Scalars and Vectors

(Physics)

Join Us for Free Study Material

❖ Telegram Official Channel	❖ Telegram.me/ExamsRoad
❖ Facebook Official Page	❖ FB.com/ExamsRoadOfficial
❖ Twitter Official Handle	❖ Twitter.com/ExamsRoad
❖ Instagram Official Page	❖ Instagram.com/ExamsRoad
❖ YOUTUBE Official CHANNEL	❖ Free Video Classes for All Exams Click Here Subscribe Now

About ExamSRoad.com -

ExamsRoad.com is focused on JEE Mains, JEE Advanced, NEET, AIIMS & Various Engineering & Medical Exams. We provide the best and easy way to learn Physics, Chemistry, Maths & Biology. We also provide detailed NCERT solutions for Class 12th, 11th, 10th, 9th, 8th, 7th & 6th.

Our key content includes

– Short Tricks &

– Doubt Solution

– NCERT Solution

– Detailed Explanation

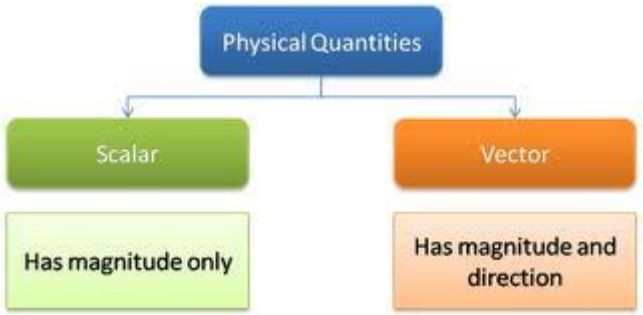
– Previous JEE & NEET Question Papers with solution

– Quizzes

– Study Material

Scalars and Vectors

Different physical quantities can be classified into the following two categories:



Scalars

Scalar quantities are those quantities which require only the magnitude for their complete specifications. Physical quantities which can be completely specified by a number and unit, and therefore have the magnitude only, are scalars. Some physical quantities which are scalar are mass, length, time, energy, volume, density, temperature, electric charge, electric potential etc. These examples obey the algebraic law of addition.

Vectors

Vector quantities are those quantities which require magnitude as well as direction for their complete specifications. Vectors are physical quantities, which besides having both magnitude and direction also obey the law of geometrical addition. (The law of geometrical addition, i.e. the law of triangular addition and law of parallelogram are discussed later in this chapter). Some physical quantities, which are vectors are displacement, velocity, acceleration, force, electric intensity, magnetic intensity, magnetic moment etc. Vector quantities cannot, in general, be added in algebraically.

Important Note:- Electric current possesses magnitude and direction (through the conductor), but it is not a vector quantity. Electric current is a scalar quantity.

Representation of a Vector:

Since vectors have directions, any representation of them has to include the direction.

To represent a vector we use a line with an arrow head. The length of the line represents the magnitude of the vector and direction of the arrow represents the direction of the vector. Let us start with a vector quantity called displacement. In the enclosed figure the change of position from point O to A is represented graphically by the directed line segment with an arrowhead to represent direction of motion.

Vectors are a Physical quantity and all physical quantities have units. Hence, the vectors also have units, they are called unit vectors.

A vector can be represented by observing the following steps:

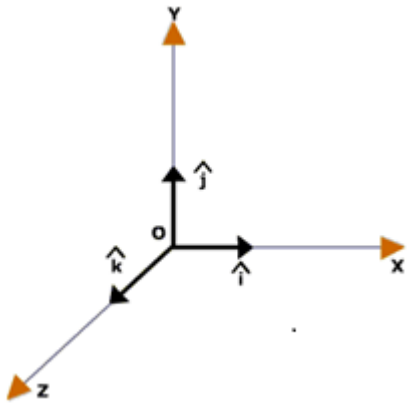
(a) Draw a line parallel to the direction of the vector.

(b) Cut a length of the line so that it represents the magnitude of the vector on a certain convenient scale.

(c) Put an arrowhead in the direction of the vector.

Unit Vectors

A unit vector is a vector having a magnitude of unity. Its only purpose is to describe a direction in space. On x-y coordinate system $\hat{i}$ denote unit vector in positive x direction and $\hat{j}$ denotes unit vectors in positive y direction.



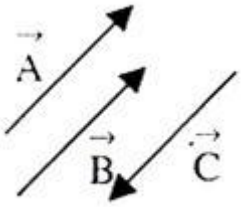
Any vector in x – y plane can be represented in terms of these unit vectors $\hat{i}$ and $\hat{j}$.

Similarly any vector in a 3 dimensional x y z space can be represented in terms of unit vectors $\hat{i}$, $\hat{j}$ and $\hat{k}$. Here, $\hat{k}$ is the unit vector in the positive z direction, as shown in figure above.

Collinear vectors:- Vectors having a common line of action are called collinear vectors. There are two types of collinear vectors. One is a parallel vector and another is an anti parallel vector.

Parallel Vectors:- Two or more vectors (which may have different magnitudes) are said to be parallel ($\theta = 0°$) when they are parallel to the same line. In the figure below, the vectors $\vec{A}$ and $\vec{B}$ are parallel.

Anti Parallel Vectors



Two or more vectors (which may have different magnitudes) acting along opposite direction are called antiparallel vectors.In the figure below, the vectors $\vec{B}$ and $\vec{C}$ are anti parallel vectors.

Equal Vectors:- Two or more, vectors are equal if they have the same magnitude (length) and direction, whatever their initial points. In the figure above, the vectors A and B are equal.

Negative Vectors:- Two vectors which have the same magnitude (length) but their direction is opposite to each other are called the negative vectors of each other. In figure above vectors A and C or B and C are negative vectors.

Null Vectors:- A vector having zero magnitude in an arbitrary direction is called zero vector or 'null vector and is written as = O vector. The initial point and the end point of such a vector coincide so that its direction is indeterminate. The concept of null vector is hypothetical but we introduce it only to explain some mathematical results.

Properties of a Null Vector

(a) It has zero magnitude.

(b) It has arbitrary direction

(c) It is represented by a point.

(d) When a null vector is added or subtracted from a given vector the resultant vector is the same as the given vector.

(e) Dot product of a null vector with any vector is always zero.

(f) Cross product of a null vector with any vector is also a null vector.

Invariance of the Vector:- Any vector is invariant so it can be taken anywhere in the space keeping its magnitude and direction the same. In other words, the vectors remain invariant under translation.

Co-planar Vector:- Vectors situated in one plane, irrespective of their directions, are known as co-planar vectors.

Localized Vectors:- Vectors whose initial point (tail) is fixed is said to be a localized or a fixed vector.

Non-localized Vectors:- Vectors whose initial point (tail) is not fixed is said to be a non-localized or a free vector.