

19. Verbal Model:  $\boxed{\text{Work done}} = \boxed{\text{Portion done by first person}} + \boxed{\text{Portion done by second person}}$

Labels: Work done = 1  
 Rate of first person =  $\frac{1}{6}$   
 Rate of second person =  $\frac{1}{8}$   
 Time for both =  $t$

Equation:  $1 = \left(\frac{1}{6}\right)(t) + \left(\frac{1}{8}\right)(t)$   
 $1 = \left(\frac{1}{6} + \frac{1}{8}\right)(t)$   
 $1 = \left(\frac{14}{48}\right)(t)$   
 3.43 hours  $\approx \frac{24}{7} = \frac{48}{14} = t$

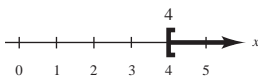
20. Perimeter of square I = 20	Perimeter of square II = 32
$4s = 20$	$4s = 32$
$s = 5$	$s = 8$
Length of side of square III = 5 + 8	Area = $s^2$
= 13	= $13^2$
	= 169 square inches

### Section 1.4 Linear Inequalities

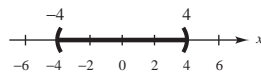
1. (a) $7(3) - 10 > 0$	(b) $7(-2) - 10 > 0$	(c) $7\left(\frac{5}{2}\right) - 10 > 0$	(d) $7\left(\frac{1}{2}\right) - 10 > 0$
$21 - 10 > 0$	$-14 - 10 > 0$	$\frac{35}{2} - 10 > 0$	$\frac{7}{2} - 10 > 0$
$11 > 0$	$-24 > 0$	$\frac{35}{2} - \frac{20}{2} > 0$	$\frac{7}{2} - \frac{20}{2} > 0$
Yes	No	$\frac{15}{2} > 0$	$-\frac{13}{2} > 0$
		Yes	No

3. (a) $0 < \frac{10+5}{6} < 2$	(b) $0 < \frac{4+5}{6} < 2$	(c) $0 < \frac{0+5}{6} < 2$	(d) $0 < \frac{-6+5}{6} < 2$
$0 < \frac{15}{6} < 2$	$0 < \frac{9}{6} < 2$	$0 < \frac{5}{6} < 2$	$0 < \frac{-1}{6} < 2$
$0 < 2\frac{3}{6} < 2$	$0 < 1\frac{3}{6} < 2$	Yes	No
No	Yes		

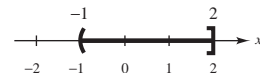
5. Matches graph (d).



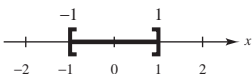
7. Matches graph (a).



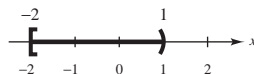
9. Matches graph (f).



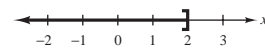
11. Matches graph (a).



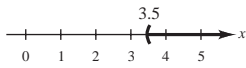
13. Matches graph (d).



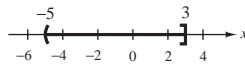
15.  $x \leq 2$



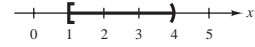
17.  $x > 3.5$



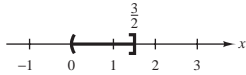
19.  $-5 < x \leq 3$



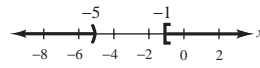
21.  $4 > x \geq 1$



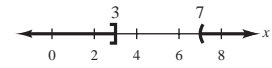
23.  $\frac{3}{2} \geq x > 0$



25.  $x < -5$  or  $x \geq -1$



27.  $x \leq 3$  or  $x > 7$



$$29. \quad 5 - \frac{1}{3}x > 8$$

$$-3\left(5 - \frac{1}{3}x\right) < (8) - 3$$

$$-15 + x < -24$$

$$31. \quad x - 4 \geq 0$$

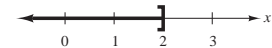
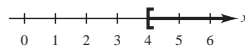
$$x - 4 + 4 \geq 0 + 4$$

$$x \geq 4$$

$$33. \quad x + 7 \leq 9$$

$$x + 7 - 7 \leq 9 - 7$$

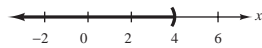
$$x \leq 2$$



35.  $2x < 8$

$$\frac{2x}{2} < \frac{8}{2}$$

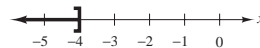
$$x < 4$$



37.  $-9x \geq 36$

$$\frac{-9x}{-9} \leq \frac{36}{-9}$$

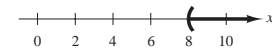
$$x \leq -4$$



39.  $-\frac{3}{4}x < -6$

$$-\frac{4}{3} \cdot -\frac{3}{4}x > -6 \cdot -\frac{4}{3}$$

$$x > 8$$



$$41. \quad 5 - x \leq -2$$

$$5 - x - 5 \leq -2 - 5$$

$$-x \leq -7$$

$$-1 \cdot x \geq -7 \cdot -1$$

$$x \geq 7$$



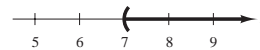
$$43. \quad 2x - 5 > 9$$

$$2x - 5 + 5 > 9 + 5$$

$$2x > 14$$

$$\frac{2x}{2} > \frac{14}{2}$$

$$x > 7$$



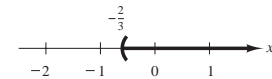
$$45. \quad 5 - 3x < 7$$

$$5 - 3x - 5 < 7 - 5$$

$$-3x < 2$$

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

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



$$47. \quad 3x - 11 > -x + 7$$

$$3x - 11 + x > -x + 7 + x$$

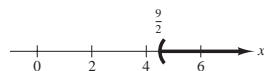
$$4x - 11 > 7$$

$$4x - 11 + 11 > 7 + 11$$

$$4x > 18$$

$$\frac{4x}{4} > \frac{18}{4}$$

$$x > \frac{9}{2}$$



$$49. \quad -3x + 7 < 8x - 13$$

$$-3x - 8x + 7 < 8x - 8x - 13$$

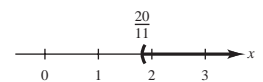
$$-11x + 7 < -13$$

$$-11x + 7 - 7 < -13 - 7$$

$$-11x < -20$$

$$\frac{-11x}{-11} > \frac{-20}{-11}$$

$$x > \frac{20}{11}$$



51.  $\frac{x}{4} > 2 - \frac{x}{2}$

$$4\left(\frac{x}{4}\right) > \left(2 - \frac{x}{2}\right)4$$

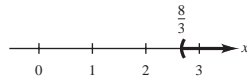
$$x > 8 - 2x$$

$$x + 2x > 8 - 2 + 2x$$

$$3x > 8$$

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

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



53.  $\frac{x-4}{3} + 3 \leq \frac{x}{8}$

$$24\left(\frac{x-4}{3} + 3\right) \leq \left(\frac{x}{8}\right)24$$

$$8(x-4) + 72 \leq 3x$$

$$8x - 32 + 72 \leq 3x$$

$$8x + 40 \leq 3x$$

$$8x - 3x + 40 \leq 3x - 3x$$

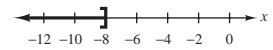
$$5x + 40 \leq 0$$

$$5x + 40 - 40 \leq 0 - 40$$

$$5x \leq -40$$

$$\frac{5x}{5} \leq \frac{-40}{5}$$

$$x \leq -8$$



55.  $\frac{3x}{5} - 4 < \frac{2x}{3} - 3$

$$15\left(\frac{3x}{5} - 4\right) < \left(\frac{2x}{3} - 3\right)15$$

$$9x - 60 < 10x - 45$$

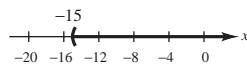
$$9x - 10x - 60 < 10x - 45 - 10x$$

$$-x - 60 < -45$$

$$-x - 60 + 60 < -45 + 60$$

$$-x < 15$$

$$x > -15$$



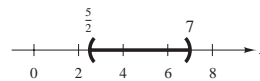
57.  $0 < 2x - 5 < 9$

$$0 + 5 < 2x - 5 + 5 < 9 + 5$$

$$5 < 2x < 14$$

$$\frac{5}{2} < \frac{2x}{2} < \frac{14}{2}$$

$$\frac{5}{2} < x < 7$$



59.  $8 < 6 - 2x \leq 12$

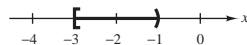
$$8 - 6 < 6 - 6 - 2x \leq 12 - 6$$

$$2 < -2x \leq 6$$

$$\frac{2}{-2} > \frac{-2x}{-2} \geq \frac{6}{-2}$$

$$-1 > x \geq -3$$

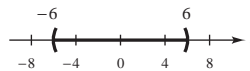
$$-3 \leq x < -1$$



61.  $-1 < -\frac{x}{6} < 1$

$$(-6)(-1) > (-6)\left(-\frac{x}{6}\right) > (-6)(1)$$

$$6 > x > -6$$



63.  $-3 < \frac{2x-3}{2} < 3$

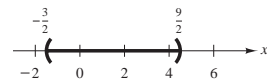
$$-6 < 2x - 3 < 6$$

$$-6 + 3 < 2x - 3 + 3 < 6 + 3$$

$$-3 < 2x < 9$$

$$\frac{-3}{2} < \frac{2x}{2} < \frac{9}{2}$$

$$-\frac{3}{2} < x < \frac{9}{2}$$

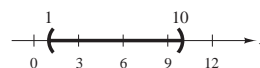


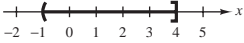
65.  $1 > \frac{x-4}{-3} > -2$

$$-3 < x - 4 < 6$$

$$-3 + 4 < x - 4 + 4 < 6 + 4$$

$$1 < x < 10$$



67.  $2x - 4 \leq 4$  and  $2x + 8 > 6$  

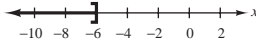
$$2x - 4 + 4 \leq 4 + 4 \quad \text{and} \quad 2x + 8 - 8 > 6 - 8$$

$$2x \leq 8 \quad \text{and} \quad 2x > -2$$

$$\frac{2x}{2} \leq \frac{8}{2} \quad \text{and} \quad \frac{2x}{2} > \frac{-2}{2}$$

$$x \leq 4 \quad \text{and} \quad x > -1$$

$$-1 < x \leq 4$$

69.  $7 + 4x < -5 + x$  and  $2x + 10 \leq -2$  

$$7 + 4x - x < -5 + x - x \quad \text{and} \quad 2x + 10 - 10 \leq -2 - 10$$

$$7 + 3x < -5 \quad \text{and} \quad 2x \leq -12$$

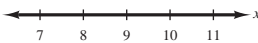
$$7 - 7 + 3x < -5 - 7 \quad \text{and} \quad \frac{2x}{2} \leq \frac{-12}{2}$$

$$3x < -12 \quad \text{and} \quad x \leq -6$$

$$\frac{3x}{3} < \frac{-12}{3}$$

$$x < -4 \quad \text{and} \quad x \leq -6$$

$$x \leq -6$$

71.  $6 - \frac{x}{2} > 1$  or  $\frac{5}{4}x - 6 \geq 4$  

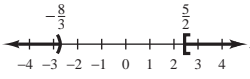
$$6 - 6 - \frac{x}{2} > 1 - 6 \quad \text{or} \quad \frac{5}{4}x - 6 + 6 \geq 4 + 6$$

$$-\frac{x}{2} > -5 \quad \text{or} \quad \frac{5}{4}x \geq 10$$

$$-2\left(-\frac{x}{2}\right) < (-5)(-2) \quad \text{or} \quad \frac{4}{5}\left(\frac{5}{4}x\right) \geq (10)$$

$$x < 10 \quad \text{or} \quad x \geq 8$$

$$-\infty < x < 10 \quad \text{or} \quad x \geq 8$$

73.  $7x + 11 < 3 + 4x$  or  $\frac{5}{2}x - 1 \geq 9 - \frac{3}{2}x$  

$$7x - 4x + 11 < 3 + 4x - 4x \quad \text{or} \quad \frac{5}{2}x + \frac{3}{2}x - 1 \geq 9 - \frac{3}{2}x + \frac{3}{2}x$$

$$3x + 11 < 3 \quad \text{or} \quad 4x - 1 \geq 9$$

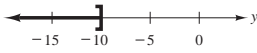
$$3x + 11 - 11 < 3 - 11 \quad \text{or} \quad 4x - 1 + 1 \geq 9 + 1$$

$$3x < -8 \quad \text{or} \quad 4x \geq 10$$

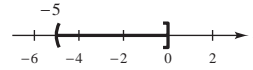
$$\frac{3x}{3} < \frac{-8}{3} \quad \text{or} \quad \frac{4x}{4} \geq \frac{10}{4}$$

$$x < -\frac{8}{3} \quad \text{or} \quad x \geq \frac{5}{2}$$

$$\begin{aligned}
 75. \quad & -3(y + 10) \geq 4(y + 10) \\
 & -3y - 30 \geq 4y + 40 \\
 3y - 3y - 30 & \geq 3y + 4y + 40 \\
 -30 & \geq 7y + 40 \\
 -40 - 30 & \geq 7y + 40 - 40 \\
 -70 & \geq 7y \\
 -10 & \geq y
 \end{aligned}$$



$$\begin{aligned}
 77. \quad & -4 \leq 2 - 3(x + 2) < 11 \\
 & -4 \leq 2 - 3x - 6 < 11 \\
 & -4 \leq 4 - 3x < 11 \\
 -4 + 4 & \leq -4 - 3x + 4 < 11 + 4 \\
 0 & \leq -3x < 15 \\
 \frac{0}{-3} & \geq \frac{-3x}{-3} > \frac{15}{-3} \\
 0 & \geq x > -5
 \end{aligned}$$



$$79. \quad x < -3 \text{ or } x \geq 2$$

$$\{x|x < -3\} \cup \{x|x \geq 2\}$$

$$81. \quad -5 \leq x < 4$$

$$\{x|x \geq -5\} \cap \{x|x < 4\}$$

$$83. \quad x \leq -2.5 \text{ or } x \geq -0.5$$

$$\{x|x \leq -2.5\} \cup \{x|x \geq -0.5\}$$

$$85. \quad \{x|x \geq -7\} \cap \{x|x < 0\}$$

$$87. \quad \{x|x < -5\} \cup \{x|x > 3\}$$

$$89. \quad \{x|x > -\frac{9}{2}\} \cap \{x|x \leq -\frac{3}{2}\}$$

91. “x is nonnegative” using inequality notation is  $x \geq 0$ .

93. “z is at least 2” using inequality notation is  $z \geq 2$ .

95. “n is at least 10, but no more than 16” using inequality notation is  $10 \leq n \leq 16$ .

97. A verbal description of  $x \geq \frac{5}{2}$  is x is at least  $\frac{5}{2}$ .

99. A verbal description of  $3 \leq y < 5$  is y is at least 3 and less than 5.

101. A verbal description of  $0 < z \leq \pi$  is z is greater than 0 and no more than  $\pi$ .

103. Verbal Model: 

Transportation costs
----------------------

 + 

Other costs
-------------

 ≤ 

Total money for trip
----------------------

Labels: Transportation costs = 1900  
Other costs = C  
Total money = 4500

Inequality:  $1900 + C \leq 4500$   
 $1900 + C - 1900 \leq 4500 - 1900$   
 $C \leq 2600$

105. Verbal Model: 

Temp in Miami
---------------

 > 

Temp in Washington
--------------------

 > 

Temp in New York
------------------

The average temperature in Miami, therefore, is greater than (>) the average temperature in New York.

107. Verbal Model: 

Operating cost
----------------

 < 

\$12,000
----------

Label: Operating cost =  $0.35m + 2900$

Inequality:  $0.35m + 2900 < 12,000$   
 $0.35m + 2900 - 2900 < 12,000 - 2900$   
 $0.35m < 9100$   
 $\frac{0.35m}{0.35} < \frac{9100}{0.35}$   
 $m < 26,000$  miles

109. Verbal Model: 

Revenue
---------

 > 

Cost
------

Labels: Revenue =  $89.95x$   
Cost =  $61x + 875$

Inequality:  $89.95x > 61x + 875$   
 $89.95x - 61x > 61x + 875 - 61x$   
 $28.95x > 875$   
 $\frac{28.95x}{28.95} > \frac{875}{28.95}$   
 $x > 30.224525$   
 $x \geq 31$

111. Verbal Model:  $\boxed{\text{Cost of first minute}} + \boxed{\text{Cost of additional minutes}} \leq \boxed{\$5.00}$

Label: Number of additional minutes =  $x$

Inequality:  $\$0.96 + \$0.75 \leq \$5.00$

$$0.96 + 0.75x - 0.96 \leq 5.00 - 0.96$$

$$0.75x \leq 4.04$$

$$\frac{0.75x}{0.75} \leq \frac{4.04}{0.75}$$

$$x \leq 5.386667$$

Since  $x$  represents the additional minutes after the first minute, the call must be less than 6.38 minutes. If a portion of a minute is billed as a full minute, then the call must be less than or equal to 6 minutes.

113. Verbal Model:  $36 \leq \boxed{\text{Perimeter}} \leq 64$

Label: Perimeter =  $2x + 32$

Inequality:  $36 \leq 2x + 32 \leq 64$

$$36 - 32 \leq 2x + 32 - 32 \leq 64 - 32$$

$$4 \leq 2x \leq 32$$

$$\frac{4}{2} \leq \frac{2x}{2} \leq \frac{32}{2}$$

$$2 \leq x \leq 16$$

115.  $12 \leq 4n \leq 30$

$$\frac{12}{4} \leq \frac{4n}{4} \leq \frac{30}{4}$$

$$3 \leq n \leq \frac{15}{2}$$

117. Verbal Model:  $\boxed{\text{Second plan}} > \boxed{\text{First plan}}$

Labels: First payment plan: \$12.50 per hour  
Second payment plan:  $\$8 + \$0.75n$  per hour where  $n$  represents the number of units produced.

Inequality:  $8 + 0.75n > 12.5$

$$0.75n > 4.5$$

$$n > 6$$

If more than 6 units are produced per hour, the second payment plan yields the greater hourly wage.

119. Verbal Model:  $\boxed{\text{Air pollutant emission}} > 6$

Label: Air pollutant emission =  $5.890 - 0.276t$

Inequality:  $5.890 - 0.276t > 6$

$$5.890 - 5.890 - 0.276t > 6 - 5.890$$

$$-0.276t > 0.11$$

$$\frac{-0.276t}{-0.276} < \frac{0.11}{-0.276}$$

$$t < -0.399$$

$$t = -1 \rightarrow \text{year 1989}$$

$$t = -2 \rightarrow \text{year 1988}$$

$$t = -3 \rightarrow \text{year 1987}$$

121. (f)  $C = 31.20 + 11.91x \leq 50$

$$11.91x \leq 18.8$$

$$x \leq \frac{18.8}{11.91}$$

$$x \leq 1.58$$

At most, you can purchase one premium movie channel.

(g)  $C = 34.19 + 3.95x \leq 50$

$$3.95x \leq 15.81$$

$$x \leq 4.00$$

At most, you can purchase four pay-per-view movies.

123. Yes, dividing both sides of an inequality by 5 is the same as multiplying both sides by  $\frac{1}{5}$ .

$$\begin{array}{rcl} 5x = 15 & & 5x = 15 \\ \frac{5x}{5} = \frac{15}{5} & & \frac{1}{5} \cdot 5x = 15 \cdot \frac{1}{5} \\ x = 3 & & x = 3 \end{array}$$

125. The multiplication and division properties differ. The inequality symbol is reversed if both sides of the inequality are multiplied or divided by a negative real number.

127. If  $-5 \leq t < 8$ , then  $(-1)(-5) \geq (-1)(t) > (-1)(8)$  and  $5 \geq -t > -8$  or  $-8 < -t \leq 5$ .

## Section 1.5 Absolute Value Equations and Inequalities

1.  $|4x + 5| = 10, x = -3$

$$|4(-3) + 5| \stackrel{?}{=} 10$$

$$|-12 + 5| \stackrel{?}{=} 10$$

$$|-7| \stackrel{?}{=} 10$$

$$7 \neq 10$$

No

3.  $|6 - 2w| = 2, w = 4$

$$|6 - 2(4)| \stackrel{?}{=} 2$$

$$|6 - 8| \stackrel{?}{=} 2$$

$$|-2| \stackrel{?}{=} 2$$

$$2 = 2$$

Yes

5.  $x - 10 = 17$  or  $x - 10 = -17$

7.  $4x + 1 = \frac{1}{2}$  or  $4x + 1 = -\frac{1}{2}$

9.  $|x| = 4$

$$x = 4 \text{ or } x = -4$$

11.  $|t| = -45$

No solution

13.  $|h| = 0$

$$h = 0$$

15.  $|5x| = 15$

$$5x = 15 \text{ or } 5x = -15$$

$$x = 3 \quad x = -3$$

17.  $|x - 16| = 5$

$$x - 16 = 5 \text{ or } x - 16 = -5$$

$$x = 21 \quad x = 11$$

19.  $|2s + 3| = 25$

$$2s + 3 = 25 \text{ or } 2s + 3 = -25$$

$$2s = 22 \quad 2s = -28$$

$$s = 11 \quad s = -14$$

21.  $|32 - 3y| = 16$

$$32 - 3y = 16 \text{ or } 32 - 3y = -16$$

$$-3y = -16 \quad -3y = -48$$

$$y = \frac{16}{3} \quad y = 16$$

23.  $|3x + 4| = -16$

No solution

25.  $|4 - 3x| = 0$

$$4 - 3x = 0$$

$$-3x = -4$$

$$x = \frac{4}{3}$$

27.  $|\frac{2}{3}x + 4| = 9$

$$\frac{2}{3}x + 4 = 9 \text{ or } \frac{2}{3}x + 4 = -9$$

$$\frac{2}{3}x = 5 \quad \frac{2}{3}x = -13$$

$$2x = 15 \quad 2x = -39$$

$$x = \frac{15}{2} \quad x = -\frac{39}{2}$$

29.  $|0.32x - 2| = 4$

$$0.32x - 2 = 4 \text{ or } 0.32x - 2 = -4$$

$$0.32x = 6 \quad 0.32x = -2$$

$$x = \frac{6}{0.32} \quad x = \frac{-2}{0.32}$$

$$x = 18.75 \quad x = -6.25$$