

Evaluating Variable Expressions

When evaluating variable expressions there are several things to remember:

1. Each variable (letter) represents some number.
2. Replace each variable with the number it represents.
3. Simplify the resulting numerical expression using the Order of Operations Agreement.
4. Your answer will be a number without a variable.

EXAMPLE 1: Evaluate $5x - 3y$ when $x = 4$ and $y = -2$

This expression is read as “five times the value of x minus three times the value of y .” Note that when you have a number and a letter (variable) next to each other with nothing in between, it means to multiply.

1. Replace x with 4 (you were told that x has a value of 4), and replace y with -2 (you were told that y has a value of -2):

$$5x - 3y = 5(4) - 3(-2)$$

2. Simplify the resulting numerical expression:

$5(4) - 3(-2)$	perform the multiplication
$= 20 - (-6)$	perform the subtraction
$= 20 + 6$	rewrite (if desired)
$= 26$	numerical answer

EXAMPLE 2: Evaluate $5xy$ when $x = 6$ and $y = -4$

This expression is read as “five times the value of x times the value of y .” Note that when you have two letters (variables) next to each other and nothing in between, it also means to multiply.

1. Replace x with 6 (you were told that x has a value of 6), and replace y with -4 (you were told that y has a value of -4).

$$5xy = 5(6)(-4)$$

2. Simplify the resulting numerical expression:

$5 * 6(-4)$	perform the first multiplication
-------------	----------------------------------

$$= 30 * -4$$

$$= -120$$

perform the second multiplication
numerical answer

EXAMPLE 3: Evaluate $-x$ when $x = -5$

This expression is read as “the opposite of the value of x .”

1. Replace x with -5 (you were told that x has a value of -5)

$$-x = -(-5)$$

$$= -(-5)$$

$$= 5$$

find the opposite of -5
numerical answer

This may also be thought of as -1 times x :

$$-1 \cdot x = -1 \cdot (-5)$$

$$= -1 \cdot (-5)$$

$$= 5$$

perform the multiplication
numerical answer

This type of problem often causes difficulties for students. You must be careful to replace each variable with the value given and leave all other signs and symbols exactly as they were.

EXAMPLE 4: Evaluate $3x^3 - 2x^2$ when $x = 2$.

This expression is read as “three times the value of x cubed minus two times the value of x squared.”

$$3(2)^3 - 2(2)^2$$

$$= 3(8) - 2(4)$$

$$= 24 - 8$$

$$= 16$$

First make the substitution ($x = 2$)
Evaluate. Simplify the exponents first.
Follow the Order of Operations Agreement.
(Multiply before you subtract.)
Numerical answer

REMEMBER that after we have made the substitutions we are simplifying the expression using the Order of Operations Agreement, which states:

1. Simplify all grouping symbols.
2. Simplify all exponential expressions.
3. Perform all multiplication and division as they occur going from left to right.
4. Perform all addition and subtraction as they occur going from left to right.

We call grouping symbols *parentheses* even though we know that includes brackets, braces, the absolute value symbol and a long fraction bar as well as parentheses. We can use the following phrase to help us remember the order:

		P arentheses (), [], {}, , etc.	P lease
		E xponents	E xcuse
Left to	{	M ultiplication	M y
Right		D ivision	D ear
Left to	{	A ddition	A unt
Right		S ubtraction	S ally

REMEMBER that this does not mean that you must multiply before you divide. It depends on which operation comes first as you move from left to right. The same is true for addition and subtraction.

You have had experience evaluating variable expressions which are parts of geometric formulas. The formula $V = \pi r^2 h$ says to find the volume (V) of a right circular cylinder by multiplying the value of π times the square of the value of the radius (r) times the height (h).

To find the volume of a cylinder with a height of 6 inches and a radius of 3 inches, you will evaluate the formula $V = \pi r^2 h$ when $\pi = 3.14$ (approximately), $r = 3$, and $h = 6$

$$V = \pi r^2 h$$

$$V = 3.14 \cdot (3)^2 \cdot 6$$

$$V = 3.14 * 9 * 6$$

$$V = 169.56 \text{ in}^3$$

Replace each letter with its value

Apply the exponent

Multiply

(Note: Volume is measured in cubic units.)

The answer is read “one hundred sixty-nine and fifty-six hundredths cubic inches.”

The formulas needed for this section are usually printed inside the cover of your textbook.