



Orienting Yourself: The Use of Coordinates

Lecture 01

CLASS-9TH

MATHS

UDAY ~~Sir~~ *Bhai*

Physics Wallah

Topics To Be Covered

1 Introduction

Index

1 Chapter 1: Orienting Yourself: The Use of Coordinates

2 Chapter 2: Introduction to Linear Polynomials

3 Chapter 3: The World of Numbers

4 Chapter 4: Exploring Algebraic Identities

Index

5 Chapter 5: I'm Up and Down, and Round and Round

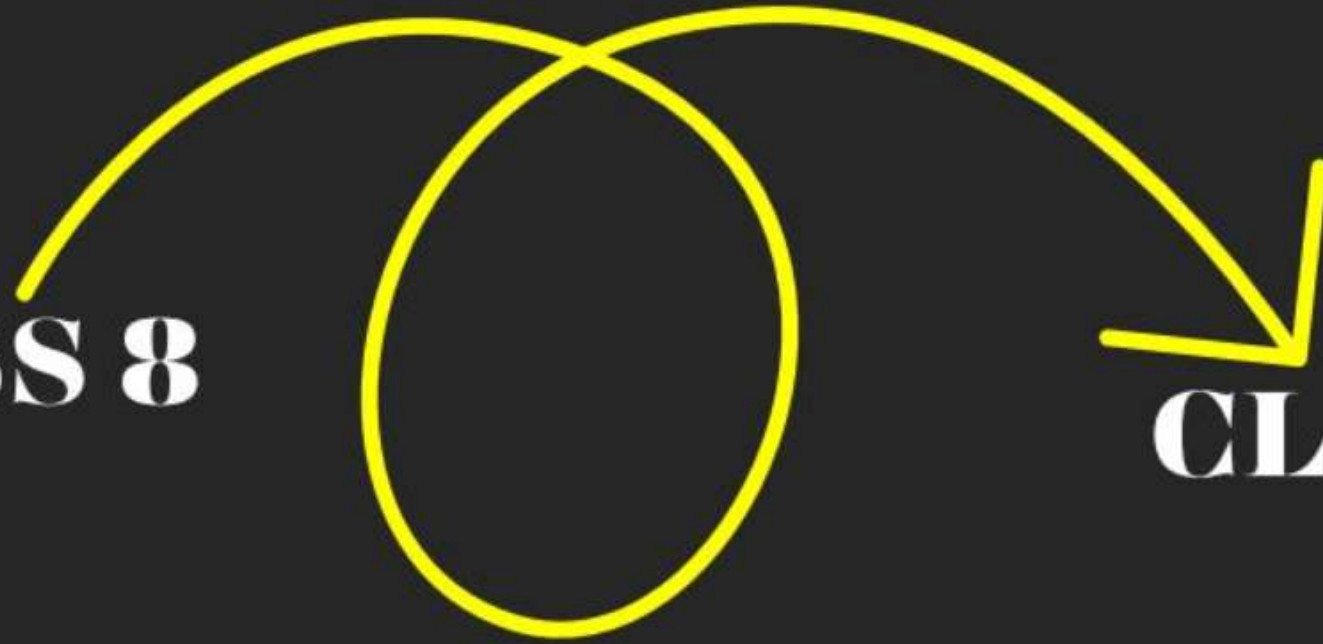
6 Chapter 6: Measuring Space: Perimeter and Area

7 Chapter 7: The Mathematics of Maybe: Introduction to Probability

8 Chapter 8: Predicting What Comes Next: Exploring Sequences and Progressions



CLASS 8



CLASS 9



A system of coordinates is a structured framework (like the grid lines on a map or graph paper) that enables us to use numbers to describe the exact physical locations of points or objects.

The idea of ‘grid-based thinking’ and the geometry required to define the locations of points in space—indeed has deep roots in Bhārat. The first systematic use of grids occurred thousands of years ago — on a massive urban scale—in the Sindhu-Sarasvatī Civilisation, where city streets were constructed with striking precision in North–South and East–West directions at uniform distances of about 10 metres apart. This was a coordinate system in practice: a merchant could find a shop or a warehouse by counting North–South and East–West units of distance from the city centre. Baudhāyana (c. 800 C.E.), as we have seen, later used East–West and North–South lines for his deep geometric constructions, developing the Baudhāyana–Pythagoras Theorem and thus laying the foundation of coordinate geometry.

Putting coordinates on the Earth’s surface later became important for navigation. Ujjayinī was described in the ancient world—at least as early as the 4th century BCE in the early Siddhāntas—as the point marking the central longitude meridian from which all other locations were measured. The Greek mathematician Ptolemy (c. 150 BCE), building on earlier works including that of Hipparchus, later described the latitudes and longitudes of thousands of locations, including ‘Ozine’ (Ujjayinī). Āryabhaṭa (c. 499 CE) replaced the Greek ‘chords’ with ‘sines’, making it much easier to calculate the coordinates of a star or a city. He mapped the sky using Celestial Coordinates, measuring coordinate distances from the ecliptic (the path of the sun).

Brahmagupta (c. 628 CE) formalised the notion and use of zero and the negative numbers as algebraic entities; in modern coordinate systems, the ‘origin’ is zero and the ‘negative axes’ represent values less than zero. Without Brahmagupta’s work, the four-quadrant Cartesian plane, as we will study in this chapter, would be impossible.

Brahmagupta's work was translated into Arabic (as the *Sindhind*), and the Ujjayinī meridian entered Arabic geography under the name 'Arin,' serving as the zero-longitude reference for early Arabic maps which also then made use of negative numbers. The influential Arab scholar Al-Bīrūnī (c. 1000 CE) travelled to India, studied the *Siddhāntas*, and used Indian trigonometric methods to calculate the coordinates of various cities across Asia. Al-Bīrūnī also later perfected the 'astrolabe', a handheld device that allowed sailors to find their coordinates by looking at the stars. Ōmar Khayyām (c. 1100 CE), who had become an expert in the Indian decimal system and algebraic formalism, was the first mathematician to solve algebraic problems using geometry by interpreting them in terms of coordinates in the plane.

These concepts eventually reached Europe in the 12th century. The final leap occurred when following the related work of Fermat (1636 CE), René Descartes (1637 CE) formalised the fact that any point in a two-dimensional plane could be defined by simply two numbers—representing the point's distances from two perpendicular axes. Points and more complex geometric shapes could then be described precisely using algebra and equations, thus bringing the areas of geometry and algebra even closer together.

In Grades 9 and 10, you will have a chance to study this amazing coordinate system which has such a rich history in human thought and endeavour. You will be able to locate objects with pinpoint accuracy. You will also see how using coordinates enables us to visualise algebraic equations as geometric shapes, and vice versa.

We begin our study of coordinates with a story that will help you understand these new terms better.

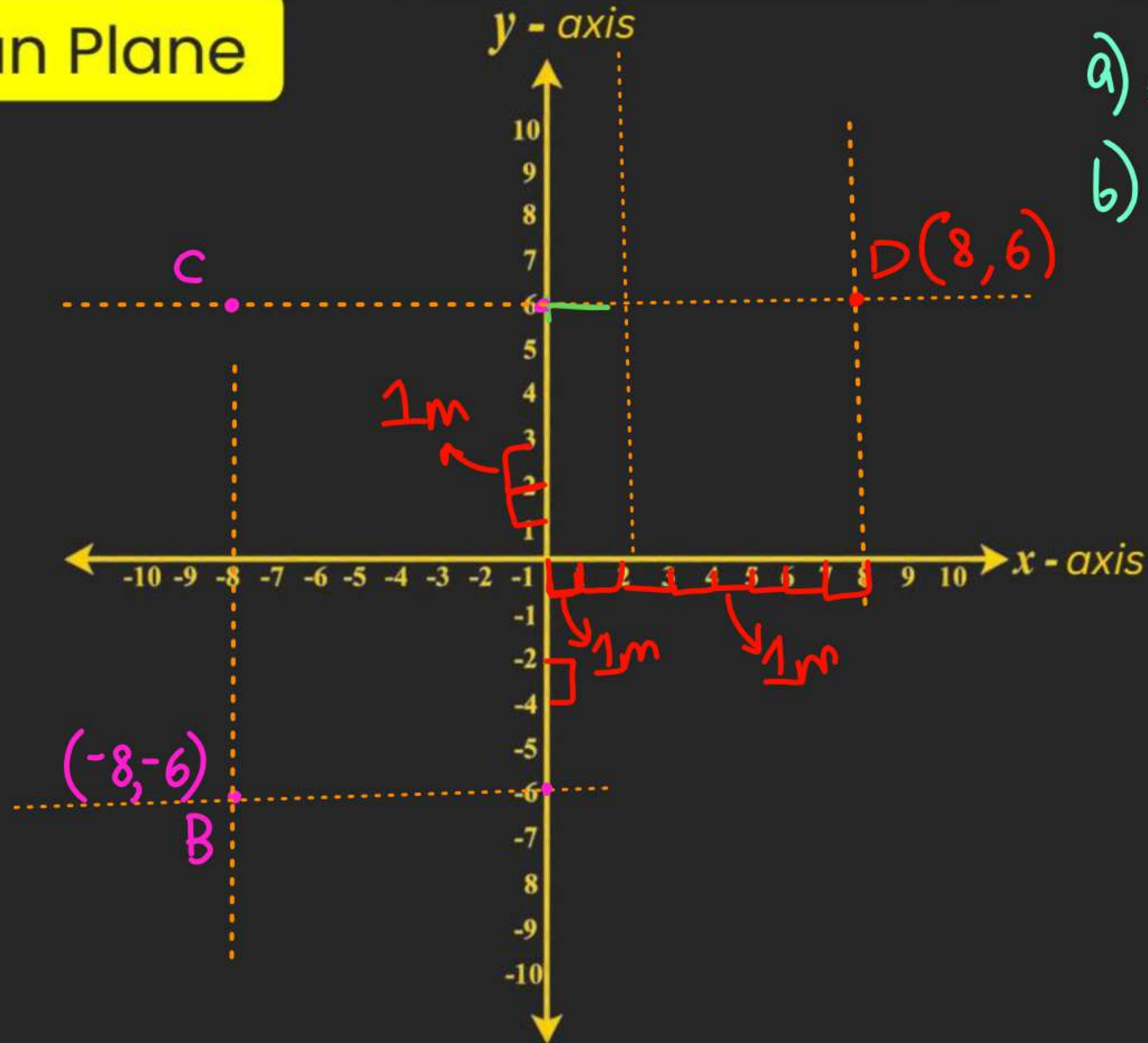
Cartesian Plane

Scale

1 unit = 1m

a) 2 unit

b) 6 unit



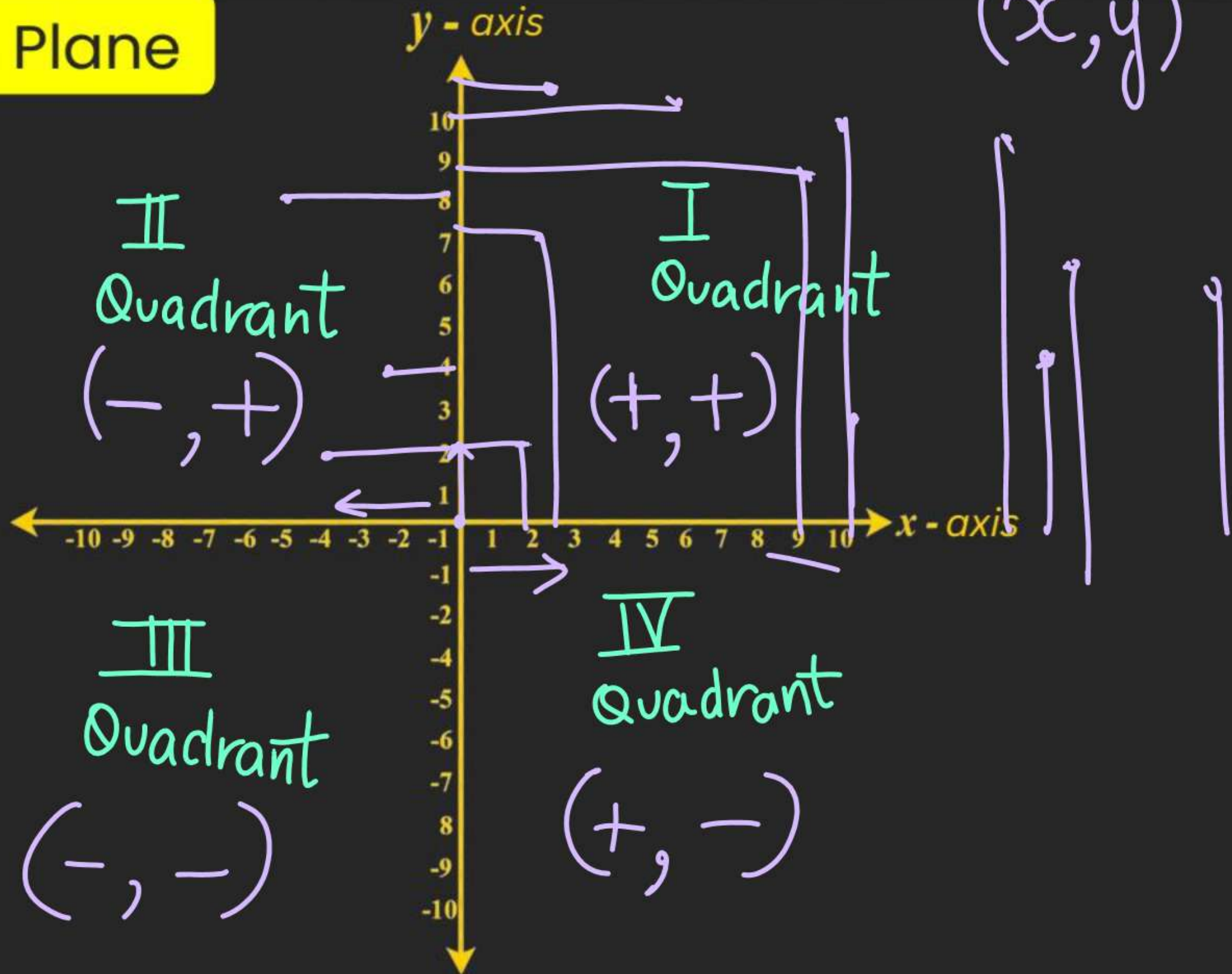
Cartesian Plane

Scale

1 unit = 1m

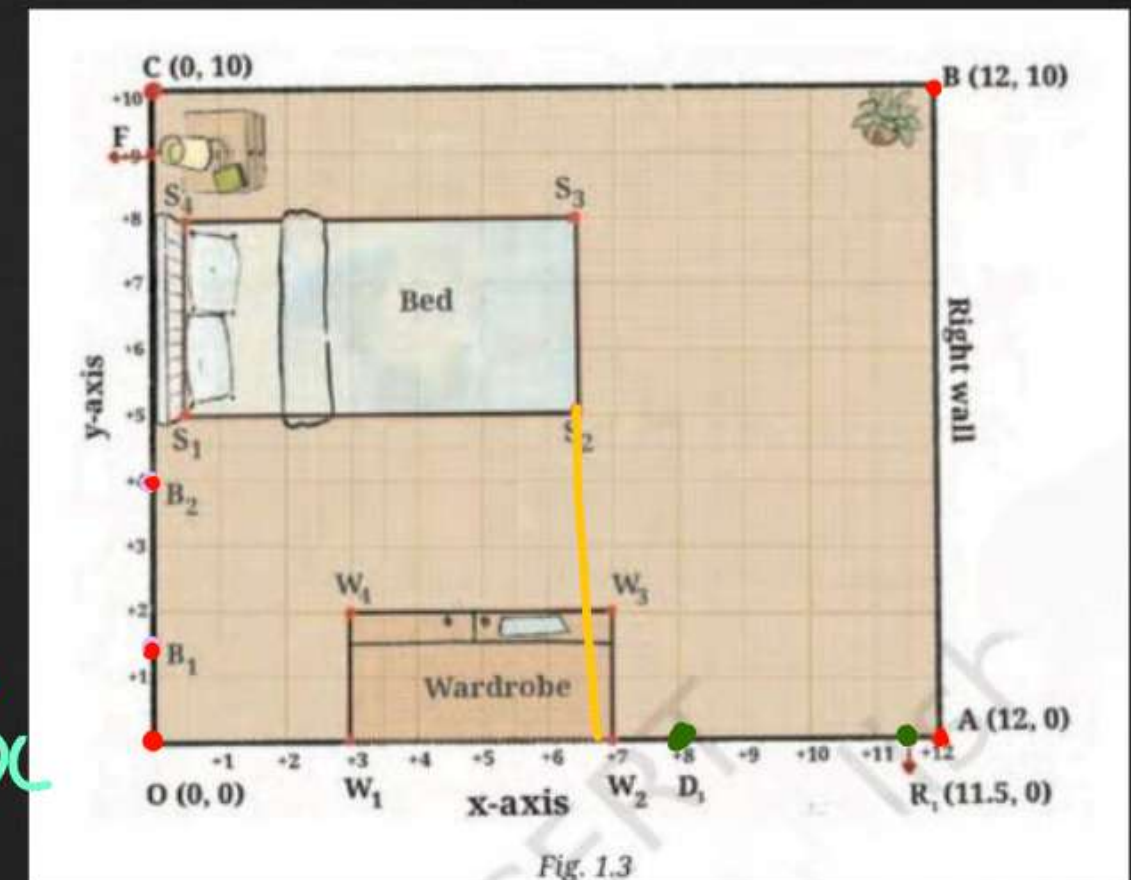
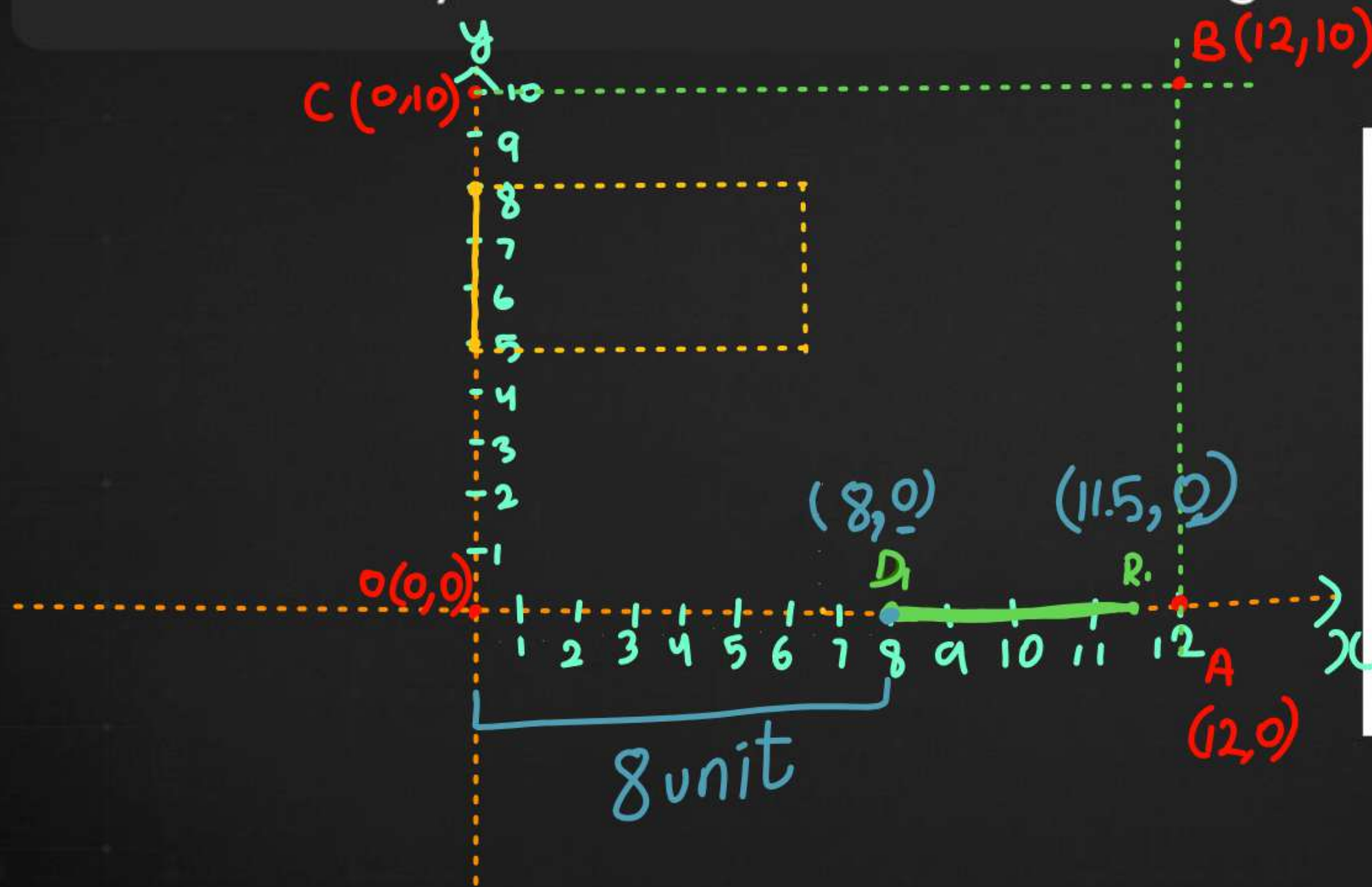
axis
↓
Singular

axes
↓
Plural



QUESTION

Fig. 1.3 shows Reiaan's room with points OABC marking its corners. The x- and y-axes are marked in the figure. Point O is the origin.



QUESTION

Referring to Fig. 1.3, answer the following questions:

- (i) If D_1R_1 represents the door to Reiaan's room, how far is the door from the left wall (the y -axis) of the room? How far is the door from the x -axis?
- (ii) What are the coordinates of D_1 ?
- (iii) If R_1 is the point $(11.5, 0)$, how wide is the door? Do you think this is a comfortable width for the room door? If a person in a wheelchair wants to enter the room, will he/she be able to do so easily?
- (iv) If $B_1 (0, 1.5)$ and $B_2 (0, 4)$ represent the ends of the bathroom door, is the bathroom door narrower or wider than the room door?

Thank,
you!