

**Lesson 1.2**  
**Order of Operations**

- Objectives:
  - Evaluate numerical expressions by using the order of operations.
  - Evaluate algebraic expressions by using the order of operations.

## Evaluate Expressions

Ex 1. Evaluate  $2^6$ .

$$2^6 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$$

Use 2 as a factor  
6 times.

$$= 64$$

Multiply.

Ex 2. Evaluate  $4^4$ .

$$4^4 = 4 \cdot 4 \cdot 4 \cdot 4$$

Use 4 as a factor  
4 times.

$$= 256$$

Multiply.

## Order of Operations

### ▶ PEMDAS

- ▶ P - Parentheses (Evaluate expressions inside grouping symbols)
- ▶ E - Exponents (Evaluate all powers)
- ▶ M - Multiplication (Multiply/divide from left to right)
- ▶ D - Division
- ▶ A - Addition (Add/subtract from left to right)
- ▶ S - Subtraction

## Order of Operations

Ex 1. Evaluate  $48 \div 2^3 \cdot 3 + 5$ .

$$\begin{aligned} 48 \div 2^3 \cdot 3 + 5 &= 48 \div 8 \cdot 3 + 5 && \text{Evaluate powers.} \\ &= 6 \cdot 3 + 5 && \text{Divide 48 by 8.} \\ &= 18 + 5 && \text{Multiply 6 and 3.} \\ &= 23 && \text{Add 18 and 5.} \end{aligned}$$

Answer: 23

**Ex 2. Evaluate  $4[12 \div (6 - 2)]^2$ .**

$$4[12 \div (6 - 2)]^2 = 4(12 \div 4)^2$$

Evaluate innermost expression first.

$$= 4(3)^2$$

Evaluate expression in grouping symbol.

$$= 4(9)$$

Evaluate power.

$$= 36$$

Multiply.

**Answer: 36**

**Bell Work!**

- 1) Write a verbal expression for  $2c^2 + d$ .
- 2) Write an algebraic expression for:
  - a) Four times the square of  $n$
  - b) 5 less than  $x$
- 3) Pencils sell for \$0.79 each and markers sell for \$0.89 each. Write an expression for the cost of  $p$  pencils and  $m$  markers.

### Order of Operations

Evaluate  $[(9^2 - 9) \div 12]5$ .

Evaluate  $(8 - 3) \bullet 3(3 + 2)$ .

## Order of Operations

**Ex 2. Evaluate**  $\frac{2^5 - 6 \cdot 2}{3^3 - 5 \cdot 3 - 2}$ .

$$\frac{2^5 - 6 \cdot 2}{3^3 - 5 \cdot 3 - 2} \text{ means } (2^5 - 6 \cdot 2) \div (3^3 - 5 \cdot 3 - 2).$$

$$\frac{2^5 - 6 \cdot 2}{3^3 - 5 \cdot 3 - 2} = \frac{32 - 6 \cdot 2}{3^3 - 5 \cdot 3 - 2}$$

Evaluate the power in the numerator.

$$= \frac{32 - 12}{3^3 - 5 \cdot 3 - 2}$$

Multiply 6 and 2 in the numerator.

$$= \frac{20}{3^3 - 5 \cdot 3 - 2}$$

Subtract 32 and 12 in the numerator.

$$= \frac{20}{27 - 5 \cdot 3 - 2}$$

Evaluate the power in the denominator.

$$= \frac{20}{27 - 15 - 2}$$

Multiply 5 and 3 in the denominator.

$$= \frac{20}{10} \text{ or } 2$$

Subtract from left to right in the denominator.

**Answer: 2**



## Order of Operations

$$2(4 + 7) \cdot (9 - 5)$$

$$3[5 - 2 \cdot 2]^2$$

$$\frac{3^3 - 4 \cdot 3}{2^5 - 5 \cdot 3 - 2}$$

## Bell Work

Evaluate each expression.

1.  $20 - 6 \cdot 3$

2.  $2(15 + 3) - 11 \cdot 2$

3.  $40 \div 5 + 5 \cdot 2(13 - 7)$

4.  $15 - [10 + (3 - 2)^2]$

5.  $\frac{(4+5)^2}{3(7-4)}$

## Evaluate Algebraic Expressions

**Ex. 1** Evaluate  $2(x^2 - y) + z^2$  if  $x = 4$ ,  $y = 3$ , and  $z = 2$ .

$$2(x^2 - y) + z^2 = 2(4^2 - 3) + 2^2$$

Replace  $x$  with 4,  $y$  with 3 and  $z$  with 2.

$$= 2(16 - 3) + 2^2$$

Evaluate  $4^2$ .

$$= 2(13) + 2^2$$

Subtract 3 from 16.

$$= 2(13) + 4$$

Evaluate  $2^2$ .

$$= 26 + 4$$

Multiply 2 and 13.

$$= 30$$

Add.

**Answer:** 30

Evaluate Algebraic Expressions

Evaluate  $x^3 - y^2 + z$ , if  $x = 3$ ,  $y = 2$ , and  $z = 5$ .

Evaluate  $3x^2 + (2y + z^3)$  if  $x = 4$ ,  $y = 5$ ,  $z = 3$ .

$a^2(3b + 5) \div c$  if  $a = 2$ ,  $b = 6$ ,  $c = 4$

## Real-World Application

Ex 1. Each side of the Great Pyramid at Giza, Egypt, is a triangle. The base of each triangle once measured 230 meters. The height of each triangle once measured 187 meters. The area of a triangle is one-half the product of the base  $b$  and its height  $h$ .

A. Write an expression that represents the area of one side of the Great Pyramid.

B. Find the area of one side of the Great Pyramid.

**A. Write an expression that represents the area of one side of the Great Pyramid.**

Words	one half	of	the product of the base and height
Variable	Let $b$ = base and $h$ = height.		
Expression	$\frac{1}{2}$	$\times$	$b \cdot h$

Answer:  $\frac{1}{2}bh$

**B. Find the area of one side of the Great Pyramid.**

Evaluate  $\frac{1}{2}bh$  for  $b = 230$  and  $h = 187$ .

$$\frac{1}{2}bh = \frac{1}{2}(230 \cdot 187) \quad \text{Replace } b \text{ with } 230 \text{ and } h \text{ with } 187.$$

$$= \frac{1}{2}(43,010) \quad \text{Multiply } 230 \text{ by } 187.$$

$$= 21,505 \quad \text{Multiply } \frac{1}{2} \text{ by } 43,010.$$

Answer: The area of one side of the Great Pyramid is  $21,505 \text{ m}^2$ .

### Real-World Application

Find the area of a triangle with a base of 123 feet and a height of 62 feet.

$$3813 \text{ ft}^2$$