

LESSON **Reteach**
3-3 Solving Inequalities by Multiplying or Dividing

The inequality sign must be reversed when multiplying by a negative number.

Multiplying by a positive number:

$$2 < 5 \quad \text{True}$$

$$3 \cdot 2 \stackrel{?}{<} 3 \cdot 5 \quad \text{Multiply both sides by a positive number.}$$

$$6 \stackrel{?}{<} 15 \checkmark \quad \text{Statement is true.}$$

Multiplying by a negative number:

$$2 < 5 \quad \text{True}$$

$$(-3) \cdot 2 \stackrel{?}{<} (-3) \cdot 5 \quad \text{Multiply both sides by a negative number.}$$

$$-6 \stackrel{?}{<} -15 \times \quad \text{Statement is false.}$$

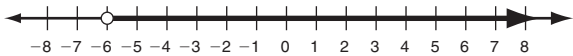
$$-6 > -15 \checkmark \quad \text{Reverse inequality sign so statement is true.}$$

Solve $\frac{x}{3} > -2$ and graph the solution.

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

$$3 \cdot \frac{x}{3} > 3 \cdot (-2) \quad \text{Multiply both sides by 3.}$$

$$x > -6$$



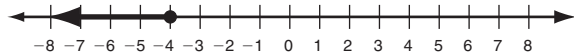
Solve $\frac{x}{-4} \geq 1$ and graph the solutions.

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

$$(-4) \cdot \frac{x}{-4} \geq (-4) \cdot 1 \quad \text{Multiply both sides by } -4.$$

$$x \leq -4$$

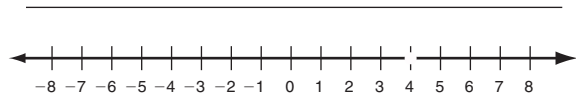
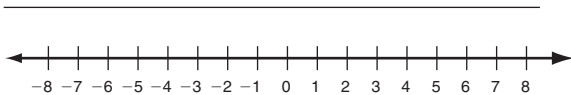
Reverse inequality sign.



Solve each inequality and graph the solutions.

1. $\frac{x}{3} \geq -2$

2. $-\frac{3}{4}g < -3$



Solve each inequality.

3. $-1 < \frac{v}{-5}$

4. $\frac{5}{6}m > 10$

LESSON

Reteach

3-3 Solving Inequalities by Multiplying or Dividing (continued)

The inequality sign must also be reversed when dividing by a negative number. Dividing by a negative number:

$8 > 6$ *True*

$\frac{8}{-2} > \frac{6}{-2}$ *Divide both sides by a negative number.*

$-4 \overset{?}{>} -3$ *Statement is false.*

$-4 < -3$ *Reverse inequality sign so statement is true.*

Solve $3x > -12$ and graph the solution.

$3x > -12$

$\frac{3x}{3} > \frac{-12}{3}$ *Divide both sides by 3.*

$x > -4$ Dividing by a positive.
Do not reverse inequality sign.



Solve $-2m \leq 10$ and graph the solutions.

$-2m \leq 10$

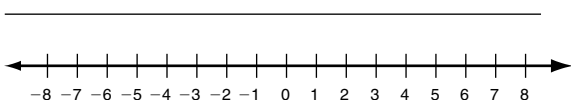
$\frac{-2m}{-2} \leq \frac{10}{-2}$ *Divide both sides by -2.*

$m \geq -5$ Dividing by a negative.
Reverse inequality sign.



Solve each inequality and graph the solutions.

5. $-5q \geq -10$



6. $4x < -16$



Solve each inequality.

7. $-x \leq 5$



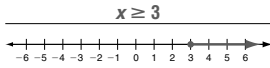
8. $30 > -10d$



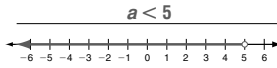
LESSON Practice A
3-3 Solving Inequalities by Multiplying or Dividing

Solve each inequality and graph the solutions.

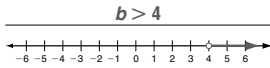
1. $2x \geq 6$



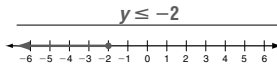
2. $\frac{a}{5} < 1$



3. $\frac{3}{4}b > 3$

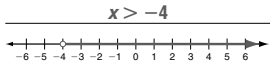


4. $15y \leq -30$

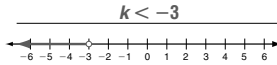


Solve each inequality and graph the solutions. Remember to switch the inequality sign.

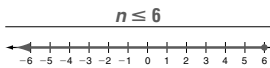
5. $-3x < 12$



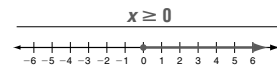
6. $\frac{k}{2} > 1.5$



7. $-\frac{2}{3}n \geq -4$



8. $-7x \leq 0$



Write and solve an inequality for each problem.

9. Joe goes to the store with \$15 to buy salad. Bags of pre-washed salad are on sale for \$2 each. What are the possible numbers of bags Joe can buy?

$2b \leq 15; b \leq 7.5; 0, 1, 2, 3, 4, 5, 6, \text{ or } 7 \text{ bags}$

10. By selling old CDs, Sarah has a store credit for \$153. A new CD costs \$18. What are the possible numbers of new CDs Sarah can buy?

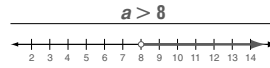
$18c \leq 153; c \leq 8.5; 0, 1, 2, 3, 4, 5, 6, 7, \text{ or } 8 \text{ CDs}$

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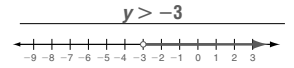
LESSON Practice B
3-3 Solving Inequalities by Multiplying or Dividing

Solve each inequality and graph the solutions.

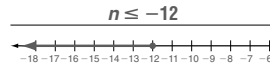
1. $4a > 32$



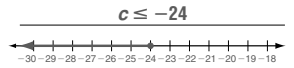
2. $-7y < 21$



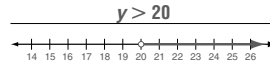
3. $1.5n \leq -18$



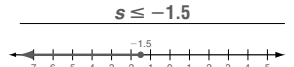
4. $-\frac{3}{8}c \geq 9$



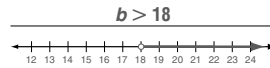
5. $\frac{y}{5} > 4$



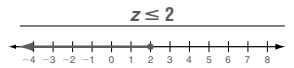
6. $2s \leq -3$



7. $-\frac{1}{3}b < -6$



8. $\frac{z}{-8} \geq -0.25$



Write and solve an inequality for each problem.

9. Phil has a strip of wood trim that is 16 feet long. He needs 5-foot pieces to trim some windows. What are the possible numbers of pieces he can cut?

$5p \leq 16; p \leq 3.2; 0, 1, 2, \text{ or } 3 \text{ pieces}$

10. A teacher buys a 128-ounce bottle of juice and serves it in 5-ounce cups. What are the possible numbers of cups she can fill?

$5s \leq 128; s \leq 25.6; 0 \text{ to } 25 \text{ cups}$

11. At an online bookstore, Kendra bought 4 copies of the same book for the members of her book club. She got free shipping because her total was at least \$50. What was the minimum price of each book?

$4b \geq 50; b \geq 12.50; \12.50 each

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LESSON Practice C
3-3 Solving Inequalities by Multiplying or Dividing

Solve each inequality.

1. $68 < 4a$

$a > 17$

2. $-13b \geq 78$

$b \leq -6$

3. $6c \leq -10$

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

4. $7.3 \geq \frac{x}{-2}$

$x \geq -14.6$

5. $-\frac{y}{3} \leq 2.5$

$y \geq -7.5$

6. $1.8z > 9.36$

$z > 5.2$

7. $-6n > \frac{3}{4}$

$n < -\frac{1}{8}$

8. $\frac{3}{8}p < \frac{9}{10}$

$p > \frac{12}{5} \text{ or } p > 2\frac{2}{5}$

9. $-16 \leq \frac{2}{5}k$

$k \geq -40$

Write an inequality for each statement.

Solve the inequality and graph the solutions.

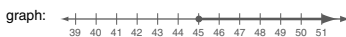
10. The product of a number and -4 is at most 24.

inequality: $-4x \leq 24$ solution: $x \geq -6$



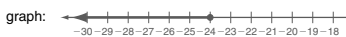
11. The quotient of a number and 15 is at least 3.

inequality: $\frac{x}{15} \geq 3$ solution: $x \geq 45$



12. The product of $\frac{2}{3}$ and x is no more than -16 .

inequality: $\frac{2}{3}x \leq -16$ solution: $x \leq -24$



Write and solve an inequality for the problem.

13. Ms. Malek is planning a breakfast meeting for 45 people. She wants at least one donut per person, but donuts are only sold in boxes of a dozen. What is the least number of boxes she should buy?

$12d \geq 45; d \geq 3.75; 4 \text{ dozen}$

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LESSON Reteach
3-3 Solving Inequalities by Multiplying or Dividing

The inequality sign must be reversed when multiplying by a negative number.

Multiplying by a positive number:

$2 < 5$

True

$3 \cdot 2 < 3 \cdot 5$

Multiply both sides by a positive number.

$6 < 15$

Statement is true.

Multiplying by a negative number:

$2 < 5$

True

$(-3) \cdot 2 < (-3) \cdot 5$

Multiply both sides by a negative number.

$-6 < -15$

Statement is false.

$-6 > -15$

Reverse inequality sign so statement is true.

Solve $\frac{x}{3} > -2$ and graph the solution.

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

$3 \cdot \frac{x}{3} > 3 \cdot (-2)$ Multiply both sides by 3.

$x > -6$



Solve $\frac{x}{-4} \geq 1$ and graph the solutions.

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

$(-4) \cdot \frac{x}{-4} \geq (-4) \cdot 1$ Multiply both sides by -4 .

$x \leq -4$

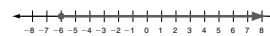
Reverse inequality sign.



Solve each inequality and graph the solutions.

1. $\frac{x}{3} \geq -2$

$x \geq -6$



2. $-\frac{3}{4}g < -3$

$g > 4$



Solve each inequality.

3. $-1 < -\frac{v}{5}$

$v < 5$

4. $\frac{5}{6}m > 10$

$m > 12$

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LESSON **Reteach**
3-3 Solving Inequalities by Multiplying or Dividing (continued)

The inequality sign must also be reversed when dividing by a negative number. Dividing by a negative number:

$8 > 6$ True

$\frac{8}{-2} > \frac{6}{-2}$ Divide both sides by a negative number.
 $-4 > -3$ Statement is false.

$-4 < -3$ Reverse inequality sign so statement is true.

Solve $3x > -12$ and graph the solution. **Solve $-2m \leq 10$ and graph the solutions.**

$3x > -12$ $-2m \leq 10$

$\frac{3x}{3} > \frac{-12}{3}$ Divide both sides by 3. $\frac{-2m}{-2} \leq \frac{10}{-2}$ Divide both sides by -2 .

$x > -4$ Dividing by a positive. Do not reverse inequality sign. $m \geq -5$ Dividing by a negative. Reverse inequality sign.

Solve each inequality and graph the solutions.

5. $-5q \geq -10$ $q \leq 2$

6. $4x < -16$ $x < -4$

Solve each inequality.

7. $-x \leq 5$ $x \geq -5$

8. $30 > -10d$ $d > -3$

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LESSON **Problem Solving**
3-3 Solving Inequalities by Multiplying or Dividing

Write and solve an inequality for each situation.

1. Karin has \$3 to spend in the arcade. The game she likes costs 50¢ per play. What are the possible numbers of times that she can play?
 $0.50g \leq 3; g \leq 6;$
 0, 1, 2, 3, 4, 5, or 6

2. Tyrone has \$21 and wants to buy juice drinks for his soccer team. There are 15 players on his team. How much can each drink cost so that Tyrone can buy one drink for each person?
 $15d \leq 21; d \leq 1.40;$
 up to \$1.40

3. A swimming pool is 7 feet deep and is being filled at the rate of 2.5 feet per hour. How long can the pool be left unattended without the water overflowing?
 $2.5h \leq 7; h \leq 2.8;$
 up to 2.8 hours

4. Megan is making quilts that require 11 feet of cloth each. She has 50 feet of cloth. What are the possible numbers of quilts that she can make?
 $11q \leq 50; q \leq 4.54;$
 0, 1, 2, 3, or 4

Alyssa, Reggie, and Cassie are meeting some friends at the movies and have stopped at the refreshment stand. The table below shows some of the items for sale and their prices. Use this information to answer questions 5–7.

Menu Item	Price (\$)
Popcorn	3.50
Drink	3.00
Hot Dog	2.50
Nachos	2.50
Fruit Snack	2.00

5. Alyssa has \$7 and would like to buy fruit snacks for as many of her friends as possible. Which inequality below can be solved to find the number of fruit snacks f she can buy?
 A $2f \leq 7$ C $7f \leq 2$
 B $2f < 7$ D $7f < 2$

6. Reggie brought \$13 and is going to buy popcorn for the group. Which answer below shows the possible numbers of popcorns p Reggie can buy for his friends?
 F 0, 1, or 2 H 0, 1, 2, 3, or 4
 G 0, 1, 2, or 3 J 0, 1, 2, 3, 4, or 5

7. The movie theater donates 12% of its sales to charity. From Cassie's purchases, the theater will donate at least \$2.15. Which inequality below shows the amount of money m that Cassie spent at the refreshment stand?
 A $m \geq 17.92$ C $m \geq 25.80$
 B $m \leq 17.92$ D $m \leq 25.80$

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LESSON **Challenge**
3-3 A Mathematical Lens

You will need a centimeter ruler for this activity.

1. Consider the inequality $-1 < 3$. Write the inequality you get when you multiply both sides by -2 . $2 > -6$

2. On the top number line, plot a point at -1 . On the bottom number line, plot the value you get when you multiply by -2 . Use your ruler to connect the two points with a straight segment.

3. Similarly, on the top, plot a point at 3 . On the bottom, plot the value you get when you multiply by -2 . Connect the two points with a segment.

4. Explain how the graph illustrates that you reverse an inequality when you multiply both sides by a negative number.
 The segments cross each other showing that the value that was lesser (-1) now corresponds to the value that is greater (2), and vice versa.

5. The two segments should intersect along the dashed segment connecting the zeroes. Measure the two pieces of the dashed segment. How is the ratio of the two lengths related to the factor -2 ?
 The ratio of these lengths is the absolute value of -2 : $\frac{\text{bottom}}{\text{top}} = \frac{2.4 \text{ cm}}{1.2 \text{ cm}} = 2$.

6. Try it again. Multiply both sides of the inequality $9 < 15$ by $-\frac{1}{3}$. yes; the segments cross each other and the ratio of the lengths of the pieces of the dashed segment is still the absolute value of the factor: $\frac{\text{bottom}}{\text{top}} = \frac{0.9 \text{ cm}}{2.7 \text{ cm}} = \frac{1}{3}$.

7. Where along the dashed line would the segments intersect if you multiplied both sides of any inequality by -1 ?
 The segments would intersect at the midpoint of the dashed line.

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LESSON **Reading Strategies**
3-3 Recognize Errors

The rules for solving inequalities are the same as for solving equations, with one exception. Analyze the problems below to avoid common errors.

$-4n > 28$ $-4n > 28$ $\frac{-4n}{-4} > \frac{28}{-4}$ $n < -7$	$\frac{x}{-8} \leq 2$ $(-8) \cdot \frac{x}{-8} \leq 2(-8)$ $x \geq -16$
Correct: When dividing by a negative number, you must reverse the inequality symbol.	Correct: When multiplying by a negative number, you must reverse the inequality symbol.
$\frac{t}{-5} \geq 4$ $(-5) \cdot \frac{t}{-5} \geq 4(-5)$ $t < -20$	$3p < -4.5$ $\frac{3p}{3} < \frac{-4.5}{3}$ $p > -1.5$
Error: Don't drop the "or equal to" part of the inequality symbol.	Error: Do not reverse the inequality symbol just because there is a negative in the problem.

Answer each question.

1. Would you reverse the inequality symbol when solving $2x > -20$? Explain.
 No; because you are dividing by a positive number.

2. What are the correct answers for the two errors shown above?
 $t \leq -20;$ $p < -1.5$

Tell whether the solution for each of the inequalities shown below is correct or incorrect. If incorrect, describe the error.

3. $-2a \geq -6; a \leq 3$ **Correct**

4. $\frac{m}{-2} \leq 9; m > -18$ **Incorrect; \leq was reversed**

5. $15 > -15t; t < -1$ **Incorrect; The sign was reversed.**

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