

MATHEMATICS • CLASS 11

CHAPTER 1

Sets

CHAPTER NOTES



WHAT IS A SET?

Meaning

A set is a well-defined collection of objects.

Well-defined means that we can decide clearly whether an object belongs to the collection.

Objects, elements and members mean the same thing.

The vowels in the English alphabet form a set.

$$V = \{a, e, i, o, u\}$$

A collection of the most renowned mathematicians is not well-defined: different people may choose different names.

Membership

Capital letters usually name sets. Small letters usually name elements.

$a \in A$: a belongs to A

$b \notin A$: b does not belong to A

For the vowel set:

$$a \in V, \quad b \notin V$$

For the prime factors of thirty:

$$P = \{2, 3, 5\}$$

$$3 \in P, \quad 15 \notin P$$

Sets help us study relations, functions, geometry, sequences and probability.

Georg Cantor developed set theory.

IMPORTANT NUMBER SETS

Natural numbers and integers

$$\mathbb{N} = \{1, 2, 3, \dots\}$$

Natural numbers begin with one in this chapter.

$$\mathbb{Z} = \{\dots, -3, -2, -1, 0, 1, 2, 3, \dots\}$$

Integers include negative whole numbers, zero and positive whole numbers.

$$\mathbb{Z}^+ = \{1, 2, 3, \dots\}$$

Rational numbers

A rational number can be written as a ratio of integers with a non-zero denominator.

$$\mathbb{Q} = \left\{x : x = \frac{p}{q}, p, q \in \mathbb{Z}, q \neq 0\right\}$$

$$-5 = \frac{-5}{1}, \quad \frac{7}{5}, \quad \frac{7}{2}, \quad \frac{-11}{3}$$

Real and irrational numbers

Real numbers include rational and irrational numbers.

$$\mathbb{T} = \{x : x \in \mathbb{R} \text{ and } x \notin \mathbb{Q}\}$$

Irrational numbers cannot be written as a ratio of integers.

$$\sqrt{2}, \sqrt{5}, \pi \in \mathbb{T}$$

$$\mathbb{N} \subset \mathbb{Z} \subset \mathbb{Q} \subset \mathbb{R}$$

$$\mathbb{T} \subset \mathbb{R}, \quad \mathbb{N} \not\subset \mathbb{T}$$

Positive rational and positive real numbers are denoted by:

$$\mathbb{Q}^+, \quad \mathbb{R}^+$$

Here the subset symbol means contained in; equality is allowed.

REPRESENTING A SET

Roster or tabular form

List distinct elements inside braces, separated by commas.

Even positive integers less than seven:

$$\{2, 4, 6\}$$

Natural-number divisors of forty-two:

$$\{1, 2, 3, 6, 7, 14, 21, 42\}$$

Order does not matter. Do not repeat an element.

Letters in SCHOOL:

$$\{S, C, H, O, L\}$$

O appears twice in the word but only once in the set.

An endless list may use dots:

$$\{1, 3, 5, 7, \dots\}$$

Set-builder form

Describe the property that selects exactly the elements of the set.

$$V = \{x : x \text{ is a vowel in the English alphabet}\}$$

Braces mean "the set of all"; the colon means "such that".

$$A = \{x : x \in \mathbb{N} \text{ and } 3 < x < 10\}$$

Only the natural numbers strictly between the two limits are included.

$$A = \{4, 5, 6, 7, 8, 9\}$$

The same set can be written in either form.

$$\{1, 3, 5, \dots\} = \{x : x \text{ is an odd natural number}\}$$

ROSTER FORM: WORKED EXAMPLES

From an equation

Write the solution set in roster form.

$$x^2 + x - 2 = 0$$

Factorise the quadratic.

$$(x - 1)(x + 2) = 0$$

A product is zero when at least one factor is zero.

$$x - 1 = 0 \quad \text{or} \quad x + 2 = 0$$

$$x = 1 \quad \text{or} \quad x = -2$$

List both solutions inside braces.

$$\text{Solution set} = \{1, -2\}$$

From a condition

Write this set in roster form.

$$\{x : x \text{ is a positive integer and } x^2 < 40\}$$

Start with positive integers and compare their squares with the limit.

$$1^2 = 1, \quad 2^2 = 4, \quad 3^2 = 9$$

$$4^2 = 16, \quad 5^2 = 25, \quad 6^2 = 36$$

$$7^2 = 49 > 40$$

The first six positive integers satisfy the condition. Larger positive integers do not.

$$\text{Required set} = \{1, 2, 3, 4, 5, 6\}$$



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