

Solving Inequalities Using Multiplication or Division

 Guide Notes

MULTIPLICATION PROPERTY OF INEQUALITIES

A. For multiplying a positive number

"If each side of a true inequality is multiplied by the **same positive number**, the resulting inequality is also true."

If a , and b are any numbers and c is a positive number, the following are true:

1. If $a > b$, then $ac > bc$.

$$\begin{array}{l} 12 > 9 \\ 12 \cdot 4 > 9 \cdot 4 \\ \hline 48 > 36 \end{array}$$

2. If $a < b$, then $ac < bc$.

$$\begin{array}{l} 16 < 22 \\ 16 \cdot 2 < 22 \cdot 2 \\ \hline 32 < 44 \end{array}$$

3. If $a \geq b$, then $ac \geq bc$.

$$\begin{array}{l} 10 \geq 9 \\ 10 \cdot 3 \geq 9 \cdot 3 \\ \hline 30 \geq 27 \end{array}$$

4. If $a \leq b$, then $ac \leq bc$.

$$\begin{array}{l} 14 \leq 15 \\ 14 \cdot 5 \leq 15 \cdot 5 \\ \hline 70 \leq 75 \end{array}$$

Sample Problem 1: Solve each inequality.

A. $\frac{x}{8} \geq 6$ $\frac{x}{8} \cdot 8 \geq 6 \cdot 8$ $x \geq 48$

B. $\frac{7}{5}a < -7$ $\frac{5}{7} \cdot \frac{7}{5}a < -7 \cdot \frac{5}{7}$ $a < -5$

C. $\frac{y}{4} \leq 13$ $\frac{y}{4} \cdot 4 \leq 13 \cdot 4$ $y \leq 52$

D. $\frac{2}{3}n > 4$ $\frac{3}{2} \cdot \frac{2}{3}n > 4 \cdot \frac{3}{2}$ $n > 6$

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B. For multiplying a negative number

"If each side of a true inequality is multiplied by the **same negative number**, the direction of the **inequality symbol must be reversed** so that the resulting inequality is also true."

If **a**, and **b** are any numbers and **c** is a negative number, the following are true:

1. If $a > b$, then $ac < bc$.

$$\begin{aligned} 15 &> 12 \\ 15(-4) &< 12(-4) \\ -60 &< -48 \end{aligned}$$

2. If $a < b$, then $ac > bc$.

$$\begin{aligned} 19 &< 25 \\ 19(-2) &> 25(-2) \\ -38 &> -50 \end{aligned}$$

3. If $a \geq b$, then $ac \leq bc$.

$$\begin{aligned} 13 &\geq 12 \\ 13(-3) &\leq 12(-3) \\ -39 &\leq -36 \end{aligned}$$

4. If $a \leq b$, then $ac \geq bc$.

$$\begin{aligned} 17 &\leq 18 \\ 17(-5) &\geq 18(-5) \\ -85 &\geq -90 \end{aligned}$$

Sample Problem 2: Solve each inequality.

A. $-\frac{5}{6}x \leq -15$ $\left(-\frac{6}{5}\right)\left(-\frac{5}{6}\right)x \geq (-15)\left(-\frac{6}{5}\right)$ $x \geq 18$

B. $-\frac{2}{3}a > 18$ $\left(-\frac{3}{2}\right)\left(-\frac{2}{3}a\right) < 18\left(-\frac{3}{2}\right)$ $a < -27$

C. $-\frac{y}{5} \geq \frac{6}{5}$ $\left(-5\right)\left(-\frac{y}{5}\right) \leq \frac{6}{5}\left(-5\right)$ $y \leq -6$

D. $-\frac{n}{16} < \frac{3}{4}$ $\left(-16\right)\left(-\frac{n}{16}\right) > \frac{3}{4}\left(-16\right)$ $n > -12$

Sample Problem 3: Write and solve each inequality.

A. One-seventh times a number is at least 15.

$$\frac{1}{7}x \geq 15 \quad (7)\left(\frac{1}{7}\right)x \geq 15(7) \quad x \geq 105$$

B. The ratio of a number and 5 is more than 25.

$$\frac{x}{5} > 25 \quad (5)\left(\frac{x}{5}\right) > 25(5) \quad x > 125$$

C. A negative number over 15 is greater than or equal to 5.

$$-\frac{x}{15} \geq 5 \quad (-15)\left(-\frac{x}{15}\right) \leq 5(-15) \quad x \leq -75$$

D. A number divided by negative nine is less than or equal to negative two.

$$\frac{x}{-9} \leq -2 \quad \left(-9\right)\left(\frac{x}{-9}\right) \geq -2(-9) \quad n \geq 18$$

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DIVISION PROPERTY OF INEQUALITIES

A. For dividing a positive number

*"If each side of a true inequality is divided by the **same positive number**, the resulting inequality is also true."*

If ***a***, and ***b*** are any numbers and ***c*** is a positive number, the following are true:

1. If $a > b$, then $\frac{a}{c} > \frac{b}{c}$.

$$\begin{array}{r} 12 > 9 \\ 12 & 9 \\ \hline 3 > 3 \\ 4 > 3 \end{array}$$

2. If $a < b$, then $\frac{a}{c} < \frac{b}{c}$.

$$\begin{array}{r} 16 < 22 \\ 16 & 22 \\ \hline 4 < 4 \\ 4 < 5\frac{1}{4} \end{array}$$

3. If $a \geq b$, then $\frac{a}{c} \geq \frac{b}{c}$.

$$\begin{array}{r} 10 \geq 9 \\ 10 & 9 \\ \hline 5 \geq 5 \\ 2 \geq 1\frac{4}{5} \end{array}$$

4. If $a \leq b$, then $\frac{a}{c} \leq \frac{b}{c}$.

$$\begin{array}{r} 14 \leq 15 \\ 14 & 15 \\ \hline 2 \leq 2 \\ 7 \leq 7\frac{1}{2} \end{array}$$

Sample Problem 4: Solve each inequality.

A. $4n \leq -12$

$$\frac{4n}{4} \leq \frac{-12}{4}$$

$$n \leq -3$$

B. $15y > 90$

$$\frac{15y}{15} > \frac{90}{15}$$

$$y > 6$$

C. $3a \geq -57$

$$\frac{3a}{3} \geq \frac{-57}{3}$$

$$a \geq -19$$

D. $2x < 5$

$$\frac{2x}{2} < \frac{5}{2}$$

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

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B. For dividing a negative number

"If each side of a true inequality is divided by the **same negative number**, the direction of the **inequality symbol must be reversed** so that the resulting inequality is also true."

If **a**, and **b** are any numbers and **c** is a negative number, the following are true:

1. If $a > b$, then $\frac{a}{c} < \frac{b}{c}$.

$$\begin{array}{r} 5 > 2 \\ \frac{5}{-3} < \frac{2}{-3} \\ -1\frac{2}{3} < -\frac{2}{3} \end{array}$$

2. If $a < b$, then $\frac{a}{c} > \frac{b}{c}$.

$$\begin{array}{r} 9 < 15 \\ \frac{9}{-4} > \frac{15}{-4} \\ -2\frac{1}{4} > -3\frac{3}{4} \end{array}$$

3. If $a \geq b$, then $\frac{a}{c} \leq \frac{b}{c}$.

$$\begin{array}{r} 3 \geq 2 \\ \frac{3}{-5} \leq \frac{2}{-5} \\ -\frac{3}{5} \leq -\frac{2}{5} \end{array}$$

4. If $a \leq b$, then $\frac{a}{c} \geq \frac{b}{c}$.

$$\begin{array}{r} 7 \leq 8 \\ \frac{7}{-2} \geq \frac{8}{-2} \\ -3\frac{1}{2} \geq -4 \end{array}$$

Sample Problem 5: Solve each inequality.

A.	$-2.4x \geq 3.6$	$\frac{-2.4x}{-2.4} \leq \frac{3.6}{-2.4}$	$x \leq -\frac{3}{2}$
B.	$-7a < 35$	$\frac{-7a}{-7} > \frac{35}{-7}$	$a > -5$
C.	$-3y \leq 7$	$\frac{-3y}{-3} \geq \frac{7}{-3}$	$y \geq -2\frac{1}{3}$
D.	$-5n > 125$	$\frac{-5n}{-5} < \frac{125}{-5}$	$n < -25$

Sample Problem 6: Write and solve each inequality.

A.	Three times a number is less than or equal to 21.	
	$3x \leq 21$	$\frac{3x}{3} \leq \frac{21}{3}$
		$x \leq 7$
B.	The product of twenty five and a number is at most nine.	
	$25x \leq 9$	$\frac{25x}{25} \leq \frac{9}{25}$
		$x \leq \frac{9}{25}$
C.	A negative number multiplied by six is greater than or equal to four.	
	$(-x)(6) \geq 4$	$\frac{(-x)(6)}{-6} \leq \frac{4}{-6}$
		$x \leq -\frac{2}{3}$
D.	Thrice a negative number is at least 18.	
	$-3x \geq 18$	$\frac{-3x}{-3} \leq \frac{18}{-3}$
		$x \leq -6$