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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 by 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.

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

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

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

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

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. $x + 5$

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

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

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

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

d. $y + z + x = 4 + 6 + 2 = 12$

e. $x + 5 = 2 + 5 = 7$

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 $c = 3$.

$a^2 - (b^3 - 4c) = 8^2 - (5^3 - 4 \cdot 3)$		Replace a with 8, b with 5, and c with 3.
$= 64 - (125 - 4 \cdot 3)$		Evaluate 8^2 and 5^3
$= 64 - (125 - 12)$		Multiply 4 and 3
$= 64 - 113$		Subtract 125 and 12
$a^2 - (b^3 - 4c) = -49$		Subtract 64 from 113

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. $tu - 3r$

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

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 $y = 2$.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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