

GRADE 7 - MODULE 7 – EQUATIONS AND INEQUALITIES

Big Ideas

Equations and inequalities can be used to represent situations and solve problems in mathematical and real-world situations.

Vocabulary

coefficients, like terms, associative, commutative and distributive properties, factor, numeric expressions, algebraic expressions, evaluate, simplify, variable, equation, balance, inverse operation(s), isolate the variable, create the possibility, inequality, less than ($<$), greater than ($>$), less than or equal to (\leq), greater than or equal to (\geq), , number line

Prior Learning

Students in Grade 6 read, write, evaluate algebraic expressions (including combining like terms in expressions), and solve one variable one-step equations and inequalities.

Essential Questions

- How can a given situation be described by an equation?
- Why do we use variables in solving equations?
- What rules and properties do you follow when solving equations?
- How is solving an equation different from evaluating an expression?
- How are equations used in contextual situations?
- How are equations solved?
- What are different properties of equations and how can they help solve them?
- What happens when two sides of an equation are not equal?
- How is solving a two-step equation different from solving a one-step equations?
- How does the solution of an inequality differ from the solution of an equation?
- What can you do to make an inequality statement true when multiplying or dividing by a negative number?
- In an addition equation, how do we isolate the variable?
- In a multiplication equation, how do we isolate the variable?

Competencies

- Students will write algebraic equations and inequalities from real-world situations.
- Students will create a situation or word problem matching an equation
- Students will solve multi-step linear equations and inequalities with rational coefficients (variables on one side) that require combining like terms.
- Students will graph inequalities on a number line (including inclusive inequalities (\leq, \geq))

Misconceptions

- Students may be confused about the steps when solving a two-step equation or inequality.
- Students may not remember the process of dividing or multiplying by a negative value when solving an inequality.
- Students may have difficulty discerning the meaning of the various inequality symbols when graphing the solution on a number line.

Resources from The Key Elements to Mathematics Success - KEMS Grade 7 for Building the Conceptual Understanding of this Module

LESSON 18 - ONE-STEP EQUATIONS WITH INTEGERS
Additional Activities: Quiz – T450, Mystery Square – T970

LESSON 19 - TWO-STEP EQUATIONS WITH INTEGERS
Additional Activities: Quiz – T482, Scavenger Hunt – T971

LESSON 20 - ONE- AND TWO-STEP INEQUALITIES
Additional Activities: Quiz – T518-T519, Mystery Square – T972

Mathematics Content Standards	Examples						
<p>7.EE.4a</p> <p>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, identifying the sequence of the operations used in each approach. <i>For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?</i></p>	<p>Students explain how they determined whether to write an equation or inequality for a real-world situation and then define the variable and appropriate units. They can also explain the properties they applied to solve the equation or inequality.</p> <p>Students will solve multi-step equations from real-world problems. Students use the arithmetic from the problem to generalize an algebraic solution</p> <p>Example 1: The youth group is going on a trip to the state fair. The trip costs \$52. Included in that price is \$11 for a concert ticket and the cost of 2 passes, one for the rides and one for the game booths. Each of the passes cost the same price. Write an equation representing the cost of the trip and determine the price of one pass.</p> <p>Solution: $x = \text{cost of one pass}$</p> <table border="1"> <tr> <td style="text-align: center;">x</td> <td style="text-align: center;">x</td> <td style="text-align: center;">11</td> </tr> <tr> <td colspan="3" style="text-align: center;">52</td> </tr> </table> <p style="margin-left: 150px;"> $2x + 11 = 52$ $2x = 41$ $x = \\$20.50$ </p> <p>Example 2: Solve: $\frac{2}{3}x - 4 = -16$</p> <p>Solution: $\frac{2}{3}x - 4 = -16$</p> <p style="margin-left: 20px;">$\frac{2}{3}x = -12$ Added 4 to both sides</p> <p style="margin-left: 20px;">$\frac{3}{2} \cdot \frac{2}{3}x = -12 \cdot \frac{3}{2}$ Multiply both sides by $\frac{3}{2}$</p> <p style="margin-left: 20px;">$x = -18$</p> <p>Students could also reason that if $\frac{2}{3}$ of some amount is -12 then $\frac{1}{3}$ is -6. Therefore, the whole amount must be 3 times -6 or -18.</p> <p>Example 3: Amy had \$26 dollars to spend on school supplies. After buying 10 pens, she had \$14.30 left. How much did each pen cost including tax?</p> <p>Solution: $x = \text{number of pens}$</p> <p>$26 = 14.30 + 10x$</p> <p>Solving for x gives \$1.17 for each pen.</p> <p>Example 4: The sum of three consecutive even numbers is 48. What is the smallest of these numbers?</p> <p>Solution:</p> <p>$x = \text{the smallest even number}$</p>	x	x	11	52		
x	x	11					
52							

$$\begin{aligned}
 x + 2 &= \text{the second even number} \\
 x + 4 &= \text{the third even number} \\
 x + x + 2 + x + 4 &= 48 \\
 3x + 6 &= 48 \\
 3x &= 42 \\
 x &= 14 \\
 \text{Example 5:} \\
 \text{Solve: } \frac{x+3}{-2} &= -5 \quad \text{Solution: } x = 7
 \end{aligned}$$

Questions for 7.EE.4a

- In which equation does x have a value of 5?
A. $2x + 10 = -5$ B. $2x - 3 = 8$ C. $-7x + 5 = -30$ D. $\frac{x}{25} + 5 = 5$
- Choose the statement that gives the correct steps and solution for solving the equation: $4x + 20 = 80$
A. Addition, then multiplication – solution $x = 400$ B. Division, then subtraction – solution $x = 0$
C. Multiplication, then addition – solution $x = 340$ D. Subtraction, then division – solution $x = 15$
- Richard worked 20 hours this week. He also got a bonus of \$25. He made a total of \$185. Write and use an equation to find the amount of money he gets paid per hour. Show your work or explain how you know.
- Lauren goes to an antique show. She purchased some wooden antiques for \$70. She purchased a table for \$44 and 2 chairs. Each of the chairs cost the same price. Write an equation representing the cost of the antiques and determine the price of one chair.
- Daniel wants to purchase some clothes. He has \$75. He buys one leather jacket for \$39 and 3 pair of socks. Each pair of socks costs the same price. Write an equation and determine the price of one pair of socks.
- Christina goes shopping on Monday. She has \$50. After buying 10 water bottles, she had \$5 left. How much did each water bottle cost?

Answer Key for Questions for 7.EE.4a

- C. $-7x + 5 = -30$**
- D. Subtraction, then division – solution $x = 15$**
- $20n + 25 = 185$**

$$\begin{array}{r}
 -25 \quad -25 \\
 \hline
 \frac{20n}{20} = \frac{160}{20} \quad n = 8
 \end{array}$$
Richard earns \$8.00 per hour.
- 4.**

$$\begin{array}{r}
 2n + 44 = 70 \\
 -44 \quad -44 \\
 \hline
 \frac{2n}{2} = \frac{26}{2} \quad n = 13
 \end{array}$$
Each chair costs \$13.00.
- $3p + 39 = 75$**

$$\begin{array}{r}
 -39 \quad -39 \\
 \hline
 \frac{3p}{3} = \frac{36}{3} \quad p = 12
 \end{array}$$
Each pair of socks costs \$12.00.

6. $10b + 5 = 50$

$$\frac{10b}{10} = \frac{45}{10} \quad x = 4.5$$

Each water bottle costs \$4.50.

Tasks for 7.EE.4a

*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

MAP: Steps to Solving Equations

<http://map.mathshell.org.uk/materials/lessons.php?taskid=431&subpage=concept>

Illustrative Math Task: Gotham City Taxis

<https://tasks.illustrativemathematics.org/content-standards/7/EE/B/3/tasks/884>

Illustrative Math Task: Bookstore Account

<https://tasks.illustrativemathematics.org/content-standards/7/NS/A/1/tasks/1475>

Illustrative Math Task: Fishing Adventures 2

<https://tasks.illustrativemathematics.org/content-standards/7/EE/B/4/tasks/643>

Extra Questions for Warm-ups and Homework for 7.EE.4a

1. Draw a pictorial representation of the following equation. Be sure to check your solution. $x + 12 = 16$
2. Solve the following equation and explain the steps: $x + 15 = 26$
3. Draw a pictorial model for the equation: $2x = 12$. Be sure to check your solution.
4. Solve the following equation using a pictorial model: $3x + 5 = 20$
5. Solve the following equation using a pictorial model: $3x + 6 = 3$
6. Solve the equation and check your solution: $4x + 5 = 37$
7. Solve the following equation using a pictorial model $2x - 8 = 12$
8. Solve and check the solution for the following equation: $3x - 5 = -26$

Mathematics Content Standards

Examples

7.EE.4b

Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p , q , and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid \$50 per week plus \$3 per sale. This week you want your pay to be at least \$100. Write an inequality for the number of sales you need to make, and describe the solutions.*

Students solve and graph inequalities and make sense of the inequality in context. Inequalities may have negative coefficients. Problems can be used to find a maximum or minimum value when in context.

Example 1: Florencia has at most \$60 to spend on clothes. She wants to buy a pair of jeans for \$22 dollars and spend the rest on t-shirts. Each t-shirt costs \$8. Write an inequality for the number of t-shirts she can purchase.

Solution: x = cost of one t-shirt

$$8x + 22 \leq 60$$

$$x \leq 4.75 \rightarrow 4 \text{ is the most t-shirts she can purchase}$$

Example 2: Steven has \$25 dollars to spend. He spent \$10.81, including tax, to buy a new DVD. He needs to save \$10.00 but wants to buy a snack. If peanuts cost \$0.38 per package including tax, what is the maximum number of packages that Steven can buy?

Solution: x = number of packages of peanuts

$$25 = 10.81 + 10.00 + 0.38x$$

$$x \leq 11.03 \rightarrow \text{Steven can buy 11 packages of peanuts}$$

Example 3: $7 - x > 5.4$

Solution: $x < 1.6$

Example 4: Solve $-0.5x - 5 < -1.5$ and graph the solution on a number line.

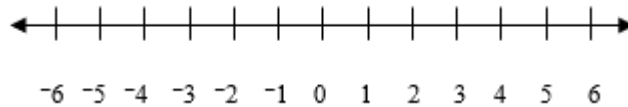


Solution: $x > -7$

Questions for 7.EE.4b

1. Solve the inequality and graph the solution.

$$3t + 7 \geq 19$$



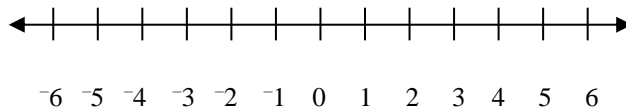
2. What is the solution to the following inequality? $5x + -3 > 12$

3. George bought three tubs of popcorn at the movies for t dollars each and some candy that cost \$6.00. If he spent less than \$21.00, what is the most a tub of popcorn could cost? Write an inequality and solve for the solution.

4. Julia has \$80. She wants to purchase a nail paint set for \$16 and earrings. She spends the rest of the money on earrings. Each pair of earrings costs \$8. Write an inequality for the number of pairs of earrings she can purchase.

5. Solve the inequality and graph the solution.

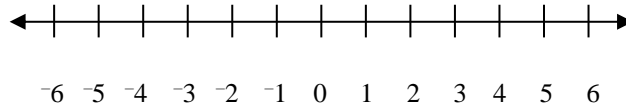
$$4x + 2 \geq 14$$



6. Tonya bought two shirts at the mall. She also bought 2 pair of jeans. She spent less than \$95. The jeans cost a total of \$59. If the shirts cost the same amount each, what is the maximum price of each shirt? Write an inequality and solve for the solution.

7. Solve the inequality and graph the solution.

$$6x + 8 \geq 20$$



8. Christina goes to the market with \$50. She buys one papaya for \$20 and spends the rest of the money on bananas. Each bunch of bananas costs \$6. Write an inequality for the number of bunches of bananas she can purchase. Solve the inequality and graph the solution on a number line.

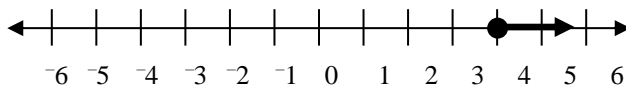
9. Rebecca bought one gold fish (\$32) and one star fish (\$12). She spends the rest of her money on guppy fish. She starts with \$80. Each guppy costs \$6. Write an inequality for the number of guppies she can purchase.

Answer Key for Questions for 7.EE.4b

1.

$$3t + 7 \geq 19$$

$$\frac{-7}{3} \geq \frac{12}{3} \quad t \geq 4$$



2. $5x + -3 > 12$

$$\frac{-3}{5} > \frac{15}{5} \quad x > 3$$

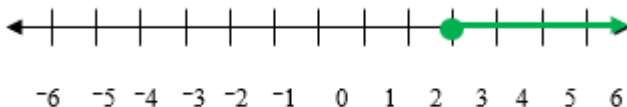
3.

$$3t + 6 < 21$$

$$\frac{-6}{3} < \frac{15}{3} \quad t < 5 \quad \text{A tub of popcorn is less than \$5.00.}$$

4. $8n + 16 \leq 80$

5. $4x + 2 \geq 14 \quad x \geq 3$

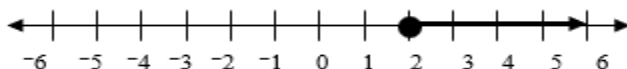


6. $2x + 59 < 95$

$$2x < 36$$

$$x < 18 \quad \text{The maximum price of each shirt is \$187.}$$

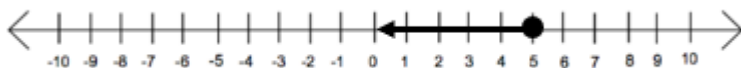
7. $6x + 8 \geq 20 \quad x \geq 2$



8.

$$6b + 20 \leq 50$$

$$\frac{-20}{6} \leq \frac{30}{6} \quad b \leq 5$$



9. $6g + 44 \leq 80$

Tasks for 7.EE.4b

*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

Illustrative Math Task: Gotham City Taxis

<https://tasks.illustrativemathematics.org/content-standards/7/EE/B/3/tasks/884>

Illustrative Math Task: Sports Equipment Set

<https://tasks.illustrativemathematics.org/content-standards/7/EE/B/4/tasks/986>

Illustrative Math Task: Fishing Adventures 2

<https://tasks.illustrativemathematics.org/content-standards/7/EE/B/4/tasks/643>

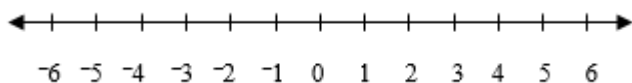
Extra Questions for Warm-ups and Homework for 7.EE.4b

1. Kyle is trying to earn money to go to camp. He needs to earn a minimum of \$150. He is earning \$45 per week helping his grandmother in her garden. How many weeks will he need to work on order to earn enough to go to camp? Write an inequality to represent the situation and solve the inequality.
2. Janice bought 4 new shirts at the mall. She spent less than \$38 and all the shirts are the same price.

Write and solve an inequality to represent this situation.

3. Solve and graph the solution to the following inequality: $x + 5 < 12$

4. Solve the inequality and graph the solution. $3t + 7 \geq 19$



Works Referenced in the Development of the Module

Common Core State Standards Initiative www.corestandards.org	Ohio Department of Education http://education.ohio.gov/Topics/Learning-in-Ohio/Mathematics
Illustrative Mathematics Project https://illustrativemathematics.org/	North Carolina Math Tools for Teachers https://tools4ncteachers.com/
Mathematics Assessment Project https://www.map.mathshell.org/index.php	Smarter Balanced Assessment Consortium https://smarterbalanced.org/
PARCC http://parconline.org/	Utah Education Network https://www.uen.org/core/math/
NOYCE Foundation: https://www.insidemathematics.org/	