- Tim / Prof. / Prof. Chumley (he/him)
- Moodle - announcements
- Webpage (tchumley.mtholyoke.edu/m203)
  - notes, worksheets, homework, syllabus
  - updated daily
- Homework (weekly)
  - written problems, submitted on Gradescope
  - due Fridays at 5 pm
- Quizzes - Wednesdays (first one is Feb 1)
- Exams - two during semester, one during finals
- Participation - come to class, be a good community member, stay in touch when something goes wrong (eg. illness)
- Office hours (tentative)
  - Mondays 4:00-5:00
  - Wednesdays 4:30-5:30
  - Thursdays 1:00-2:00

  drop in (Clapp 423), no appointment necessary

10.1 Basics of Cartesian Coordinates

Focus of semester: qualitative and quantitative study of functions of functions of multiple variables; generalizing ideas from calc I and II

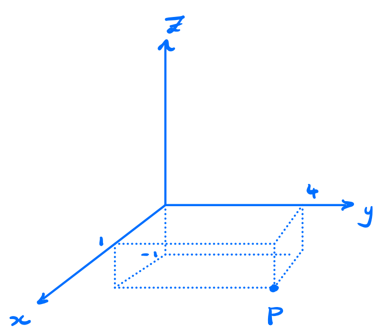
Today introduction to 3d space (plotting on xyz-axes)

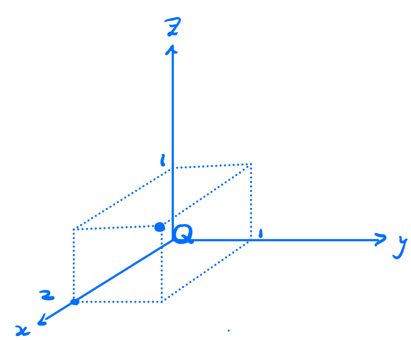
A point P in 3d-space is an ordered triple:

$$P = (a, b, c).$$

The set of all points of the form (x, y, z) is called Euclidean space or 3d space. Denoted as $\mathbb{R}^3$.

Example Plot the points $P = (1, 4, -1)$ and $Q = (2, 1, 1)$.





orientation of x, y, z axes matters!

plotting is clearest if you draw a rectangular box with appropriate dimensions!

<u>Distance formula</u> The distance between two points,

$P = (x_1, y_1, z_1)$ and $Q = (x_2, y_2, z_2)$ is given by

$$d(P,Q) = \sqrt{(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2}$$

<u>Example</u> Find distance between

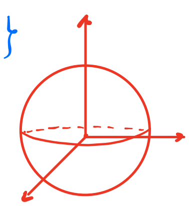
$P = (1,4,-1)$ and $Q = (2,1,1)$.

$$d(P,Q) = \sqrt{(1-2)^2 + (4-1)^2 + (-1-1)^2} = \sqrt{14}$$

<u>Common surface described by equations</u>

<u>Spheres</u> State the center and radius

① $x^2+y^2+z^2 = 1$ $\{(x,y,z) \in \mathbb{R}^3 : x^2+y^2+z^2=1\}$



$$x^2+y^2+z^2=1 \iff \sqrt{(x-0)^2+(y-0)^2+(z-0)^2} = 1$$

$$\iff d((x,y,z),(0,0,0)) = 1$$

All points in $\mathbb{R}^3$ whose distance to $(0,0,0)$ is equal to 1. This is a (hollow) sphere centered at $(0,0,0)$ with radius 1.

② $x^2+y^2+z^2 = 9$.

sphere centered at $(0,0,0)$ with radius 3

③ $(x-a)^2 + (y-b)^2 + (z-c)^2 = r^2$

sphere centered at (a,b,c) with radius r

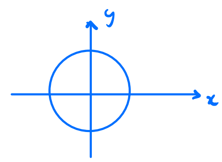
Circular cylinders

Draw the shape given by the formula:

① $x^2 + y^2 = 1$

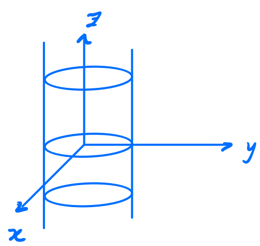
In 2d xy-plane:

$\{ (x,y) \in \mathbb{R}^2 : x^2 + y^2 = 1 \}$



In 3d space:

$\{ (x,y,z) \in \mathbb{R}^3 : x^2 + y^2 = 1 \}$

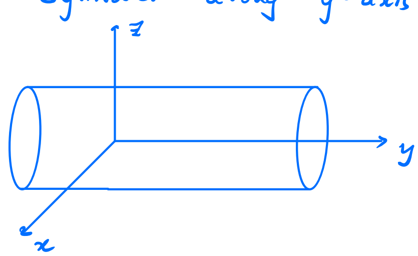


(hollow) circular cylinder that extends infinitely in z direction (no restriction on z)

② $x^2 + z^2 = 4$

In 3d space:

circular cylinder along y-axis with radius 2



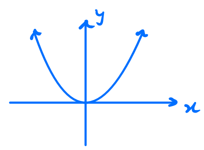
Parabolic cylinders

Draw the shape given by the formula

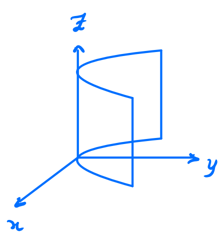
① $y = x^2$

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

parabola:



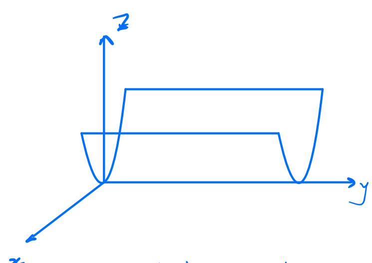
In 3d: $\{(x,y,z) \in \mathbb{R}^3 : y = x^2\}$ ← no restriction on z



parabolic cylinder along z-axis

② $z = x^2$

In 3d:



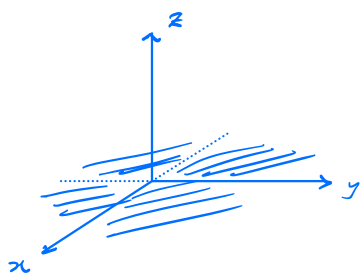
parabolic cylinder along y-axis

Planes

Draw the shape with given formula.

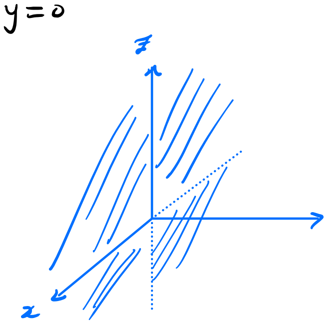
① $z = 0$

$\{(x,y,z) \in \mathbb{R}^3 : z = 0\}$ all points of the form $(x,y,0)$



xy-plane in 3d space

② $y = 0$



xz-plane in 3d space.