

Pennsylvania Keystone Grade 9 Math Step by Step

A Beginner Friendly Guide to Learning Math

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CHAPTER

1

Foundations of Algebra

★ What's Inside ★

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★ 1.1 Classifying Real Numbers ★

🎯 Learning Goals

- Classify numbers as natural, whole, integer, rational, or irrational
- Know that rational decimals terminate or repeat

🎓 Number Subsets

Every number you use belongs to at least one of these groups:

- **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 number that equals $\frac{a}{b}$ 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. $\text{Natural} \subset \text{Whole} \subset \text{Integer} \subset \text{Rational}$. Rational and Irrational together make the **real numbers**.

✏️ Classifying Numbers

Place each number in all groups that fit.

1. 7 — Natural, Whole, Integer, Rational ($\frac{7}{1}$), Real
2. 0 — Whole, Integer, Rational ($\frac{0}{1}$), Real
3. -3 — Integer, Rational ($\frac{-3}{1}$), Real
4. $\frac{2}{5} = 0.4$ — Rational (terminates), Real
5. $\sqrt{3} = 1.7320\dots$ — Irrational (never repeats), Real



“ Every integer is rational! Just write it over 1. For example, $-5 = \frac{-5}{1}$. ”



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Rational Numbers

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

Irrational Numbers

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

 **Classifying Real Numbers** 

1. Classify -12 : natural, whole, integer, rational, or irrational?
2. Is $\sqrt{25}$ rational or irrational?
3. Is $\sqrt{7}$ rational or irrational?
4. Write $0.\overline{3}$ as a fraction.
5. All whole numbers are integers.

True False 

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CHAPTER

2

Introduction to Functions

★ *What's Inside* ★

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★ 2.1 What Is a Function? ★

🎯 Learning Goals

- Decide whether a relation is a function
- Use the vertical line test on graphs

🎓 What Is a Function?

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

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

Think of a vending machine. Press button **A3**, you always get the same snack. If one button gave a random item each time, that machine would not be a function!

Ways to show a relation: ordered pairs, table, graph, mapping diagram, or equation.

✏️ Checking a Table

Is this relation a function?

x	1	2	3	1
y	5	8	10	7

The input $x = 1$ maps to both 5 and 7. One input gives two outputs, so this is **not a function**.



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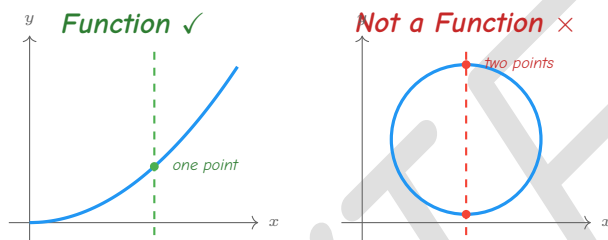


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The Vertical Line Test

- 1 Draw or look at the graph of the relation.
- 2 Imagine sliding a vertical line across the graph from left to right.
- 3 If the vertical line ever hits the graph in **two or more points** at the same time, 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. If one input gives two answers, it breaks the rule! ”



TIP

In a mapping diagram, each input arrow must point to exactly one output. An input with two arrows means it is not a function.

What Is a Function?

1. A relation has the pairs $(2, 4)$, $(3, 6)$, $(4, 8)$, $(5, 10)$. Is it a function?
2. A relation has the pairs $(1, 3)$, $(2, 5)$, $(1, 7)$. Is it a function?
3. A circle is drawn on a coordinate plane. Does it pass the vertical line test?
4. Every function is a relation. True False
5. A mapping diagram shows $3 \rightarrow 9$, $4 \rightarrow 16$, $5 \rightarrow 25$. Is it a function?



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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

2 Rational

3 Irrational

4 $\frac{1}{3}$

5 True

Explanations

1 -12 is negative, so not natural or whole. It is an integer. Since $-12 = \frac{-12}{1}$, it is also rational.

2 $\sqrt{25} = 5$, a whole number. Every integer is rational: $5 = \frac{5}{1}$.

3 7 is not a perfect square. So $\sqrt{7}$ is a non-repeating, non-terminating decimal.

4 $0.\overline{3} = 0.333\dots$ The repeating decimal equals $\frac{1}{3}$, which is rational.

Chapter 2



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[> Section 2.1](#)

1 Yes

2 No

3 No

4 True

5 Yes

 Explanations

1 Each input appears only once. Every x -value maps to exactly one y -value, so it is a function.

2 The input $x = 1$ maps to both 3 and 7. One input gives two outputs, so it is not a function.

3 A vertical line through the middle of a circle hits it at two points. So a circle is not a function.

5 Each input maps to exactly one output. No input is repeated, so it is a function.



Well done checking your answers!

Keep practicing to strengthen your skills.



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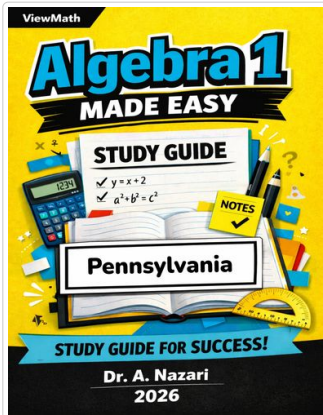


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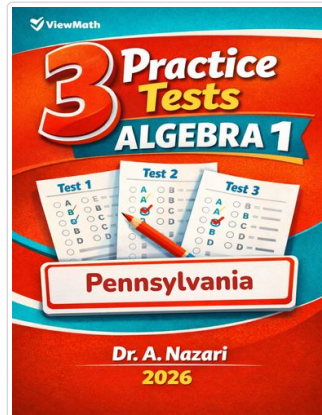
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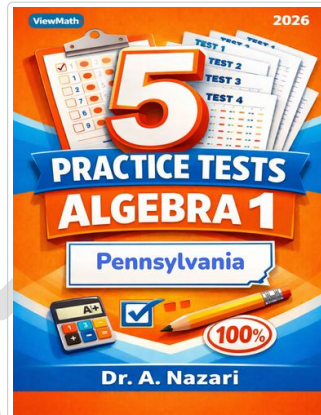
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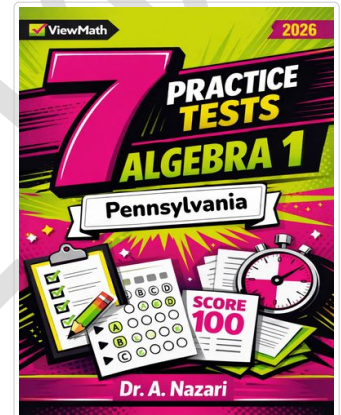
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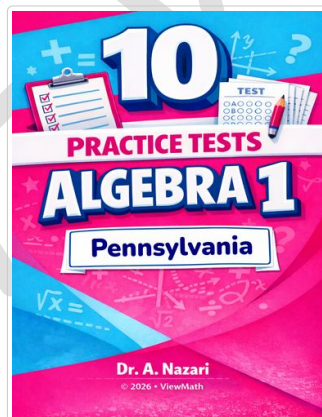
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7 Practice Tests



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10 Practice Tests



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