

Study Guide

Order of Operations

Ian said Shelley won first prize and I won second prize. Without punctuation, this sentence has three possible meanings.

Ian said, “Shelley won first prize and I won second prize.”

or

“Ian,” said Shelley, “won first prize and I won second prize.”

or

Ian said Shelley won first prize and I [that is, the speaker] won second prize.

In mathematics, in order to avoid confusion about meaning, an agreed-upon order of operations tells us whether a mathematical expression such as $15 - 12 \div 4$ means $(15 - 12) \div 4$ or $15 - (12 \div 4)$. That order is shown at the right.

Order of Operations
1. Simplify expressions inside grouping symbols.
2. Evaluate all powers.
3. Do all multiplications and divisions from left to right.
4. Do all additions and subtractions from left to right.

You can evaluate an algebraic expression when the value of each variable is known. Replace each variable with its value and then use the order of operations to perform the indicated operations. Remember to do all operations within grouping symbols first.

Example 1: Evaluate $15 - 12 \div 4$.

$$\begin{aligned} 15 - 12 \div 4 &= 15 - 3 \\ &= 12 \end{aligned}$$

Example 2: Evaluate $x^3 + 5(y - 3)$ if $x = 2$ and $y = 12$.

$$\begin{aligned} x^3 + 5(y - 3) &= 2^3 + 5(12 - 3) \\ &= 2^3 + 5(9) \\ &= 8 + 5(9) \\ &= 8 + 45 \\ &= 53 \end{aligned}$$

Evaluate each expression.

1. $10 + 8 \cdot 1$

2. $3^2 \div 3 + 2^2 \cdot 7 - 20 \div 5$

3. $12(20 - 17) - 3 \cdot 6$

4. $\frac{15 + 60}{30 - 5}$

Evaluate each expression when $x = 2$, $y = 3$, $a = \frac{4}{5}$, and $b = \frac{3}{5}$.

5. $x + 7$

6. $3x - 5$

7. $6a + 8b$

8. $a^2 + 2b$

9. $\frac{5a^2b}{y}$

10. $(10x)^2 + 100a$

11. $23 - (a + b)$

12. $\frac{x^4 - y^2}{3ay}$