

Numerical and Algebraic Expressions: math lesson, Grade 6 – download the PDF

Mathematicians love short, powerful sentences. An **expression** lets you describe a calculation in a few symbols, even when one of the numbers is still unknown. In this chapter you will read, write, evaluate, rewrite, and simplify numerical and algebraic expressions. These skills are the foundation of everything you will do in algebra.

1. Numerical and algebraic expressions

D Expressions

A **numerical expression** is made only of numbers and operations, such as $14 - 3 \cdot 2$.
An **algebraic expression** also contains at least one **variable**, a letter that stands for a number that can change, such as $5n + 2$.

An expression is like a phrase: it has no equal sign and it does not say anything is true or false. An *equation* such as $5n + 2 = 17$ is a complete sentence because it has an equal sign. In this chapter we work with phrases only.

Expression	Type	Why
$25 - 4 \cdot 3$	numerical	only numbers and operations
$7k + 1$	algebraic	contains the variable k
$2^3 + 5$	numerical	an exponent is still a number operation
$3(a + b)$	algebraic	contains the variables a and b

In algebra we do not write the multiplication sign between a number and a letter. So $4 \cdot x$ is written $4x$, and $x \cdot y$ is written xy . A fraction bar means division: $\frac{n}{3}$ is the same as $n \div 3$.

2. Exponents

D Exponent and base

An **exponent** tells how many times a number, called the **base**, is used as a factor. In a^n , the base is a and the exponent is n .

For example, $2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$. We read it “2 to the fifth power.” The exponent 2 is read “squared” and the exponent 3 is read “cubed.”

Power	Repeated multiplication	Value
3^2	$3 \cdot 3$	9
4^3	$4 \cdot 4 \cdot 4$	64
2^4	$2 \cdot 2 \cdot 2 \cdot 2$	16
10^2	$10 \cdot 10$	100



Common mistake

The exponent is *not* a multiplier. $2^3 = 2 \cdot 2 \cdot 2 = 8$, not $2 \cdot 3 = 6$. Also notice that $1^n = 1$ for every exponent, and $10^3 = 1,000$: the exponent counts the zeros after the 1.

3. Order of operations

If everyone calculated in a different order, the same expression would give different answers. Mathematicians agreed on one order so that every expression has exactly one value.



Order of operations (PEMDAS)

1. Do the operations inside **P**arentheses (grouping symbols) first.
2. Evaluate **E**xponents.
3. Do **M**ultiplication and **D**ivision from left to right.
4. Do **A**ddition and **S**ubtraction from left to right.



Example 1

Find the value of $3 + 4 \cdot (8 - 5)^2 - 6 \div 2$.

Parentheses: $8 - 5 = 3$, so we have $3 + 4 \cdot 3^2 - 6 \div 2$.

Exponent: $3^2 = 9$, so we have $3 + 4 \cdot 9 - 6 \div 2$.

Multiplication and division: $4 \cdot 9 = 36$ and $6 \div 2 = 3$, so we have $3 + 36 - 3$.

Addition and subtraction from left to right: $3 + 36 = 39$, then $39 - 3 = 36$.

The value is **36**.



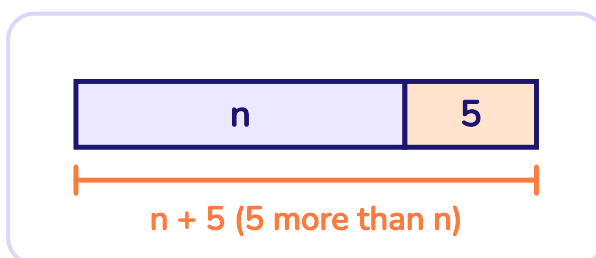
Common mistake

Multiplication does not always come before division, and addition does not always come before subtraction. They share the same level, so you go from left to right. For example, $24 \div 4 \cdot 3 = 6 \cdot 3 = 18$, not $24 \div 12 = 2$.

4. Writing expressions from words

To turn a sentence into an expression, find the unknown number, choose a letter for it, and translate each key word into an operation.

Operation	Key words	Example in words	Expression
addition	sum, plus, more than, increased by	5 more than n	$n + 5$
subtraction	difference, minus, less than, decreased by	4 less than n	$n - 4$
multiplication	product, times, twice	twice a number n	$2n$
division	quotient, divided by, per	a number n divided by 3	$\frac{n}{3}$





Watch the order

“8 *less than* a number n ” is written $n - 8$, not $8 - n$. The phrase “less than” reverses the order in which the numbers appear in the words.



Example 2

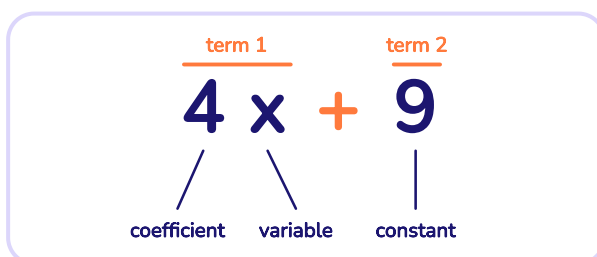
Write an expression for “8 less than three times a number n .”

“Three times a number” is $3n$. “8 less than” that quantity means we subtract 8 from it. The expression is $3n - 8$.

Another one: “the product of 6 and the sum of y and 2” is $6(y + 2)$. We need parentheses because the sum is calculated first.

5. Parts of an expression

An expression is built from pieces that have names. Knowing them lets you describe any expression precisely.





Vocabulary

- A **term** is a number, a variable, or a product of numbers and variables. Terms are separated by $+$ or $-$ signs.
- A **coefficient** is the number multiplied by a variable in a term.
- A **constant** is a term with no variable. Its value never changes.
- A **variable** is a letter that stands for a number.

In $9m + 4n + 6$ there are three terms: $9m$, $4n$, and 6 . The coefficient of m is 9, the coefficient of n is 4, and the constant is 6. A variable alone, like x , has a coefficient of 1 because $x = 1x$.

6. Evaluating expressions

To **evaluate** an expression means to find its value when each variable is replaced by a given number.



How to evaluate

1. Rewrite the expression and replace each variable with its value, written in parentheses.
2. Follow the order of operations.
3. Write the answer with the right unit if there is one.

E**Example 3**

Evaluate $3x^2 - 4$ when $x = 5$, and evaluate $2a + b^2$ when $a = 6$ and $b = 3$.

First: $3(5)^2 - 4 = 3 \cdot 25 - 4 = 75 - 4 = 71$.

Second: $2(6) + (3)^2 = 12 + 9 = 21$.

A**Common mistake**

In $3x^2$, only x is squared. With $x = 5$, $3x^2 = 3 \cdot 25 = 75$, while $(3x)^2 = 15^2 = 225$.

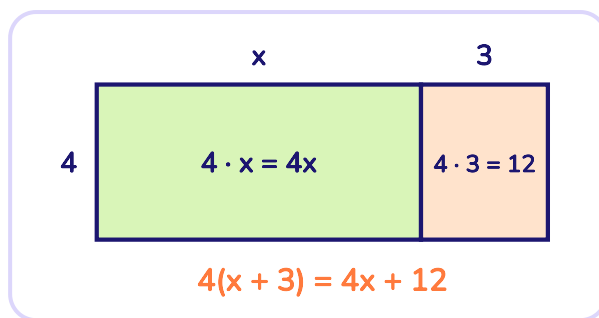
7. Equivalent expressions and the distributive property**D****Equivalent expressions**

Two expressions are **equivalent** if they have the same value for every possible value of the variable. For example, $x + x$ and $2x$ are equivalent.

P**Distributive property**

Multiplying a number by a sum or a difference is the same as multiplying it by each part and then adding or subtracting:

$$a(b + c) = ab + ac \quad \text{and} \quad a(b - c) = ab - ac.$$



The picture shows why it works. The big rectangle has height 4 and width $x + 3$, so its area is $4(x + 3)$. Cut it into two smaller rectangles: one has area $4x$ and the other has area $4 \cdot 3 = 12$. Together they give $4x + 12$.

E Example 4

Expand $4(x + 3)$ and factor $18y + 12$.

Expanding: $4(x + 3) = 4 \cdot x + 4 \cdot 3 = 4x + 12$. Check with $x = 5$: $4(8) = 32$ and $4(5) + 12 = 32$.

Factoring: the greatest common factor of 18 and 12 is 6, so
 $18y + 12 = 6 \cdot 3y + 6 \cdot 2 = 6(3y + 2)$.

! Zyro's tip

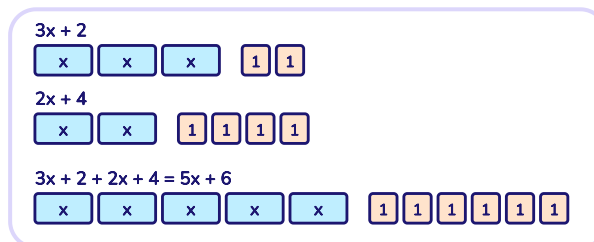
On my planet we test a suspicious pair of expressions with a number first. If the two values are different, the expressions are not equivalent. If they match, try a second number, and then explain why with a property.

8. Combining like terms

D Like terms

Like terms have exactly the same variable part. $5x$ and $2x$ are like terms, and so are 8 and 4 . But $5x$ and $5y$ are not like terms, and neither are $5x$ and 5 .

To combine like terms, add or subtract their coefficients and keep the variable part. This is the distributive property read backward: $5x + 2x = (5 + 2)x = 7x$.



E Example 5

Simplify $6x + 4 + 2x + 9$ and $7y + 3 + y$.

Group the like terms: $(6x + 2x) + (4 + 9) = 8x + 13$.

Remember that $y = 1y$: $(7y + y) + 3 = 8y + 3$.



Common mistake

Do not combine unlike terms. $5x + 3$ is already as simple as it gets; it is not $8x$. Test with $x = 2$: $5(2) + 3 = 13$, but $8(2) = 16$.

Key takeaways

- A numerical expression has only numbers; an algebraic expression has at least one variable. Neither has an equal sign.
- a^n means a multiplied by itself n times, so $2^3 = 8$.
- Order of operations: parentheses, exponents, multiplication and division left to right, addition and subtraction left to right.
- Key words such as sum, difference, product, quotient, and “less than” tell you which operation to write.
- An expression is made of terms; a term may have a coefficient, a variable, or be a constant.
- To evaluate, replace the variable with its value in parentheses, then follow the order of operations.
- Distributive property: $a(b + c) = ab + ac$. Like terms can be combined, unlike terms cannot.



Test yourself: quick challenge for Grade 6

[Change level](#)

Level : **Grade 6**

6 random questions, instant feedback.



Start the challenge



 **Speed drill for Grade 6: how many in 60 seconds?**

 Keep exploring with Zyro

 Math practice

Numerical and Algebraic Expressions:
math practice, Grade 6

 Math tests

Numerical and Algebraic Expressions:
math test, Grade 6

 Math quizzes

Numerical and Algebraic Expressions:
math quiz, Grade 6

 Math practice

Equations and Inequalities: math
practice, Grade 6

 Math practice

Dependent and Independent Variables:
math practice, Grade 6

 Math tests

Equations and Inequalities: math test,
Grade 6

Zyro vous emmène sur nos sites partenaires

Embarquez pour d'autres planètes du savoir et leurs applis.

Décollage