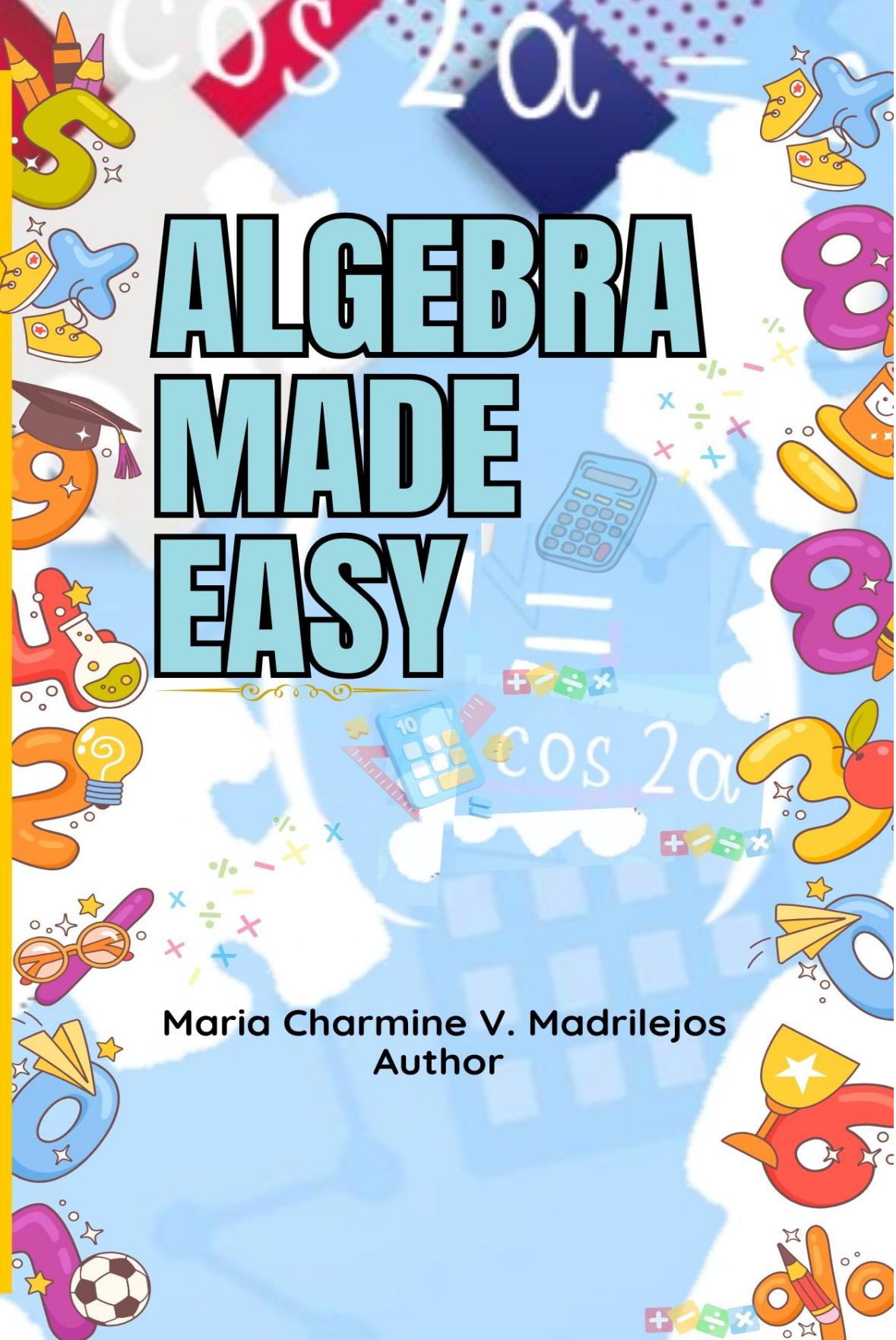A Comprehensive Guide to Algebraic Expressions for Grade 9 Learners

ALGEBRA MADE EASY

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Author

ALGEBRA MADE EASY:
A Comprehensive Guide to Algebraic Expressions for Grade 9 Learners

PHIL-CAD

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PUBLISHING

Maria Charmine V. Madrilejos

Dedication

To my dear students, whose curiosity and determination inspire me every day - this book is for you. May it guide you through the beauty of algebra and empower you with the confidence to solve any challenge that comes your way.

To my fellow educators, who tirelessly shape young minds with patience and passion - may this book serve as a valuable tool in your mission to ignite the love of learning.

And to my family and friends, whose unwavering support and encouragement fuel my journey - thank you for believing in me.

With gratitude and dedication,

Maria Charmine V. Madrilejos
Author

Preface

Mathematics is a fundamental skill that shapes the way we analyze, solve problems, and understand the world around us. However, many students find algebra challenging due to its abstract nature. This book, **"ALGEBRA MADE EASY: A Comprehensive Guide to Algebraic Expressions for Grade 9 Learners,"** aims to bridge that gap by providing a structured, engaging, and student-friendly approach to mastering algebraic expressions.

The primary purpose of this book is to simplify algebraic concepts and develop students' confidence in handling mathematical expressions. Through clear explanations, step-by-step examples, and interactive exercises, learners will gain a deeper understanding of algebra while improving their problem-solving skills.

How to Use This Book

1. ***Step-by-Step Learning:*** *Each chapter introduces a concept with clear explanations, followed by worked-out examples and guided practice exercises.*

2. ***Interactive Activities:*** *Digital games and exercises are included to make learning algebra more engaging and fun.*

3. ***Practice for Mastery:*** *Comprehensive worksheets at the end of each section reinforce learning and help students track their progress.*

4. ***Real-World Applications:*** *Connections to real-life scenarios show the importance of algebra in everyday decision-making and problem-solving.*

This book is designed for self-paced learning, classroom use, and supplementary study. Teachers can integrate the exercises into their lesson plans, while students can use this resource independently to strengthen their understanding.

By the end of this book, learners will not only master algebraic expressions but also develop critical thinking and problem solving skills essential for higher-level mathematics.

Let's embark on this journey together and make algebra an enjoyable learning experience!

Foreword

Algebra is a gateway to advanced mathematics, yet many students struggle with its complexities. As an educator dedicated to making learning accessible, I believe that effective teaching materials can transform how students perceive and engage with math.

This book was created with the vision of breaking down algebraic expressions into simpler, digestible parts while incorporating digital tools and exercises to enhance student engagement. With a strong foundation in algebra, students can approach mathematics with confidence and curiosity.

I invite learners, educators, and parents to explore this book as a valuable resource in making algebra more approachable and enjoyable. Let's empower students to unlock their mathematical potential—one equation at a time!

Maria Charmine V. Madrilejos

Author

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Introduction

Algebra is often seen as a challenging subject, but it is also one of the most powerful tools in mathematics. It serves as the foundation for higher-level math and real-world problem-solving. At its core, algebra helps us understand patterns, relationships, and structures that appear in everyday life—from calculating expenses to predicting trends in science and business.

This book, **"Algebra Made Easy: A Comprehensive Guide to Algebraic Expressions for Grade 9 Learners,"** is designed to make learning algebra simple, engaging, and accessible. It focuses on algebraic expressions, which are the building blocks of algebra.

By mastering these concepts, students will develop critical thinking skills and gain confidence in their mathematical abilities.

What You Will Learn

Throughout this book, students will explore:

1. The fundamentals of algebraic expressions, including terms, coefficients, and variables.

2. How to simplify, factor, and manipulate expressions using different techniques.

3. The four operations—addition, subtraction, multiplication, and division - applied to algebraic expressions.

4. Real-world applications of algebra to demonstrate its importance in daily life.

5. Fun and interactive exercises to reinforce learning and improve problem-solving skills.

This book is designed for self-paced learning, allowing students to progress at their own speed. Whether used in the classroom or for independent study, it provides step-by-step explanations, examples, and practice problems to ensure a deep understanding of the topics covered.

Mathematics is not just about numbers it is about thinking logically and solving problems efficiently. With patience and practice, every student can master algebra. Let's begin this journey together!

Maria Charmine V. Madrilejos

Author

What Are Integers?

Definition: Positive and negative whole numbers, including zero.
Examples: -5, -3, 0, 4, 7.
Visual Representation on a Number Line.

Addition of Integers

Basic Concept

Adding positive integers: Moving right on the number line.
Adding negative integers: Moving left on the number line.

Same Signs:

Example 1:
Both positive, so add and keep the positive sign.

$$5+3=8 \qquad 7+2=9 \qquad 10+6=16 \qquad 3+8=11$$

Example 2:
Both negative, so add and keep the negative sign.

$$-4+(-2)=-6 \qquad -5+(-9)=-14 \qquad -12+(-3)=-15 \qquad -7+(-2)=-9$$

Different Signs:

Example 1:
Subtract the smaller absolute value from the larger absolute value and use the sign of the larger number.

$$8+(-5)=3 \qquad -6+10=4 \qquad -4+9=5 \qquad 7+(-11)=-4$$

Shortcut:
- If the signs are the same, simply add the numbers and keep the sign.
- If the signs are different, subtract the smaller from the larger, and use the sign of the larger number.

Activity: Integer Adventure: Adding Positive and Negative Numbers

Directions: Solve the following integer addition problems and write the correct answers.

1. 8+(−3)= _____   2. −5+(−6)= _____   3. 14+(−7)= _____   4. −9+4= _____   5. −2+10= ___

6. 3+(−8)= _____   7. −4+(−3)= _____   8. 12+(−5)= _____   9. −7+9= _____   10. 6+7= ___

Subtraction of Integers

Basic Concept

Subtraction of integers can be thought of as adding the opposite of the number.

Example: 5 - (-3) = 5 + 3 = 8

Shortcut Rules for Subtracting Integers

- **Smaller Minus Bigger –** Subtract the numbers, and the answer is negative.

  Examples: 3−8= −5

  2−6= −4

  5−9= −4

- **Bigger Minus Smaller** – Subtract the numbers, and the answer is positive.
  Together (Two Negative Signs Side by Side) – Change subtraction to addition, then add the numbers. The answer is positive.

  Examples: 10−4= 6

  7−2= 5

  15−9= 6

- **Together (Two Negative Signs Side by Side)** – Change subtraction to addition, then add the numbers. The answer is positive.

  Examples: 5−(−2)= 5+2=7   11−(−6) = 11+6= 17

  8−(−4)= 8+4=12

- **Alternate (Negative Signs Are Separated)** – Change subtraction to addition, then add the numbers. The answer takes the negative sign.

  Examples: $-3-5=-3+(-5)=-8$ $-7-2=-7+(-2)=-9$

- **Combination of Together and Alternate** – Follow the integer addition rules after converting subtraction into addition.

  Examples: $-10-(-4)=-10+4=-6$ $-12-(-7)=-12+7=-5$

Activity: Mastering Integer Subtraction – The Shortcut Way!

Directions: Subtract the integers using the shortcut rules. Show your solutions clearly.

1. $8 - 5 =$ _____   2. $12 -(-4)=$ _____   3. $-7 -3=$ _____   4. $-10 - (-6)=$ _____   5. $15 - 20=$ _____

6. $-9- (-2) =$ _____   7. $25-(-10)=$ _____   8. $-14 - 5=$ _____   9. $-3-(-8)=$ _____   10. $6-(-7)=$ _____

Review: Mastering Multiplication and Division

The Power of Multiplication

Multiplication is one of the most important math operations that you will use throughout your Grade 9 lessons. It is a quicker way of adding the same number multiple times. Learning multiplication well will make solving division problems easier.

One of the best ways to learn multiplication is by using finger tricks to count multiples. This method makes it easy to memorize multiplication tables and helps you solve problems quickly.

Using Your Fingers to Learn Multiplication Tables

For some multiplication tables, you can use your fingers to count and find the answers quickly. Here are some useful tricks:

1. Multiples of 9:
2. Hold out both hands with fingers spread apart.
3. To find 9×3, fold down your 3rd finger.
4. Count the fingers to the left of the folded finger (2) and to the right (7).
5. The answer is 27.

Division Finger Trick for 9s

Just like the 9× table finger trick, you can use it to divide by 9.

1. If 81 ÷ 9 is the problem, think: "What times 9 gives me 81?"
2. Use the 9× table finger trick to quickly recall that 9 × 9 = 81.
3. Answer: 81 ÷ 9 = 9.

x	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

Memorizing the multiples of numbers from 1 to 10 is crucial in mastering multiplication and division, especially when using the finger method. This foundational knowledge helps students quickly recall the products, making it easier to solve problems without needing to refer to external tools or calculators. With this solid base, students can then focus on refining their understanding of how multiplication and division work, leading to greater fluency and confidence in math. Plus, the finger method provides a visual and tactile way to engage with the numbers, reinforcing their memorization in a fun and

Multiplication and Division of Integers

Basic Concept

Multiplying integers follows simple rules based on signs:

Positive × Positive = Positive
Positive × Negative = Negative
Negative × Positive = Negative
Negative × Negative = Positive

Division of integers follows similar rules to multiplication:

Positive ÷ Positive = Positive
Positive ÷ Negative = Negative
Negative ÷ Positive = Negative
Negative ÷ Negative = Positive

Rules for Multiplication and Division

If both numbers have the **same sign**, the result is **positive**.

If the numbers have **different signs,** the result is **negative.**

- **Multiplying integers follows simple rules based on signs.**

    Examples:

    $4 \times 3 = 12$ (Same signs, positive result)

    $(-3) \times 5 = -15$ (Different signs, negative result)

    $(-4) \times (-2) = -8$ (Same signs, positive result)

    $(2) \times (-5) = -10$ (Different signs, negative result)

- **Multiplying integers follows simple rules based on signs.**

    Examples:

    $12 \div 3 = 4$ (Same signs, positive result)

    $(-12) \div 3 = -4$ (Different signs, negative result)

    $(-12) \div (-3) = 4$ (Same signs, positive result)

    $12 \div (-3) = -4$ (Different signs, negative result)

Activity: Integer Mastery Activity: Multiplication and Division

Part 1: Multiplication of Integers

Directions: Multiply the integers and write the correct answer.

1. $(7)(-3) =$ _____   2. $(-5)(-6) =$ _____   3. $(4)(9) =$ _____   4. $(-4)(-2) =$ _____

5. $(7)(3) =$ _____   6. $(2)(-7) =$ _____   7. $(3)(2) =$ _____   8. $(-4)(-5) =$ _____

Part 2: Division of Integers

Directions: Divide the integers and write the correct answer.

9. 36 ÷ (−6)=_____   10. (−42) ÷ 7= _____   11. (−56)÷(−8)=_____   12. 81÷(−9)=_____

13. 18 ÷ (−3)=_____   14. (−90) ÷ 10= _____   15. (−21) ÷ (−3)=_____   16. 54 ÷ (−8)=_____

Activity: Signed Numbers Operations

Directions: Solve each of the following problems involving signed integers.

1.   12 + 7 = _____
2.   15 − (− 8) = _____
3.   (− 6) × 9 = _____
4.   81 ÷ (− 9) = _____
5.   (− 4) + (− 10) = _____
6.   −3 − 14 = _____
7.   (− 5) × (− 3) = _____
8.   −64 ÷ 8 = _____
9.   −20 + 13 = _____
10. −7 − 18 = _____
11. 7 × (− 11) = _____
12. −48 ÷ (− 6) = _____
13. 24 + (− 18) = _____
14. −12 − (− 30) = _____
15. (− 9) × 5 = _____
16. 56 ÷ (− 8) = _____
17. 13 + (− 27) = _____
18. −22 − 5 = _____
19. (− 3) × (− 14) = _____
20. −72 ÷ − 9 = _____

21. 12 + 7 = _____
22. 15 − (− 8) = _____
23. (− 6) × 9 = _____
24. 81 ÷ (− 9) = _____
25. (− 4) + (− 10) = _____
26. −3 − 14 = _____
27. (− 5) × (− 3) = _____
28. −64 ÷ 8 = _____
29. −20 + 13 = _____
30. −7 − 18 = _____
31. 7 × (− 11) = _____
32. −48 ÷ (− 6) = _____
33. 24 + (− 18) = _____
34. −12 − (− 30) = _____
35. (− 9) × 5 = _____
36. 56 ÷ (− 8) = _____
37. 13 + (− 27) = _____
38. −22 − 5 = _____
39. (− 3) × (− 14) = _____
40. −72 ÷ − 9 = _____

Simplifying Fractions

Introduction to Fractions

What Are Fractions?

A **fraction** represents a part of a whole. It consists of two parts:

1. **Numerator (Top Number):** Represents how many parts are being considered.
2. **Denominator (Bottom Number):** Represents the total number of equal parts in a whole.

Types of Fractions

1. **Proper Fractions:** The numerator is smaller than the denominator.

   Example: $\dfrac{3}{5}$

2. **Improper Fractions:** The numerator is greater than or equal to the denominator.

   Example: $\dfrac{7}{4}$

3. **Mixed Numbers:** A combination of a whole number and a fraction.

   Example: $2\dfrac{1}{3}$

4. **Equivalent Fractions:** Different fractions that represent the same value.

   Example: $\dfrac{2}{4} = \dfrac{1}{2}$

Simplifying Fractions

To simplify fractions quickly, follow these steps:

1. **Find the Greatest Common Factor (GCF):**
   Identify the largest number that evenly divides both the numerator and denominator.

2. **Divide Both Terms by the GCF:**
   Reduce the fraction by dividing both the numerator and denominator by their GCF.

3. **Check for Further Reduction:** If the fraction can still be simplified, repeat the process.

Examples:

1. Simplify: Solution:

$$\frac{12}{16} \qquad \frac{12 \div 4}{16 \div 4} = \frac{3}{4}$$

GCF: 4
(They are both divisible by 4.)

2. Simplify: Solution:

$$\frac{14}{35} \qquad \frac{14 \div 7}{35 \div 7} = \frac{2}{5}$$

GCF: 6
(They are both divisible by 6.)

Simplifying Fractions with Different Signs

When simplifying fractions with different signs, it's important to consider the following rule:

Same signs = **Positive** result

Different signs = **Negative** result

Examples:

1. Simplify: Solution:

$$\frac{8}{12} = \frac{8}{12} \div \frac{4}{4} = \frac{2}{3}$$

Same signs

(positive ÷ negative or negative ÷ positive)
give a **positive result**.

2. Simplify: Solution:

$$\frac{-15}{25} = \frac{-15}{25} \div \frac{5}{5} = \frac{-3}{5}$$

Different signs

(positive ÷ negative or negative ÷ positive)
give a **negative result**.

3. Simplify: Solution:

$$\frac{-12}{-8} = \frac{-12}{-8} \div \frac{4}{4} = \frac{3}{2}$$

Same signs

(positive ÷ negative or negative ÷ positive)
give a **positive result**.

4. Simplify: Solution:

$$\frac{20}{-30} = \frac{20}{-30} \div \frac{10}{10} = \frac{2}{-3}$$

Different signs

(positive ÷ negative or negative ÷ positive)
give a **negative result**.

Special Case Fractions

Let's go through some examples of simplifying fractions:

1. Both the numerator and denominator are the same.

When you divide any number by itself (except 0), the result is always **1**.

Examples:

$$\frac{2}{2} = 1 \qquad\qquad \frac{6}{6} = 1 \qquad\qquad \frac{15}{15} = 1$$

2. Dividing by zero is undefined.

There's no valid number you can multiply by 0 to get any number, so division by **zero is not allowed in mathematics.**

Examples: $\frac{3}{0}$ is undefined. $\qquad \frac{5}{0}$ is undefined. $\qquad \frac{-8}{0}$ is undefined.

3. When the numerator is zero, the result is always 0.

When the **numerator is zero**, the result is always **0**, no matter what the denominator is (as long as the denominator is not zero).

Examples:

$$\frac{0}{6} = 0 \qquad\qquad \frac{0}{10} = 0 \qquad\qquad \frac{0}{100} = 0$$

4. Any fraction with a denominator of 1 is simply the numerator.

Examples:

$$\frac{13}{1} = 13 \qquad\qquad \frac{50}{1} = 50 \qquad\qquad \frac{7}{1} = 7$$

Activity: Simplifying Fractions

Directions: Simplify the following fractions. Find the GCF if applicable. Show your solution.

1. $\frac{16}{24}$

2. $\frac{35}{50}$

3. $\frac{48}{72}$

4. $\frac{25}{35}$

5. $\frac{12}{30}$

6. $\frac{-36}{48} =$

7. $\frac{-9}{27} =$

8. $\frac{8}{-64} =$

9. $\frac{-28}{56} =$

10. $\frac{10}{-25} =$

11. $\frac{-16}{-24} =$

12. $\frac{-30}{-45} =$

13. $\frac{-48}{-72} =$

14. $\frac{-25}{-35} =$

15. $\frac{-12}{-30} =$

16. $\frac{-36}{-48}$

17. $\frac{54}{81}$

18. $\frac{-40}{60}$

19. $\frac{9}{27}$

20. $\frac{8}{-64}$

21. $\frac{4}{0} =$

22. $\frac{12}{12} =$

23. $\frac{9}{1} =$

24. $\frac{1}{9} =$

25. $\frac{0}{2} =$

26. $\frac{4}{1} =$

27. $\frac{8}{8} =$

28. $\frac{9}{0} =$

3 Operations on Fractions

Addition and Subtraction of Fractions

Steps:

1. If the denominators are already the same, simply add the numerators.
2. If the denominators are different, find the Least Common Denominator (LCD), then adjust the fractions so that they have the same denominator.
3. Add the numerators and keep the common denominator.
4. Simplify the result if necessary.

Adding and Subtracting Fractions with the Same Denominator

Examples:

1. Add:

$$\frac{3}{8} + \frac{2}{8} = \frac{3+2}{8} = \frac{5}{8}$$

2. Subtract:

$$\frac{7}{9} - \frac{2}{9} = \frac{7-2}{9} = \frac{5}{9}$$

Adding Fractions with Different Denominators

Examples:

Add: $\frac{1}{4} + \frac{1}{6}$

Step 1: Find the LCD of 4 and 6, which is 12.

Step 2: Convert both fractions to have a denominator of 12:

$$\frac{1}{4} = \frac{3}{12}, \quad \frac{1}{6} = \frac{2}{12}$$

Step 3: Add the numerators:

$$\frac{3}{12} + \frac{2}{12} = \frac{5}{12}$$

Subtract:

$$\frac{5}{6} - \frac{1}{2}$$

1. Find the least common denominator (LCD) of 6 and 2.
   The LCD is 6.

2. Rewrite each fraction with the common denominator of 6:

$$\frac{5}{6} = \frac{5}{6}, \quad \frac{1}{2} = \frac{3}{6}$$

3. Now, subtract the fractions:

$$\frac{5}{6} - \frac{3}{6} = \frac{2}{6}$$

4. Simplify the result:

$$\frac{2}{6} = \frac{1}{3}$$

Shortcut: Addition and Subtraction of Fractions Using the Butterfly Method

Introduction

The **Butterfly Method** works for both addition and subtraction of fractions that have different denominators. Here's the idea:

Step 1: Write the two fractions so that their numerators are on the top, and the denominators are on the bottom.

Step 2: Multiply the **numerator of the first fraction** by the **denominator of the second fraction**, and vice versa. This is the "butterfly wings" part.

Step 3: Add or subtract the two products depending on the operation (addition or subtraction).

Step 4: Multiply the **denominators** of both fractions together. This is the "body" of the butterfly.

Step 5: Simplify the resulting fraction if necessary.

Addition of Fractions

Examples:

1. **Add:**

$$\frac{3}{4} + \frac{2}{5}$$

Solution:

Multiply   15   +   8   Multiply

$$\overset{}{\underset{}{\frac{3}{4}}} + \overset{}{\underset{}{\frac{2}{5}}}$$

Multiply

Add → $\dfrac{23}{20}$

Copy

2. **Add:**

$$\frac{-3}{4} + \frac{5}{6}$$

Solution:

Multiply   -18   +   20   Multiply

$$\overset{}{\underset{}{\frac{-3}{4}}} + \overset{}{\underset{}{\frac{5}{6}}}$$

Multiply

24

Add

Always Simplify

$$= \frac{2}{24} = \frac{1}{12}$$

Copy

Subtraction of Fractions

Examples:

1. **Subtract:**

$$\frac{5}{6} - \frac{1}{3}$$

Solution:

Multiply   15   -   6   Multiply

$$\frac{5}{6} - \frac{1}{3}$$

Multiply

18

Subtract

$$= \frac{9}{18} = \frac{1}{2}$$

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2. **Subtract:**

$$\frac{-7}{8} - \frac{3}{4}$$

Solution:

Multiply   -28   -   -24   Multiply

$$\frac{-7}{8} - \frac{-3}{4}$$

Multiply

32

Subtract

Always Simplify

$$= \frac{-4}{32} = \frac{-1}{8}$$

Copy

Part I Activity: Addition and Subtraction of Similar Fractions

Directions: Solve the following problems. Show your solution, simplify your final answer, and write it in the box.

1. $\frac{-2}{7} + \frac{3}{7} =$

2. $\frac{5}{9} + \frac{-4}{9} =$

3. $\frac{-6}{11} + \frac{-2}{11} =$

4. $\frac{7}{8} + \frac{1}{8} =$

5. $\frac{-5}{12} + \frac{-7}{12} =$

6. $\frac{-3}{5} - \frac{1}{5} =$

7. $\frac{4}{6} - \frac{-2}{6} =$

8. $\frac{-7}{9} - \frac{-5}{9} =$

9. $\frac{8}{10} - \frac{3}{10} =$

10. $\frac{-9}{12} - \frac{-4}{12} =$

Part II Activity: Addition and Subtraction of Dissimilar Fractions

Directions: Solve the following problems. Show your solution, simplify your final answer, and write it in the box.

1. $\frac{-1}{3} + \frac{2}{5} =$

2. $\frac{3}{4} + \frac{-5}{6} =$

3. $\frac{-2}{7} + \frac{3}{8} =$

4. $\frac{4}{9} + \frac{-1}{6} =$

5. $\frac{-5}{12} + \frac{7}{10} =$

6. $\frac{-3}{5} - \frac{1}{4} =$

7. $\frac{5}{6} - \frac{-2}{9} =$

8. $\frac{-4}{7} - \frac{3}{5} =$

9. $\frac{2}{9} - \frac{-1}{8} =$

10. $\frac{-7}{10} - \frac{2}{15} =$

Multiplication of Fractions

1. Long Method for Multiplying Fractions

In the long method, you multiply the numerators (top numbers) and the denominators (bottom numbers) separately.

Example:

Multiply: $\dfrac{3}{4} \times \dfrac{2}{5}$

Solution: $\dfrac{3}{4} \times \dfrac{2}{5} = \dfrac{3 \times 2}{4 \times 5} = \dfrac{6}{20} = \dfrac{3}{10}$

2. Multiplying Fractions Using the Cancellation Method

The **cancellation method** (also known as cross-canceling) is a shortcut that allows you to simplify fractions before multiplying. This method helps to make the multiplication easier and avoids dealing with larger numbers.

Steps for Using the Cancellation Method:

1. **Look for common factors** between the numerator of one fraction and the denominator of the other fraction.
2. **Cancel out** these common factors.
   You cancel a factor by dividing both the numerator and the denominator by their greatest common divisor (GCD).
3. **Multiply the remaining numerators** and **denominators**.

Example 1:

$$\dfrac{4}{3} \times \dfrac{5}{2} = \dfrac{\cancel{4}^{2}}{3} \times \dfrac{5}{\cancel{2}_{1}} = \dfrac{2}{3} \times \dfrac{5}{1} = \dfrac{2 \times 5}{3 \times 1} = \dfrac{10}{3}$$

Example 2:

$$\dfrac{-3}{4} \times \dfrac{2}{5} = \dfrac{-6}{20} = \dfrac{-3}{10}$$

Example 3:

$$\dfrac{-6}{8} \times \dfrac{4}{5} = \dfrac{-6}{8} \times \dfrac{\cancel{4}^{1}}{5} = \dfrac{-6}{10} = \dfrac{-3}{5}$$

Activity: Multiplication of Fractions

Directions: Multiply the fractions and simplify if necessary. Show your solution. Write in the box.

1. $\frac{3}{5} \times \frac{2}{7} =$

2. $\frac{4}{9} \times \frac{3}{8} =$

3. $\frac{6}{11} \times \frac{5}{6} =$

4. $\frac{2}{3} \times \frac{4}{5} =$

5. $\frac{7}{12} \times \frac{6}{10} =$

6. $\frac{3}{8} \times \frac{-4}{9} =$

7. $\frac{-6}{11} \times \frac{7}{2} =$

8. $\frac{4}{5} \times \frac{-9}{14} =$

9. $\frac{-3}{8} \times \frac{-5}{6} =$

10. $\frac{7}{13} \times \frac{-2}{3} =$

Division of Fractions

Steps:

1. Flip the second fraction (reciprocal).
2. Change the division to multiplication.
3. Multiply the numerators and denominators.
4. Simplify the result if needed.

Example 1:

$$\frac{3}{4} \div \frac{5}{2} = \frac{3}{4} \times \frac{2}{5} = \frac{6}{20} = \boxed{\frac{3}{10}}$$

Copy

Flip

The reciprocal of $\frac{5}{2}$ is $\frac{2}{5}$.

Example 2:

$$\frac{7}{8} \div \frac{3}{4} = \frac{7}{\cancel{8}_2} \times \frac{\cancel{4}^1}{3} = \frac{7}{6}$$

Example 3:

$$\frac{-6}{10} \div \frac{5}{12} = \frac{-6}{\cancel{10}_5} \times \frac{\cancel{12}^6}{5} = \frac{-36}{25}$$

Dividing fractions is simple once you remember to flip the second fraction and **change the division to multiplication.**

Activity: Division of Fractions

Directions: Divide the fractions and simplify if necessary. Show your solution. Write in the box.

1. $\frac{3}{4} \div \frac{2}{5} =$

2. $\frac{7}{9} \div \frac{5}{8} =$

3. $\frac{6}{7} \div \frac{4}{3} =$

4. $\frac{-2}{5} \div \frac{3}{4} =$

5. $\frac{5}{6} \div \frac{-4}{9} =$

4   PEMDAS – The Order of Operations

Introduction

When solving mathematical expressions, it's important to follow a specific order of operations to ensure we get the correct result. **PEMDAS** is the acronym that represents this order:

The rule for PEMDAS is:

1.   **P** – Parentheses

2.   **E** – Exponents (including square roots, powers)

3.   **MD** – Multiplication and Division (from left to right)

4.   **AS** – Addition and Subtraction (from left to right)

Solving an Expression with PEMDAS

Example 1:

$$5 + (2 \times 3^2 - 4) \div 2$$

1. Parentheses first: Solve inside the parentheses.
   $3^2 = 9$
   So, the expression becomes:
   $5 + (2 \times 9 - 4) \div 2$
2. Multiplication and Division (inside parentheses):
   $2 \times 9 = 18$
   The expression becomes:
   $5 + (18 - 4) \div 2$
3. Subtraction inside parentheses:
   $18 - 4 = 14$
   Now, the expression is:
   $5 + 14 \div 2$
4. Division:
   $14 \div 2 = 7$
   The expression becomes:
   $5 + 7$
5. Addition:
   $5 + 7 = 12$
   The final answer is:
   12

Solution:

$5 + (2 \times 3^2 - 4) \div 2$

$= 5 + (2 \times 9 - 4) \div 2$

$= 5 + (18 - 4) \div 2$

$= 5 + 14 \div 2$

$= 5 + 7$

$= 12$

Example 2:	Example 3:	Example 4:

$$(8+2) \times 4 - 6 \div 3$$
$$= (10) \times 4 - 2$$
$$= 40 - 2$$
$$= 38$$

$$(4-6) \times 5 - (-12 \div 4)$$
$$= (-2) \times 5 - (-3)$$
$$= -10 + 3$$
$$= -7$$

$$\frac{8}{5}\left(2 - \frac{3}{4}\right) + \frac{1}{2}$$
$$= \frac{8}{5}\left(\frac{8}{4} - \frac{3}{4}\right) + \frac{1}{2}$$
$$= \frac{8}{5} \times \frac{5}{4} + \frac{1}{2}$$
$$= \frac{40}{20} + \frac{1}{2}$$
$$= 2 + \frac{1}{2}$$
$$= \frac{5}{2}$$

Important Notes:

- Always work left to right for multiplication and division, and for addition and subtraction.
- Parentheses and exponents must be solved first, as they "override" the order of the other operations.

PEMDAS Activity: Simplify the Following Expressions

Directions: Instructions: Simplify each expression step by step following the order of operations.

1. $8 + 2 \times (3^2 - 5) = $ _____

2. $9 + 6 \div 2 \times 3 = $ _____

3. $(4^2 - 5) + 6 = $ _____

4. $(-2 + 5) \times 4 - 8 \div 2 = $ ____

5. $-10 + (-3 \times 2 - 4) = $ _____

6. $2\left(\frac{5}{6} - \frac{1}{3}\right) = $ ____

Introduction

Algebra is a branch of mathematics that uses symbols, letters, and numbers to represent and solve problems. The primary focus is on the operations that can be performed on these symbols, with the goal of solving for unknown variables and discovering relationships between quantities.

Expressions:

- Combinations of numbers, variables (e.g., x, y), and operations (addition, multiplication, etc.).
- Do not have an equal sign.

    Examples: 1. $3x + 5$,   2. $2y - 4$

Equations:

- Statements that show two expressions are equal.
- Contain an equal sign (=).
- Used to solve for unknown values.

    Examples: 1. $3x + 5 = 11,$ 2. $2y - 4 = 8$

Understanding Variables and Constants

- **Variables-** A symbol (typically a letter) used to represent a number whose value is not yet known. For example, in the expression $2x + 5,$ *x is the variable.*

- **Constants-** A fixed number that does not change. In the expression $2x + 5, 5$ *is the constant.*
- **Coefficient term-** is a term in an algebraic expression where a constant number (called the coefficient) is multiplied by a variable. In the expression $2x + 5,$ $2x$ *is the coefficient term.*

    Example: 4x+5 = 2   **Variable:** x   **Constants:** 5 and 3   **Coefficient Term:** 4x

Activity: Identifying Variables, Constants, and Coefficients

Directions: Identify the variable(s), constant(s), and coefficient terms (s) in each algebraic expression.

Given	Variable(s)	Constant(s)	Coefficient Term(s)
4x+7			
2a+6b−9			
4a − 3b + 7c − 2 + 8			

Understanding Like and Unlike

Like Terms

- **Like terms** are terms that have the **same variable(s)** raised to the **same exponent(s).**
- Only the coefficients (**numerical values**) of like terms **can be added or subtracted**.

Examples of Like Terms:

✔ 3x and 5x   (Same variable "x")

✔ 2y² and -7y²   (Same variable "y" with the same exponent ²)

✔ 4xy and -3xy   (Same variables "x" and "y")

Examples of Unlike Terms:

3x and 2y   (Different variables)

5a² and 4a   (Same variable but different exponents)

2mn and 3m   (Missing "n" in the second term)

◈ **Key Rule:**
   Only like terms can be combined when adding or subtracting algebraic expressions.

Activity: Identifying Like and Unlike Terms

Directions: For each pair or group of terms, determine whether they are like terms or unlike terms. Write "Like Terms" or "Unlike Terms" as your answer.

_____ 1. $4x$ and $7x$	_____ 6. $7x^2y$ and $2x^2y$
_____ 2. $5a^2$ and $3a^2$	_____ 7. $3ab$ and $5ba$
_____ 3. $2y$ and $2y^2$	_____ 8. $8xy$ and $8yx^2$
_____ 4. $6m$ and $-3m$	_____ 9. $-4c^2$ and $6c^2$
_____ 5. $9p^3$ and $4p^2$	_____ 10. $10x^3y^2$ and $5x^2y^3$

Addition and Subtraction of Algebraic

Adding Algebraic Expressions Rule:

Rule: To add algebraic expressions, add the coefficients of like terms and keep the variable part unchanged.

Example 1:

$$3x + 5x$$ ☞ Identify like terms: 3x and 5x

$$= (3 + 5)x$$ ☞ Add coefficients: 3 + 5 = 8

$$= 8x$$ ☞ Final answer: 8x

Example 2:

$$2y^2 + 7y^2$$ ☞ Identify like terms: 2y² and 7y²

$$= (2 + 7)y^2$$ ☞ Add coefficients: 2 + 7 = 9

$$= 9y^2$$ ☞ Final answer: 9y²

Subtracting Algebraic Expressions

Rule: To subtract algebraic expressions, subtract the coefficients of like terms and keep the variable part unchanged.

Example 1:

$$2y^2 + 7y^2$$ ☞ Identify like terms: 9m and 4m

$$= (2 + 7)y^2$$ ☞ Subtract coefficients: 9 - 4 = 5

$$= 9y^2$$ ☞ Final answer: 5m

Example 2:

$$8x^2 - 3x^2$$ ☞ Identify like terms: 8x² and -3x²

$$= (8 - 3)x^2$$ ☞ Subtract coefficients: 8 - 3 = 5

$$= 5x^2$$ ☞ Final answer: 5x²

Adding and Subtracting Expressions with Multiple Terms

Example 1:

$$5m - 3m + 2n - 7n$$

$$= (5m - 3m) + (2n - 7n)$$

$$= 2m - 5n$$

☞ Identify like terms:

    5m and -3m

    2n and -7n

☞ Subtract coefficients:

    5m - 3m = 2m

    2n - 7n = -5n

☞ Final answer: 2m - 5n

Activity: Identifying Like and Unlike Terms

Directions: Simplify the following algebraic expressions by performing the addition or subtraction. Write your final answer inside the box.

Addition:

1. Simplify: $5x + 3x =$
2. Simplify: $2a + 7a =$
3. Simplify: $4m - 3m + 2m =$
4. Simplify: $8p + 5q - 3p + 7q =$
5. Simplify: $3x + 4y + 2x - 6y =$

Addition with Exponents:

1. Simplify: $2x^2 + 3x^2 =$
2. Simplify: $5a^3 + 2a^3 =$
3. Simplify: $4m^2 + 3m^2 - 2m^2 =$
4. Simplify: $7p^2 + 4p - 3p^2 + 5p =$
5. Simplify: $3x^3 + 2x^2 + x^3 - 4x^2 =$

Subtraction:

1. Simplify: $9a - 4a =$
2. Simplify: $6x - 2x =$
3. Simplify: $7m - 3m - 2m =$
4. Simplify: $10p - 3q - 4p + 5q =$
5. Simplify: $5x - 3y - 2x + 4y =$

Subtraction with Exponents:

1. Simplify: $8a^4 - 3a^4 =$
2. Simplify: $6x^3 - 4x^3 =$
3. Simplify: $7m^2 - 3m^2 - 2m^2 =$
4. Simplify: $5p^3 - 2p^3 - p^3 =$
5. Simplify: $9x^4 - 2x^2 - 3x^4 + 4x^2 =$

Multiplication of Algebraic Expressions

Multiply the Coefficients

When multiplying algebraic expressions, the first step is to **multiply the numerical coefficients** (the numbers in front of the variables).

Apply the Exponent Rules

When multiplying terms that contain the same base (variable), apply the following exponent rule:

$$a^m \times a^n = a^{m+n}$$

This means that when you multiply terms with the same base, you add the exponents.

1. **Multiplying Coefficients:** When you multiply algebraic expressions, first multiply the numerical coefficients (numbers in front of the variables).

Example: $(3x)\,(4y) = 12xy$ **Solution:** $(3)\,(4) = 12$, $(x)\,(y) = xy$, $= 12xy$

Here, 3 and 4 are the coefficients, and they are multiplied to get 12.

2. **Multiplying Like Variables:** When multiplying the same variables, add their exponents.

Example: $x^2 + x^3$ **Solution:** $x^{2+3} = x^5$

The exponents are added because of the law of exponents.

3. **Distributive Property:** This is also known as the FOIL (First, Outer, Inner, Last) method when multiplying binomials, or simply distributing when multiplying polynomials.

Example:

$$(a + b)(c + d) = ac + ad + bc + bd$$

Here, each term in the first expression is multiplied by each term in the second expression.

Step-by-Step Process for Multiplying Algebraic Expressions

Let's apply the rules to different cases:

1. **Multiplying Two Binomials:** Example: $(x + 2)(x + 3)$

   Steps:

   - Multiply $x \times x = x^2$
   - Multiply $x \times 3 = 3x$
   - Multiply $2 \times x = 2x$
   - Multiply $2 \times 3 = 6$

   Combining all terms:

   $$x^2 + 3x + 2x + 6 = x^2 + 5x + 6$$
   Combine like terms

   So, the result is $x^2 + 5x + 6$.

2. **Multiplying a Monomial by a Binomial**: Example: $3x(2x+4)$

   Steps:

   - Multiply $3x \times 2x = 6x^2$

   - Multiply $3x \times 4 = 12x$

   Result:

   $$6x^2 + 12x$$

   So, the result is $6x^2 + 12x$.

3. **Multiplying Polynomials with More Than Two Terms:**

   Example: $(x+1)(x^2 - x + 3)$

   - Multiply $x \times x^2 = x^3$

   - Multiply $x \times -x = -x^2$

   - Multiply $x \times 3 = 3x$

   - Multiply $1 \times x^2 = x^2$

   - Multiply $1 \times -x = -x$

   - Multiply $1 \times 3 = 3$

   Combining all terms:

   $$x^3 - x^2 + 3x + x^2 - x + 3 = x^3 + 2x + 3$$

   So, the result is $x^3 + 2x + 3$.

Division of Algebraic Expressions

In dividing algebraic expressions, we apply the following rules:

1. **Divide the coefficients** (numerical values of terms).
2. **Apply the quotient rule of exponents**: When dividing terms with the same base, subtract the exponents.

$$a^m \div a^n = a^{m-n}, \quad \text{where } m > n$$

3. **Simplify the expression** by reducing like terms.

Examples:

1. Division of Monomials

Example: $\frac{8x^3}{2x}$ Solution: $\left(\frac{8}{2}\right)\left(x^{3-1}\right) = 4x^2$

Example: $\frac{15a^5}{3a^2}$ Solution: $\left(\frac{15}{3}\right)\left(a^{5-2}\right) = 5a^3$

2. Division of Polynomials by Monomials

Example: $\frac{6x^4 + 9x^3}{3x^2}$

Divide each term of the polynomial by the monomial:

$$\frac{6x^3}{3x} + \frac{9x^2}{3x} - \frac{12x}{3x}$$

Simplify each fraction:

$$2x^2 + 3x - 4$$

Final Answer:

$$2x^2 + 3x - 4$$

Activity: Division of Algebraic Expressions

Directions: Simplify each expression.

1. $\frac{12x^5}{4x^2} =$

2. $\frac{18a^7}{6a^3} =$

3. $\frac{30y^6}{5y^2} =$

4. $\frac{50m^4}{10m} =$

5. $\frac{21b^8}{7b^5} =$

6. $\frac{9x^3 + 12x^2}{3x} =$

7. $\frac{15y^5 + 20y^3}{5y^2} =$

8. $\frac{16a^6 - 8a^4 + 4a^2}{4a^2} =$

8 Simplifying Algebraic Expressions

Introduction

An algebraic expression is a mathematical phrase that includes numbers, variables, and operations.

Examples:

$$3x + 5y - 2$$

$$4a - 7b + 9$$

$$2(x + 3) - 5$$

Key Concepts:

1. **Terms**: Parts of an expression separated by **+** or **-** signs.
   - Example: In **5x + 3y - 7**, the terms are **5x**, **3y**, and **-7**.
2. **Like Terms**: Terms that have the **same variables** raised to the **same exponents**.
   - Example: In **3x + 5x - 2**, the terms **3x** and **5x** are like terms.
3. **Unlike Terms**: Terms that have **different variables or exponents**.
   - Example: In **4m + 2n**, the terms **4m** and **2n** are unlike terms.

Steps to Simplify Algebraic Expressions

Step 1: Apply the Distributive Property (if needed)
The distributive property states that **a(b + c) = ab + ac**.
Example: $2(x + 3) - 4(x - 2) = 2x + 6 - 4x + 8$

Step 2: Identify and Combine Like Terms
Example: $5x + 3x - 2y + 7y - 4$

- Combine **5x** and **3x** → **8x**
- Combine **-2y** and **7y** → **5y**
- The constant **-4** remains unchanged.
- Final Answer: **8x + 5y – 4**

Step 3: Follow the Order of Operations (PEMDAS)

1. Parentheses
2. Exponents
3. Multiplication and Division (left to right)
4. Addition and Subtraction (left to right)

Example: $3(2x - 4) + 5x$

Distribute:
Combine like terms:
Final Answer: **11x - 12**

Example 1

1. Distribute: $4(3x - 2) + 5(x + 4)$
2. Combine like terms: $: 12x - 8 + 5x + 20$
3. Final Answer: **17x + 12**

Example 2

1. Distribute: $6y + 30 - 6y + 12$
2. Combine like terms: $(6y - 6y) + (30 + 12)$
3. Final Answer: **42**

Activity: Algebra Challenge - Simplify & Win!

Directions: Solve and simplify the expression correctly. Show your solution.

1. Simplify: 4a + 3b - 2a + 5b =

2. Simplify: 2(x - 3) + 4(2x + 1) =

3. Simplify: 6m - 2(3m - 4) + 8 =

4. Simplify: 5(2x - 1) - 3(x + 4) =

5. Simplify: 3(4y - 2) + 2(y + 5) =

6. Simplify: 7(x + 3) - 2(4x - 1) =

7. Simplify: 4(2a - 3) + 5(3a + 2) =

8. Simplify: 8p - 3(2p - 5) + 4 =

9. Simplify: 9(2k - 4) - 5(k + 6) =

10. Simplify: 10(3m - 2) - 6(m - 5) =

Finding the Value of x

Understanding the Role of x

In algebra, **x** is commonly used as a variable representing an unknown number. The goal of solving an equation is to **isolate x** and determine its value

Solving for x in Different Types of Equations

1. One-Step Equations

These equations require just one operation to isolate x.

📌 **Example 1:** $x + 5 = 12$

👉 **Subtract** 5 from both sides:

(or transfer out the constant to the right side of the equation then change the sign or combine like terms)

$$x + 5 = 12$$
$$x = 12 - 5$$
$$x = 7$$

Checking:
$$7 + 5 = 12$$
$$12 = 12 \checkmark$$

📌 **Example 2:** $3x = 15$

👉 **Divide** both sides by 3:

$$\frac{3x}{3} = \frac{15}{3}$$
$$x = \frac{15}{3}$$
$$x = 5$$

Checking:
$$3(5) = 15$$
$$15 = 15 \checkmark$$

2. One-Step Equations

These equations require two operations to isolate x.

📌 **Example:** $2x + 3 = 11$

👉 **Step 1:** Subtract 3 from both sides

(or transfer out the constant to the right side of the equation then change the sign or combine like terms)

👉 **Step 2:** Divide by 2

$$2x + 3 = 11$$
$$2x = 11 - 3$$
$$2x = 8$$
$$x = \frac{8}{2}$$
$$x = 4$$

Checking:
$$2(4) + 3 = 8 + 3$$
$$11 = 11 \checkmark$$

3. Equations with Variables on Both Sides

📌 **Example:** $4x - 5 = 2x + 7$ **Checking:**

👉 **Step 1:** Move all x terms to one side by subtracting 2x

👉 **Step 2:** Add 5 to both sides

👉 **Step 3:** Divide by 2

$$4x - 5 = 2x + 7$$
$$4x - 2x = 7 + 5$$
$$2x = 12$$
$$x = \frac{12}{2}$$
$$x = 6$$

$$4(6) - 5 = 2(6) + 7$$
$$24 - 5 = 12 + 7$$
$$19 = 19 \quad \checkmark$$

4. Equations with Fractions

📌 **Example:** $3x + 2 = 5$ **Checking:**

👉 **Step 1:** Subtract 2 from both sides

$$3x + 2 = 5$$
$$3x = 5 - 2$$
$$3x = 3$$
$$x = \frac{3}{3}$$
$$x = 1$$

$$3(1) + 2 = 3 + 2$$
$$5 = 5 \quad \checkmark$$

Activity: Crack the Code: Solving for x!

Directions: Solve for x. Show your solution.

1. $x + 8 = 15$

2. $3x = 24$

3. $5x - 7 = 18$

4. $2x + 4 = 14$

5. $\frac{x}{4} + 3 = 7$

6. $7x - 2 = 5x + 10$

7. $\frac{2x}{3} = 10$

8. $4(x - 3) = 16$

Glossary

A

Algebra – A branch of mathematics that deals with symbols and the rules for manipulating them.
Algebraic Expression – A mathematical phrase that includes numbers, variables, and operations but does not have an equal sign.
Associative Property – A property stating that the grouping of numbers does not affect the result in addition and multiplication.

C

Coefficient – The numerical factor in a term with a variable (e.g., in 3x, the coefficient is 3).
Constant – A term in an algebraic expression that has a fixed value and does not contain a variable (e.g., in 5x + 7, the constant is 7).
Commutative Property – A property stating that the order of numbers does not affect the sum or product (e.g., a + b = b + a).

D

Distributive Property – A property stating that multiplication distributes over addition or subtraction: a(b + c) = ab + ac.
Division of Monomials – The process of dividing monomials by subtracting the exponents of like bases.

E

Equation – A mathematical statement that shows the equality of two expressions using an equal sign (=).
Exponent – A number that indicates how many times a base is multiplied by itself (e.g., in x^3, the exponent is 3).
Expression – A mathematical phrase that can include numbers, variables, and operations but does not have an equal sign.

F

Factorization – The process of breaking down an expression into its simplest multiplicative components.

I

Inequality – A mathematical statement that compares two values using symbols like <, >, ≤, or ≥.
Like Terms – Terms that have the same variables raised to the same exponents (e.g., 3x and 5x).

M

Monomial – An algebraic expression with only one term (e.g., $4x^2$).
Multiplication of Monomials – The process of multiplying monomials by adding their exponents when bases are the same.

P

Polynomial – An algebraic expression consisting of one or more terms, such as monomials, binomials, and trinomials.

S

Subtraction of Monomials – The process of subtracting like terms by subtracting their coefficients.
Substitution – The process of replacing a variable with a given number in an expression or equation.
Sum – The result of adding two or more numbers or terms.

T

Term – A single number, variable, or product of numbers and variables in an expression (e.g., $3x^2$ is a term in the expression $3x^2$ + 5x - 2).
Trinomial – A polynomial with three terms (e.g., x^2 + 2x + 3).

V

Variable – A symbol (usually a letter) that represents an unknown or changing value in an algebraic expression.

References

This book was developed using a combination of academic research, educational resources, and practical teaching methodologies to ensure clarity and effectiveness in learning algebraic expressions. Below are the key sources referenced and recommended for further reading.

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About the Author

Maria Charmine V. Madrilejos is a passionate mathematics educator dedicated to academic excellence and student empowerment. She earned her Bachelor of Secondary Education, Major in Mathematics from Cavite State University (2010–2014) and is currently pursuing a Master of Arts in Education (Mathematics) at the Philippine College of Health and Sciences, having already completed the academic requirements. Additionally, she holds a Computer Technician Certification (2009–2010), showcasing her expertise in integrating technology into education.

A licensed professional since May 23, 2015, Maria Charmine has been shaping young minds for over a decade. She began her teaching career at San Sebastian College-Recoletos de Cavite (2014–2016), where she designed K-12-aligned lesson plans and implemented technology-driven teaching strategies. In 2016, she joined Cavite National High School, where she continues to inspire students with innovative instructional methods. As a math coach, she has led students to numerous championship victories in local and regional competitions.

Beyond teaching, she is a dedicated advocate for student well-being and leadership. She previously served as President of the Cavite City Division Federation for Barkada Kontra Droga (BKD) from 2022 to 2023 and continues to be an active BKD adviser at Cavite National High School. Her commitment to promoting a drug-free environment and empowering students has earned her several accolades, including Most Outstanding BKD Teacher-Adviser 2024, Gawad Siklab Finalist 2024, and Division Finalist for Most Outstanding BKD Teacher-Adviser in 2021.

In 2024, her expertise in media and information literacy was nationally recognized when she was awarded Outstanding Media Information Literacy – Integrated Lesson Plan (Mathematics) by the National Council for Children's Television, a government agency in the Philippines responsible for promoting and ensuring child-friendly television content. It operates under the Department of Education (DepEd) and was established through Republic Act No. 8370, also known as the Children's Television Act of 1997.

She is also the author of the article *Strategies Used by Students of Mathematics in the 9th Grade to Solve Number-Pattern Problems*, which explores effective problem-solving approaches among high school learners.

With a strong background in mathematics education, student coaching, and advocacy, Maria Charmine continues to inspire and make a meaningful impact in both academics and student leadership.

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