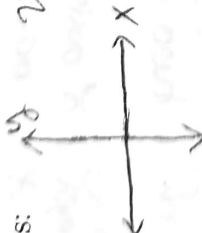# Section 13.2 and 13.6: Space, Cylinders and Quadric Surfaces
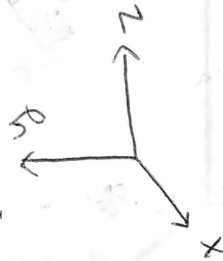
13.2: Space

The Plane $\mathbb{R}^2$

Axes:
2D plane divided into 4 quadrants

1st quadrant: $x>0$ and $y>0$

Origin:
$(0,0)$ where 2 coordinate axes meet

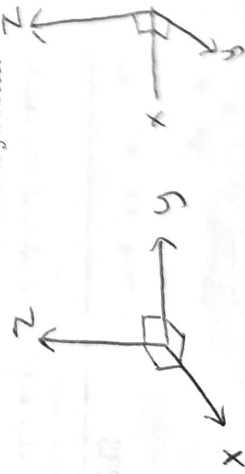Points: ordered pairs (a,b)

(a,b)

Space $\mathbb{R}^3$

3D Space divided into 8 octants

1st octant: $x>0$, $y>0$, $z>0$

$(0,0,0)$ where 3 coordinate axes meet

ordered triples (a,b,c)

(a,b,c)

Right-handed Coordinate System:

w/ fingers on x let y be →

x pointed (thumb)
z
y (middle)

not an example

not righthand

1. Plot the following points on the same set of coordinate axes.
- P (2, 3, 4)
- Q (-1, 0, 1)
- R (2, 3, 0)

P is in the first octant
Q is in the xz coordinate plane
R is the projection of P into the xy plane

} not in an octant
} but in a boundary
   of an octant

3D Space

P

2D plane Q

R 2D plane

5

3
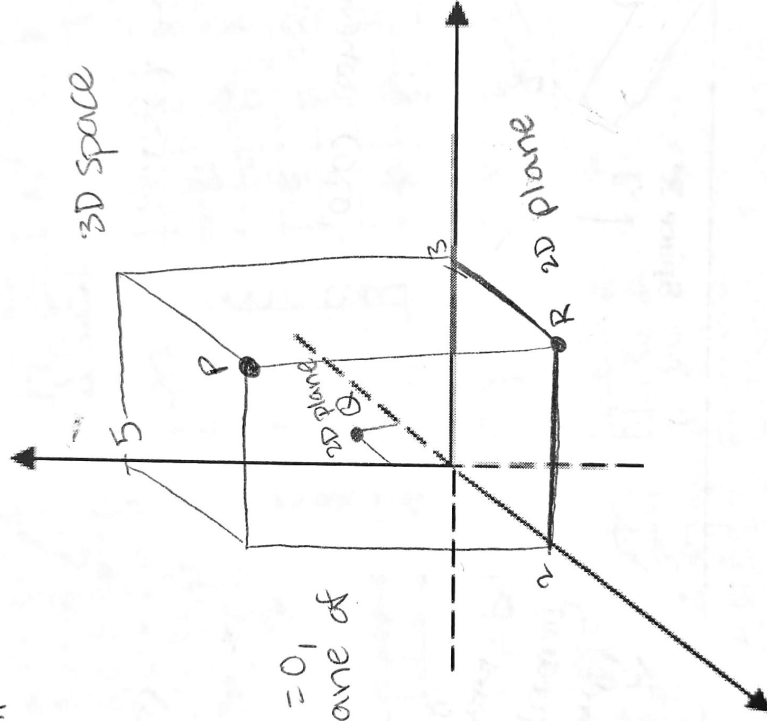
- If any of x, y, or z = 0, then you get a 2D plane of the other 2 vals ≠ 0

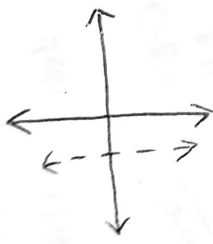- If any two of x, y, or z = 0, then you get an axis of the other one val ≠ 0

ex) the set of points in 1st octant and coordinate planes @ boundaries: x ≥ 0, y ≥ 0, z ≥ 0
        axes & origin
        ie areas = 0 somehow

ex) x-axis: (x, 0, 0)

2. Identify / describe the set of points satisfying each of the following:

(a) $x = -1$ in $\mathbb{R}^2$

$(-1, y)$ is a vertical line thru $(-1, 0)$
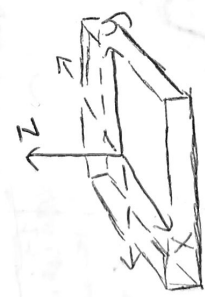
y is unrestricted

note: $z = 0$ bc $\mathbb{R}^2$ plane

(b) $x = -1$ in $\mathbb{R}^3$

$(-1, y, z)$ is a vertical plane parallel to yz-plane
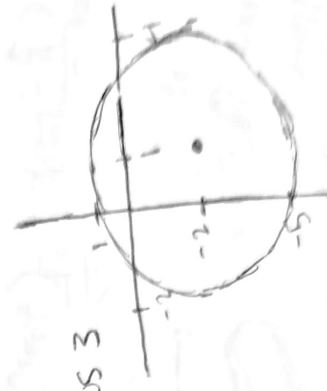
y and z are unrestricted, x is fixed

back view

(c) $z < 0$ in $\mathbb{R}^3$

all points below xy plane

Recall
circle eqn:
$(x-h)^2 + (y-k)^2 = r^2$
r is radius
(h, k) is the center

(d) $(x-1)^2 + (y+2)^2 = 9$ in $\mathbb{R}^2$

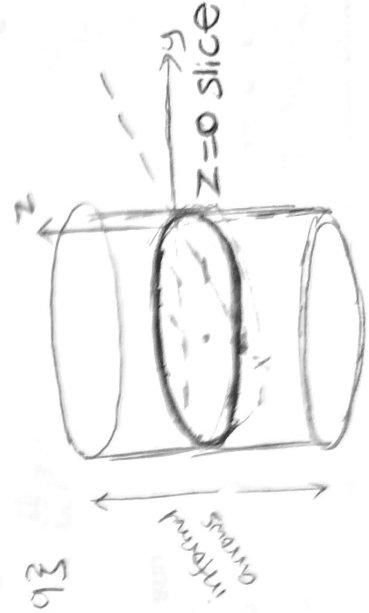a circle centered @ $(1, -2)$ w/ radius 3

Set notation: $\{(x, y, z) \in \mathbb{R}^3: (x-1)^2 + (y+2)^2 = 9, z = 0\}$

or

$\{(x, y, 0) \in \mathbb{R}^3: (x-1)^2 + (y+2)^2 = 9\}$

(e) $(x-1)^2 + (y+2)^2 = 9$ in $\mathbb{R}^3$

Set notation: $\{(x, y, z) \in \mathbb{R}^3: (x-1)^2 + (y+2)^2 = 9\}$

a right circular cylinder w/ vertical axis $(1, -2, 0)$ as the center and radius 3

x and y must lie in the circle (fixed),
z is unrestricted

$z = 0$ slice