

NUMBER 67.89 IS RATIONAL OR IRRATIONAL

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UNDERSTANDING WHETHER A NUMBER IS RATIONAL OR IRRATIONAL IS FUNDAMENTAL IN MATHEMATICS. THIS DISTINCTION HELPS IN GRASPING THE NATURE OF NUMBERS, THEIR REPRESENTATIONS, AND HOW THEY BEHAVE WITHIN VARIOUS MATHEMATICAL CONTEXTS. ONE COMMON QUESTION THAT ARISES IS WHETHER A SPECIFIC DECIMAL, SUCH AS 67.89, IS RATIONAL OR IRRATIONAL. IN THIS ARTICLE, WE WILL EXPLORE THE DEFINITIONS OF RATIONAL AND IRRATIONAL NUMBERS, ANALYZE THE SPECIFIC CASE OF 67.89, AND PROVIDE A COMPREHENSIVE EXPLANATION TO CLARIFY THIS MATHEMATICAL CONCEPT.

WHAT IS A RATIONAL NUMBER?

DEFINITION OF RATIONAL NUMBERS

A RATIONAL NUMBER IS ANY NUMBER THAT CAN BE EXPRESSED AS THE QUOTIENT OR FRACTION OF TWO INTEGERS, WHERE THE DENOMINATOR IS NOT ZERO. IN SIMPLE TERMS, IF A NUMBER CAN BE WRITTEN IN THE FORM:

$$\left[\frac{A}{B} \right]$$

WHERE A AND B ARE INTEGERS, AND $B \neq 0$, THEN THE NUMBER IS RATIONAL.

EXAMPLES OF RATIONAL NUMBERS

- $\frac{3}{4}$ (WHICH IS 0.75)
- $-\frac{2}{5}$ (WHICH IS -0.4)
- 0 (WHICH CAN BE WRITTEN AS $\frac{0}{1}$)
- 5 (WHICH CAN BE WRITTEN AS $\frac{5}{1}$)

PROPERTIES OF RATIONAL NUMBERS

- THEY HAVE DECIMAL EXPANSIONS THAT ARE EITHER TERMINATING OR REPEATING.
- THEY CAN ALWAYS BE EXPRESSED AS A FRACTION OF INTEGERS.
- THEY ARE CLOSED UNDER ADDITION, SUBTRACTION, MULTIPLICATION, AND DIVISION (EXCEPT DIVISION BY ZERO).

WHAT IS AN IRRATIONAL NUMBER?

DEFINITION OF IRRATIONAL NUMBERS

AN IRRATIONAL NUMBER CANNOT BE EXPRESSED AS A FRACTION OF TWO INTEGERS. ITS DECIMAL EXPANSION IS NON-TERMINATING AND NON-REPEATING. THESE NUMBERS CANNOT BE WRITTEN PRECISELY AS A SIMPLE FRACTION, AND THEIR DECIMAL FORMS GO ON INFINITELY WITHOUT ANY REPEATING PATTERN.

EXAMPLES OF IRRATIONAL NUMBERS

- $\sqrt{2}$ (THE SQUARE ROOT OF 2)
- π (PI)
- e (EULER'S NUMBER)

- THE GOLDEN RATIO (APPROXIMATELY 1.618...)

PROPERTIES OF IRRATIONAL NUMBERS

- THEIR DECIMAL EXPANSIONS ARE INFINITE AND NON-REPEATING.
- THEY CANNOT BE WRITTEN AS EXACT FRACTIONS.
- THEY OFTEN ARISE FROM ROOTS OF NON-PERFECT SQUARES OR TRANSCENDENTAL FUNCTIONS.

ANALYZING THE NUMBER 67.89: IS IT RATIONAL OR IRRATIONAL?

REPRESENTATION OF 67.89

THE NUMBER 67.89 IS A DECIMAL NUMBER WITH A FINITE NUMBER OF DIGITS AFTER THE DECIMAL POINT. SPECIFICALLY, IT CAN BE WRITTEN AS:

$$[67.89]$$

THIS DECIMAL TERMINATES AFTER TWO DECIMAL PLACES, WHICH IS CRUCIAL IN DETERMINING ITS RATIONALITY.

EXPRESSING 67.89 AS A FRACTION

TO DETERMINE IF 67.89 IS RATIONAL, WE ATTEMPT TO EXPRESS IT AS A FRACTION OF TWO INTEGERS:

1. RECOGNIZE THAT 67.89 IS A TERMINATING DECIMAL.
2. CONVERT TO A FRACTION:

$$[67.89 = \frac{6789}{100}]$$

SINCE MOVING THE DECIMAL POINT TWO PLACES TO THE RIGHT CONVERTS THE DECIMAL TO AN INTEGER, AND WE DIVIDE BY 100 TO ACCOUNT FOR THE DECIMAL SHIFT.

3. SIMPLIFY THE FRACTION:

- FIND THE GREATEST COMMON DIVISOR (GCD) OF 6789 AND 100.

USING PRIME FACTORIZATION OR EUCLIDEAN ALGORITHM:

- $\text{GCD}(6789, 100)$:
 - 100 DIVIDES INTO 6789 APPROXIMATELY 67 TIMES WITH A REMAINDER.
 - APPLYING THE EUCLIDEAN ALGORITHM:
 - $6789 \div 100 = 67$ WITH A REMAINDER OF 89.
 - $\text{GCD}(100, 89)$:
 - $100 \div 89 = 1$ WITH A REMAINDER OF 11.
 - $\text{GCD}(89, 11)$:
 - $89 \div 11 = 8$ WITH A REMAINDER OF 1.
 - $\text{GCD}(11, 1)$:
 - $11 \div 1 = 11$ WITH A REMAINDER OF 0.
 - WHEN THE REMAINDER REACHES ZERO, THE GCD IS THE LAST NON-ZERO REMAINDER, WHICH IS 1.

SINCE $\text{GCD}(6789, 100) = 1$, THE FRACTION $\left(\frac{6789}{100}\right)$ IS ALREADY IN ITS SIMPLEST FORM.

CONCLUSION: 67.89 CAN BE EXPRESSED AS $\left(\frac{6789}{100}\right)$, A RATIO OF TWO INTEGERS, INDICATING THAT 67.89 IS A RATIONAL NUMBER.

ADDITIONAL INSIGHTS ON RATIONAL NUMBERS WITH FINITE DECIMALS

TERMINATING DECIMALS ARE RATIONAL

ANY DECIMAL NUMBER THAT TERMINATES AFTER A FINITE NUMBER OF DIGITS IS ALWAYS RATIONAL BECAUSE IT CAN BE WRITTEN AS A FRACTION WITH A POWER OF 10 IN THE DENOMINATOR. FOR EXAMPLE:

- $0.5 = \left(\frac{1}{2}\right)$
- $0.125 = \left(\frac{1}{8}\right)$
- $67.89 = \left(\frac{6789}{100}\right)$

REPEATING DECIMALS ARE RATIONAL

SIMILARLY, DECIMAL NUMBERS WITH REPEATING PATTERNS, SUCH AS 0.333... OR 0.142857142857..., ARE RATIONAL BECAUSE THEY CAN BE CONVERTED INTO FRACTIONS USING ALGEBRAIC METHODS.

SUMMARY: IS 67.89 RATIONAL OR IRRATIONAL?

BASED ON THE ANALYSIS ABOVE:

- 67.89 IS A DECIMAL WITH A FINITE NUMBER OF DIGITS AFTER THE DECIMAL POINT.
- IT CAN BE PRECISELY EXPRESSED AS A RATIO OF TWO INTEGERS: $\left(\frac{6789}{100}\right)$.
- THEREFORE, 67.89 IS A RATIONAL NUMBER.

WHY IT MATTERS TO KNOW IF A NUMBER IS RATIONAL OR IRRATIONAL

UNDERSTANDING THE RATIONALITY OF A NUMBER HAS IMPORTANT IMPLICATIONS IN VARIOUS FIELDS SUCH AS ALGEBRA, CALCULUS, NUMBER THEORY, AND APPLIED MATHEMATICS. RECOGNIZING WHETHER A NUMBER IS RATIONAL OR IRRATIONAL HELPS IN:

- SIMPLIFYING MATHEMATICAL EXPRESSIONS
- APPROXIMATING IRRATIONAL NUMBERS
- ANALYZING THE PROPERTIES OF FUNCTIONS AND SEQUENCES
- SOLVING EQUATIONS INVOLVING REAL NUMBERS

COMMON MISCONCEPTIONS AND CLARIFICATIONS

- **NOT ALL DECIMALS ARE IRRATIONAL.** DECIMALS THAT TERMINATE OR REPEAT ARE RATIONAL, WHEREAS NON-REPEATING, NON-TERMINATING DECIMALS ARE IRRATIONAL.
- **NUMBERS LIKE 67.89 ARE ALWAYS RATIONAL.** BECAUSE THEY CAN BE WRITTEN AS FRACTIONS, THESE NUMBERS ARE

CLASSIFIED AS RATIONAL.

- **SOME IRRATIONAL NUMBERS CAN BE APPROXIMATED BY RATIONALS.** FOR EXAMPLE, $\pi \approx 3.14159$, BUT IT CANNOT BE EXACTLY EXPRESSED AS A FRACTION.

CONCLUSION

IN CONCLUSION, THE NUMBER 67.89 IS UNDENIABLY A RATIONAL NUMBER BECAUSE IT CAN BE EXPRESSED PRECISELY AS THE FRACTION $\frac{6789}{100}$. ITS FINITE DECIMAL EXPANSION CONFIRMS ITS RATIONALITY, ALIGNING WITH THE FUNDAMENTAL PROPERTIES OF RATIONAL NUMBERS. RECOGNIZING THE DIFFERENCE BETWEEN RATIONAL AND IRRATIONAL NUMBERS IS VITAL FOR MATHEMATICAL LITERACY AND PROBLEM-SOLVING ACROSS VARIOUS DISCIPLINES. WHETHER DEALING WITH SIMPLE DECIMALS LIKE 67.89 OR MORE COMPLEX IRRATIONAL NUMBERS, UNDERSTANDING THEIR NATURE PROVIDES CLARITY AND INSIGHT INTO THE STRUCTURE OF NUMBERS AND THEIR RELATIONSHIPS.

FREQUENTLY ASKED QUESTIONS

IS THE NUMBER 67.89 RATIONAL OR IRRATIONAL?

THE NUMBER 67.89 IS RATIONAL BECAUSE IT CAN BE EXPRESSED AS A FRACTION $(6789/100)$, WHICH IS A RATIO OF TWO INTEGERS.

HOW CAN YOU DETERMINE IF A DECIMAL NUMBER LIKE 67.89 IS RATIONAL?

ANY DECIMAL NUMBER THAT TERMINATES OR REPEATS CAN BE WRITTEN AS A FRACTION, MAKING IT RATIONAL. SINCE 67.89 TERMINATES, IT IS RATIONAL.

CAN 67.89 BE WRITTEN IN THE FORM OF A FRACTION?

YES, 67.89 CAN BE WRITTEN AS $6789/100$, WHICH CONFIRMS IT IS A RATIONAL NUMBER.

IS 67.89 AN IRRATIONAL NUMBER?

NO, 67.89 IS NOT IRRATIONAL; IT IS A RATIONAL NUMBER BECAUSE IT TERMINATES AND CAN BE EXPRESSED AS A FRACTION.

WHY IS 67.89 CLASSIFIED AS A RATIONAL NUMBER?

BECAUSE IT CAN BE EXPRESSED AS THE RATIO OF TWO INTEGERS $(6789/100)$, AND ITS DECIMAL FORM TERMINATES, FITTING THE DEFINITION OF RATIONAL NUMBERS.

ADDITIONAL RESOURCES

NUMBER 67.89 IS RATIONAL OR IRRATIONAL

UNDERSTANDING THE NATURE OF SPECIFIC NUMBERS—WHETHER THEY ARE RATIONAL OR IRRATIONAL—HAS BEEN A FUNDAMENTAL PURSUIT WITHIN MATHEMATICS FOR CENTURIES. AMONG THE MANY REAL NUMBERS THAT POPULATE THE NUMBER LINE, 67.89 EMERGES AS A SEEMINGLY STRAIGHTFORWARD DECIMAL. YET, BENEATH ITS APPARENT SIMPLICITY LIES A DEEPER MATHEMATICAL INQUIRY: IS 67.89 A RATIONAL NUMBER OR AN IRRATIONAL NUMBER? THIS QUESTION, WHILE SEEMINGLY ELEMENTARY, OPENS THE DOOR TO EXPLORING THE FOUNDATIONAL DEFINITIONS OF RATIONALITY IN NUMBERS, THE PROPERTIES OF DECIMAL

EXPANSIONS, AND THE BROADER IMPLICATIONS WITHIN NUMBER THEORY.

IN THIS COMPREHENSIVE ANALYSIS, WE WILL EXAMINE THE CLASSIFICATION OF 67.89 , DELVE INTO THE CRITERIA THAT DISTINGUISH RATIONAL FROM IRRATIONAL NUMBERS, EXPLORE THE DECIMAL REPRESENTATIONS OF BOTH, AND CONSIDER THE HISTORICAL AND THEORETICAL SIGNIFICANCE OF THIS DISTINCTION.

UNDERSTANDING RATIONAL AND IRRATIONAL NUMBERS

BEFORE SCRUTINIZING 67.89 SPECIFICALLY, IT'S ESSENTIAL TO ESTABLISH A CLEAR UNDERSTANDING OF WHAT DEFINES RATIONAL AND IRRATIONAL NUMBERS.

WHAT ARE RATIONAL NUMBERS?

A RATIONAL NUMBER IS ANY NUMBER THAT CAN BE EXPRESSED AS THE QUOTIENT OR FRACTION OF TWO INTEGERS, WHERE THE DENOMINATOR IS NOT ZERO. FORMALLY, A NUMBER (r) IS RATIONAL IF IT CAN BE WRITTEN AS:

$$\left[\begin{array}{l} \\ r = \frac{p}{q} \\ \end{array} \right]$$

WHERE (p) AND (q) ARE INTEGERS, AND $(q \neq 0)$.

KEY CHARACTERISTICS OF RATIONAL NUMBERS INCLUDE:

- THEIR DECIMAL EXPANSION EITHER TERMINATES AFTER A FINITE NUMBER OF DIGITS OR REPEATS PERIODICALLY.
- THEY CAN ALWAYS BE EXPRESSED IN FRACTIONAL FORM.

EXAMPLES:

- $(\frac{1}{2} = 0.5)$
- $(\frac{22}{7} \approx 3.142857...)$ (REPEATING DECIMAL)
- $(0.75 = \frac{3}{4})$

WHAT ARE IRRATIONAL NUMBERS?

AN IRRATIONAL NUMBER CANNOT BE EXPRESSED AS A SIMPLE FRACTION OF TWO INTEGERS. THEIR DECIMAL EXPANSIONS ARE NON-TERMINATING AND NON-REPEATING.

KEY CHARACTERISTICS:

- THEIR DECIMAL EXPANSION GOES ON INFINITELY WITHOUT REPEATING PATTERNS.
- THEY CANNOT BE WRITTEN EXACTLY AS A RATIO OF TWO INTEGERS.

EXAMPLES:

- (π)
- $(\sqrt{2})$
- (e) (EULER'S NUMBER)

ANALYZING 67.89: IS IT RATIONAL OR IRRATIONAL?

GIVEN THE DEFINITIONS ABOVE, THE CRITICAL QUESTION IS: CAN 67.89 BE EXPRESSED AS A FRACTION? THE ANSWER HINGES ON THE NATURE OF ITS DECIMAL EXPANSION.

DECIMAL REPRESENTATION OF 67.89

THE NUMBER 67.89 IS EXPRESSED IN DECIMAL FORM WITH TWO DIGITS AFTER THE DECIMAL POINT. THIS IMMEDIATELY SUGGESTS THAT IT IS A TERMINATING DECIMAL.

TERMINATING DECIMALS ARE A SUBSET OF RATIONAL NUMBERS, AS THEY CAN ALWAYS BE WRITTEN AS FRACTIONS WITH POWERS OF 10 IN THE DENOMINATOR.

CONVERSION OF 67.89 TO FRACTIONAL FORM:

$$67.89 = \frac{6789}{100}$$

HERE, 6789 AND 100 ARE INTEGERS, AND $100 \neq 0$, SATISFYING THE CRITERIA FOR RATIONAL NUMBERS.

SIMPLIFICATION:

- $\frac{6789}{100}$ IS ALREADY IN SIMPLEST FORM IF 6789 AND 100 SHARE NO COMMON FACTORS. SINCE 100 FACTORS INTO $(2^2 \times 5^2)$, AND 6789 DOES NOT END WITH 0 OR 5, THE FRACTION IS ALREADY IN LOWEST TERMS.

CONCLUSION:

BECAUSE 67.89 CAN BE EXPRESSED PRECISELY AS A FRACTION, IT IS A RATIONAL NUMBER.

HISTORICAL AND THEORETICAL CONTEXT

THE CLASSIFICATION OF NUMBERS LIKE 67.89 UNDERSCORES FUNDAMENTAL PRINCIPLES IN NUMBER THEORY AND DECIMAL REPRESENTATION.

HISTORICAL DEVELOPMENT OF RATIONAL AND IRRATIONAL NUMBERS

THE DISTINCTION BETWEEN RATIONAL AND IRRATIONAL NUMBERS DATES BACK TO ANCIENT GREECE, WHERE MATHEMATICIANS LIKE PYTHAGORAS DISCOVERED THAT SOME QUANTITIES, SUCH AS $\sqrt{2}$, COULD NOT BE EXPRESSED AS RATIOS OF INTEGERS, LEADING TO THE CONCEPT OF IRRATIONALITY.

THE REALIZATION THAT DECIMAL REPRESENTATIONS COULD BE EITHER TERMINATING, REPEATING, OR NON-REPEATING WAS FORMALIZED MUCH LATER, ESPECIALLY WITH THE DEVELOPMENT OF DECIMAL NOTATION IN THE 16TH AND 17TH CENTURIES.

IMPLICATIONS FOR MODERN MATHEMATICS

UNDERSTANDING WHETHER A NUMBER IS RATIONAL OR IRRATIONAL IMPACTS VARIOUS MATHEMATICAL DISCIPLINES, INCLUDING:

- NUMBER THEORY
- ALGEBRA
- ANALYSIS
- CRYPTOGRAPHY

IT ALSO INFLUENCES COMPUTATIONAL APPROACHES, AS RATIONAL NUMBERS ARE EXACT IN DIGITAL REPRESENTATIONS (TO FINITE PRECISION), WHILE IRRATIONAL NUMBERS REQUIRE APPROXIMATION.

EXPLORING THE PROPERTIES OF 67.89

BEYOND ITS CLASSIFICATION, EXAMINING THE PROPERTIES OF 67.89 PROVIDES INSIGHTS INTO ITS BEHAVIOR WITHIN MATHEMATICAL SYSTEMS.

PROPERTIES OF 67.89 AS A RATIONAL NUMBER

- EXPRESSIBILITY: AS SHOWN, $67.89 = \frac{6789}{100}$.
- FINITE DECIMAL EXPANSION: IT TERMINATES AFTER TWO DECIMAL PLACES.
- REPEATED DECIMAL EXPANSION: SINCE IT TERMINATES, ITS DECIMAL EXPANSION CAN BE VIEWED AS A REPEATING PATTERN OF ZEROS (E.G., 67.890000...).
- ALGEBRAIC OPERATIONS: RATIONAL NUMBERS ARE CLOSED UNDER ADDITION, SUBTRACTION, MULTIPLICATION, AND DIVISION (EXCEPT DIVISION BY ZERO). FOR EXAMPLE:

$$67.89 \times 2 = 135.78$$

WHICH IS ALSO RATIONAL.

POTENTIAL MISCONCEPTIONS AND CLARIFICATIONS

SOME MIGHT CONFUSE THE DECIMAL 67.89 WITH REPEATING DECIMALS OR NON-TERMINATING DECIMALS THAT APPROXIMATE IRRATIONAL NUMBERS. CLARIFYING THIS:

- THE DECIMAL 67.89 IS EXACTLY EQUAL TO ITS FRACTIONAL FORM.
- APPROXIMATIONS SUCH AS 67.890000... ARE STILL RATIONAL BECAUSE THEY TERMINATE OR REPEAT IN ZEROS.
- NON-TERMINATING, NON-REPEATING DECIMALS (E.G., 0.1010010001...) ARE IRRATIONAL, UNLIKE 67.89.

BROADER IMPLICATIONS AND APPLICATIONS

UNDERSTANDING THE RATIONALITY OF NUMBERS LIKE 67.89 IS MORE THAN ACADEMIC; IT INFLUENCES PRACTICAL APPLICATIONS.

FINANCIAL CALCULATIONS

- MONETARY VALUES FREQUENTLY INVOLVE DECIMAL NUMBERS LIKE 67.89.
- THESE ARE MODELED AS RATIONAL NUMBERS FOR EXACT CALCULATIONS, AVOIDING ROUNDING ERRORS.

- PRECISION IS MAINTAINED BY EXPRESSING SUCH VALUES AS FRACTIONS OR FIXED DECIMAL POINTS.

COMPUTATIONAL MATHEMATICS

- RATIONAL NUMBERS ARE STORED PRECISELY IN COMPUTER SYSTEMS USING FRACTIONAL REPRESENTATIONS OR FIXED DECIMAL FORMATS.
- IRRATIONAL NUMBERS, BY CONTRAST, REQUIRE APPROXIMATIONS, WHICH CAN INTRODUCE ERRORS IN CALCULATIONS.
- RECOGNIZING WHETHER A NUMBER IS RATIONAL HELPS OPTIMIZE ALGORITHMS AND DATA STORAGE.

EDUCATIONAL SIGNIFICANCE

- TEACHING THE RATIONALITY OF DECIMALS LIKE 67.89 AIDS IN UNDERSTANDING DECIMAL NOTATION AND ITS RELATION TO FRACTIONS.
- IT PROVIDES A FOUNDATION FOR EXPLORING MORE COMPLEX IRRATIONAL NUMBERS.

CONCLUSION: THE RATIONALITY OF 67.89

BASED ON THE FUNDAMENTAL DEFINITIONS AND PROPERTIES OUTLINED, IT IS CLEAR THAT NUMBER 67.89 IS A RATIONAL NUMBER. ITS DECIMAL EXPANSION TERMINATES, WHICH DIRECTLY CORRELATES WITH ITS EXPRESSIBILITY AS A FRACTION OF INTEGERS. THE PRECISE FRACTIONAL FORM $\left(\frac{6789}{100}\right)$ CONFIRMS ITS RATIONAL STATUS, ALIGNING WITH THE ESTABLISHED MATHEMATICAL PRINCIPLES DISTINGUISHING RATIONAL AND IRRATIONAL NUMBERS.

THIS EXPLORATION UNDERSCORES THE IMPORTANCE OF DECIMAL REPRESENTATIONS IN UNDERSTANDING THE DEEPER NATURE OF NUMBERS. WHILE 67.89 APPEARS SIMPLE, ITS CLASSIFICATION EXEMPLIFIES CORE CONCEPTS IN NUMBER THEORY THAT INFLUENCE BOTH THEORETICAL MATHEMATICS AND PRACTICAL APPLICATIONS ACROSS VARIOUS FIELDS.

IN THE GRAND CONTINUUM OF THE NUMBER LINE, 67.89 STANDS FIRMLY WITHIN THE REALM OF RATIONAL NUMBERS, EXEMPLIFYING THE ELEGANT SIMPLICITY THAT UNDERPINS MUCH OF MATHEMATICS.

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