MA.5.AR.2.3

Overarching Standard: ***MA.5.AR.2:*** *Demonstrate an understanding of equality, the order of the operations and equivalent numerical expressions.*

Benchmark of Focus

MA.5.AR.2.3: Determine and explain whether an equation involving any of the four operations is true or false.

> *Examples:* The equation 2.5 + (6 × 2) = 16 − 1.5 can be determined to be true because the expression on both sides of the equal sign are equivalent to 14.5.

Benchmark Clarifications

Clarification 1: Problem types include equations that include parenthesis but not nested parentheses.

Clarification 2: Instruction focuses on the connection between properties of equality and order of operations.

Related Benchmark/Horizontal Alignment

- MA.5.NSO.1.1/1.2/1.3/1.4/1.5
- MA.5.NSO.2.1/2.3/2.5

Vertical Alignment

Previous Benchmarks	Next Benchmarks
MA.4.AR.2.1	MA.6.AR.2.1

Terms from the K-12 Glossary

- Equal Sign
- Equation
- Expression

Purpose and Instructional Strategies

The purpose of this benchmark is to determine if students can connect their understanding of using the four operations reliably or fluently (MTR.3.1) to the concept of the meaning of the equal sign. Students have evaluated whether equations are true or false since Grade 2. In Grade 5, additional expectations include non-whole numbers and parentheses. In Grade 6, students extend this work to involve negative numbers and inequalities (MA.6.AR.2.1).

- Students will use their understanding of order of operations (MA.5.AR.2.2) to simplify expressions on each side of an equation (MTR.5.1).
- Students will determine if the expression on the left of equal sign is equivalent to the expression to the right of the equal sign. If these expressions are equivalent, then theequation is true.
- Students may use comparative relational thinking, instead of solving, in order todetermine if the equation is true or false (MTR.2.1, MTR.3.1, MTR.5.1).

Common Misconceptions or Errors

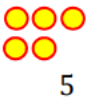
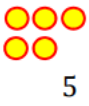
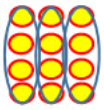
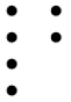
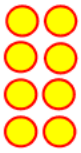
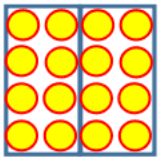
- Some students may not understand that the equal sign is a relational symbol showing expressions on both sides that are the same. While justifying whether equations are true or false, students should explain what makes the equation true.

Strategies to Support Tiered Instruction

- Instruction includes opportunities to explore the meaning of the equal sign. The teacher provides explicit clarification that the equal sign means "the same as" rather than "the answer is" along with multiple examples for students to evaluate equations as true or false using the four operations with the answers on both the left and right side of the equation. Instruction begins by using single numbers on either side of the equal sign to build understanding using the same equations written in different ways to reinforce the concept.
    - For example, the teacher shows the following equations, asking students if they are true or false statements. Students explain why each equation is true or false. This is repeated with additional true and false equations using the four operations.

Example	True/ False	Sample Student Rationale
$\frac{2}{10} = \frac{1}{5}$	True	They are both the same value; $\frac{2}{10}$ is equivalent to $\frac{1}{5}$.
$9 \div 2 = 3$	False	Nine and three have different values; they are not the same.
$2 + 11 = 13$	True	When you add two and eleven, the total has a value of thirteen.
Three cookies shared among 5 friends is equivalent to $\frac{3}{5}$.	True	The fractional value of the cookies that each friend will get is equal to $\frac{3}{5}$.
$4 + 2 = 42$	False	The sum of four and two is six, not forty-two.
$4 + 1 = 2 + 3$	True	Four plus one has a value of five. Two plus three also has a value of five.
$2 \times 2 = 8 \div 2$	True	Two times two has a value of four. Eight divided two also has a value of four.
$(3 + 1) \times 2 = 16 \div 2$	True	Three plus one is four and four times two is eight. Sixteen divided by two is also eight.
$18 \div (1.5 \times 2) = (18 \div 2) + 3$	False	One and five-tenths times two is three. Eighteen divided by three is six. Eighteen divided by two is nine. Nine plus three is twelve. Six is not equal to twelve.

    - For example, the teacher shows the following equations having students use counters, drawings, or base-ten blocks on a t-chart to represent the equation. The teacher asks students if they are true or false statements and to explain what makes equations true. This is repeated with additional true and false equations using the four operations.

Example	Visual Representation		True/ False	Sample Student Rationale
$5 = 5$	 5	 5	**True**	They are both the same number; the same amount is on both sides.
$12 \div 4 = 6 \div 2$	 $12 \div 4$	 $6 \div 2$	**True**	Twelve divided into groups of 4 equals 3 whole groups. Six divided into groups of 2 also equals 3 whole groups.
$4 + 2 = 42$			**False**	The sum of four and two is six, not forty-two. The value on each side is different.
$(3 + 1) \times 2 = 16 \div 2$			**True**	Three plus one is four and four times two is eight. Sixteen divided by two is also eight.

Questions to ask students:

- **Is the following equation true or false:** $\frac{1}{4} \times (2 \times 3) = (24 - 18) - 4\frac{2}{4}$
- Sample answer that indicates understanding: The equation is true because the expressions on each side of the equal sign are equivalent to $1\frac{2}{4}$.
- **How does the order of operations help you understand if an equation is true or false?**
- Sample answer that indicates understanding: Order of operations gives guidance as to the order of how this problem should be solved. The operations in parenthesis should be solved first, any exponents second, then from left to right, multiplication or division, and finally any addition or subtraction.

Instructional Tasks

Instructional Task 1

Using the numbers below, create an equation that is true.

(_____ × _____) - _____ = _____ - _____

12, 6.2, $5\frac{1}{5}$, 4, 3.5

Instructional Items

Instructional Item 1

Which best explains the equation below?

$$13.8 - 6 + 3 = 4 \times 1.2$$

a. This equation is true because both sides of the equation are equal to 4.8.
b. This equation is true because both sides of the equation are equal to 10.8.
c. This equation is false because both sides of the equation are equal to 4.8.
d. This equation is false because both sides of the equation are unequal.

Achievement Level Descriptors

Benchmark	Context	Assessment Limits
MA.5.AR.2.3 Determine and explain whether an equation involving any of the four operations is true or false. Example: The equation 2.5 + (6 × 2) = 16 − 1.5 can be determined to be true because the expression on both sides of the equal sign are equivalent to 14.5. Clarification 1: Problem types include equations that include parenthesis but not nested parentheses. Clarification 2: Instruction focuses on the connection between properties of equality and order of operations.	Mathematical	Items including decimals will not include fractions. Items including fractions will not include decimals. Items will include at least two different arithmetic operations on at least one side of the equation. Items will not exceed three operations on either side of the equation.

ALD 2	ALD 3	ALD 4	ALD 5
Determines whether an equation, with whole numbers and parentheses or multiple operations on at least one side of the equation, involving any of the four operations is true or false.	Determines whether an equation with decimals or fractions involving any of the four operations is true or false.	Determines and explains whether an equation involving any of the four operations is true or false.	N/A

Additional Resources:
CPALMS Resources

Resources/Tasks to Support Your Child at Home:
Khan Academy: Order of Operations Example

Additional Examples:
Are the following equations True or False?

Show your work to explain how you know.

a. $7 \times (14 - 7) = 21 + (4 \times 7)$

b. $60 + (9 \times 5) = 110 - 11 + 6$

c. $6.2 \times 8 = (10 \times 5) - 2$

a. True $49 = 49$

b. True $105 = 105$

c. False $49.6 \neq 48$