

- Tim / Prof. / Prof. Chunley (he/him)
- Moodle - announcements
- Webpage (tchunley.mtholyoke.edu/m203)
 - notes, worksheets, homework, syllabus
 - updated daily
- Homework (weekly)
 - Written problems, submitted on Gradescope
 - due Fridays at 5 pm
- Quizzes - Fridays (first one is Feb 6)
- 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 4:00 - 5:00
 - Thursdays 11:00 - 12:00 } 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

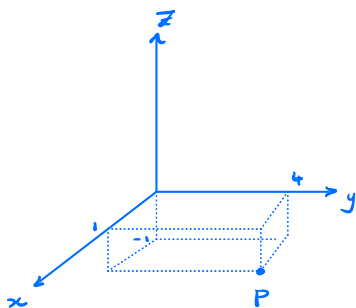
Today introduction to 3d space (plotting on xyz -axes)

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

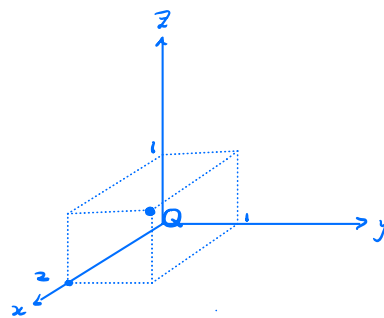
$$P = (a, b, c).$$

The set of all points of the form (x, y, z) is called Euclidean space or 3-d 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!

Distance formula The distance between two points,

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

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

Example Find distance between

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

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

Common surface described by equations

Spheres State the center and radius

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

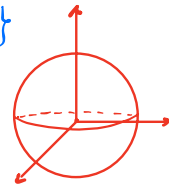
$$x^2 + y^2 + z^2 = 1 \Leftrightarrow \sqrt{(x-0)^2 + (y-0)^2 + (z-0)^2} = 1$$

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

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.



$$\textcircled{2} \quad x^2 + y^2 + z^2 = 9.$$

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

$$\textcircled{3} \quad (x-a)^2 + (y-b)^2 + (z-c)^2 = r^2$$

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

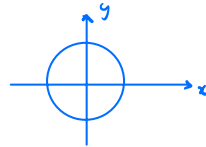
Circular cylinders

Draw the shape given by the formula:

① $x^2 + y^2 = 1$

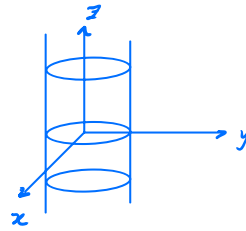
In 2d xy -plane:

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



In 3d space:

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

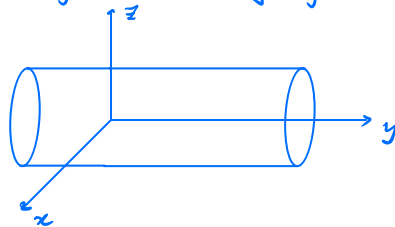


(hollow) circular cylinder that extends infinitely in z direction (no restriction on z)

② $x^2 + z^2 = 4$

In 3d space:

circular cylinder along y -axis with radius 2

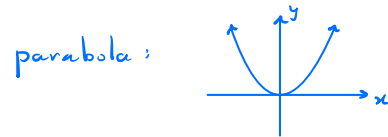


Parabolic cylinders

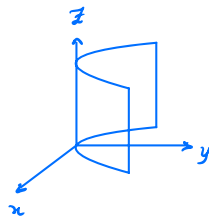
Draw the shape given by the formula

① $y = x^2$

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



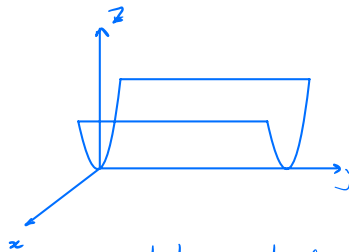
In 3d: $\{(x, y, z) \in \mathbb{R}^3 : y = x^2\}$ ← no restriction on z



parabolic cylinder along z -axis

② $z = x^2$

In 3d:



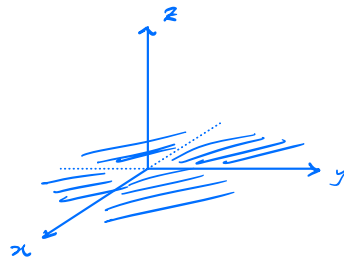
parabolic cylinder along y -axis

Planes

Draw the shape with given formula.

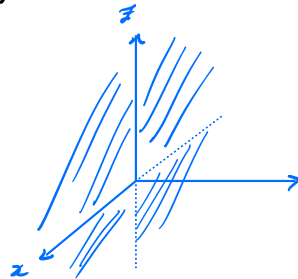
① $z=0$

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



xy-plane in 3d space

② $y=0$



xz-plane in 3d space.