Expressions

Glossary

TERM	DEFINITION
order of operations	**the order in which the operations of a mathematical expression are completed**
expression	*a collection of numbers, variables, or symbols that express a quantity*
numerical expression	**a mathematical expression that includes numbers and symbols only**
evaluate	**to find the value of an expression**
algebraic expressions	**a mathematical expression that includes at least one variable**
variables	**an unknown quantity, usually represented by a letter**
term	*a single number, a single variable, or a product of numbers and variables; in an expression, terms are related by addition or subtraction*
constant	**a fixed value; a number on its own or a letter that stands for a fixed number**
coefficient	**a number that is multiplied by a variable in a term**
factor	*a part of a term that is being multiplied by another part or other parts of a term*
like terms	**terms in which the same variable(s) are raised to the same exponent**
simplify	*to reduce something to a less complicated form by dividing out common factors, regrouping terms with the same variable or base, and making sure fractions are in simplest form and there are no negative or zero exponents*
distributive property	*the property stating that multiplication can be distributed over terms being added; $a(b + c) = ab + ac$*
absolute value	**a number's distance from zero**

Objective

In this lesson, you will **use expressions to model and solve problems.**

Numerical Expressions

$-2 + 5(9 - 12)$ is an example of a numerical expression. A numerical expression can have only one value.

The order of operations is used to **evaluate** numerical expressions.

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Evaluate the expression: $-3[(-7)^2 - 16] + 4 \div \frac{2}{5}$

Simplify within the parentheses.	$-3[(-7)^2 - 16] + 4 \div \frac{2}{5}$ $= -3[$ **49** $- 16] + 4 \div \frac{2}{5}$ $= -3[$ **33** $] + 4 \div \frac{2}{5}$
Perform multiplication and division from left to right.	$=$ **-99** $+ 4 \div \frac{2}{5}$ $=$ **-99** $+$ **10**
Perform addition and subtraction from left to right.	$=$ **-89**

Algebraic Expressions

Algebraic expressions describe a **quantity**. They can be as simple as a number, or they can include a **combination** of numbers, variables, and symbols.	**Examples:** $3x$ $ab^2 + 14$ $m - \frac{1}{2}(n-1)^3$ $\frac{4-z}{w}$

Parts of an Algebraic Expression

Term: A term can consist of a single number or the product of some numbers and variables. Terms are separated by addition or subtraction signs placed outside of grouping symbols such as parentheses, brackets, and braces.

Example: *4n , 7*

$4n + 7$

Constant: A constant is a number that has a **fixed** value.

Example: **7**

Coefficient: A coefficient is a number that is **multiplied** by a **variable** or an expression.

Example: **4**

Factor: Factors are parts of an expression that are **multiplied**. Coefficients, **variables**, and quantities in grouping symbols can be factors.

Example: **4 and *n***

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Like Terms

→ Like terms are terms that have the same variables raised to the same power.
→ Like terms can have different coefficients.
→ All constants are like terms.

Examples of Like Terms	*Examples of Unlike Terms*
-2x, 5x	*7a, -a²*
7a, -a	**-2x, 5y**
-24, 243	**-24, 243x**

The Distributive Property

We can rewrite algebraic expressions by using the distributive property and combining like terms.

Question

Simplify this expression: $-18-9\left(\frac{1}{2}n+7\right)+4n$

To simplify the expression, apply the **distributive** property and then combine like terms:

$$-18-9\left(\frac{1}{2}n+7\right)+4n$$

$$=-18+\left(\boxed{-9}\cdot\frac{1}{2}n\right)+(\boxed{-9}\cdot 7)+4n$$

$$=-18+\left(-\frac{9}{2}n\right)+(-63)+4n$$

$$=-18-\frac{9}{2}n-\boxed{63}+4n$$

$$=-\frac{9}{2}n+4n-18-\boxed{63}$$

$$=-\frac{1}{2}n-\boxed{81}$$

Evaluating Algebraic Expressions

The value of an algebraic expression depends on the value of each variable in the expression. In other words, the value of an algebraic expression **changes** for different values of the **variables**.

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Jocelyn writes an expression to represent the total number of hours it will take her to complete *p* problems:

$$\frac{5+4p}{60}$$

How long will it take Jocelyn to complete 22 math problems?

To evaluate an expression, replace, or substitute, each **variable** with its given value. Place parentheses around each substitution. Now the expression is a **numerical** expression, and we can simplify it using the **order** of **operations**.	$= \frac{5 + 4(\textbf{22})}{60}$
For a fractional expression like this one, complete all operations in the numerator and denominator separately before dividing.	$= \frac{5 + \textbf{88}}{60}$ $= \frac{\boxed{\textbf{93}}}{\boxed{\textbf{60}}}$
It will take Jocelyn about **1.55** hours to complete 22 homework problems.	

Question

What is the value of the expression, $6a - 4(2 + a^2) + b^3$ when $a = -\frac{2}{3}$ and $b = -2$?

Substitute the given values of *a* and *b* into the expression.	$= 6\left(-\frac{2}{3}\right) - 4\left[2 + \left(-\frac{2}{3}\right)^2\right] + (-2)^3$
1. parentheses or brackets from the inside out	$= 6\left(-\frac{2}{3}\right) - 4[2 + \left(\frac{\boxed{\textbf{4}}}{\boxed{\textbf{9}}}\right)] + (-2)^3$ $= 6\left(-\frac{2}{3}\right) - 4\left(\frac{\boxed{\textbf{22}}}{\boxed{\textbf{9}}}\right) + (-2)^3$
2. exponents	$= 6\left(-\frac{2}{3}\right) - 4\left(\frac{\boxed{\textbf{22}}}{\boxed{\textbf{9}}}\right) + (-8)$
3. multiplication and division from left to right	$= -4 - \frac{\boxed{\textbf{88}}}{\boxed{\textbf{9}}} + (-8)$

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4. addition and subtraction from left to right	$= -\frac{124}{9} + (-8)$ $= -13\frac{7}{9} + (-8)$ $= -21\frac{7}{9}$

Algebraic Expressions with Absolute Value

Absolute value represents a value's distance from 0 on the number line. It is expressed using a pair of vertical bars.

In the order of operations, absolute value signs are considered like parentheses and other grouping symbols. We complete the operations inside the absolute value signs first to get a single number. Then we take the absolute value of the number at the same time we evaluate exponents in the expression.

Evaluate the algebraic expression $-3|n - 0.5| + 4^3$ for $n = -4$ using the order of operations.

Substitute the given value of *n* into the expression, placing it in parentheses.	$-3\|n - 0.5\| + 4^3$ $= -3\|(\text{-4}) - 0.5\| + 4^3$
1) grouping symbols from the inside out	$= -3\|\text{-4.5}\| + 4^3$
2) exponents and absolute value	$= -3(\text{4.5}) + 4^3$ $= -3(\text{4.5}) + \text{64}$
3) multiplication and division from left to right	$= \text{13.5} + \text{64}$
4) addition and subtraction from left to right	$= \text{50.5}$

Summary

What is the difference between numerical and algebraic expressions? How is the order of operations used to evaluate these expressions?

Numerical expressions use only numbers and symbols. Algebraic expressions use numbers, variables, and operations. The order of operations (parentheses, exponents, multiplication and division from left to right, addition and subtraction from left to right) is used to guarantee that each expression is read, simplified, or evaluated in the same way.

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