GRADE 7 · UNIT 10 · LESSON 3

Exploring Inequalities – Part 2

MA.7.AR.2.1

I can explain why multiplying or dividing both sides of an inequality by a negative number reverses the symbol, and use it to solve inequalities like $-3x < 12$.

Warm-Up

1. Solve: $x - 2.5 > 1$
2. Find the value of $-3n$ when $n = -4$.
3. Find the value: $-18 \div (-3)$
4. Compare with < or >: 2 and 6; then –2 and –6.

Warm-Up

1. Solve: $x - 2.5 > 1$ **$x > 3.5$**
2. Find the value of $-3n$ when $n = -4$. **12**
3. Find the value: $-18 \div (-3)$ **6**
4. Compare with < or >: 2 and 6; then –2 and –6.

   2 < 6, but –2 > –6

Vocabulary

multiplication property of inequality

multiply both sides by a positive number and the symbol stays; by a negative number and it reverses

division property of inequality

divide both sides by a positive number and the symbol stays; by a negative number and it reverses

reverse

turn the symbol around: $<$ becomes $>$, and $\leq$ becomes $\geq$

Notes

I. Multiply by a negative: the symbol reverses

$6 > -7$ is true.

Multiply both sides by 3: $18 > -21$ is still true.

Multiply both sides by –3: $-18 > 21$ is false.

So the symbol reverses: $-18 < 21$ is true.

Notes

II. Dividing does the same — and when the symbol stays

$-12 < 8$. Divide both sides by -4: $3 > -2$ — reversed.

Add or subtract any number: the symbol stays.

Multiply or divide by a positive number: the symbol stays.

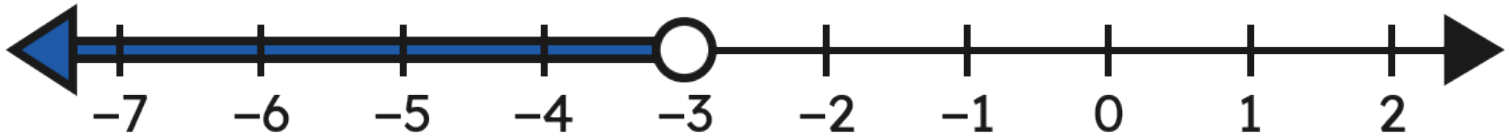
Multiply or divide by a negative number: the symbol reverses.

Notes

III. Solve: reverse on the line where the negative is used

$-2x > 6$: divide both sides by -2, and reverse on that line.

$x < -3$



Check -4: $-2(-4) = 8$, and $8 > 6$ is true.

Check 0: $-2(0) = 0$, and $0 > 6$ is false.

Example 1

$$-4n \leq 20$$

Solve it. Then check one number on each side of the boundary.

Example 1

$$-4n \leq 20$$

Divide both sides by −4, and reverse: $n \geq 20 \div (-4)$, so $n \geq -5$.

Graph: a closed circle at −5, the arrow to the right.

Check 0: $-4 \times 0 = 0$, and $0 \leq 20$ is true.

Check −6: $-4 \times (-6) = 24$, and $24 \leq 20$ is false.

Answer: $n \geq -5$

Your Turn

$$-5k > 30$$

Solve it. Then check one number on each side of the boundary.

Your Turn

$$-5k > 30$$

Solve it. Then check one number on each side of the boundary.

Divide both sides by −5, and reverse: $30 \div (-5) = -6$, so $k < -6$

Check −7: $-5 \times (-7) = 35$, and $35 > 30$ is true

Check 0: $-5 \times 0 = 0$, and $0 > 30$ is false

Answer: $k < -6$

Example 2

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

Solve it.

Example 2

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

Multiply both sides by −2, and reverse: $x > 3 \times (-2)$, so $x > -6$.

Graph: an open circle at −6, the arrow to the right.

Check −8: $-8 \div (-2) = 4$, and $4 < 3$ is false — −8 is off the arrow.

Answer: $x > -6$

Your Turn

$$\frac{y}{-3} \geq 3$$

Solve it.

Your Turn

$$\frac{y}{-3} \geq 3$$

Solve it.

Multiply both sides by –3, and reverse: $3 \times (-3) = -9$, so $y \leq -9$

Graph: a closed circle at –9, the arrow to the left

Answer: $y \leq -9$

Whiteboards · Question 1 of 9

$-3x > 15$

Solve it.

Answer it.

Whiteboards · Question 1 of 9

$-3x > 15$

Solve it.

Divide both sides by −3, and reverse: $15 \div (-3) = -5$

$x < -5$

Answer: $x < -5$

Whiteboards · Question 2 of 9

$3x > -15$

Solve it.

Answer it.

Whiteboards · Question 2 of 9

$3x > -15$

Solve it.

Divide both sides by 3, a positive: $-15 \div 3 = -5$

$x > -5$: dividing by a positive keeps the symbol

Answer: $x > -5$

Whiteboards · Question 3 of 9

$-6y \leq -42$

Solve it.

A. $y \geq 7$

B. $y \leq -36$

C. $y \leq 7$

D. $y \geq -7$

Answer it.

Whiteboards · Question 3 of 9

$-6y \leq -42$

Solve it.

Divide both sides by −6, and reverse: $-42 \div (-6) = 7$

$y \geq 7$

Answer: A — $y \geq 7$

Whiteboards · Question 4 of 9

$$\frac{m}{-5} < 2$$

Solve it.

Answer it.

Whiteboards · Question 4 of 9

$$\frac{m}{-5} < 2$$

Solve it.

Multiply both sides by –5, and reverse: $2 \times (-5) = -10$

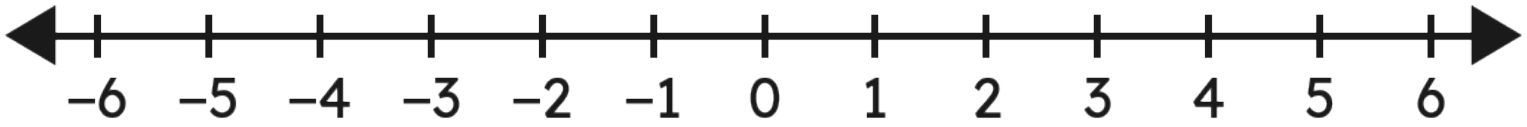
$m > -10$

Answer: m > –10

Whiteboards · Question 5 of 9

$-x \geq 3$

Solve it. Then graph the solutions.

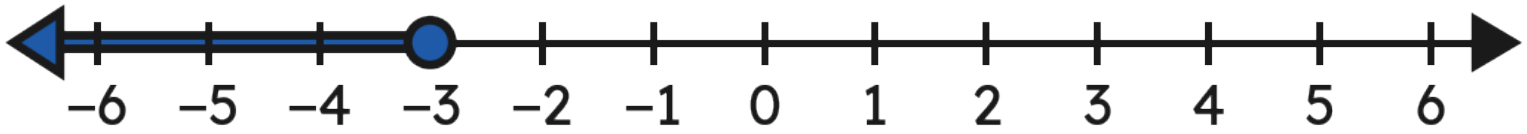


Answer it.

Whiteboards · Question 5 of 9

$-x \geq 3$

Solve it. Then graph the solutions.



$-x$ is -1 times x: divide both sides by -1, and reverse the symbol

$x \leq -3$: a closed circle at -3, the arrow to the left

Answer: $x \leq -3$

Whiteboards · Question 6 of 9

$-14 < -2k$

Solve it. Write the answer with the variable first.

Answer it.

Whiteboards · Question 6 of 9

$-14 < -2k$

Solve it. Write the answer with the variable first.

Divide both sides by −2, and reverse: $-14 \div (-2) = 7$, so $7 > k$

Read it from the variable: $k < 7$

Answer: $k < 7$

Whiteboards · Question 7 of 9

$\frac{n}{-4} \geq -2$

Solve it.

A. $n \leq \frac{1}{2}$

B. $n \leq -8$

C. $n \leq 8$

D. $n \geq 8$

Answer it.

Whiteboards · Question 7 of 9

$$\frac{n}{-4} \geq -2$$

Solve it.

Multiply both sides by −4, and reverse: $-2 \times (-4) = 8$

$n \leq 8$

Answer: C — $n \leq 8$

Whiteboards · Question 8 of 9

A submarine with 3 crew dives from the surface at 9 meters a minute.

For which times t, in minutes, is it above –45 meters?

Answer it.

Whiteboards · Question 8 of 9

A submarine with 3 crew dives from the surface at 9 meters a minute.

For which times t, in minutes, is it above –45 meters?

After t minutes it is at $-9t$. Above –45: $-9t > -45$

Divide by –9, and reverse: $-45 \div (-9) = 5$, so $t < 5$

Answer: t < 5: for the first 5 minutes

Whiteboards · Question 9 of 9

Sam says $-3x < 27$ becomes $x < -9$.

What is Sam's mistake? Fix it, and check with a number.

Write your answer in sentences.

Whiteboards · Question 9 of 9

Sam says $-3x < 27$ becomes $x < -9$.

What is Sam's mistake? Fix it, and check with a number.

Dividing by -3 reverses the symbol: $x > -9$

Check 0: $-3 \times 0 = 0$, and $0 < 27$ is true

Answer: He did not reverse: $x > -9$

Independent Practice

1. Solve: $-7a \geq 28$
2. Solve: $7a \geq -28$
3. Solve: $-10 > -5w$
4. Solve: $\frac{c}{-6} \leq 0.5$
5. Solve: $-r < 4.5$
6. Describe the graph of the solutions of $-2p > 7$.

Before You Go

Multiply or divide by a negative: the symbol reverses.

Reverse it on the line where the negative is used.

Monday: fraction and decimal coefficients, and word problems.

IXL

1. Open IXL and start today's skills.
2. Work on paper where the question needs work. The answer box does not show it.
3. Every skill listed is required, to a SmartScore of 60. No new skill today: the plan lists none for 10.03. Keep 7MP, 9WP and 9GC going to 60: every Unit 10 skill is due by the Unit 10 test.

Today's skills — all required

Solve one-step addition and subtraction inequalities (7MP)

Solve and graph one-step addition and subtraction inequalities (9WP)

Solve one-step addition and subtraction inequalities: word problems (9GC)