National University of Computer & Emerging Sciences – FAST

FAST SCHOOL OF COMPUTING

Course Code: NS 1001

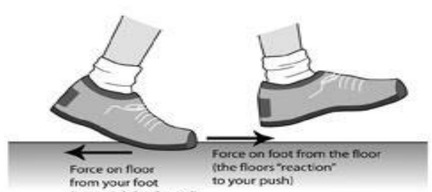
Course Title: Applied Physics
Instructor: Dr. Muhammad Adeel
Fall Semester 2024

AN INTRODUCTION & A SHORT REVIEW OF PHYSICS

Definition of Physics:

Branch of science deals with the study of matter and energy along with the interaction between them.

Application of Physics:



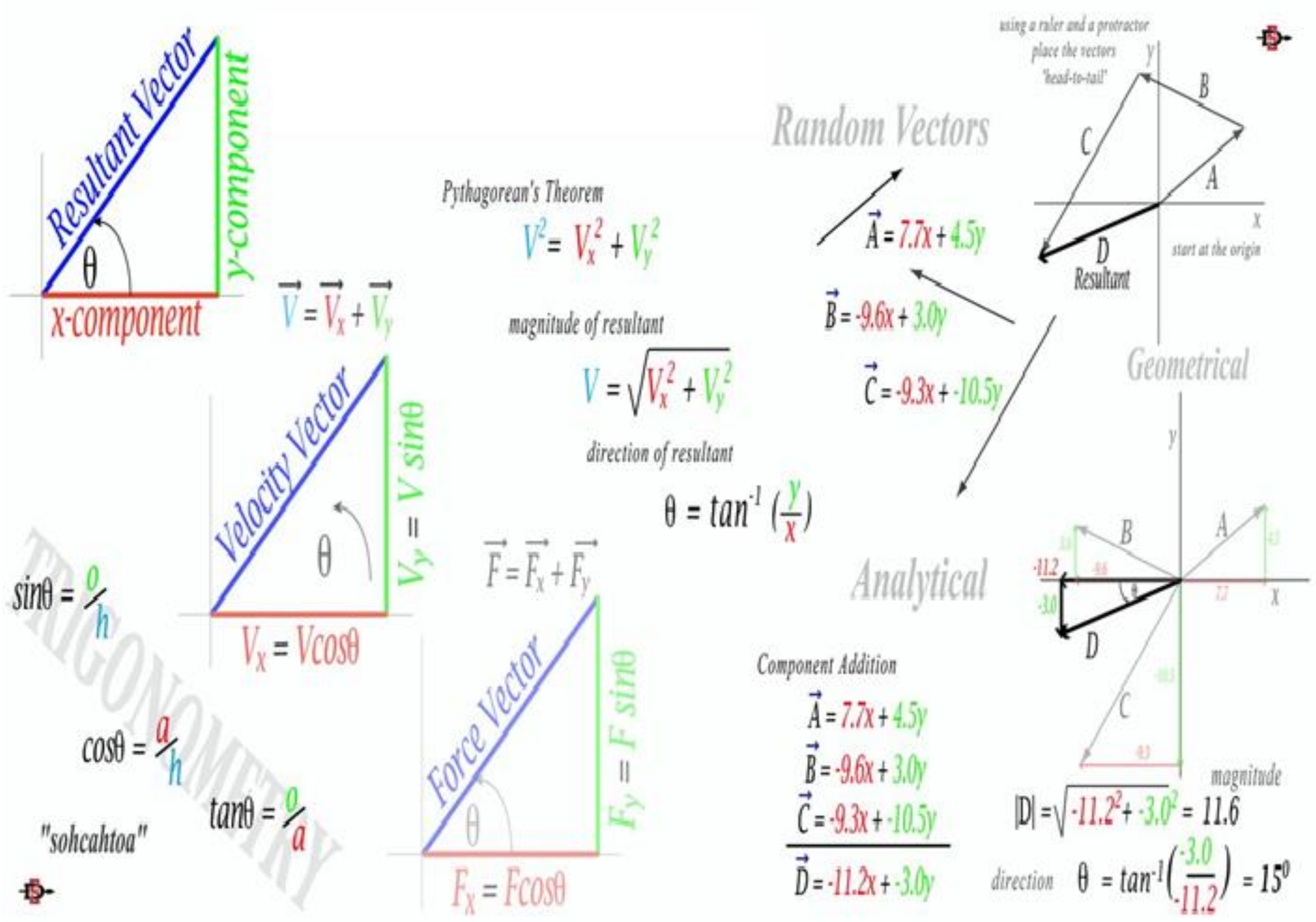
WHY APPLIED PHYSICS?

Difference of Pure Physics and Applied Physics:

- **Physics** is field of study of the natural phenomenon, whereas **Applied Physics** is a field of study under **Physics**.

Need to study Applied Physics:

- It is the physics for Engineers, because it develops connection between physical laws and principles to Engineering.


Resultant Vector
y-component
x-component
θ
$\vec{V} = \vec{V}_x + \vec{V}_y$
Velocity Vector
$V_y = V\sin\theta$
$V_x = V\cos\theta$
Pythagorean's Theorem
$V^2 = V_x^2 + V_y^2$
magnitude of resultant
$V = \sqrt{V_x^2 + V_y^2}$
direction of resultant
$\theta = \tan^{-1}(\frac{y}{x})$
$\vec{F} = \vec{F}_x + \vec{F}_y$
Force Vector
$F_y = F\sin\theta$
$F_x = F\cos\theta$
$\sin\theta = o/h$
$\cos\theta = a/h$
$\tan\theta = o/a$
"sohcahtoa"
TRIGONOMETRY
Random Vectors
$\vec{A} = 7.7x + 4.5y$
$\vec{B} = -9.6x + 3.0y$
$\vec{C} = -9.3x + -10.5y$
using a ruler and a protractor place the vectors "head-to-tail"
start at the origin
Resultant
Geometrical
Analytical
Component Addition
$\vec{A} = 7.7x + 4.5y$
$\vec{B} = -9.6x + 3.0y$
$\vec{C} = -9.3x + -10.5y$
$\vec{D} = -11.2x + -3.0y$
magnitude
$|D| = \sqrt{-11.2^2 + -3.0^2} = 11.6$
direction $\theta = \tan^{-1}\left(\frac{-3.0}{-11.2}\right) = 15^0$

VECTORS

CONTENTS

INTRODUCTION

Definition of Vectors & Scalars

Physical quantities can be classified under two main headings,

- Scalars
- Vectors
- A Scalar quantity that has magnitude only, while direction is not taken into account.

Examples: Speed, Pressure, Temperature, Energy etc.

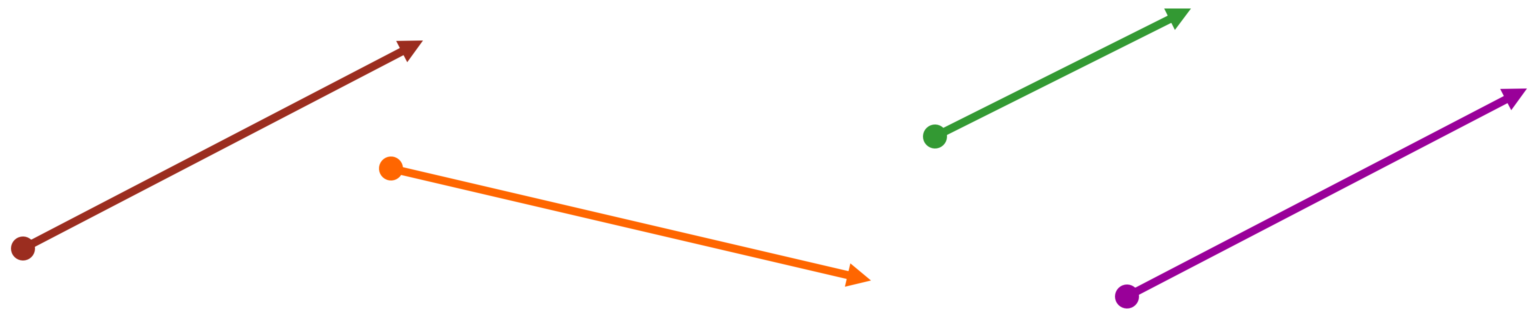
- A quantity that has both magnitude and direction and obeys certain algebraic laws is called a Vector quantity.

Examples: Velocity, Acceleration, Force, Displacement etc.

Graphical Realization of Vector

Vector is represented by an arrow.

The length of the vector represents the magnitude, and the arrow indicates the direction of the vector.



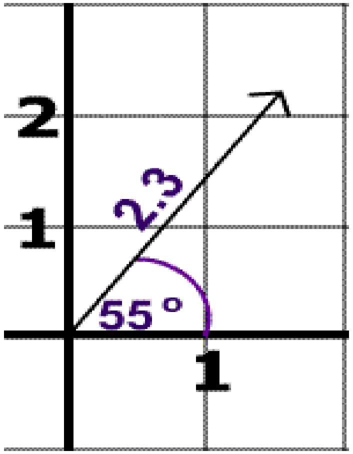
Brown and orange vectors have same magnitude but different direction.

Brown and purple vectors have same magnitude and direction, so they are equal.

Brown and green vectors have same direction but different magnitude.

Two vectors are equal if they have the same direction and magnitude (length).

GRAPHICAL REALIZATION OF VECTOR



- The **direction** of the vector is 55° North of East
- The **magnitude** of the vector is 2.3.

In order to distinguish vector and scalar quantities, different conventions are used.

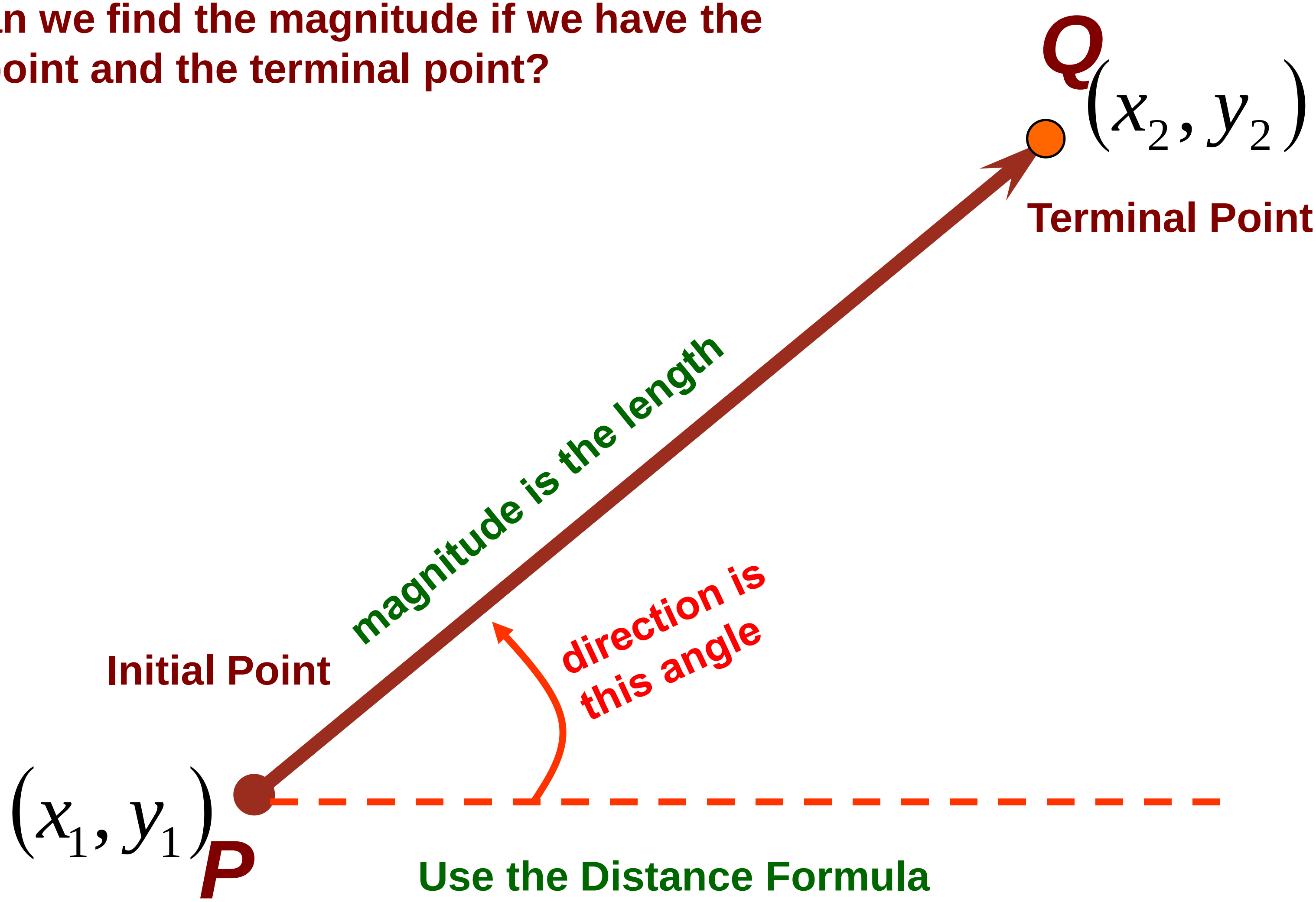
An arrow over a letter: $\vec{V}$ or a letter with bold face $\boldsymbol{V}$

An arrow over two letters, the initial and terminal points $\overrightarrow{AB}$

or both letters in bold face $\boldsymbol{AB}$

The magnitude (length) of a vector is notated with double vertical lines $\|\vec{V}\|$ $\|\overrightarrow{AB}\|$

How can we find the magnitude if we have the initial point and the terminal point?



Use the Distance Formula

or the

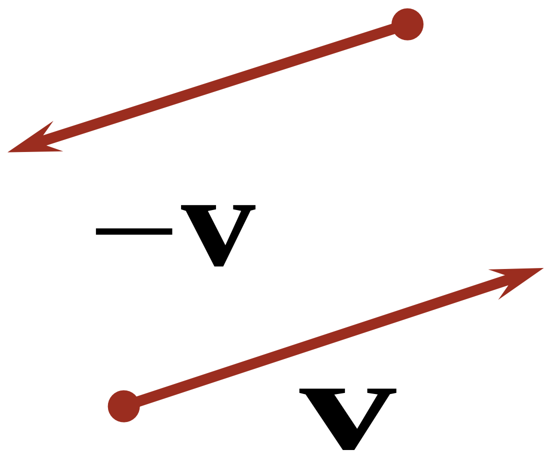
Pythagorean Theorem

MATHEMATICAL REALIZATION OF VECTOR & VECTOR COMPONENTS

- Negative of a Vector
- Vector Components and Resolution of Vector
- Vector Addition, Subtraction
- Multiplication of Vector
- Unit Vector and Coordinate system
- Dot Product and Cross Product

Negative of a Vector

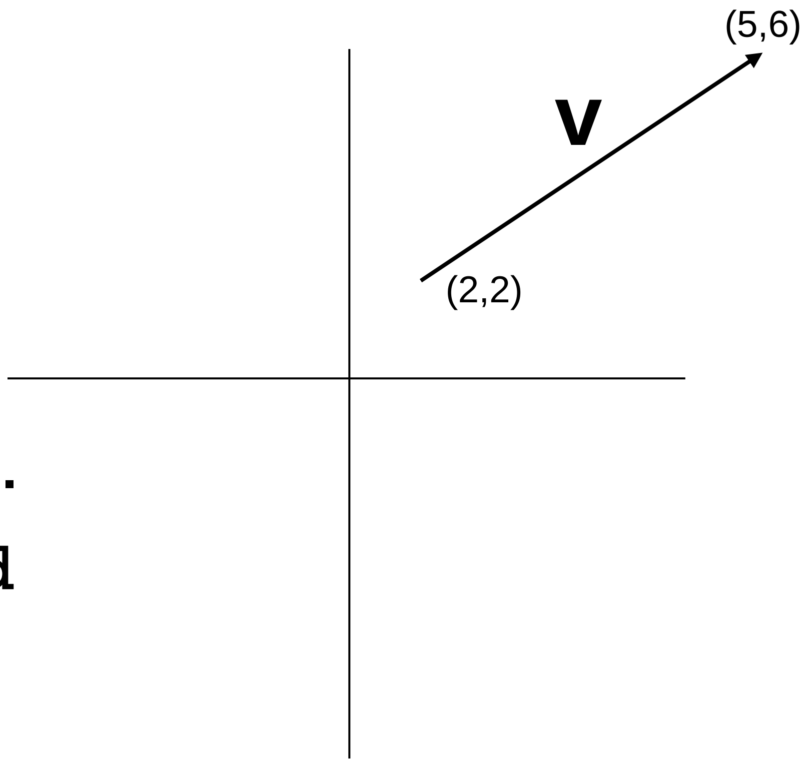
The Negative of A Vector is just a vector going the opposite way.



- The negative of a vector when added to the original vector, gives a resultant of zero ! Represented as **"– V"**
- **V + (– V) = 0**

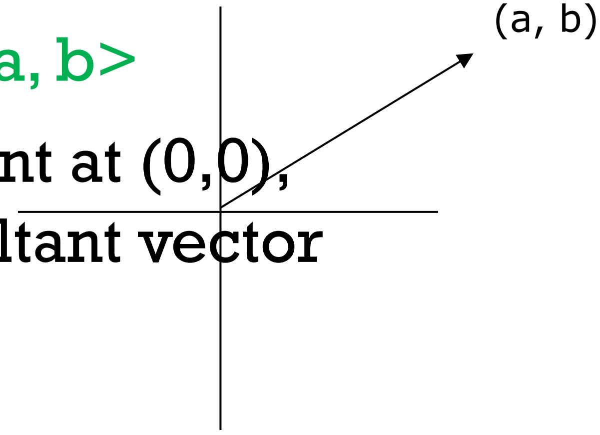
COMPONENTS OF A VECTOR

- To do computations with vectors, we place them in the plane and find their **components**.
- The initial point is the **tail**, the **head** is the terminal point. The components are obtained by subtracting coordinates of the initial point from those of the terminal point.



Components of a Vector

Vector is shown by angle brackets <a, b>



Example: Let a vector with Initial point at (0,0), Terminal point at (a, b) then the resultant vector will be $\mathbf{v} = \langle a-0, b-0 \rangle$

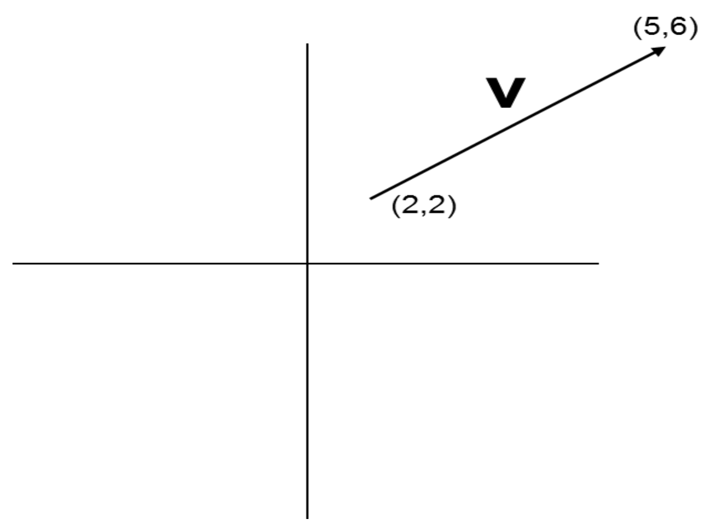
$$\mathbf{v} = \langle a, b \rangle$$

Mathematically ,

The first component of v is 5 -2 = 3.

The second is 6 -2 = 4.

We write $\mathbf{v} = \langle 3, 4 \rangle$



VECTOR RESOLUTION

- Vectors that are acting at an angle can be broken down into the horizontal and vertical parts which make them up.
- Any vector can be broken down into a horizontal component and a vertical component.
- The sum of the two components should give you back your original vector.
- What is nice about vector components is that they form right triangle, since one acts vertically and the other acts horizontally. Thus, the original vector forms the hypotenuse of the right triangle formed by its components. The process of breaking a vector down into its components is called VECTOR RESOLUTION