9th Grade Math

Unit 2 Notes

Solving Linear Inequalities

Name _____

Period _____

LESSON 2.1 / 2.2 BELLWORK

Solve each equation for x.

1. $16 + x = 5x$

$-x \quad -x$

$\frac{16}{4} = \frac{4x}{4}$

$4 = x$

2. $4p + 10 = p - 14$

$-p \quad -p$

$3p + 10 = -14$

$-10 \quad -10$

$\frac{3p}{3} = \frac{-24}{3}$

$p = -8$

3. $-4r - 11 = 14r + 9$

$+4r \quad +4r$

$-11 = 18r + 9$

$-9 \quad -9$

$\frac{-20}{18} = \frac{18r}{18}$

$-\frac{10}{9} = -1\frac{1}{9} = r$

4. $8 - 2x + 13x = x - 2$

$8 + 11x = x - 2$

$-x \quad -x$

$8 + 10x = -2$

$-8 \quad -8$

$\frac{10x}{10} = \frac{-10}{10}$

$x = -1$

5. $4(3x - 5) = -2(-6x + 10)$

$12x - 20 = 12x - 20$

All real #'s

∞ sol !

6. $|2x - 4| - 6 = 10$

$+6 \quad +6$

$|2x - 4| = 16$

$2x - 4 = 16$ $\qquad$ $2x - 4 = -16$

$+4 \quad +4$ $\qquad$ $+4 \quad +4$

$\frac{2x}{2} = \frac{20}{2}$ $\qquad$ $\frac{2x}{2} = \frac{-12}{2}$

$x = 10$ $\qquad$ $x = -6$

7. What do each of the following symbols mean?

$\leq$ less than or equal to $\geq$ greater than or = to $>$ greater than $<$ less than

Lesson 2.1 / 2.2 - Writing and Graphing Inequalities & Solving Inequalities using + and −.

GOAL: I can write and graph inequalities and solve inequalities using + and −

Word	Definition	Picture or Example
Inequality	Mathematical sentence that compares expressions	Greater than, less than, $<$, $>$, $\leq$, $\geq$
Solution of an inequality	A value that makes the inequality true	4 is a solution to $x > 2$ since $4 > 2$

Write each sentence as an inequality.

1. A number x is less than 2

$x < 2$

2. A number m plus 4 is greater than or equal to 7

$m + 4 \geq 7$

3. Ten is no less than a number q multiplied by 6

$10 \geq 6q$

4. Six is more than the difference of a number d and one

$6 > d - 1$

Tell whether the value is a solution of the inequality.

1. $u + 7 < 4$; $u = 2$

$2 + 7 < 4$
$9 < 4$ No!

2. $5p \geq 24$; $p = 6$

$5 \cdot 6 \geq 24$ Yes!
$30 \geq 24$ ✓

3. $-3 > -\frac{x}{5}$; $x = 10$

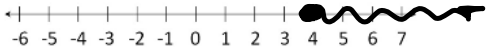
$-3 > -\frac{10}{5}$ No!
$-3 > -2$

4. $15 \leq 4w$; $w = 3$

$15 \leq 12$ No!

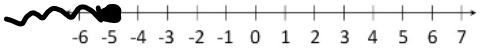
Graph each inequality.

1. $x \geq 4$

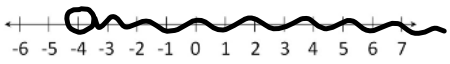


2. $j < 3$

3. $-5 \geq q$ $q \leq -5$

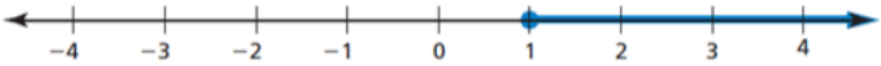


4. $-4 < f$ $f > -4$

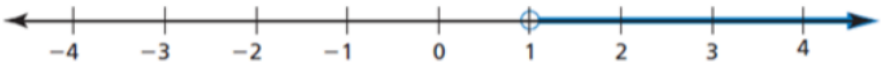


Write an inequality that represents each graph.

a. $x \geq 1$

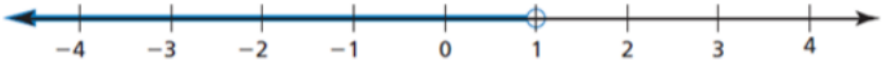


b. $x > 1$



c. $x \leq 1$

d. $x < 1$



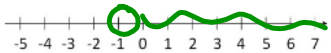
Solve each inequality. Graph the solution.

1. $t - 3 > -2$ $t > 1$

2. $2 \geq h - 5$ $7 \geq h$ $h \leq 7$

3. $p + 3 \leq 4$ $p \leq 1$

4. $6 + k > 5$ $k > -1$



5. $3 - 11 + t > -2$ $t > 6$

6. $4 \leq 6a - 4a - 2$ $4 \leq 2a - 2$ $6 \leq 2a$ $3 \leq a$ $a \geq 3$

Write each sentence as an inequality, then solve.

1. A number plus 10 is less than 34

$x + 10 < 34$

$-10 \quad -10$

$x < 24$

2. The sum of a number and 7 is less than 15

$x + 7 < 15$

$-7 \quad -7$

$x < 8$

3. Nine is less than or equal to the difference of a number and one

$9 \leq x - 1$

$+1 \quad +1$

$10 \leq x$

4. Eight is greater than or equal to the sum of a number and three

$8 \geq x + 3$

$-3 \quad -3$

$5 \geq x$

You and your friend are planning to walk across an old bridge. The bridge can hold at most 1000 pounds. The total weight of the people currently on the bridge is 675 pounds. You weight 156 pounds.

a. Write and solve an inequality that represents how much your friend can weigh within the limits of the bridge.

$675 + 156 + x \leq 1000$

$831 + x \leq 1000$

$-831 \quad -831$

$x \leq 169$ lbs!

b. Your friend weighs 182 pounds. Can you and your friend both walk on the bridge? Explain.

No!

$182 > 169$

Homework 21 / 22:

pg 58:1-43 odds

2.1 Exercises

Dynamic Solutions available at *BigIdeasMath.com*

Vocabulary and Core Concept Check

1. **COMPLETE THE SENTENCE** A mathematical sentence using the symbols $<$, $>$, $\leq$, or $\geq$ is called a(n)_____.
2. **VOCABULARY** Is 5 in the solution set of $x + 3 > 8$? Explain.
3. **ATTENDING TO PRECISION** Describe how to graph an inequality.
4. **DIFFERENT WORDS, SAME QUESTION** Which is different? Write "both" inequalities.

w is greater than or equal to -7.

w is no less than -7.

w is no more than -7.

w is at least -7.

Monitoring Progress and Modeling with Mathematics

In Exercises 5–12, write the sentence as an inequality. *(See Example 1.)*

5. A number x is greater than 3.
6. A number n plus 7 is less than or equal to 9.
7. Fifteen is no more than a number t divided by 5.
8. Three times a number w is less than 18.
9. One-half of a number y is more than 22.
10. Three is less than the sum of a number s and 4.
11. Thirteen is at least the difference of a number v and 1.
12. Four is no less than the quotient of a number x and 2.1.
13. **MODELING WITH MATHEMATICS** On a fishing trip, you catch two fish. The weight of the first fish is shown. The second fish weighs at least 0.5 pound more than the first fish. Write an inequality that represents the possible weights of the second fish.

14. **MODELING WITH MATHEMATICS** There are 430 people in a wave pool. Write an inequality that represents how many more people can enter the pool.

In Exercises 15–24, tell whether the value is a solution of the inequality. *(See Example 2.)*

15. $r + 4 > 8; r = 2$
16. $5 - x < 8; x = -3$
17. $3s \leq 19; s = -6$
18. $17 \geq 2y; y = 7$
19. $-1 > -\frac{x}{2}; x = 3$
20. $\frac{4}{z} \geq 3; z = 2$
21. $14 \geq -2n + 4; n = -5$
22. $-5 \div (2s) < -1; s = 10$
23. $20 \leq \frac{10}{2z} + 20; z = 5$
24. $\frac{3m}{6} - 2 > 3; m = 8$
25. **MODELING WITH MATHEMATICS** The tallest person who ever lived was approximately 8 feet 11 inches tall.
    a. Write an inequality that represents the heights of every other person who has ever lived.
    b. Is 9 feet a solution of the inequality? Explain.

26. DRAWING CONCLUSIONS 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.

b. Was one of the other competitors able to bench-press 379 pounds? Explain.

ERROR ANALYSIS In Exercises 27 and 28, describe and correct the error in determining whether 8 is in the solution set of the inequality.

27.

$$-y + 7 < -4$$
$$-8 + 7 \stackrel{?}{<} -4$$
$$-1 < -4$$

8 is in the solution set.

28.

$$\tfrac{1}{2}x + 2 \leq 6$$
$$\tfrac{1}{2}(8) + 2 \stackrel{?}{\leq} 6$$
$$4 + 2 \stackrel{?}{\leq} 6$$
$$6 \leq 6$$

8 is *not* in the solution set.

In Exercises 29–36, graph the inequality. *(See Example 3.)*

29. $x \geq 2$

30. $z \leq 5$

31. $-1 > t$

32. $-2 < w$

33. $v \leq -4$

34. $s < 1$

35. $\frac{1}{4} < p$

36. $r \geq -|5|$

In Exercises 37–40, write and graph an inequality for the given solution set.

37. $\{x \mid x < 7\}$

38. $\{n \mid n \geq -2\}$

39. $\{z \mid 1.3 \leq z\}$

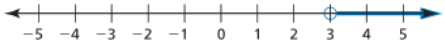
40. $\{w \mid 5.2 > w\}$

In Exercises 41–44, write an inequality that represents the graph. *(See Example 4.)*

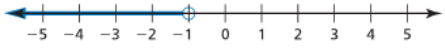
41.

42.

43.

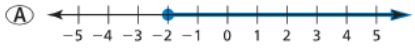


44.



45. ANALYZING RELATIONSHIPS The water temperature of a swimming pool must be no less than 76°F. The temperature is currently 74°F. Which graph correctly shows how much the temperature needs to increase? Explain your reasoning.

A



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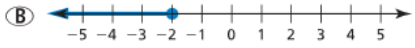

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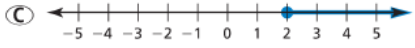


D

46. MODELING WITH MATHEMATICS According to a state law for vehicles traveling on state roads, the maximum total weight of a vehicle and its contents depends on the number of axles on the vehicle. For each type of vehicle, write and graph an inequality that represents the possible total weights w (in pounds) of the vehicle and its contents.

Maximum Total Weights

47. PROBLEM SOLVING 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 and graph an inequality that represents the lengths ℓ (in *inches*) of all other natural arches.

48. THOUGHT PROVOKING A student works no more than 25 hours each week at a part-time job. Write an inequality that represents how many hours the student can work each day.

49. WRITING Describe a real-life situation modeled by the inequality $23 + x \leq 31$.

50. HOW DO YOU SEE IT? The graph represents the known melting points of all metallic elements (in degrees Celsius).

a. Write an inequality represented by the graph.

b. Is it possible for a metallic element to have a melting point of −38.87°C? Explain.

51. DRAWING CONCLUSIONS A one-way ride on a subway costs \$0.90. A monthly pass costs \$24. Write an inequality that represents how many one-way rides you can buy before it is cheaper to buy the monthly pass. Is it cheaper to pay the one-way fare for 25 rides? Explain.

Subway Prices	
One-way ride	\$0.90
Monthly pass	\$24.00

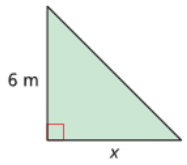
52. MAKING AN ARGUMENT The inequality $x \leq 1324$ represents the weights (in pounds) of all mako sharks ever caught using a rod and reel. Your friend says this means no one using a rod and reel has ever caught a mako shark that weighs 1324 pounds. Your cousin says this means someone using a rod and reel *has* caught a mako shark that weighs 1324 pounds. Who is correct? Explain your reasoning.

53. CRITICAL THINKING Describe a real-life situation that can be modeled by more than one inequality.

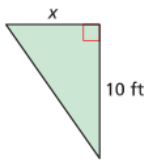
54. MODELING WITH MATHEMATICS In 1997, Superman's cape from the 1978 movie *Superman* was sold at an auction. The winning bid was \$17,000. Write and graph an inequality that represents the amounts all the losing bids.

MATHEMATICAL CONNECTIONS In Exercises 55–58, write an inequality that represents the missing dimension x.

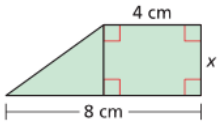
55. The area is less than 42 square meters.



56. The area is greater than or equal to 8 square feet.



57. The area is less than 18 square centimeters.



58. The area is greater than 12 square inches.

59. WRITING A runner finishes a 200-meter dash in 35 seconds. Let r represent any speed (in meters per second) faster than the runner's speed.

a. Write an inequality that represents r. Then graph the inequality.

b. Every point on the graph represents a speed faster than the runner's speed. Do you think every point could represent the speed of a runner? Explain.

Maintaining Mathematical Proficiency

Reviewing what you learned in previous grades and lessons

Solve the equation. Check your solution. *(Section 1.1)*

60. $x + 2 = 3$

61. $y - 9 = 5$

62. $6 = 4 + y$

63. $-12 = y - 11$

Solve the literal equation for x. *(Section 1.5)*

64. $v = x \cdot y \cdot z$

65. $s = 2r + 3x$

66. $w = 5 + 3(x - 1)$

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

2.2 pg 65 #'s 7-27 odds

2.2 Exercises

Dynamic Solutions available at *BigIdeasMath.com*

Vocabulary and Core Concept Check

1. **VOCABULARY** Why is the inequality $x \leq 6$ equivalent to the inequality $x - 5 \leq 6 - 5$?
2. **WRITING** Compare solving equations using addition with solving inequalities using addition.

Monitoring Progress and Modeling with Mathematics

In Exercises 3–6, tell which number you would add to or subtract from each side of the inequality to solve it.

3. $k + 11 < -3$
4. $v - 2 > 14$
5. $-1 \geq b - 9$
6. $-6 \leq 17 + p$

In Exercises 7–20, solve the inequality. Graph the solution. *(See Examples 1 and 2.)*

7. $x - 4 < -5$
8. $1 \leq s - 8$
9. $6 \geq m - 1$
10. $c - 12 > -4$
11. $r + 4 < 5$
12. $-8 \leq 8 + y$
13. $9 + w > 7$
14. $15 \geq q + 3$
15. $h - (-2) \geq 10$
16. $-6 > t - (-13)$
17. $j + 9 - 3 < 8$
18. $1 - 12 + y \geq -5$
19. $10 \geq 3p - 2p - 7$
20. $18 - 5z + 6z > 3 + 6$

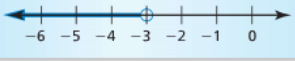
In Exercises 21–24, write the sentence as an inequality. Then solve the inequality.

21. A number plus 8 is greater than 11.
22. A number minus 3 is at least -5.
23. The difference of a number and 9 is fewer than 4.
24. Six is less than or equal to the sum of a number and 15.
25. **MODELING WITH MATHEMATICS** You are riding a train. Your carry-on bag can weigh no more than 50 pounds. Your bag weighs 38 pounds. *(See Example 3.)*
    a. Write and solve an inequality that represents how much weight you can add to your bag.
    b. Can you add both a 9-pound laptop and a 5-pound pair of boots to your bag without going over the weight limit? Explain.
26. **MODELING WITH MATHEMATICS** You order the hardcover book shown from a website that offers free shipping on orders of $25 or more. Write and solve an inequality that represents how much more you must spend to get free shipping.

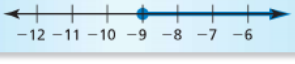
Price: $19.76

ERROR ANALYSIS **In Exercises 27 and 28, describe and correct the error in solving the inequality or graphing the solution.**

27.
$$-17 < x - 14$$
$$-17 + 14 < x - 14 + 14$$
$$-3 < x$$



28.
$$-10 + x \geq -9$$
$$-10 + 10 + x \geq -9$$
$$x \geq -9$$



29. **PROBLEM SOLVING** An NHL hockey player has 59 goals so far in a season. What are the possible numbers of additional goals the player can score to match or break the NHL record of 92 goals in a season?

30. **MAKING AN ARGUMENT** In an aerial ski competition, you perform two acrobatic ski jumps. The scores on the two jumps are then added together.

Ski jump	Competitor's score	Your score
1	117.1	119.5
2	119.8	

a. Describe the score that you must earn on your second jump to beat your competitor.

b. Your coach says that you will beat your competitor if you score 118.4 points. A teammate says that you only need 117.5 points. Who is correct? Explain.

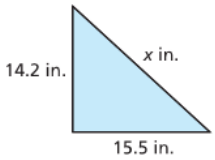
31. **REASONING** Which of the following inequalities are equivalent to the inequality $x - b < 3$, where b is a constant? Justify your answer.

Ⓐ $x - b - 3 < 0$ Ⓑ $0 > b - x + 3$

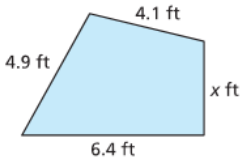
Ⓒ $x < 3 - b$ Ⓓ $-3 < b - x$

MATHEMATICAL CONNECTIONS **In Exercises 32 and 33, write and solve an inequality to find the possible values of x.**

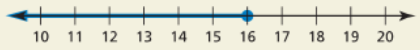
32. Perimeter < 51.3 inches



33. Perimeter ≤ 18.7 feet

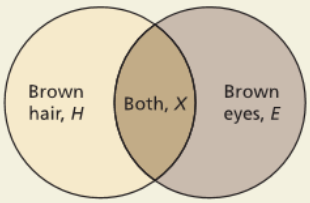


34. **THOUGHT PROVOKING** Write an inequality that has the solution shown in the graph. Describe a real-life situation that can be modeled by the inequality.



35. **WRITING** Is it possible to check all the numbers in the solution set of an inequality? When you solve the inequality $x - 11 \geq -3$, which numbers can you check to verify your solution? Explain your reasoning.

36. **HOW DO YOU SEE IT?** The diagram represents the numbers of students in a school with brown eyes, brown hair, or both.



Determine whether each inequality must be true. Explain your reasoning.

a. $H \geq E$ **b.** $H + 10 \geq E$

c. $H \geq X$ **d.** $H + 10 \geq X$

e. $H > X$ **f.** $H + 10 > X$

37. **REASONING** Write and graph an inequality that represents the numbers that are *not* solutions of each inequality.

a. $x + 8 < 14$

b. $x - 12 \geq 5.7$

38. **PROBLEM SOLVING** Use the inequalities $c - 3 \geq d$, $b + 4 < a + 1$, and $a - 2 \leq d - 7$ to order a, b, c, and d from least to greatest.

Maintaining Mathematical Proficiency

Reviewing what you learned in previous grades and lessons

Find the product or quotient. *(Skills Review Handbook)*

39. $7 \cdot (-9)$ **40.** $-11 \cdot (-12)$ **41.** $-27 \div (-3)$ **42.** $20 \div (-5)$

Solve the equation. Check your solution. *(Section 1.1)*

43. $6x = 24$ **44.** $-3y = -18$ **45.** $\frac{s}{-8} = 13$ **46.** $\frac{n}{4} = -7.3$