Equations

8.EE.C.7 Procedural Skill and Fluency Mini-Assessment by Student Achievement Partners

OVERVIEW

This mini-assessment is designed to illustrate aspects of the standard 8.EE.C.7, specifically the expectation that students solve linear equations. This mini-assessment is designed for teachers to use either in the classroom, for self-learning, or in professional development settings to:

- **Evaluate** students' progress toward some of the skills described by 8.EE.C.7 in order to prepare to teach this material or to check for student ability with grade-appropriate content;
- **Gain knowledge about** assessing skills at the depth expected at grade 8;
- **Illustrate CCR-aligned** assessment problems;
- **Illustrate best practices** for writing tasks that allow access for all learners; and
- **Support mathematical language acquisition** by offering specific guidance.

MAKING THE SHIFTS

This mini-assessment attends to **focus** as it addresses solving and analyzing linear equations, which are key components of the Major Work of the Grade.[1] It illustrates **coherence** across grades as the questions require students to extend their understanding of solving equations. While this mini-assessment primarily targets *procedural skill and fluency,* one of the three aspects of **rigor**, there are also some questions that intentionally assess *conceptual understanding*.

A CLOSER LOOK

8.EE.C.7: Solve linear equations in one variable.
8.EE.C.7a: 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 forms $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers).
8.EE.C.7b: Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the

In the CCSS, procedural skill builds alongside conceptual understanding. Students are adding to their set of strategies toolbox for transforming expressions and solving equations where possible. As students work with a variety of equations, they come to understand that equations may result in one solution, no solutions, or infinitely many solutions. In this mini-assessment, questions 1 and 2 address both procedural skill and conceptual understanding as they require students to reason about equations and their solutions. Questions 3–10 present a variety of equations for students to solve. They include rational numbers as coefficients and solutions to maintain coherence with students' broader work with the number system. It is not expected that all students use exactly the same set of steps to solve a given equation, as procedural skill in solving equations also grants students flexibility to manipulate equations differently.

Work in grade 8 synthesizes the developed skills and fluencies in grades 6 and 7 as students display full understanding of the processes used to solve a variety of equations. They should be asking themselves when analyzing and solving equations, "What value of the variable makes this linear equation true?" Students who leave grade 8 without meeting the expectations of 8.EE.C.7 are likely to have difficulty with the work of the Reasoning with Equations and Inequalities domain of the high school standards.

[1] For more on the Major Work of the Grade, see achievethecore.org/focus.

SUPPORT FOR ENGLISH LANGUAGE LEARNERS

This lesson was designed to include specific features that support access for all students and align to best practice for English Language Learner (ELL) instruction and assessment. Go here to learn more about the research behind these supports. Features that support access in this mini-assessment include:

- Tasks that allow for multi-modal representations, which can deepen understanding of the mathematics and make it easier for students, especially ELLs, to give mathematical explanations.
- Tasks that avoid unnecessarily complex language to allow students, especially ELLs, to access and demonstrate what they know about the mathematics of the assessment.

Prior to this mini-assessment, ensure students have had ample opportunities in instruction to read, write, speak, listen for, and understand the mathematical concepts that are represented by the following terms and concepts:

- equation
- value of x
- solution
- positive
- negative
- infinitely many

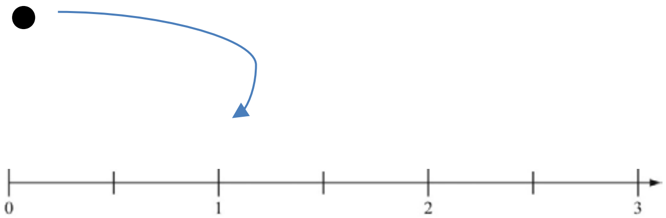
Students should engage with these terms and concepts in the context of mathematical learning, not as a separate vocabulary study. Students should have access to multi-modal representations of these terms and concepts, including: pictures, diagrams, written explanations, gestures, and sharing of non-examples. These representations will encourage precise language, while prioritizing students' articulation of concepts. These terms and concepts should be reinforced in teacher instruction, classroom discussion, and student work (for example, through engagement in mathematical routines).

ELLs may need support with the following Tier 2 words found in this mini-assessment:

- true
- correct
- row

In preparation for giving this mini-assessment, teachers should strive to use these words in context so they become familiar to students. It will be important to offer synonyms, rephrasing, visual cues, and modeling of what these words mean in the specific contexts represented in the items in this mini-assessment. Additionally, teachers may offer students the use of a student-friendly dictionary, or visual glossary to ensure they understand what is being asked of them in each item.

Sketch	

Point	
Locate	

An example of a visual glossary for student use.

Equations Mini- Assessment

Name:____Date:___________________

1) Complete the equation so that it is true for no values of x.

$7x - 3x + 2 - x =$ _________ $x +$ __________

2) Decide whether the solution to each equation is positive, negative, zero, or there are no solutions. Check the correct box for each row.

	solution is positive	solution is negative	solution is zero	there are no solutions
$3x = 5$				
$5z + 7 = 3$				
$7 - 5w = 3$				
$4a = 9a$				
$y = y + 1$				

Solve each equation or write that there are no solutions or infinitely many solutions. Show your work.

3. $\frac{x+3}{2} = 5$	4. $17 + 5(2x - 9) = (-6x + 10) + 4$

5. $8(2x+9)=56$	6. $37x+\frac{1}{2}-\left(x+\frac{1}{4}\right)=9(4x-7)+5$
7. $4-\frac{x-5}{2}=-\frac{1}{2}(x-5)+4$	8. $\frac{2}{3}(2x+12)=16$
9. $(-x+7)+\frac{5}{3}=\frac{1}{2}x+9$	10. $-4x-2(8x+1)=-(-2x-10)$

Name:____Date:______________

1) Complete the equation so that it is true for no values of x.
$7x - 3x + 2 - x =$ __$3x$__ + __5__

Any expression of the form mx+b where m is 3 and b is not 2.

2) Decide whether the solution to each equation is positive, negative, zero, or there are no solutions. Check the correct box for each row.

	solution is positive	solution is negative	solution is zero	there is no solution
$3x = 5$	✓			
$5z + 7 = 3$		✓		
$7 - 5w = 3$	✓			
$4a = 9a$			✓	
$y = y + 1$				✓

Solve each equation or write that there are no solutions or infinitely many solutions. Show your work.

3.

$$\frac{x+3}{2} = 5$$

Possible solution:

$$2\left(\frac{x+3}{2}\right) = 2(5)$$
$$x + 3 = 10$$
$$x + 3 - 3 = 10 - 3$$
$$x = 7$$

4.

$$17 + 5(2x - 9) = (-6x + 10) + 4$$

Possible solution:

$$17 + 10x - 45 = -6x + 14$$
$$-28 + 10x = -6x + 14$$
$$-28 + 28 + 10x = -6x + 14 + 28$$
$$10x = -6x + 42$$
$$10x + 6x = -6x + 6x + 42$$
$$16x = 42$$
$$\frac{16x}{16} = \frac{42}{16}$$
$$x = \frac{42}{16} \text{ or equivalent}$$

5.

$$8(2x+9)=56$$

Possible solution:

$$\frac{8(2x+9)}{8}=\frac{56}{8}$$
$$(2x+9)=7$$
$$2x+9-9=7-9$$
$$2x=-2$$
$$\frac{2x}{2}=\frac{-2}{2}$$
$$x=-1$$

6.

$$37x+\frac{1}{2}-\left(x+\frac{1}{4}\right)=9(4x-7)+5$$

Possible solution:

$$37x+\frac{1}{2}-x-\frac{1}{4}=36x-63+5$$
$$36x+\frac{1}{2}=36x-58$$
$$36x-36x+\frac{1}{2}=36x-36x-58$$
$$\frac{1}{2}\neq -58$$

No solutions

7.

$$4-\frac{x-5}{2}=-\frac{1}{2}(x-5)+4$$

Possible solution:

$$4-4-\frac{x-5}{2}=-\frac{1}{2}(x-5)+4-4$$
$$-\frac{x-5}{2}=-\frac{1}{2}(x-5)$$
$$2(-\frac{x-5}{2})=2(-\frac{1}{2}(x-5))$$
$$-x+5=-x+5$$

Infinitely many solutions

Students who analyze the equation may recognize early in the solution pathway that the expressions on both sides of the equal sign are equivalent. Therefore, they may not show much work in order to identify that this equation has infinitely many solutions.

8.

$$\frac{2}{3}(2x+12)=16$$

Possible solution:

$$\frac{3}{2}(\frac{2}{3}(2x+12))=\frac{3}{2}(16)$$
$$2x+12=24$$
$$2x+12-12=24-12$$
$$2x=12$$
$$\frac{2x}{2}=\frac{12}{2}$$
$$x=6$$

Students may use structure to recognize that they can divide each side of the equation by $\frac{2}{3}$ rather than distributing the coefficient which will allow them to only work with whole numbers as they solve the equation.

9.	10.
$$(-x+7)+\frac{5}{3}=\frac{1}{2}x+9$$ *Possible solution:* $$-x+\frac{26}{3}=\frac{1}{2}x+9$$ $$-x+x+\frac{26}{3}=\frac{1}{2}x+x+9$$ $$\frac{26}{3}=\frac{3}{2}x+9$$ $$\frac{26}{3}-9=\frac{3}{2}x+9-9$$ $$-\frac{1}{3}=\frac{3}{2}x$$ $$\frac{2}{3}(-\frac{1}{3})=\frac{2}{3}(\frac{3}{2}x)$$ $$-\frac{2}{9}=x$$	$$-4x-2(8x+1)=-(-2x-10)$$ *Possible solution:* $$-4x-16x-2=2x+10$$ $$-20x-2+2=2x+10+2$$ $$-20x=2x+12$$ $$-20x-2x=2x-2x+12$$ $$-22x=12$$ $$\frac{-22x}{-22}=\frac{12}{-22}$$ $$x=-\frac{12}{22}$$