Pakistan School
Kingdom of Bahrain

Vectors
Class 11

Objective

- Student will be able to define and then differentiate different types of vectors.

Vectors

- Those physical quantities, which can be completely described by magnitude as well as specific direction, are called vectors. They are also called directional quantities. For example, Force, torque, linear momentum, displacement, and velocity etc.

- Representation

- Vectors can be represented symbolically as well as graphically. Symbolically vectors can be represented by bold face letters either capital **A**, or small **a**. Vectors can also be represented by simple face letters with an arrow head

- upon or below that letter. As $\overrightarrow{A}, \vec{B}, \vec{C}, \vec{a}, \vec{b}, \vec{c}$ and $\underline{A}\,\underline{B}\,\underline{C}$

- In this chapter vector is symbolically represented by A, B, C, or The magnitude of a vector can be represented by simple face letter as A. or A (read as A modulus). Symbolically the direction of a vector is represented as $\hat{A}$ (read as "A cap"). As a vector has a magnitude and a direction, therefore, symbolically can be expressed as:

- $\vec{A} = |\vec{A}|\ \hat{A}$ (2.1)

- Graphically a vector is represented by an arrow which is drawn according to a scale. The length of the arrow gives the magnitude of the vector quantity under the selected scale and the arrow head indicates the direction of the vector.

- For example a student traveled 100 m from school towards east. Graphically it can be represented as:

- Let 1 cm represents 10 m.

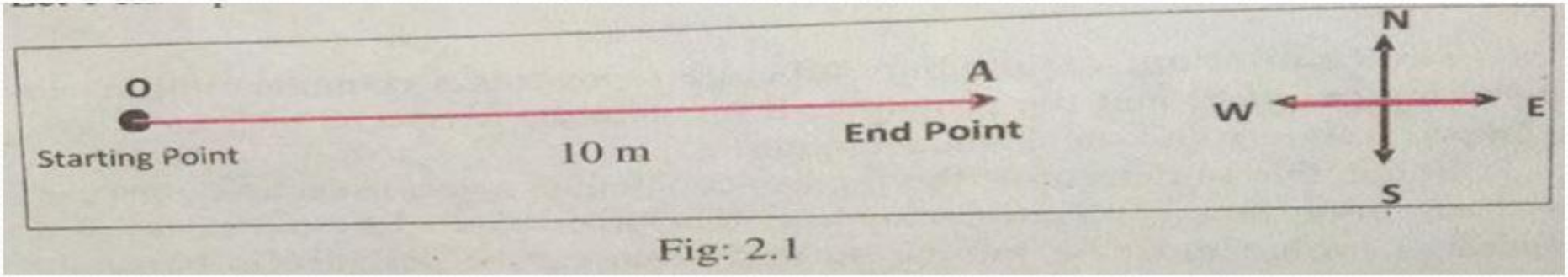


Fig: 2.1

- The starting point is usually called origin or tail of a vector. The end point is usually called head of the vector.

Cartesian Coordinate System or Rectangular Coordinate System

- For the graphical representation of vectors beside north— south and east — west direction the concept of up — down and right — left can also be used. But for the sake of simplicity and uniformity a set of two mutually perpendicular lines for two dimensional cases are used shown in fig. 2.2 (a).

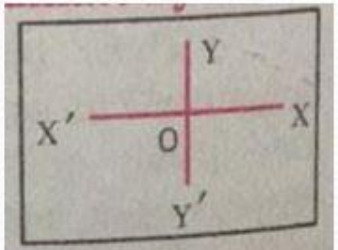


Fig:2.2 (a)

These are called coordinate axes and their point of intersection is known as origin. This system of coordinate axes is called Cartesian or rectangular coordinate system. One of the lines is named as x-axis and the other as y-axis. Usually the x-axis is taken as the horizontal axis, with a positive direction to the right and the y-axis as vertical axis, with the positive direction upward.

The direction of a vector in XY-plane is denoted by the angle which the representative line of the vector makes with positive x-axis in the anti-clockwise direction, as shown in fig. 2.2(b).

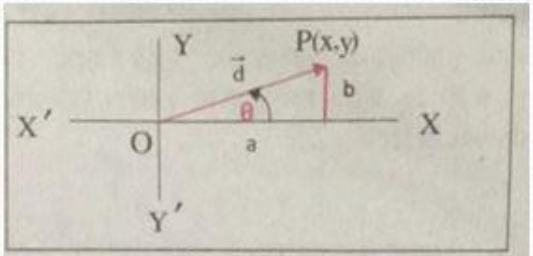


Fig. 2.2 (b)

The point P shown in fig. 2.2(b) has coordinates (x, y). It means that we can reach point P by moving a units along positive x-axis and b units along positive y-axis. To describe the direction of a vector in space (3-D) another axis is required along with x- and y-axes.

3-D

The third axis is usually called z-axis and it is perpendicular to x- and y- axes. Three mutually perpendicular lines (for 3 — dimensional cases, as in figure 2.3 (a).

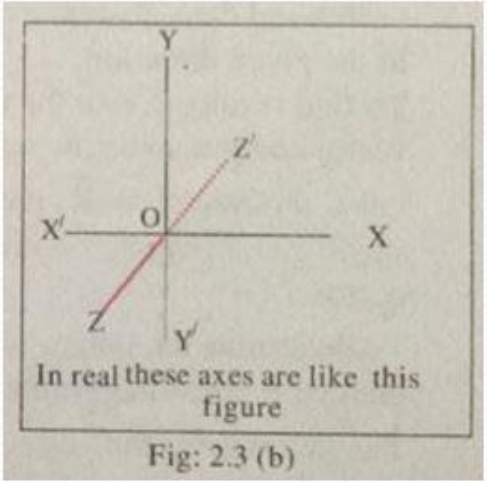


Fig: 2.3 (b)

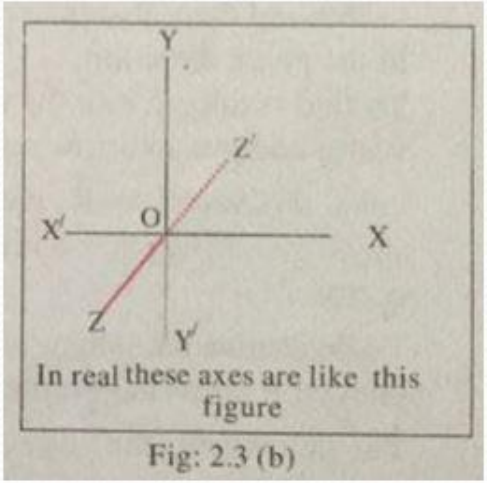
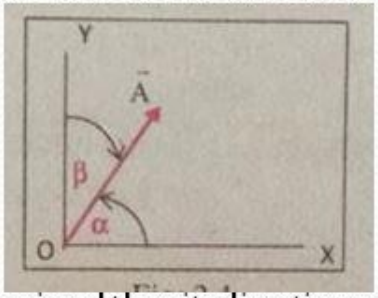


Fig: 2.3 (b)

- These lines are usually named as x — axis, y — axis and z — axis, as shown in 2.3 (a) and 2.3 (b).
- For two dimensional case i.e, when a vector lies in aplane, only one angle eithera (angle with respect to x-axis or 13 (angle with respect to y-axis) must be known to describe the exact direction, as shown in figure 2.4



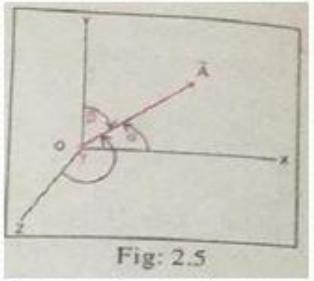
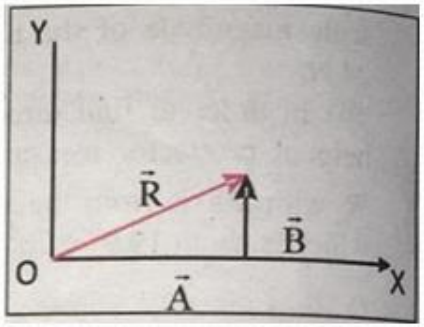


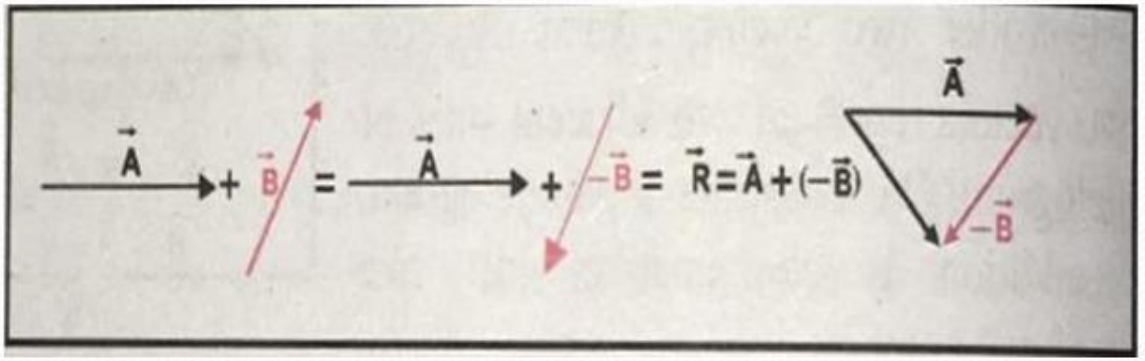
Fig: 2.5

- Similarly, if a vector lies in space i.e. 3 — dimensional then its direction can only be determined if its angles with respect to x-axis (a), with respect to y-axis (Ii) as well as with respect to z-axis (7) are known, as shown in figure 2.5.

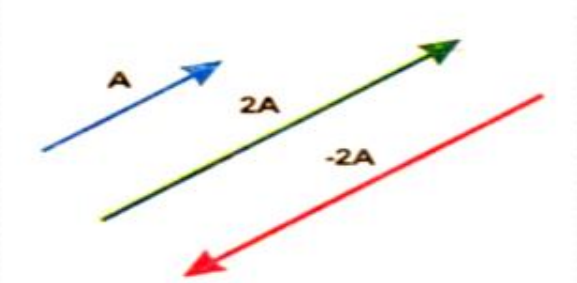
Subtraction of Vectors:

- There is no direct method for determining the result of subtraction of two vectors. Even for subtraction we use the method of addition as:
- If vector B is supposed to be subtracted from **A** then first we find the negative of B , which is - **B** and then we add this negative of **B** with **A** as shown:





- ## Multiplication of a Vector by a Number or Scalar
- Let A is a given vector and n is a number then nxA = n A (a vector quantity). Following are the different possibilities:
- When a vector is multiplied by a +ve number then only its magnitude changes
- but
- if it is multiplied by a —ve number its magnitude as well as its direction change.



Addition of Vectors

Fig. 2.3(a)

Fig. 2.3(b)

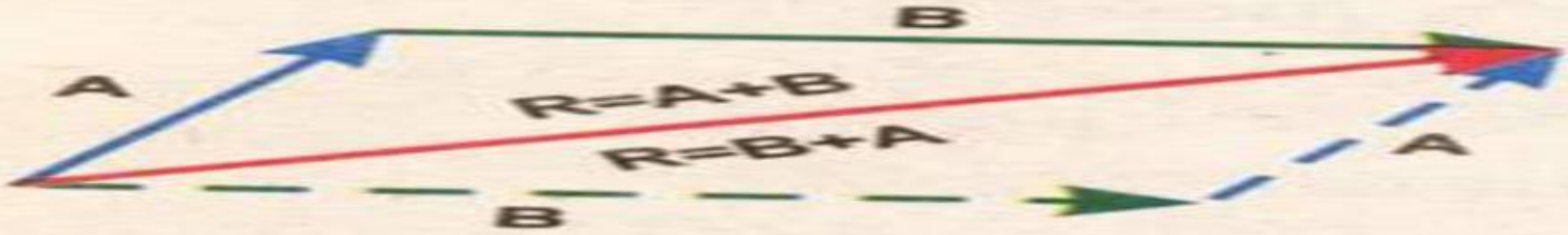


Fig. 2.3(C)

Closure

- How are Vectors added or subtracted?
- By Head to tail rule

Home Work

- Write a note how to represent a vector?

Or

Create a map from your house to your school using vectors?