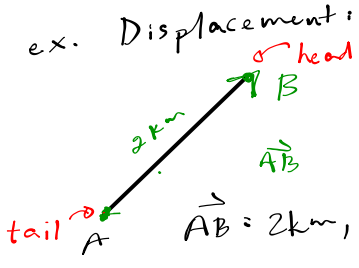
Unit 1: Vector Notation and Symbols

Definition: a vector is a measurement with a direction

. a scalar is just a measurement

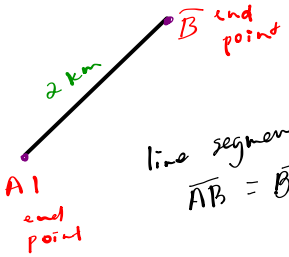
Vectors	Scalars
. Displacement: 5 km north	. Distance: 5 km
. Force: Gravity 60 N down	60 N → measurement scalar norm
Velocity: 60 km/h, South	. Speed 60 km/h

ex. Displacement:



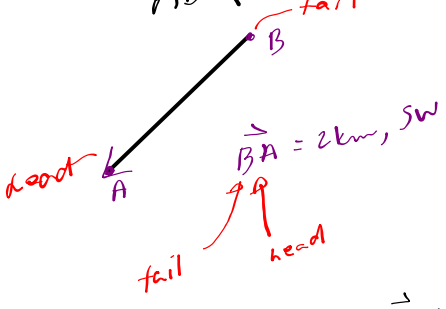
$\vec{AB}$: 2km, NE

ex. Distance 2 km



line segment $\overline{AB} = \overline{BA}$

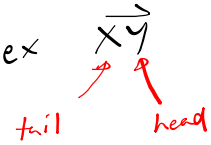
$\vec{AB} \neq \vec{BA}$



Note: $\vec{AB} \neq \vec{BA}$ $\|\vec{AB}\| = \|\vec{BA}\| = 2\text{km}$

. norm
. measurement
. scalar

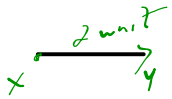
ex $\vec{xy}$



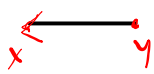
$\vec{xy} \neq \vec{yx}$

$\vec{xy} = -\vec{yx}$

$\vec{xy}$ = 2 unit, East.

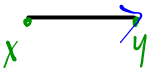


$\vec{yx}$ = 2 unit west



$-\vec{yx}$ = 2 unit, East

negative only affect direction of vector



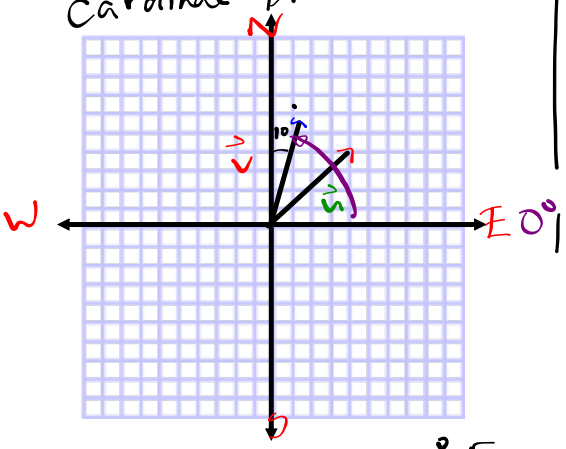
$\vec{xy} = -\vec{yx}$

A vector ($\vec{AB}$, $\vec{u}$) can be given/written in norm, angle form or component form.

i. Norm, angle form of a Vector:

$\vec{u}$ = 5 m, NE

Cardinal Direction



$\vec{v}$ = 6 units, N 10° E

primary direction

deviation

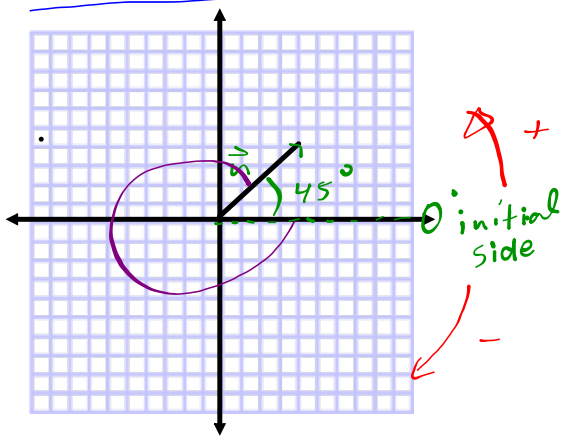
$\vec{v}$ = 6 units, 10° E of N

deviation

primary direction

$\vec{u}$ = 5m, 45°

θ = Absolute Angle Direction.



$\vec{u}$ = 5m, −315

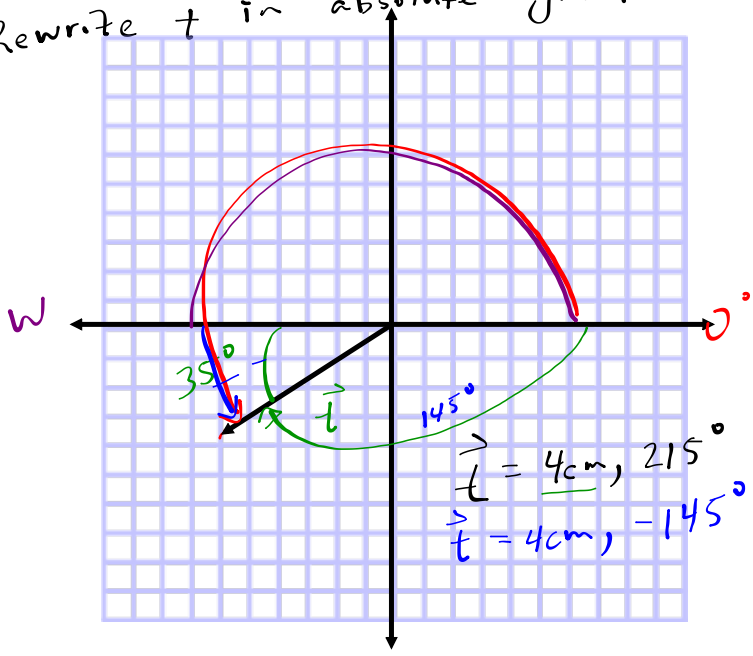
$\vec{v}$ = 6 units, 80°

Draw $\vec{u} = 6.5\text{ m}, 110°$

Rewrite $\vec{u}$ in cardinal direction form (as many different version as possible)

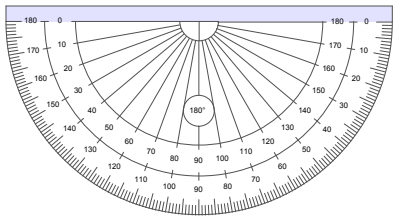
Draw $\vec{t} = 4\text{ cm}$, W 35° S = 180° + 35° = 215°
(primary)

Rewrite $\vec{t}$ in absolute angle form.



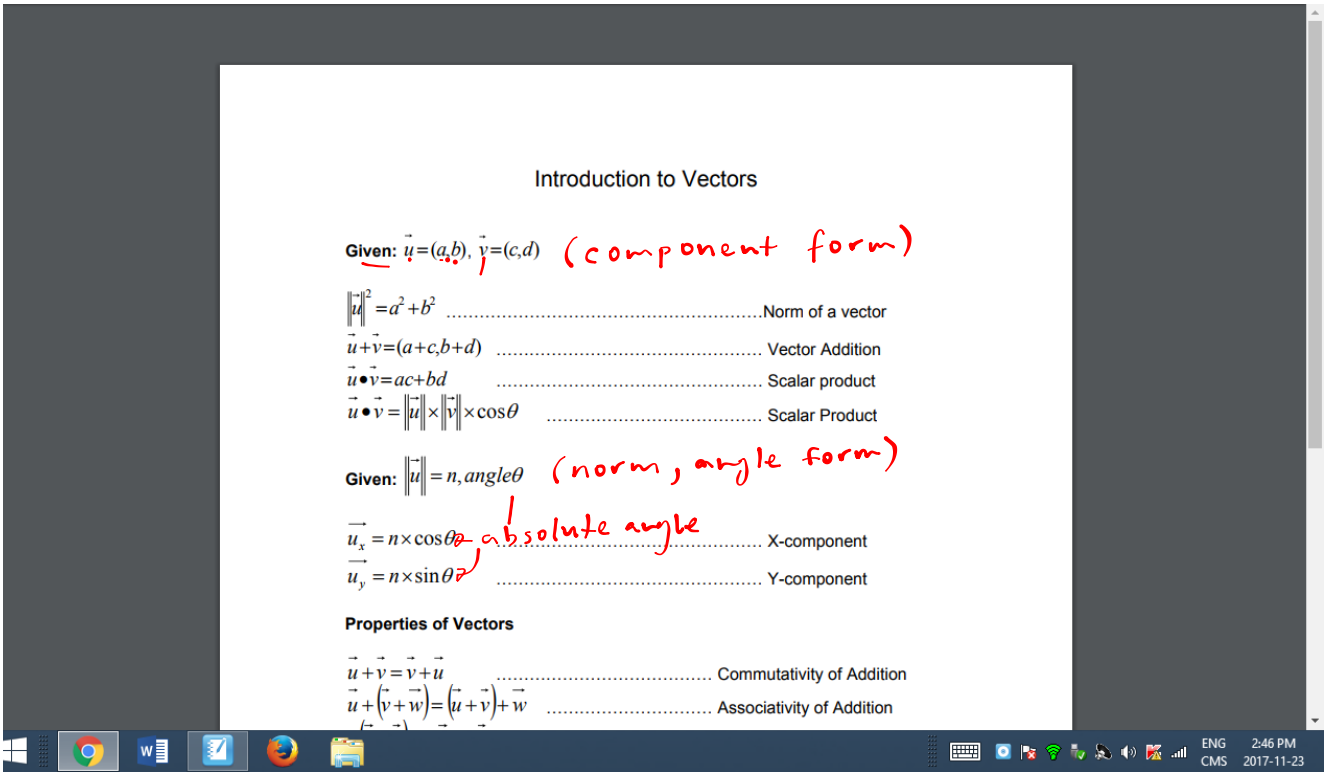
$\vec{t} = 4\text{cm}, 215°$

$\vec{t} = 4\text{cm}, -145°$



HMWK:
converting from Absolute to Cardinal and vice versa

p 1.9 – 1.16 *



Introduction to Vectors

Given: $\vec{u}=(a,b)$, $\vec{v}=(c,d)$ (component form)

$\|\vec{u}\|^2=a^2+b^2$ ..... Norm of a vector

$\vec{u}+\vec{v}=(a+c,b+d)$ ..... Vector Addition

$\vec{u}\bullet\vec{v}=ac+bd$ ..... Scalar product

$\vec{u}\bullet\vec{v}=\|\vec{u}\|\times\|\vec{v}\|\times\cos\theta$ ..... Scalar Product

Given: $\|\vec{u}\|=n, angle\theta$ (norm, angle form)

$\vec{u}_x=n\times\cos\theta$ ..... X-component (absolute angle)

$\vec{u}_y=n\times\sin\theta$ ..... Y-component

Properties of Vectors

$\vec{u}+\vec{v}=\vec{v}+\vec{u}$ ..... Commutativity of Addition

$\vec{u}+(\vec{v}+\vec{w})=(\vec{u}+\vec{v})+\vec{w}$ ..... Associativity of Addition

Draw

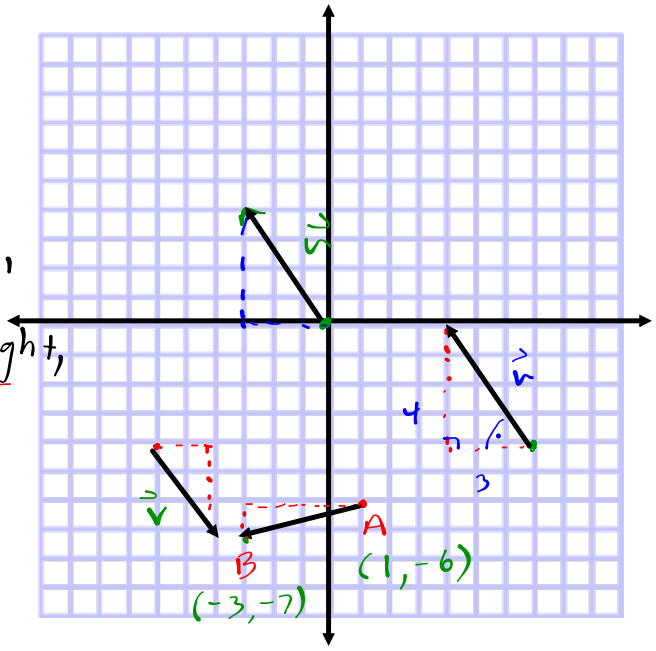
$\vec{t} = 4.5, 315°$

and rewrite $\vec{t}$ in cardinal direction.

ii Component Form of a Vector

ex $\vec{u} = (-3, 4)$
$(\vec{u}_x \quad \vec{u}_y)$

To graph, from the origin (or any other point),
the x component tells us how many units to go left/right, − +
the y component tells us how many units up/down + −



Draw $\vec{v} = (2, -3)$

$\vec{AB} = (-4, -1)$

tail, head

$A = (1, -6)$

$B = (-3, -7)$

$\vec{AB} = (-4, -1)$

$\vec{BA} = (4, 1)$

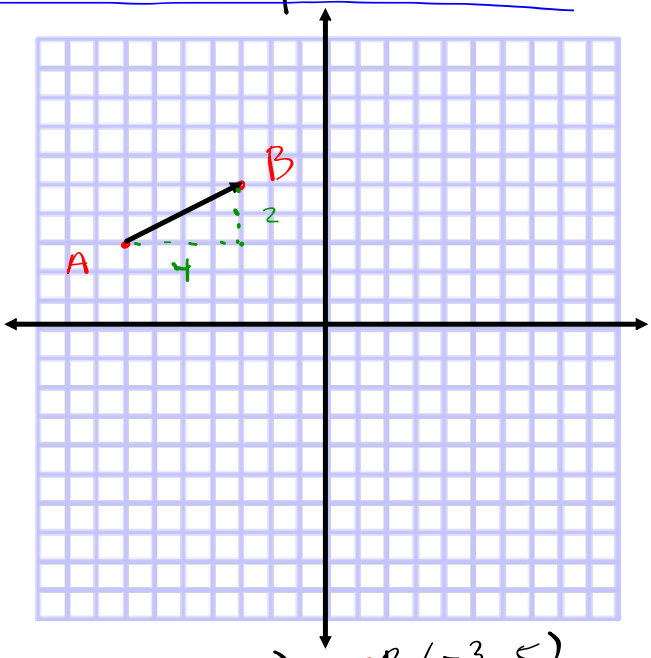
Finding the components of $\vec{AB}$ when given coordinates of point A and B.

if A (-7, 3)
B (-3, 5)

find $\vec{AB}$

(the components)

(step i) graph



$\vec{AB} = (4, 2)$

step ii use formula

$\vec{AB} = (\Delta x, \Delta y)$

$\vec{AB} = (x_2 - x_1, y_2 - y_1)$

$P_1 P_2$

Note! Order is important
LABEL!

P_1 A (-7, 3) B_2 B (-3, 5)
x_1 y_1 x_2 y_2

$\vec{AB} = (x_2 - x_1, y_2 - y_1)$

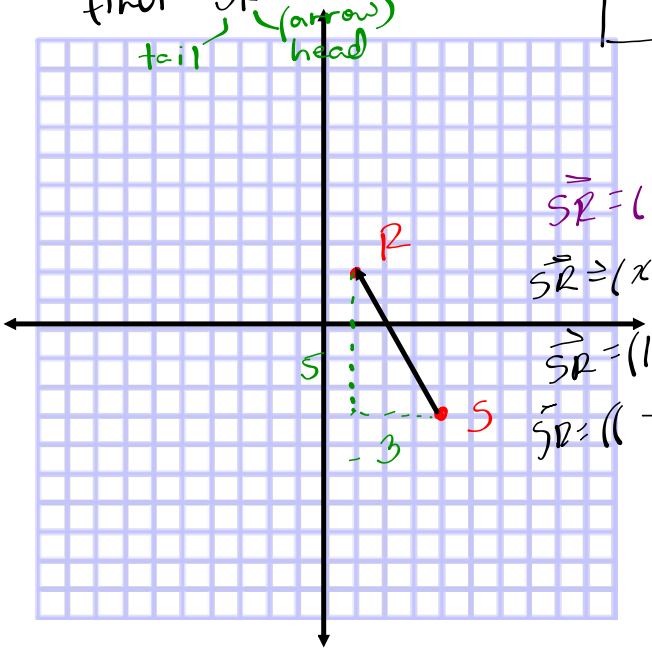
$\vec{AB} = (-3 - (-7), 5 - 3)$

$\vec{AB} = (4, 2)$

if $P_2 R = (1, 2)$ (x_2 y_2)
$P_1 S = (4, -3)$ (x_1 y_1)

find $\vec{SR}$ ($P_1 P_2$)

tail (arrow) head



$\vec{SR} = (-3, 5)$

$\vec{SR} = (x_2 - x_1, y_2 - y_1)$

$\vec{SR} = (1 - 4, 2 - (-3))$

$\vec{SR} = (-3, 5)$

HMWK

#4 p 1.53

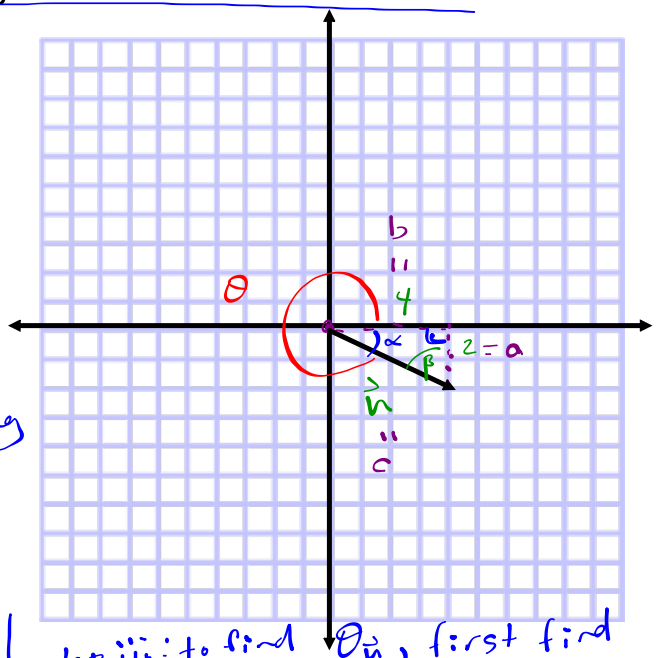
. first graph vectors
. and then find norm

Find the Norm/Angle Form of a Vector given component form

ex. if $\vec{u}(4, -2)$

find $\|\vec{u}\|$ (norm)

and $\theta_{\vec{u}}$ (absolute)



step i: graph.

step ii: find $\|\vec{u}\|$ by using Pythagorean Theorem

$c^2 = a^2 + b^2$

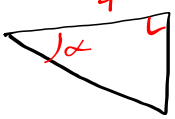
$\|\vec{u}\|^2 = a^2 + b^2$

$\|\vec{u}\|^2 = (-2)^2 + 4^2$

$\|\vec{u}\| = 2\sqrt{5}$ units

$\|\vec{u}\| = 4.47$ units

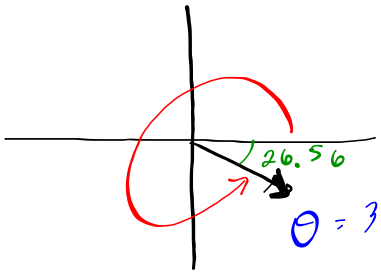
step iii: to find $\theta_{\vec{u}}$, first find α in triangle, by using SOH CAH TOA



$\tan\alpha = \frac{opp}{adj}$

$\tan^{-1}\tan\alpha = \tan^{-1}\left(\frac{2}{4}\right)$

$\alpha = 26.56°$



$\theta_{\vec{u}} = 360 - 26.56$

$\theta_{\vec{u}} = 333.44°$

$\vec{u} = 4.47$ unit @ $333.44°$

$\vec{u} = 4.47$ units @ S 63.44 E

E 26.56° S

if $\vec{XY} = (-3, -4)$

find $\|\vec{XY}\|$

and $\theta_{\vec{XY}}$

if $A(-1, 3)$

$B(-5, -2)$

find $\|\vec{BA}\|$ and $\theta_{\vec{BA}}$

if $A(-1, 3)$
$B(-5, -2)$

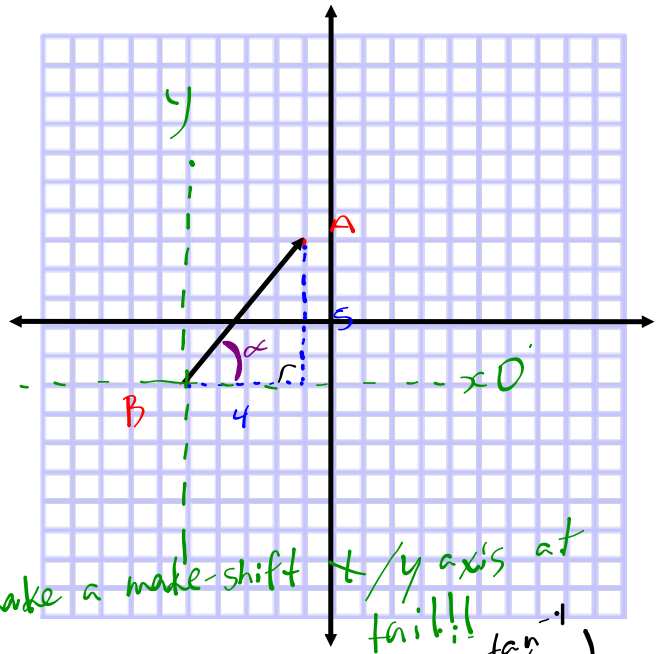
find $\|\vec{BA}\|$ and $\theta_{\vec{BA}}$
tail head

$\vec{BA} = (4, 5)$

$\|\vec{BA}\| = \sqrt{4^2 + 5^2}$

$\|\vec{BA}\| = 6.4$

find $\theta_{\vec{BA}}$ → make a make-shift + / y axis at tail!!



$\tan\alpha = \frac{o}{a}$

$\tan\alpha = \left(\frac{5}{4}\right)$

$\tan^{-1}$ $\tan^{-1}$

$\alpha = 51.34°$

$\vec{BA} = 6.4$ units, $51.34°$

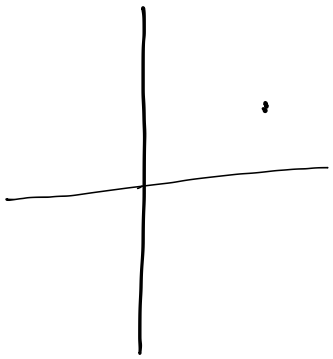
#3 pg 1.64

Definitions:

The zero vector $\vec{0}$

$\vec{0}$ = 0 units, 0°

the zero vector is a point



if A(5, 2)

$\vec{0} = \vec{AA}$ $\vec{BB} = \vec{0}$

Opposite Vectors

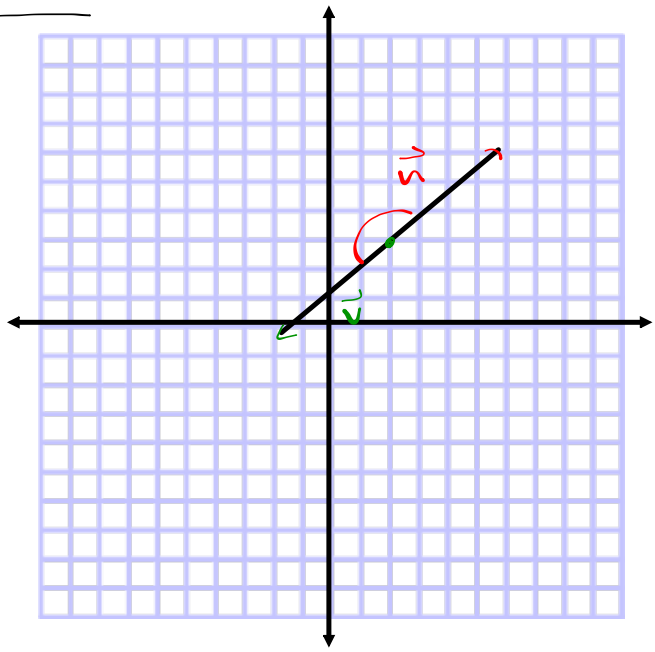
e.g. $\vec{u}$ & $\vec{v}$

$\|\vec{u}\| = \|\vec{v}\|$

$\theta_{\vec{u}} \neq \theta_{\vec{v}}$

$\theta_{\vec{v}} - \theta_{\vec{u}} = 180^\circ$

p 1.37



Equipollent Vectors

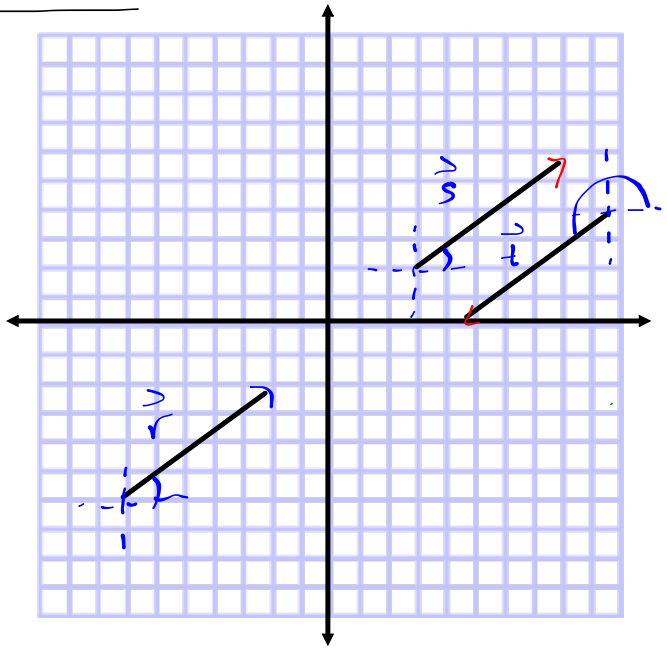
(the same vector)

$||\vec{s}|| = ||\vec{r}||$

$\theta_{\vec{s}} = \theta_{\vec{r}}$

$\vec{r}$ & $\vec{s}$ equipollent

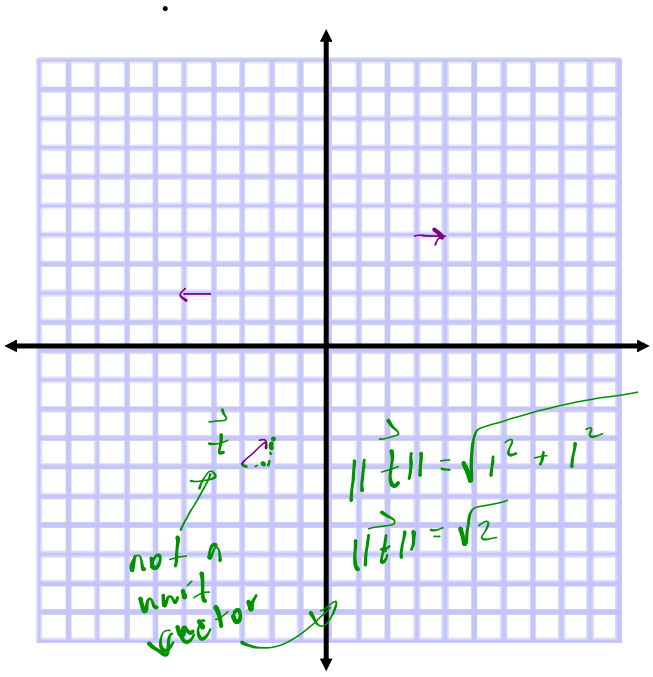
$\vec{r}$ & $\vec{t}$ opposite



Unit Vector:

$\vec{u}$: $\|\vec{u}\|$, $\theta_{\vec{u}}$

$\|\vec{u}\| = 1$ unit



P 1.38

Orthogonal Vector

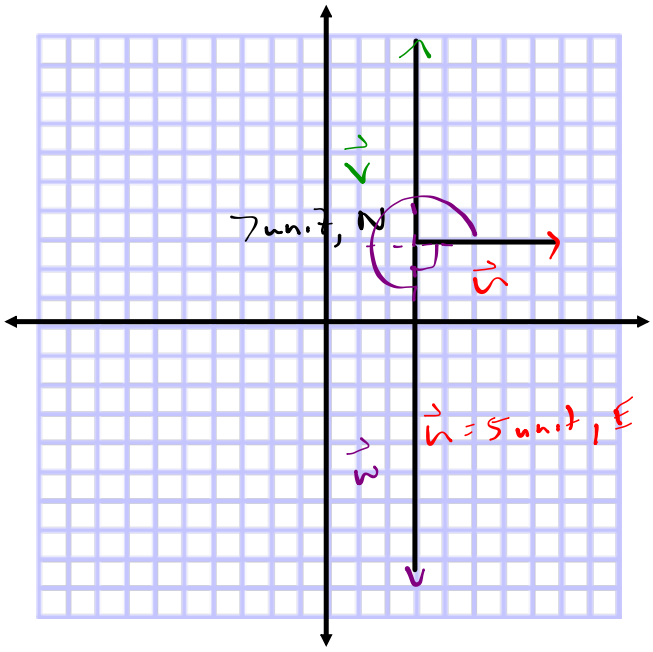
$\perp$ vectors

norms don't have to be the same

$\theta_{\vec{v}} - \theta_{\vec{u}} = 90^\circ$

or

$\theta_{\vec{w}} - \theta_{\vec{u}} = 270^\circ$



Collinear Vectors

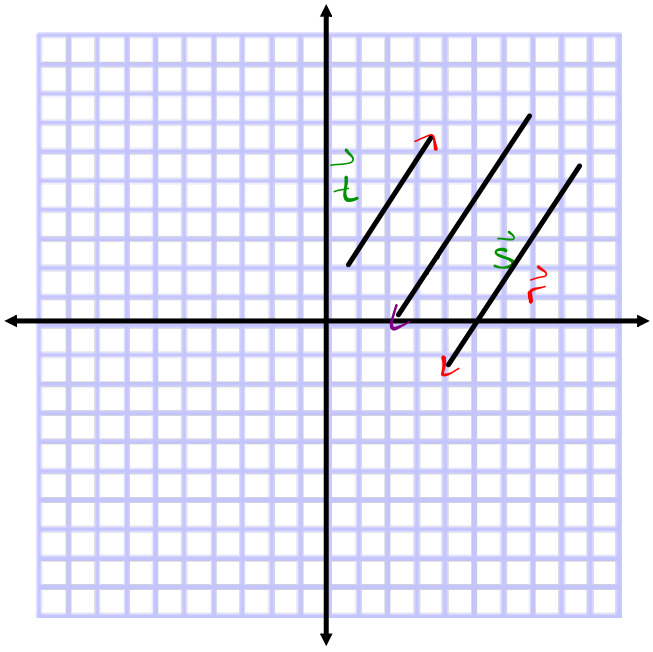
$\parallel$ vectors
(parallel)

(norms don't have to be the same)

$\vec{s}$ & $\vec{t}$ are collinear

$\theta_{\vec{s}} - \theta_{\vec{t}} = 180^\circ$

$\theta_{\vec{s}} - \theta_{\vec{r}} = 0^\circ$



HMWK
P 1.43 #1.3
1.47