

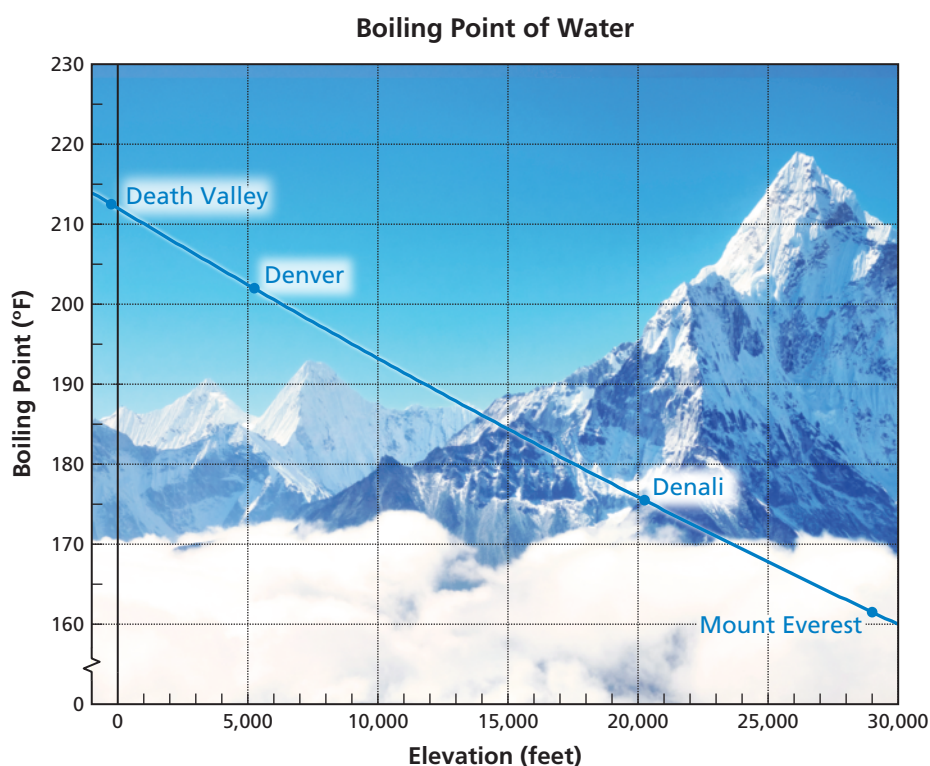
Student Edition
page 57

Big Idea of the Chapter

Reason About Linear Inequalities

To solve a linear inequality, use properties similar to the ones you use to solve linear equations. You can do this by using methods such as distributing and combining like terms, and then isolating the variable.

The boiling point of a liquid varies with elevation. The normal boiling point is measured at sea level. The normal boiling point of water is 212°F (100°C).



The boiling point (in degrees Fahrenheit) of water drops about 1°F for every 500-foot increase in elevation.

- Write a formula for the boiling point of water in terms of the elevation.

$$y = -\frac{1}{500}x + 212$$

- Use the graph to estimate the elevations at which the boiling point of water is less than 200°F. *Sample answer: over 6,000 feet*
- Write an inequality that represents the elevations at which the boiling point of water is less than 200°F. *Sample answer: $x > 6,000$*

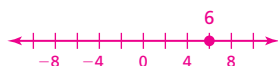
Getting Ready for Chapter 2

Graphing Numbers on a Number Line

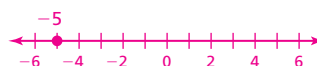
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Graph the number.

1. 6



2. -5



3. $-\frac{1}{4}$



4. $|2|$



5. $|-1|$



6. $-|-2.2|$



Comparing Real Numbers

Complete the statement with $<$, $>$, or $=$.

7. $2 \text{ } \square \text{ } 9 <$

8. $-6 \text{ } \square \text{ } 5 <$

9. $-\frac{1}{2} \text{ } \square \text{ } -4 >$

10. $-7 \text{ } \square \text{ } -7.5 >$

11. $|-8| \text{ } \square \text{ } |8| =$

12. $-1\frac{2}{5} \text{ } \square \text{ } \left| -3\frac{5}{8} \right| <$

2.1 Writing and Graphing Inequalities

2.1

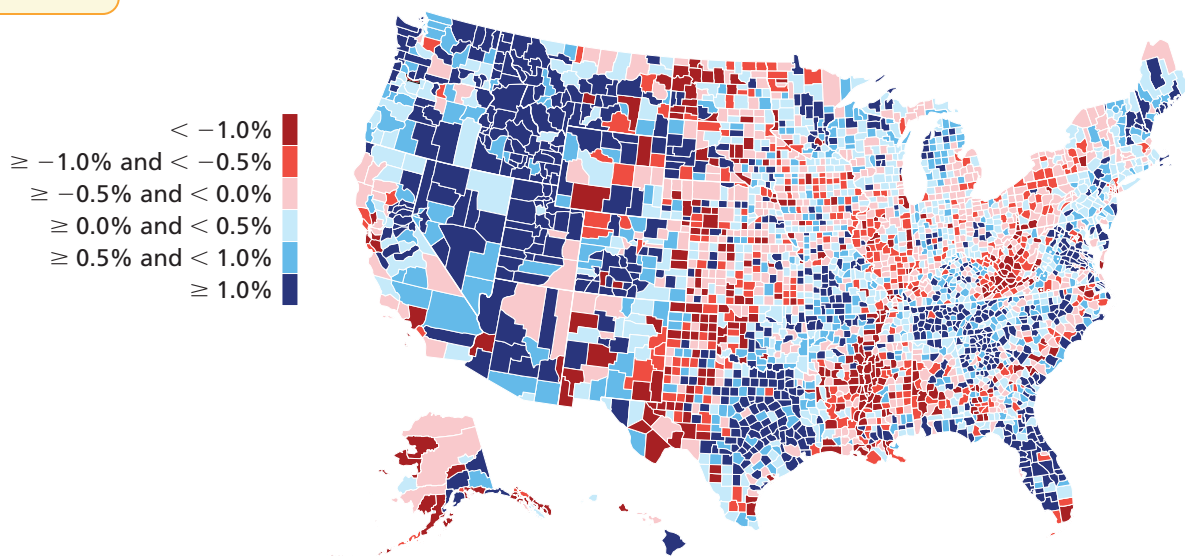
INVESTIGATE

Writing and Graphing Inequalities

Work with a partner. Use the diagram shown.

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Population Change in a Recent Year



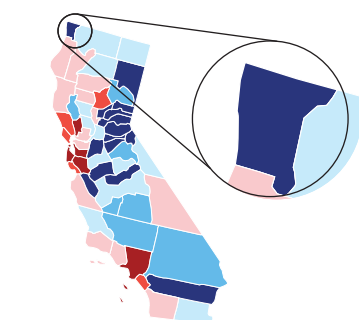
1. Explain what the diagram represents in your own words.

Sample answer: The diagram represents the population changes in a recent year in different counties of the United States.

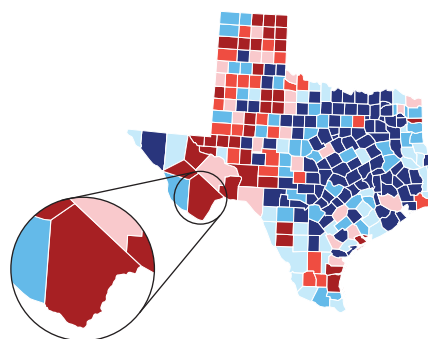
2. Write an inequality that represents the population change of each county below. Then graph the numbers that make each inequality true.

a. Del Norte County, CA

b. Brewster County, TX



$$x \geq 1.0\%$$



$$x < -1.0\%$$



In-Class Practice

Self-Assessment

Write the sentence as an inequality.

1. A number b is fewer than 30.4. $b < 30.4$
2. Eleven is more than a number y divided by 4. $11 > y \div 4$
3. $-\frac{7}{10}$ is at least twice a number k minus 4. $-\frac{7}{10} \geq 2k - 4$

Tell whether -6 is a solution of the inequality.

4. $c + 4 < -1$ **yes**
5. $10 \leq 3 - m$ **no**
6. $21 \div x \geq -3.5$ **yes**

Graph the inequality.

7. $b > -8$



8. $1.4 \geq g$



9. $r < \frac{1}{2}$



10. The graph shows the height restriction h (in inches) of a water slide. Write and interpret an inequality for the restriction.



$h < 52$; You must be less than 52 inches to go on the water slide.

11. **SMP.2 WHAT IF?** In Example 5, $B < A$. Interpret each inequality and tell whether it is true.

a. $\frac{A}{B} < \frac{B}{A}$

$\frac{A}{B}$ represents how many times more students are in the band than in the choir. $\frac{B}{A}$ represents how many times more students are in the choir than in the band; not true

b. $\frac{B}{A+B} \geq \frac{1}{2}$

$\frac{B}{A+B}$ relates the number of choir students to the total number of students in the band and the choir; not true

2.1 Practice

with
Calc Chat and **Calc View**

Student Edition pages 64–66

Write the sentence as an inequality. (See Example 1.)

1. A number x is greater than 3. $x > 3$
2. A number n plus 7 is less than or equal to 9. $n + 7 \leq 9$
- ▶ 3. Fifteen is no more than a number t divided by 5. $15 \leq \frac{t}{5}$
4. One-half of a number y is more than 22. $\frac{1}{2}y > 22$
5. The sum of a number v and 6.2 is at least -4.7 . $v + 6.2 \geq -4.7$
6. Four is no less than the quotient of a number x and 2.1. $4 \geq \frac{x}{2.1}$

Tell whether the value is a solution of the inequality. (See Example 2.)

7. $r + 4 > 8$; $r = 2$ **no**

8. $5 - x < 8$; $x = -3$ **no**

9. $3s \leq 19$; $s = -6$ **yes**

10. $17 \geq 2y$; $y = 7$ **yes**

11. $\frac{3m}{6} - 2 > 3$; $m = 8$ **no**

12. $10.4 \geq -2n + 4.6$; $n = -2.9$ **yes**

13. The Xianren Bridge is located in Guangxi Province, China. This arch is the world's longest natural arch, with a length of 400 feet. Write an inequality that represents the possible lengths ℓ (in inches) of all other natural arches.



14. The winner of a weight-lifting competition bench-pressed 400 pounds. The other competitors all bench-pressed at least 23 pounds less.

- a. Write an inequality that represents the weights that the other competitors bench-pressed. $x \leq 377$
- b. How do you know if one of the other competitors bench-pressed 379 pounds?

A weight of 379 pounds is not a solution of the inequality in part (a), so no other competitor bench-pressed 379 pounds.



India's Notes

Equity in Action

Display images of the Xianren Bridge and celebrate China's culture with your students. If you have any students from China, ensure they contribute to the discussion so they are able to share what they love most about their home country.

? "What Chinese landmarks are you familiar with?" **Sample answer:** The Great Wall of China, Mount Everest, Yangtze River

- Remind students that you will always strive to keep learning about diverse cultures and celebrate diversity and inclusion in your classroom.

OPEN-ENDED Describe a real-life situation that can be modeled by the inequality.

15. $12x \geq 60$ **Check students' work.**

16. $23 + x \leq 31$ **Check students' work.**

Graph the inequality. (See Example 3.)

17. $x \geq 2$



18. $z \leq 5$



19. $-1 > t$



20. $-2 < w$



EL English Learner Support

Productive

Have EL students work together to complete Practice Exercises 15 and 16. "An open-ended question has many correct responses. For example, 'Which foods are your favorites?' may have many different answers." Support students in the following ways.

Emerging: Allow students to determine their real-life situations in their home language then use a translation device to translate their situations to English. Assist students with any grammatical answers. Then have students read their scenarios aloud.

Expanding: Have partners write a real-life situation for each exercise then compare their situations with another pair. Have students determine if each other's responses are accurate.

Bridging: Have students write a real-life situation for each exercise then compare their situations with a partner. Have students determine if each other's responses are accurate.

21. $s < \frac{3}{2}$

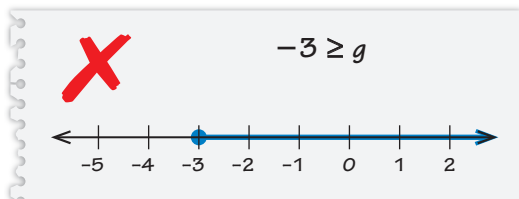


22. $r \geq -|5|$



SMP.3 ERROR ANALYSIS Describe and correct the error in graphing the inequality.

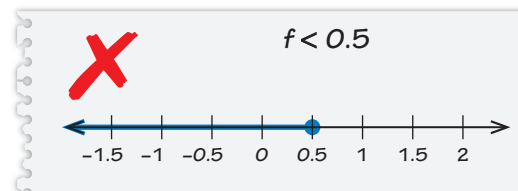
23.



The arrow should point to the left.



24.

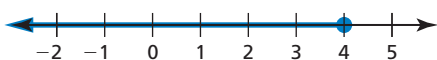


There should be an open circle at 0.5.



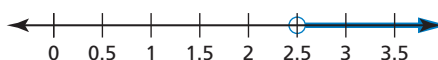
Write an inequality that represents the graph.

25.



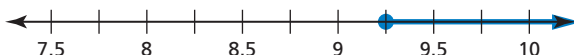
$$x \leq 4$$

26.



$$x > 2.5$$

27. **CONNECTION TO REAL LIFE** The graph shows the minimum hourly wage m (in dollars) for employees in a state. Write and interpret an inequality that represents the state's minimum wage. (See Example 4.)



$m \geq 9.25$; Hourly workers in the state must be paid at least \$9.25 per hour.

28. **SMP.6 MOUNTAINEER SUPPLEMENTAL OXYGEN**

Supplemental oxygen is recommended when climbing higher than 18,000 feet above sea level. A mountaineer plans to climb a mountain with an elevation of 6,282 meters. Is supplemental oxygen recommended for the climb? **yes**



India's Notes Talk About Careers

"Mountaineers may challenge themselves to climb some of the highest peaks around the world. They may climb for several weeks to reach the summit, so they must make preparation and safety top priorities. Supplemental oxygen is essential for the most challenging climbs."

? "What other kinds of supplies may be essential for mountaineers?"

? "Why might it be important for a mountaineer to become a survival expert?"

SMP.2 CONNECTION TO REAL LIFE Let X and Y represent the populations of two cities, where X is greater than Y . Interpret the inequality and tell whether it is true. (See Example 5.)

► 29. $2Y > X + Y$

$2Y$ represents double the population of the second city. $X + Y$ represents the total population of the two cities; not true

30. $\frac{X + Y}{X} < \frac{X + Y}{Y}$

$\frac{X + Y}{X}$ represents how many times greater the total population of the two cities is compared to the population of the first city. $\frac{X + Y}{Y}$ represents how many times greater the total population of the two cities is compared to the population of the second city; true

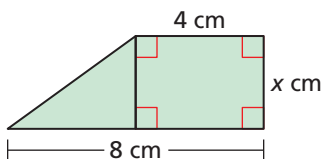
31. **CONNECT CONCEPTS** Complete the inequality

$$2 \square |x + 5|$$

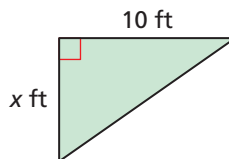
with $<$, $\leq$, $>$, or $\geq$ so that $x = 3$ and $x = -3$ are both solutions of the inequality. $\leq$

CONNECT CONCEPTS Write an inequality that represents the missing dimension x .

32. The area is less than 18 square centimeters. $x < 3$



33. The area is greater than or equal to 8 square feet. $x \geq 1.6$



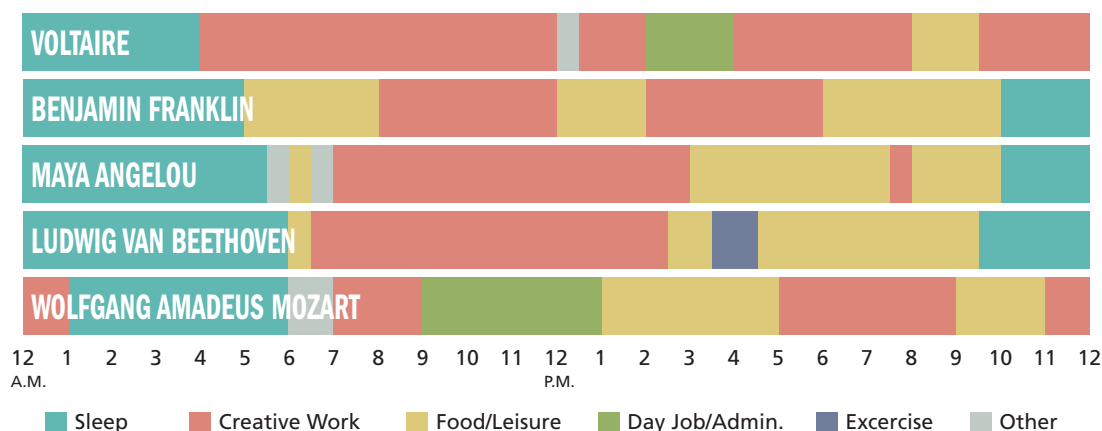
34. **CONNECTION TO REAL LIFE** A one-way bus ride costs \$1.65. A monthly pass costs \$52. You ride the bus twice each weekday. Is the monthly pass more cost effective? yes

35. **SMP.2 DIG DEEPER** A company charges A dollars per unit for x units, plus an initial fee B (in dollars) for a product, where B is greater than A . Explain what $\frac{Ax + B}{x}$ represents and write an inequality that represents its possible values.

the average cost per unit; $A < \frac{Ax + B}{x} \leq A + B$

Interpreting Data

DAILY ROUTINES Many people use daily routines to help them work creatively. The daily routines of five famous creative people are shown.



36. Let x be the number of hours a person sleeps in a 24-hour period. Which of the people satisfy the inequality $x \geq 8$?

Ludwig Van Beethoven

37. Let y be the number of hours a person spends on creative work in a 24-hour period. Which of the people satisfy the inequality $y > 8$?

Voltaire, Maya Angelou

38. Sketch an image that represents your daily routine or the daily routine of someone that you interview.

Check students' work.

India's Notes SEL Connection

Discuss **Self-Management** and the importance of getting adequate sleep every night.

? "Studies show that teenagers need between 8–10 hours of sleep every night. About how many hours of sleep do you usually get per night?"

? "Why do you think it's important to ensure your body and mind are well-rested?"

Data Talk

- What do you notice? What do you wonder?

? "How do you think the number of hours of sleep they received relates to their hours of creativity?"

Review & Refresh

Solve the equation.

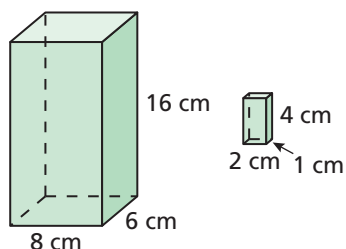
39. $-12 = y - 11$ $y = -1$

40. $|2a - 3| = 15$ $a = -6, a = 9$

41. $3.4v - 7 = 17 - 4.6v$ $v = 3$

42. $3(5s + 2) - 9s = -42$ $s = -8$

43. Determine whether the solids are similar.
not similar



Complete the statement.

44. $84 \text{ c} = \text{ } \text{gal}$ 5.25

45. $3.6 \text{ m} = \text{ } \text{mm}$ 3,600

Solve the equation for x .

46. $w = 5 + 3(x - 1)$ $x = \frac{w - 2}{3}$

47. $n = \frac{2x + 1}{2}$ $x = n - \frac{1}{2}$

48. A board is exactly 12 feet long. The table shows the lengths given by three different laser measuring devices. Which measurement is the most accurate? 12.01 ft

Laser measure	1	2	3
Length (feet)	12.01	11.989	12.1

2.2 Solving Inequalities Using Addition or Subtraction

INVESTIGATE

Quarterback Passing Efficiency

Student Edition
pages 67–70

Work with a partner. The National Collegiate Athletic Association (NCAA) uses the following formula to rank the passing efficiencies P of quarterbacks.

$$P = \frac{8.4Y + 100C + 330T - 200N}{A}$$

Y : total length (in **Y**ards) of all completed passes

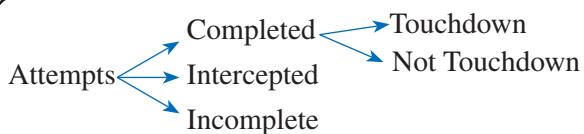
N : **i**Ntercepted passes

C : **C**ompleted passes

A : **A**ttempted passes

T : passes resulting in a **T**ouchdown

M : inco**M**plete passes



1. **SMP.2** Determine whether each inequality must be true. Explain.
- $T < C$
not true; If all completed passes are touchdowns, $T = C$. So, $T \leq C$.
 - $N < A$
not true; If the attempted passes are all intercepted, $N = A$. So, $N \leq A$.
 - $C + N \leq A$
true; Because $C + N + M = A$ and $C + N \leq C + N + M$, $C + N \leq A$.
 - $A - C \geq M$
true; Because $A = C + N + M$, $A - C = N + M$ and $N + M \geq M$. So, $A - C \geq M$.
2. For each inequality below, complete a table with passing statistics that satisfy the inequality. Then describe the values of P that make each inequality true.

Attempts	Completions	Yards	Touchdowns	Interceptions

- $P < 0$ *Sample answer:* A: 32, C: 3, Y: 25, T: 0, N: 3; values of P less than 0
- $P + 100 \geq 250$ *Sample answer:* A: 40, C: 32, Y: 250, T: 4, N: 0; values of P greater than or equal to 150
- $P - 250 > -80$ *Sample answer:* A: 45, C: 36, Y: 375, T: 6, N: 0; values of P greater than 170

In-Class Practice

Self-Assessment

Solve the inequality. Graph the solution.

1. $b - 2 > -9$

$$b > -7$$



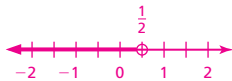
2. $m - 3 \leq 5$

$$m \leq 8$$



3. $\frac{1}{4} > y - \frac{1}{4}$

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



Solve the inequality. Graph the solution.

4. $k + 5 \leq -3$

$$k \leq -8$$



5. $75 < 58 + w$

$$w > 17$$



6. $\frac{5}{6} \leq z + \frac{1}{6}$

$$z \geq \frac{2}{3}$$



7. Your cloud storage has 12.1 gigabytes of free space. You upload a 1.92-gigabyte file and a 3.4-gigabyte file to the cloud. Which other folders can you also upload?



Any of the three individual folders, or both the Miscellaneous and Music folders

2.2 Practice

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Solve the inequality. Graph the solution. (See Examples 1 and 2.)

► 1. $6 \geq m - 1$

$m \leq 7$



2. $c - 12 > -4$

$c > 8$



► 3. $9 + w > 7$

$w > -2$



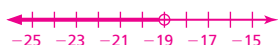
4. $15 \geq q + 3$

$q \leq 12$



5. $-6 > t - (-13)$

$t < -19$



6. $j + 1.7 < -2.1$

$j < -3.8$



7. $-5.2 + y \geq -7.4$

$y \geq -2.2$



8. $-\frac{4}{5} \geq p - \frac{2}{5}$

$p \leq -\frac{2}{5}$



9. $\frac{1}{6} + z > 2\frac{2}{3}$

$z > 2\frac{1}{2}$



10. **CONNECTION TO REAL LIFE** You want your daily sodium intake to be less than 2,300 milligrams. You eat a cereal bar with the nutrition label shown. What are the possible amounts of sodium you can eat during the rest of the day?



Nutrition Facts	
Serving Size	1 Bar (37g)
Servings Per Container	8
Amount Per Serving	
Calories 120	Calories from Fat 30
% Daily Value*	
Total Fat 3g	5%
Saturated Fat 0.5g	3%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 125mg	5%

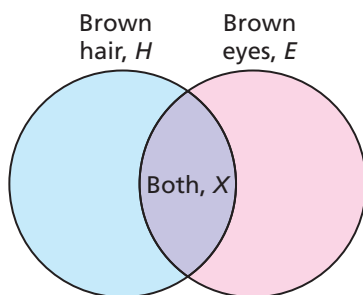


less than 2,175 mg

11. **CONNECTION TO REAL LIFE** An airline charges an extra fee for a checked bag that weighs more than 50 pounds. Your bag weighs 44.9 pounds. You have a 2.5-pound hair dryer, a 1.3-pound souvenir, and a 3.6-pound pair of boots. Which items can you add to the bag without paying the extra fee? (See Example 3.)

Any of the three individual items, both the hair dryer and souvenir, or both the souvenir and boots

12. **SMP.2** The diagram represents the numbers of students in a school with brown eyes, brown hair, or both. Determine whether each inequality must be true.



- a. $H \geq E$ no b. $H + 10 \geq E$ no
c. $H \geq X$ yes d. $H + 10 \geq X$ yes
e. $H > X$ no f. $H + 10 > X$ yes
13. Write and graph an inequality that represents the numbers that are *not* solutions of each inequality.

a. $x + 8 < 14$

$x \geq 6$



b. $x - 12 \geq 5.7$

$x < 17.7$



14. **SMP.1** Write an inequality for the possible values of $2n + 7$ when $\frac{7}{12} \geq \frac{5}{6} + n$. Explain your reasoning.

$2n + 7 \leq \frac{13}{2}$

15. **SMP.1 DIG DEEPER** Use the inequalities below to order a , b , c , and d from least to greatest. Justify your answer.

$c - 3 \geq d$

$b + 4 < a + 1$

$a - 2 \leq d - 7$

b, a, d, c

SMP.1 "What does each inequality tell you about a relationship between the variables? Are all the variables related by an inequality? What strategy can you use to compare a and c , or c and d ?" Have partners share their strategies for solving and check their answers with different methods.

EL English Learner Support Collaborative

Support EL students with Practice Exercise 12 by ensuring they understand how to use a Venn Diagram. Allow students time to practice as needed. Support students with Exercise 12 in the following ways.

Emerging: As partners work to determine if each inequality must be true, provide sentence frames for students to use to explain their reasoning. For example, "(Yes, No), the inequality (is, is not) true because ____."

Expanding: Have partners work to determine if each inequality must be true. Provide sentence starters for students to use to explain their reasoning.

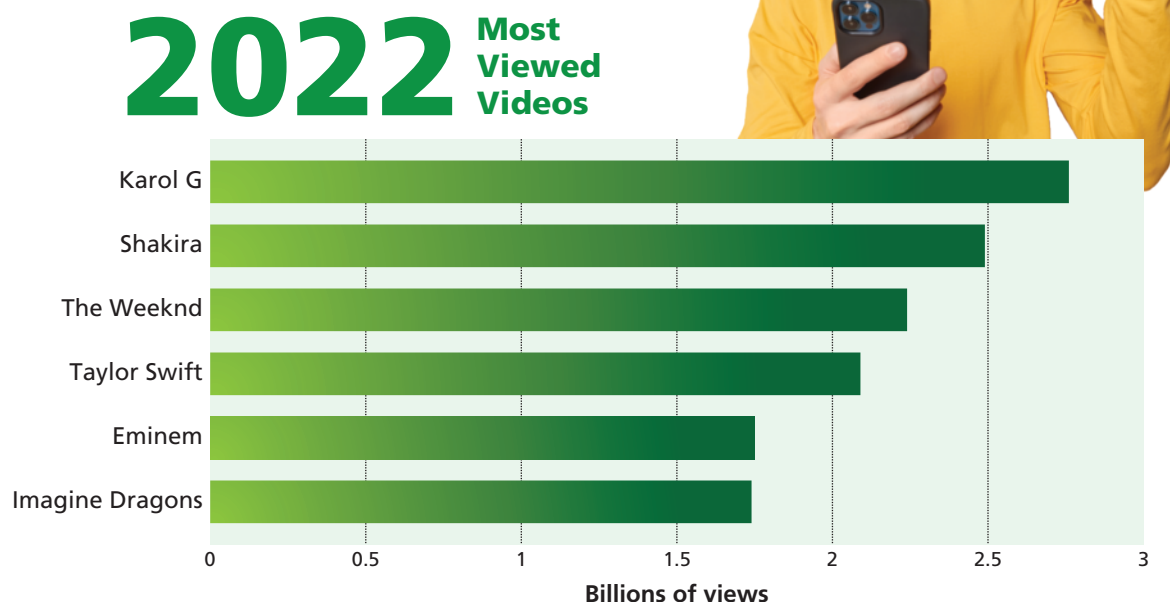
Bridging: Have students determine if each inequality must be true. Then have students compare their answers with a partner. Ensure students use complete sentences to explain their reasoning.

SMP.1 Instead of rushing to solve, have students reason about a solution pathway. "How can you restate the problem statement in your own words? What information do you need to find first?" Once students obtain a solution, ask, "What values can you test to validate your solution?"

Interpreting Data

2.2

MOST WATCHED MUSIC VIDEOS An entertainment reporter creates a list each year of which musicians' videos had the greatest number of views worldwide.



- Let x be the number (in billions) of views an artist has during a year. For which artists was the inequality $x - 3 > 0$ true in 2022? *none of them*
- Research a current list of musicians with the most viewed videos. Compare the musicians on the current list to the ones on the 2022 list. *Check students' work.*

India's Notes SEL Connection

Discussing music is a great way to build your students' **Relationship Skills**. Remind your students that good communication skills involve the abilities to listen respectfully and accept diverse opinions.

? "Who is your favorite musician and why?"

? "What are some ways we can respectfully disagree about our music preferences?"

Data Talk

- What do you notice? What do you wonder?

? "Based on your listening history, how would you order these artists?"

Review & Refresh

Solve the equation.

18. $-3y = -18$ $y = 6$

19. $\frac{n}{4} = -7.3$ $n = -29.2$

20. The graph shows the age requirement x (in years) for obtaining a driver's license in a state. Write and interpret an inequality that represents the age requirement.



$x \geq 16$; You must be 16 years or older to obtain a driver's license in the state.

21. Describe the values of a for which the equation $|x + 12| - 10 = a$ has no solution.
 $a < -10$

22. You randomly choose one of the letters shown. What is the theoretical probability of choosing a vowel?



$\frac{3}{7}$, or about 42.9%

Find the product or quotient.

23. $7 \cdot (-9)$ -63

24. $-11 \cdot (-12)$ 132

25. $-27 \div (-3)$ 9

26. $20 \div (-5)$ -4

2.3 Solving Inequalities Using Multiplication or Division

INVESTIGATE

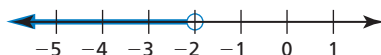
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Solving Inequalities

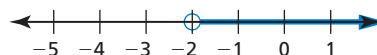
Work with a partner.

1. Which graph represents the solutions of $-6 > 3x$? Does the other graph represent the solutions of $6 < -3x$? Explain your reasoning.

Graph 1



Graph 2



Graph 1; no; The solution to both inequalities is $x < -2$, so Graph 1 represents the solutions of both inequalities.

2. Your friend solves $6 < -3x$ two different ways, but gets two different answers. Is either solution correct? What did your friend do wrong?

Solution Method #1

X $6 < -3x$ Write the inequality.
 $-2 < x$ Divide each side by -3 .
 The solution is $x > -2$.

Solution Method #2

X $6 < -3x$ Write the inequality.
 $3x + 6 < 0$ Add $3x$ to each side.
 $3x < -6$ Subtract 6 from each side.
 $x < -2$ Divide each side by 3 .
 The solution is $x < -2$.

Yes, solution method #2 is correct; The inequality symbol in solution method #1 should be reversed when dividing by a negative number.

3. Write a rule that describes how to solve an inequality of the form $ax < b$ when a is positive and when a is negative.

When a is positive, divide each side of the inequality by a . When a is negative, divide each side of the inequality by a and reverse the inequality sign.



In-Class Practice

Self-Assessment

Solve the inequality. Graph the solution.

1. $\frac{n}{7} \geq -1$

$n \geq -7$



2. $-6 \geq \frac{1}{5}w$

$w \leq -30$



3. $4b \geq 39$

$b \geq 9.75$



Solve the inequality. Graph the solution.

4. $\frac{x}{-5} \leq -5$

$x \geq 25$



5. $1 \geq -\frac{1}{10}z$

$z \geq -10$



6. $-9m > 67.5$

$m < -7.5$



7. The photograph shows the speed limit for cars on a highway during the day and at night.
- How many hours does it take a car traveling at the speed limit to travel 175 miles during the day? **2.5 h**
 - The car in part (a) travels at or below the nighttime speed limit on the return trip. Describe how much longer the return trip could take. **at least 11.5 min longer**



2.3 Practice

with
Calc Chat and **Calc View**

Student Edition pages 77–78

Solve the inequality. Graph the solution. (See Examples 1 and 2.)

► 1. $3y \leq -9$

$y \leq -3$



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

$x > -4$



► 3. $-15 \leq -3c$

$c \leq 5$



4. $-9y > 27$

$y < -3$



5. $-20 \leq 10n$

$n \geq -2$



6. $\frac{w}{-5} \leq 16$

$w \geq -80$



7. $\frac{a}{4} < 10.2$

$a < 40.8$



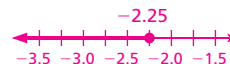
8. $-6 > -\frac{2}{3}y$

$y > 9$



9. $-\frac{n}{3} \geq 0.75$

$n \leq -2.25$



10. **SMP.3 ERROR ANALYSIS** Describe and correct the error in solving the inequality.
The inequality symbol should not be reversed when multiplying each side by $\frac{3}{2}$; $x < -9$
11. **CONNECTION TO REAL LIFE** A weather forecaster predicts that the temperature in Antarctica will decrease 8°F each hour for the next 6 hours. How many hours will it take for the temperature to drop at least 36°F ? (See Example 3.) **at least 4.5 h**



$$\begin{aligned} -6 &> \frac{2}{3}x \\ \frac{3}{2} \cdot (-6) &< \frac{3}{2} \cdot \frac{2}{3}x \\ -\frac{18}{2} &< x \\ -9 &< x \end{aligned}$$

The solution is $x > -9$.

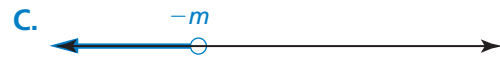
12. **MATCHING** Let $m > 0$. Match each inequality with its graph.

a. $\frac{x}{m} < -1$ **C**

b. $\frac{x}{m} > 1$ **A**

c. $\frac{x}{m} < 1$ **B**

d. $-\frac{x}{m} < 1$ **D**



EL English Learner Support

Productive

Create an anchor chart for EL students to use while answering matching exercises. For example:

- Read all the answer choices first.
- Match the easy answers first.
- Check off the answers you have used.

Have students refer to the chart and work in pairs to complete Practice Exercise 12. Support students in the following ways.

Emerging: Have students point to each step on the chart as they complete the matching.

Expanding: Have students read aloud each step from the chart as they use them.

Bridging: Have students work with emerging or expanding students to encourage peer collaboration.

13. **SMP.4 DIG DEEPER** Your class wants to raise at least \$100 for a charity by collecting bottles. Each glass bottle earns \$0.05. Each plastic bottle earns \$0.10.

- Describe the numbers of glass bottles your class needs to collect if no plastic bottles are collected. **at least 2,000 glass bottles**
- Describe the numbers of plastic bottles your class needs to collect if no glass bottles are collected. **at least 1,000 plastic bottles**
- Write an inequality that represents how many of each type of bottle your class can collect to reach the goal. **$0.05g + 0.10p \geq 100$**



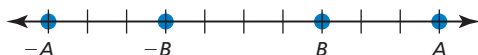
Environmental Principle 4

- "Plastic bottles can break down into miniscule particles, called **microplastics**, which make their way into our water. This can pose risks to human health, particularly when that water is used in our food."
- "Plastic can also leach toxic chemicals. When animals ingest those chemicals, the animal and human food chains are affected."

? "How does recycling plastic bottles help prevent these problems?"
Sample answer: Recycling bottles keeps them out of landfills.

SMP.4 "What representation did you choose to model the relationship? How are your models different in parts (a) and (b)?" Once students answer part (c), ask, "Use your model to find a number of glass bottles and plastic bottles that will reach the goal. Does this answer seem reasonable based on your answers in parts (a) and (b)?"

14. **SMP.3** Use the number line shown to explain why the direction of the inequality symbol must be reversed when multiplying or dividing each side of an inequality by the same negative number.



As numbers move farther away from zero, their absolute value becomes larger. $A > B$ and $|A| > |B|$. $-A < -B$ and $|-A| > |-B|$.

SMP.3 Ask several students to share their work. Record all unique answers without judgment. As students share their thinking, ask questions to help students express themselves, understand each other, and clarify their thinking. For example, "How does the number line help to illustrate your argument? What examples could prove or disprove your statement? What math language will help you to prove your answer?" After the volunteers finish sharing their work, ask, "How are all the answers different? How are they the same?"

Interpreting Data

2.3

DENALI *Denali* is an Koyukon Athabascan word meaning “the tall one.” The Athabascan people who inhabit the area around North America’s tallest mountain have referred to the peak as Denali for centuries. In 1917, the United States government officially recognized the name of the mountain as “Mount McKinley.” But in 2015, the government officially changed the name to Denali.

5 Tallest Mountains in North America

Mountain	Elevation (m)	Country
Denali	6,190	United States
Mount Logan	5,959	Canada
Pico de Orizaba	5,636	Mexico
Mount Saint Elias	5,489	United States
Popocatepetl	5,410	Mexico

15. Let x represent the elevation of a mountain. Which mountains in North America have elevations (in meters) that satisfy the inequality $x - 5,500 > 0$?

Denali, Mount Logan, Pico de Orizaba

16. Mount Everest has an elevation of 8,850 meters. Write an inequality that describes the elevation of Mount Everest, but not the elevation of Denali.

Sample answer: $x > 8,000$

17. Use an inequality to compare the elevations of Denali and the tallest mountain of a different continent of your choice.

Check students’ work.

Data Talk

- What do you notice? What do you wonder?

? “How do you think these elevations compare with the tallest mountains in other countries?” *Denali is taller than the tallest mountains in Europe, Africa, and Australia but shorter than the tallest mountains in South America and Asia.*

Review & Refresh

Solve the equation.

18. $5x + 3 = 13$ $x = 2$

19. $\frac{1}{4}(6x + 8) = -5\left(2 + \frac{1}{2}x\right)$ $x = -3$

20. You deposit \$2,000 in an account that earns simple interest at an annual rate of 3.5%. How long must you leave the money in the account to earn \$175 in interest? *2.5 years*

Solve the inequality. Graph the solution.

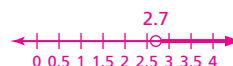
21. $6 \geq w + 11$

$w \leq -5$



22. $x - 4.5 > -1.8$

$x > 2.7$



23. One-fifth of the greater of two consecutive integers is 7 less than one-half of the lesser integer. What are the integers? **24, 25**
24. Write the prime factorization of 72. **$2^3 \cdot 3^2$**
25. An icosahedron has twenty congruent faces numbered 1 through 20. Find the probability that each event will occur when you roll the icosahedron.
- rolling a 20 **$\frac{1}{20}$, or 5%**
 - rolling a one-digit number **$\frac{9}{20}$, or 45%**
 - rolling a multiple of 4 **$\frac{1}{4}$, or 25%**
26. The graph of a proportional relationship passes through the points (2, 56) and (x, 154). Find x. **$x = 5.5$**
- Tell which number is greater.**
27. 0.8, 85%
85%
28. $\frac{7}{30}$, 25%
25%

2.4 Solving Multi-Step Inequalities

INVESTIGATE

Solving Multi-Step Inequalities

*Student Edition
pages 79–82*

Work with a partner. Use what you already know about solving equations and inequalities to solve each inequality. Match each inequality with its graph.

1. $2x + 3 \leq x + 5$

$x \leq 2$; B

2. $-2x + 3 > x + 9$

$x < -2$; A

3. $27 \geq 5x + 4x$

$x \leq 3$; E

4. $-8x + 2x - 16 < -5x + 7x$

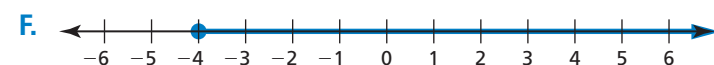
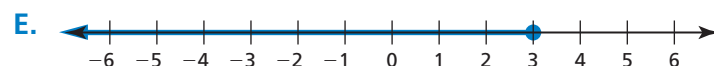
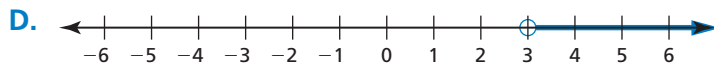
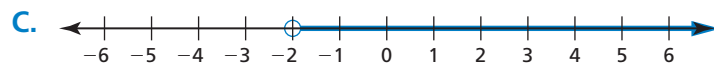
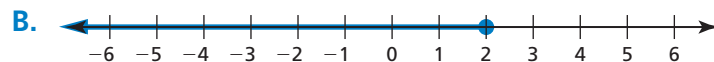
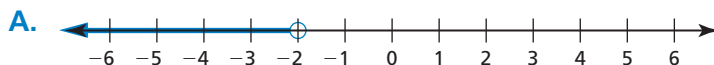
$x > -2$; C

5. $3(x - 3) - 5x > -3x - 6$

$x > 3$; D

6. $-5x - 6x \leq 8 - 8x - x$

$x \geq -4$; F



In-Class Practice

Self-Assessment

Solve the inequality. Graph the solution.

1. $4b - 1 < 7$

$b < 2$



2. $\frac{n}{-2} + 11 > 12$

$n < -2$



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

$x \leq 4$



4. $3(2a - 1) \geq \frac{3}{4}a - 17$

$a \geq -\frac{8}{3}$



Solve the inequality. Graph the solution, if possible.

5. $2(k - 5) < 2k + 5$

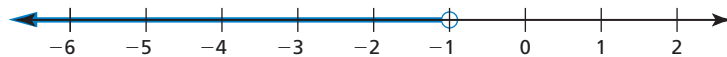
all real numbers



6. $-4(3n - 1) > -12n + 5.2$

no solution

7. **OPEN-ENDED** Write two different multi-step inequalities whose solutions are represented by the graph.



Sample answer: $3x + 4 < 1$, $-2x - 10 > -8$

8. **WHAT IF?** You need a mean score of at least 85 points to advance to the next round. What scores in the fifth game will allow you to advance?

a score of at least 73 points

2.4 Practice

Student Edition pages 83–84

Solve the inequality. Graph the solution. (See Example 1.)

1. $2x - 3 > 7$

$x > 5$



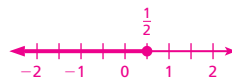
2. $\frac{w}{2} + 4 > 5$

$w > 2$



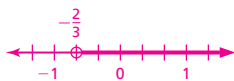
3. $-3 \leq 1 - 8v$

$v \leq \frac{1}{2}$



4. $-8 > -3t - 10$

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



5. $\frac{1}{2} + \frac{r}{-4} \leq \frac{5}{6}$

$r \geq -\frac{4}{3}$



6. $14.7 \leq 3.5(b - 4)$

$b \geq 8.2$



Solve the inequality. Graph the solution, if possible. (See Examples 2 and 3.)

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

$m > 3$



8. $8n + 2 \leq 8n - 9$

no solution

9. $-2d - 2 < 3d + 8$

$d > -2$



10. $8 + 10f > 14 - 2f$

$f > 0.5$



11. $8g - 5g - 4 \leq -3 + 3g$

all real numbers



12. $3w - 5 > 2w + w - 7$

all real numbers



13. $6(\ell + 3) < 3(2\ell + 6)$

no solution

14. $15\left(\frac{1}{3}b + 3\right) \leq 6(b + 9)$

$b \geq -9$



15. $9j - 4.5 + 6j \geq 3(5j - 1.5)$

all real numbers



16. **SMP.3 ERROR ANALYSIS** Describe and correct the error in solving $\frac{x}{4} + 6 \geq 3$.

In the first step, you need to use the Distributive Property on the left side when multiplying by 4; $x \geq -12$

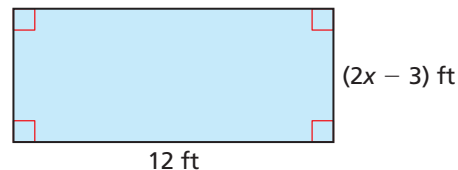
X

$$\begin{aligned} \frac{x}{4} + 6 &\geq 3 \\ x + 6 &\geq 12 \\ x &\geq 6 \end{aligned}$$

Day	Cost (dollars)
Sunday	\$0
Monday	\$3.00
Tuesday	\$1.50
Wednesday	\$2.75
Thursday	\$2.25
Friday	\$5.50

17. **CONNECTION TO REAL LIFE** On average, you want to spend less than \$2.50 per day on parking meters in a week. How much money can you spend on Saturday to achieve your goal? (See Example 4.) *less than \$2.50*

18. **CONNECT CONCEPTS** The area of the rectangle is greater than 60 square feet. Find the possible values of x . *$x > 4$*



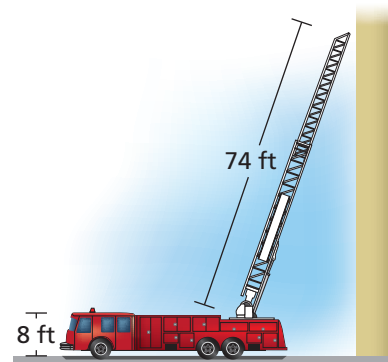
Find the value of a for which the solutions of the inequality are all real numbers.

19. $a(x + 3) < 5x + 15 - x$ *$a = 4$*

20. $3x + 8 + 2ax \geq 3ax - 4a$ *$a = 3$*

21. **SMP.1 DIG DEEPER** Each story of a building is about 10 feet tall. The bottom of the ladder must be at least 24 feet away from the building. How many stories can the ladder reach? Justify your answer.

7 stories; Using the Pythagorean Theorem, the 74-foot ladder can reach at most 70 feet. Solving the inequality $10n - 8 \leq 70$ gives $n \leq 7.8$, so the ladder cannot quite reach the 8th story.



EL English Learner Support

Interpretive

Provide background knowledge for Practice Exercises 18, 21, and 26 in the following ways.

- “How is the area of a rectangle calculated?” See below for support suggestions.
- “You will need to use the *Pythagorean Theorem* to complete Exercise 21.” See below for support suggestions.
- “A *histrogram* is one way to display data. Explain the data that this histogram displays.” See below for support suggestions.

Emerging: Students may not have prior knowledge of these concepts. Provide small-group guided instruction for each exercise. Review/introduce how the area of a rectangle is calculated, how to use the Pythagorean Theorem, how to interpret a histogram, and how to determine a percentage.

Expanding: Review how the area of a rectangle is calculated, how to use the Pythagorean Theorem, how to interpret a histogram, and how to determine a percentage. Have partners work through Exercises 18, 21, and 26 then compare their answers with another pair.

Bridging: Have partners complete each exercise then compare answers with another pair. Remind them to justify their reasoning using complete sentence.

Interpreting Data

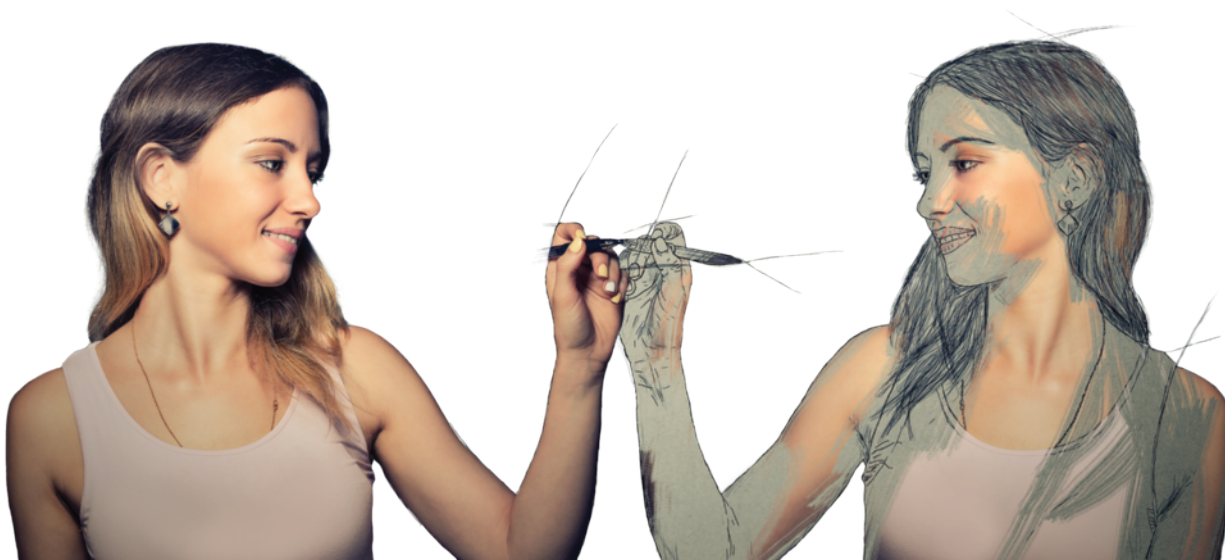
SELF PORTRAITS Vincent Van Gogh painted about 40 self portraits during his career. He wrote, “People say, and I am willing to believe it, that it is hard to know yourself. But it is not easy to paint yourself, either.”

22. Out of the 143 paintings that Frida Kahlo created in her life, 55 were self portraits. The heights varied from 19 to 119 centimeters. The widths varied from 15 to 82 centimeters. Write inequalities that describe the heights and widths of Kahlo’s self portraits.

$$h \geq 19, h \leq 119, w \geq 15, w \leq 82$$

23. Almost all of Van Gogh’s and Kahlo’s self portraits have the property that the height of the painting is greater than the width. Why do you think this is true?

Sample answer: The human body is typically greater in height than in width.



Data Talk

- What do you notice? What do you wonder?

? “What percent of Frida Kahlo’s paintings were self-portraits?” $\frac{55}{143} = 38\%$

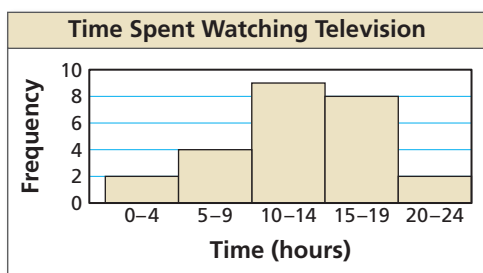
Review & Refresh

Solve the equation.

24. $\frac{z}{8} + \frac{1}{4} = -\frac{z}{8}$
 $z = -1$

25. $4.9k + 6 - 1.2k = 8 + 3.7k$
 no solution

26. The histogram shows the numbers of hours that students in a class spent watching television last week. How many students are in the class? What percent of the students watched at least 15 hours of television?



25 students; 40%

27. Tell whether x and y are proportional.

x	3	6	9	12
y	2	4	6	8

yes

28. Solve the literal equation $6x + 5 = 3 - 2y$ for y .

$$y = -3x - 1$$

29. Solve $\frac{10}{x} = \frac{25}{20}$.
 $x = 8$

Write the sentence as an inequality.

30. Six times a number y is no greater than 10.

$$6y \leq 10$$

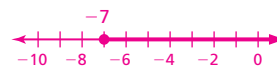
31. A number p plus 7 is greater than 24.8.

$$p + 7 > 24.8$$

Solve the inequality. Graph the solution.

32. $n - 13 \geq -20$

$$n \geq -7$$



33. $4 < \frac{b}{-3.8}$

$$b < -15.2$$



2.5 Solving Compound Inequalities

2.5

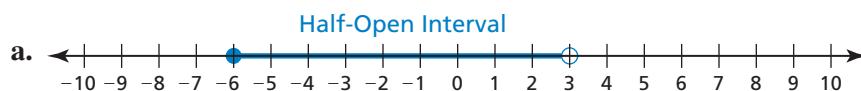
INVESTIGATE

Describing Intervals on the Number Line

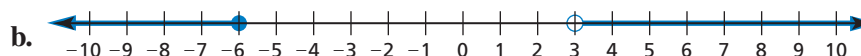
*Student Edition
pages 85–89*

Work with a partner.

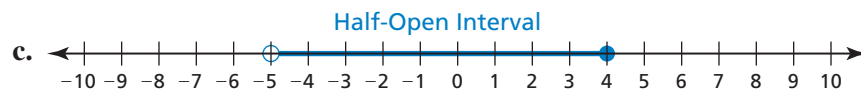
1. Use inequalities to describe each interval.



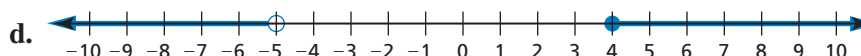
$$x \geq -6 \text{ and } x < 3$$



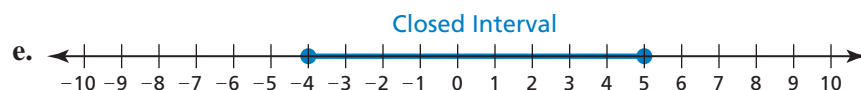
$$x \leq -6 \text{ or } x > 3$$



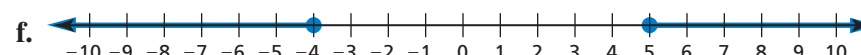
$$x > -5 \text{ and } x \leq 4$$



$$x < -5 \text{ or } x \geq 4$$



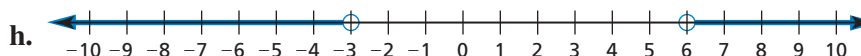
$$x \geq -4 \text{ and } x \leq 5$$



$$x \leq -4 \text{ or } x \geq 5$$



$$x > -3 \text{ and } x < 6$$



$$x < -3 \text{ or } x > 6$$

2. Did you use “and” or “or” when writing the inequalities?

Use “and” when the graph shows a segment between the numbers. Use “or” when the graph shows two opposite rays.

In-Class Practice

Self-Assessment

Write the sentence as an inequality. Graph the inequality.

1. A number d is more than 0 and less than 10.

$$0 < d < 10$$



2. A number a is fewer than -6 or no less than -3 .

$$a < -6 \text{ or } a \geq -3$$



Solve the inequality. Graph the solution.

3. $5 \leq m + 4 < 10$

$$1 \leq m < 6$$



4. $-3 < \frac{2}{3}k - 5 < 0$

$$3 < k < \frac{15}{2}$$



5. $4c + 3 \leq -5 \text{ or } c - 8 > -1$

$$c \leq -2 \text{ or } c > 7$$



6. $2p + 1 < -4 \text{ or } 3 - 8p \leq -1$

$$p < -\frac{5}{2} \text{ or } p \geq \frac{1}{2}$$



Solve the inequality. Write the solution using set-builder notation.

7. $0 < 2n - 7 \leq 1$

$$\{n \mid \frac{7}{2} < n \leq 4\}$$

8. $4x + 5 \leq 1 \text{ or } -\frac{1}{2}x + 10 \geq 10$

$$\{x \mid x \leq 0\}$$

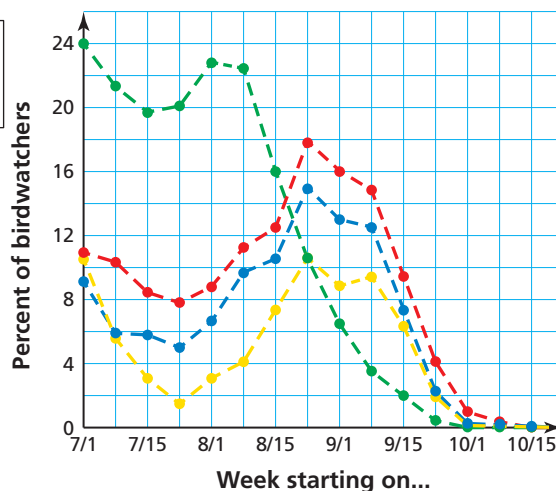
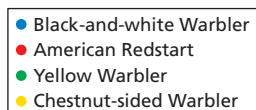
9. Write the description in set-builder notation.

the set of all real numbers n such that n is no less than -3 and no greater than $\frac{1}{2}$

$$\{n \mid -3 \leq n \leq \frac{1}{2}\}$$

10. Birdwatchers record the types of birds they see or hear. The graph shows observations from a location in Canada. Write an inequality that represents the percents of birdwatchers who saw or heard a Black-and-white Warbler from July 1 to September 15.

$$5 \leq x \leq 15$$



2.5 Practice

Student Edition pages 90–92

Write the sentence as an inequality. Graph the inequality. (See Example 1.)

- 1. A number p is less than 6 and greater than 2.

$$2 < p < 6$$



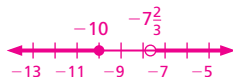
2. A number n is less than or equal to -7 or greater than 12.

$$n \leq -7 \text{ or } n > 12$$



3. A number m is more than $-7\frac{2}{3}$ or at most -10 .

$$m > -7\frac{2}{3} \text{ or } m \leq -10$$



4. A number r is no less than -1.5 and fewer than 9.5.

$$-1.5 \leq r < 9.5$$



Solve the inequality. Graph the solution. (See Examples 2 and 3.)

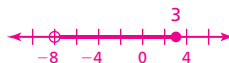
- 5. $6 < x + 5 \leq 11$

$$1 < x \leq 6$$



6. $24 > -3r \geq -9$

$$-8 < r \leq 3$$



- 7. $v + 8 < 3 \text{ or } -8v < -40$

$$v < -5 \text{ or } v > 5$$



8. $-14 > w + 3 \text{ or } 3w \geq -27$

$$w < -17 \text{ or } w \geq -9$$



9. $\frac{1}{2}r + 3 < \frac{7}{4} \text{ or } -r + \frac{3}{4} \leq \frac{3}{8}$

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



10. $-12 < \frac{1}{2}(4x + 16) < 18$

$$-10 < x < 5$$



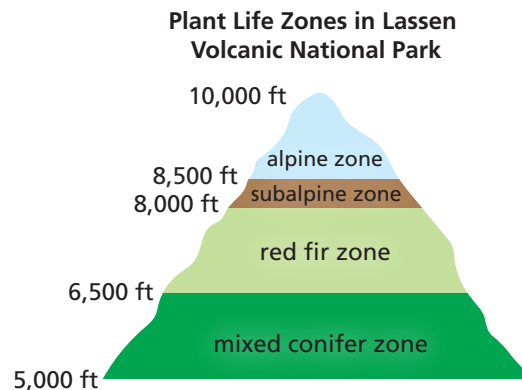
11. The plant life zones in Lassen Volcanic National Park can be approximately classified by elevation. Write an inequality that represents the elevation range for each type of plant life.

a. trees in the mixed conifer zone

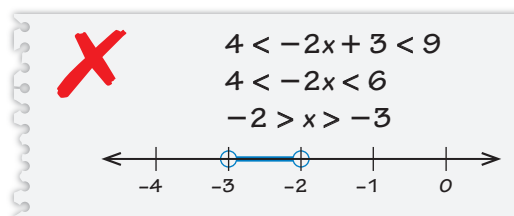
Sample answer: $5,000 < h \leq 6,500$

b. flowers in the subalpine and alpine zones

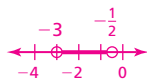
Sample answer: $8,000 < h \leq 10,000$



12. **SMP.3 ERROR ANALYSIS** Describe and correct the error in solving the inequality and graphing the solution.



In the first step, 3 should have been subtracted from 4 on the left side; $-\frac{1}{2} > x > -3$



Solve the inequality. Write the solution using set-builder notation. (See Example 4.)

► 13. $7 \leq x + 3 < 15$

$\{x | 4 \leq x < 12\}$

14. $16 > -4v \geq -8$

$\{v | -4 < v \leq 2\}$

15. $w + 6 \leq 2$ or $-6w < -48$

$\{w | w \leq -4 \text{ or } w > 8\}$

16. $18 \geq p + 13$ or $4p > -28$

$\{p | p \leq 5 \text{ or } p > -7\}$

17. $2.3 \leq 3t + 6.2 < 8$

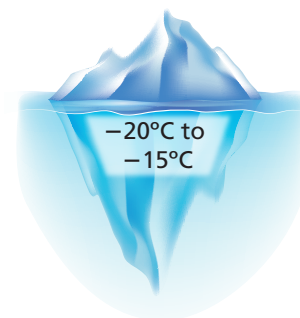
$\{t | -1.3 \leq t < 0.6\}$

18. $6 \leq \frac{1}{3}(9x + 27) \leq 6$

$\{x | x = -1\}$

19. **CONNECTION TO REAL LIFE** Write an inequality that represents the temperatures (in degrees Fahrenheit) of the interior of the iceberg. (See Example 5.)

$-4 \leq F \leq 5$



20. When a solid melts, it becomes a liquid. When a liquid boils, it becomes a gas.

Element	Melting point (°C)	Boiling point (°C)
Gold	1,064	2,807
Silver	962	2,212
Copper	1,083	2,567

- a. Write an inequality that represents the temperatures (in degrees Fahrenheit) of each element as a liquid.

Gold: $1,947.2 \leq F < 5,084.6$,

Silver: $1,763.6 \leq F < 4,013.6$,

Copper: $1,981.4 \leq F < 4,652.6$

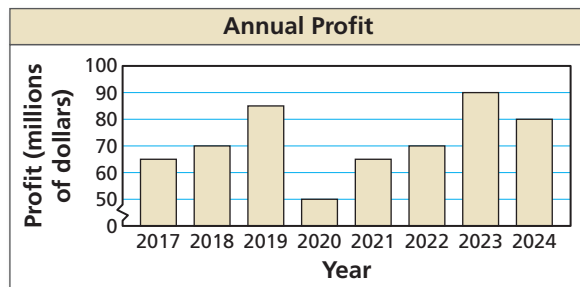
- b. Describe a situation in which someone might need to know the melting point of one of these elements.

Sample answer: A plumber uses solder to connect two copper pipes. The temperature of the plumber's torch needs to be hot enough to melt the solder without melting the copper pipes.

Solve the inequality. Graph the solution, if possible.

21. $22 < -3c + 4 < 14$

no solution



22. $x - 8 \leq 4$ or $2x + 3 > 9$

all real numbers



23. The graph shows the annual profits of a company over 8 years. Write an inequality that represents the annual profits from 2017 to 2024. $50 \leq P \leq 90$

24. **SMP.1 SMP.7 DIG DEEPER** Find the value of k for which the inequality $0.5 < -4x + k \leq 12 - k$ has the solution set $\{x \mid 1.25 \leq x < 2\}$. Justify your answer.

$k = 8.5$; Isolating x in the inequality gives the inequality $-0.125 + 0.25k > x \geq -3 + 0.5k$. Using the solution set, set the left side of the inequality equal to 2 and the right side equal to 1.25. Solving both for k gives $k = 8.5$.

SMP.7 Students can work through this problem in different ways, depending on how they see the structure in the given inequalities. Have partners work together and each take turns restating the problem statement in their own words. Provide time for students to look for structure to inform their solution pathway.

25. Complete the inequality with $<$, $\leq$, $>$, or $\geq$ so that the solution is only one value.

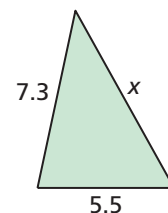
$4(x - 6) \quad \square \quad 2(x - 10)$ and $5(x + 2) \geq 2(x + 8) \leq$

26. **CONNECT CONCEPTS** The sum of the lengths of any two sides of a triangle is greater than the length of the third side.

- a. Write three inequalities that represent the possible values of x .

$7.3 + 5.5 > x$, $7.3 + x > 5.5$, $5.5 + x > 7.3$

- b. Your friend claims the value of x can be 1.5. Is your friend correct? **no**



27. **SMP.4 PERFORMANCE TASK** You want to plan a road trip using a round-trip fuel budget of \$200. You will use a car with a fuel range of 25–34 miles per gallon. Use current gasoline prices to determine the distances you can travel. Then plan the trip. Use inequalities to represent how much you will spend on gasoline, the speeds at which you can travel, and how long the trip will take.

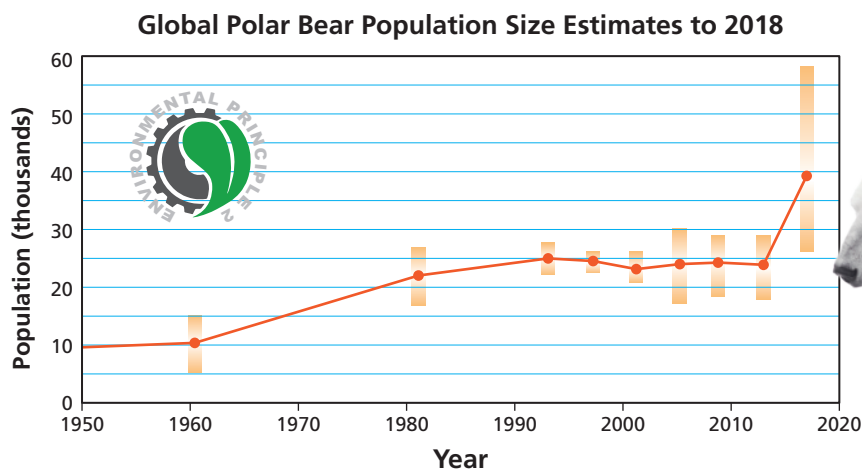
Check students' work.

SMP.4 This open task provides rich opportunities for students to engage in the modeling process. After capturing current gasoline prices and the vehicles fuel economy in a model to find the possible distances, then students will create models to find costs, speeds, and travel times for the trip. Ask probing questions such as, "How might a hybrid vehicle change your travel options? What other factors might influence the rate of fuel consumption?"



Interpreting Data

POLAR BEAR POPULATION The global polar bear population has increased in recent decades. In 1950, the population was estimated to be about 10,000. In 2018, it was estimated to be about 40,000.



28. Use the graph to write a compound inequality that represents the global population of polar bears in 2018.

Sample answer: $26,000 \leq p \leq 58,000$

29. Why does the graph show a range for the polar bear populations instead of exact numbers?

It is not possible to count every polar bear.

Environmental Principle 2

- "Starting in the 18th century, European, Russian, and North American hunters and trappers killed many polar bears. In the 1970s there was concern about the survival of the population."
- "In 1973, several countries signed an international agreement that strictly regulated hunting of polar bears."

? "How might the warming of the planet affect polar bears?"
Sample answer: The polar bear population will likely decrease. Polar bears live in very cold climates and there will be fewer places that are cold enough for them.

Data Talk

- What do you notice? What do you wonder?
- ?** "Do you think it would be reasonable to predict the polar bear population in 2030?" *Sample answer:* No, it is not reasonable. We are not sure this increase would continue. There may be other factors that will affect the population of polar bears.

Review & Refresh

Solve the equation. Graph the solutions, if possible.

30. $\left|\frac{d}{9}\right| = 6$

$d = 54, d = -54$



31. $7|5p - 7| = -21$

no solution

32. Predict the number of times you will spin a 4 in 50 spins on the spinner shown.



Sample answer: about 8 times

Solve the inequality. Graph the solution.

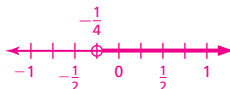
33. $9.4 + q \leq 15.2$

$q \leq 5.8$



34. $z - \left(-\frac{3}{5}\right) > \frac{7}{20}$

$z > -\frac{1}{4}$



35. $2 \leq -\frac{2}{9}x$

$x \leq -9$



36. $2x \geq \frac{3}{4}$

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



37. Solve $-4y + 6x = 12$ for y .

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

38. You need an average exam score of at least 84 to receive a B in a class. For what scores on the fourth exam will you receive a B in the class?

Exam	Score
1	78
2	93
3	82

83 or higher

39. Solve $\frac{12}{x} = \frac{3}{8}$.

$x = 32$

Write the sentence as an inequality.

40. Twelve less than a number h is no more than 5.

$h - 12 \leq 5$

41. Three is more than twice a number b plus 7.

$3 > 2b + 7$

2.6 Solving Absolute Value Inequalities

INVESTIGATE

Finding Solutions of an Absolute Value Inequality

*Student Edition
pages 93–97*

Work with a partner. Consider the inequality $|x + 2| \leq 3$.

- Find a number that makes the inequality true.

Sample answer: $x = 1$

- Do you think there are other numbers that make the inequality true? If so, find several of them. Compare your answers with your classmates.

yes; Sample answer: $x = -5, x = -3, x = -1, x = 0$

INVESTIGATE

Graphing Solutions of an Absolute Value Inequality

Work with a partner. Consider the inequality $|x + 2| \leq 3$.

- On the number line, locate the point for which $|x + 2|$ is equal to 0. Then locate the numbers you found in Exercises 1 and 2. What do you notice?

Sample answer:



Every point is within 3 units of -2 .

INVESTIGATE

Solving an Absolute Value Inequality Numerically

Work with a partner. Consider the inequality $|x + 2| \leq 3$.

- Complete the table. Use your results to solve the inequality.

x	-6	-5	-4	-3	-2	-1	0	1	2
$ x + 2 $	4	3	2	1	0	1	2	3	4

$-5 \leq x \leq 1$



In-Class Practice

Self-Assessment

2.6

Solve the inequality. Graph the solution, if possible.

1. $|x| \leq 3.5$

$-3.5 \leq x \leq 3.5$



2. $|k - 3| < -1$

no solution

3. $|\frac{1}{2}w - 1| < 11$

$-20 < w < 24$



Solve the inequality. Graph the solution.

4. $|x + 3| > 8$

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



5. $|n + 2| - 3.7 \geq -6$

all real numbers



6. $3|d + 1| - 7 \geq -2$

$d \leq -\frac{8}{3}$ or $d \geq \frac{2}{3}$



Write the inequality in interval notation.

7. $x \geq -2$

$[-2, \infty)$

8. $-7 < x < -4$

$(-7, -4)$

9. $-10 < x \leq -1$

$(-10, -1]$

10. A softball team will spend three nights at a hotel. Each hotel offers a 50% discount for the third night. The coach wants to keep the total cost per player at \$225 with an absolute deviation of at most \$25. Which hotels meet this condition?

Hotels A and D

Hotel	Price per night
A	\$80
B	\$105
C	\$75
D	\$90



2.6 Practice

Student Edition pages 98–100

Solve the inequality. Graph the solution, if possible. (See Examples 1 and 2.)

1. $|x| < 3$

$-3 < x < 3$



2. $|h - 5| \leq 10$

$-5 \leq h \leq 15$



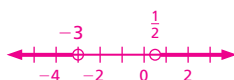
3. $|d + 9| > 3$

$d < -12$ or $d > -6$



4. $|4c + 5| > 7$

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



5. $|5p + 2| < -4$

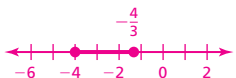
no solution

6. $|3j - 1| + 6 < 0$

no solution

7. $2|3w + 8| - 12.5 \leq -4.5$

$-4 \leq w \leq -\frac{4}{3}$



8. $-4|6b - 8| \leq 12$

all real numbers



9. $6\left|-\frac{1}{4}f + 3\right| + 7 > 7$

$f < 12$ or $f > 12$



In Exercises 10 and 11, write the sentence as an absolute value inequality. Then solve the inequality.

10. A number is less than 6 units from 0.

$|n| < 6$; $-6 < n < 6$

11. Twice a number is no less than 10 units from -1 .

$|2n + 1| \geq 10$; $n \leq -\frac{11}{2}$ or $n \geq \frac{9}{2}$

12. Entries in an essay contest can have 500 words with an absolute deviation of at most 30 words. Write and solve an absolute value inequality that represents the acceptable numbers of words.

$|w - 500| \leq 30$; 470 to 530 words

13. The normal body temperature of a camel is 37°C and varies by up to 3°C . Write and solve an absolute value inequality that represents the range of normal body temperatures (in degrees Celsius) of the camel.

$|T - 37| \leq 3$; 34°C to 40°C



SMP.3 ERROR ANALYSIS Describe and correct the error in solving the absolute value inequality.

14.

$$\begin{array}{l} \text{X} \quad |x - 5| < 20 \\ \quad x - 5 < 20 \\ \quad x < 25 \end{array}$$

The absolute value inequality should be written as a compound inequality; $-15 < x < 25$

15.

$$\begin{array}{l} \text{X} \quad |x + 4| > 13 \\ \quad x + 4 > -13 \quad \text{and} \quad x + 4 < 13 \\ \quad x > -17 \quad \text{and} \quad x < 9 \\ \quad -17 < x < 9 \end{array}$$

The compound inequality should be joined by “or”, and both inequality symbols are reversed; $x < -17$ or $x > 9$

Write the inequality in interval notation. (See Example 3.)

16. $-5 < x \leq 20$

$(-5, 20]$

▶ 17. $3 < x < 9$

$(3, 9)$

18. $x \geq -13$

$[-13, \infty)$

19. $x \leq 58$

$(-\infty, 58]$

20. $x < 19$

$(-\infty, 19)$

21. $x > 71$

$(71, \infty)$

22. The height of an elevator in a skyscraper ranges from 20 feet underground to 520 feet above ground. Write the range of heights in interval notation and in set-builder notation.

$[-20, 520]; \{h \mid -20 \leq h \leq 520\}$

23. **CONNECTION TO REAL LIFE** A manufacturer throws out gears with weights that have an absolute deviation of more than 0.06 pound from the mean weight of the batch. Which gears should be thrown out? (See Example 4.)

the gear with a weight of 0.53 lb

Gear Weights (pounds)				
0.58	0.63	0.65	0.53	0.61

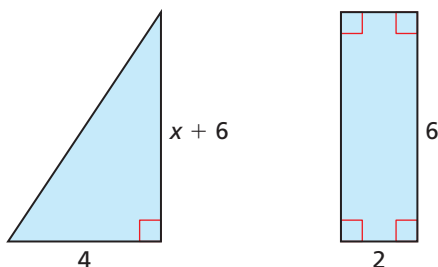
24. The table shows the total lengths of four trails. You want to complete a trail in $1\frac{1}{2}$ hours with an absolute deviation of at most 15 minutes. You hike at a rate of 3 miles per hour. Which trails can you hike? Use an absolute value inequality to justify your answer.

Trail	A	B	C	D
Miles	$5\frac{1}{4}$	$4\frac{3}{4}$	$3\frac{1}{2}$	4

$$A, B, D; \left| \frac{d}{3} - 1\frac{1}{2} \right| \leq \frac{1}{4}, 3\frac{3}{4} \leq d \leq 5\frac{1}{4}$$

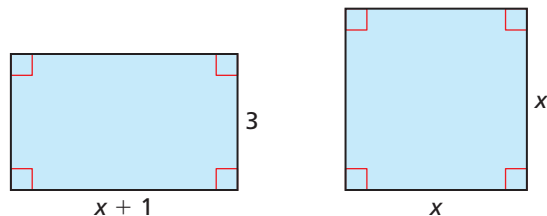
CONNECT CONCEPTS Write and solve an absolute value inequality that represents the situation.

25. The difference between the areas of the figures is less than 2.



$$\left| \frac{1}{2} \cdot 4(x + 6) - 2 \cdot 6 \right| < 2; -1 < x < 1$$

26. The difference between the perimeters of the figures is less than or equal to 3.

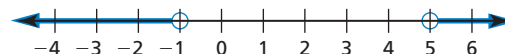
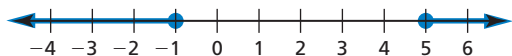


$$|2(x + 1) + 2 \cdot 3 - 4x| \leq 3; \frac{5}{2} \leq x \leq \frac{11}{2}$$

27. **SMP.3 SMP.6** Your classmate claims that the solution of $|n| > 0$ is all real numbers. Is your classmate correct? Explain your reasoning.

no; If n is 0, the statement is false.

28. Write an absolute value inequality for each graph. How did you decide which inequality symbol to use for each inequality?



Sample answer: $|x - 2| \geq 3$; $|x - 2| < 3$; $|x - 2| \leq 3$; $|x - 2| > 3$; A segment indicated $<$, two opposite rays indicated $>$, and an open or closed circle indicated whether or not to add “or equal to”.

SMP.3 SMP.6 This problem provides an opportunity for mathematical discourse. Encourage pairs of students to describe what mathematical thinking was likely used to make the claim, and then discuss whether they agree or disagree. Listen for students to use precise mathematical language as they discuss the reasons that the argument makes sense, or reasons to challenge the claim.

- SMP.3 SMP.7** Tell whether the statement is *true* or *false*. If it is false, explain why.

29. If a is a solution of $|x + 3| \leq 8$, then a is also a solution of $x + 3 \geq -8$.

true

30. If a is a solution of $|x + 3| > 8$, then a is also a solution of $x + 3 > 8$.

false; It could be a solution of $x + 3 < -8$.

31. If a is a solution of $|x + 3| \geq 8$, then a is also a solution of $x + 3 \geq -8$.

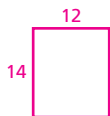
false; It could be a solution of $x + 3 \leq -8$.

32. If a is a solution of $x + 3 \leq -8$, then a is also a solution of $|x + 3| \geq 8$.

true

33. **OPEN-ENDED** Draw and label a geometric figure so that the perimeter P of the figure is a solution of the inequality $|P - 60| \leq 12$.

Sample answer:



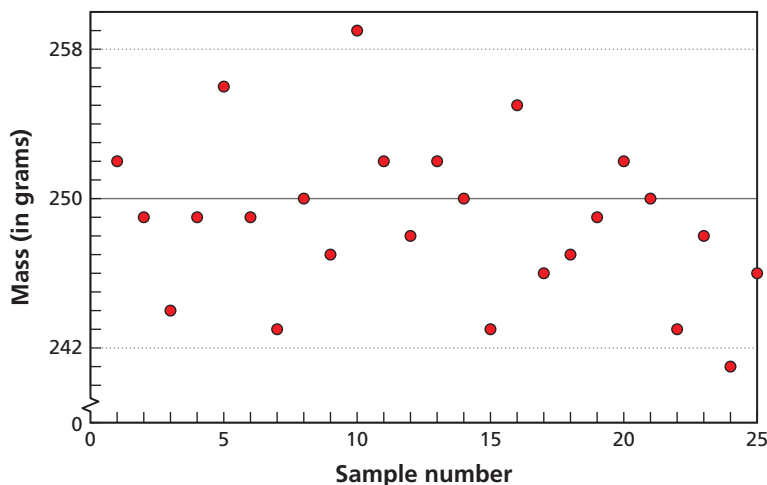
34. **SMP.1 DIG DEEPER** Solve the compound inequality $|x - 3| < 4$ and $|x + 2| > 8$. Explain your reasoning.

$6 < x < 7$; Sample answer: Solve each inequality, then graph the solutions on the same number line. The solutions intersect between 6 and 7.

Interpreting Data

2.6

QUALITY CONTROL IN THE FOOD INDUSTRY To test the mass of food in an assembly line, a quality control technician randomly selects 25 items and finds the mass of each sample.



35. Let x be the mass of a sample. The expected mass is 250 grams. The absolute deviation is allowed to be 8 grams. Write an absolute value inequality that represents the samples that pass the test. How many samples did not pass?

$$|x - 250| \leq 8; 2 \text{ samples}$$

36. Explain why manufactured food items might not all have the same mass.

Sample answer: It could be difficult to get every piece to be exactly the same.



India's Notes

Developing Grit

Remind your students to cultivate their grit by persisting if their first attempt is incorrect or challenging.

? "What can you do when you face a challenge?"

? "Mistakes are a part of the learning process, and you can prevail! Tap into your grit! You've got this!"

Data Talk

- What do you notice? What do you wonder?

? "What do you think may have happened with the samples that were outside the guideline values?"

Review & Refresh

Plot the ordered pair in a coordinate plane.

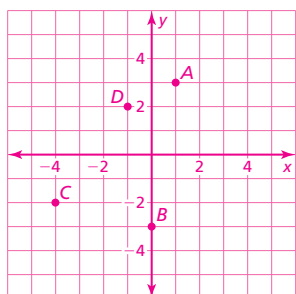
37. $A(1, 3)$

38. $B(0, -3)$

39. $C(-4, -2)$

40. $D(-1, 2)$

37–40.



41. Complete the table.

x	0	1	2	3	4
$5x + 1$	1	6	11	16	21

Solve the equation.

42. $3(5m - 1) - 7m = -9$

$m = -\frac{3}{4}$

43. $|2x + 7| - 8 = -5$

$x = -5, x = -2$

44. $-\frac{1}{2}(4h - 3) = \frac{1}{4}(6 - 8h)$

all real numbers

45. Write an inequality that represents the graph.



$x < -4$

46. You bike 12 miles per hour. Your friend bikes 270 meters per minute. Who bikes faster?

you

Solve the inequality. Graph the solution.

47. $\frac{t}{-5} - 2 \geq 1.7$

$t \leq -18.5$



48. $-3 < 4y + 5 \leq 9$

$-2 < y \leq 1$

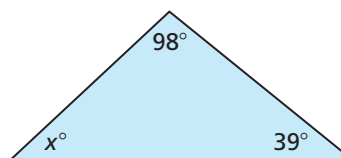


49. $b + \frac{1}{3} \leq \frac{5}{3}$ or $1 - 3b \leq -5$

$b \leq \frac{4}{3}$ or $b \geq 2$



50. Find the value of x .



43

Student Edition pages 101–103

2.1

Writing and Graphing Inequalities (pp. 59–66)

Learning Target: Write inequalities and represent solutions of inequalities on number lines.

Write the sentence as an inequality.

1. A number
- d
- minus 2 is less than
- -1
- .

$$d - 2 < -1$$

2. Ten is at least the product of a number
- h
- and 5.

$$10 \geq 5h$$

Tell whether -5 is a solution of the inequality.

- 3.
- $p - 12 \leq -7$

yes

- 4.
- $b + 6 > 1$

no

- 5.
- $\frac{3}{5}d \geq -3$

yes

- 6.
- $w - 2.5 > -8$

yes

Graph the inequality.

- 7.
- $x > 4$



- 8.
- $y \leq 2$



- 9.
- $-1.5 \geq z$



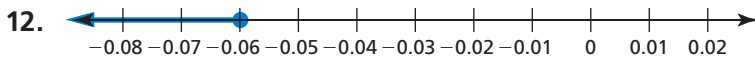
- 10.
- $w < \frac{2}{3}$



Write an inequality that represents the graph.



$$x > 2$$



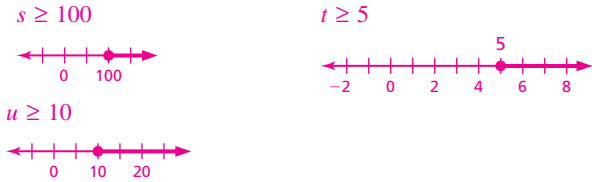
$$x \leq -0.06$$

Vocabulary

inequality
solution of an
inequality
solution set
graph of an inequality

13. Three requirements for a lifeguard training course are shown.

- a. Write and graph three inequalities that represent the requirements.



- b. You can swim 250 feet, tread water for 6 minutes, and swim 35 feet underwater without taking a breath. Do you satisfy the requirements of the course? **no**

LIFEGUARDS NEEDED

TAKE OUR
TRAINING
COURSE NOW!!!

Lifeguard Training Requirements

- Swim at least 100 yards.
- Tread water for at least 5 minutes.
- Swim 10 yards or more underwater without taking a breath.

14. Given that $M > N$, determine whether the inequality

$$\frac{M}{N} > \frac{N}{M}$$

is *always*, *sometimes*, or *never* true. **sometimes**

2.2

Solving Inequalities Using Addition or Subtraction (pp. 67–72)

Learning Target: Write and solve inequalities using addition or subtraction.

Solve the inequality. Graph the solution.

15. $p + 4 < 10$



16. $r - 4 > -6$



17. $2.1 \geq m - 6.7$



18. $x + 2.5 \leq -8$



Vocabulary

equivalent
inequalities

19. Write an inequality that requires using addition or subtraction to solve and has a solution of $-\frac{2}{3} > b$.

Sample answer: $-1 > b - \frac{1}{3}$

20. The Douglas Sea Scale describes the roughness of a sea for navigation. Waves currently reach a height of 12.82 meters. By what amounts can the wave heights increase for the sea to be described as *phenomenal*?

Wave height (m)	2.50–4.00	4.01–6.00	6.01–9.00	9.01–14.00	> 14.00
Description	Rough	Very Rough	High	Very High	Phenomenal

more than 1.18 m

2.3

Solving Inequalities Using Multiplication or Division (pp. 73–78)

Learning Target: Write and solve inequalities using multiplication or division.

Solve the inequality. Graph the solution.

21. $3x > -21$



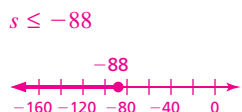
22. $-4 \leq \frac{g}{5}$



23. $-\frac{3}{4}n \leq 3$



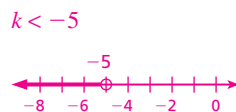
24. $\frac{s}{-8} \geq 11$



25. $36 < 2q$



26. $-1.2k > 6$



27. Write an inequality that requires using multiplication or division to solve and has a solution of $h \geq 3.25$.

Sample answer: $3h \geq 9.75$

2.4

Solving Multi-Step Inequalities (pp. 79–84)

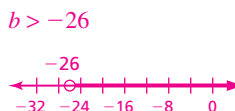
Learning Target: Write and solve multi-step inequalities.

Solve the inequality. Graph the solution, if possible.

28. $3x - 4 > 11$



29. $-4 < \frac{b}{2} + 9$



30. $6(2t + 9) \leq 12t - 1$

no solution

31. $2r - 8 > \frac{3}{4}(r - 6)$



32. You want to subscribe to an online streaming service for live television. For what numbers of months is the total cost of Channel Champ less than the total cost of TV Mania?



16 or more months

2.5

Solving Compound Inequalities (pp. 85–92)

Learning Target: Write and solve compound inequalities.

Vocabulary

compound inequality

33. Write the sentence below as an inequality. Graph the inequality.

A number x is more than -6 and at most 8 .

$$-6 < x \leq 8$$



Solve the inequality. Graph the solution.

34. $12 > 4p$ or $16 \leq 2p$

$$p < 3 \text{ or } p \geq 8$$



35. $5 < 5x \leq 20$

$$1 < x \leq 4$$



36. $19 \geq 3z + 1 \geq -5$

$$-2 \leq z \leq 6$$



37. $-3p \geq -6$ or $4p + 1 > 13$

$$p \leq 2 \text{ or } p > 3$$



38. $\frac{r}{4} < -5$ or $-2r - 7 \leq 3$

$$r < -20 \text{ or } r \geq -5$$

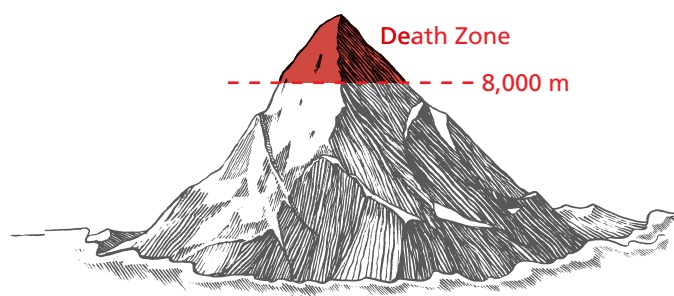


39. $-1 \leq -2d + 7 < 10$

$$-\frac{3}{2} < d \leq 4$$



40. Mount Everest has an elevation of about 8,850 meters. Any location above 8,000 meters is in the *death zone*. Write an inequality that represents the possible elevations of climbers in the death zone on Mount Everest.



$$8,000 < x \leq 8,850$$

41. A highway has a minimum speed limit of 45 miles per hour and a maximum speed limit of 70 miles per hour. Write and solve an inequality that represents the legal driving speeds in kilometers per hour.

$$45 \leq \frac{k}{1.61} \leq 70 \text{ or } 45 \leq 0.62k \leq 70; \text{ about } 73 \text{ km/h to about } 113 \text{ km/h}$$

2.6

Solving Absolute Value Inequalities (pp. 93–100)

Learning Target: Write and solve inequalities involving absolute value.

Vocabulary

absolute value
inequality
bounded interval
unbounded interval
absolute deviation

Solve the inequality. Graph the solution, if possible.

42. $|m| \geq 10$

$m \geq 10$ or $m \leq -10$



43. $|k - 9| < -4$

no solution

44. $|x + 3| > 2$

$x > -1$ or $x < -5$



45. $|g - 5| - 11 \leq -3$

$-3 \leq g \leq 13$



46. $|-1.5g - 2| + 1 < 6$

$-\frac{14}{3} < g < 2$



47. $|9 - 2j| + 10 \geq 2$

all real numbers



48. A safety regulation states that the height of a guardrail should be 106 centimeters with an absolute deviation of no more than 7 centimeters. Write and solve an absolute value inequality that represents the acceptable heights of a guardrail.

$|h - 106| \leq 7$; 99 cm to 113 cm

1. Explain what is shown in the display. What do you notice? What do you wonder?

Sample answer: The display shows several elevation points of Mount Everest. Check students' work.

2. Write three inequalities that can be used to represent a climbing trip on Everest.

Sample answer: $26,300 \leq h \leq 29,035$, $t < 20$, $9 \leq t \leq 13$

3. What does the inequality $|x - 11| \leq 2$ represent in this situation? Graph the solution on a number line.

approximate ascent times

