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Order of Operations and Evaluating Expressions

Unit 1 Lesson 2

ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

Students will be able to:

evaluate algebraic expression
by using the order of operations.

Key Vocabulary:

- Evaluate
- Order of Operations
- Grouping Symbols
- Fraction bar

ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

EVALUATE ALGEBRAIC EXPRESSIONS means to find its numerical value.

ORDER OF OPERATIONS is a method used to evaluate an expression involving more than one operation. In algebraic expressions, it can only be evaluated if the values of the variables are known.

Step 1 Replace the variables with their numerical values.

Step 2 Evaluate expressions inside grouping symbols.

Step 3 Evaluate all powers.

Step 4 Do all multiplications and/or divisions from left to right.

Step 5 Do all additions and/or subtractions from left to right.

ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

Example: Evaluate $z^4 - 3$, if $z = 2$.

$$z^4 - 3 = 2^4 - 3 \quad \text{Replace } z \text{ with } 2.$$

$$= 16 - 3 \quad \text{Evaluate } 2^4$$

$$z^4 - 3 = 13 \quad \text{Subtract } 16 \text{ and } 3$$

ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

Sample Problem 1: Evaluate each expression if $x = 2$, $y = 4$, and $z = 6$.

a. $x^3 + 10y$

b. $\frac{22}{x} + 16$

c. $\frac{z}{3} + y$

d. $y + z + x$

e. $x + 5$

ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

Sample Problem 1: Evaluate each expression if $x = 2$, $y = 4$, and $z = 6$.

$$\text{a. } x^3 + 10y = 2^3 + 10 \cdot 4 = 8 + 40 = 48$$

$$\text{b. } \frac{22}{x} + 16 = \frac{22}{2} + 16 = 11 + 16 = 27$$

$$\text{c. } \frac{z}{3} + y = \frac{6}{3} + 4 = 2 + 4 = 6$$

$$\text{d. } y + z + x = 4 + 6 + 2 = 12$$

$$\text{e. } x + 5 = 2 + 5 = 7$$

ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

GROUPING SYMBOLS, such as parentheses () or brackets [], indicate the order in which the operations should be performed first.

Example: Evaluate $a^2 - (b^3 - 4c)$, if $a = 8$, $b = 5$, and $c = 3$.

$$a^2 - (b^3 - 4c) = 8^2 - (5^3 - 4 \cdot 3) \quad \text{Replace } a \text{ with } 8, b \text{ with } 5, \text{ and } c \text{ with } 3.$$

$$= 64 - (125 - 4 \cdot 3) \quad \text{Evaluate } 8^2 \text{ and } 5^3$$

$$= 64 - (125 - 12) \quad \text{Multiply } 4 \text{ and } 3$$

$$= 64 - 113 \quad \text{Subtract } 125 \text{ and } 12$$

$$a^2 - (b^3 - 4c) = -49 \quad \text{Subtract } 64 \text{ from } 113$$



ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

Sample Problem 2: Evaluate each expression if $r = 4$, $s = 6$, $t = 3$, and $u = 12$.

a. $2r + st^2 - u$

b. $tu - rs$

c. $st - 4r$

d. $r^3 + u + s^t$

e. $tu - 3r$

ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

Sample Problem 2: Evaluate each expression if $r = 4$, $s = 6$, $t = 3$, and $u = 12$.

a. $2r + st^2 - u = 2(4) + (6)(3^2) - 12 = 8 + 6(9) - 12 = 54 - 4 = 50$

b. $tu - rs = (3)(12) - (4)(6) = 36 - 24 = 12$

c. $st - 4r = (6)(3) - 4(4) = 18 - 16 = 2$

d. $r^3 + u + s^t = 4^3 + 12 + 6^3 = 64 + 12 + 216 = 292$

e. $tu - 3r = (3)(12) - 3(4) = 36 - 12 = 24$

ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

FRACTION BAR is another type of grouping symbol. It indicates that the numerator and denominator should each be treated as a single value.

Example: Evaluate $\frac{x^2-1}{4y^2}$, if $x = 9$, and $y = 2$.

$$\frac{x^2 - 1}{4y^2} = \frac{9^2 - 1}{4 \cdot 2^2} \quad \text{Replace } x \text{ with } 9, \text{ and } y \text{ with } 2.$$

$$\frac{x^2 - 1}{4y^2} = \frac{81 - 1}{4 \cdot 4} \quad \text{Evaluate } 9^2 \text{ and } 2^2$$

$$\frac{x^2 - 1}{4y^2} = \frac{81 - 1}{16} \quad \text{Multiply } 4 \text{ and } 81$$

$$\frac{x^2 - 1}{4y^2} = \frac{80}{16} \quad \text{Subtract } 81 \text{ from } 1$$

$$\frac{x^2 - 1}{4y^2} = 5 \quad \text{Divide } 80 \text{ to } 16$$

ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

Sample Problem 3: Evaluate each expression if $r = 4$, $s = 6$, $t = 3$, and $u = 12$.

a.
$$\frac{2r(s - t)}{tu - s}$$

b.
$$\frac{u}{s} + \frac{3s}{t^2}$$

c.
$$\frac{rs^2 - 3u}{2}$$

d.
$$\frac{3r + s}{t^2 - s}$$

e.
$$\frac{2u + s^2}{r + 2t}$$

ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

Sample Problem 3: Evaluate each expression if $r = 4$, $s = 6$, $t = 3$, and $u = 12$.

$$\text{a. } \frac{2r(s - t)}{tu - s} = \frac{2(4)(6 - 3)}{(3)(12) - 6} = \frac{8(3)}{36 - 6} = \frac{24}{30} = \frac{4}{5}$$

$$\text{b. } \frac{u}{s} + \frac{3s}{t^2} = \frac{12}{6} + \frac{3(6)}{3^2} = 2 + \frac{18}{9} = 2 + 2 = 4$$

$$\text{c. } \frac{rs^2 - 3u}{2} = \frac{(4)(6^2) - 3(12)}{2} = \frac{4(36) - 36}{2} = \frac{144 - 36}{2} = \frac{108}{2} = 54$$

$$\text{d. } \frac{3r + s}{t^2 - s} = \frac{3(4) + 6}{3^2 - 6} = \frac{12 + 6}{9 - 6} = \frac{18}{3} = 6$$

$$\text{e. } \frac{2u + s^2}{r + 2t} = \frac{2(12) + 6^2}{4 + 2(3)} = \frac{24 + 36}{4 + 6} = \frac{60}{10} = 6$$

