# Number Systems: Natural, Whole, Integers, Rational

**Maths · CBSE Class 9 · Number Systems · PrayogX short notes**

▸ **Video explanation:** Watch the PrayogX reel on Instagram

**In one line:** each new family of numbers answers a question the old one could not, and every family lives inside the next: **N** ⊂ **W** ⊂ **Z** ⊂ **Q**.

## Key definitions

| Family | Set | The question it answers |
|---|---|---|
| **Natural numbers (N)** | {1, 2, 3, 4, …} | How do we count? |
| **Whole numbers (W)** | {0, 1, 2, 3, …} | How many apples on an empty plate? Zero. |
| **Integers (Z)** | {…, −3, −2, −1, 0, 1, 2, 3, …} | Temperature below zero, like −5 °C? |
| **Rational numbers (Q)** | p/q, where p and q are integers and q ≠ 0 | Half a pizza each for two friends? 1/2. |

## Key ideas

- Every natural number is a whole number, every whole number is an integer, and every integer is rational: **N** ⊂ **W** ⊂ **Z** ⊂ **Q**.
- An integer n is rational because n = n/1 (for example, 5 = 5/1 and −3 = −3/1).
- Rational numbers can be positive, negative or zero: 3/4, −7/2, 0 = 0/5.
- A rational number has many forms: 1/2 = 2/4 = 50/100 (equivalent fractions).
- Not every number is rational: √2 and π cannot be written as p/q. They are **irrational** (next topic).

## Rule to remember

**Rational number = p/q, with p, q integers and q ≠ 0.** Division by zero is not allowed, so 5/0 is not a number at all.

## Examples

- 7 is natural, whole, an integer and rational.
- 0 is whole, an integer and rational, but **not** natural.
- −4 is an integer and rational, but not whole or natural.
- 2/3 and −1/2 are rational only.

## Common mistakes

- "Zero is a natural number." In CBSE / NCERT, N starts at 1.
- "Negative numbers are whole numbers." Whole numbers start at 0 and go up.
- "Integers are not rational." Every integer is rational (n = n/1).
- "0/5 is undefined." 0/5 = 0 is fine; it is 5/0 that is undefined.

## Quick check

1. Is −8 a whole number? *No; it is an integer and a rational number.*
2. Write 6 as a rational number. *6/1 (or 12/2, 18/3, …).*
3. Which is the smallest whole number? *0.*
4. Is 3/0 rational? *No, q cannot be 0.*

## Takeaway

**Counting → add zero → add negatives → add fractions: N → W → Z → Q.** And the question for next time: can every number be written as p/q?

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