

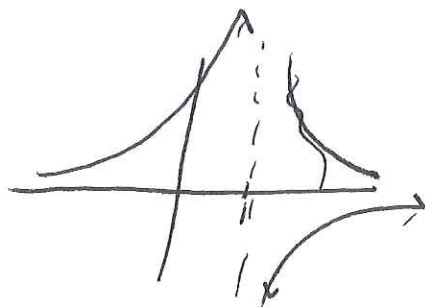
Math 241 Lecture 1

I. Go over into sheet 1 * Read Chpt 12

II. Multivariable vs Single

Single $f: \mathbb{R} \rightarrow \mathbb{R}$ Ex $f(x) = \frac{1}{1-x}$ Domain = $(-\infty, 1) \cup (1, \infty)$
Range = $(-\infty, 0) \cup (0, \infty)$

Graph:



plot points $(x, f(x))$

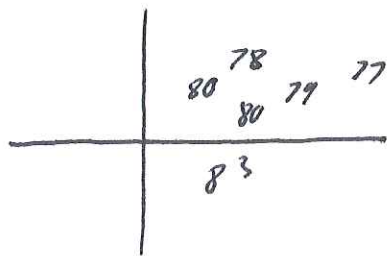
Ex $v(t) = 6t + 13$ ~~height~~ velocity at time t
 $v'(t) = \frac{dv}{dt} = 6$ rate of change.

$$s'(t) = v(t) = 6t + 13$$

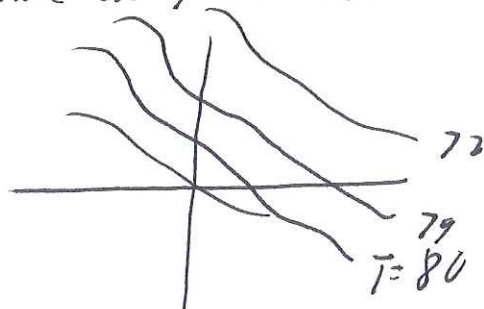
Goal Understand things like graphs, limits, derivatives, continuity, integrals, etc. for more complicated functions

i.e. more than one variable
range in \mathbb{R}^m

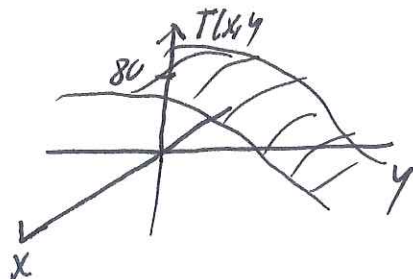
Ex $T: \mathbb{R}^2 \rightarrow \mathbb{R}$ $T(x, y) =$ temperature at point (x, y)



Level
Curves



Graph



• Graph is a surface
in 3 dimensions

III. Coordinates

- need orientation in \mathbb{R}^3 , right hand rule
- 8 octants

• Single equation gives a curve in \mathbb{R}^2 , surface in \mathbb{R}^3

Examples $x=2$, $x^2+2y^2=3$

Distance formula Let $P_1 = (x_1, y_1, z_1)$, $P_2 = (x_2, y_2, z_2)$

$$\text{distance} = |P_1 P_2| = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2} \quad \text{PE Pyth. Thm.}$$

Example:

Generalize:


Application Fix a point (h, k, l)

$$(x-h)^2 + (y-k)^2 + (z-l)^2 = r^2 \quad \text{sphere radius } r$$

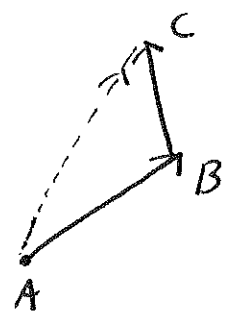
Ex 1. $x^2 + y^2 + z^2 - 6x + 4y - 2z = 11$ Find center

2. Sketch $4 \leq x^2 + y^2 + z^2 \leq 9$

Vectors What is a vector quantity? Ex Velocity, momentum

Ex Displacement vector  $\vec{v} = \vec{AB}$ "zero vector"
has initial and terminal point.

Operations



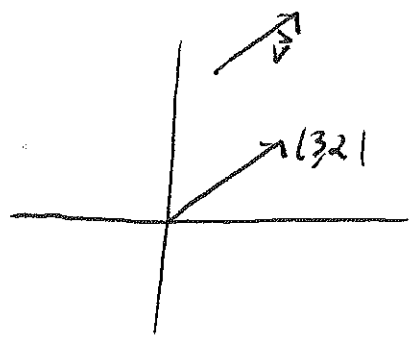
$$\vec{AC} = \vec{AB} + \vec{BC}$$

How to add vectors $\vec{u} + \vec{v}$ put init pt of \vec{v} at end of \vec{u}

Check $\vec{u} + \vec{v} = \vec{v} + \vec{u}$.

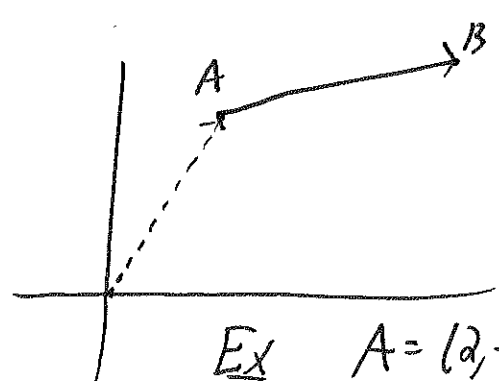
Scalar Multiples, Subtraction

Coordinates Put initial point at origin



$$\vec{v} = [3, 2]$$

Book writes $\langle 3, 2 \rangle$ for vector w/ tail at (0,0) and head at (3,2) $P(a_1, a_2, a_3)$



subtract

Ex $A = (2, -3, 7)$ $B = (1, 1, 6)$ What is

repr of \vec{AB}

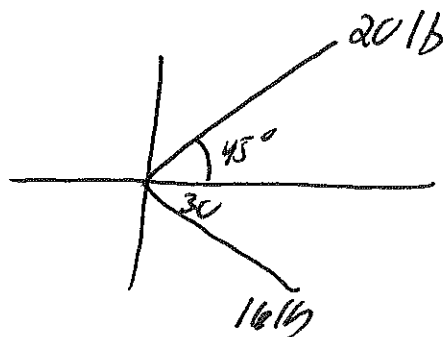
Operations

$+$, $c\vec{v}$, length

Standard Basis vectors

\vec{i} , \vec{j} , \vec{k}

Ex #32



Find mag of result force