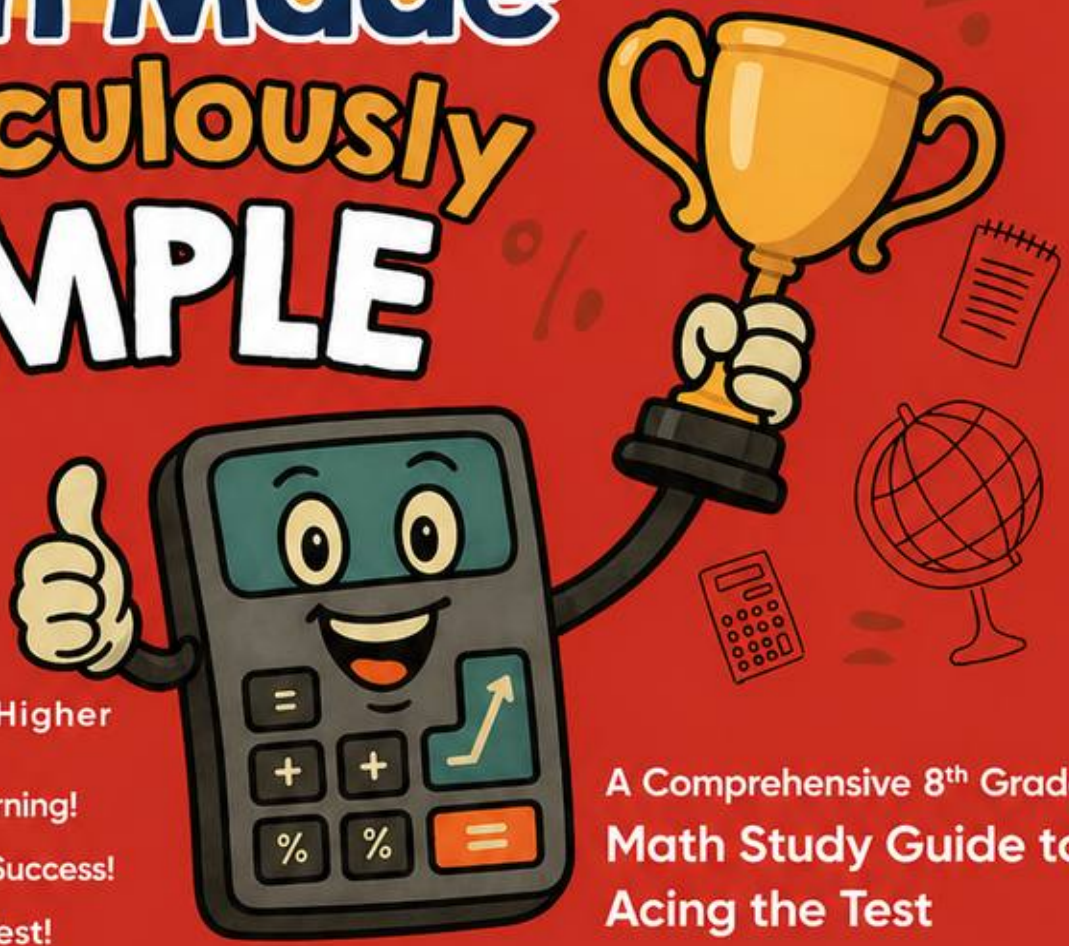
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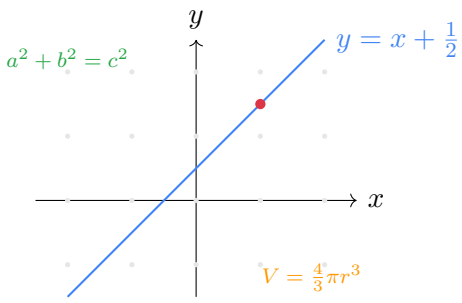
A Comprehensive 8th Grade Math Study Guide to Acing the Test

Learn Faster · Understand Deeper · Succeed with Confidence

Nebraska NSCAS Grade 8 Math

Made Ridiculously Simple

A Comprehensive 8th Grade Math Study Guide to Acing the NSCAS Test



Reza Nazari

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CHAPTER

1

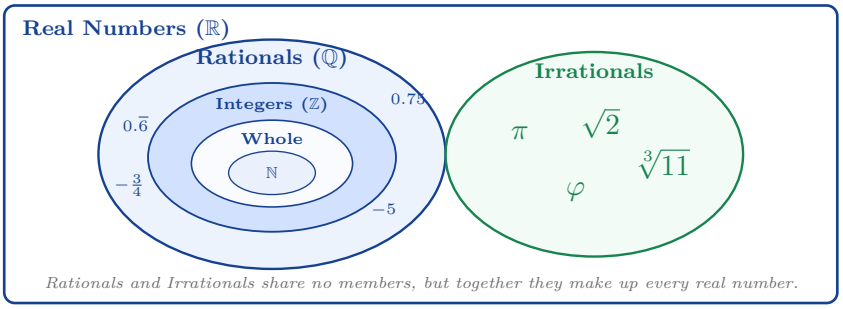
Real Numbers & Number Sense

1. Rational and Irrational Numbers 8.N.1
2. Turning Repeating Decimals into Fractions 8.A.1
3. Estimating Irrational Numbers 8.N.1
4. Estimating Expressions with Irrational Numbers 8.N.1

1.1 Rational and Irrational Numbers

8.N.1

Let's think about this: every real number is either **rational** or **irrational**— together they fill up the entire number line with no gaps! A rational number is one that can be written as a fraction $\frac{p}{q}$ where p and q are integers and $q \neq 0$. This is why whole numbers, fractions, terminating decimals (like 0.75), and repeating decimals (like $0.\overline{3}$) are all rational—they all come from exact fractions! **Irrational numbers are the rebels:** their decimal form goes on forever without ever repeating the same block. Famous examples are π, $\sqrt{2}$, and the golden ratio φ. Here's a helpful way to think about it: ask yourself, "Could I write this as an exact fraction?" If yes, it's rational. If no, it's irrational. The Venn diagram below shows how the whole real-number family nests together, and the comparison table that follows pairs them side by side.



Rationals and Irrationals share no members, but together they make up every real number.

Rational Numbers	Irrational Numbers
$\frac{3}{4} = 0.75$ (terminates)	$\sqrt{2} = 1.41421356\ldots$ (no pattern)
$\frac{1}{3} = 0.\overline{3}$ (repeating block)	$\pi = 3.14159265\ldots$ (no pattern)
$\sqrt{25} = 5$ (perfect square)	$\sqrt{7} = 2.64575\ldots$ (no pattern)
$-\frac{9}{5} = -1.8$ (terminates)	$\sqrt[3]{11} = 2.22398\ldots$ (no pattern)

Key Concepts & Quick Review

Rational: $\frac{p}{q}$, integers p and $q \neq 0$; decimal either *stops* or *repeats the same block forever.*

Irrational: No fraction form possible; decimal *never stops* and *never repeats.*

Quick Test: $\sqrt{n}$ is rational only when n is a perfect square $(1, 4, 9, 16, 25, 36, 49, 64, 81, 100, \ldots)$. All other square roots are irrational—no exceptions!

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✍ Word Problems

13. A square garden has an area of 75 m^2. The gardener wants to know whether the side length is closer to 8 m or 9 m so she can decide how many fence posts to order. Between which two consecutive integers does the side length fall, and which integer is it closest to?

_____

14. Two drones take off from the same point and fly in perpendicular directions. Drone A travels $\sqrt{60}$ km and Drone B travels 7.5 km. Without using a calculator, determine which drone flies farther.

_____

15. A park ranger estimates the distance across a circular lake. The lake's area is 200 m^2. (a) The radius satisfies $\pi r^2 = 200$. Find r^2. (b) Estimate r to the nearest tenth. (c) Estimate the diameter to the nearest metre.

_____

16. Between which two consecutive whole numbers does each value lie? (a) $\sqrt{50}$ (b) $\sqrt[3]{100}$ (c) Order from least to greatest: $\sqrt{50}$, $\sqrt[3]{100}$, 7.2

_____

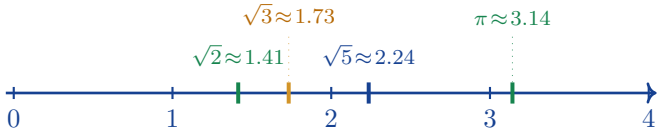
17. A square garden has area 150 ft^2. You need to buy fencing for all four sides. Fencing is sold in whole-foot lengths. (a) Find the exact side length. (b) Estimate the perimeter to the nearest tenth of a foot. (c) How many whole feet of fencing must you buy?

_____

1.4 Estimating Expressions with Irrational Numbers

8.N.1

Estimating a *single* irrational number like $\sqrt{45}$ is one thing—you squeeze it between two perfect squares and zero in on the decimal. But what happens when an expression mixes **several** irrational numbers with addition, subtraction, multiplication, or exponents? **Here's how you handle it:** replace each irrational number with its decimal approximation, then carry out the arithmetic step by step. But here's the real secret that saves time and keeps your answer exact—**simplify before you substitute!** For example, $(\sqrt{3})^2 = 3$ exactly (no decimal needed!), and $\sqrt{2} \cdot \sqrt{8} = \sqrt{16} = 4$—the irrational parts cancel out completely. Only use decimal approximations for the parts that *truly* stay irrational. One more important rule: **round at the very end, not in the middle.** Early rounding piles up error and throws off your final answer. The reference line below collects the key approximations you'll need most.



Key Concepts & Quick Review

Useful approximations: $\sqrt{2} \approx 1.41$, $\sqrt{3} \approx 1.73$, $\sqrt{5} \approx 2.24$, $\pi \approx 3.14$

Strategy: Substitute ⇒ Simplify ⇒ Round to the required number of decimal places.

Bounding: Computing both a *lower bound* (using smaller approximations) and an *upper bound* (using larger ones) confirms how accurate the estimate is.

Examples

① Estimate π^2 to two decimal places.

Start by substituting: use $\pi \approx 3.14$. Then compute $\pi^2 \approx 3.14 \times 3.14$. **Break it into parts:** $3 \times 3.14 = 9.42$ and $0.14 \times 3.14 = 0.4396$. **Add them:** $9.42 + 0.44 = 9.86$ (rounding 0.4396 to 0.44). **Check your work:** the actual value is $9.8696\ldots$, so our estimate of 9.86 is spot-on! That's the power of smart substitution.

Answer: $\pi^2 \approx 9.86$

② Estimate $3\sqrt{5} - 2$ to one decimal place.

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First, substitute $\sqrt{5} \approx 2.236$ into the expression. **Multiply:** $3 \times 2.236 = 6.708$. **Subtract:** $6.708 - 2 = 4.708$. **Round to one decimal place:** 4.7. Here's a smart check—use bounds to verify your answer! Since $2.2 < \sqrt{5} < 2.3$, the expression must fall between $3(2.2) - 2 = 4.6$ and $3(2.3) - 2 = 4.9$. Our answer of 4.7 fits perfectly in that range!

Answer: $3\sqrt{5} - 2 \approx 4.7$

Practice Problems

Estimate each expression to one decimal place. Use $\sqrt{2} \approx 1.41$, $\sqrt{3} \approx 1.73$, $\sqrt{5} \approx 2.24$, $\pi \approx 3.14$.

1. $2\pi \approx$ _____

2. $\pi + 1 \approx$ _____

3. $4\sqrt{2} \approx$ _____

4. $\sqrt{3} + 2 \approx$ _____

5. $3\pi - 5 \approx$ _____

6. $(\sqrt{2})^2 =$ _____

7. $2\sqrt{5} + \sqrt{3} \approx$ _____

8. $\pi^2 - 4 \approx$ _____

9. $5\sqrt{2} - 3\sqrt{3} \approx$ _____

10. $\frac{\pi}{2} + \sqrt{5} \approx$ _____

11. $(\sqrt{3})^2 + (\sqrt{2})^2 =$ _____

12. $\sqrt{2} \cdot \sqrt{3} \approx$ _____

Study Tips

- **Remember this golden rule:** $(\sqrt{n})^2 = n$ exactly—no approximation ever needed! $(\sqrt{5})^2 = 5$ precisely, not some messy decimal like 5.0176. Take advantage of this!
- Always, always state which approximation you used. Using $\pi \approx 3.14$ versus $\pi \approx 3.1416$ gives slightly different answers, and both can be right depending on the precision required. Transparency matters!
- **Double-check your estimate with bounding:** compute both a lower and upper bound to confirm your answer sits in a believable range. It's your verification superpower!

Word Problems

13. A circular fountain has a radius of exactly $\sqrt{3}$ metres. Estimate the area of the fountain to the nearest tenth of a square metre. Use $\pi \approx 3.14$ and $\sqrt{3} \approx 1.732$.

_____

14. Rope A has length $\pi + \sqrt{2}$ metres and Rope B has length 4 metres. Which rope is longer, and by approximately how much? Use $\pi \approx 3.14$ and $\sqrt{2} \approx 1.41$.

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