

Illinois IAR Grade 8 Math Workbook

Practice Problems & Exercises with Answer Key

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Published by View Math Education

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PRACTICE MAKES PERMANENT

Grade 8 Math Workbook

Practice Problems • Word Problems • Complete Answer Key

Grade 8 math marks the bridge between middle school arithmetic and high-school algebra. This workbook gives you focused practice on every topic — from irrational numbers and exponents to linear equations, functions, geometry transformations, and data analysis.

Work through each section at your own pace, show every step, then check the answer key in the back. Mistakes are not failures — they are the moments where real learning happens.

 32 Topics Across 6 Chapters

Irrational numbers, scientific notation, linear equations, functions, geometry, and data analysis — every Grade 8 standard.

 Progressive Difficulty

Each topic builds from foundational recall to multi-step reasoning.

 Real-World Applications

Apply your skills to science, engineering, finance, and everyday problem solving.

 Complete Answer Key

Every problem has a detailed answer in the back. Check your work, identify mistakes, and strengthen weak spots.



How to Use This Workbook

Four steps to get the most out of every section.

1

Read the Quick Review

Every topic opens with a brief reminder of the key idea or formula. If something feels unfamiliar, pair this workbook with the matching study guide for a full explanation before diving into problems.

2

Work the Problems in Order

Problems are arranged from straightforward to challenging. Starting with the easier ones builds momentum and warms up your thinking before the tougher questions arrive.

3

Show Every Step

Write out your reasoning on scratch paper. When an answer is wrong, your written work reveals exactly where the logic broke down — and that is the fastest way to fix it.

4

Check Answers and Reflect

After finishing a section, flip to the Answer Key and mark every problem. For each mistake, figure out why it happened. Then try a similar problem again until it clicks.



Suggested Weekly Routine

- **Mon–Thu:** One topic per day (20–30 minutes).
- **Friday:** Review the week's mistakes and redo missed problems.
- **Weekend:** Rest — or tackle a challenge problem!



Tips for Parents & Teachers

- Let your student work independently first.
- Review mistakes together — focus on why, not just the answer.
- Praise effort and persistence, not just correct answers.

 Pair It Up

This workbook focuses on practice. For detailed explanations, worked examples, and teaching notes, use it alongside the Grade 8 Math Study Guide or your classroom textbook.

PREVIEW



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What You'll Need

Gather these supplies before you start.



Pencils

Mechanical or sharpened



Eraser

Good erasers save time



Graph Paper

For graphing & coordinates



Ruler & Protractor

For geometry sections



Scientific Calculator

For checking, not shortcuts



A Focused Mindset

Persistence is the key

A Note for Parents & Teachers

- This workbook pairs perfectly with the **Grade 8 Math Study Guide**. Use the Study Guide to learn concepts, then this workbook for focused practice.
- Topics follow the same order as the Study Guide for easy cross-reference.
- Keep sessions to 20–30 minutes for best focus and retention.
- Encourage students to show all work — the process matters as much as the answer.
- Celebrate progress. Even a few problems each day builds lasting math confidence.

Math Symbols & Vocabulary

A quick reference you can come back to any time.

X¹ Key Symbols & Notation

Symbol	Name	What It Means	
a^n	Exponent	a multiplied by itself n times.	$2^3 = 8$
$\sqrt{\quad}$	Square Root	The number that, multiplied by itself, gives the original.	$\sqrt{49} = 7$
$\sqrt[3]{\quad}$	Cube Root	The number whose cube equals the original.	$\sqrt[3]{27} = 3$
$ x $	Absolute Value	Distance from zero on the number line.	$ -5 = 5$
$\approx$	Approximately Equal	Close in value but not exact.	$\pi \approx 3.14$
$\neq$	Not Equal To	The two sides are different.	$3 \neq 5$
$\leq, \geq$	Less/Greater or Equal	Includes the boundary value.	$x \leq 10$
$f(x)$	Function Notation	The output of function f for input x .	$f(3) = 7$

Key Vocabulary for Grade 8

- **Rational number** — can be written as $\frac{a}{b}$
- **Irrational number** — non-repeating, non-terminating decimal
- **Scientific notation** — $a \times 10^n$ form
- **Slope** — steepness of a line ($\frac{\text{rise}}{\text{run}}$)
- **y-intercept** — where a line crosses the y-axis
- **System of equations** — two or more equations together
- **Function** — each input maps to exactly one output
- **Linear** — constant rate of change; a straight line
- **Nonlinear** — rate of change varies; curved graph
- **Transformation** — move, flip, rotate, or resize a figure
- **Congruent** — same shape and size
- **Similar** — same shape, different size (proportional)
- **Hypotenuse** — longest side of a right triangle
- **Scatter plot** — graph showing data point pairs

Useful Number Facts

Fraction	Decimal	Percent	
$\frac{1}{2} = 0.5 = 50\%$	$\frac{1}{3} \approx 0.333 = 33.\bar{3}\%$	$\frac{1}{4} = 0.25 = 25\%$	
$\frac{1}{5} = 0.2 = 20\%$	$\frac{1}{8} = 0.125 = 12.5\%$	$\frac{3}{4} = 0.75 = 75\%$	
$\pi \approx 3.14159$	$\sqrt{2} \approx 1.414$	$\sqrt{3} \approx 1.732$	$\sqrt{5} \approx 2.236$



Grade 8 Formula Reference

Keep this page handy — you may use it during your practice tests!

Exponent Rules

$$a^m \cdot a^n = a^{m+n} \quad (a^m)^n = a^{mn} \quad (ab)^n = a^n \cdot b^n$$
$$\frac{a^m}{a^n} = a^{m-n} \quad a^0 = 1 \quad (a \neq 0) \quad a^{-n} = \frac{1}{a^n}$$

Lines & Linear Equations

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

m = slope b = y -intercept

Slope-intercept: $y = mx + b$

Parallel lines: same slope

Proportional: $y = mx$

Proportional: passes through origin

Scientific Notation

$a \times 10^n$ where $1 \leq |a| < 10$

Multiply: add exponents

Divide: subtract exponents

Roots & Number Sense

Perfect squares: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144

Perfect cubes: 1, 8, 27, 64, 125 $\sqrt{2} \approx 1.414$ $\sqrt{3} \approx 1.732$ $\pi \approx 3.14159$

Pythagorean Theorem & Distance

$a^2 + b^2 = c^2$ c = hypotenuse (longest side of a right triangle) **Distance:** $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Volume Formulas

Cylinder $V = \pi r^2 h$ **Cone** $V = \frac{1}{3} \pi r^2 h$ **Sphere** $V = \frac{4}{3} \pi r^3$

Angle Relationships

Triangle angle sum: 180°

Exterior angle = sum of two remote interior angles

Parallel lines + transversal: Alternate interior angles are equal • Co-interior angles sum to 180°

Functions

Each input $\rightarrow$ exactly one output **Vertical line test:** if any vertical line hits graph more than once $\Rightarrow$ not a function

Linear: constant rate of change ($y = mx + b$)

Nonlinear: rate of change varies

Transformations

Translation: slide

Reflection: flip

Rotation: turn

Dilation: resize

Congruent = same shape & size

Similar = same shape, proportional size



Tip: Bookmark this page! Review it before each test so these formulas become second nature.



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My Progress Log

Track your work through every chapter and topic.

This book belongs to: _____

 Chapter 1: Irrational Numbers

Done ☐ Score: _____ / _____

 Chapter 2: Powers, Roots, & Scientific Notation

Done ☐ Score: _____ / _____

 Chapter 3: Lines and Linear Equations

Done ☐ Score: _____ / _____

 Chapter 4: Functions

Done ☐ Score: _____ / _____

 Chapter 5: Geometry

Done ☐ Score: _____ / _____

 Chapter 6: Data and Relationships

Done ☐ Score: _____ / _____

🎯 My Goal

I want to finish _____ topics each week.

Target date:



★ Table of Contents ★

Here's what we'll explore together!

★ 1	<i>Irrational Numbers</i>	2
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Let's learn and have fun!



CHAPTER

1

Irrational Numbers

★ *What's Inside* ★

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★ 1.1 Rational and Irrational Numbers ★

Rational and Irrational Numbers

Quick Review: Rational vs. Irrational Numbers

A **rational number** can be written as $\frac{a}{b}$ where a and b are integers and $b \neq 0$. An **irrational number** cannot be written as a fraction of two integers.

- **Terminates:** $0.75 = \frac{3}{4} \rightarrow$ rational
- **Repeats:** $0.\overline{3} = \frac{1}{3} \rightarrow$ rational
- **Never terminates or repeats:** $\sqrt{2} = 1.41421 \dots \rightarrow$ irrational

Quick test: Can you write it as $\frac{a}{b}$? Yes $\rightarrow$ rational. No $\rightarrow$ irrational.

Remember: Every integer is rational! For example, $-3 = \frac{-3}{1}$.

Warm-Up

Classify Each Number

Write **Rational** or **Irrational** for each number.

1. $\frac{5}{8}$ _____

4. -7 _____

2. $\sqrt{16}$ _____

5. $0.\overline{6}$ _____

3. π _____

6. $\sqrt{7}$ _____



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What Kind of Decimal?

For each number, state whether its decimal expansion **terminates**, **repeats**, or **neither terminates nor repeats**. Then classify the number as rational or irrational.

7. $\frac{3}{4}$ _____

8. $\frac{5}{11}$ _____

9. $\sqrt{10}$ _____

10. 0.125 _____

11. $\sqrt{36}$ _____

12. $\frac{1}{7}$ _____

Write as a Fraction

If the number is rational, write it as a fraction $\frac{a}{b}$ in simplest form. If it is irrational, write "Irrational."

13. 0.4 _____

16. $\sqrt{25}$ _____

14. $\sqrt{2}$ _____

17. 1.2 _____

15. -0.75 _____

18. $\sqrt{15}$ _____

True or False?

19. Every whole number is a rational number.

True ☐ False ☐

20. The number $\sqrt{9}$ is irrational.

True ☐ False ☐

21. All decimals that go on forever are irrational.

True ☐ False ☐

22. The number 0 is rational.

True ☐ False ☐



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 Word Problems

23. Marcus says that $\sqrt{50}$ is rational because it simplifies to $5\sqrt{2}$. Is Marcus correct? Explain.

Answer: _____

24. Give an example of a number that is a fraction but is NOT rational. If no such number exists, explain why.

Answer: _____

25. A calculator shows $0.142857142857\dots$ for a division problem. Is the result rational or irrational? How do you know?

Answer: _____

 Challenge!

26. Without a calculator, determine whether $\sqrt{144}$ is rational or irrational. Explain your reasoning.

27. Is $\sqrt{2} + \sqrt{2}$ rational or irrational? Justify your answer.

Awesome work! You can now tell rational and irrational numbers apart like a pro!



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CHAPTER

2

Lines and Linear Equations

★ *What's Inside* ★

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★ 2.1 Graphing Proportional Relationships ★

Graphing Proportional Relationships

Quick Review: Proportional Relationships

A **proportional relationship** has the equation $y = kx$, where k is the **constant of proportionality** (unit rate).

- On a graph, a proportional relationship is a **straight line through the origin** $(0, 0)$.
- To find k from a point: $k = \frac{y}{x}$.
- To compare two relationships, compare their values of k .

Example: A graph passes through $(4, 12)$. Then $k = \frac{12}{4} = 3$, so the equation is $y = 3x$.

Warm-Up

Find the Unit Rate

Find k for each proportional relationship.

1. A car drives 120 miles in 2 hours. _____

2. A machine makes 45 parts in 5 minutes. _____

3. A graph passes through $(3, 21)$. _____
4. A recipe uses 8 cups of flour for 4 batches. _____
5. A graph passes through $(6, 18)$. _____



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✎ Write the Equation ✎

From a Point to an Equation

Each point lies on a proportional relationship. Write the equation $y = kx$.

6. $(2, 10)$ _____

8. $(3, 7.5)$ _____

7. $(5, 20)$ _____

9. $(8, 6)$ _____

From a Table to an Equation

Write the equation $y = kx$ for each table.

10.

x	1	3	5	7
y	4	12	20	28

11.

x	2	4	6	10
y	7	14	21	35

✎ Comparing Relationships ✎

12. Store A sells oranges at \$3 per pound. Store B sells 5 pounds for \$12.50. Which store has the lower price per pound?
13. Hose A: $y = 6x$ (gallons per minute). Hose B fills 100 gallons in 20 minutes. Which is faster?
14. Cyclist A rides through $(2, 24)$ on a distance-time graph. Cyclist B: $y = 10x$. Who is faster?
15. Employee A earns \$90 for 6 hours. Employee B earns \$130 for 10 hours. Who has the higher hourly rate?



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 True or False?

16. Every proportional relationship passes through the origin. True ☐ False ☐
17. If $(3, 9)$ is on a proportional graph, then $(6, 18)$ must also be on it. True ☐ False ☐
18. A proportional relationship can have a negative constant of proportionality. True ☐ False ☐
19. The equation $y = 5x + 3$ represents a proportional relationship. True ☐ False ☐

 Word Problems

20. A factory produces widgets at a constant rate. It makes 240 widgets in 8 hours. Write the equation and predict how many widgets are made in 15 hours.

Answer: _____ widgets

21. Two printers are compared. Printer A prints $y = 12x$ pages per minute. Printer B prints 200 pages in 25 minutes. Which printer is faster, and by how much?

Answer: _____ pages/min

22. A proportional relationship passes through $(4, 22)$. What is the y -value when $x = 10$?

Answer: _____

 Challenge!

23. A bike ride is proportional with $k = 15$ km/h. A bus goes 180 km in 3 hours. You need to travel 90 km. How much sooner does the bus arrive than the bike?

24. The point $(a, 36)$ lies on the proportional graph $y = 9x$. Find a .



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Awesome work! You can spot proportional relationships anywhere now!

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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 Rational

2 Rational

3 Irrational

4 Rational

5 Rational

6 Irrational

7 Terminates; Rational

8 Repeats; Rational

9 Neither; Irrational

10 Terminates; Rational

11 Terminates; Rational

12 Repeats; Rational

13 $\frac{2}{5}$

14 Irrational

15 $-\frac{3}{4}$ 16 $\frac{5}{1}$ or 517 $\frac{6}{5}$

18 Irrational

19 True

20 False

21 False

22 True

23 No, Marcus is incorrect

24 No such number exists

25 Rational

26 Rational

27 Irrational

Explanations

1 $\frac{5}{8}$ is a fraction of two integers (5 and 8), so it is rational. Its decimal is 0.625, which terminates.

2 $\sqrt{16} = 4$, which is an integer. Every integer can be written as a fraction, so it is rational.



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- 3 $\pi = 3.14159 \dots$ is a non-terminating, non-repeating decimal. It cannot be written as $\frac{a}{b}$.
- 4 $-7 = \frac{-7}{1}$. Since it can be expressed as a fraction of two integers, it is rational.
- 5 $0.\overline{6} = 0.666 \dots$ is a repeating decimal, which means it is rational. In fact, $0.\overline{6} = \frac{2}{3}$.
- 6 7 is not a perfect square, so $\sqrt{7}$ cannot be written as a fraction. Its decimal never terminates or repeats.
- 7 $\frac{3}{4} = 0.75$, which terminates after two decimal places. Terminating decimals are always rational.
- 8 $\frac{5}{11} = 0.\overline{45}$, which repeats. Repeating decimals are always rational.
- 9 10 is not a perfect square, so $\sqrt{10} = 3.16227 \dots$ neither terminates nor repeats. It is irrational.
- 10 0.125 terminates. It equals $\frac{125}{1000} = \frac{1}{8}$, which is a fraction of two integers.
- 11 $\sqrt{36} = 6 = 6.0$, a terminating decimal. Since 6 is an integer, it is rational.
- 12 $\frac{1}{7} = 0.\overline{142857}$, which repeats with a 6-digit block. Repeating decimals are rational.
- 13 $0.4 = \frac{4}{10} = \frac{2}{5}$ after simplifying by dividing numerator and denominator by 2.
- 14 2 is not a perfect square, so $\sqrt{2}$ cannot be expressed as a fraction. It is irrational.
- 15 $-0.75 = -\frac{75}{100} = -\frac{3}{4}$ after dividing numerator and denominator by 25.



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16 $\sqrt{25} = 5$, which is an integer. As a fraction: $\frac{5}{1}$.

17 $1.2 = \frac{12}{10} = \frac{6}{5}$ after dividing numerator and denominator by 2.

18 15 is not a perfect square ($3^2 = 9$, $4^2 = 16$), so $\sqrt{15}$ is irrational.

19 Every whole number n can be written as $\frac{n}{1}$, which is a fraction of two integers. So every whole number is rational.

20 $\sqrt{9} = 3$, which is an integer. Integers are rational, not irrational.

21 Repeating decimals go on forever but are rational. For example, $0.\overline{3} = \frac{1}{3}$ is rational. Only non-repeating, non-terminating decimals are irrational.

22 $0 = \frac{0}{1}$, which is a fraction of two integers with a non-zero denominator. So 0 is rational.

23 Simplifying $\sqrt{50}$ to $5\sqrt{2}$ does not make it rational. The factor $\sqrt{2}$ is irrational, and multiplying an irrational number by a non-zero rational (5) still gives an irrational result. So $\sqrt{50}$ is irrational.

24 By definition, a rational number is any number that can be written as $\frac{a}{b}$ with a, b integers and $b \neq 0$. Every fraction with integer numerator and denominator is automatically rational. Expressions like $\frac{\sqrt{2}}{3}$ use an irrational numerator and are not "fractions" in the $\frac{a}{b}$ sense.

25 The digits 142857 repeat in a cycle. A repeating decimal can always be converted to a fraction (this one equals $\frac{1}{7}$). Therefore the result is rational.

26 $144 = 12^2$, so $\sqrt{144} = 12$. Since 12 is an integer, it is rational.

27 $\sqrt{2} + \sqrt{2} = 2\sqrt{2}$. Since $\sqrt{2}$ is irrational and 2 is a non-zero rational number, the product $2\sqrt{2}$ is still irrational.



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 Chapter 2

> Section 2.1

1 60 mph

2 9 parts/min

3 7

4 2 cups/batch

5 3

6 $y = 5x$ 7 $y = 4x$ 8 $y = 2.5x$ 9 $y = 0.75x$ 10 $y = 4x$ 11 $y = 3.5x$

12 Store B

13 Hose A

14 Cyclist A

15 Employee A

16 True

17 True

18 True

19 False

20 $y = 30x$; 450 widgets

21 Printer A by 4 pages/min

22 55

23 3 hours sooner

24 4

 Explanations
1 Divide distance by time: $k = \frac{120}{2} = 60$ miles per hour.2 Divide parts by minutes: $k = \frac{45}{5} = 9$ parts per minute.3 $k = \frac{y}{x} = \frac{21}{3} = 7$.4 Divide cups by batches: $k = \frac{8}{4} = 2$ cups per batch.5 $k = \frac{y}{x} = \frac{18}{6} = 3$.6 $k = \frac{10}{2} = 5$, so $y = 5x$.Find more at
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7 $k = \frac{20}{5} = 4$, so $y = 4x$.

8 $k = \frac{7.5}{3} = 2.5$, so $y = 2.5x$.

9 $k = \frac{6}{8} = 0.75$, so $y = 0.75x$.

10 Every $\frac{y}{x}$ ratio equals 4: $\frac{4}{1} = \frac{12}{3} = \frac{20}{5} = \frac{28}{7} = 4$. So $y = 4x$.

11 $\frac{7}{2} = 3.5$, and each ratio confirms this. So $y = 3.5x$.

12 Store A: $k = 3$. Store B: $k = \frac{12.50}{5} = 2.50$. Since $2.50 < 3$, Store B is cheaper.

13 Hose A: $k = 6$ gal/min. Hose B: $k = \frac{100}{20} = 5$ gal/min. Hose A is faster.

14 Cyclist A: $k = \frac{24}{2} = 12$ km/h. Cyclist B: $k = 10$ km/h. Cyclist A is faster.

15 Employee A: $k = \frac{90}{6} = 15$ /hr. Employee B: $k = \frac{130}{10} = 13$ /hr. Employee A earns more per hour.

16 By definition, $y = kx$ gives $y = 0$ when $x = 0$, so the graph always passes through $(0, 0)$.

17 The constant is $k = \frac{9}{3} = 3$. For $x = 6$: $y = 3 \times 6 = 18$. So $(6, 18)$ is on the graph.

18 If $y = -2x$, the line passes through the origin with slope -2 . This is still proportional.

19 Proportional relationships have the form $y = kx$ with no added constant. The $+3$ means the line does not pass through the origin.



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20 $k = \frac{240}{8} = 30$ widgets/hr. Equation: $y = 30x$. At 15 hours: $y = 30 \times 15 = 450$ widgets.

21 Printer A: $k = 12$. Printer B: $k = \frac{200}{25} = 8$. Printer A is faster by $12 - 8 = 4$ pages per minute.

22 $k = \frac{22}{4} = 5.5$. When $x = 10$: $y = 5.5 \times 10 = 55$.

23 Bike time: $\frac{90}{15} = 6$ hours. Bus rate: $\frac{180}{3} = 60$ km/h, so bus time: $\frac{90}{60} = 1.5$ hours. Difference: $6 - 1.5 = 4.5$ hours.

24 Substitute into $y = 9x$: $36 = 9a$, so $a = \frac{36}{9} = 4$.



Well done checking your answers!

Keep practicing to strengthen your skills.



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