

CLASS 9 MATHEMATICS – CHAPTER 1

NOTES

Orienting Yourself: The Use of Coordinates

 **New NCERT Ganita Manjari | Grade 9 | Part I | 2026–27**

These notes are prepared **according to the new 2026–27 Class 9 Mathematics syllabus and the Ganita Manjari textbook** rather than the old Class 9 Coordinate Geometry chapter. The new curriculum emphasises conceptual understanding, visualisation, logical reasoning, real-life applications and computational thinking.

The textbook chapter begins with the history and real-life use of coordinate systems, then develops the **2-D Cartesian coordinate system, coordinates of points, quadrants, distance between two points and reflection**.

CHAPTER 1: ORIENTING YOURSELF – THE USE OF COORDINATES

Learning Objectives

After studying this chapter, you should be able to:

- ✓ Understand what a coordinate system is
- ✓ Explain how coordinates help us locate objects
- ✓ Understand the **2-D Cartesian coordinate system**
- ✓ Identify the **x-axis, y-axis and origin**
- ✓ Write coordinates in the correct order (x, y)
- ✓ Locate points on a coordinate plane
- ✓ Identify the four quadrants
- ✓ Determine the signs of coordinates in each quadrant
- ✓ Find distances between points
- ✓ Use the **Baudhāyana–Pythagoras theorem** to find distance
- ✓ Understand reflection of points and figures

- ✓ Apply coordinates to real-life situations such as floor plans and maps
 - ✓ Use coordinate reasoning to solve problems logically
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1. INTRODUCTION TO COORDINATES

What is a Coordinate System?

A **coordinate system** is a structured system that uses numbers to describe the exact position of a point or object.

 For example:

- A map uses locations to identify places.
- A chessboard uses rows and columns to locate a piece.
- Graph paper uses coordinates to locate points.
- A floor plan can use coordinates to locate doors, furniture and rooms.

The textbook describes coordinate systems as similar to the grid lines used on maps and graph paper.

Why are coordinates useful?

Coordinates allow us to:

-  Locate an object precisely
 -  Identify places on maps
 -  Represent geometric figures
 -  Draw graphs
 -  Design floor plans
 -  Navigate from one location to another
 -  Create computer graphics
 -  Locate objects in space
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2. COORDINATES AND THEIR HISTORICAL DEVELOPMENT

The new textbook gives considerable importance to the **history of mathematical ideas**, including contributions from India.

Sindhu-Sarasvatī Civilisation

The textbook connects coordinate-like grid thinking with the planning of cities in the **Sindhu-Sarasvatī Civilisation**.

Cities used carefully planned:

-  North–South directions
-  South–North directions
-  East–West directions

This helped people locate streets, shops and buildings using distances from reference points.

Baudhāyana

Baudhāyana used East–West and North–South lines in geometric constructions.

His work is connected with the **Baudhāyana–Pythagoras theorem**, which becomes important later in this chapter for finding the distance between two points.

Brahmagupta

Brahmagupta played an important role in formalising the use of **zero and negative numbers**.

Negative numbers are extremely important in coordinate geometry because they allow us to represent positions to the left and below the origin.

Āryabhaṭa

Āryabhaṭa worked with coordinates in astronomy and used mathematical methods to describe the positions of stars and cities.

Ujjayinī

The textbook discusses **Ujjayinī** as an important reference meridian in the history of geographical coordinates.

René Descartes

Later, **René Descartes** formalised the idea that a point in a two-dimensional plane can be represented using two numbers.

This system is called the **Cartesian coordinate system**.

📌 This brought together:

Geometry + Algebra = Coordinate Geometry

3. REAL-LIFE APPLICATION: A FLOOR PLAN

The textbook introduces coordinates through the story of **Reiaan and Shalini**.

Shalini creates a grid representing the floor of a room so that positions of objects can be identified using coordinates.

📌 A scale such as:

1 cm : 1 foot

can be used to represent actual distances on a drawing.

Important idea

A floor plan represents the **floor**, so objects whose positions depend on height, such as windows, cannot necessarily be represented correctly on a simple floor map.

This shows an important feature of mathematical models:

A model represents only the information relevant to the situation being studied.

4. THE 2-D CARTESIAN COORDINATE SYSTEM

◆ What is a 2-D coordinate system?

A **two-dimensional coordinate system** uses two perpendicular lines to locate points in a plane.

These two lines are:

→ **x-axis** – horizontal

↑ **y-axis** – vertical

They intersect at one point called the **origin**.

★ Important Terms

Term	Meaning
x-axis	Horizontal reference line
y-axis	Vertical reference line
Origin	Point where x-axis and y-axis meet
Coordinate plane	Plane containing the two axes
x-coordinate	First coordinate
y-coordinate	Second coordinate

★ 5. THE ORIGIN

The point where the x-axis and y-axis intersect is called the **origin**.

It is represented by:

$$O = (0, 0)$$

Therefore:

📌 x-coordinate of origin = 0

📌 y-coordinate of origin = 0

So:

$$★ \text{Origin} = (0, 0)$$

6. POSITIVE AND NEGATIVE DIRECTIONS

Starting from the origin:

On the x-axis

 Right = **positive**

 Left = **negative**

On the y-axis

 Upward = **positive**

 Downward = **negative**

Easy Memory Trick

RIGHT = $+x$ 

LEFT = $-x$ 

UP = $+y$ 

DOWN = $-y$ 

The textbook follows exactly this sign convention.

7. COORDINATES OF A POINT

The position of a point is represented using an ordered pair:

(x, y)

where:

 x = x-coordinate

 y = y-coordinate

 **Very Important**

The order is always:

First → **x-coordinate**

Second → **y-coordinate**

Example:

$$P = (4, 3)$$

means:

→ Move **4 units horizontally** from the origin

↑ Move **3 units vertically**



8. ORDER OF COORDINATES MATTERS

(x, y) and (y, x) are generally **different points**.

For example:

$$A = (2, 5)$$

and

$$B = (5, 2)$$

are different points.

They are equal only when:

$$x = y$$

For example:

$$(4, 4) = (4, 4)$$

But:

$$(2, 5) \neq (5, 2)$$

The textbook specifically asks students to reason about this relationship.

9. POINTS ON THE X-AXIS

Any point lying on the x-axis has:

$$y = 0$$

Therefore, its general form is:

$$(x, 0)$$

Examples:

$$A = (5, 0)$$

$$B = (-3, 0)$$

$$C = (7.5, 0)$$

All these points lie on the x-axis.

Why?

Because their vertical distance from the x-axis is zero.

10. POINTS ON THE Y-AXIS

Any point lying on the y-axis has:

$$x = 0$$

Therefore, its general form is:

$$(0, y)$$

Examples:

$$P = (0, 4)$$
$$Q = (0, -6)$$
$$R = (0, 2.5)$$

All lie on the y-axis.

The textbook illustrates points such as $(4.5, 0)$, $(0, -4.5)$ and $(0, 4)$.

11. IMPORTANT AXIS RULE

Remember:

 **x-axis** $\rightarrow y = 0$

$$(x, 0)$$

 **y-axis** $\rightarrow x = 0$

$$(0, y)$$

 **Origin**

$$(0, 0)$$

 **Trick:**

The coordinate that becomes zero tells you the axis.

12. CARTESIAN PLANE

The plane containing the x-axis and y-axis is called the:

Cartesian Plane

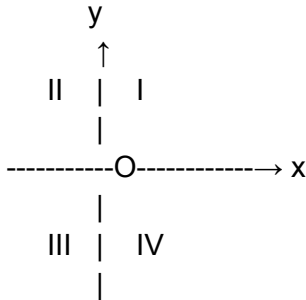
It is also called:

- Coordinate Plane
- xy-plane

The two axes divide the plane into **four parts** called **quadrants**.

13. THE FOUR QUADRANTS

The four quadrants are numbered **anticlockwise** starting from the upper-right region.



Quadrant I

Both coordinates are positive.

(+, +)

Example:

(3, 5)

Quadrant II

x-coordinate is negative and y-coordinate is positive.

(-, +)

Example:

(-4, 3)

Quadrant III

Both coordinates are negative.

$(-, -)$

Example:

$(-5, -2)$

Quadrant IV

x-coordinate is positive and y-coordinate is negative.

$(+, -)$

Example:

$(6, -4)$



QUADRANT MEMORY TRICK

Remember the signs in anticlockwise order:

I $\rightarrow (+, +)$

II $\rightarrow (-, +)$

III $\rightarrow (-, -)$

IV $\rightarrow (+, -)$

Or remember:

All $\rightarrow$ Students $\rightarrow$ Take $\rightarrow$ Coffee

- I $\rightarrow$ All positive

- II $\rightarrow$ x negative, y positive
 - III $\rightarrow$ both negative
 - IV $\rightarrow$ x positive, y negative
-

14. HOW TO IDENTIFY THE QUADRANT

Suppose:

$$P = (3, -5)$$

$$x = +3$$

$$y = -5$$

Therefore:

$$(+, -) \rightarrow \text{Quadrant IV}$$

The textbook gives this exact type of example.

Example 2

$$Q = (-5, 3)$$

$$x = -5$$

$$y = +3$$

Therefore:

$$(-, +) \rightarrow \text{Quadrant II}$$



IMPORTANT

Points lying on an axis are not in any quadrant.

For example:

$(4, 0) \rightarrow$ x-axis

$(-3, 0) \rightarrow$ x-axis

$(0, 5) \rightarrow$ y-axis

$(0, -2) \rightarrow$ y-axis

$(0, 0) \rightarrow$ origin



15. DISTANCE BETWEEN TWO POINTS

The chapter next introduces distance between points in the 2-D plane.

There are two situations.



Case 1: Points on a Horizontal Line

If two points have the same y-coordinate:

$A(x_1, y)$ and $B(x_2, y)$

then the horizontal distance is:

$$\text{Distance} = |x_2 - x_1|$$

Example:

$A = (2, 4)$

$B = (7, 4)$

Distance:

$$= |7 - 2|$$

$$= 5 \text{ units}$$

Case 2: Points on a Vertical Line

If two points have the same x-coordinate:

$$A(x, y_1) \text{ and } B(x, y_2)$$

then:

$$\text{Distance} = |y_2 - y_1|$$

Example:

$$A = (3, 2)$$

$$B = (3, 8)$$

Distance:

$$= |8 - 2|$$

$$= 6 \text{ units}$$



16. DISTANCE BETWEEN ANY TWO POINTS

Suppose:

$$A = (x_1, y_1)$$

and

$$B = (x_2, y_2)$$

The horizontal change is:

$$x_2 - x_1$$

The vertical change is:

$$y_2 - y_1$$

These changes form the two perpendicular sides of a right triangle.

Therefore, using the **Baudhāyana–Pythagoras theorem**:

Distance Formula

$$AB = \sqrt{[(x_2 - x_1)^2 + (y_2 - y_1)^2]}$$

The textbook derives the formula using a right triangle formed by the horizontal and vertical shifts.

17. WORKED EXAMPLE – DISTANCE FORMULA

Find the distance between:

$$A = (3, 4)$$

and

$$D = (7, 1)$$

Step 1: Find horizontal change

$$7 - 3 = 4$$

Step 2: Find vertical change

$$4 - 1 = 3$$

Step 3: Apply Pythagoras

$$AD = \sqrt{4^2 + 3^2}$$

$$= \sqrt{16 + 9}$$

$$= \sqrt{25}$$

= 5 units

✓ **Answer:**

AD = 5 units

This is the worked coordinate example developed in the textbook.

18. WHY DO WE SQUARE THE DIFFERENCES?

Suppose:

$$x_2 - x_1 = -4$$

Then:

$$(-4)^2 = 16$$

So the negative sign disappears.

Similarly:

$$(-3)^2 = 9$$

Therefore:

$$\sqrt{(-4)^2 + (-3)^2}$$

$$= \sqrt{16 + 9}$$

$$= 5$$

★ **Important:**

The signs of the coordinate differences do not affect the final distance because the differences are **squared**.



19. REFLECTION IN THE COORDINATE PLANE

Reflection means creating the **mirror image** of a point or figure.

For example, when a figure is reflected in the y-axis, it appears as if the y-axis is a mirror.

The textbook demonstrates this using triangle ADM and its reflection.



20. REFLECTION IN THE Y-AXIS

When a point:

$$P = (x, y)$$

is reflected in the **y-axis**:

$$(x, y) \rightarrow (-x, y)$$

Only the **x-coordinate** changes sign.

Example:

$$P = (3, 4)$$

Reflection in y-axis:

$$P' = (-3, 4)$$

Another example:

$$A = (-5, 2)$$

Reflection in y-axis:

$$A' = (5, 2)$$



21. REFLECTION IN THE X-AXIS

When a point:

$$P = (x, y)$$

is reflected in the **x-axis**:

$$(x, y) \rightarrow (x, -y)$$

Only the **y-coordinate** changes sign.

Example:

$$P = (3, 4)$$

Reflection in x-axis:

$$P' = (3, -4)$$



REFLECTION MEMORY TRICK

Reflection in Y-axis → Change X

$$(x, y) \rightarrow (-x, y)$$

Reflection in X-axis → Change Y

$$(x, y) \rightarrow (x, -y)$$

★ The axis of reflection is **NOT** changed; the other coordinate changes sign.



22. REFLECTION PRESERVES DISTANCE

When a figure is reflected:

- ✓ Lengths remain the same
- ✓ Shape remains the same
- ✓ Corresponding points are at equal distances from the mirror axis

The textbook verifies that the side lengths of the reflected triangle remain unchanged.

Therefore:

Reflection changes position, but not size or shape.

23. COORDINATE REASONING

Coordinates can be used to determine whether lines are:

- Horizontal
- ↑ Vertical
- ↔ Parallel to an axis
- ⊥ Perpendicular to another line
- Mirror images

Horizontal line

Points have the **same y-coordinate**.

Example:

A(2, 5) and B(7, 5)

Vertical line

Points have the **same x-coordinate**.

Example:

P(-3, 2) and Q(-3, 8)



24. SAME X-COORDINATE

If two points have the same x-coordinate:

$$A(x, y_1)$$

$$B(x, y_2)$$

then they lie on a line **parallel to the y-axis**.

Example:

$$A(4, 2)$$

$$B(4, 7)$$

→ AB is vertical.



25. SAME Y-COORDINATE

If two points have the same y-coordinate:

$$A(x_1, y)$$

$$B(x_2, y)$$

then they lie on a line **parallel to the x-axis**.

Example:

$$A(2, 5)$$

$$B(8, 5)$$

→ AB is horizontal.



26. MIDPOINT IDEA

Coordinate reasoning can also be used to identify whether a point is the **midpoint** of a line segment.

For points:

$$S = (x_1, y_1)$$

and

$$T = (x_2, y_2)$$

the midpoint is:

$$M = ((x_1 + x_2)/2, (y_1 + y_2)/2)$$

Example:

$$S = (2, 4)$$

$$T = (8, 10)$$

Then:

$$M = ((2 + 8)/2, (4 + 10)/2)$$

$$M = (10/2, 14/2)$$

$$M = (5, 7)$$

This coordinate relationship is also used in the chapter's end-of-chapter exercises.



27. CHECKING WHETHER THREE POINTS ARE COLLINEAR

Collinear points are points that lie on the same straight line.

For example:

$$A(-3, -4)$$

$$B(0, 0)$$

$$C(6, 8)$$

can be checked using coordinate relationships.

One useful method is to compare the ratios of coordinate changes.

For the textbook's example:

From A to B:

$$\Delta y / \Delta x = 4/3$$

From B to C:

$$\Delta y / \Delta x = 8/6 = 4/3$$

Since the ratios are equal, the points lie on the same straight line.



28. APPLICATIONS OF COORDINATES

Coordinates are not just theoretical mathematics.

They are used in:



Floor plans – locating furniture and doors



Maps – locating places



Navigation – determining positions



Aviation – locating aircraft



Astronomy – locating celestial objects



Computer graphics – positioning objects on a screen



Video games – determining character and object positions



Architecture – designing structures



Graphs – representing mathematical relationships

The textbook specifically develops applications through room layouts and coordinate-based spatial reasoning.



29. IMPORTANT FORMULAS



Coordinates of a point

$$P = (x, y)$$

Point on x-axis

$(x, 0)$

Point on y-axis

$(0, y)$

Origin

$(0, 0)$

Horizontal distance

Distance = $|x_2 - x_1|$

Vertical distance

Distance = $|y_2 - y_1|$

Distance between two points

$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Midpoint

$$M = ((x_1 + x_2)/2, (y_1 + y_2)/2)$$

Reflection in y-axis

$$(x, y) \rightarrow (-x, y)$$

Reflection in x-axis

$$(x, y) \rightarrow (x, -y)$$



30. QUICK QUADRANT TABLE

Quadrant	x-coordinat e	y-coordinat e	Sign
I	Positive	Positive	(+, +)
II	Negative	Positive	(-, +)
III	Negative	Negative	(-, -)
IV	Positive	Negative	(+, -)

31. MOST IMPORTANT POINTS FOR EXAM

- ◆ Coordinates are written as (x, y) .
 - ◆ The first coordinate is always the **x-coordinate**.
 - ◆ The second coordinate is always the **y-coordinate**.
 - ◆ The x-axis is horizontal.
 - ◆ The y-axis is vertical.
 - ◆ The origin is $(0, 0)$.
 - ◆ A point on the x-axis has $y = 0$.
 - ◆ A point on the y-axis has $x = 0$.
 - ◆ The coordinate plane has **four quadrants**.
 - ◆ Quadrant I = $(+, +)$.
 - ◆ Quadrant II = $(-, +)$.
 - ◆ Quadrant III = $(-, -)$.
 - ◆ Quadrant IV = $(+, -)$.
 - ◆ Distance is found using the **Baudhāyana–Pythagoras theorem**.
 - ◆ Reflection in the y-axis changes the sign of x .
 - ◆ Reflection in the x-axis changes the sign of y .
 - ◆ Reflection preserves lengths.
 - ◆ (x, y) and (y, x) are generally different points.
-

32. COMMON MISTAKES TO AVOID

Mistake 1

Writing (y, x) instead of (x, y) .

Correct

Always write:

(x, y)

Mistake 2

Saying $(0, 5)$ lies on the x-axis.

Correct

$(0, 5)$ lies on the **y-axis**.

✗ Mistake 3

Saying $(5, 0)$ lies on the y-axis.

✓ Correct

$(5, 0)$ lies on the **x-axis**.

✗ Mistake 4

Forgetting negative signs.

$(-4, 3) \rightarrow$ Quadrant II

not Quadrant I.

✗ Mistake 5

Changing both coordinates during reflection.

For y-axis reflection:

$(x, y) \rightarrow (-x, y)$

Only **x** changes.

✗ Mistake 6

Using subtraction without squaring in the distance formula.

✓ Correct

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

33. COMPETENCY-BASED THINKING

The new syllabus places strong emphasis on **problem-solving, visualisation, mathematical modelling, computational thinking and real-life applications.**

For this chapter, you should therefore be prepared for questions such as:

 **Identify:** Which quadrant contains a point?

 **Reason:** Why does $(x, 0)$ lie on the x-axis?

 **Apply:** Find the distance between two points.

 **Model:** Represent a room or floor plan using coordinates.

 **Analyse:** Determine the coordinates of a reflected point.

 **Compare:** Explain why (x, y) and (y, x) are different.

 **Create:** Choose coordinates to construct a particular geometric figure.

The syllabus specifically expects students to specify locations using coordinates, represent floor plans, calculate distances, determine whether points lie in a straight line, find midpoints and verify geometric properties through systematic reasoning.

34. TEXTBOOK-BASED PRACTICE AREAS

The new textbook's Chapter 1 exercises include applications such as:

 locating objects in a room

 plotting points

 finding lengths

 analysing door widths

 interpreting bathroom layouts

 identifying coordinates of corners

 finding distances

 constructing right-angled triangles

 identifying mirror images

 checking whether points are collinear

- ▲ constructing triangles using coordinates
- ÷ checking midpoint relationships

The end-of-chapter questions include both direct questions and higher-level/application problems.



35. ONE-PAGE REVISION



Coordinate System

A numerical system used to locate points.



Cartesian Plane

Plane formed by the x-axis and y-axis.



Origin

$(0, 0)$



x-axis

Horizontal line.



y-axis

Vertical line.



Point

(x, y)



Quadrant I

$(+, +)$



Quadrant II

$(-, +)$

Quadrant III

$(-, -)$

Quadrant IV

$(+, -)$

Horizontal distance

$$|x_2 - x_1|$$

Vertical distance

$$|y_2 - y_1|$$

Distance formula

$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Reflection in y-axis

$$(x, y) \rightarrow (-x, y)$$

Reflection in x-axis

$$(x, y) \rightarrow (x, -y)$$

Midpoint

$$((x_1 + x_2)/2, (y_1 + y_2)/2)$$



CHAPTER TAKEAWAY

Coordinates give us a mathematical language for describing location. 

The chapter progresses from the simple idea of locating an object on a grid to the full **2-D Cartesian coordinate system**. We learn how to identify axes, origin and quadrants, represent points using ordered pairs, calculate distances and understand reflections.

 **Remember:**

Locate → **Plot** → **Identify** → **Measure** → **Reflect** → **Reason**     

This is the foundation for much of the coordinate geometry and graphical mathematics you will study in higher classes.