

Section 2.1. The Cartesian coordinate system

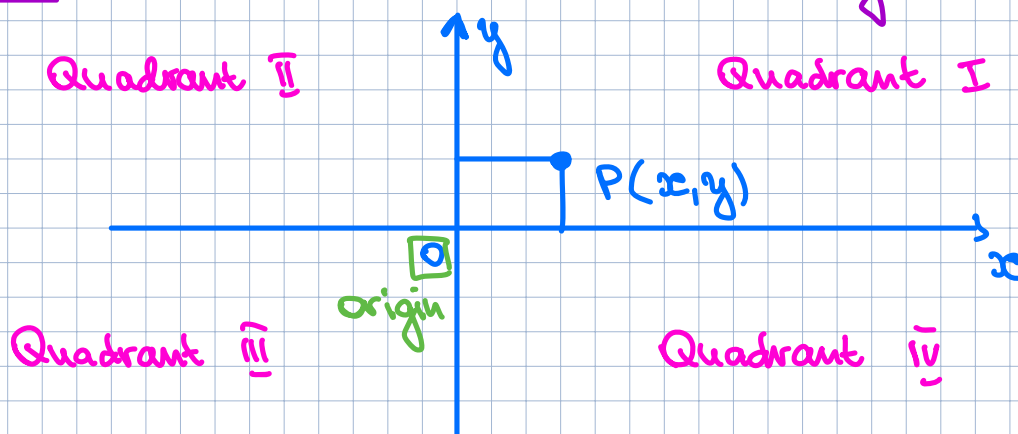
1. Def.

An ordered pair (a, b) consists of two real numbers a and b .

Unlike sets, the order of the elements in an ordered pair matters; that is $(a, b) \neq (b, a)$ unless $a = b$.

(a, b)
↑ ↑
first second
coordinate coordinate

Def. (The Cartesian coordinate system $\mathbb{R} \times \mathbb{R}$)



2.

Graphing equations

(a, b)
↑ ↑
x-coordinate y-coordinate

Example

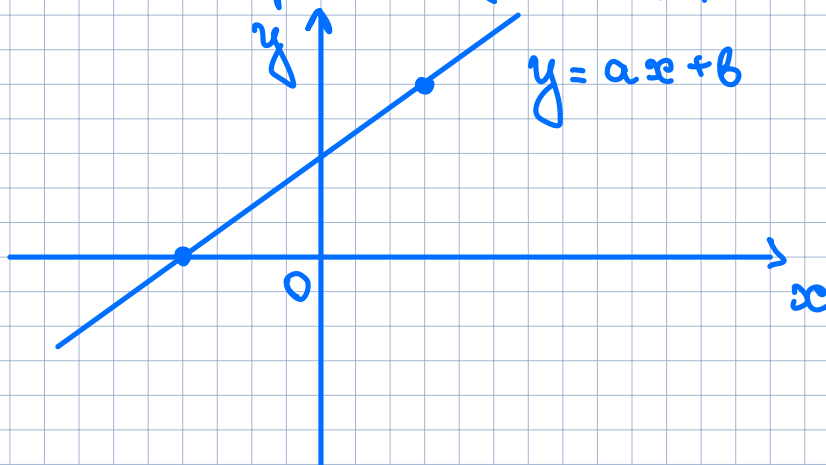
- Straight line

$$y = \underbrace{a}x + \underbrace{b} \quad (1)$$

constants

The line is formed by the set of ordered pairs (\tilde{x}, \tilde{y}) which satisfies (1).

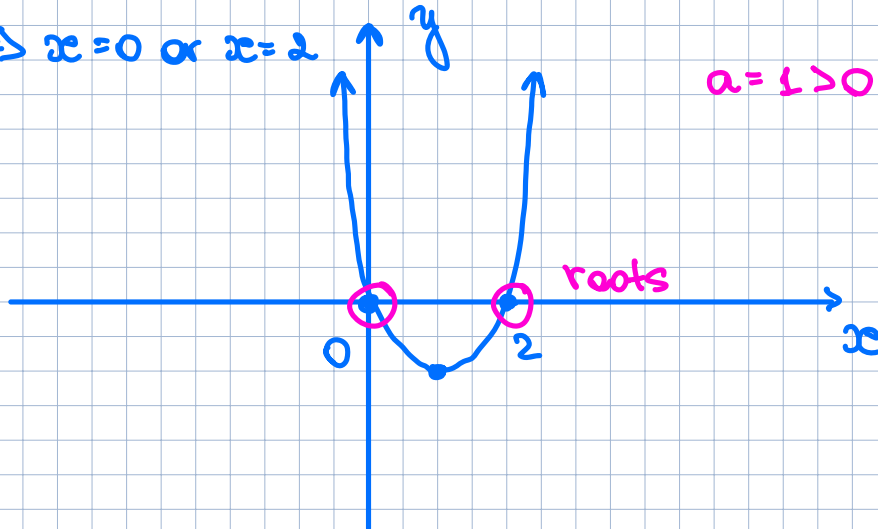
To draw the straight line we need at least two points $(A, B), (C, 0)$.



- Parabola (quadratic polynomial) (upward)

$$y = x^2 - 2x = x(x-2)$$

$$y = 0 \Rightarrow x = 0 \text{ or } x = 2$$



- circle

$$(x-a)^2 + (y-b)^2 = r^2$$

(a, b) is the center of a circle
 r is the radius of a circle

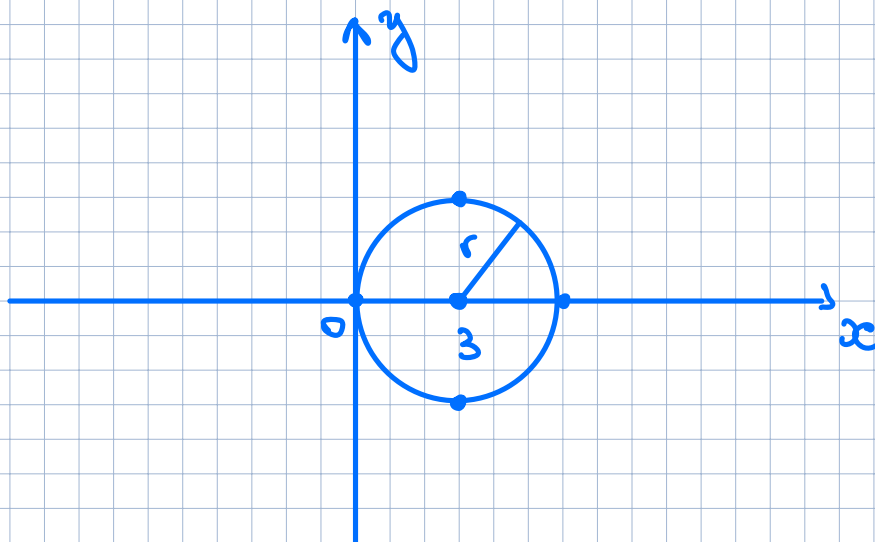
$$x^2 + y^2 - 6x = 0$$

$$(x^2 - 6x + 9) + y^2 - 9 = 0$$

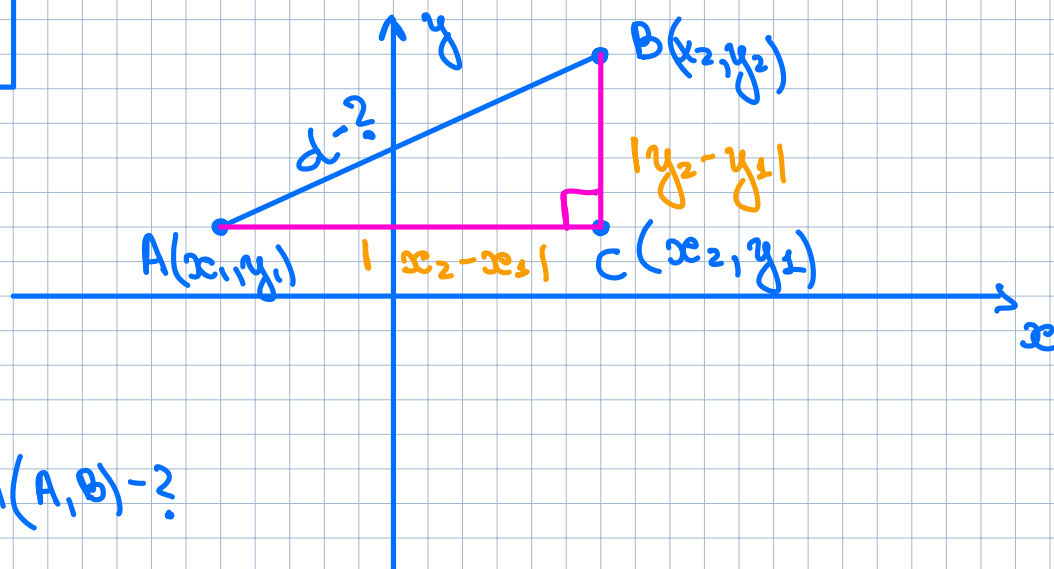
$$(x-3)^2 + y^2 = 3^2$$

$(3, 0)$ is a center

$r = 3$ is a radius



3.



$d(A, B) = ?$

$$d^2(A, B) = AC^2 + BC^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

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

d is a distance between points A and B on the Cartesian plane \mathbb{R}^2 .

Example

Find $d(A, B)$ -?

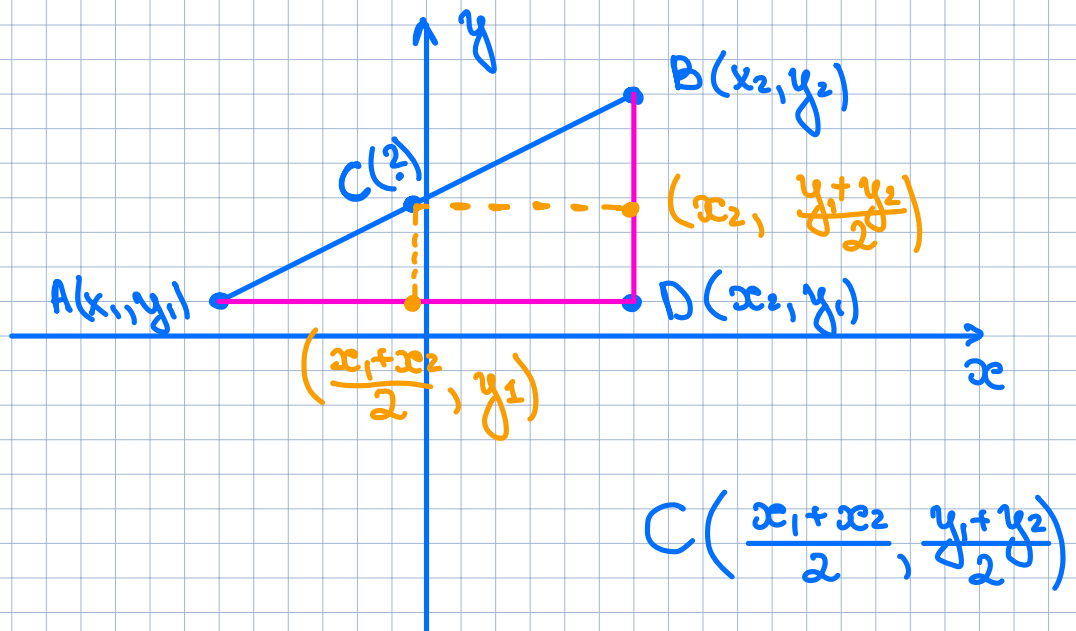
where $A = (-4, -2)$

$B = (-7, 2)$

$$\begin{aligned} d(A, B) &= \sqrt{(-7+4)^2 + (2+2)^2} = \sqrt{3^2 + 4^2} = \\ &= \sqrt{9+16} = \sqrt{25} = \boxed{5} \end{aligned}$$



The Midpoint Formula:



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The midpoint between two points (x_1, y_1) and

(x_1, y_1) in the Cartesian plane has the following coordinates

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