Vector Basics

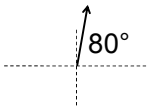
- Scalar – A number with a unit.
- Vector – A number with a unit and a direction.
- Commonly used to represent
  - Displacement
  - Force
  - Velocity
  - Acceleration

1

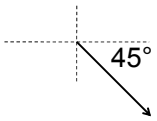
Vector Direction (2 Common Ways)

- Labeled degrees north or south of x-axis
- Absolute Angle: degrees from east direction (0°)

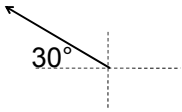
80° N of East
Or 80°



45° S of East
Or 315°



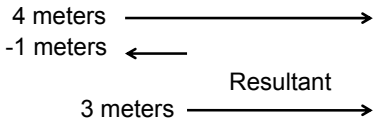
30° N of West
Or 150°



2

Combining Vectors

- Resultant – combination of two or more vectors.
  - Add vectors in the same direction.
  - Subtract vectors in opposite direction
  - A negative sign means opposite direction



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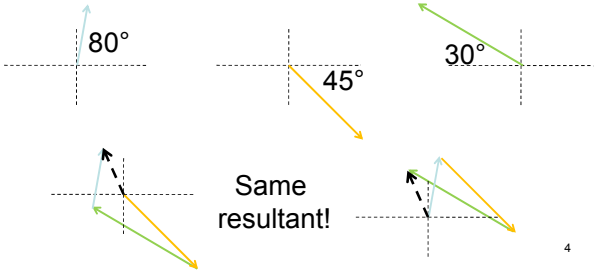
Graphical Way - Head to Tail Method

- Arrange vectors so tail starts from last head
- The resultant is the tail to the last head
- The order you arrange does not matter



4

Subtracting a Vector Graphically

- Draw arrow in reverse
  - Directions are swapped

    Ex: 30° N of W becomes 30 °S of E

    Absolute angle differs by 180° → 130° becomes 330°

5

Vector Resolution

Vectors can be broken into x and y components
- Vectors at angle are split in two directions
- This is used to easily add many vectors

Using the angle from the x-axis:

x-Component
$R_x = R \cos \theta$

y-Component
$R_y = R \sin \theta$

6

Combining Vectors (not perpendicular)

When vectors are at angle from each other:
- break into components
- Add x and y components separately
- Find new resultant and angle

Finding the resultant vector:

Magnitude

$R = \sqrt{R_x^2 + R_y^2}$

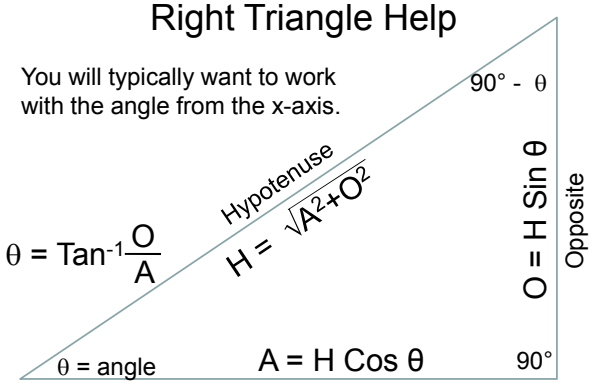
Direction

$\theta = \text{Tan}^{-1}\frac{O}{A}$

7

Right Triangle Help

You will typically want to work with the angle from the x-axis.



8

90° Triangles

- Pythagorean Theorem:

$R^2 = A^2 + B^2$

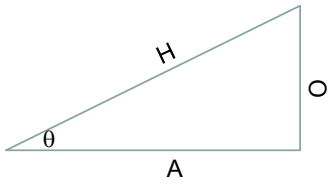
SOH	CAH	TOA
$\text{Sin}\,\theta = \frac{O}{H}$	$\text{Cos}\,\theta = \frac{A}{H}$	$\text{Tan}\,\theta = \frac{O}{A}$

9

Finding an Angle

SOH	CAH	TOA
$\theta = \text{Sin}^{-1}\frac{O}{H}$	$= \text{Cos}^{-1}\frac{A}{H}$	$= \text{Tan}^{-1}\frac{O}{A}$

Used a lot!



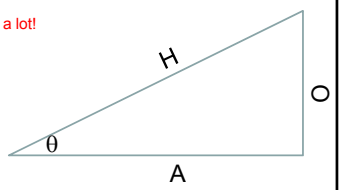
10

Finding the Opposite Side

$O = H \text{ Sin } \theta$ Used a lot!

$O = A \text{ Tan } \theta$

$O = \sqrt{H^2 - A^2}$



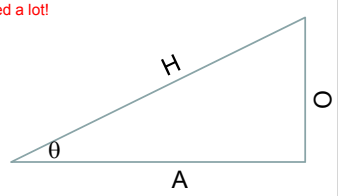
11

Finding the Adjacent Side

$A = H \text{ Cos } \theta$ Used a lot!

$A = \frac{O}{\text{Tan } \theta}$

$A = \sqrt{H^2 - O^2}$



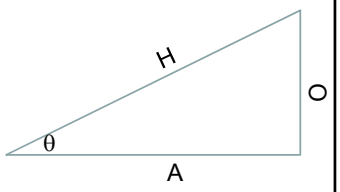
12

Finding the Hypotenuse

$H = \frac{O}{\text{Sin } \theta}$

$H = \frac{A}{\text{Cos } \theta}$

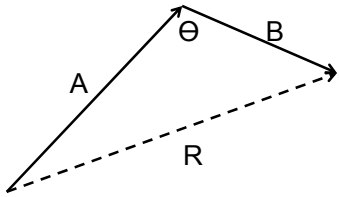
$H = \sqrt{A^2+O^2}$



13

Law of Cosines

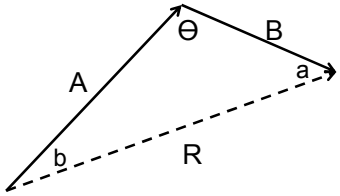
- $R^2 = A^2 + B^2 – 2AB \cos \Theta$



14

Law of Sines

$$\frac{R}{Sin(\theta)} = \frac{A}{Sin(a)} = \frac{A}{Sin(a)}$$



15