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Learning Outcomes

- Evaluate algebraic expressions for different values

Evaluate Algebraic Expressions

In the last section, we simplified expressions using the order of operations. In this section, we'll evaluate expressions—again following the order of operations. We substitute the given number for the variable in the expression and then simplify the expression using the order of operations.

Any variable in an algebraic expression may take on or be assigned different values. When that happens, the value of the algebraic expression changes. To evaluate an algebraic expression means to determine the value of the expression for a given value of each variable in the expression. Replace each variable in the expression with the given value then simplify the resulting expression using the order of operations. If the algebraic expression contains more than one variable, replace each variable with its assigned value and simplify the expression as before. In the next example we show how to substitute various types of numbers into a mathematical expression.

example

Evaluate $x+7$ when

1. $x=3$
2. $x=12$

Solution:

1. To evaluate, substitute 3 for x in the expression, and then simplify.

	$x+7$
Substitute.	$\textcolor{red}{3}+7$
Add.	10

When $x=3$, the expression $x+7$ has a value of 10 .

2. To evaluate, substitute 12 for x in the expression, and then simplify.

	$x+7$
Substitute.	$\textcolor{red}{12}+7$
Add.	19

When $x=12$, the expression $x+7$ has a value of 19 .

Notice that we got different results for parts 1 and 2 even though we started with the same expression. This is because the values used for x were different. When we evaluate an expression, the value varies depending on the value used for the variable.

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example

Evaluate $9x - 2$ when

- $x=5$
- $x=1$

Show Solution

Solution

Remember ab means a times b , so $9x$ means 9 times x .

1. To evaluate the expression when $x=5$, we substitute 5 for x , and then simplify.

	$9x-2$
Substitute $\textcolor{red}{5}$ for x .	$9\cdot\textcolor{red}{5}-2$
Multiply.	$45-2$
Subtract.	43

2. To evaluate the expression when $x=1$, we substitute 1 for x , and then simplify.

	$9x-2$
Substitute $\textcolor{red}{1}$ for x .	$9(\textcolor{red}{1})-2$
Multiply.	$9-2$
Subtract.	7

Notice that in part 1 that we wrote $9\cdot 5$ and in part 2 we wrote $9\left(1\right)$. Both the dot and the parentheses tell us to multiply.

Exercises

Evaluate the expression $2x + 7$ for each value for x .

- $x=0$
- $x=1$

Show Solution

- Substitute 0 for x .
$$\begin{array}{l} 2x+7 \\ =2\left(0\right)+7 \\ =7 \end{array}$$
- Substitute 1 for x .

$$\begin{array}{ll} 2x+7 & \text{\\hfill} \\ = 2\text{\\left(1\\right)}+7 & \text{\\hfill} \\ = 2+7 & \text{\\hfill} \\ = 9 & \end{array}$$

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example

Evaluate x^2 when $x=10$.

Show Solution

Solution

We substitute 10 for x , and then simplify the expression.

	x^2
Substitute $\textcolor{red}{10}$ for x .	$\textcolor{red}{10}^2$
Use the definition of exponent.	$10 \cdot 10$
Multiply.	100

When $x=10$, the expression x^2 has a value of 100 .

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example

Evaluate 2^x when $x=5$.

Show Solution

Solution

In this expression, the variable is an exponent.

	2^x
Substitute $\textcolor{red}{5}$ for x .	$2^{\textcolor{red}{5}}$
Use the definition of exponent.	$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
Multiply.	32

When $x=5$, the expression 2^x has a value of 32 .

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example

$\text{Evaluate } 3x+4y - 6 \text{ when } x=10 \text{ and } y=2$.

Show Solution

Solution

This expression contains two variables, so we must make two substitutions.

$3x+4y-6$

Substitute $\textcolor{red}{10}$ for x and $\textcolor{blue}{2}$ for y .	$3(\textcolor{red}{10})+4(\textcolor{blue}{2})-6$
Multiply.	$30+8-6$
Add and subtract left to right.	32

When $x=10$ and $y=2$, the expression $3x+4y - 6$ has a value of 32 .

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example

Evaluate $2x^2+3x+8$ when $x=4$.

Show Solution

Solution

We need to be careful when an expression has a variable with an exponent. In this expression,

$2x^2$ means $2 \cdot x \cdot x$ and is different from the expression $(2x)^2$, which means $2x \cdot 2x$.

	$2x^2+3x+8$
Substitute $\textcolor{red}{4}$ for each x .	$2(\textcolor{red}{4})^2+3(\textcolor{red}{4})+8$
Simplify 4^2 .	$2(16)+3(4)+8$
Multiply.	$32+12+8$
Add.	52

try it



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In the video below we show more examples of how to substitute a value for variable in an expression, then evaluate the expression.



[Video Link](#)

Eventually you will be performing these operations on decimals, fractions, and negative numbers, so it is important that you get all the rules mastered with whole numbers first!

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