Lesson 1

Foundations of College Algebra

Exponential Notation

Definitions

For any expression a^n, a is a factor multiplied by itself n times if n is a positive integer. That is

$$a^n = \underbrace{a \cdot a \cdot \cdots \cdot a}_{n \text{ times}}.$$

The number a is the **base** and the number n is the **exponent**.

Examples

Write each expression in exponential form.

1. $9 \cdot 9 \cdot 9 \cdot 9 \cdot 9$
2. $16 \cdot 16 \cdot 16 \cdot 16 \cdot 16 \cdot 16 \cdot 16$
3. $4 \cdot 4 \cdot 4 \cdot 5 \cdot 5 \cdot 7 \cdot 7 \cdot 7 \cdot 7$

Write each exponential expression in standard form.

1. 8^6

Simplify the following.

1. 3^4
2. 4^3
3. $2^3 \cdot 3^2$

You Try

Write each expression in exponential form.

1. $7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$
2. $41 \cdot 41 \cdot 41 \cdot 41 \cdot 41$
3. $3 \cdot 3 \cdot 4 \cdot 4 \cdot 12 \cdot 12 \cdot 12 \cdot 12$

Write each exponential expression in standard form.

1. 4^8

Simplify the following.

1. 7^2

2. 5^3

3. 1^9

4. $4^2 \cdot 3^2$

Square Roots

Definition

- A number whose square is m is called a **square root** of m. That is, if $n^2 = m$, then n is a square root of m.
- Every positive number has two square roots: one positive and one negative.
- The positive square root is called the **principle square root** is denoted with a **radical sign**: $\sqrt{m}$.

Examples

Simplify the following.

1. $\sqrt{25}$
2. $\sqrt{121}$

You Try

Simplify the following.

1. $\sqrt{16}$

2. $\sqrt{169}$

Remixed from *Prealgebra 2e* by Lynn Marecek, MaryAnne Anthony-Smith, Andrea Honeycutt Mathis.
Access for free at https://openstax.org/books/prealgebra-2e/pages/1-introduction

Order of Operations

How To - Using the Order of Operations

When simplifying mathematical expressions, perform the operations in the following order:

1. **P**arentheses and grouping symbols, working on the innermost parentheses first.
2. **E**xponents
3. **M**ultiplication and **D**ivision left to right.
4. **A**ddition and **S**ubtraction left to right.

Examples

Simplify.

1. $3 \cdot 8 - 5 \cdot 2$
2. $20 \div 4 + 6 \cdot 5$
3. $20 \div (4 + 6) \cdot 5$
4. $3(1 + 9 \cdot 6) - 4$

You Try

Simplify.

1. $4 + 6(3 + 6)$
2. $6 + 10 \div 2 + 2$
3. $33 \div (3 + 8) \cdot 2$
4. $5\,[2 + 4(3 - 2)]$

Review of Fractions

Definition

- A **fraction** is written $\frac{a}{b}$, where a and b are whole numbers and $b \neq 0$.
- The **denominator** is the bottom number and tells how many parts make a whole.
- The **numerator** is the top number and tells how many parts are in the measurement.

Division Properties

- Any number (except 0) divided by itself is 1.
- Any number divided by 1 is the same number.
- Zero divided by any number (except 0) is 0.
- Dividing a number (except 0) by 0 is undefined.
- Zero divided by zero is indeterminate.

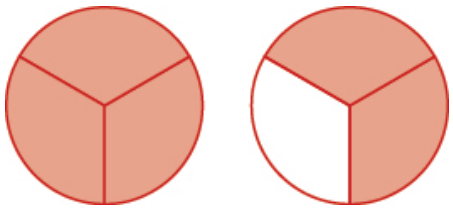
Mixed Numbers and Improper Fractions

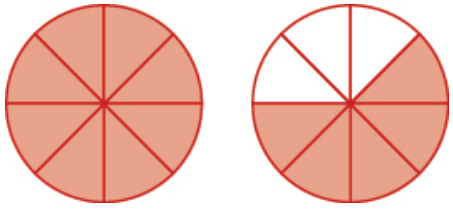
Definitions

- A fraction is a **proper fraction** if the numerator is less than the denominator.
- A fraction is an **improper fraction** if the numerator is greater than or equal to the denominator.
- A **mixed number** consists of a whole number and a proper fraction.

Examples

Name the improper fraction. Write it as a mixed number.

1. 

2. 

Remixed from *Prealgebra 2e* by Lynn Marecek, MaryAnne Anthony-Smith, Andrea Honeycutt Mathis.
Access for free at https://openstax.org/books/prealgebra-2e/pages/1-introduction

How To - Convert a Mixed Number to an Improper Fraction

1. Multiply the whole number by the denominator.
2. Add the numerator to the product found in Step 1.
3. Write the final sum over the original denominator.

Examples

Convert the mixed numbers into improper fractions.

1. $10\frac{2}{7}$
2. $4\frac{6}{11}$

You Try

Convert the mixed numbers into improper fractions.

1. $1\frac{5}{16}$
2. $11\frac{1}{3}$

How To - Convert an Improper Fraction to a Mixed Number

1. Divide the denominator into the numerator.
2. Identify the quotient, remainder, and divisor.
3. Write the mixed number as

$$\text{quotient}\frac{\text{remainder}}{\text{divisor}}.$$

Examples

Convert the improper fractions into mixed numbers.

1. $\frac{33}{8}$
2. $\frac{183}{5}$

You Try

Convert the improper fractions into mixed numbers.

1. $\frac{23}{7}$

2. $\frac{48}{11}$

Remixed from *Prealgebra 2e* by Lynn Marecek, MaryAnne Anthony-Smith, Andrea Honeycutt Mathis.
Access for free at https://openstax.org/books/prealgebra-2e/pages/1-introduction

Prime Factorization

Definitions

- When two numbers are multiplied together, each number is called a **factor**. The answer to the multiplication is called the **product**.
- A **prime** number is a whole number greater than 1 whose only factors are 1 and itself.
- A **composite** number is a whole number that is not prime.
- The **prime factorization** of a number is the product of prime numbers that equals the number.

Examples

Find all factors of the following numbers.

1. 22

2. 72

Identify the following numbers as either prime or composite.

1. 83

2. 77

Find the prime factorization of the following numbers.

1. 36

2. 80

3. 588

You Try

Find all factors of the following numbers.

1. 18

2. 96

Identify the following numbers as either prime or composite.

1. 57

2. 91

Find the prime factorization of the following numbers.

1. 60

2. 126

Remixed from *Prealgebra 2e* by Lynn Marecek, MaryAnne Anthony-Smith, Andrea Honeycutt Mathis.
Access for free at https://openstax.org/books/prealgebra-2e/pages/1-introduction