

C – Expressions and Equations, Lesson 3, Solving Linear Equations (r. 2018)

EXPRESSIONS AND EQUATIONS

Solving Linear Equations

Common Core Standard	Next Generation Standard
A-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	AI-A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. Note: Algebra I tasks do not involve solving compound inequalities.

LEARNING OBJECTIVES

Students will be able to:

- 1) Solve one step and multiple step equations.
- 2) Explain each step involved in solving one step and multiple step equations.
- 3) Do a check to see if the solution is correct.

Overview of Lesson

Teacher Centered Introduction	Student Centered Activities
Overview of Lesson - activate students' prior knowledge - vocabulary - learning objective(s) - big ideas: direct instruction - modeling	guided practice ←Teacher: anticipates, monitors, selects, sequences, and connects student work - developing essential skills - Regents exam questions - formative assessment assignment (exit slip, explain the math, or journal entry)

VOCABULARY

balance

check

common sense

DIMS

four column strategy

four general rules

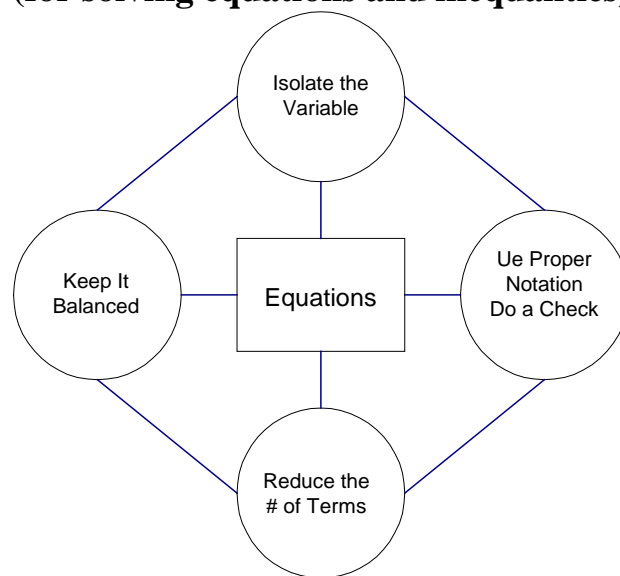
isolate

plug

proper notation

substitute

BIG IDEAS
The Four General Rules
(for solving equations and inequalities)



Isolate the Variable: The goal of solving any equation is to isolate the desired variable in either the left or right expression.

Keep It Balanced: During each step of the equation solving process, the left and right expressions must equal one another.

Reduce the Number of Terms: Any step that reduces the number of terms in an equation is usually a good step.

Use Proper Notation and Do a Check: You check your answers in algebra on two levels: first, you see if the answer actually makes sense, and then you plug your answer back into the problem to see if it works.

- **Proper Notation** involves making short notes that describe the action taken during each step of solving an equation. Academic language is sometimes required.
- **Does It Make Sense (DIMS)**
The first step in checking a solution is to use “common sense.” For example, if your solution is $x = 5$, and you are solving for a football player’s weight in pounds, you have probably made a mistake because it does not make sense that a football player weighs only five pounds. On the other hand, if you are solving for the number of pennies in a nickel, it makes perfect sense.
- **Plug (substitute) the answer back into the problem to see if it works.**
The second step in checking a solution is to substitute your solution into the original equation and solve the equation once again with your solution in it. If the left expression is equal to the right expression, the equation balances and your solution is correct.

The Four Column Strategy

The four column strategy focuses on organizing and documenting each step in solving an equation or inequality. Emphasis is given to explaining each step and keeping the equal signs (or inequality signs) aligned in a vertical column. The vertical and horizontal lines are simply scaffolds that can be removed as students acquire understanding and skills in solving equations.

((keep the equation/inequality signs aligned vertically))

Notes	Left Hand Expression	Sign	Right Hand Expression
Given	$2x - 6$	=	2
Add (6)	+ 6		+ 6
	$2x + 0$	=	8
Divide (2)	$\frac{2x}{2}$	=	$\frac{8}{2}$
Answer	x	=	4
Check	$2(4) - 6$	=	2
	8-6	=	2
	2	=	2

DEVELOPING ESSENTIAL SKILLS

Use the four general rules and the four column strategy to solve the following problems:

If $3(x - 2) = 2x + 6$, the value of x is **12**

Notes	Left Hand Expression	Sign	Right Hand Expression
Given	$3(x - 2)$	=	$2x + 6$
Distributive Property	$3x - 6$	=	$2x + 6$
Subtract $2x$	$-2x$		$-2x$
Simplify	$x - 6$	=	6
Add 6	+6		+6
Solution	x	=	12
Check	$3(x - 2) = 2x + 6$ $3(12 - 2) = 2(12) + 6$ $3(10) = 24 + 6$ $30 = 30$		

What is the value of x in the equation $\frac{3}{4}x + 2 = \frac{5}{4}x - 6$? **16**

Notes	Left Hand Expression	Sign	Right Hand Expression
Given	$\frac{3}{4}x + 2$	=	$\frac{5}{4}x - 6$
Multiply by 4	$3x + 8$	=	$5x - 24$
Subtract $3x$	8	=	$2x - 24$
Add 24	32	=	2x

Divide by 2	16	=	X
Check	$\frac{3}{4}x + 2 = \frac{54}{4}x - 6$ $\frac{3}{4}(16) + 2 = \frac{5}{4}(16) - 6$ $\frac{48}{4} + 2 = \frac{80}{4} - 6$ $12 + 2 = 20 - 6$ $14 = 14$		

REGENTS EXAM QUESTIONS (through June 2018)

A.REI.B.3: Solving Linear Equations

- 55) Which value of x satisfies the equation $\frac{7}{3}\left(x + \frac{9}{28}\right) = 20$?
- 1) 8.25
2) 8.89
3) 19.25
4) 44.92
- 56) What is the value of x in the equation $\frac{x-2}{3} + \frac{1}{6} = \frac{5}{6}$?
- 1) 4
2) 6
3) 8
4) 11
- 57) An equation is given below.
- $$4(x - 7) = 0.3(x + 2) + 2.11$$
- The solution to the equation is
- 1) 8.3
2) 8.7
3) 3
4) -3
- 58) Which value of x satisfies the equation $\frac{5}{6}\left(\frac{3}{8} - x\right) = 16$?
- 1) -19.575
2) -18.825
3) -16.3125
4) -15.6875
- 59) The value of x which makes $\frac{2}{3}\left(\frac{1}{4}x - 2\right) = \frac{1}{5}\left(\frac{4}{3}x - 1\right)$ true is
- 1) -10
2) -2
3) $-9.\overline{09}$
4) $-11.\overline{3}$
- 60) Solve the equation below algebraically for the exact value of x .
- $$6 - \frac{2}{3}(x + 5) = 4x$$

SOLUTIONS

55) ANS: 1

Strategy: Use the four column method.

Notes	Left Expression	Sign	Right Expression
Given	$\frac{7}{3} \left(x + \frac{9}{28} \right)$	=	20
Divide both expressions by $\frac{7}{3}$ (Division property of equality)	$\frac{\frac{7}{3} \left(x + \frac{9}{28} \right)}{\frac{7}{3}}$	=	$\frac{20}{\frac{7}{3}}$
Cancel and Simplify	$x + \frac{9}{28}$	=	$\frac{60}{7}$
Subtract $\frac{9}{28}$ from both expressions (Subtraction property of equality)	x	=	$\frac{60}{7} - \frac{9}{28}$
Simplify	x	=	$\frac{231}{28}$
Simplify	x	=	8.25

or

Notes	Left Expression	Sign	Right Expression
Given	$\frac{7}{3} \left(x + \frac{9}{28} \right)$	=	20
Distributive Property	$\frac{7}{3}x + \frac{7}{3} \left(\frac{9}{28} \right)$	=	20
Cancellation	$\frac{7}{3}x + \frac{1}{3} \left(\frac{9}{4} \right)$	=	20
Simplification	$\frac{7}{3}x + \frac{3}{4}$	=	20
Subtract $\frac{3}{4}$ from both expressions (Subtraction Property of Equality)	$\frac{7}{3}x$	=	$20 - \frac{3}{4}$
Simplification	$\frac{7}{3}x$	=	$\frac{77}{4}$
Multiply both expressions by 12 (Multiplication property of equality)	$\frac{12}{1} \left(\frac{7x}{3} \right)$	=	$\frac{12}{1} \left(\frac{77}{4} \right)$
Cancel	$\frac{4}{1} \left(\frac{7x}{1} \right)$	=	$\frac{3}{1} \left(\frac{77}{1} \right)$
Simplify	28x	=	231
Divide both expressions by 28 (Division property of equality)	$\frac{28x}{28}$	=	$\frac{231}{28}$

Simplify	x	=	8.25
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PTS: 2 NAT: A.REI.B.3 TOP: Solving Linear Equations
 KEY: fractional expressions

56) ANS: 1

Strategy: Use the four column method.

Notes	Left Expression	Sign	Right Expression
Given:	$\frac{x-2}{3}$	=	$\frac{4}{6}$
Multiply both expressions by 6 (Multiplication property of equality)	$\frac{6}{1} \left(\frac{x-2}{3} \right)$	=	$\frac{6}{1} \left(\frac{4}{6} \right)$
Cancel and Simplify	$\frac{2}{1} \left(\frac{x-2}{1} \right)$	=	$\frac{1}{1} \left(\frac{4}{1} \right)$
Simplify	$2x - 4$	=	4
Add +4 to both expressions (Addition property of equality)	$2x$	=	8
Divide both expressions by 2 (Division property of equality)	x	=	4

PTS: 2 NAT: A.REI.B.3 TOP: Solving Linear Equations
 KEY: fractional expressions

57) ANS: 1

$$4(x - 7) = 0.3(x + 2) + 2.11$$

$$4x - 28 = .3x + 2.71$$

$$4x - .3x = 2.71 + 28$$

$$3.7x = 30.71$$

$$x = 8.3$$

PTS: 2 NAT: A.REI.B.3 TOP: Solving Linear Equations
 KEY: decimals

58) ANS: 2

$$\frac{5}{6} \left(\frac{3}{8} - x \right) = 16$$

$$5 \left(\frac{3}{8} - x \right) = 96$$

$$\frac{3}{8} - x = \frac{96}{5}$$

$$-x = \frac{96}{5} - \frac{3}{8}$$

$$-x = 18.825$$

$$x = -18.825$$

PTS: 2 NAT: A.REI.B.3 TOP: Solving Linear Equations

KEY: fractional expressions

59) ANS: 4

Solve for x:

$$\frac{2}{3} \left(\frac{1}{4}x - 2 \right) = \frac{1}{5} \left(\frac{4}{3}x - 1 \right)$$

Multiply by 3 to clear the first fraction.

$$\left(\frac{3}{1} \right) \frac{2}{3} \left(\frac{1}{4}x - 2 \right) = \left(\frac{3}{1} \right) \frac{1}{5} \left(\frac{4}{3}x - 1 \right)$$

$$2 \left(\frac{1}{4}x - 2 \right) = \frac{3}{5} \left(\frac{4}{3}x - 1 \right)$$

Multiply by 5 to clear the remaining fraction.

$$(5) 2 \left(\frac{1}{4}x - 2 \right) = \left(\frac{5}{1} \right) \frac{3}{5} \left(\frac{4}{3}x - 1 \right)$$

$$10 \left(\frac{1}{4}x - 2 \right) = 3 \left(\frac{4}{3}x - 1 \right)$$

Use distributive property to clear parentheses.

$$\frac{10}{4}x - 20 = 4x - 3$$

Multiply by 4 to clear fraction.

$$(4) \frac{10}{4}x - (4)20 = (4)4x - (4)3$$

$$10x - 80 = 16x - 12$$

Transpose and solve for x.

$$-6x = 68$$

$$\frac{-6x}{-6} = \frac{68}{-6}$$

$$x = -11.\overline{33}$$

PTS: 2 NAT: A.REI.B.3 TOP: Solving Linear Equations

KEY: fractional expressions

60) ANS:

Answer: $\frac{4}{7}$

Strategy: Solve algebraically (without a calculator).

Notes	Left Expression	Sign	Right Expression
Given	$6 - \frac{2}{3}(x + 5)$	=	$4x$
Multiply by 3	$18 - 2(x + 5)$	=	$12x$
Distributive Property	$18 - 2x - 10$	=	$12x$
Add 2x	$18 - 10$	=	$14x$
Simplify	8	=	$14x$
Divide by 14	$\frac{8}{14}$	=	x
Simplify	$\frac{4}{7}$	=	x

Check.is Optional

Notes	Left Expression	Sign	Right Expression
Given	$6 - \frac{2}{3}(x + 5)$	=	$4x$
Evaluate for $x = \frac{4}{7}$	$6 - \frac{2}{3}\left(\frac{4}{7} + 5\right)$	=	$4\left(\frac{4}{7}\right)$
Get a Common Denominator Inside Parentheses	$6 - \frac{2}{3}\left(\frac{4}{7} + \frac{35}{7}\right)$	=	$4\left(\frac{4}{7}\right)$
Do Addition Inside Parentheses	$6 - \frac{2}{3}\left(\frac{39}{7}\right)$	=	$4\left(\frac{4}{7}\right)$
Remove Parentheses Using Multiplication of Fractions	$6 - \frac{78}{21}$	=	$\frac{16}{7}$
Get a Common Denominator	$\frac{126}{21} - \frac{78}{21}$	=	$\frac{48}{21}$
Simplify	$\frac{48}{21}$	=	$\frac{48}{21}$

PTS: 3 NAT: A.REI.B.3 TOP: Solving Linear Equations

KEY: fractional expressions