Solve Inequalities Using Multiplication

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Printed: March 25, 2015

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CHAPTER 1

Solve Inequalities Using Multiplication

Here you'll solve inequalities using multiplication.

Have you ever had to solve an inequality by using multiplication? Take a look at this dilemma.

Emma Frances took a whole pile of cookies and divided them up by 11. When she was done, she had 22 piles of cookies. She knows that she started with greater than or equal to 242 cookies.

Can you use this inequality to prove that Emma is correct?

$\frac{x}{11} > 22$

Pay attention. This Concept will show you how to do this successfully.

Guidance

An ***inequality*** **is a mathematical statement where a quantity may be equal to or less than or greater than another quantity.** You can identify an inequality and solve inequalities using all four operations. Now we are going to look at solving inequalities that involve multiplication.

Let's look at this more closely.

Just as you sometimes need to multiply or divide both sides of an equation by the same number in order to solve an equation, you may sometimes need to multiply or divide both sides of an inequality by the same number in order to solve it. However, doing so may be a little more complicated.

First, let's take a look at a property that we can use to help us when solving an inequality that involves multiplication.

The *multiplication property of inequality* states that if each side of an inequality is multiplied by the same positive number, the sense of the inequality stays the same. In other words, the inequality symbol does not change.

If $a > b$ and $c > 0$, then $a \times c > b \times c$. If $a \geq b$ and $c > 0$, then $a \times c \geq b \times c$.

If $a < b$ and $c > 0$, then $a \times c < b \times c$. If $a \leq b$ and $c > 0$, then $a \times c \leq b \times c$.

However, if each side of an inequality is multiplied by the same *negative* number, the sense of the inequality changes and the inequality symbol must be reversed.

If $a > b$ and $d < 0$, then $a \times d < b \times d$. If $a \geq b$ and $d < 0$, then $a \times d \leq b \times d$

If $a < b$ and $d < 0$, then $a \times d > b \times d$. If $a \leq b$ and $d < 0$, then $a \times d \geq b \times d$

When you solve an inequality by using multiplication, you will see division in the original problem.

Yes. When you solve an inequality by using multiplication, the original problem will show division. Think about it this way, you use the inverse operation to solve an inequality. To solve by using multiplication, you must see division first.

Solve this inequality: $1 < \frac{x}{2}$.

Solve this inequality as you would solve an equation, by using inverse operations. Notice the fraction bar is used here to show division. Since the x is divided by 2, multiply both sides of the inequality by 2 to solve it. Since this involves multiplying both sides of the inequality by a positive number, the sense of the inequality will stay the same and you will not need to reverse the inequality symbol.

$$\begin{aligned} 1 &< \frac{x}{2} \\ 1 \times 2 &< \frac{x}{2} \times 2 \\ 2 &< \frac{x}{\cancel{2}} \times \frac{\cancel{2}}{1} \\ 2 &< x \end{aligned}$$

The answer is that x is greater than 2 or you could say 2 is less than x.

Identify the inequality symbol that goes in each blank.

Example A

$$\begin{aligned} k &> m \\ k \times 3 &\_\_ m \times 3 \end{aligned}$$

Solution: $>$

Example B

$$\begin{aligned} m &\geq n \\ m \times \left(-\frac{1}{2}\right) &\_\_ m \times \left(-\frac{1}{2}\right) \end{aligned}$$

Solution: $=$

Example C

$$-1 \ < 2$$
$$(-1) \times (-3) \ \_\_ \ 2 \times (-3)$$

Solution: $<$

Now let's go back to the dilemma at the beginning of the Concept.

$\frac{x}{11} > 22$

Notice that this inequality has division in it, so we can use multiplication to solve it. We multiply both sides by 11. The left side cancels. On the right side here is our work.

$x > 11(22)$

$x > 242$

Using multiplication, proves that Emma's statement is correct.

Guided Practice

Here is one for you to try on your own.

Solve for the unknown variable.

$\frac{x}{4} \leq -9$

Solution

This problem has division in it, so we can use the inverse to solve it.

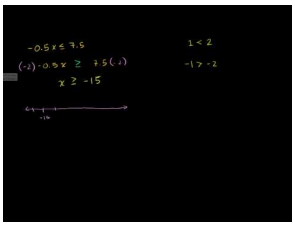
The inverse of division is multiplication. We multiply both sides of the inequality by 4. Then we can simplify and multiply to find the solution.

$x \leq -9(4)$

$x \leq -36$

This is our answer.

Video Review



MEDIA

Click image to the left or use the URL below.

URL: http://www.ck12.org/flx/render/embeddedobject/91

Khan Academy Inequalities Using Multiplication and Division

Explore More

Directions: Solve each inequality using multiplication.

1. $\frac{a}{3} < 10$
2. $\frac{x}{2} > 20$
3. $\frac{b}{4} < 25$
4. $\frac{x}{5} > 100$
5. $\frac{c}{2} \leq 20$
6. $\frac{x}{7} > 6$
7. $\frac{y}{9} \leq 2$
8. $\frac{y}{11} \geq 5$
9. $\frac{x}{2} < 3$
10. $\frac{y}{8} \geq -7$
11. $\frac{x}{3} < -2$
12. $\frac{y}{4} \leq -3$
13. $\frac{x}{2} \geq -11$
14. $\frac{a}{13} \geq -3$
15. $\frac{x}{22} \geq -5$