Physics 201 - Lecture 3

(i) Scalars and Vectors

(ii) The Algebra of Scalars

(iii) the Algebra of Vectors.

Every thing that we measure in an experiment (a physical quantity) can be classified as either a scalar or a vector

SCALARS

- number + unit

VECTORS

- number + unit + [illegible]

direction

Examples:

32 kg

7.4 m

100 m^3

32 K

10 km East

400 N upward

10.2 m 30° west of North

Scalars

mass → m

temp → T

pressure → P

density → ρ

150 lbs ~~North~~

no direction

Algebra of Scalars. → same!

$y = mx + b$

$x = y^2$ $\quad y = \log_{10}(x)$

(i) Be careful about units.

$$m_1 = m_2 + m_3^2 \quad \times$$

$$kg \quad kg \quad kg^2$$

(ii) EASY!

Algebra of Vectors.

→ Several ways to do this

→ easiest, most robust.

(i) DRAW A PICTURE!

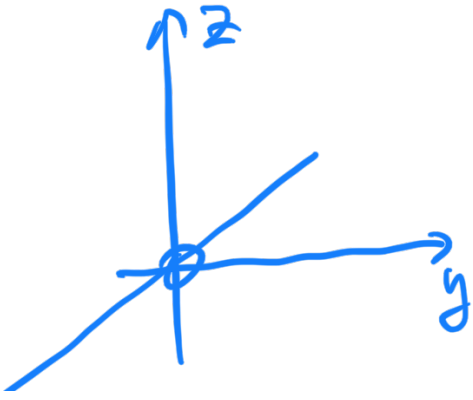
→ tech.

'Relative to the CWU campus'

→ origin of a coordinate system.

→ center of universe

1D, 2D



75 miles west

S

NEWS

VECTORS

from origin to the point of interest.

86 miles NW

Algebra of Vectors.

"the method"

↳ rules for $+, -, \times, \div$, $(\,)^{\sim}$, $\log(\,)$

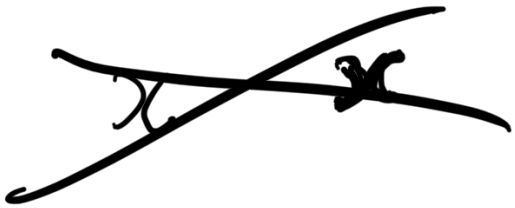
m, ρ, P

Symbols

position, velocity, force, ...

$\vec{x}$ $\vec{v}$ $\vec{F}$

Textbooks → boldface



$\vec{x}$ = 80 miles NW

$\vec{y}$ = 60 miles West

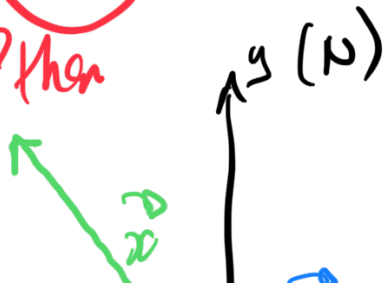
$\vec{z}$ = 30 miles 30° N of East

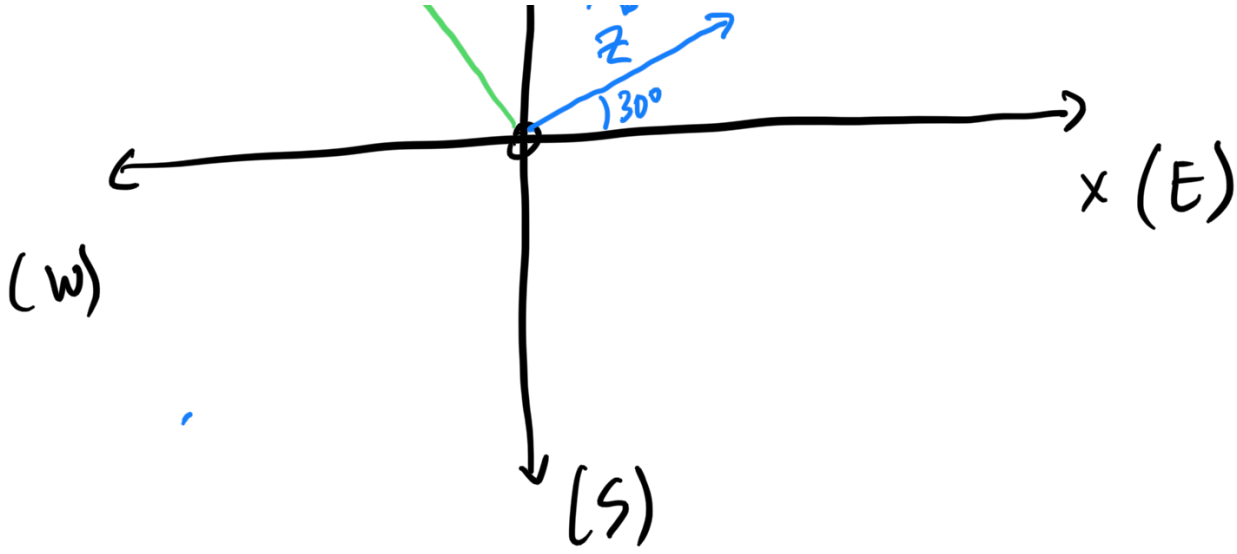
3 + 2

$\vec{x} + \vec{z} = ?$

0

first then



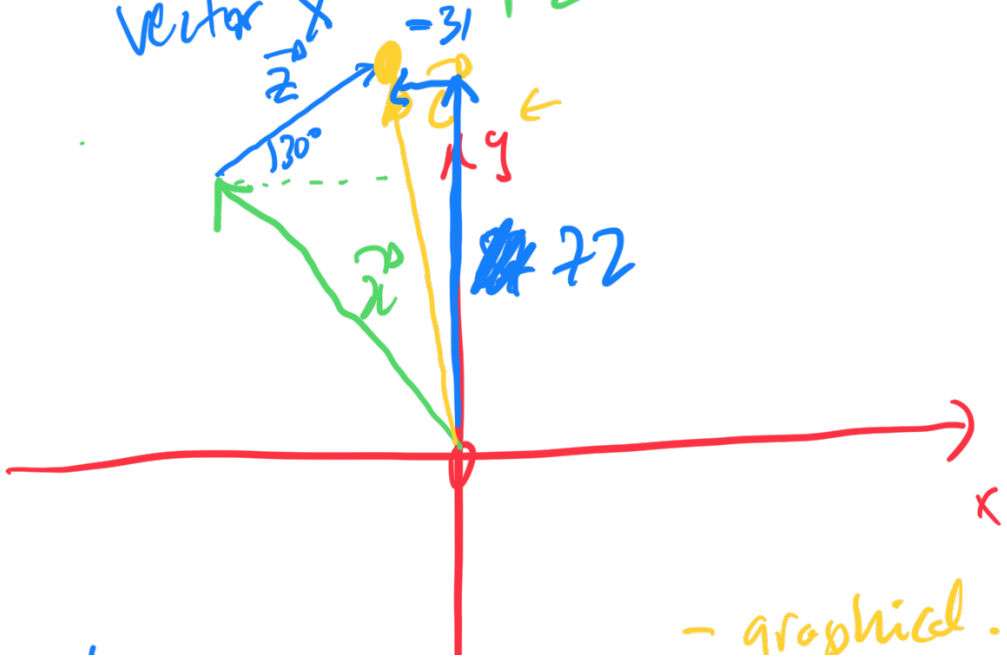


Length of vector:

$$|\vec{x}| = 80 \text{ miles}$$

* length of the vector $\vec{x}$

$$|\vec{z}| = 30 \text{ miles}$$



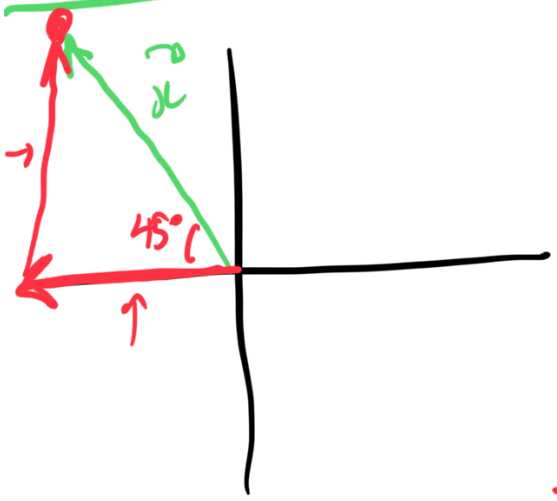
- graphical.

$$\vec{C} = \vec{X} + \vec{Z}$$

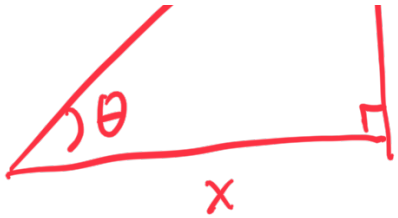
- law of sines and cosines. (trig & geom

Physics method: Recipe:

1. Draw each vector individually.
2. Break into x- and y-compone
3. Add x-components, y-compone



SOH CAH TOA

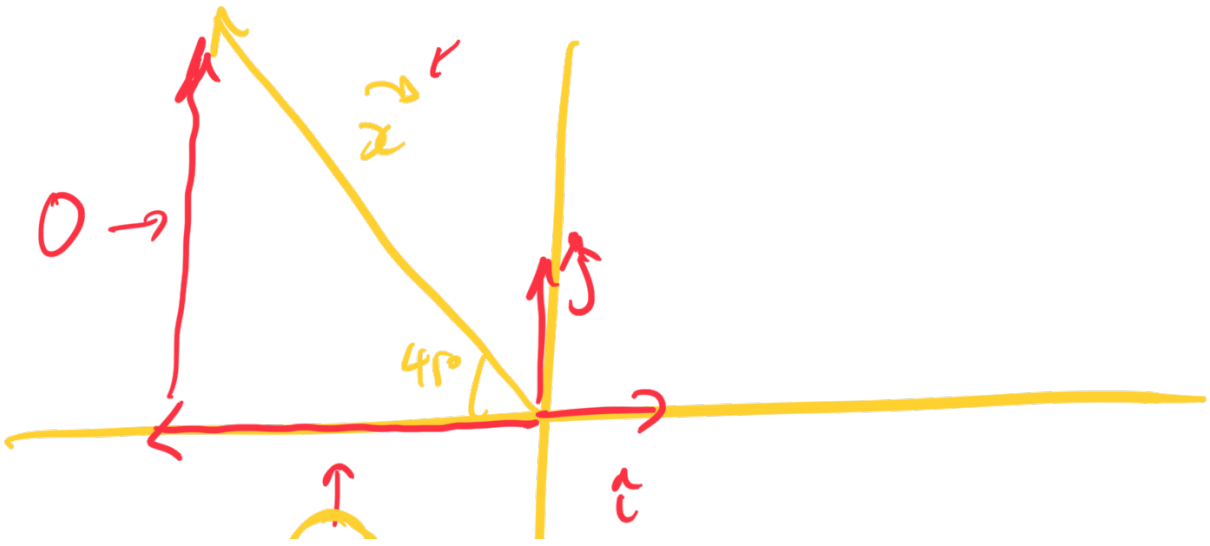


$$\sin\theta = \frac{y}{z} \qquad \cos\theta = \frac{x}{z}$$

$$\tan\theta = \frac{y}{x}$$

θ → theta ✓ angle

~~feta~~ ~~x~~ chase



(a)

$\cos 45° = \frac{a}{|\vec{x}|}$

$\sin 45° = \frac{o}{|\vec{x}|}$

$a = |\vec{x}| \cos 45°$

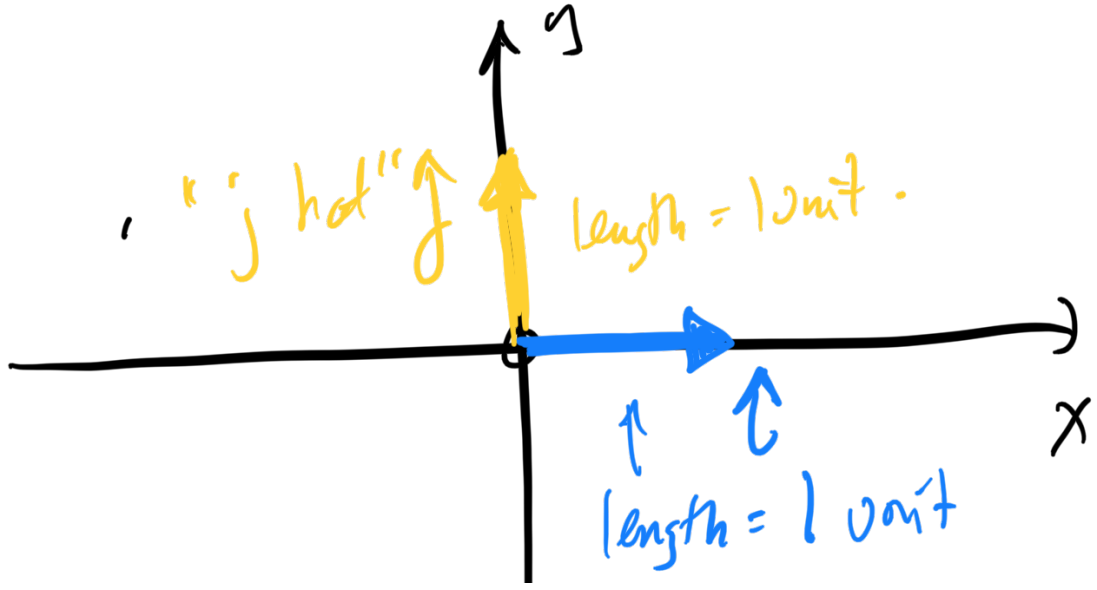
80 miles.

$o = |\vec{x}| \sin 45°$

$o = 56.5685$ miles

$a = 56.5685$ miles

Unit Vectors. !!! ... Super important



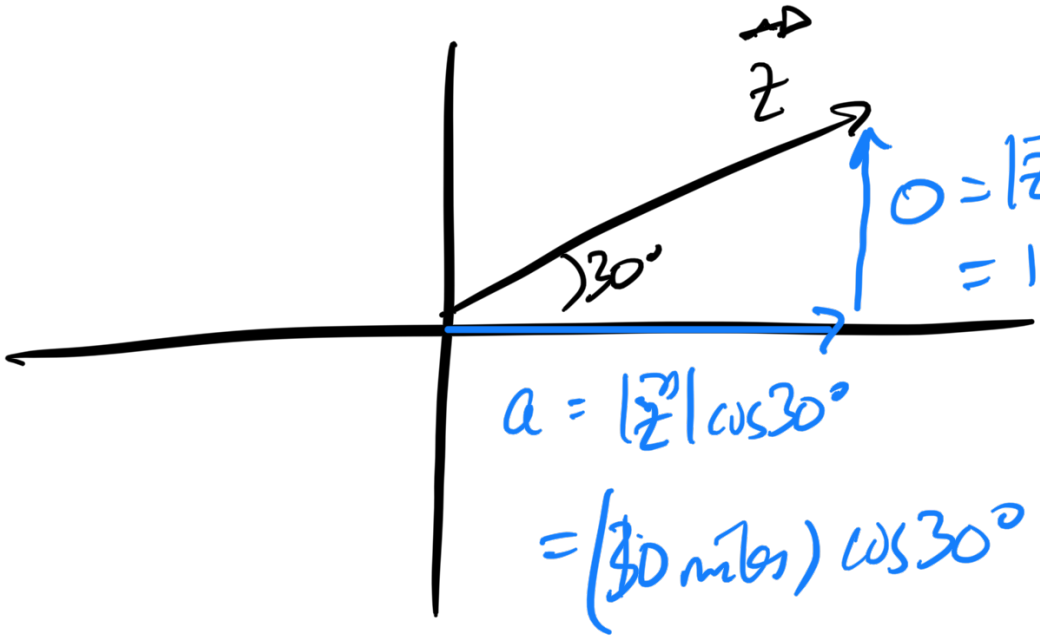
= 1 mile

"$\hat{\imath}$ hat"

$$\vec{x} = -56.5685\,\hat{\imath} + 56.5685\,\hat{\jmath}$$

!!!

Broken down into x- and y- components.



$$\vec{z} = 25.98\,\hat{i} + \;\hat{j}$$

$$+\;\vec{x} = -56.57\,\hat{i} + 56.57\,\hat{j}$$

$$\vec{C} = -30.6\,\hat{i} + \sout{86.6}\;71.6\,\hat{j}$$

Does it make sense?