1.4 Rules of Algebra

Vocabulary

- **term**: parts of an algebraic expression separated by + or -
- **coefficient**: the numerical part of a term
- **constant term**: a term that has no variable
- **like terms**: terms that have exactly the same variables and exponents

Example 1.4.1. Consider the following algebraic expression and answer each question.

$$6x + 2x + 11$$

1. how many terms are there?
2. what is the coefficient of the first term?
3. what is the constant term?
4. what like terms are there, if any?

It is also important that you be able to identify **equivalent algebraic expressions**. When two or more expressions are evaluated for the same values of x, we call them *equivalent* if they evaluate to the same value.

Properties of Real Numbers and Algebraic Expressions

- Commutative
  - addition: $a + b = b + a$
  - multiplication: $ab = ba$
- Associative
  - addition: $(a + b) + c = a + (b + c)$
  - multiplication: $(ab)c = a(bc)$
- Distributive
  - $a(b + c) = ab + ac$

Example 1.4.2. Simplify fully:

$$8 + (12 + x)$$

Example 1.4.3. Simplify fully:

$$6(5x)$$

Example 1.4.4. Write an equivalent expression for

$$8 + (x + 4)$$

Example 1.4.5. Simplify fully:

$$5(x+3)$$

Example 1.4.6. Simplify fully:

$$6(4y+7)$$

Combining Like Terms

The distribution property allows us to combine like terms and reduce the number of terms given in an expression.
How does this work? Consider the following where ax and bx are like terms.

$$ax + bx = x(a+b) = (a+b)x$$

Example 1.4.7. Combine like terms:

$$7x + 3x$$

Example 1.4.8. Combine like terms:

$$9a - 4a$$

Grouping Multiple Like Terms

The process remains the same when it comes to combining like terms even if we have multiple groups of like terms.

Example 1.4.9. Combine like terms:

$$8x + 7 + 10x + 3$$

Example 1.4.10. Combine like terms:

$$9x + 6y - 5x + 2y$$

Simplifying Algebraic Expressions

An algebraic expression is considered **simplified** when all parenthesis have been removed and all like terms have been combined.

Process

1. Use the distributive property to remove parentheses.
2. Rearrange terms and group like terms together.
3. Combine like terms.

Example 1.4.11. Simplify fully:

$$7(2x + 3) + 11x$$

Example 1.4.12. Simplify fully:

$$7(4x + 3y) + 2(5x + y)$$