

**ENGINEERING MECHANICS****CHAPTER 2: COPLANAR CONCURRENT FORCES**

Lecture 2:

**Effect of a force on a body :** The following effects may be produced on a body when acted upon by a force.

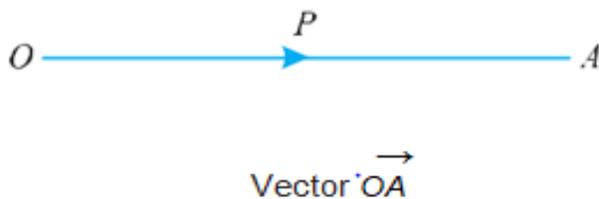
- 1) It may change the motion of a body. *i.e.* if a body is at rest, the force may set it in motion. And if the body is already in motion, the force may accelerate it.
- 2) It may retard the motion of a body.
- 3) It may retard the forces, already acting on a body, thus bringing it to rest or in equilibrium.
- 4) It may give rise to the internal stresses in the body, on which it acts.

2.2 Scalar and Vector Quantities, Representation of a force as a Vector, Addition and subtraction of vectors.

**Scalar Quantities:** The scalar quantities (or sometimes known as scalars) are those quantities which have magnitude only such as length, mass, time, distance, volume, density, temperature, speed etc.

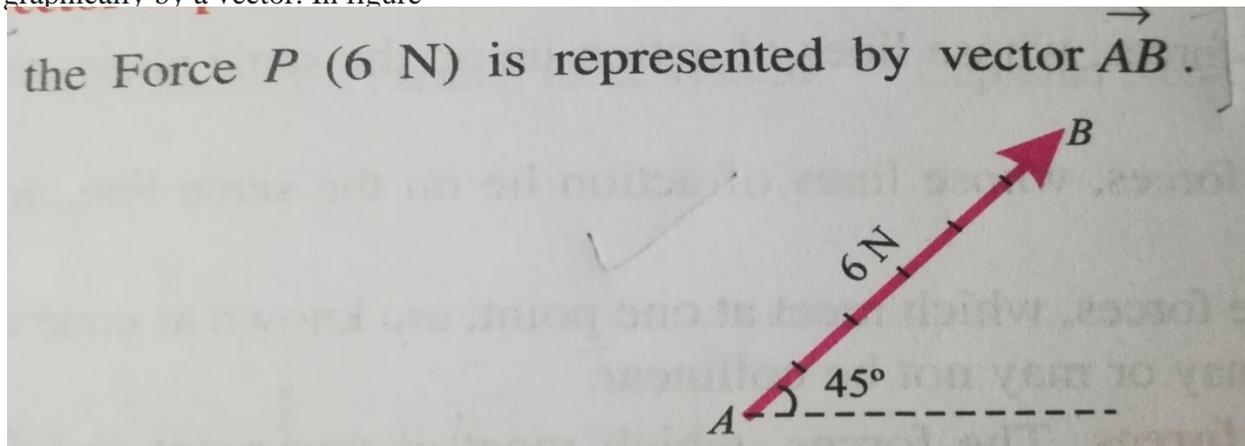
**Vector Quantities:** The vector quantities (or sometimes known as vectors) are those quantities which have both magnitude and direction such as force, displacement, velocity, acceleration, momentum etc.

A vector is represented by means of a straight line with an arrow as shown below:



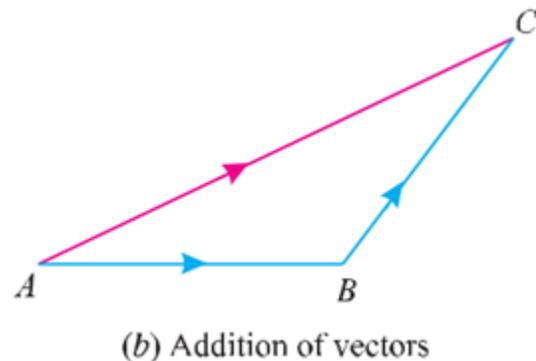
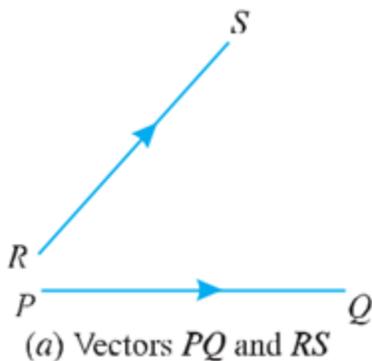
The length  $OA$  represents the magnitude of the vector  $\vec{OA}$ . The direction of the vector  $\vec{OA}$  is from  $O$  (*i.e.*, starting point) to  $A$  (*i.e.*, end point). It is also known as vector  $P$ .

**Representation of a force as a vector:** Vector representation is a method of representing a force graphically by a vector. In figure



**Addition and subtraction of vectors:**

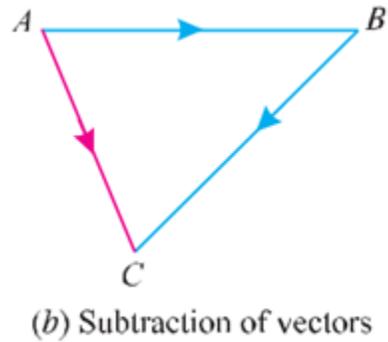
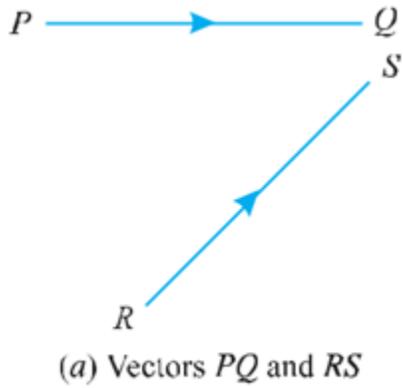
**Addition of vectors:** We consider two vectors  $PQ$  and  $RS$ , which are required to be added as shown in figure.



We take a point  $A$ , and draw line  $AB$  parallel and equal in magnitude to the vector  $PQ$  to some convenient scale. Through  $B$ , we draw  $BC$  parallel and equal to vector  $RS$  to the same scale. We join  $AC$  which will give the required sum of vectors  $PQ$  and  $RS$  as shown above.

This method of adding the two vectors is called the Triangle Law of Addition of Vectors. Similarly, if more than two vectors are to be added, the same may be done first by adding the two vectors, and then by adding the third vector to the resultant of the first two and so on. This method of adding more than two vectors is called Polygon Law of Addition of Vectors.

**Subtraction of vectors:** We consider two vectors  $PQ$  and  $RS$  in which the vector  $RS$  is required to be subtracted as shown in figure.



We take a point  $A$ , and draw line  $AB$  parallel and equal in magnitude to the vector  $PQ$  to some convenient scale. Through  $B$ , we draw  $BC$  parallel and equal to the vector  $RS$ , but in *opposite direction*, to that of the vector  $RS$  to the same scale. We join  $AC$ , which will give the resultant when the vector  $PQ$  is subtracted from vector  $RS$  as shown above.