

Vertical Progression:

7th Grade	<p>7.EE.B Solve real-life and mathematical problems using numerical and algebraic expressions and equations.</p> <ul style="list-style-type: none"> ○ 7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations to solve problems by reasoning about the quantities. ○ 7.EE.B.4.a Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution.
8th Grade	<p>8.EE.C Analyze and solve linear equations and pairs of simultaneous linear equations.</p> <ul style="list-style-type: none"> ○ 8.EE.C.7 Solve linear equations in one variable ○ 8.EE.C.7.a Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers.) ○ 8.EE.C.7.b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
Algebra 1	<p>ELG.MA.HS.A.8: Understand solving equations as a process of reasoning and explain the reasoning</p> <ul style="list-style-type: none"> ○ A-REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
Algebra 2	<p>ELG.MA.HS.A.8: Understand solving equations as a process of reasoning and explain the reasoning</p> <ul style="list-style-type: none"> ○ A-REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. ○ A-REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Students will demonstrate command of the ELG by:

- Justifying each step in solving simple equations.
- Explaining how/why various steps preserve the equality relationship.

Vocabulary:

- Addition property of equality
- Equation / equality
- Multiplication property of equality
- Solution

Sample Instructional/Assessment Tasks:

1) Standard(s): A-REI.A.1, A-REI.B.3

Source: <https://www.illustrativemathematics.org/content-standards/HSA/REI/A/1/tasks/807>

Reasoning with linear inequalities

Item Prompt:

The following is a student solution to the inequality:

$$\begin{aligned} \frac{5}{18} - \frac{x-2}{9} &\leq \frac{x-4}{6} \\ \frac{5}{18} - \frac{2x-2}{9} &\leq \frac{3x-4}{6} \\ \frac{5}{18} - \frac{2x-2}{18} &\leq \frac{3x-4}{18} \\ 5 - (2x-2) &\leq 3x-4 \\ 5 - 2x + 2 &\leq 3x-4 \\ 7 - 2x &\leq 3x-4 \\ -5x &\leq -11 \\ x &\leq \frac{11}{5} \end{aligned}$$

There are two mathematical errors in this work. Identify at what step each mathematical error occurred and explain why it is mathematically incorrect.

- How would you help the student understand his mistakes?
- Solve the inequality correctly.

Correct Answer:

- I) The first mathematical error occurred going from line 2 to line 3. The error is an incorrect application of the distributive property in two places. The second term should be $\frac{2x-4}{18}$ and the term on the right hand side of the inequality should be $\frac{3x-12}{18}$.
 - II) The second mathematical error occurred going from line 7 to line 8. Why it is incorrect: The student divided both sides of an inequality by -5; the direction of the inequality should be reversed when multiplying (dividing) by a negative number.
- b. Answers may vary. One correct solution is below.

$$\begin{aligned} \frac{5}{18} - \frac{x-2}{9} &\leq \frac{x-4}{6} \\ 18\left(\frac{5}{18} - \frac{x-2}{9}\right) &\leq 18\left(\frac{x-4}{6}\right) \\ 5 - 2(x-2) &\leq 3(x-4) \\ 5 - 2x + 4 &\leq 3x - 12 \\ 9 - 2x &\leq 3x - 12 \\ -5x &\leq -21 \\ x &\geq \frac{21}{5} \end{aligned}$$

2) Standard(s): A-REI.A.1

Source: Jonathan Mattes-Ritz

What Happened? Justify It!

Item Prompt:

Below is a solution to an equation. For each step, tell what was done and justify it with a property of equality or an explanation.

Steps	What Happened?	Justify / Explain
$\frac{5}{4} - \frac{2x+3}{6} = \frac{5-2x}{3} + \frac{7}{2}$		
$12\left(\frac{5}{4} - \frac{2x+3}{6}\right) = 12\left(\frac{5-2x}{3} + \frac{7}{2}\right)$		
$15 - 2(2x+3) = 4(5-2x) + 42$		
$15 - 4x - 6 = 20 - 8x + 42$		
$9 - 4x = -8x + 62$		
$9 + 4x = 62$		
$4x = 53$		
$x = \frac{53}{4}$		

Correct Answer:

Steps	What Happened?	Justify / Explain
$\frac{5}{4} - \frac{2x+3}{6} = \frac{5-2x}{3} + \frac{7}{2}$		
$12\left(\frac{5}{4} - \frac{2x+3}{6}\right) = 12\left(\frac{5-2x}{3} + \frac{7}{2}\right)$	Multiplied both sides by 12, the LCM of all denominators, to clear all fractions.	Multiplication property of equality. You can multiply both sides of an equation by the same value.
$15 - 2(2x+3) = 4(5-2x) + 42$	Distributed 12 over both sets of parenthesis.	Distributive property of multiplication over addition. $a(b+c)=ab+ac$
$15 - 4x - 6 = 20 - 8x + 42$	Distributed -2 and 4 over the parenthesis.	Distributive property of multiplication over addition. $a(b+c)=ab+ac$
$9 - 4x - 6 = 20 - 8x + 42$	Added 15 and -6 on the left side. Added 20 and 42 on the right side.	Combined like terms.
$9 - 4x = -8x + 62$	Added 8x to both sides.	Addition property of equality You can add the same value to both sides of an equation.
$9 + 4x = 62$	Added -9 to both sides.	Addition property of equality You can add the same value to both sides of an equation.
$4x = 53$		
$x = \frac{53}{4}$	Multiplied both sides by $\frac{1}{4}$.	Multiplication property of equality. You can multiply both sides of an equation by the same value.