$ or $1.16h > 220$

$h < 129.3$ or $h > 189.7$

The shop does not provide skis for skiers who are under 129.3 centimeters or over 189.7 centimeters.

43. a. $C < 0$ or $C > 100$

$\frac{5}{9}(F - 32) < 0$ or $\frac{5}{9}(F - 32) > 100$

$F - 32 < 0$ or $F - 32 > 180$

$F < 32$ or $F > 212$

Water is not a liquid when it is less than 32°F or more than 212°F.

b.

Temperature (°F)	Temperature (°C)
23	−5
86	30
140	60
194	90
239	115

Water is not a liquid at 23°F or 239°F.

44. $-9 \leq -22 + 1.3a \leq -2.5$

$13 \leq 1.3a \leq 19.5$

$10 \leq a \leq 15$

Possible air temperatures range from 10°F to 15°F.

45. a. $8 \leq \frac{t}{300} \leq 10$

$2400 \leq t \leq 3000$

Total amplification needs to be from 2400 watts to 3000 watts.

b. $y = \frac{t}{p} = \frac{2900}{350} = 8.29$

$y = \frac{t}{p} = \frac{2900}{400} = 7.25$

The amplifier will be strong enough for 350 people because the amplification per person would be 8.29 watts, which falls within the required range of 8 to 10 watts. The amplifier will not be strong enough for 400 people because the amplification of 7.25 watts per person does not fall in the required range.

c. $8 \leq \frac{t}{600}$

$4800 \leq t$

The least amount of amplification that your amplifier should provide is 4800 watts. This will provide the minimum amplification of 8 watts per person for a maximum crowd of 600.

46. Let t = total cost of meals

$10 \leq \frac{t + 0.15t}{3} \leq 20$

$30 \leq 1.15t \leq 60$

$26.09 \leq t \leq 52.17$

You can spend \$26.09 to \$52.17 on meals before the tip is added.

Quiz for the lessons "Solve Multi-Step Inequalities" and "Solve Compound Inequalities"

1. $-\frac{1}{5}(x - 5) > x - 9$

$-\frac{1}{5}x + 1 > x - 9$

$-\frac{6}{5}x > -10$

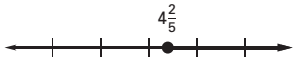
$x < 8\frac{1}{3}$

2. $\frac{1}{2}y - 8 \geq -2y + 3$

$\frac{5}{2}y - 8 \geq 3$

$\frac{5}{2}y \geq 11$

$y \geq 4\frac{2}{5}$

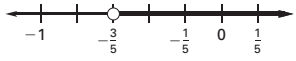


3. $-4r + 7 \leq r + 10$

$-5r + 7 \leq 10$

$-5r \leq 3$

$r \geq -\frac{3}{5}$



4. $-2(s + 6) \le -2s + 8$

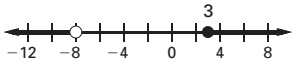
$-2s - 12 \le -2s + 8$

$-12 \le 8$

The statement is true, so the solution is all real numbers.

5. $a - 4 \ge -1$ or $3a < -24$

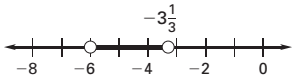
$a \ge 3$ or $a < -8$



6. $22 > -3c + 4 > 14$

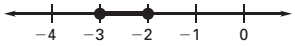
$18 > -3c > 10$

$-6 < c < -3\frac{1}{3}$



7. $-27 \le 9m \le -18$

$-3 \le m \le -2$

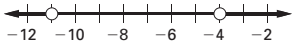


8. $5n + 2 > -18$ or $-3(n + 4) > 21$

$5n > -20$ or $-3n - 12 > 21$

$n > -4$ or $-3n > 33$

$n > -4$ or $n < -11$

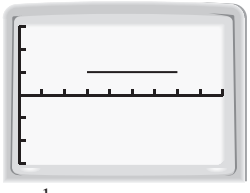


Graphing Calculator Activity for the leson "Solve Compound Inequalities"

1. The graphs look the same on a graphing calculator.

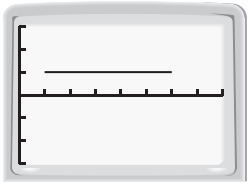
2. You have to know if the problem used less than/greater than or less than or equal to/greater than or equal to inequality symbols since the graphs on the calculator look identical.

3. $9 \le 3x \le 21$

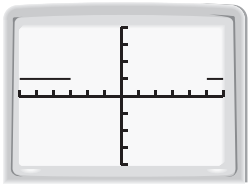


4. $4 < 4x < 8$

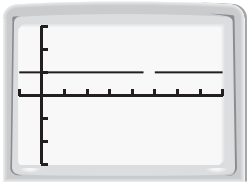
5. $2 \le \frac{1}{4}x \le 12$



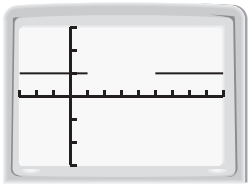
6. $-6x > 18$ or $9x > 45$



7. $4x \le 18$ or $5x \ge 25$



8. $8x \le 16$ or $3x \ge 30$



Mixed Review of Problem Solving for the lessons "Solve Inequalities Using Addition and Subtraction", "Solve Inequalities Using Multiplication and Division", "Solve Multi-Step Inequalities", and "Solve Compound Inequalities"

1. a. $50 \le C \le 500$

$50 \le \frac{5}{9}(F - 32) \le 500$

$90 \le F - 32 \le 900$

$122 \le F \le 932$

The thermometer can measure temperatures from 122°F to 932°F.

b.

c. The thermometer cannot measure a temperature of 1000°F because that is out of the range it can measure.

2. a. $\frac{75 + 82 + 90 + 84 + 71 + x}{6} \ge 80$

$\frac{402 + x}{6} \ge 80$

$402 + x \ge 480$

$x \ge 78$

You must score at least 78 on your sixth test.

b. $\frac{402 + x}{6} \ge 90$

$402 + x \ge 540$

$x \ge 138$

It is not possible for you to have an average of 90 after your sixth test because you would have to score 138 on that test, which is not possible.

3. Let x = number of cartons

$12x \ge 34$

$x \ge 2.83$

You must buy at least 3 cartons.

4. a. Let x = amount spent on socks

$x + 2(85) \le 300$

$x + 170 \le 300$

$x \le 130$

You can spend up to \$130 on socks.

b. Let y = pairs of socks

$4.75y \le 130$

$y \le 27.37$

You can buy up to 27 pairs of socks.

5. Answers will vary.

6. a. Let x = average weight of each adult

$6x + 6(10) + 180 \le 1520$

$6x \le 1280$

$x \le 213.33$

The average weight of each adult cannot exceed 213.33 pounds.

b. Yes, the raft can accommodate all of the people and baggage because none of the adults are heavier than the average weight of each of them.

7. a. $0.03(600) \le x \le 0.03(10{,}000)$

$18 \le x \le 300$

b. Their incomes were greater than \$10,000 because they paid more taxes than those with incomes from \$600 to \$10,000 (from part (a)).

$400 \le 0.03(10{,}000) + 0.05x \le 750$

$2000 \le x \le 9000$

$10{,}000 + 2000 = 12{,}000$

$10{,}000 + 9000 = 19{,}000$

$12{,}000 \le x \le 19{,}000$

Their incomes were from \$12,000 to \$19,000.

c. Let x = total income

$0.04x < 0.03(10{,}000) + 0.05(x - 10{,}000)$

$0.04x < 300 + 0.05x - 500$

$-0.01x < -200$

$x > 20{,}000$

Based on the inequality shown above, the 4% tax rate would result in less taxes for those with incomes greater than \$20,000.

Lesson 5.5 Solve Absolute Value Equations

Guided Practice for the lesson "Solve Absolute Value Equations"

1. a. $|x| = 3$

$x = 3$ or $x = -3$

b. $|x| = 15$

$x = 15$ or $x = -15$

2. $|r - 7| = 9$

$r - 7 = 9$ or $r - 7 = -9$

$r = 16$ or $r = -2$

The solutions are 16 and -2.

3. $2|s| + 4.1 = 18.9$

$2|s| = 14.8$

$|s| = 7.4$

$s = 7.4$ or $s = -7.4$

The solutions are 7.4 and -7.4.

4. $4|t + 9| - 5 = 19$

$4|t + 9| = 24$

$|t + 9| = 6$

$t + 9 = 6$ or $t + 9 = -6$

$t = -3$ or $t = -15$

The solutions are -3 and -15.

5. $2|m - 5| + 4 = 2$

$2|m - 5| = -2$

$|m - 5| = -1$

There are no solutions.

6. $-3|n + 2| - 7 = -10$

$-3|n + 2| = -3$

$|n + 2| = 1$

$n + 2 = 1$ or $n + 2 = -1$

$n = -1$ or $n = -3$

The solutions are -1 and -3.

7. $5.2 = |x - 7.6|$

$5.2 = x - 7.6$ or $-5.2 = x - 7.6$

$12.8 = x$ or $2.4 = x$

The solutions are 12.8 and 2.4.

Exercises for the lesson "Solve Absolute Value Equations"

Skill Practice

1. The equation $|x - 7| = 0.15$ is an example of an *absolute value equation*

2. The absolute deviation of x from 9 is 5.

3. $|x| = 5$

$x = 5$ or $x = -5$

4. $|y| = 36$

$y = 36$ or $y = -36$

5. $|v| = 0.7$

$v = 0.7$ or $v = -0.7$

6. $|w| = 9.2$

$w = 9.2$ or $w = -9.2$

7. $|r| = \frac{1}{2}$

$r = \frac{1}{2}$ or $r = -\frac{1}{2}$

8. $|s| = \frac{7}{4}$

$s = \frac{7}{4}$ or $s = -\frac{7}{4}$

9. $|m + 3| = 7$

$m + 3 = 7$ or $m + 3 = -7$

$m = 4$ or $m = -10$

10. $|4n - 5| = 18$

$4n - 5 = 18$ or $4n - 5 = -18$

$4n = 23$ or $4n = -13$

$n = 5\frac{3}{4}$ or $n = -3\frac{1}{4}$

11. $|3p + 7| = 4$

$3p + 7 = 4$ or $3p + 7 = -4$

$3p = -3$ or $3p = -11$

$p = -1$ or $p = -3\frac{2}{3}$

12. $|q + 8| = 2$

$q + 8 = 2$ or $q + 8 = -2$

$q = -6$ or $q = -10$

13. $|2d + 7| = 11$

$2d + 7 = 11$ or $2d + 7 = -11$

$2d = 4$ or $2d = -18$

$d = 2$ or $d = -9$

14. $|f - 8| = 14$

$f - 8 = 14$ or $f - 8 = -14$

$f = 22$ or $f = -6$

15. $3\left|13-2t\right|=15$

$\left|13-2t\right|=5$

$13-2t=5$ or $13-2t=-5$

$-2t=-8$ or $-2t=-18$

$t=4$ or $t=9$

16. $4\left|b-1\right|-7=17$

$4\left|b-1\right|=24$

$\left|b-1\right|=6$

$b-1=6$ or $b-1=-6$

$b=7$ or $b=-5$

17. $\frac{1}{3}\left|2c-5\right|+3=7$

$\frac{1}{3}\left|2c-5\right|=4$

$\left|2c-5\right|=12$

$2c-5=12$ or $2c-5=-12$

$2c=17$ or $2c=-7$

$c=8\frac{1}{2}$ or $c=-3\frac{1}{2}$

18. $\frac{7}{4}\left|3j+5\right|+1=15$

$\frac{7}{4}\left|3j+5\right|=14$

$\left|3j+5\right|=8$

$3j+5=8$ or $3j+5=-8$

$3j=3$ or $3j=-13$

$j=1$ or $j=-4\frac{1}{3}$

19. $4\left|2k+3\right|-2=6$

$4\left|2k+3\right|=8$

$\left|2k+3\right|=2$

$2k+3=2$ or $2k+3=-2$

$2k=-1$ or $2k=-5$

$k=-\frac{1}{2}$ or $k=-2\frac{1}{2}$

20. $-3\left|5g+1\right|-6=-9$

$-3\left|5g+1\right|=-3$

$\left|5g+1\right|=1$

$5g+1=1$ or $5g+1=-1$

$5g=0$ or $5g=-2$

$g=0$ or $g=-\frac{2}{5}$

21. The absolute value equation has to be rewritten as two equations.

$\left|x+4\right|=13$

$x+4=13$ or $x+4=-13$

$x=9$ or $x=-17$

22. The absolute value of a number is never negative, so this equation has no solution.

23. $\left|x-1\right|+5=2$

$\left|x-1\right|=-3$

This equation has no solution.

24. $\left|y-4\right|+8=6$

$\left|y-4\right|=-2$

This equation has no solution.

25. $\left|m+5\right|+1.5=2$

$\left|m+5\right|=0.5$

$m+5=0.5$ or $m+5=-0.5$

$m=-4.5$ or $m=-5.5$

26. $-4\left|8-5n\right|=13$

$\left|8-5n\right|=-3.25$

The equation has no solution.

27. $-3\left|1-\frac{2}{3}v\right|=-9$

$\left|1-\frac{2}{3}v\right|=3$

$1-\frac{2}{3}v=3$ or $1-\frac{2}{3}v=-3$

$-\frac{2}{3}v=2$ or $-\frac{2}{3}v=-4$

$v=-3$ or $v=6$

28. $-5\left|\frac{4}{5}w+6\right|=-10$

$\left|\frac{4}{5}w+6\right|=2$

$\frac{4}{5}w+6=2$ or $\frac{4}{5}w+6=-2$

$\frac{4}{5}w=-4$ or $\frac{4}{5}w=-8$

$w=-5$ or $w=-10$

29. $-10\left|14-r\right|-2=-7$

$-10\left|14-r\right|=-5$

$\left|14-r\right|=\frac{1}{2}$

$14-r=\frac{1}{2}$ or $14-r=-\frac{1}{2}$

$-r=-13\frac{1}{2}$ or $-r=-14\frac{1}{2}$

$r=13\frac{1}{2}$ or $r=14\frac{1}{2}$

30. $-2\left|\frac{1}{3}s-5\right|+3=8$

$-2\left|\frac{1}{3}s-5\right|=5$

$\left|\frac{1}{3}s-5\right|=-2\frac{1}{2}$

The equation has no solution.

31. $-9\left|4p+2\right|-8=-35$

$-9\left|4p+2\right|=-27$

$\left|4p+2\right|=3$

$4p+2=3$ or $4p+2=-3$

$4p=1$ or $4p=-5$

$p=\frac{1}{4}$ or $p=-1\frac{1}{4}$

32. D; $|4x - 1| + 2 = 1$

$|4x - 1| = -1$

There is no solution.

33. $8 = |x - 5|$

$8 = x - 5$ or $-8 = x - 5$

$13 = x$ or $-3 = x$

34. $|x - 20| = 5$

$x - 20 = 5$ or $x - 20 = -5$

$x = 25$ or $x = 15$

35. $|x - (-9.1)| = 1.6$

$x + 9.1 = 1.6$ or $x + 9.1 = -1.6$

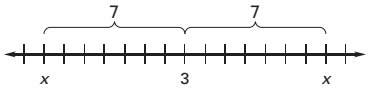
$x = -7.5$ or $x = -10.7$

36. $|x - (-3.4)| = 6.7$

$x + 3.4 = 6.7$ or $x + 3.4 = -6.7$

$x = 3.3$ or $x = -10.1$

37.



$|x - 3| = 7$

$x - 3 = 7$ or $x - 3 = -7$

$x = 10$ or $x = -4$

38. $|x - 3| + 4 = 8$

$|x - 3| = 4$

$x - 3 = 4$ or $x - 3 = -4$

$x = 7$ or $x = -1$

39. $5|2x - (-9)| = 15$

$|2x + 9| = 3$

$2x + 9 = 3$ or $2x + 9 = -3$

$2x = -6$ or $2x = -12$

$x = -3$ or $x = -6$

40. They are equivalent when a is positive or zero. They are not equivalent when a is negative. Example:

Let $a = 4$, let $x = 2$

$a|x| = 4|2| = 8$

$|ax| = |4 \cdot 2| = 8$

Let $a = -4$, let $x = 2$

$a|x| = -4|2| = -8$

$|ax| = |-4 \cdot 2| = 8$

Let $a = 0$, let $x = 2$

$a|x| = 0|2| = 0$

$|ax| = |0 \cdot 2| = 0$

41. $a|x + b| + c = d$

if $a > 0$, $c = d$

$a|x + b| = 0$

$|x + b| = 0$

$x + b = 0$

$x = -b$

The equation has one solution.

If $a < 0$, $c >$ d

$a|x + b| + c = d$

$-a|x + b| = d - c$ (negative number)

$|x + b| =$ (positive number)

$x + b =$ positive or $x + b =$ negative

The equation has two solutions.

Problem Solving

42. $|x - 42| = 3$

$x - 42 = 3$ or $x - 42 = -3$

$x = 45$ or $x = 39$

The minimum height is 39 inches, and the maximum height is 45 inches.

43. $|x - 4(60)| = 5$

$|x - 240| = 5$

$x - 240 = 5$ or $x - 240 = -5$

$x = 245$ or $x = 235$

The least amount of time the program can last is 235 seconds, and the most the program can last is 245 seconds.

44. C; 2.255 inches

$|x - 2.25| = 0.005$

$x - 2.25 = 0.005$ or $x - 2.25 = -0.005$

$x = 2.255$ or $x = 2.245$

45. a. $|x - 54.675| = 2.213$

$x - 54.675 = 2.213$ or $x - 54.675 = -2.213$

$x = 56.888$ or $x = 52.462$

The least score was 52.462, and the greatest score was 56.888.

b. $|x - 56.738| = 0.45$

$x - 56.738 = 0.45$ or $x - 56.738 = -0.45$

$x = 57.188$ or $x = 56.288$

$57.188 - 56.888 = 0.3$

This year's greatest score is 0.3 points more than last year's.

46. $|x - 12| = 0.05(12)$

$x - 12 = 0.6$ or $x - 12 = -0.6$

$x = 12.6$ or $x = 11.4$

The minimum weight is 11.4 carats, and the maximum weight is 12.6 carats.

47. a. $|s - 450| = p$

b. $|s - 450| = 150$

$s - 450 = 150$ or $s - 450 = -150$

$s = 600$ or $s = 300$

You can have a score of 300 or a score of 600.

48. a. $p = 0.165|t - 60| + 4.8$

$13 = 0.165|t - 60| + 4.8$

$8.2 = 0.165|t - 60|$

$49.7 = |t - 60|$

$t - 60 = 49.7$ or $t - 60 = -49.7$

$t = 109.7$ or $t = 10.3$

$1910 + 10.3 = 1920.3$

In 1920, foreign-born residents accounted for about 13% of all residents.

b. $1910 + 109.7 = 2019.7$

In around 2020, foreign-born residents will again account for 13% of all residents.

c. $4 = 0.165|t - 60| + 4.8$

$-0.8 = 0.165|t - 60|$

$-4.85 = |t - 60|$

Foreign-born residents did not account for 4% of all residents during this time because the given equation has no solution when $p = 4$.

49. a. $p = 2.3|m - 7| + 9.57$

$16.15 = 2.3|m - 7| + 9.57$

$6.58 = 2.3|m - 7|$

$2.86 = |m - 7|$

$m - 7 = 2.86$ or $m - 7 = -2.86$

$m = 9.86$ or $m = 4.14$

The average price was \$16.15 in July 2005. the average price will again be \$16.15 in around December 2005.

b. $p = 2.3|7 - 7| + 9.57$

$p = 9.57$

The stock's lowest price during this period was \$9.57.

50. $|t - \text{average of two times}| = \frac{\text{Difference of times}}{2}$

$1 \text{ min } 54.04s = 114.04s$

$1 \text{ min } 57.48s = 117.48s$

$\bar{x} = \frac{114.04 + 117.48}{2} = 115.76$

Difference $= 117.48 - 114.04 = 3.44$

$|t - 115.76| = \frac{3.44}{2}$

$|t - 115.76| = 1.72$

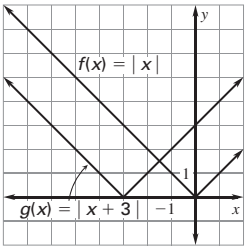
$t - 115.76 = 1.72$ or $t - 115.76 = -1.72$

$t = 117.48$ or $t = 114.04$

Extension for the extension "Graph Absolute Value Functions"

1. $g(x) = |x + 3|$

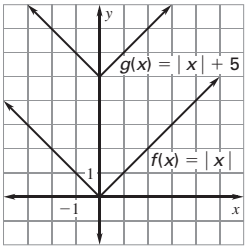
x	-5	-4	-3	-2	-1
$g(x)$	2	1	0	1	2



The graph is 3 units to the left of the graph of $f(x) = |x|$.

2. $g(x) = |x| + 5$

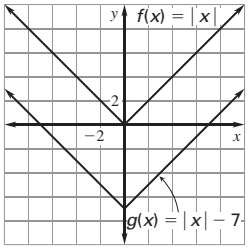
x	-2	-1	0	1	2
$g(x)$	7	6	5	6	7



The graph is 5 units above the graph of $f(x) = |x|$.

3. $g(x) = |x| - 7$

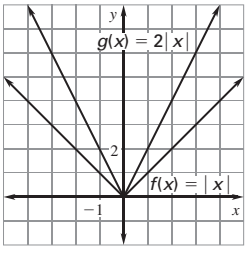
x	-2	-1	0	1	2
$g(x)$	-5	-6	-7	-6	-5



The graph is 7 units below the graph of $f(x) = |x|$.

4. $g(x) = 2|x|$

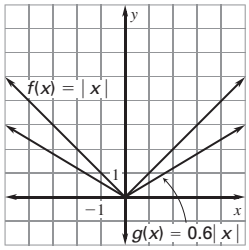
x	-2	-1	0	1	2
$g(x)$	4	2	0	2	4



The graph is narrower than the graph of $f(x) = |x|$.

5. $g(x) = 0.6|x|$

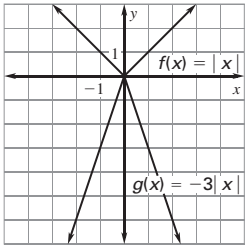
x	-2	-1	0	1	2
$g(x)$	1.2	0.6	0	0.6	1.2



The graph is wider than the graph of $f(x) = |x|$.

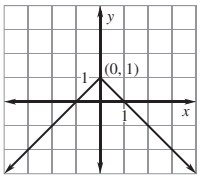
6. $g(x) = -3|x|$

x	-2	-1	0	1	2
$g(x)$	-6	-3	0	-3	-6



The graph is narrower than the graph of $f(x) = |x|$, and it opens down instead of up.

7.



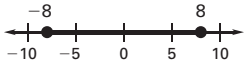
The domain of the function is all real numbers, and the range is $y \le 1$. The vertex is (0, 1). The maximum value occurs at the vertex, so the maximum value is 1.

Lesson 5.6 Solve Absolute Value Inequalities

Guided Practice for the lesson "Solve Absolute Value Inequalities"

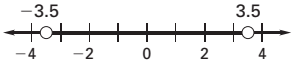
1. $|x| \le 8$

$-8 \le x \le 8$



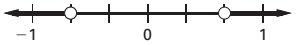
2. $|u| < 3.5$

$-3.5 < u < 3.5$



3. $|v| > \frac{2}{3}$

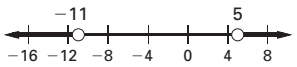
$v < -\frac{2}{3}$ or $v > \frac{2}{3}$



4. $|x + 3| > 8$

$x + 3 < -8$ or $x + 3 > 8$

$x < -11$ or $x > 5$

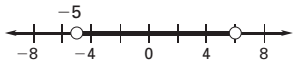


5. $|2w - 1| < 11$

$-11 < 2w - 1 < 11$

$-10 < 2w < 12$

$-5 < w < 6$



6. $3|5m - 6| - 8 \le 13$

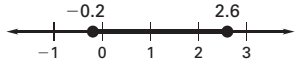
$3|5m - 6| \le 21$

$|5m - 6| \le 7$

$-7 \le 5m - 6 \le 7$

$-1 \le 5m \le 13$

$-0.2 \le m \le 2.6$



7. $|x - 664| \le 75$

$-75 \le x - 664 \le 75$

$589 \le x \le 739$

5 computer prices meet this condition.

Exercises for the lesson "Solve Absolute Value Inequalities"

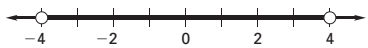
Skill Practice

1. The inequalities $|x| > 8$ and $x > 8$ or $x < -8$ are *equivalent inequalities.*

2. $|x| \le 5$ is equivalent to $-5 \le x \le 5$, but $|x| \ge 5$ is equivalent to $x \le -5$ or $x \ge 5$.

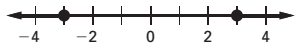
3. $|x| < 4$

$-4 < x < 4$



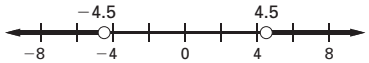
4. $|y| \ge 3$

$y \le -3$ or $y \ge 3$



5. $|h| > 4.5$

$h < -4.5$ or $h > 4.5$



6. $|p| < 1.3$

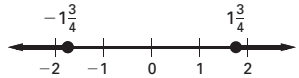
$-1.3 < p < 1.3$

7. $|t| \le \frac{3}{5}$

$-\frac{3}{5} \le t \le \frac{3}{5}$

8. $|j| \ge 1\frac{3}{4}$

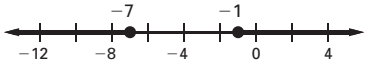
$j \le -1\frac{3}{4}$ or $j \ge 1\frac{3}{4}$



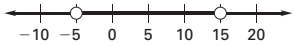
9. $|d + 4| \ge 3$

$d + 4 \le -3$ or $d + 4 \ge 3$

$d \le -7$ or $d \ge -1$



10. $|b - 5| < 10$



$-10 < b - 5 < 10$

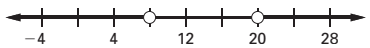
$-5 < b < 15$

11. $|14 - m| > 6$

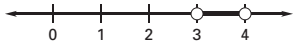
$14 - m < -6$ or $14 - m > 6$

$-m < -20$ or $-m > -8$

$m > 20$ or $m < 8$



12. $|2s - 7| < 1$



$-1 < 2s - 7 < 1$

$6 < 2s < 8$

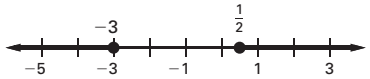
$3 < s < 4$

13. $|4x + 5| \geq 7$

$4c + 5 \leq -7$ or $4c + 5 \geq 7$

$4c \leq -12$ or $4c \geq 2$

$c \leq -3$ or $c \geq \frac{1}{2}$



14. $|9 - 4n| \leq 5$

$-5 \leq 9 - 4n \leq 5$

$-14 \leq -4n \leq -4$

$3.5 \geq n \geq 1$

$1 \leq n \leq 3.5$

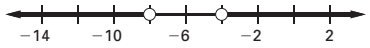
15. $5\left|\frac{1}{2}r + 3\right| > 5$

$\left|\frac{1}{2}r + 3\right| > 1$

$\frac{1}{2}r + 3 < -1$ or $\frac{1}{2}r + 3 > 1$

$\frac{1}{2}r < -4$ or $\frac{1}{2}r > -2$

$r < -8$ or $r > -4$



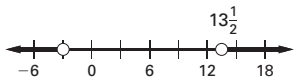
16. $\left|\frac{4}{3}s - 7\right| - 8 > 3$

$\left|\frac{4}{3}s - 7\right| > 11$

$\frac{4}{3}s - 7 < -11$ or $\frac{4}{3}s - 7 > 11$

$\frac{4}{3}s < -4$ or $\frac{4}{3}s > 18$

$s < -3$ or $s > 13.5$



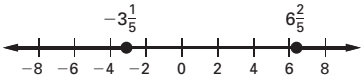
17. $-3\left|2 - \frac{5}{4}u\right| \leq -18$

$\left|2 - \frac{5}{4}u\right| \geq 6$

$2 - \frac{5}{4}u \leq -6$ or $2 - \frac{5}{4}u \geq 6$

$-\frac{5}{4}u \leq -8$ or $-\frac{5}{4}u \geq 4$

$u \geq 6\frac{2}{5}$ or $u \leq -3\frac{1}{5}$



18. $2\left|3w + 8\right| - 13 < -5$

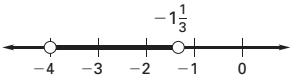
$2\left|3w + 8\right| < 8$

$\left|3w + 8\right| < 4$

$-4 < 3w + 8 < 4$

$-12 < 3w - 4$

$-4 < w < -1\frac{1}{3}$



19. $2\left|\frac{1}{4}v - 5\right| - 4 > 3$

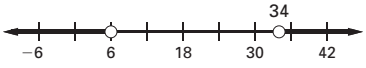
$2\left|\frac{1}{4}v - 5\right| > 7$

$\left|\frac{1}{4}v - 5\right| > 3\frac{1}{2}$

$\frac{1}{4}v - 5 < -3\frac{1}{2}$ or $\frac{1}{4}v - 5 > 3\frac{1}{2}$

$\frac{1}{4}v < 1\frac{1}{2}$ or $\frac{1}{4}v > 8\frac{1}{2}$

$v < 6$ or $v > 34$



20. $\frac{2}{7}\left|4f + 6\right| - 2 \geq 10$

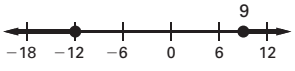
$\frac{2}{7}\left|4f + 6\right| \geq 12$

$\left|4f + 6\right| \geq 42$

$4f + 6 \leq -42$ or $4f + 6 \geq 42$

$4f \leq -48$ or $4f \geq 36$

$f \leq -12$ or $f \geq 9$



21. B; $3\left|6 - 2x\right| > 12$

Try $\left|x + 8\right| - 2 > 10$

$\left|x + 8\right| > 12$

$x + 8 < -12$ or $x + 8 > 12$

$x < -20$ or $x > 4$

Try $3\left|6 - 2x\right| > 12$

$\left|6 - 2x\right| > 4$

$6 - 2x < -4$ or $6 - 2x > 4$

$-2x < -10$ or $-2x > -2$

$x > 5$ or $x < 1$

22. If the absolute value is less than (or less than or equal to) a number, then it is equivalent to a compound inequality with *and*. If the absolute value is greater than (or greater than or equal to) a number, then it is equivalent to a compound inequality with *or*.

23. Because the absolute value is greater than 13, it is equivalent to a compound inequality with *or*, not *and*.

$|x + 4| > 13$

$x + 4 < -13$ or $x + 4 > 13$

$x < -17$ or $x > 9$

24. Because $|x - 5|$ is an absolute value, it is equivalent to a compound inequality.

$|x - 5| < 20$

$-20 < x - 5 < 20$

$-15 < x < 25$

25. $|x - 6| \leq 4$

$-4 \leq x - 6 \leq 4$

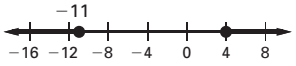
$2 \leq x \leq 10$

26. $|2x - (-7)| \geq 15$

$2x + 7 \leq -15$ or $2x + 7 \geq 15$

$2x \leq -22$ or $2x \geq 8$

$x \leq -11$ or $x \geq 4$



27. $|-4x - 7| + 3 > 10$

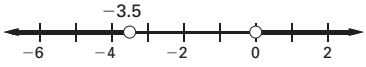
$|-4x - 7| > 7$

$-4x - 7 < -7$ or $-4x - 7 > 7$

$-4x < 0$ or $-4x > 14$

$x > 0$ or $x < \frac{14}{-4}$

$x < -3.5$

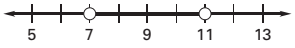


28. $4|x - 9| < 8$

$|x - 9| < 2$

$-2 < x - 9 < 2$

$7 < x < 11$



29. The statement is true.

30. The statement is false.

Counterexample: $a = -12$

-12 is a solution of $|x + 3| > 8$.

$|-12 + 3| > 8$

$|-9| > 8$

$9 > 8$ ✓

-12 is not a solution of $x + 3 > 8$.

$-12 + 3 > 8$

$-9 \not> 8$

31. The statement is false.

Counterexample: $a = 6$

6 is a solution of $|x + 3| \geq 8$.

$|6 + 3| \geq 8$

$9 \geq 8$ ✓

6 is not a solution of $|x + 3| \leq -8$.

$|6 + 3| \leq -8$

$9 \not\leq -8$

32. The statement is true.

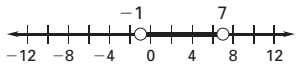
33. Solve each inequality

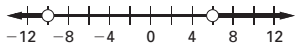
$|x - 3| < 4$ and $|x + 2| > 8$

$-4 < x - 3 < 4$ and $x + 2 < -8$ or $x + 2 > 8$

$-1 < x < 7$ and $x < -10$ or $x > 6$

Graph each inequality.





Look for where the two graphs overlap. The only values that fulfill both inequalities are between 6 and 7. So the solution is $6 < x < 7$.

34. $|ax + b| < c, c < 0$

This inequality has no solution because an absolute value cannot be negative, and therefore cannot be less than a negative number.

$|ax + b| > c, c < 0$

The solution to this inequality is all real numbers. The absolute value of any number is nonnegative, so if c is a negative number, $|ax + b| > c$.

Problem Solving

35. $|x - 500| < 30$

$-30 < x - 500 < 30$

$470 < x < 530$

The essay can have between 470 and 530 words.

36. $|x - 0| > 0.5$

$x - 0 < -0.5$ or $x - 0 > 0.5$

$x < -0.5$ or $x > 0.5$

The water is highly corrosive when the saturation index is less than -0.5 or greater than 0.5.

37. $|x - 346| \leq 2$

$-2 \leq x - 346 \leq 2$

$344 \leq x \leq 348$

You should continue to preheat the oven because the oven temperature is at most 348°F, so it still needs to heat to 350°F.

38. a.

Measured compression (pounds)	Absolute deviation (pounds)
275	75
325	25
375	25
425	75
475	125

b. $|p - 350| \le 50$

$-50 \le p - 350 \le 50$

$300 \le p \le 400$

The organization will allow compressions of 300 to 400 pounds. The values of p that are solutions of the inequality are 325 and 375.

39. a. $\bar{x} = \frac{10.50 + 9.52 + 9.73 + 9.86 + 9.78 + 10.90 + 9.86}{7}$

$\bar{x} = 10.02$

The mean is 10.02 m/sec^2.

b. $|x - 10.02| \le d$

$|10.90 - 10.02| \le d$

$0.88 \le d$

40. a. $18{,}000(0.2) = 3600$

The absolute deviation is 3600.

b. $|x - 18{,}000| \le 3600$

$-3600 \le x - 18{,}000 \le 3600$

$14{,}400 \le x \le 21{,}600$

There are from 14,400 to 21,600 antelope in Nevada.

c. The actual population would not necessarily be greater.

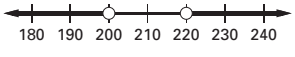
The possible numbers of antelope would cover a greater range. So there could be more, less, or the same amount.

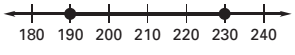
41. $10 < |x - 210| \le 20$

$|x - 210| > 10$ and $|x - 210| \le 20$

$x - 210 < -10$ or $x - 210 > 10$ and $-20 \le x - 210 \le 20$

$x < 200$ or $x > 220$ and $190 \le x \le 230$





$190 \le x < 200$ or $220 < x \le 230$

The skater receives a 0.1 penalty point if he/she finishes from 190 seconds, up to but not including, 200 seconds or from, but not including, 220 seconds to 230 seconds.

Investigating Algebra for the lesson "Graph Linear Inequalities in Two Variables"

Activity for the lesson "Graph Linear Inequalities in Two Variables"

Answers will vary.

Lesson 5.7 Graph Linear Inequalities in Two Variables

Guided Practice for the lesson "Graph Linear Inequalities in Two Variables"

1. $-x + 2y < 8$; (0, 0)

$-0 + 2(0) < 8$

$0 < 8$ ✓

2. $-x + 2y < 8$; (0, 4)

$-0 + 2(4) < 8$

$8 < 8$ ✗

3. $-x + 2y < 8$; (3, 5)

$-3 + 2(5) < 8$

$-3 + 10 < 8$

$7 < 8$ ✓

(3, 5) is a solution.

4. $x + 3y \ge -1$

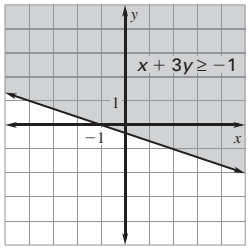
$3y \ge -x - 1$

$y \ge -\frac{1}{3}x - \frac{1}{3}$

Test (0, 0).

$0 + 3(0) \ge -1$

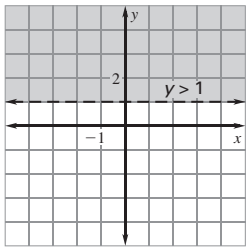
$0 \ge -1$ ✓



5. $y > 1$

Test (0, 0).

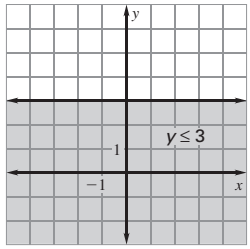
$0 > 1$ ✗



6. $y \le 3$

Test (0, 0).

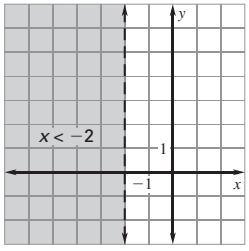
$0 \le 3$ ✓



7. $x < -2$

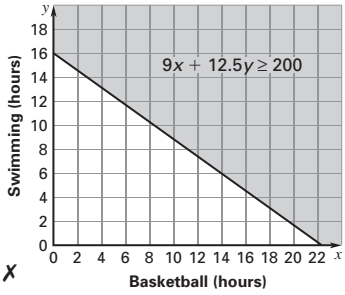
Test $(-3, 0)$.

$-3 < -2$ ✓



8. Basketball pay rate $\cdot$ Basketball time $+$ Swimming pay rate $\cdot$ Swimming Time $\ge$ Total earnings

$9x + 12.5y \geq 200$



Test (5, 5).

$9(5) + 12.5(5) \geq 200$

$107.5 \geq 200$ ✗

Basketball time (hours)	10	15	20
Swimming time (hours)	15	10	20
Total earnings (dollars)	277.50	260	430

Exercises for the lesson "Graph Linear Inequalities in Two Variables

Skill Practice

1. The ordered pair $(2, -4)$ is a *solution* of $3x - y > 7$.

2. When you graph a linear inequality in two variables, you have to graph the line and then shade the half plane that represents the many solutions to the inequality.You do not have to shade when you graph linear equations.

3. $x + y < -4$; $(0, 0)$

$0 + 0 < -4$

$0 < -4$ ✗

$(0, 0)$ is not a solution.

4. $x - y \leq 5$; $(8, 3)$

$8 - 3 \leq 5$

$5 \leq 5$ ✓

$(8, 3)$ is a solution.

5. $y - x > -2$; $(-1, -4)$

$-4 - (-1) > -2$

$-3 > -2$ ✗

$(-1, -4)$ is not a solution.

6. $2x + 3y \geq 14$; $(5, 2)$

$2(5) + 3(2) \geq 14$

$16 \geq 14$ ✓

$(5, 2)$ is a solution.

7. $4x - 7y > 28$; $(-2, 4)$

$4(-2) - 7(4) > 28$

$-36 > 28$ ✗

$(-2, 4)$ is not a solution.

8. $-3y - 2x < 12$; $(5, -6)$

$-3(-6) - 2(5) < 12$

$8 < 12$ ✓

$(5, -6)$ is a solution.

9. $2.8x + 4.1y \leq 1$; $(0, 0)$

$2.8(0) + 4.1(0) \leq 1$

$0 \leq 1$ ✓

$(0, 0)$ is a solution.

10. $0.5y - 0.5x > 3.5$; $(6, 2)$

$0.5(2) - 0.5(6) > 3.5$

$-2 > 3.5$ ✗

$(6, 2)$ is not a solution.

11. $x \geq -3$; $(-4, 0)$

$-4 \geq -3$ ✗

$(-4, 0)$ is not a solution.

12. $y \leq 8$; $(-9, -7)$

$-7 \leq 8$ ✓

$(-9, -7)$ is a solution.

13. $\frac{3}{4}x - \frac{1}{3}y < 6$; $(-8, 12)$

$\frac{3}{4}(-8) - \frac{1}{3}(12) < 6$

$-6 - 4 < 6$

$-10 < 6$

$(-8, 12)$ is a solution.

14. $\frac{2}{5}x + y \geq 2$; $(1, 2)$

$\frac{2}{5}(1) + 2 \geq 2$

$2\frac{2}{5} \geq 2$ ✓

$(1, 2)$ is a solution.

15. C; $(1, 3)$

$x + 5y < 15$

Try $(-1, -3)$.

$-1 + 5(-3) < 15$

$-16 < 15$ ✓

Try $(-1, 3)$.

$-1 + 5(3) < 15$

$14 < 15$ ✓

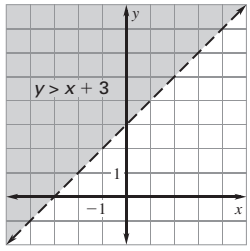
Try $(1, 3)$.

$1 + 5(3) < 15$

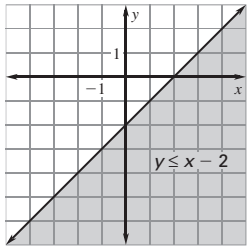
$16 < 15$ ✗

16. A; $x + y \leq -1$

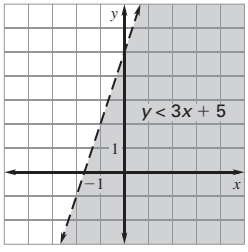
17. $y > x + 3$



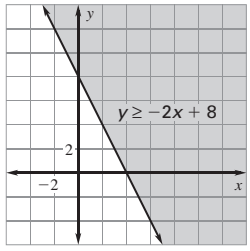
18. $y \leq x - 2$



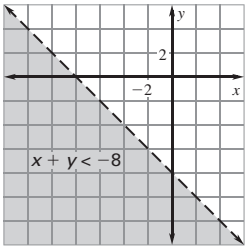
19. $y < 3x + 5$



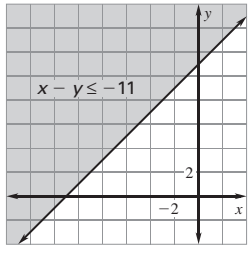
20. $y \geq -2x + 8$



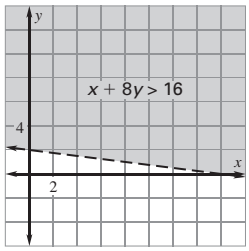
21. $x + y < -8$



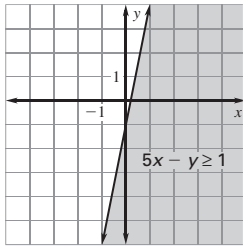
22. $x - y \leq -11$



23. $x + 8y > 16$



24. $5x - y \geq 1$

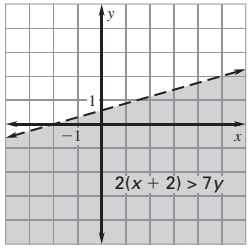


25. $2(x + 2) > 7y$

$2x + 4 > 7y$

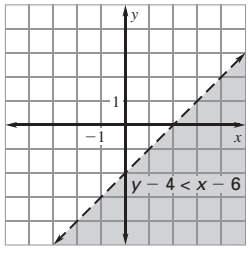
$\frac{2}{7}x + \frac{4}{7} > y$

$y < \frac{2}{7}x + \frac{4}{7}$



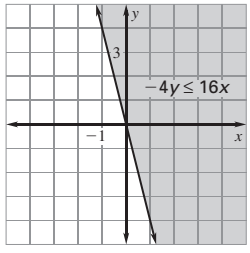
26. $y - 4 < x - 6$

$y < x - 2$



27. $-4y \leq 16x$

$y \geq -4x$

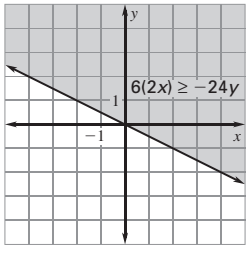


28. $6(2x) \geq -24y$

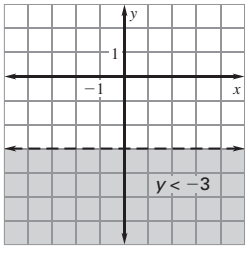
$12x \geq -24y$

$-\frac{1}{2}x \leq y$

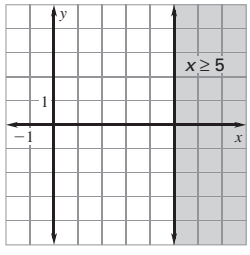
$y \geq -\frac{1}{2}x$



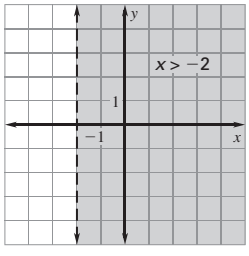
29. $y < -3$



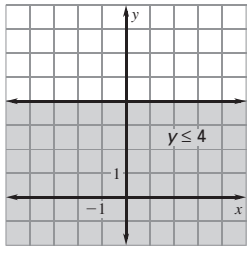
30. $x \geq 5$



31. $x > -2$



32. $y \leq 4$

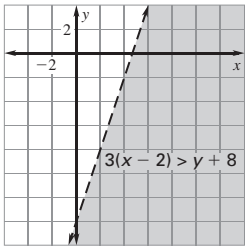


33. $3(x - 2) > y + 8$

$3x - 6 > y + 8$

$3x - 14 > y$

$y < 3x - 14$



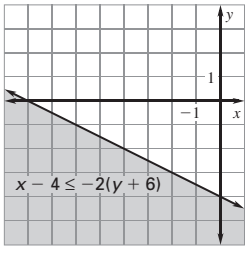
34. $x - 4 \leq -2(y + 6)$

$x - 4 \leq -2y - 12$

$x + 8 \leq -2y$

$-\frac{1}{2}x - 4 \geq y$

$y \leq -\frac{1}{2}x - 4$

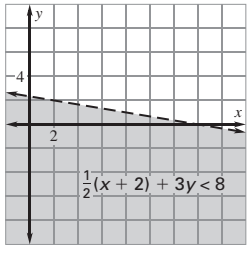


35. $\frac{1}{2}(x - 2) + 3y < 8$

$\frac{1}{2}x + 1 + 3y < 8$

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

$y < -\frac{1}{6}x + 2\frac{1}{3}$



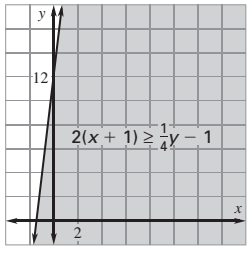
36. $2(x + 1) \geq \frac{1}{4}y - 1$

$2x + 2 \geq \frac{1}{4}y - 1$

$2x + 3 \geq \frac{1}{4}y$

$8x + 12 \geq y$

$y \leq 8x + 12$

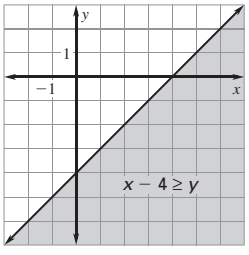


37. The graph should have been shaded above the line, not below.

38. The vertical line at $x = -3$ should have been a solid line because the inequality symbol is "less than or equal to" not "less than."

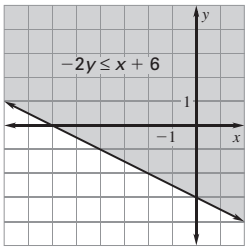
39. You cannot use (0, 0) as a test point because the line representing $2x = -5y$ passes through the origin, and since the inequality symbol is "greater than", that line will be a dashed line indicating that points on the line are not solutions to the inequality.

40. $x - 4 \geq y$



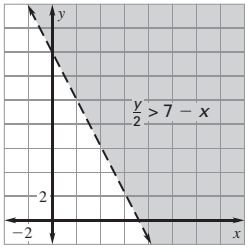
41. $-2y \le x + 6$

$y \ge -\frac{1}{2}x - 3$



42. $\frac{y}{2} > 7 - x$

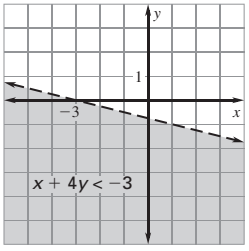
$y > 14 - 2x$



43. $x + 4y < -3$

$4y < -x - 3$

$y < -\frac{1}{4}x - \frac{3}{4}$



44. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - 3}{3 - (-1)} = -\frac{5}{4}$

$y = mx + b$

$3 = -\frac{5}{4}(-1) + b$

$1\frac{3}{4} = b$

$y > -\frac{5}{4}x + 1\frac{3}{4}$

45. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - (-2)}{6 - (-1)} = \frac{5}{7}$

$y = mx + b$

$3 = \frac{5}{7}(6) + b$

$-\frac{9}{7} = b$

$y \le \frac{5}{7}x - \frac{9}{7}$

46. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 0}{0 - (-4)} = \frac{2}{4} = \frac{1}{2}$

$y = mx + b$

$2 = \frac{1}{2}(0) + b$

$2 = b$

$y > \frac{1}{2}x + 2$

47–50. Answers will vary.

51. $(2, 5), (-3, -5)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5 - 5}{-3 - 2} = \frac{-10}{-5} = 2$

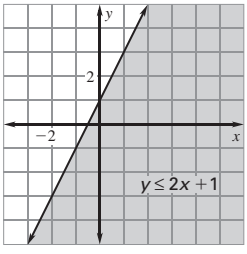
$y = mx + b$

$5 = 2(2) + b$

$1 = b$

$y = 2x + 1$

$y \le 2x + 1$



52. $(-7, -16), (1, 8)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{8 - (-16)}{1 - (-7)} = \frac{24}{8} = 3$

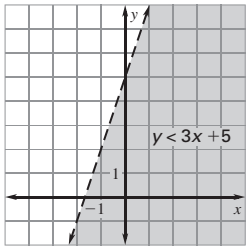
$y = mx + b$

$8 = (3)1 + b$

$5 = b$

$y = 3x + 5$

$y < 3x + 5$

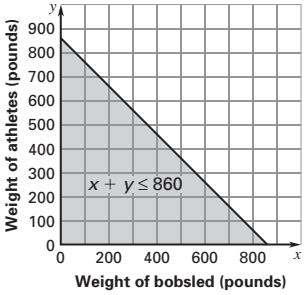


Problem Solving

53. $x + y \le 860$

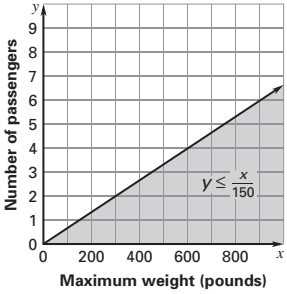
$y \le -x + 860$

A possible solution is the weight of the bobsled being 400 pounds and the weight of the athletes being 400 pounds. (Examples will vary.)



54. $y \le \frac{x}{150}$

If the elevator's maximum capacity is 400 pounds, it can hold 2 passengers. (Examples will vary.)



55. a. Let x = hours tutoring Spanish.

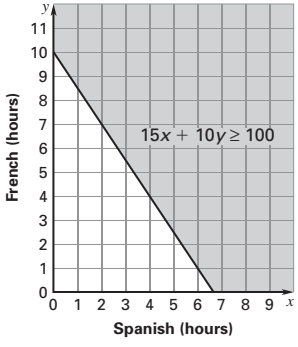
Let y = hours tutoring French.

$15x + 10y \ge 100$

b. $10y \ge -15x + 100$

$y \ge -\frac{3}{2}x + 10$

Possible combinations include: 10 hours tutoring Spanish and 5 hours tutoring French, 5 hours tutoring Spanish and 7 hours tutoring French, or 12 hours tutoring Spanish and 2 hours tutoring French. (Examples will vary.)



c.

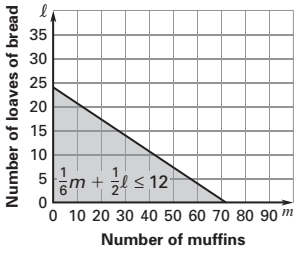
Hours Tutoring Spanish	Hours Tutoring French	Total Earned (dollars)
10	5	200
5	7	145
12	2	200

56. B; $x + y \leq 15$

57. a. $\frac{1}{6}m + \frac{1}{2}\ell \leq 12$

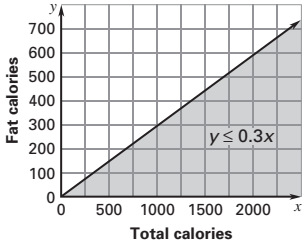
$\frac{1}{2}\ell \leq -\frac{1}{6}m + 12$

$\ell \leq -\frac{1}{3}m + 24$



b. If you make 4 loaves of bread, you can make up to 60 muffins.

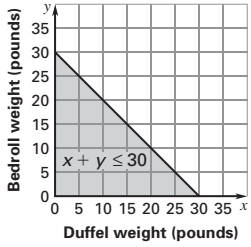
58. a. $y \leq 0.3x$



b. $600 - (2 \cdot 40 + 20) = 600 - 100 = 500$

You can consume up to 500 more fat calories today.

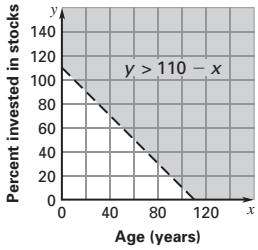
59. a. $x + y \leq 30$



Possible combinations: 10 pound duffel and a 15 pound bedroll, 15 pound duffel and a 10 pound bedroll, or a 20 pound duffel and a 5 pound bedroll. (Examples will vary.)

b. (0, 30) and (30, 0) are solutions to the inequality, but they do not make sense in this situation because neither the duffel nor the bedroll could weigh 0 pounds.

60. a. $y > 110 - x$



b. A 30 year-old agressive investor should invest over 80% in stocks.

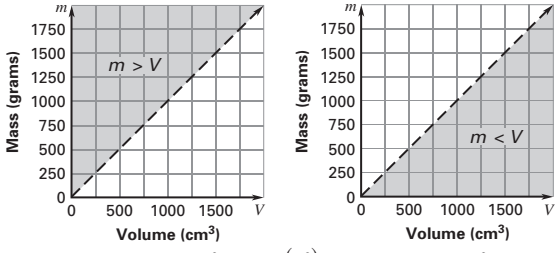
c. Prior to age 10, none of the solutions make sense because they say to invest over 100%.

61. a. Sinks:

$\frac{m}{v} > 1, m > v$

Floats:

$\frac{m}{v} < 1, m < v$



b. Volume $= \pi r^2 h = \pi (5^2)(10) = 785.4 \text{ cm}^3$

$m = 2119.5\text{g}$

Since its mass is greater than its volume, it will sink.

Quiz for the lessons "Solve Absolute Value Equations", "Solve Absolute Value Inequalities", and "Graph Linear Inequalities in Two Variables"

1. $|x| = 5$

$x = 5$ or $x = -5$

2. $|c - 8| = 24$

$c - 8 = 24$ or $c - 8 = -24$

$c = 32$ or $c = -16$

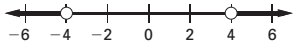
3. $-2|r - 5| = -6$

$|r - 5| = 3$

$r - 5 = 3$ or $r - 5 = -3$

$r = 8$ or $r = 2$

4. $|y| > 4$



$y < -4$ or $y > 4$

5. $|2t - 5| < 3$

$-3 < 2t - 5 < 3$

$2 < 2t < 8$

$1 < t < 4$

6. $4|3s + 7| - 5 \geq 7$

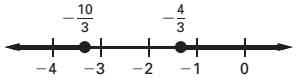
$4|3s + 7| \geq 12$

$|3s + 7| \geq 3$

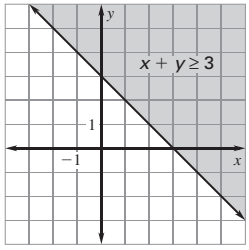
$3s + 7 \leq -3$ or $3s + 7 \geq 3$

$3s + 7 \leq -10$ or $3s \geq -4$

$s \leq -3\frac{1}{3}$ or $s \geq -1\frac{1}{3}$

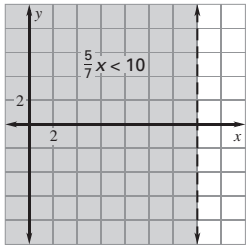


7. $x + y \geq 3$



8. $\frac{5}{7}x < 10$

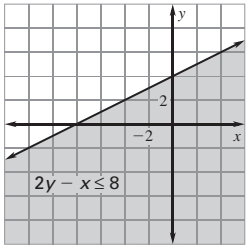
$x < 14$



9. $2y - x \leq 8$

$2y \leq x + 8$

$y \leq \frac{1}{2}x + 4$



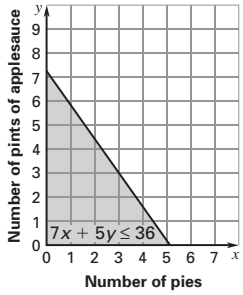
Mixed Review of Problem Solving for the lessons "Solve Absolute Value Equations", "Solve Absolute Value Inequalities", and "Graph Linear Inequalities in Two Variables"

1. a. Let x = number of apple pies.

Let y = pints of applesauce.

$7x + 5y \leq 36$

b.



c. Possible combinations include: 1 pie and 4 pints of applesauce, 3 pies and 2 pints of applesauce, or 2 pies and 3 pints of applesauce. (Examples will vary.)

2. a. $|x - 4| \leq 0.5$

$-0.5 \leq x - 4 \leq 0.5$

$3.5 \leq x \leq 4.5$

Each scoop must weigh from 3.5 to 4.5 ounces.

b. 8 of the 10 scoops must weigh in the correct range in order for 80% to meet the weight requirement. 8 of your scoops do meet the weight requirement, so you can start working at the shop.

3. $|x - 15| \leq 1.5$

$-1.5 \leq x - 15 \leq 1.5$

$13.5 \leq x \leq 16.5$

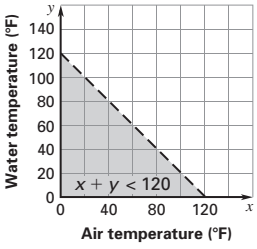
The maximum possible duration of your presentation is 16.5 minutes.

4. Answers will vary.

5. a. Let x = air temperature.

Let y = water temperature.

$x + y < 120$



b. If the water temperature is 40°, a protective suit is recommended for air temperatures below 80°F.

c. The y-intercept would be 100, and the x-intercept would be 100, instead of 120. This would represent the sum of the air and water temperatures being less than 100°F.

6. a. $\bar{x} = \frac{139 + 249 + 229 + 199 + 179 + 359 + 199 + 209}{8}$

$= 220.25$

The mean price is $220.25.

b. $|x - 220.25| \leq 50$

$-50 \leq x - 220.25 \leq 50$

$170.25 \leq x \leq 270.25$

You will consider phones priced from $170.25 to $270.25.

c. You will consider 6 of the phones on the website.

Chapter Review for the chapter "Solving and Graphing Linear Inequalities"

1. $|x - 19| = 8$

2. $2x - 3y \geq -10$

(1, 4), (2, 1), (3, 2)

Answers will vary.

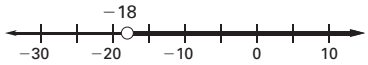
3. The boundary line is a solid line if the inequality sign is "less than or equal to" or "greater than or equal to". The boundary line is a dashed line if the inequality sign is "less than" or "greater than". You know which half-plane

to shade by choosing a point in one of the half-planes and testing to see if it is a solution of the inequality. If it is a solution, shade the half-plane where that point lies. If it is not a solution, shade the other half-plane.

4. $x > -10$

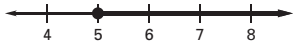
5. $x + 5 > -13$

$x > -18$



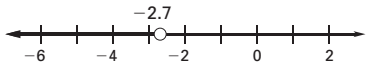
6. $m - 9 \geq -4$

$m \geq 5$



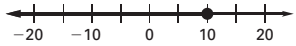
7. $s + 3.7 < 1$

$s < -2.7$



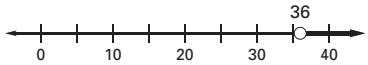
8. $\frac{p}{2} \leq 5$

$p \leq 10$



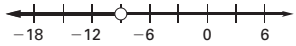
9. $\frac{n}{-4.5} < -8$

$n > 36$



10. $-3x > 27$

$x < -9$

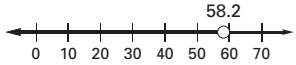


11. $2y \geq 18$

$y \geq 9$

12. $\frac{x}{6} \leq 9.7$

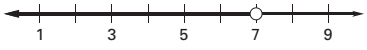
$x \leq 58.2$



13. $2g + 11 < 25$

$2g < 14$

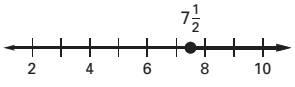
$g < 7$



14. $\frac{2}{3}r - 4 \geq 1$

$\frac{2}{3}r \geq 5$

$r \geq 7.5$



15. $1 - 3x \leq -14 + 2x$

$15 \leq 5x$

$3 \leq x$

$x \geq 3$

16. $3(q + 1) < 3q + 7$

$3q + 3 < 3q + 7$

$3 < 7$

The solution is all real numbers.

17. $8(t - 1) > -8 + 8t$

$8t - 8 > -8 + 8t$

$-8 > -8$

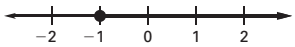
The statement is false, so the inequality has no solution.

18. $-3(2n - 1) \geq 1 - 8n$

$-6n + 3 \geq 1 - 8n$

$2n \geq -2$

$n \geq -1$



19. Let x = number of tickets.

$7x + 4 \leq 40$

$7x \leq 36$

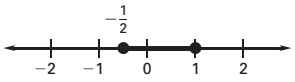
$x \leq 5.14$

You can buy up to 5 tickets.

20. $-6 \leq 2t - 5 \leq -3$

$-1 \leq 2t \leq 2$

$-\frac{1}{2} \leq t \leq 1$

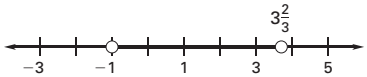


21. $-3 < -3x + 8 < 11$

$-11 < -3x < 3$

$3\frac{2}{3} > x > -1$

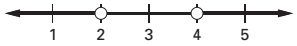
$-1 < x < 3\frac{2}{3}$



22. $9s - 6 < 12$ or $3s + 1 > 13$

$9s < 18$ or $3s > 12$

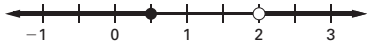
$s < 2$ or $s > 4$



23. $-4w + 12 \geq 10$ or $5w - 14 > -4$

$-4w \geq -2$ or $5w > 10$

$w \leq \frac{1}{2}$ or $w > 2$



24. $|r| = 7$

$r = 7$ or $r = -7$

25. $|a + 6| = 2$

$a + 6 = 2$ or $a + 6 = -2$

$a = -4$ or $a = -8$

26. $|2c + 5| = 21$

$2c + 5 = 21$ or $2c + 5 = -21$

$2c = 16$ or $2c = -26$

$c = 8$ $c = -13$

27. $2|x-3|+1=5$

$2|x-3|=4$

$|x-3|=2$

$x-3=2$ or $x-3=-2$

$x=5$ or $x=1$

28. $3|2q+1|-5=1$

$3|2q+1|=6$

$|2q+1|=2$

$2q+1=2$ or $2q+1=-2$

$2q=1$ or $2q=-3$

$q=\frac{1}{2}$ $\quad q=-\frac{3}{2}$

29. $4|3p-2|+5=11$

$4|3p-2|=6$

$|3p-2|=\frac{3}{2}$

$3p-2=\frac{3}{2}$ or $3p-2=-\frac{3}{2}$

$3p=\frac{7}{2}$ or $3p=\frac{1}{2}$

$p=\frac{7}{6}$ or $p=\frac{1}{6}$

30. $|x-15|=0.03125$

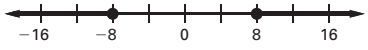
$x-15=0.03125$ or $x-15=-0.03125$

$x=15.03125$ or $x=14.96875$

The minimum height is 14.96875 inches, and the maximum height is 15.03125 inches.

31. $|m|\geq 8$

$m\leq -8$ or $m\geq 8$

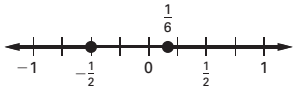


32. $|6k+1|\geq 2$

$6k+1\leq -2$ or $6k+1\geq 2$

$6k\leq -3$ or $6k\geq 1$

$k\leq -\frac{1}{2}$ or $k\geq \frac{1}{6}$



33. $|3g-2|<5$

$-5<3g-2<5$

$-3<3g<7$

$-1<g<2\frac{1}{3}$

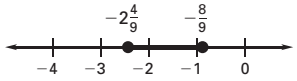
34. $6|3x+5|\leq 14$

$|3x+5|\leq 2\frac{1}{3}$

$-2\frac{1}{3}\leq 3x+5\leq 2\frac{1}{3}$

$-7\frac{1}{3}\leq 3x\leq -2\frac{2}{3}$

$-2\frac{4}{9}\leq x\leq -\frac{8}{9}$



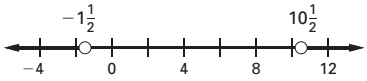
35. $|2j-9|-2>10$

$|2j-9|>12$

$2j-9<-12$ or $2j-9>12$

$2j<-3$ or $2j>21$

$j<-1\frac{1}{2}$ or $j>10\frac{1}{2}$



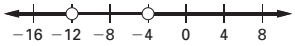
36. $5|d+8|-7>13$

$5|d+8|>20$

$|d+8|>4$

$d+8<-4$ or $d+8>4$

$d<-12$ or $d>-4$



37. $-3x+2y\geq 16$; $(-2, 8)$

$-3(-2)+2(8)\geq 16$

$22\geq 16$ ✓

$(-2, 8)$ is a solution.

38. $-3x+2y\geq 16$; $(-1, -1)$

$-3(-1)+2(-1)\geq 16$

$1\geq 16$ ✗

$(-1, -1)$ is not a solution.

39. $-3x+2y\geq 16$; $(-2, 10)$

$-3(-2)+2(10)\geq 16$

$26\geq 16$ ✓

$(-2, 10)$ is a solution.

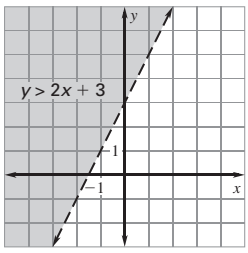
40. $-3x+2y\geq 16$; $(9, -5)$

$-3(9)+2(-5)\geq 16$

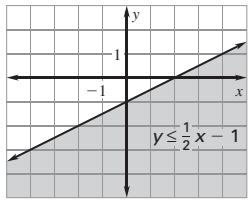
$-37\geq 16$ ✗

$(9, -5)$ is not a solution.

41. $y>2x+3$



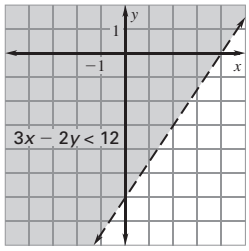
42. $y\leq \frac{1}{2}x-1$



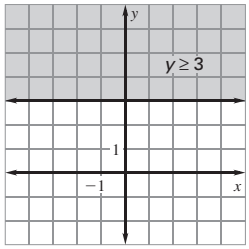
43. $3x - 2y < 12$

$-2y < -3x + 12$

$y > \frac{3}{2}x - 6$



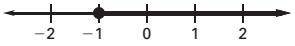
44. $y \geq 3$



Chapter Test for the chapter "Solving and Graphing Linear Inequalities"

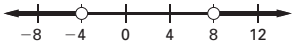
1. $x < 5$

2. $x \geq -1$



3. $-2 < x \leq 7$

4. $x > 8$ or $x < -4$



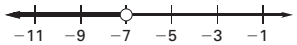
5. $x - 9 \geq -5$

$x \geq 4$

6. $-2 > 5 + y$

$-7 > y$

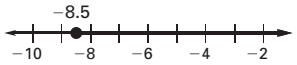
$y < -7$



7. $-0.8 \leq z + 7.7$

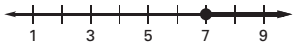
$-8.5 \leq z$

$z \geq -8.5$



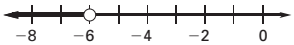
8. $5m \geq 35$

$m \geq 7$



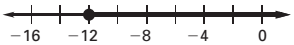
9. $\frac{n}{6} < -1$

$n < -6$



10. $\frac{r}{-3} \leq 4$

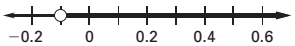
$r \geq -12$



11. $-4s < 6s + 1$

$-10s < 1$

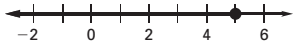
$s > -\frac{1}{10}$



12. $4t - 7 \leq 13$

$4t \leq 20$

$t \leq 5$

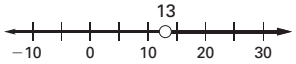


13. $-8 > 5 - v$

$-13 > -v$

$13 < v$

$v > 13$

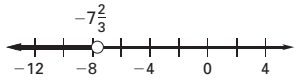


14. $3(5w + 4) < 12w - 11$

$15w + 12 < 12w - 11$

$3w < -23$

$w < -7\frac{2}{3}$



15. $4p - 3 > 2(2p + 1)$

$4p - 3 > 4p + 2$

$-3 > 2$

The inequality has no solution.

16. $9q - 12 \geq 3(3q - 4)$

$9q - 12 \geq 9q - 12$

$-12 \geq -12$

The solution is all real numbers.

17. $-2 \leq 4 - 3a \leq 13$

$-6 \leq -3a \leq 9$

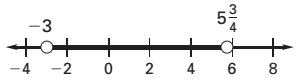
$2 \geq a \geq -3$

$-3 \leq a \leq 2$

18. $-7 < 2c - 1 < 10\frac{1}{2}$

$-6 < 2c < 11\frac{1}{2}$

$-3 < c < 5\frac{3}{4}$

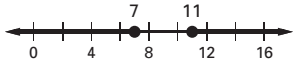


19. $-5 \leq 2 - h$ or $6h + 5 \geq 71$

$-7 \leq -h$ or $6h \geq 66$

$7 \geq h$ or $h \geq 11$

$h \leq 7$ or $h \geq 11$

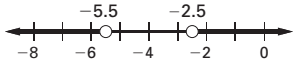


20. $|2d + 8| > 3$

$2d + 8 < -3$ or $2d + 8 > 3$

$2d < -11$ or $2d > -5$

$d < -5\frac{1}{2}$ or $d > -2\frac{1}{2}$



21. $2|3f - 7| + 5 < 11$

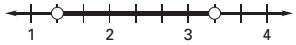
$2|3f - 7| < 6$

$|3f - 7| < 3$

$-3 < 3f - 7 < 3$

$4 < 3f < 10$

$1\frac{1}{3} < f < 3\frac{1}{3}$

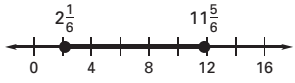


22. $|j - 7| - 1 \le 3\frac{5}{6}$

$|j - 7| \le 4\frac{5}{6}$

$-4\frac{5}{6} \le j - 7 \le 4\frac{5}{6}$

$2\frac{1}{6} \le j \le 11\frac{5}{6}$



23. $-\frac{3}{4}|x - 3| = \frac{1}{4}$

$|x - 3| = -\frac{1}{3}$

The equation has no solution because an absolute value cannot be equal to a negative number.

24. $|3y + 1| - 6 = -2$

$|3y + 1| = 4$

$3y + 1 = 4$ or $3y + 1 = -4$

$3y = 3$ or $3y = -5$

$y = 1$ or $y = -\frac{5}{3}$

25. $4|2z + 5| + 9 = 5$

$4|2z + 5| = -4$

$|2z + 5| = -1$

The equation has no solution because an absolute value cannot be equal to a negative number.

26. $2x - y < 4$; $(2, -1)$

$2(2) - (-1) < 4$

$5 < 4$ ✗

$(2, -1)$ is not a solution.

27. $y + 3x \ge -5$, $(-3, -4)$

$-4 + 3(-3) \ge -5$

$-13 \ge -5$ ✗

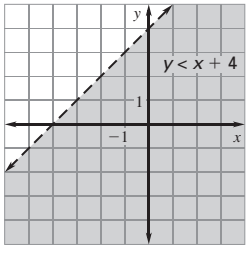
$(-3, -4)$ is not a solution.

28. $y \le -3$; $(4, -7)$

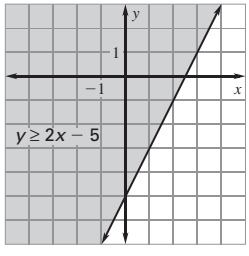
$-7 \le -3$ ✓

$(4, -7)$ is a solution.

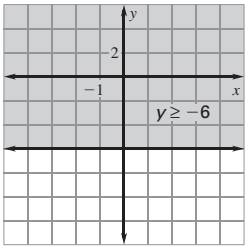
29. $y < x + 4$



30. $y \ge 2x - 5$



31. $y \ge -6$



32. Let r = revenues ($).

$r - 155 \ge 250$

$r \ge 405$

Your friend must earn at least $405.

33. $|x - 0.3| \le 0.0003$

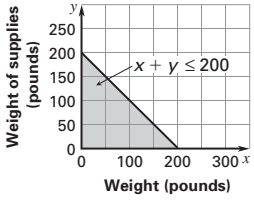
$-0.0003 \le x - 0.3 \le 0.0003$

$0.2997 \le x \le 0.3003$

The widths of the bicycle chains can be 0.2997 inches to 0.3003 inches.

34. a. $x + y \le 0.2(1000)$

$x + y \le 200$



b. A possible solution is that you weigh 140 pounds and your supplies weigh 20 pounds. (Examples will vary.)

Extra Practice for the chatper "Solving and Graphing Linear Inequalities"

1. $y - 2 > 3$

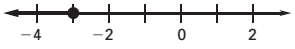
$y - 2 + 2 > 3 + 2$

$y > 5$

2. $5 + x \le 2$

$5 - 5 + x \le 2 - 5$

$x \le -3$



3. $4 \ge x - 3$

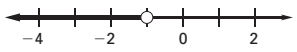
$4 + 3 \ge x - 3 + 3$

$7 \ge x$

4. $m + 3 < 2$

$m + 3 - 3 < 2 - 3$

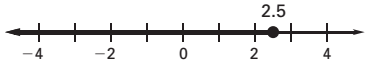
$m < -1$



5. $2 + n \le 4\frac{1}{2}$

$2 - 2 + n \le 4\frac{1}{2} - 2$

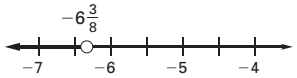
$n \le 2\frac{1}{2}$



6. $2\frac{3}{4} + n < -3\frac{5}{8}$

$2\frac{3}{4} - 2\frac{3}{4} + n < -3\frac{5}{8} - 2\frac{3}{4}$

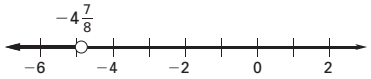
$n < -6\frac{3}{8}$



7. $1\frac{7}{8} > 6\frac{3}{4} + z$

$1\frac{7}{8} - 6\frac{3}{4} > 6\frac{3}{4} - 6\frac{3}{4} + z$

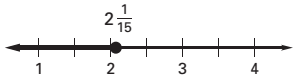
$-4\frac{7}{8} > z$



8. $3\frac{2}{5} \ge 1\frac{1}{3} + k$

$3\frac{2}{5} - 1\frac{1}{3} \ge 1\frac{1}{3} - 1\frac{1}{3} + k$

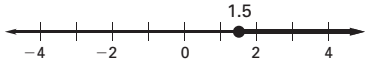
$2\frac{1}{15} \ge k$



9. $-8.5 \le t - 10$

$-8.5 + 10 \le t - 10 + 10$

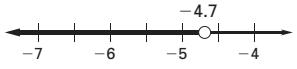
$1.5 \le t$



10. $r + 4 < -0.7$

$r + 4 - 4 < -0.7 - 4$

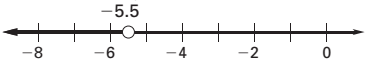
$r < -4.7$



11. $-6.9 > -1.4 + y$

$-6.9 + 1.4 > -1.4 + 1.4 + y$

$-5.5 > y$

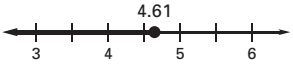


12. $1.48 - m \ge -3.13$

$1.48 - 1.48 - m \ge -3.13 - 1.48$

$-m \ge -4.61$

$m \le 4.61$



13. $3p \le 27$

$\frac{3p}{3} \le \frac{27}{3}$

$p \le 9$

14. $-13t > 26$

$\frac{-13t}{-13} < \frac{26}{-13}$

$t < -2$

15. $\frac{x}{3} \ge 2$

$3 \cdot \frac{x}{3} \ge 3 \cdot 2$

$x \ge 6$

16. $\frac{y}{-2} < 5$

$-2 \cdot \frac{y}{-2} > -2 \cdot 5$

$y > -10$

17. $-6m \ge -9$

$\frac{-6m}{-6} \le \frac{-9}{-6}$

$m \le \frac{3}{2}$

18. $-3 \ge \frac{n}{2}$

$2 \cdot (-3) \ge 2 \cdot \frac{n}{2}$

$-6 \ge n$

19. $0.3z \le 2.4$

$\frac{0.3z}{0.3} \le \frac{2.4}{0.3}$

$z \le 8$

20. $25 > -2.5s$

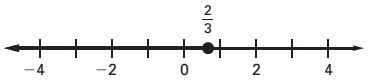
$\frac{25}{-2.5} < \frac{-2.5s}{-2.5}$

$-10 < s$

21. $4.8z \le 3.2$

$\frac{4.8z}{4.8} \le \frac{3.2}{4.8}$

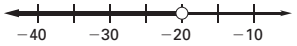
$z \le \frac{2}{3}$



22. $0.09d < -1.8$

$\frac{0.09d}{0.09} < \frac{-1.8}{0.09}$

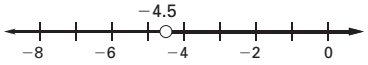
$d < -20$



23. $\frac{y}{0.3} > -15$

$0.3 \cdot \frac{y}{0.3} > 0.3(-15)$

$y > -4.5$



24. $-1.8t < 9$

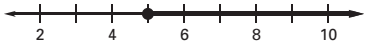
$\frac{-1.8t}{-1.8} > \frac{9}{-1.8}$

$t > -5$

25. $3x + 5 \ge 20$

$3x \ge 15$

$x \ge 5$



26. $6z - 5 < 13$

$6z < 18$

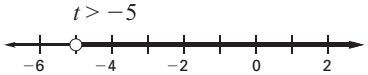
$z < 3$

27. $8(t + 4) > -8$

$8t + 32 > -8$

$8t > -40$

$t > -5$

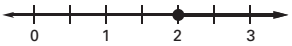


28. $7 - 8n \le 4n - 17$

$7 \le 12n - 17$

$24 \le 12n$

$2 \le n$

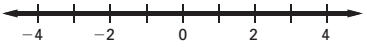


29. $8(m + 2) < 4(5 + 2m)$

$8m + 16 < 20 + 8m$

$16 < 20$

All real numbers are solutions because $16 < 20$ is true.

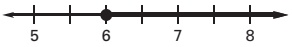


30. $6d - 4 - 3d \ge 14$

$3d - 4 \ge 14$

$3d \ge 18$

$d \ge 6$

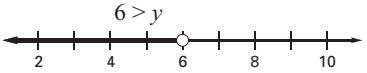


31. $\frac{2}{3}y + 28 > 20 + 2y$

$\frac{2}{3}y + 8 > 2y$

$8 \ge 1\frac{1}{3}y$

$6 > y$

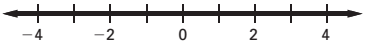


32. $6(-5 + 3p) \ge 3(6p - 10)$

$-30 + 18p \ge 18p - 30$

$-30 \ge -30$

All real numbers are solutions because $-30 \ge -30$ is true.



33. $\frac{5}{6}(12z - 24) > \frac{2}{5}(25z - 25)$

$10z - 20 > 10z - 10$

$-20 > -10$

There are no solutions because $-20 > -10$ is false.

34. $2 \le y - 4 < 7$

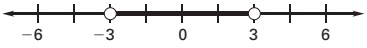
$2 + 4 \le y - 4 + 4 < 7 + 4$

$6 \le y < 11$

35. $-27 < 9x < 27$

$-\frac{27}{9} < \frac{9x}{9} < \frac{27}{9}$

$-3 < x < 3$



36. $2 < 6z - 10 < 20$

$2 + 10 < 6z - 10 + 10 < 20 + 10$

$12 < 6z < 30$

$\frac{12}{6} < \frac{6z}{6} < \frac{30}{6}$

$2 < z < 5$

37. $15 < \frac{5}{9}(18a - 9) \leq 30$

$\frac{9}{5} \cdot 15 < \frac{9}{5} \cdot \frac{5}{9}(18a - 9) \leq \frac{9}{5} \cdot 30$

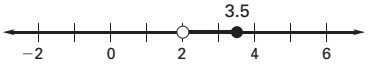
$27 < 18a - 9 \leq 54$

$27 + 9 < 18a - 9 + 9 \leq 54 + 9$

$36 < 18a \leq 63$

$\frac{36}{18} < \frac{18a}{18} \leq \frac{63}{18}$

$2 < a \leq 3\frac{1}{2}$

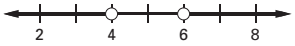


38. $2v > 12$ or $v + 2 < 6$

$2v > 12$ or $v + 2 < 6$

$\frac{2v}{2} > \frac{12}{2}$ or $v + 2 - 2 < 6 - 2$

$v > 6$ or $v < 4$



39. $3r + 7 < -5$ or $32 \leq 7r + 46$

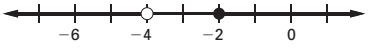
$3r + 7 < -5$ or $32 \leq 7r + 46$

$3r + 7 - 7 < -5 - 7$ or $32 - 46 \leq 7r + 46 - 46$

$3r < -12$ or $-14 \leq 7r$

$\frac{3r}{3} < \frac{-12}{3}$ or $-\frac{14}{7} \leq \frac{7r}{7}$

$r < -4$ or $-2 \leq r$



40. $-4m < 8$ or $2m - 2 < -12$

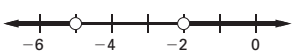
$-4m < 8$ or $2m - 2 < -12$

$\frac{-4m}{-4} > \frac{8}{-4}$ or $2m - 2 + 2 < -12 + 2$

$m > -2$ or $2m < -10$

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

$m < -5$



41. $9t - 20 \geq 4t$ or $4 < -\frac{1}{2}t$

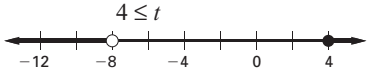
$9t - 20 \geq 4t$ or $4 < -\frac{1}{2}t$

$9t - 9t - 20 \geq 4t - 9t$ or $-2 \cdot 4 > -2 \cdot \left(-\frac{1}{2}\right)t$

$-20 \geq -5t$ or $-8 > t$

$\frac{-20}{-5} \leq \frac{-5t}{-5}$

$4 \leq t$



42. $-n - 1 > 1$ or $2n + 8 > n + 8$

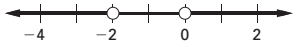
$-n - 1 > 1$ or $2n + 8 > n + 8$

$-n - 1 + 1 > 1 + 1$ or $2n - n + 8 > n - n + 8$

$-n > 2$ $\quad n + 8 > 8$

$\frac{-n}{-1} < \frac{2}{-1}$ $\quad n + 8 - 8 > 8 - 8$

$n < -2$ $\quad n > 0$



43. $|x| = 8$

The distance between x and 0 is 8. So $x = 8$ and $x = -8$. The solutions are 8 and -8.

44. $|y| = -10$

The absolute value of a number is never negative. So, there is no solution.

45. $|m + 6| = 5$

$m + 6 = 5$ or $m + 6 = -5$

$m = -1$ or $m = -11$

The solutions are -11 and -1.

46. $|4z - 2| = 14$

$4z - 2 = 14$ or $4z - 2 = -14$

$4z = 16$ or $4z = -12$

$z = 4$ or $z = -3$

The solutions are -3 and 4.

47. $|t - 7| = 21$

$t - 7 = 21$ or $t - 7 = -21$

$t = 28$ or $t = -14$

The solutions are -14 and 28.

48. $6|z - 4| = 36$

$|z - 4| = 6$

$z - 4 = 6$ or $z - 4 = -6$

$z = 10$ or $z = -2$

The solutions are -2 and 10.

49. $4|6s + 11| = -52$

$|6s + 11| = -13$

The absolute value of a number is never negative. So, there is no solution.

50. $r + 3 - 16 = -4$

$|r + 3| = 12$

$r + 3 = 12$ or $r + 3 = -12$

$r = 9$ or $r = -15$

The solutions are -15 and 9.

51. $|5r| + 10 = 15$

$|5r| = 5$

$5r = 5$ or $5r = -5$

$r = 1$ or $r = -1$

The solutions are -1 and 1.

52. $2|3s + 4| = 14$

$|3s + 4| = 7$

$3s + 4 = 7$ or $3s + 4 = -7$

$3s = 3$ or $3s = -11$

$s = 1$ or $s = -3\frac{2}{3}$

The solutions are $-3\frac{2}{3}$ and 1.

53. $-4|7v + 2| = 32$

$|7v + 2| = -8$

The absolute value of a number is never negative. So, there is no solution.

54. $12\left|\frac{5}{6}w - 4\right| - 4 = 8$

$12\left|\frac{5}{6}w - 4\right| = 12$

$\left|\frac{5}{6}w - 4\right| = 1$

$\frac{5}{6}w - 4 = 1$ or $\frac{5}{6}w - 4 = -1$

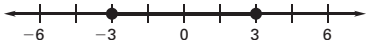
$\frac{5}{6}w = 5$ or $\frac{5}{6}w = 3$

$w = 6$ or $w = 3\frac{3}{5}$

The solutions are $3\frac{3}{5}$ and 6.

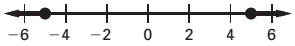
55. $1 \times 1 \leq 3$

The distance between x and 0 is less than or equal to 3. So, $-3 \leq x \leq 3$.



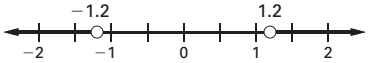
56. $|y| \geq 5$

The distance between y and 0 is greater or equal to 5. So, $y \leq -5$ or $y \geq 5$.



57. $|s| > 1.2$

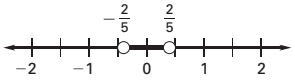
The distance between s and 0 is greater than 1.2. So, $s < -1.2$ or $s > 1.2$.



58. $|q| < \frac{2}{5}$

The distance between q and 0 is less than $\frac{2}{5}$.

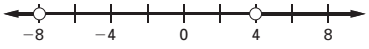
So, $-\frac{2}{5} < q < \frac{2}{5}$.



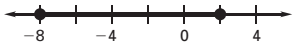
59. $|x + 2| > 6$

$x + 2 > 6$ or $x + 2 < -6$

$x > 4$ or $x < -8$



60. $|y + 3| \leq 5$



$-5 \leq y + 3 \leq 5$

$-8 \leq y \leq 2$

61. $|8 - m| < 3$

$-3 < 8 - m < 3$

$-11 < -m < -5$

$11 > m > 5$

$5 < m < 11$

62. $|4n - 1| \geq 7$

$4n - 1 \geq 7$ or $4n - 1 \leq -7$

$4n \geq 8$ or $4n \leq -6$

$n \geq 2$ or $n \leq -\frac{3}{2}$

63. $3|p - 3| \leq 12$

$|p - 3| \leq 4$

$-4 \leq p - 3 \leq 4$

$-1 \leq p \leq 7$

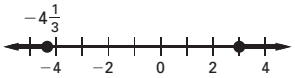
64. $|3q + 2| - 3 \geq 8$

$|3q + 2| \geq 11$

$3q + 2 \geq 11$ or $3q + 2 \leq -11$

$3q \geq 9$ or $3q \leq -13$

$q \geq 3$ or $q \leq -4\frac{1}{3}$



65. $2|5a - 1| + 3 \leq 11$

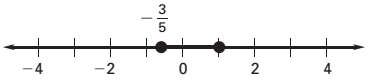
$2|5a - 1| \leq 8$

$|5a - 1| \leq 4$

$-4 \leq 5a - 1 \leq 4$

$-3 \leq 5a \leq 5$

$-\frac{3}{5} \leq a \leq 1$



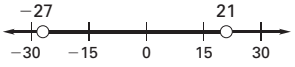
66. $4\left|\frac{2}{3}c + 2\right| < 64$

$\left|\frac{2}{3}c + 2\right| < 16$

$-16 < \frac{2}{3}c + 2 < 16$

$-18 < \frac{2}{3}c < 14$

$-27 < c < 21$



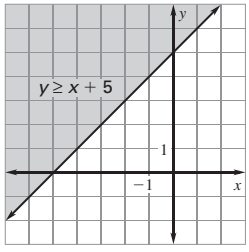
67. $y \geq x + 5$

Test (0, 0) in $y \geq x + 5$.

$0 \stackrel{?}{\geq} (0) + 5$

$0 \not\geq 5$

The side that does not contain (0, 0) should be shaded.



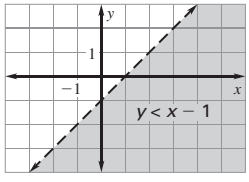
68. $y < x - 1$

Test (0, 0) in $y < x - 1$.

$0 \stackrel{?}{<} 0 - 1$

$0 \not< -1$

Shade the half-plane that does not contain (0, 0).



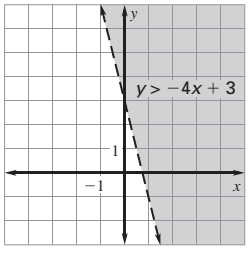
69. $4x + y > 3$

Test (0, 0) in $4x + y > 3$.

$4(0) + (0) \stackrel{?}{>} 3$

$0 \not> 3$

Shade the half-plane that does not contain (0, 0).



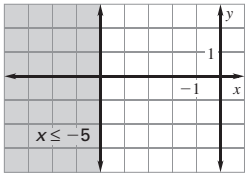
70. $x \leq -5$

Test (2, 2) in $x \leq -5$.

$(2) \stackrel{?}{\leq} -5$

$2 \not< -5$

Shade the half-plane that does not contain (2, 2).



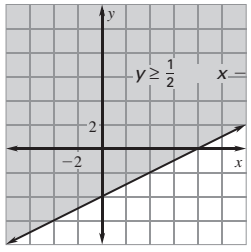
71. $3(x - 8) \leq 6y$

Test (2, 2) in $3(x - 8) \leq 6y$

$3(2 - 8) \stackrel{?}{\leq} 6(2)$

$-18 \leq 12$

Shade the half-plane that contains the point (2, 2).



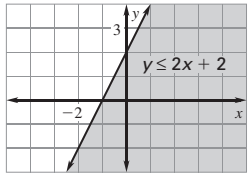
72. $2x - y \geq -2$

Test (2, 0) in $2x - y \geq -2$

$2(2) - 0 \stackrel{?}{\geq} -2$

$4 \geq -2$

Shade the half-plane that contains the point (2, 0).

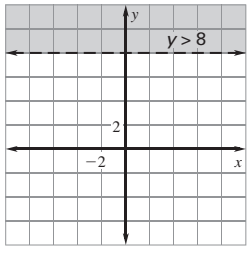


73. $y > 8$

Test (0, 0) in $y > 8$

$0 \not> 8$

Shade the half-plane that does not contain the point (0, 0).



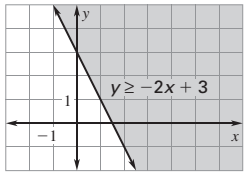
74. $2(x - 1) \geq 1 - y$

Test (0, 0) in $2(x - 1) \geq 1 - y$

$2(0 - 1) \stackrel{?}{\geq} 1 - (0)$

$-2 \not\geq 1$

Shade the half-plane that does not contain the point (0, 0).



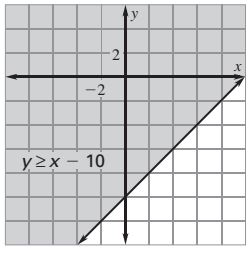
75. $x - 8 \leq y + 2$

Test (0, 0) in $x - 8 \leq y + 2$

$0 - 8 \stackrel{?}{\leq} 0 + 2$

$-8 \leq 2$

Shade the half-plane that contains the point (0, 0).



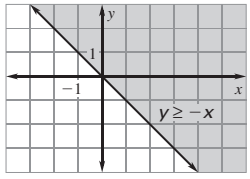
76. $2x \geq -2y$

Test (1, 1) in $2x \geq -2y$

$2(1) \stackrel{?}{\geq} -2(1)$

$2 \geq -2$

Shade the half-plane that contains the point (1, 1).



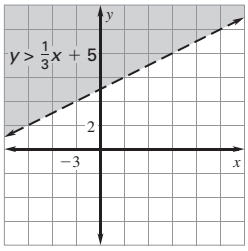
77. $3(y - 8) > x - 9$

Test (0, 0) in $3(y - 8) > x - 9$

$$3(0 - 8) \stackrel{?}{\geq} 0 - 9$$

$$-24 \not> -9$$

Shade the half-plane that does not contain the point (0, 0).

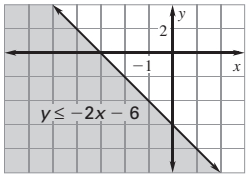


78. $2(-x - 1) \geq 4 + y$

Test (0, 0) in $2(-x - 1) \geq 4 + y$

$$2(-(0) - 1) \stackrel{?}{\geq} 4 + (0)$$

$$-2 \not\geq 4$$



Shade the half-plane that does not contain the point (0, 0).