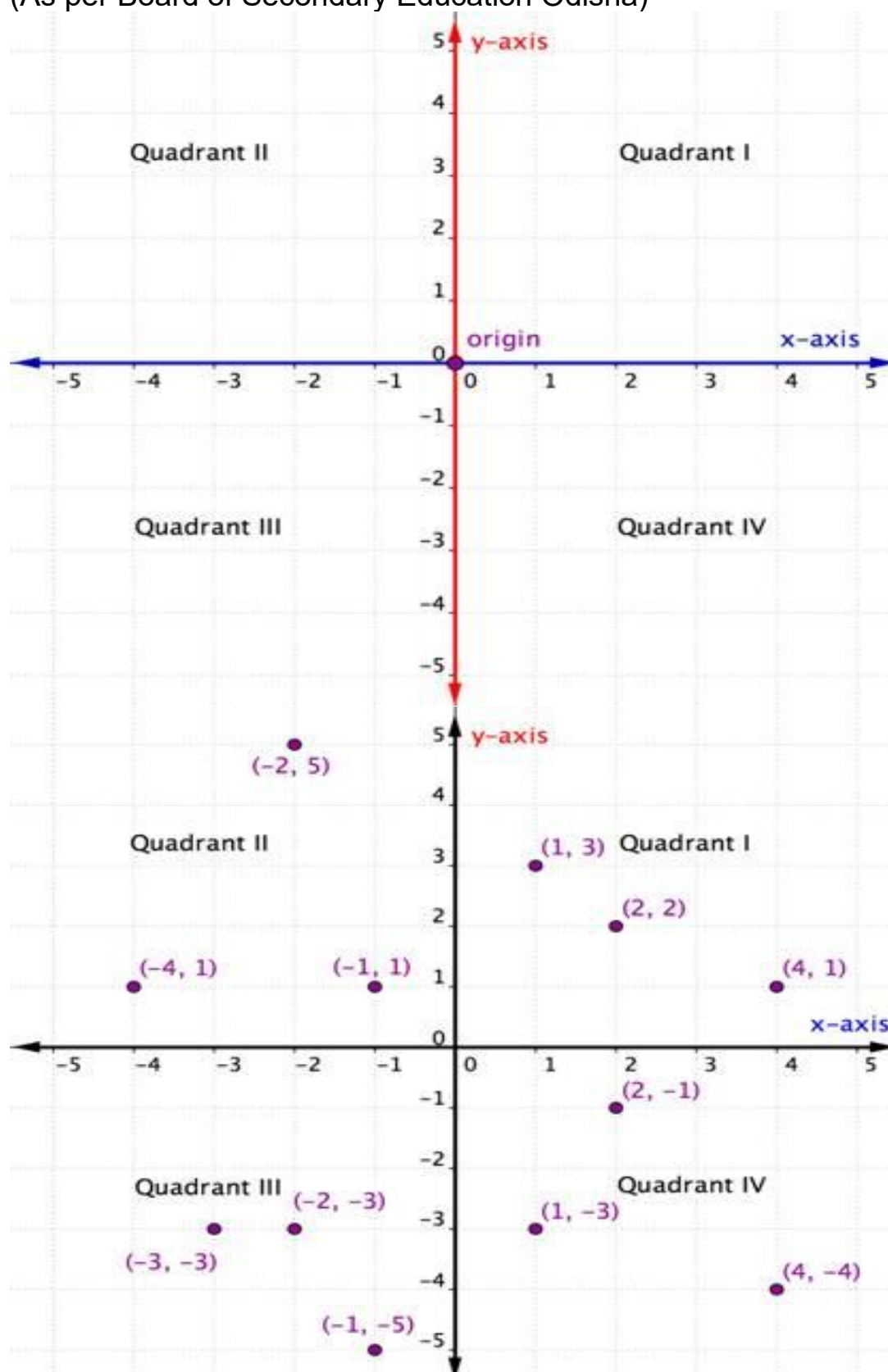


Class X Mathematics
Chapter 6: CO-ORDINATE GEOMETRY

ସ୍ଥାନାଙ୍କ ଜ୍ୟାମିତି

(As per Board of Secondary Education Odisha)





6.1 INTRODUCTION

Introduction | ପରିଚୟ

English

Coordinate Geometry helps us locate the exact position of a point on a plane using numbers. It connects **algebra** with **geometry** and is useful in distance, midpoint, area of triangle, and division of line segments.

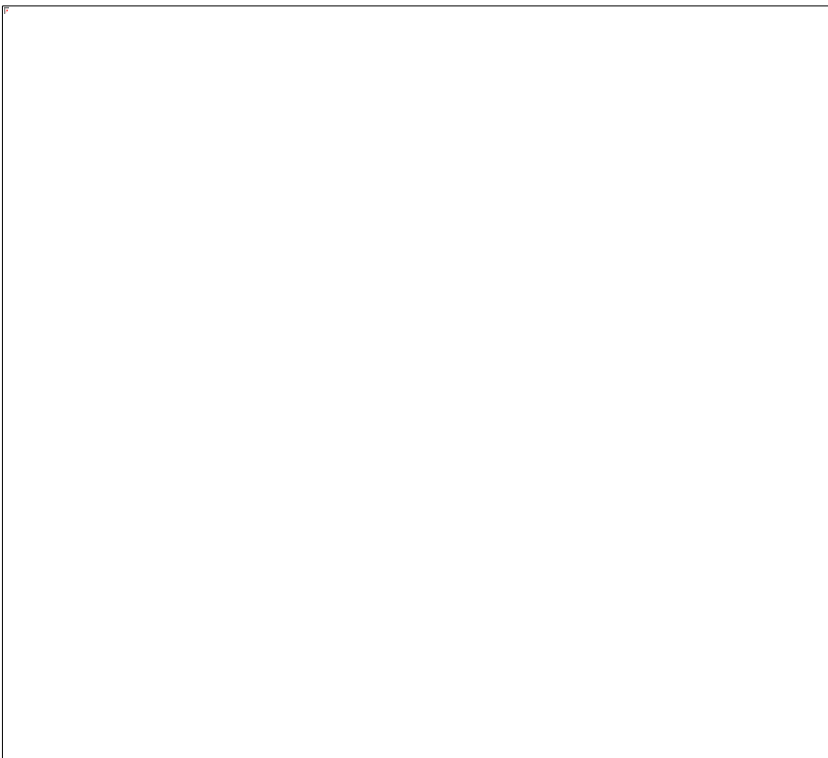
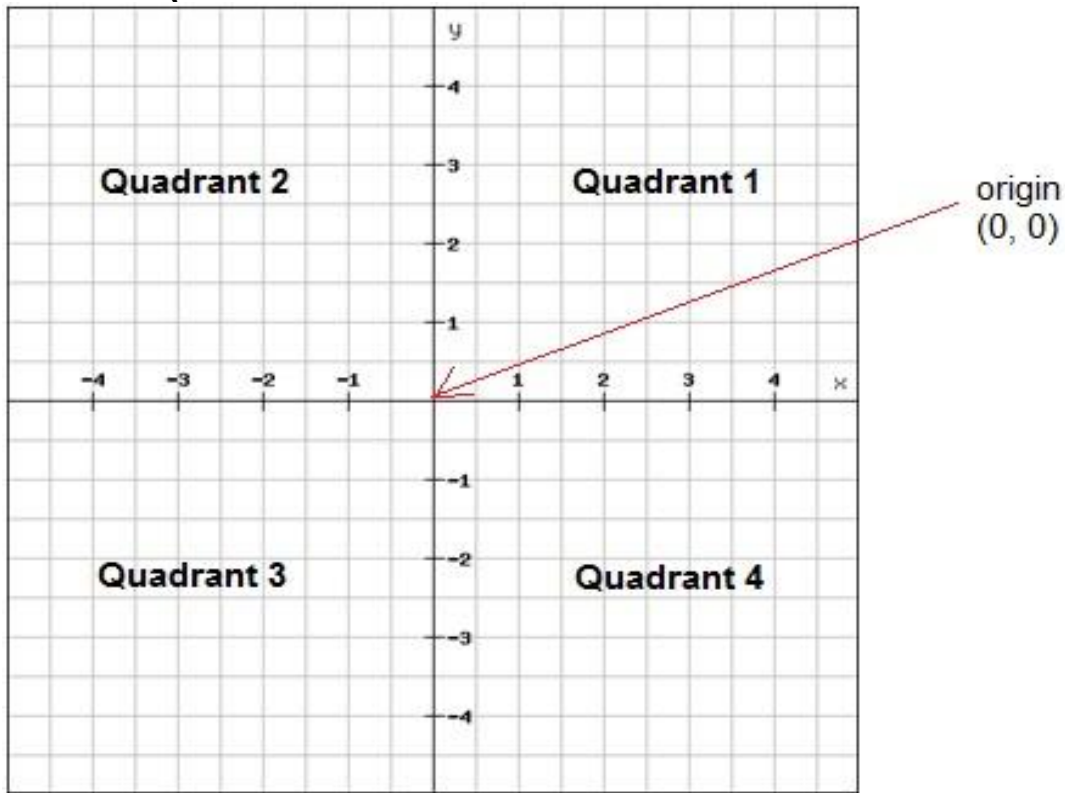
ଓଡ଼ିଆ

ସ୍ଥାନାଙ୍କ ଜ୍ୟାମିତିରେ ସଂଖ୍ୟାର ସାହାଯ୍ୟରେ ସମତଳ ଉପରେ କୌଣସି ବିନ୍ଦୁର ସଠିକ୍ ସ୍ଥାନ ନିର୍ଣ୍ଣୟ କରାଯାଏ । ଏହା ଆଲଜେବ୍ରା ଓ ଜ୍ୟାମିତିକୁ ଯୋଡ଼େ ।

6.2 CARTESIAN PLANE & CO-ORDINATES

Cartesian Plane and Cartesian Coordinates

କାର୍ଟେସିଆନ୍ ସମତଳ ଓ ସ୍ଥାନାଙ୍କ



English

- Two perpendicular number lines intersect at point **O (0,0)** called **Origin**
- Horizontal line → **x-axis**
- Vertical line → **y-axis**
- Plane is divided into **four quadrants**

•

Quadrant Condition

Q1 $x > 0, y > 0$

Q2 $x < 0, y > 0$

Q3 $x < 0, y < 0$

Q4 $x > 0, y < 0$

A point is written as **(x, y)**

- $x \rightarrow$ **Abcissa**
- $y \rightarrow$ **Ordinate**

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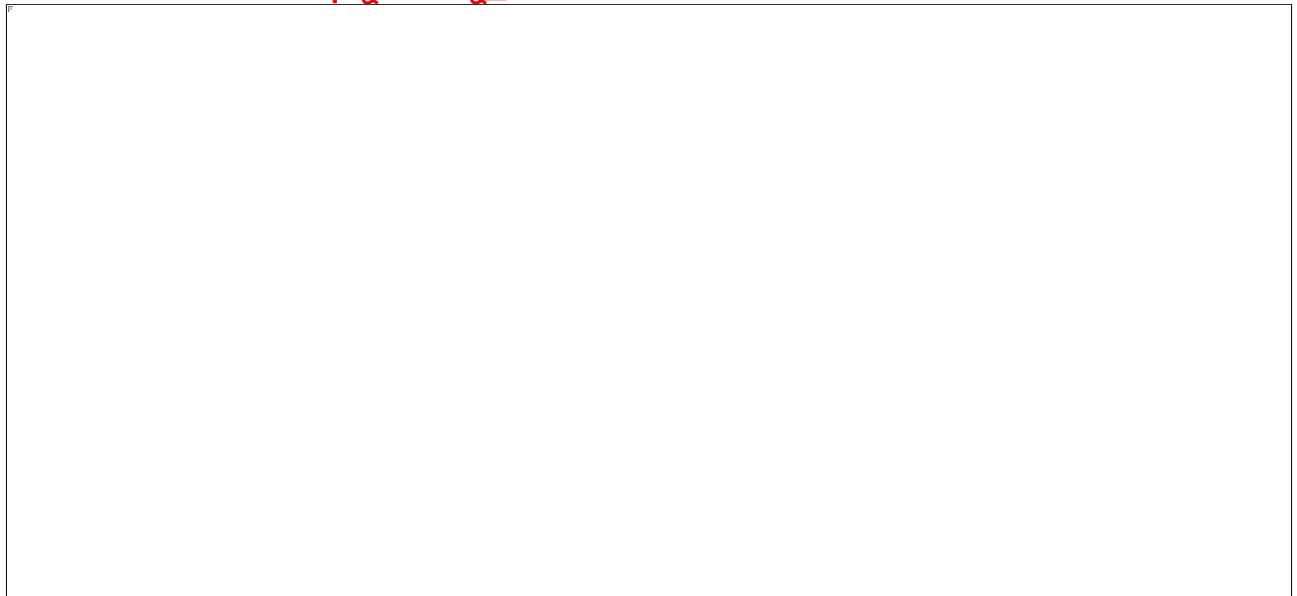
- ଦୁଇଟି ଲମ୍ବ ସଂଖ୍ୟାରେଖା $O(0,0)$ ଠାରେ କାଟେ
- ଅନୁଲମ୍ବ $\rightarrow$ x-ଅକ୍ଷ
- ଉର୍ଦ୍ଧ୍ବ $\rightarrow$ y-ଅକ୍ଷ
- ସମତଳ 4ଟି ପାଦ (Quadrants) ରେ ବିଭକ୍ତ

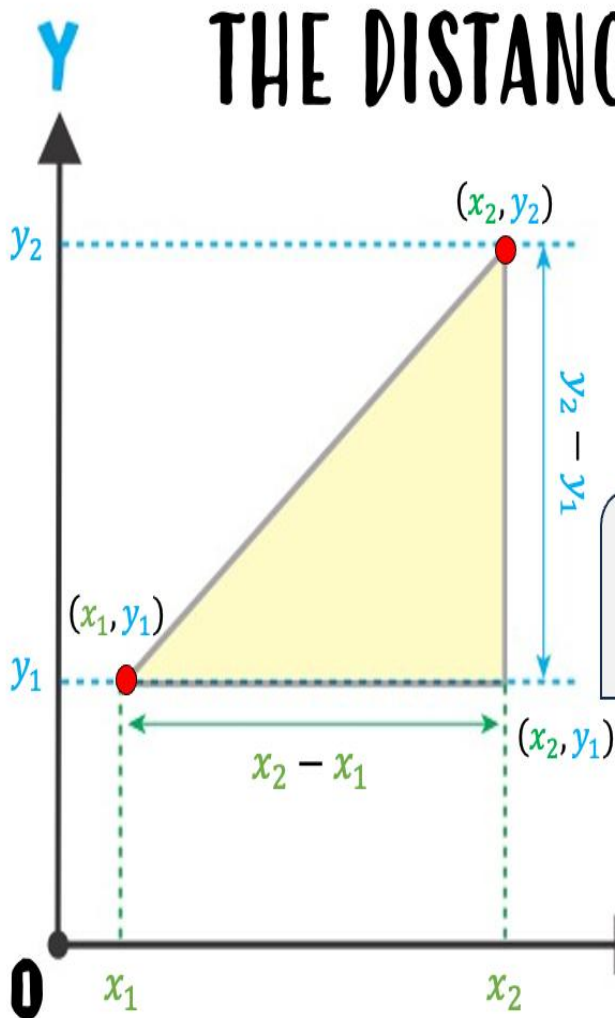
କ୍ରମିତ ଯୁଗଳ $\rightarrow$ **(x, y)**

$x =$ ଅବ୍ସିସା, $y =$ ଅର୍ଡିନେଟ୍

6.3 DISTANCE BETWEEN TWO POINTS

Distance Formula | ଦୂରତା ସୂତ୍ର





THE DISTANCE FORMULA

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The distance between the points (x_1, y_1) and (x_2, y_2) is

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

NOTE: The distance formula ALWAYS produces a positive result because the difference is squared.

Formula

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

Special Cases

- From origin $(0,0)$:

$$\sqrt{x^2 + y^2}$$

- On x-axis: $|x_2 - x_1|$
- On y-axis: $|y_2 - y_1|$

Example

Find distance between $A(0, -5)$ and $B(4, -6)$

$$= \sqrt{(4-0)^2 + (-6+5)^2} = \sqrt{16+1} = \sqrt{17}$$

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ଦୁଇ ବିନ୍ଦୁର ଦୂରତା:

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

6.4 DIVISION FORMULA

Division of a Line Segment | ବିଭାଜନ ସୂତ୍ର





Internal Division (m:n)

$$(mx_2 + nx_1, my_2 + ny_1) \left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n} \right)$$

Midpoint Formula

$$(x_1 + x_2, y_1 + y_2) \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

Example

Midpoint of (1, -2) and (-3, -4)

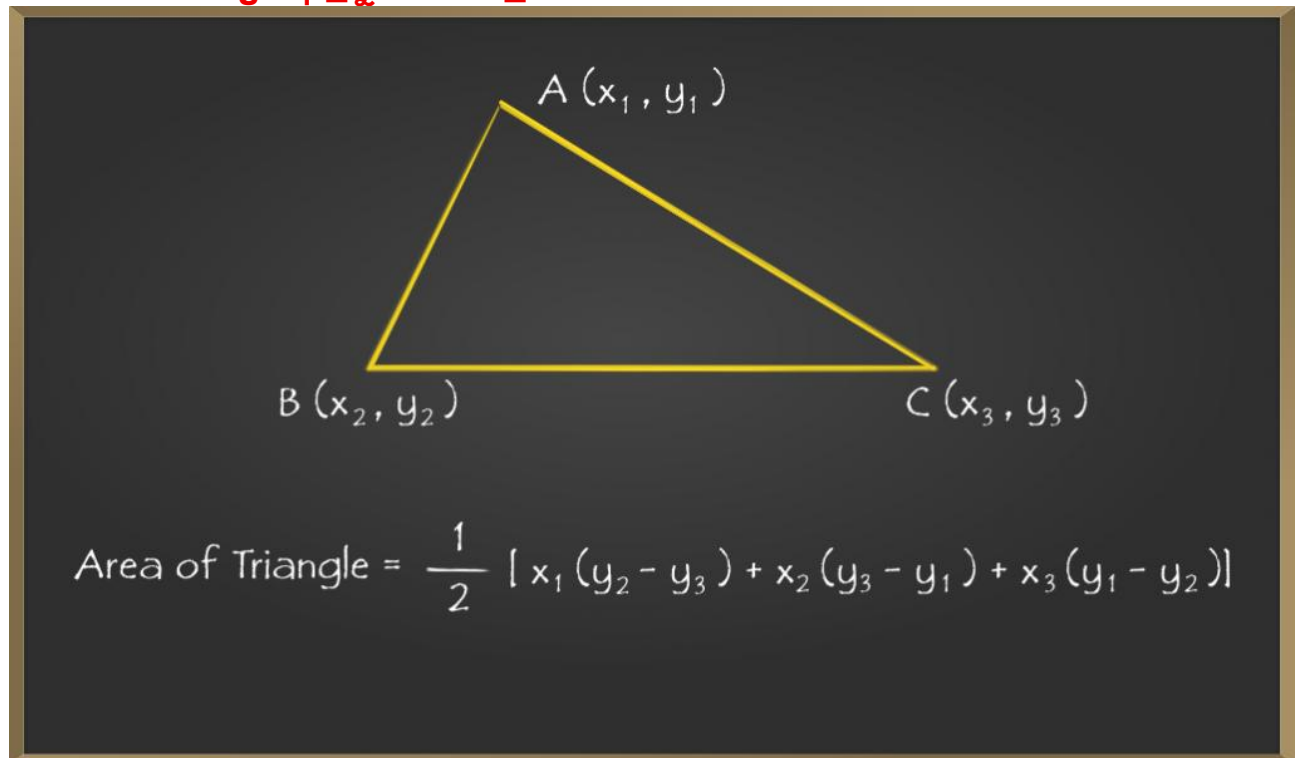
$$(1 - 3, -2 - 4) = (-1, -3) \left(\frac{1 - 3}{2}, \frac{-2 - 4}{2} \right) = (-1, -3)$$

ଓଡ଼ିଆ

ରେଖାଖଣ୍ଡକୁ m:n ଅନୁପାତରେ ଭାଗ କରିବା ସୂତ୍ର

6.5 AREA OF A TRIANGLE

Area of Triangle | ତ୍ରିଭୁଜର କ୍ଷେତ୍ରଫଳ



Formula

For points (x_1, y_1) , (x_2, y_2) , (x_3, y_3) :

$$\text{Area} = \frac{1}{2} |x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$$

Important Results

- Area = 0 $\rightarrow$ points are **collinear**
- If one vertex is origin:

$$\frac{1}{2}|x_1y_2 - x_2y_1|$$

Example

Vertices: (1,3), (-7,6), (5,-1)

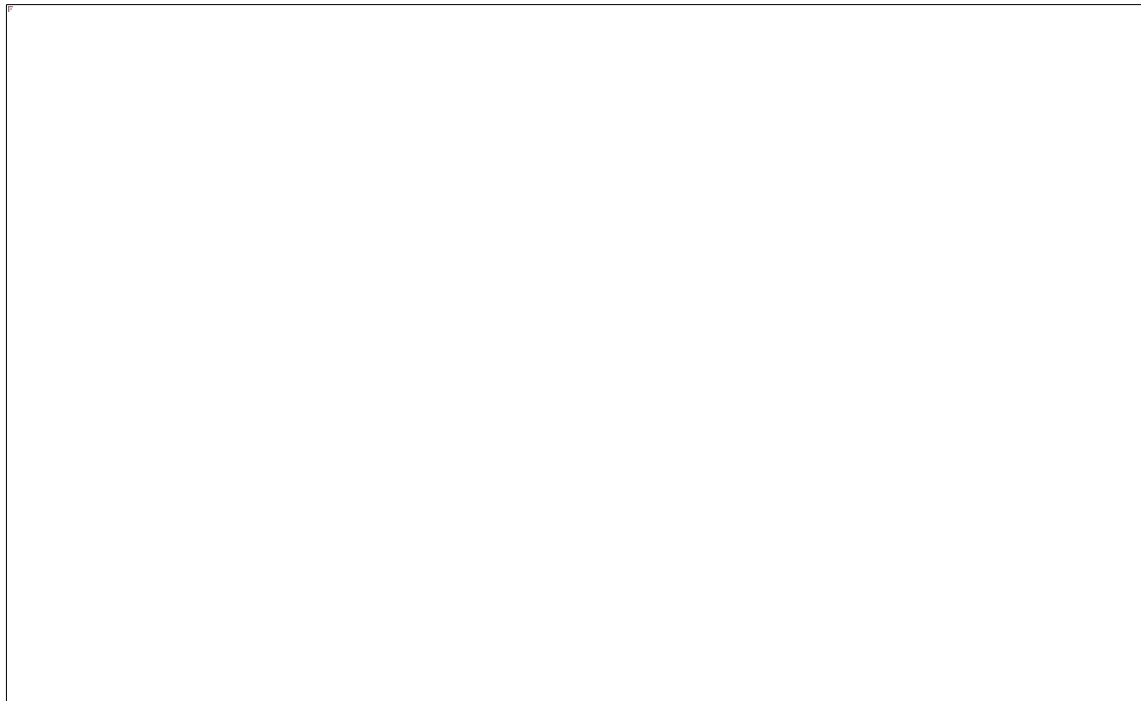
Area = **10 sq units**

ଉଦାହରଣ

କ୍ଷେତ୍ରଫଳ ଶୂନ୍ୟ ହେଲେ ବିନ୍ଦୁଗୁଡ଼ିକ ଏକରେଖୀୟ

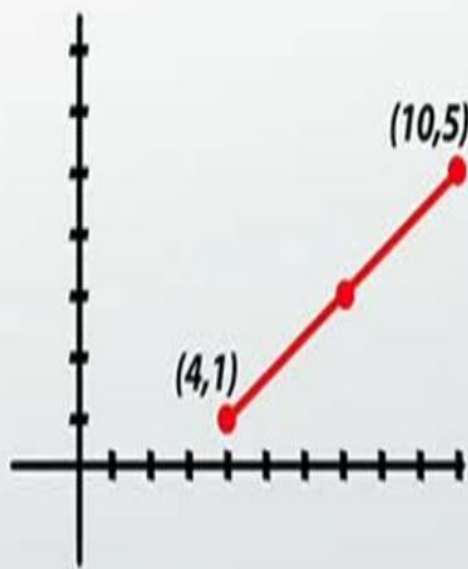
CHAPTER 6: CO-ORDINATE GEOMETRY

Key Scoring Formulas & Concepts



The Midpoint Formula

$$\text{midpoint} = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$



$$= \left(\frac{4 + 10}{2}, \frac{1 + 5}{2} \right)$$

$$= (7, 3)$$

1. DISTANCE FORMULA

Distance Between Two Points

ଦୁଇ ବିନ୍ଦୁ ମଧ୍ୟରେ ଦୂରତା

Formula | ସୂତ୍ର

For points **A(x₁, y₁)** and **B(x₂, y₂)**

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

Odia Explanation | ଓଡ଼ିଆ ବ୍ୟାଖ୍ୟା

ଦୁଇଟି ବିନ୍ଦୁର x-ସ୍ଥାନାଙ୍କର ଡିଫରେନ୍ସ ବର୍ଗ ଓ
y-ସ୍ଥାନାଙ୍କର ଡିଫରେନ୍ସ ବର୍ଗର ଯୋଗର ମୂଳ ହେଉଛି ଦୂରତା।

Special Cases | ବିଶେଷ ଅବସ୍ଥା

(i) From Origin (0,0)

$$OP = \sqrt{x^2 + y^2}$$

(ii) Points on x-axis

$$|x_2 - x_1|$$

(iii) Points on y-axis

$$|y_2 - y_1| \text{ or } |y_2 - y_1|$$

Example | ଉଦାହରଣ

Find the distance between **A(0, -5)** and **B(4, -6)**

$$(4-0)^2 + (-6+5)^2 = 16+1=17 \sqrt{(4-0)^2 + (-6+5)^2} = \sqrt{16+1} = \sqrt{17}$$

Answer | ଉତ୍ତର: $\sqrt{17}$

2. MIDPOINT FORMULA

Midpoint of a Line Segment

ମଧ୍ୟବିନ୍ଦୁ ସୂତ୍ର

Formula | ସୂତ୍ର

For points **A(x₁, y₁)** and **B(x₂, y₂)**

$$\text{Midpoint} = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

Odia Explanation | ଓଡ଼ିଆ

ଦୁଇ ବିନ୍ଦୁର x-ସ୍ଥାନାଙ୍କ ଓ y-ସ୍ଥାନାଙ୍କର ଗଠା ହେଉଛି ମଧ୍ୟବିନ୍ଦୁ ।

Example | ଉଦାହରଣ

Find midpoint of **A(1, -2)** and **B(-3, -4)**

$$\left(\frac{1-3}{2}, \frac{-2-4}{2} \right) = (-1, -3)$$

Exam Tip (Midpoint)

Asked directly or inside long questions

Very easy **2–3 sure marks**

3. DIVISION FORMULA (VERY IMPORTANT)

Division of a Line Segment

ରେଖାଖଣ୍ଡର ବିଭାଜନ

(A) INTERNAL DIVISION

ଅନ୍ତର୍ଭାଗ ବିଭାଜନ (m : n)

Formula | ସୂତ୍ର

Point **P(x, y)** dividing **A(x₁, y₁)** and **B(x₂, y₂)** in ratio **m:n**

$$P\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n} \right)$$

Odia Explanation | ଓଡ଼ିଆ

ରେଖାଖଣ୍ଡକୁ $m : n$ ଅନୁପାତରେ ଭାଗ କରୁଥିବା ବିନ୍ଦୁର ସ୍ଥାନାଙ୍କ ।

Example | ଉଦାହରଣ

Find point dividing **A(2,3)** and **B(8,5)** internally in ratio **1:2**

$$(1 \times 8 + 2 \times 2, 1 \times 5 + 2 \times 3) = (4, 11) \left(\frac{1 \times 8 + 2 \times 2}{3}, \frac{1 \times 5 + 2 \times 3}{3} \right) \\ = \left(4, \frac{11}{3} \right) (3 \times 8 + 2 \times 2, 3 \times 5 + 2 \times 3) = (4, 31)$$

(B) MIDPOINT AS A SPECIAL CASE

When $m = n$

Midpoint Formula \text{Midpoint Formula} Midpoint Formula

QUESTION TYPE – 1

Distance Between Two Points (5 Marks)

ଦୁଇ ବିନ୍ଦୁ ମଧ୍ୟରେ ଦୂରତା (୫ ମାର୍କ୍ସ)

Question (English)

Find the distance between the points **A(2, -3)** and **B(6, 3)**.

ପ୍ରଶ୍ନ (ଓଡ଼ିଆ)

A(2, -3) ଓ B(6, 3) ବିନ୍ଦୁ ଦୁଇଟିର ମଧ୍ୟରେ ଦୂରତା ନିର୍ଣ୍ଣୟ କର ।

Solution | ସମାଧାନ

Step-1 (Formula):

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

Step-2 (Substitution):

$$= \sqrt{(6 - 2)^2 + (3 - (-3))^2} = \sqrt{(6 - 2)^2 + (3 - (-3))^2}$$

Step-3 (Calculation):

$$= \sqrt{4^2 + 6^2} = \sqrt{16 + 36} = \sqrt{52} = 4\sqrt{13}$$

Answer | ଉତ୍ତର:

$$4\sqrt{13}$$

QUESTION TYPE – 2

Division Formula (Internal Division) – 5 Marks

ଅନ୍ତର୍ଭାଗ ବିଭାଜନ ସୂତ୍ର (୫ ମାର୍କ୍ସ)

Question (English)

Find the coordinates of the point which divides the line joining **A(2, 3)** and **B(8, 5)** internally in the ratio **1 : 2**.

ପ୍ରଶ୍ନ (ଓଡ଼ିଆ)

A(2, 3) ଓ B(8, 5) ବିନ୍ଦୁକୁ ଯୋଗ କରୁଥିବା ରେଖାଖଣ୍ଡକୁ **1 : 2** ଅନୁପାତରେ ଅନ୍ତର୍ଭାଗରେ ବିଭାଜନ କରୁଥିବା ବିନ୍ଦୁର ସ୍ଥାନାଙ୍କ ନିର୍ଣ୍ଣୟ କର।

Solution | ସମାଧାନ

Step-1 (Formula):

$$P\left(\frac{mx_2+nx_1}{m+n}, \frac{my_2+ny_1}{m+n}\right)$$

Step-2 (Given):

$$x_1=2, y_1=3, x_2=8, y_2=5, m=1, n=2$$

Step-3 (Substitution):

$$P=\left(\frac{1 \times 8 + 2 \times 2}{1+2}, \frac{1 \times 5 + 2 \times 3}{1+2}\right)$$

Step-4 (Calculation):

$$P=\left(\frac{12}{3}, \frac{11}{3}\right)$$

Answer | ଉତ୍ତର:

$$\left(4, \frac{11}{3}\right)$$

QUESTION TYPE – 3

Midpoint as a 5-Mark Question

ମଧ୍ୟବିନ୍ଦୁ (* ମାର୍କରେ ଆସେ)

Question

Find the midpoint of the line joining **A(-4, 6)** and **B(2, -2)**.

Solution

$$M=\left(\frac{-4+2}{2}, \frac{6-2}{2}\right)$$

Answer: (-1, 2)

1 – Distance Using Distance Formula

Q: In what ratio does the x-axis divide the line joining the points A(3, 6) and B(-12, -3)? (Odisha Board 2023) [EDUREV.IN](https://www.edurev.in)

ଯୋଗ: x-ଅକ୍ଷ A(3, 6) ଓ B(-12, -3) ବିନ୍ଦୁକୁ କେଉଁ ଅନୁପାତରେ ଭାଗ କରେ?

Solution | ସମାଧାନ:

The x-axis has $y = 0$.

Let the required point be $P(x, 0)$.

Use section formula (internal division):

$$\frac{y_2 - y_1}{y_1 - y_2} = \frac{x_2 - x_1}{x_1 - x_2} \Rightarrow \frac{0 - 6}{6 - 3} = \frac{x - 0}{0 - 3} \Rightarrow \frac{-6}{3} = \frac{x}{-3} \Rightarrow x = 2$$

⇒ **Ratio = 2 : 3 (or 2:3)**

ଉତ୍ତର: 2 : 3 [EDUREV.IN](https://www.edurev.in)

Board Style Answer:

Identify that the x-axis has $y = 0 \rightarrow$ use section formula for $y \rightarrow$ ratio 2:3.

2 – Centre-to-Point Distance (Concept from Coord. Geometry)

Q: The centre of a circle is $(2a, a-7)$. Find the value of a if the circle passes through $(11, -9)$ with radius $= 5\sqrt{2}$. (Odisha Board 2023) [EDUREV.IN](https://www.edurev.in)

Solution | ସମାଧାନ:

Distance between centre and point on circle = radius

$$(11-2a)^2 + (-9-(a-7))^2 = 50 \Rightarrow (11-2a)^2 + (-9-a+7)^2 = 50 \Rightarrow (11-2a)^2 + (-a-2)^2 = 50$$

Square both sides ⇒ solve for a

Work out:

$$(11-2a)^2 + (-a-2)^2 = 50 \Rightarrow 121 - 44a + 4a^2 + a^2 + 4a + 4 = 50 \Rightarrow 5a^2 - 40a + 125 = 50$$

Expand:

$$121 - 44a + 4a^2 + a^2 + 4a + 4 = 50 \Rightarrow 5a^2 - 40a + 125 = 50$$

$$5a^2 - 40a + 125 = 50 \Rightarrow 5a^2 - 40a + 75 = 0$$

$$5a^2 - 40a + 75 = 0 \Rightarrow a^2 - 8a + 15 = 0$$

$$a^2 - 8a + 15 = 0 \Rightarrow (a-3)(a-5) = 0$$

$$(a-3)(a-5) = 0 \Rightarrow a = 3 \text{ or } 5$$

⇒ **$a = 3$ or 5**

✓ **Answer:** $a = 3$ or 5

ଉତ୍ତର: $a = 3$ କିମ୍ବା 5

3 – Typical Midpoint / Section Type (Commonly Asked)

Q: Find the midpoint of the line joining $P(-4, 2)$ and $Q(6, 10)$ using midpoint formula.

ପ୍ରଶ୍ନ: $P(-4, 2)$ ଓ $Q(6, 10)$ ବିନ୍ଦୁର ମଧ୍ୟବିନ୍ଦୁ ନିର୍ଣ୍ଣୟ କର।

Solution | ସମାଧାନ:

Midpoint =

$$(-4+6, 2+10) = (1, 6) \left(\frac{-4+6}{2}, \frac{2+10}{2} \right) = (1, 6) (2-4+6, 2+10) = (1, 6)$$

✓ **Answer | ଉତ୍ତର:** (1, 6)

(Though not directly from a released BSE paper online, this type appears extremely often and follows Board pattern.)

4 – Application of Distance in Geometry

Q: If A(0,0), B(3,4), C(3,0) are vertices of ΔABC , show if it's right angled.

ପ୍ରଶ୍ନ: ΔABC ଗର $ABC = \{A(0,0), B(3,4), C(3,0)\}$ ଅଛି. ଏହା right angled ତ?

Solution | ସମାଧାନ:

$$AB^2 = (3-0)^2 + (4-0)^2 = 9+16 = 25$$

$$BC^2 = (3-3)^2 + (0-4)^2 = 0+16 = 16$$

$$AC^2 = (3-0)^2 + (0-0)^2 = 9+0 = 9$$

Check:

$$BC^2 + AC^2 = 16+9 = 25 = AB^2$$

$\Rightarrow \Delta ABC$ is right-angled at C

✓ **Answer:** Right-angled at C

(This style is commonly asked as a Geometry + Coord. problem.)

5 – Section Ratio using Coordinates

Q: In what ratio does the y-axis divide the line joining P(8,3) and Q(−4,9)?

ପ୍ରଶ୍ନ: y-ଅକ୍ଷ P(8,3) ଓ Q(−4,9) ବିନ୍ଦୁକୁ କେଉଁ ଅନୁପାତରେ ଭାଗ କରେ?

Solution:

y-axis has $x = 0$.

Use section formula on x:

$$0-8-4-8 = -8-12 = 23 \frac{0-8}{-4-8} = \frac{-8}{-12} = \frac{2}{3} -4-80-8 = -12-8 = 32$$

$\Rightarrow$ Ratio = 2 : 3

✓ **Answer:** 2 : 3

JAI HIND! - BINAYA