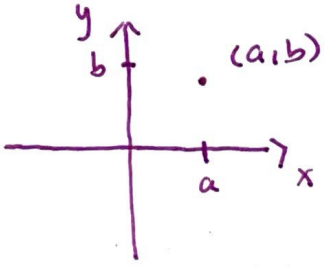
§12.1 : Three Dimension Coordinate System

Two Dimension : xy plane

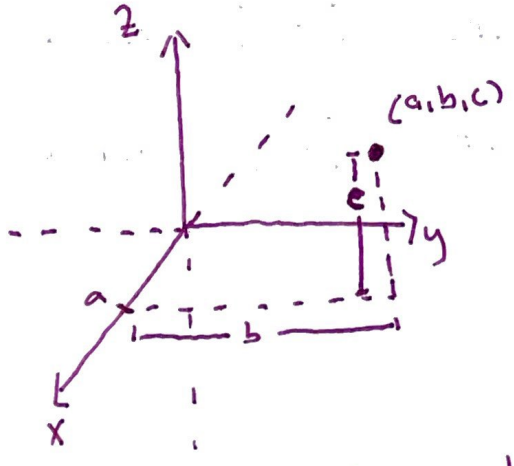


x-axis and y-axis are perpendicular

Any point in the plane can be represented by an ordered pair, (a, b), of real numbers.

$\mathbb{R}^2 = \{ (x,y) : x, y \in \mathbb{R} \}$

Three Dimension : xyz space

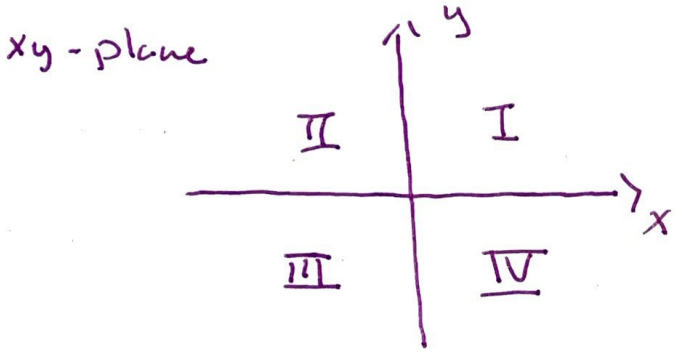


x-axis, y-axis, and z-axis are pairwise perpendicular

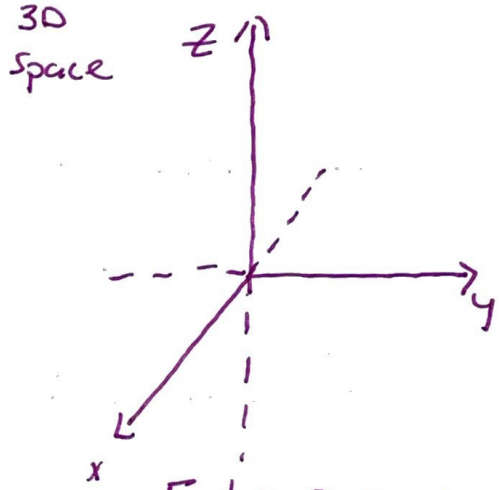
Any point in three dimensional space can be represented by an ordered triple (a, b, c) of real numbers.

$\mathbb{R}^3 = \{(x,y,z) : x, y, z \in \mathbb{R}\}$

Right Hand Rule is used to determine the direction of the positive z-axis. : Using your right hand, curl fingers from positive x-axis to positive y-axis. Then your thumb points in the direction of positive z-axis.



Four Quadrants



Eight Octants

Octants I - IV are quadrants I - IV with $z > 0$.

Octants V - VIII are quadrants I - IV with $z < 0$

Coordinate Planes: Axes system determine coordinate planes.

① xy plane contains x and y axes. $(z=0)$

Horizontal Plane

② yz plane contains y and z axes $(x=0)$

Vertical Plane

③ xz plane contains x and z axes $(y=0)$

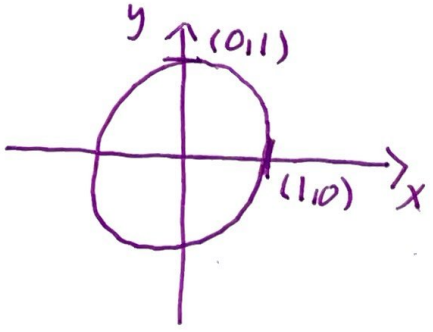
Vertical Plane

Note: In $\mathbb{R}^2$, the equation $f(x,y)=c$ defines a curve in the xy plane.

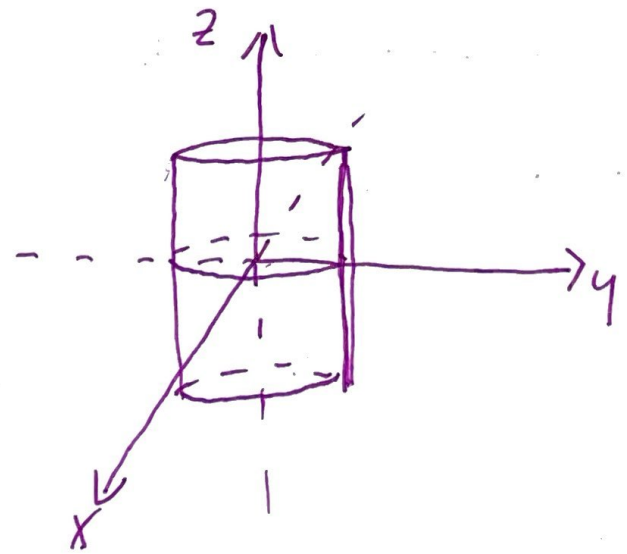
In $\mathbb{R}^3$, the equation $g(x,y,z)=c$ defines a surface in space.

Ex: $x^2 + y^2 = 1$

a) In $\mathbb{R}^2$, $x^2+y^2=1$ is a circle of radius 1 centered at $(0,0)$.

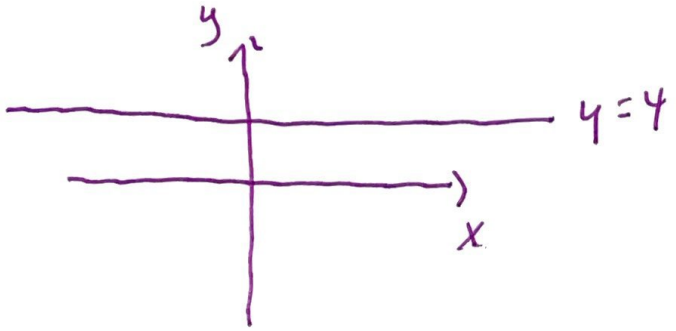


b) In $\mathbb{R}^3$, $x^2+y^2=1$ places no restriction on z so the z-coordinate of the surface can be any real number. Surface defines a circular cylinder.

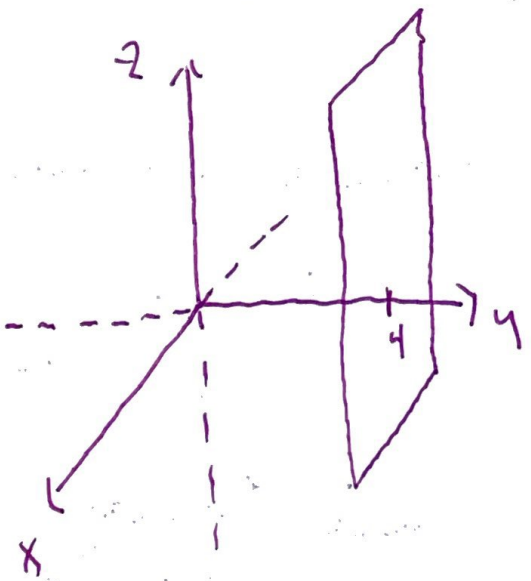


Ex': $y=4$

a) In $\mathbb{R}^2$, $y=4$ is a horizontal line parallel to x-axis,



b) In $\mathbb{R}^3$, $y=4$ is a vertical plane parallel to xz coordinate plane ($y=0$).



In general, $x=k$ is a vertical plane parallel to yz plane, $y=k$ is a vertical plane parallel to xz plane, and $z=k$ is a horizontal plane parallel to xy plane.