UNIVERSIDAD TECNOLÓGICA DE
SAN LUIS RIO COLORADO

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San Luis Rio Colorado, Sonora Junio, 2020

2.1 Introduction to the Cartesian Plane

Coordinate Geometry

A system of geometry were the position of points on the plane is described using an ordered pair of numbers (X, Y).

Recall that a plane is a flat surface that goes on forever in both directions. If we were to place a point on the plane, coordinate geometry give us a way to describe exactly where it is, by using two numbers.

Ordered pair: The coordinates are written as an "ordered pair" as shown below. The letter P is simply the name of the point and is used to distinguish it from others. Name (X, Y) = P(12, 23)

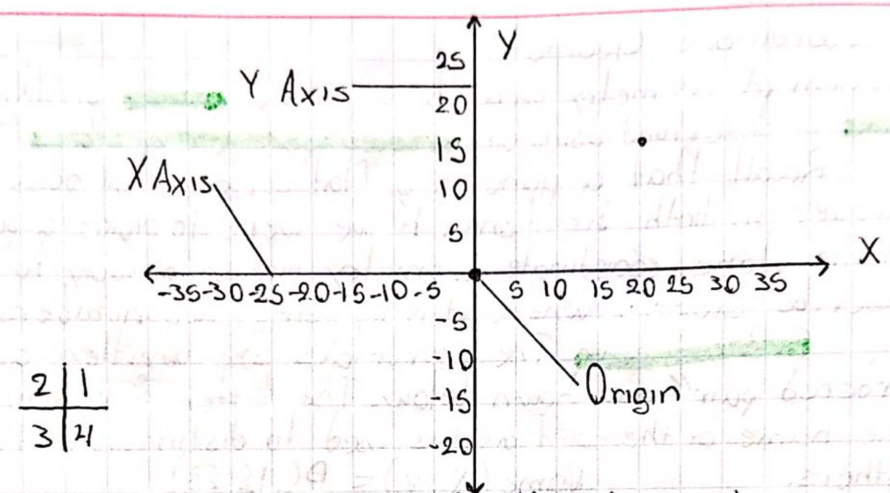
History: The method of describing the location of points in this way was prosped by the french mathematician René Descartes (1596-1650). (Pronounced "day CART"). He proposed futher that curves and lines could be described by equations using this technique, thus being the first to link algebra and geometry. In honor of his work, the coordinates of a point are often referred to as its Cartesian Coordinates, and the coordinate plane as the Cartesian Coordinate Plane.

The Coordinate Plane and Elements

In coordinate geometry, points are placed on the "Coordinate plane" as shown below.

It has two scales - one running across the plane called the "X axis" and another a right angles to it called the "Y axis". The point where the axes cross is called the origin and is where both x and y are zero.

Axis is a line, used as a reference to determine position, symmetry and rotation. (Plural: "axes" pronounced "AXE-ease")



Quadrants. The two axes divide the plane into four areas called quadrants. The first quadrant, by convention, is the top right, and then they go around counter-clockwise. In the diagram above the are are labed Quadrant 1, 2 etc. It is conventional to label them with numerals but we talk about them as "first, second, third, and fourth quadrant." They are also sometimes labelled with Roman numerals: I, II, III, IV.

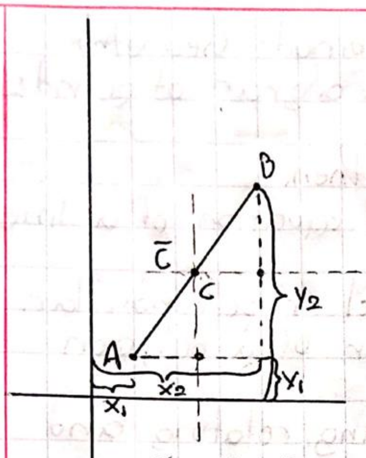
The **abscissa** is another name for the x (horizontal) coordinate of a point. Pronounced "ab-SISS-ah" (the "c" is silent). Not used very much. Most commonly, the term "x-coordinate" is used.

The **ordinate** is another name for the y (vertical) coordinate of a point. Pronounced "ORD-inet". Not used very much. Most commonly, the term "y-coordinated" is used.

Things you can do in Coordinate Geometry

if you know the coordinates of a grap of points you can:

- Determine the distance between then.
- find the midpoint, slope and equation of a line segment.
- Determine if lines are parallel or perpendicular.
- Find the area and perimeter of a polygon defined by the points.
- Transform a shape by moving, rotating and reflecting it.
- Define the equations of curves, circles and elipses.



$\overline{AB} = \bar{c} = 5$

A(1, 1) B(4, 5)
X_1 Y_1 X_2 Y_2

$\bar{c} = \sqrt{a^2 + b^2}$

$\bar{c} = \sqrt{25}$

$\bar{c} = 5$

$X_2 - X_1 = 3 = a$

$Y_2 - Y_1 = 4 = b$

$DAB = \sqrt{dx^2 + dy^2}$

$DAB = \sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2}$

c (2.5, 3)
X_3 Y_3

$$C_{y3} = \frac{Y_1 + Y_2}{2} = \frac{1+5}{2} = \frac{6}{2} = 3$$

$$C_{x3} = \frac{X_1 + X_2}{2} = \frac{1+4}{2} = \frac{5}{2} = 2.5$$

2.2.1 Distance between 2 points

1. A $(30, 25)$ B $(30, 10)$ $\overline{AB} = \overline{C} = 15$

x_1 y_1 x_2 y_2

$DAB = \sqrt{(30-(30))^2 + (10-(25))^2}$

$DAB = \sqrt{0 + 225}$

$DAB = 15$

2. A $(-10, 10)$ B $(10, 30)$ $AB = \overline{C} = 28.28$

x_1 y_1 x_2 y_2

$DAB = \sqrt{(10-(-10)^2 + (30-(10))^2}$

$DAB = \sqrt{400 + 400}$

$DAB = 28.28$

3. A $(-10, -5)$ B $(-10, -15)$ $AB = \overline{C} = 10$

x y_1 x_2 y_2

$DAB = \sqrt{(-10-(-10)^2 + (-15-(5))^2}$

$DAB = \sqrt{0 + 100}$

$DAB = 10$

2.2.2 Ex midpoint of a line segment

Silver

Calculate the midpoint of the line segments joining the two points below.

a) (3, 6) (5, 10)
X_1 Y_1 X_2 Y_2 Midpoint (4 , 8)
X_3 Y_3

Midpoint $X_3 = \frac{X_1 + X_2}{2} = \frac{3+(5)}{2} = 4$

Midpoint $Y_3 = \frac{Y_1 + Y_2}{2} = \frac{6+(10)}{2} = 8$

b (0, 1) (4, 3)
X_1 Y_1 X_2 Y_2 Midpoint (2 , 2)
X_3 Y_3

Midpoint $X_3 = \frac{0+(4)}{2} = 2$ Midpoint $Y_3 = \frac{1+(3)}{2} =$

c (-3, 2) (3, 2)
X_1 Y_1 X_2 Y_2 Midpoint (0 , 2)
X_3 Y_3

Midpoint $X_3 = \frac{-3+(3)}{2} = 0$ Midpoint $Y_3 = \frac{2+(2)}{2} = 2$

d (-8; 7) (4, 9)
X_1 Y_1 X_2 X_2 Midpoint (-2 , 1)
X_3 Y_3

Midpoint $X_3 = \frac{-8+(4)}{2} = -2$ Midpoint $Y_3 = \frac{-7+(9)}{2} =$

Gold

A The midpoint of the line segment AB is at (3.5, 2.5). The coordinates of A are (2,5). Work out the coordinates of B.

$A(2,5)$ $x_1\ y_1$ $B(9,10)$ $x_2\ y_2$ $C(3.5, 2.5)$ $x_3\ y_3$

$X_2 = X_1 + 2x_3 =$
$X_2 = 2 + 2(3.5) =$
$X_2 = 9$

$Y_2 = Y_1 + 2Y_3 =$
$Y_2 = 5 + 2(2.5) =$
$Y_2 = 10$

B The coordinates (2,-1) (12,-1) (12,9) (2,9) are joined up to form a square. Find the centre of the square.

$\frac{2+(12)}{2} = 7$

$\frac{-1+(-1)}{2} = -1$

$\frac{12+(2)}{2} = 7$

$\frac{9+(9)}{2} = 9$

$\frac{-1+(9)}{2} = 4$

$\frac{-1+9}{2} = 4$

Center (7, 4)