

# West Virginia WVGSA Grade 6 Math Step by Step

*A Beginner Friendly Guide to Learning Math*

**Dr. A. Nazari**

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Published by View Math Education

ViewMath.com

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MATH ONE STEP AT A TIME

# Step-by-Step Math

Read • Follow the Steps • Practice • Master

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*Some math problems look complicated. But every problem, no matter how tricky, can be broken down into simple steps.*

*This book shows you exactly how. For every Grade 6 topic, you'll get a clear concept explanation followed by detailed, numbered steps that walk you through the solution process. No leaps, no shortcuts you don't understand yet — just one logical step after another.*

*Follow the steps, then try the practice problems on your own. Before long, those steps will become second nature.*



## Understand

*Get the idea  
behind the math*



## Follow Steps

*Step-by-step solutions  
you can trace*



## Do It Yourself

*Practice until  
it clicks*

# How Every Topic Works

*Each topic follows this pattern so you always know what to expect.*

1

## The Concept

*A short, clear explanation of the key idea. This is the “why” behind the math — the understanding that makes everything else click.*

2

## Step-by-Step Walkthrough

*A worked example broken into numbered steps. Each step shows what to do and why. Follow along with pencil and paper.*

3

## Tips & Shortcuts

*Quick tricks, memory aids, and common mistakes to avoid. These come from the owl mascot or a tip box.*

4

## Practice on Your Own

*Problems that start easy and get harder. Try to solve each one using the steps you just learned, then check your answers.*

### 💡 How to get the most out of each topic:

1. **Read the concept first.** Don't skip it.
2. **Cover the example solution.** Try each step before reading it.
3. **Do every practice problem.** Skipping problems means skipping learning.
4. **Check answers honestly.** When you get one wrong, redo it before moving on.

# What You'll Need

*Gather these supplies before you start.*

## Essentials

- ✓ **Pencils** — at least two sharpened pencils.
- ✓ **Eraser** — mistakes are part of learning.
- ✓ **Scratch paper** — for showing your work.
- ✓ **Ruler** — for geometry and number lines.

## Helpful Extras

- ✓ **Colored pencils** — for graphs, diagrams, and the coordinate plane.
- ✓ **Calculator** — check your arithmetic after solving by hand.
- ✓ **Highlighter** — mark key formulas and vocabulary.
- ✓ **Notebook** — keep your work organized in one place.

### 💡 Study Space Tips

- Find a quiet spot with good light.
- Put your phone out of reach.
- Set a timer for 20–30 minutes, then take a short break.
- Keep a water bottle nearby.

**i** You don't need everything at once. Pencil, eraser, and this book are enough to get started.

# Formula Reference Sheet

## Area Formulas

**Rectangle**  $A = l \times w$

**Parallelogram**  $A = b \times h$

**Triangle**  $A = \frac{1}{2} \times b \times h$

**Trapezoid**  $A = \frac{1}{2}(b_1 + b_2) \times h$

## Volume

**Rectangular Prism**  $V = l \times w \times h$

**Prism**

## Surface Area

Find the area of each face, then add them all up.

**Rectangular Prism:**

$$SA = 2lw + 2lh + 2wh$$

## Order of Operations

**P** Parentheses first

**E** Exponents

**M/D** Multiply & Divide (left to right)

**A/S** Add & Subtract (left to right)

## Ratios & Percents

**Ratio:**  $a : b$  or  $\frac{a}{b}$

**Unit rate:** amount per 1 unit

**Percent:** a ratio out of 100

$$\text{Part} = \text{Percent} \times \text{Whole}$$

## Integers & Absolute Value

**Integers:**

$\dots, -3, -2, -1, 0, 1, 2, 3, \dots$

$$|-5| = 5 \quad |5| = 5$$

**Absolute value** = distance from 0

## Expressions & Equations

**Exponent:**  $3^4 = 3 \times 3 \times 3 \times 3 = 81$

**Variable:** a letter that stands for a number

**Equation:** two expressions joined by =

**Inequality:** uses  $<$ ,  $>$ ,  $\leq$ ,  $\geq$

## Coordinate Plane

**Ordered pair:**  $(x, y)$

**x-axis:** horizontal    **y-axis:** vertical

**Origin:**  $(0, 0)$

**Four quadrants** (I, II, III, IV)

## Statistics

**Mean:** sum of values  $\div$  count

**Median:** middle value (sorted)

**Range:** max  $-$  min

# Key Math Vocabulary

Words you'll see again and again in Grade 6 math.

## Ratios & Rates

**Ratio** — A comparison of two quantities.

**Equivalent ratios** — Ratios that represent the same relationship.

**Rate** — A ratio comparing two different units.

**Unit rate** — A rate with a denominator of 1.

**Percent** — A ratio that compares a number to 100.

## The Number System

**Integer** — A whole number or its opposite (...-2, -1, 0, 1, 2 ...).

**Rational number** — Any number that can be written as a fraction.

**Absolute value** — The distance of a number from zero on a number line.

**Opposite** — Two numbers the same distance from zero on opposite sides.

**Reciprocal** — Flip the numerator and denominator: the reciprocal of  $\frac{2}{3}$  is  $\frac{3}{2}$ .

**GCF** — Greatest Common Factor — the largest factor shared by two numbers.

**LCM** — Least Common Multiple — the smallest multiple shared by two numbers.

## Expressions & Equations

**Variable** — A letter that represents an unknown number.

**Coefficient** — The number multiplied by a variable (6 in  $6x$ ).

**Constant** — A fixed number with no variable (+3 in  $2x + 3$ ).

**Expression** — Numbers, variables, and operations combined (no = sign).

**Equation** — A statement that two expressions are equal.

**Inequality** — A statement that uses  $<$ ,  $>$ ,  $\leq$ , or  $\geq$ .

**Exponent** — Tells how many times to multiply a base by itself.

**Distributive property** —  $a(b + c) = ab + ac$ .

## Geometry

**Area** — The space inside a flat shape, in square units.

**Base** — The bottom side of a shape (or any side used for the formula).

**Height** — The perpendicular distance from the base to the top.

**Volume** — The space inside a 3-D shape, in cubic units.

**Surface area** — The total area of all faces of a 3-D shape.

**Net** — A flat pattern that folds into a 3-D shape.

**Face** — A flat surface of a solid figure.

**Edge** — The line segment where two faces meet.

**Vertex** — A point where edges meet.

### Coordinate Plane

**Ordered pair** — A pair  $(x, y)$  that names a location on the plane.

**Origin** — The point  $(0, 0)$  where the axes cross.

**Quadrant** — One of the four sections of the coordinate plane.

**x-axis** — The horizontal number line.

**y-axis** — The vertical number line.

### Statistics & Data

**Mean** — The average — sum of values divided by the count.

**Median** — The middle value when data is in order.

**Range** — The difference between the greatest and least values.

**Dot plot** — A number line with dots showing data frequency.

**Histogram** — A bar graph that shows data grouped in intervals.

**Box plot** — A diagram showing the five-number summary of data.

**IQR** — Interquartile Range — the spread of the middle 50% of data.

**MAD** — Mean Absolute Deviation — average distance from the mean.



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## ★ Table of Contents ★

*Here's what we'll explore together!*

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*Let's learn and have fun!*





CHAPTER

1

# Ratios, Rates, and Percents

## ★ What's Inside ★

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## ★ 1.1 What Is a Ratio? ★

### What Is a Ratio?

#### 🎯 Learning Goals

- Understand that a ratio compares two quantities
- Write ratios in three different forms
- Identify and describe ratios in everyday situations

#### 🌍 Ratios Are Everywhere

Imagine you're making a fruit smoothie. The recipe says to use 2 cups of strawberries for every 3 cups of banana. That "2 for every 3" is a **ratio** — and you use ratios all the time, whether you realize it or not!

#### 🎓 What Is a Ratio?

A **ratio** is a comparison of two quantities. It tells you how much of one thing there is compared to another.

For example, if a bag has 5 red marbles and 3 blue marbles, you can compare them with a ratio:

- The ratio of red to blue is 5 to 3.
- The ratio of blue to red is 3 to 5.

**Order matters! The ratio 5 to 3 is NOT the same as 3 to 5.**



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“Think of a ratio like a recipe — the order of the ingredients matters! “2 cups flour to 1 cup sugar” is very different from “1 cup flour to 2 cups sugar.””

### Three Ways to Write a Ratio

You can write the same ratio in three different forms:

| Words  | Colon | Fraction      |
|--------|-------|---------------|
| 5 to 3 | 5 : 3 | $\frac{5}{3}$ |

All three mean the same thing: for every 5 of the first quantity, there are 3 of the second.



**TIP**

When you write a ratio as a fraction, it does NOT mean “5 divided by 3.” It’s still a comparison. The context tells you it’s a ratio, not a division problem.

### Writing Ratios from a Picture

A parking lot has 4 trucks and 7 cars.

Write the ratio of trucks to cars in three ways.

**Solution:**

1. Identify the two quantities: trucks = 4, cars = 7.
2. Write the ratio in order — trucks first, cars second.

| Words  | Colon | Fraction      |
|--------|-------|---------------|
| 4 to 7 | 4 : 7 | $\frac{4}{7}$ |



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What about the ratio of cars to trucks?

✓ **Answer:** 7 to 4, 7 : 4,  $\frac{7}{4}$

### Part-to-Part vs. Part-to-Whole

A classroom has 12 boys and 18 girls.

**Part-to-Part:**

- Boys to girls: 12 : 18
- Girls to boys: 18 : 12

**Part-to-Whole:**

- Total students:  $12 + 18 = 30$
- Boys to total: 12 : 30
- Girls to total: 18 : 30

**Part-to-part** ratios compare one part of a group to another part.

**Part-to-whole** ratios compare one part to the entire group.

Always read the problem carefully to know which type is being asked for!

*The same situation can give you many different ratios depending on what you're comparing.*

### Identifying Ratios in Real Life

A pizza shop sells 3 cheese pizzas for every 2 pepperoni pizzas. On Saturday they sold 15 cheese pizzas. How many pepperoni pizzas did they sell?

**Solution:**



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1. The ratio of cheese to pepperoni is 3 : 2.
2. They sold 15 cheese pizzas. That's  $15 \div 3 = 5$  groups of 3.
3. So there must be 5 groups of 2 pepperoni pizzas:  $5 \times 2 = 10$ .

✓ **Answer:** They sold 10 pepperoni pizzas.

 **Watch the Order!**

If a problem says "the ratio of cats to dogs is 3 : 5," that means:

- Cats = 3, Dogs = 5 ✓
- Dogs = 3, Cats = 5 **WRONG!**

Always match the first number to the first thing named, and the second number to the second thing named.



 **What Is a Ratio? — Practice** **Write the Ratio**

A bag contains 6 apples and 10 oranges. Write each ratio in all three forms (words, colon, fraction).

1. The ratio of apples to oranges.
2. The ratio of oranges to apples.
3. The ratio of apples to total fruit.

**Read and Write Ratios**

4. A recipe uses 3 eggs and 5 cups of flour. What is the ratio of eggs to flour?
5. In a class, there are 14 students who walk to school and 8 who ride the bus. Write the ratio of bus riders to walkers as a fraction.
6. A team won 9 games and lost 6 games. Write the ratio of wins to total games played.

**Apply It**

7. A store sells phones and tablets in a ratio of 5 : 2. If the store sold 20 phones, how many tablets did it sell?
8. At a concert, the ratio of adults to children is 7 : 3. If there are 21 adults, how many children are there?



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*You just learned ratios — one of  
the most useful ideas in all of math!*

PREVIEW



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CHAPTER

2

## *Expressions and Equations*

### ★ *What's Inside* ★

|                                                           |           |
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## ★ 2.1 Exponents and Order of Operations ★

### 🎯 Learning Goals

- Write repeated multiplication using exponents
- Evaluate expressions with whole-number exponents
- Apply the order of operations (PEMDAS)

### 🎓 Exponents

An **exponent** tells you how many times to multiply the base by itself.

$$3^4 = 3 \times 3 \times 3 \times 3 = 81$$

- 3 is the **base** — the number being multiplied.
- 4 is the **exponent** — how many times.
- We say “3 to the fourth power.”

Any number to the power of 1 is itself:  $7^1 = 7$ . Any number to the power of 0 is 1:  $5^0 = 1$ .

### ✏️ Order of Operations (PEMDAS)

Evaluate:  $5 + 2 \times 3^2$

**Solution:**

1. **Exponents first:**  $3^2 = 9$ .
2. **Multiply:**  $2 \times 9 = 18$ .
3. **Add:**  $5 + 18 = 23$ .



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✓ **Answer:** 23



“PEMDAS: *P*arentheses, *E*xponents, *M*ultiply/*D*ivide (left to right), *A*dd/*S*ubtract (left to right).”



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 *Exponents and Order of Operations Practice* *Write Using Exponents*

1.  $7 \times 7 \times 7$

2.  $2 \times 2 \times 2 \times 2 \times 2$

*Evaluate*

3.  $4^3$

4.  $10^2 - 6 \times 5$

*Apply PEMDAS*

5.  $(8 + 2)^2 \div 5$

6. Maria says  $3 + 4 \times 2 = 14$ . Jake says the answer is 11. Who is correct?Find more at  
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# *Answer Key*



## Answer Key

Try each problem on your own first, then check your work here.

### Chapter 1

#### > Section 1.1

1 6 to 10,  $6 : 10$ ,  $\frac{6}{10}$

2 10 to 6,  $10 : 6$ ,  $\frac{10}{6}$

3 6 to 16,  $6 : 16$ ,  $\frac{6}{16}$

4  $3 : 5$

5  $\frac{8}{14}$

6  $9 : 15$

7 8 tablets

8 9 children

#### Explanations

1 Apples first, then oranges.

2 Oranges first, then apples.

3  $Total = 6 + 10 = 16$ . This is a part-to-whole ratio.

6  $Total\ games = 9 + 6 = 15$ .

7  $20 \div 5 = 4$  groups.  $4 \times 2 = 8$  tablets.



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8  $21 \div 7 = 3$  groups.  $3 \times 3 = 9$  children.

## Chapter 2

### > Section 2.1

1  $7^3$

2  $2^5$

3 64

4 70

5 20

6 Jake

### Explanations

1 The base 7 is multiplied 3 times.

2 The base 2 is multiplied 5 times.

3  $4 \times 4 = 16$ , then  $16 \times 4 = 64$ .

4 Exponent:  $10^2 = 100$ . Multiply:  $6 \times 5 = 30$ . Subtract:  $100 - 30 = 70$ .

5 Parentheses:  $8 + 2 = 10$ . Exponent:  $10^2 = 100$ . Divide:  $100 \div 5 = 20$ .

6 Multiply first:  $4 \times 2 = 8$ . Then add:  $3 + 8 = 11$ . Maria added before multiplying.



**Well done checking your answers!**

*Keep practicing to strengthen your skills.*



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THANK YOU

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