

Virginia SOL Grade 9 Math Made Easy

Study Guide with Key Concepts, Review & Practice

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YOUR ALGEBRA 1 STUDY GUIDE

Math Made Easy

Key Concepts • Worked Examples • Practice with Answers

Algebra 1 is the foundation of all higher mathematics. This study guide covers every key concept you need — from real numbers and exponents through linear and quadratic functions, systems of equations, polynomials, exponential models, and data analysis.

Each topic is explained simply, backed by worked examples, and followed by focused practice with a full answer key. Use it to learn new ideas, review before a test, or fill in gaps any time.

 **37 Topics Across 9 Chapters**

Real numbers, linear equations, functions, systems, polynomials, quadratics, exponentials, and statistics — every Algebra 1 standard.

 **Clear Explanations & Worked Examples**

Every concept is broken down step by step with real examples so you understand the why, not just the how.

 **Practice with Every Topic**

Short, focused problem sets after each lesson let you test your understanding immediately.

 **Complete Answer Key**

Every practice problem has a detailed answer and explanation in the back of the book.

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How to Use This Study Guide

Four steps to master every topic.

1

Read the Concept Box

Each topic starts with a clear explanation of the key idea or formula. Read it carefully — this is the foundation for everything that follows. Underline anything you want to remember.

2

Study the Worked Examples

Worked examples show you exactly how to apply the concept step by step. Cover the solution, try it yourself first, then compare. That one extra effort makes the method stick.

3

Solve the Practice Problems

After each explanation, a short set of problems tests your understanding. Work them on paper — writing out every step is the fastest way to learn.

4

Check Answers and Fix Mistakes

Flip to the Answer Key and mark your work. For any mistake, re-read the explanation and try again. Mistakes show you exactly where to focus next.



Study Plan Ideas

- **Daily:** One topic per day (15–25 minutes).
- **Weekly:** Review the week's concepts each Friday.
- **Before a test:** Re-do any problems you got wrong.



Tips for Parents & Teachers

- Use the guide alongside classroom lessons for extra support.
- Review mistakes together — focus on understanding, not just answers.
- Praise effort and persistence over speed or scores.

Algebra Quick Reference

Key formulas and facts for Algebra 1 – tear out or bookmark this page.

Exponent Rules

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

$$\frac{a^m}{a^n} = a^{m-n}$$

$$(a^m)^n = a^{mn}$$

$$a^0 = 1 \quad (a \neq 0)$$

$$a^{-n} = \frac{1}{a^n}$$

Systems of Equations

Substitution: Solve one equation for a variable, plug into the other.

Elimination: Add/subtract equations to cancel a variable.

One solution: lines cross

No solution: parallel lines

Infinite: same line

Slope & Linear Equations

$$\text{Slope: } m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{rise}}{\text{run}}$$

$$\text{Slope-intercept: } y = mx + b$$

$$\text{Point-slope: } y - y_1 = m(x - x_1)$$

$$\text{Standard: } Ax + By = C$$

Parallel: same slope

$$\text{Perpendicular: } m_1 \cdot m_2 = -1$$

Functions

A function maps each input to exactly one output.

$f(x)$ means "the output for input x "

Domain: set of all inputs

Range: set of all outputs

Vertical line test: if a vertical line hits the graph twice, it's not a function.

Algebra Quick Reference

Continued

Factoring Polynomials

GCF first, always.

$$a^2 - b^2 = (a + b)(a - b)$$

$$a^2 + 2ab + b^2 = (a + b)^2$$

$$a^2 - 2ab + b^2 = (a - b)^2$$

$$x^2 + bx + c = (x + p)(x + q)$$

where $p + q = b$ and $pq = c$

Quadratic Functions

Standard: $f(x) = ax^2 + bx + c$

Vertex: $f(x) = a(x - h)^2 + k$

Axis of symmetry: $x = -\frac{b}{2a}$

Vertex: $\left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$

$a > 0$: opens up $a < 0$: opens down

Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Discriminant: $\Delta = b^2 - 4ac$

$\Delta > 0$: two real solutions

$\Delta = 0$: one real solution

$\Delta < 0$: no real solutions

Exponential Functions

$$f(x) = a \cdot b^x$$

a = initial value (y-intercept)

$b > 1$: growth $0 < b < 1$: decay

Growth rate: $r = b - 1$






Arithmetic seq: $a_n = a_1 + (n - 1)d$

Geometric seq: $a_n = a_1 \cdot r^{n-1}$

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CHAPTER

1

Foundations of Algebra

★ What's Inside ★

1.1 Classifying Real Numbers	2
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★ 1.1 Classifying Real Numbers ★

🎯 Learning Goals

- Classify numbers into all applicable real number subsets
- Describe how the number subsets nest inside each other

🎓 The Real Number Subsets

Every number belongs to one or more subsets of the **real numbers**:

- **Natural numbers:** $1, 2, 3, \dots$ (counting numbers)
- **Whole numbers:** $0, 1, 2, 3, \dots$ (naturals plus zero)
- **Integers:** $\dots, -2, -1, 0, 1, 2, \dots$ (whole numbers and negatives)
- **Rational numbers:** any $\frac{a}{b}$ where a, b are integers and $b \neq 0$
- **Irrational numbers:** decimals that never end and never repeat ($\sqrt{2}, \pi$)

These sets nest like rings in a **Venn diagram**:

$\text{Natural} \subset \text{Whole} \subset \text{Integer} \subset \text{Rational} \subset \text{Real}$

Irrational numbers sit beside Rational, inside Real. Every real number is either rational **or** irrational—never both.

✏️ Classify Into All Subsets

Place each number in **every** subset that applies.

1. 7 : Natural, Whole, Integer, Rational, Real
2. 0 : Whole, Integer, Rational ($\frac{0}{1}$), Real
3. -3 : Integer, Rational ($\frac{-3}{1}$), Real
4. $\frac{2}{3} = 0.\bar{6}$: Rational (repeats), Real
5. $0.75 = \frac{3}{4}$: Rational (terminates), Real



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6. $\pi = 3.14159\dots$: Irrational, Real

7. $\sqrt{3} = 1.732\dots$: Irrational, Real

Rational Numbers

- Written as $\frac{a}{b}$, $b \neq 0$
- Decimals terminate or repeat
- Examples: $\frac{3}{4}$, -2 , $0.\bar{6}$

Irrational Numbers

- Cannot be written as $\frac{a}{b}$
- Decimals never terminate or repeat
- Examples: $\sqrt{2}$, π , $\sqrt{10}$



“ Every integer is rational! Write it over 1: $-5 = \frac{-5}{1}$, $0 = \frac{0}{1}$. ”

Classifying Real Numbers

1. Classify -7 into all applicable subsets.
2. Classify $\sqrt{3}$ into all applicable subsets.
3. Classify 0.75 into all applicable subsets.
4. List all subsets for $\sqrt{25}$.
5. Every whole number is also a rational number.

True False



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CHAPTER

2

Introduction to Functions

★ What's Inside ★

2.1 What Is a Function?	5
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★ 2.1 What Is a Function? ★

🎯 Learning Goals

- Decide whether a relation is a function using multiple representations
- Represent relations as ordered pairs, tables, mapping diagrams, and graphs

🎓 What Is a Function?

A **relation** is any set of ordered pairs (x, y) .

A **function** is a relation where every input (x) gives exactly one output (y) . No x -value may repeat with a different y -value.

Ways to represent a relation:

- **Set of ordered pairs:** $\{(1, 4), (2, 5), (3, 6)\}$
- **Table:** inputs in one row, outputs in another
- **Mapping diagram:** arrows from each input to its output
- **Graph:** points or curves on a coordinate plane

A relation is **discrete** if it has separate, countable points. A relation is **continuous** if it has a connected line or curve.

✏️ Checking Multiple Representations

Is the relation $\{(1, 5), (2, 8), (3, 10), (1, 7)\}$ a function?

Ordered pairs: $x = 1$ appears twice with outputs 5 and 7.

Mapping diagram: 1 has two arrows ($1 \rightarrow 5$ and $1 \rightarrow 7$).

One input gives two outputs, so this is **not a function**.



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The Vertical Line Test

- 1 Draw or look at the graph of the relation.
- 2 Slide a vertical line across the graph from left to right.
- 3 If the line ever hits **two or more points**, it is **not** a function.
- 4 If every vertical line hits at most one point, it **is** a function.



“ A function is like a rule: one question, one answer. In a mapping diagram, each input gets exactly one arrow! ”



TIP

Two different inputs **can** share the same output and still be a function. Only repeated inputs with different outputs break the rule.

What Is a Function?

1. Is $\{(2, 4), (3, 6), (4, 8), (5, 10)\}$ a function?
2. Is $\{(1, 3), (2, 5), (1, 7)\}$ a function?
3. A mapping diagram shows $3 \rightarrow 9$, $4 \rightarrow 16$, $5 \rightarrow 9$. Is it a function?
4. Is the relation $\{(1, 2), (3, 4), (5, 6)\}$ discrete or continuous?
5. Every function is a relation.

True False



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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 Integer, Rational, Real

2 Irrational, Real

3 Rational, Real

4 Nat, Whole, Int, Rat, Real

5 True

Explanations

1 -7 is negative, so not natural or whole. It is an integer. Since $-7 = \frac{-7}{1}$, it is also rational.

2 3 is not a perfect square. $\sqrt{3}$ is a non-repeating, non-terminating decimal—irrational and real.

3 $0.75 = \frac{3}{4}$, a terminating decimal. Rational and real, but not an integer.

4 $\sqrt{25} = 5$. Since 5 is a counting number, it belongs to every subset except irrational.



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 **Chapter 2****> Section 2.1****1** Yes**2** No**3** Yes**4** Discrete**5** True **Explanations**

1 Each input appears only once. Every x -value maps to exactly one y -value.

2 $x = 1$ maps to both 3 and 7. One input gives two outputs.

3 Each input maps to one output. Two inputs may share an output—that is still a function.

4 The relation is a set of separate points. Discrete means individual, countable points.



Well done checking your answers!

Keep practicing to strengthen your skills.



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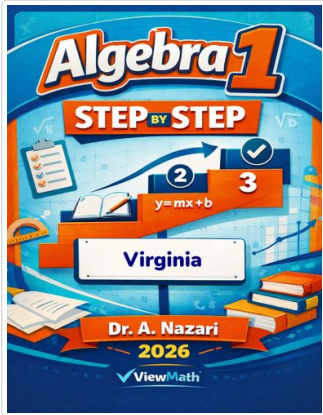


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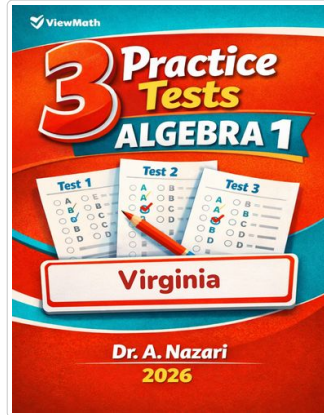


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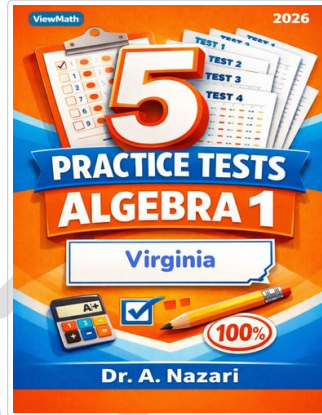
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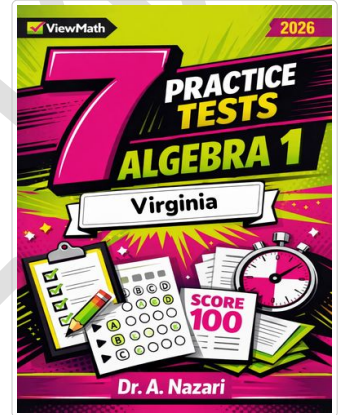
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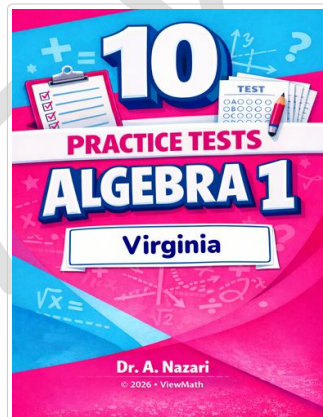
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5 Practice Tests



7 Practice Tests



10 Practice Tests



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