

Please evaluate these operations on your whiteboard as you enter quietly today.

$$4 + 3 \times 6 =$$

$$7 \times 3 + 2 - 4 =$$

$$7 - 4 \times 3 + 2 =$$

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Lesson 6: Order of Operations

$$6 + 2 \times 3 = 24$$

$$6 + 6 = 12$$

Student Outcomes

- Students evaluate numerical expressions. They recognize that in the absence of parentheses, exponents are evaluated first.

Classwork

Example 1: Expressions with Only Addition, Subtraction, Multiplication, and Division

What operations are evaluated first?

Mult. & Div. left to Right
 $6 \div 3 \times 2$

What operations are always evaluated last?

Add & Subtract Left to Right
 $12 - 6 + 4$

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Exercises

1. $4 + 2 \times 7 = 18$
 $4 + 14 = 18$

2. $36 \div 3 \times 4$
 $12 \times 4 = 48$
 48

3. $20 - 5 \times 2$
 $20 - 10 =$
 10

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Example 2: Expressions with (Four Operations and Exponents)

Expression

$$4 + 9^2 \div 3 \times 2 - 2$$

$$4 + 81 \div 3 \times 2 - 2$$

$$4 + 27 \times 2 - 2$$

$$4 + 54 - 2$$

$$58 - 2$$

$$56$$

What operation is evaluated first?

Exponents

What operations are evaluated next?

What operations are always evaluated last?

What is the final answer?

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Exercises

4. $90 - 5^2 \times 3$

5. $4^3 + 2 \times 8$

Example 3: Expressions with Parentheses

Consider a family of 4 that goes to a soccer game. Tickets are \$5.00 each. The mom also buys a soft drink for \$2.00. How would you write this expression?

How much will this outing cost?

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Consider a different scenario: the family goes to the game like before, but each of the family members wants a drink. How would you write this expression?

Why would you add the 5 and 2 first?

How much will this outing cost?

How many groups are there?

What is each group comprised of?

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Exercises

6. $2 + (9^2 - 4)$

$$\begin{aligned} & 2 + (9 \times 9 - 4) \\ & 2 + (81 - 4) \\ & 2 + 77 \\ & \quad \text{79} \end{aligned}$$

7. $2 \cdot (13 + 5 - 14 \div (3 + 4))$

$$\begin{aligned} & 2 \cdot (13 + 5 - 14 \div 7) \\ & 2 \cdot (13 + 5 - 2) \\ & 2 \cdot (18 - 2) \\ & \quad \underline{2 \cdot 16 = 32} \end{aligned}$$

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Example 4: Expressions with Parentheses and Exponents

$$2 \times (3 + 4^2)$$

Which value will we evaluate first within the parentheses? Evaluate.

Evaluate the rest of the expression.

What do you think will happen when the exponent in this expression is outside of the parentheses?

$$2 \times (3 + 4)^2$$

Will the answer be the same?

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Which should we evaluate first? Evaluate.

What happens differently here than in our last example?

What should our next step be?

Evaluate to find the final answer.

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What do you notice about the two answers?

What was different between the two expressions?

What conclusions can you draw about evaluating expressions with parentheses and exponents?

Exercises

8. $7 + (12 - 3^2)$

9. $7 + (12 - 3)^2$

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Lesson Summary

Numerical Expression: A *numerical expression* is a number, or it is any combination of sums, differences, products or divisions of numbers that evaluates to a number.

Statements like, " $3 +$ " or " $3 \div 0$," are not numerical expressions because neither represents a point on the number line. Note: raising numbers to whole number powers are considered numerical expressions as well, since the operation is just an abbreviated form of multiplication: $2^3 = 2 \cdot 2 \cdot 2$.

Value of a Numerical Expression: The *value* of a numerical expression is the number found by evaluating the expression.

For example: $\frac{1}{3} \cdot (2 + 4) + 7$ is a numerical expression and its value is 9.

Problem Set

Evaluate each expression.

- $3 \times 5 + 2 \times 8 + 2$
- $(\$1.75 + 2 \times \$0.25 + 5 \times \$0.05) \times 24$
- $(2 \times 6) + (8 \times 4) + 1$
- $((8 \times 1.95) + (3 \times 2.95) + 10.95) \times 1.06$
- $((12 \div 3)^2 - (18 \div 3^2)) \times (4 \div 2)$

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Exit Ticket

- Evaluate this expression: $39 \div (2 + 1) - 2 \times (4 + 1)$
- Evaluate this expression: $12 \times (3 + 2^2) \div 2 - 10$
- Evaluate this expression: $12 \times (3 + 2)^2 \div 2 - 10$

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