Marwari College Darbhanga

Subject - Science (Physics)
Class - I.Sc first year (XIth)
Topic - Vector Analysis
Lecture Series - 01

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Vector Analysis

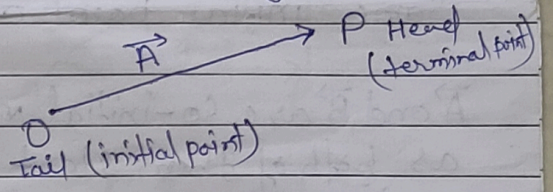
physical quantities can be divided into two classes, scalar and vectors.

(i) Scalar → Those physical quantities which possess only magnitude and no direction are called scalars.
eg - Mass, length, time, temperature etc.
Scalars combine with one another according to the laws of ordinary arithmetic.

(ii) Vectors → Those physical quantities which possess both magnitude and direction are called vectors.
eg - Displacement, velocity, momentum, force, accln etc.
Vectors combine with one another according to the laws of vector algebra.

Representation of a vector

Analytically, a vector is represented by a letter with an arrow on it. eg - $\vec{A}$ or **A** (bold letters)
The magnitude of this vector is represented by $|\vec{A}|$ (mod $\vec{A}$) or A.



Types of vectors

(1) Fixed or localized vector → If the initial point of a vector is fixed, it is called a fixed vector.

(2) Free or non-localized vector → If the initial point of a vector is not fixed, it is called a free or a non-localized vector.

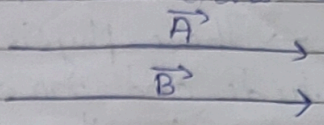
(3) Unit vector → It is that vector whose magnitude is unity and direction is the same as that of the given vector.
Unit vector is represented as.

$\vec{A} = A\hat{A}$ $\quad\quad$ $\hat{A}$ = A hat/caret

A = magnitud of vector ($\vec{A}$) = 1
$\hat{A}$ → Unit vector

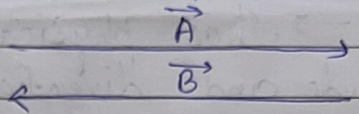
④ Equal vectors → Two vectors are said to be equal if their magnitudes as well as the directions are the same.

$\vec{A}$ and $\vec{B}$ are equal vectors.



⑤ Negative Vectors → A vector is said to be a negative of a given vector if its magnitude is the same as that of the given vector but its direction is opposite.

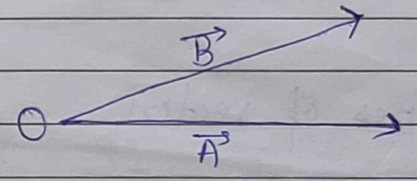
$\vec{B}$ is negative vector of $\vec{A}$.



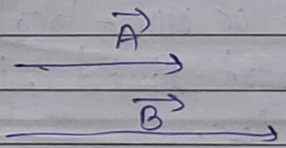
⑥ Scalar multiple of a vector → If we multiply a vector $\vec{A}$ with n, then we get a vector $n\vec{A}$ whose direction is the same as that of $\vec{A}$, but its magnitude is n times that of $\vec{A}$, where n is real number.

⑦ Co-initial vectors → Two vectors which have got a same initial point are called co-initial vectors.

$\vec{A}$ and $\vec{B}$ are co-initial vectors as both of them start from the same point.



⑧ Collinear vectors → Two vectors which either act along the same line or along parallel lines, are called collinear vectors.



Addition of vectors

① Addition of Collinear or Parallel vectors

The resultant of two or more vectors is that single vector whose effect is the same as that of the given vectors when acting simultaneously.

(iii) $\vec{A}$, $\vec{B}$ → $\vec{R} = \vec{A} + \vec{B}$

(iv) $\vec{R} = \vec{A} + \vec{B}$ ∴ $\vec{R} = \vec{A} + \vec{B}$

(B) Addition of two vectors which are inclined to each other

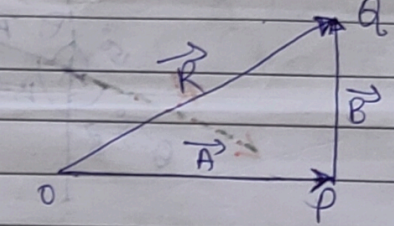
(i) Traingle law of vector addition.
(ii) Parallelogram law of vector addition.
(iii) polygon law of vector addition

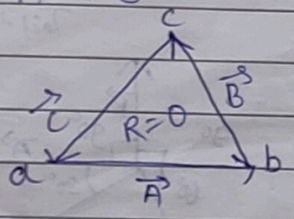
(1) Traingle law of vectors

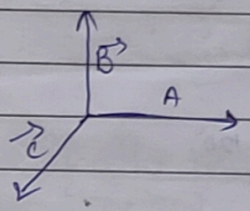
If two vectors can be represented in magnitude and direction by the two sides of a traingle taken in the same order, then their resultant is represented completely, both in magnitude and direction, by the third side of the traingle taken in the opposite order.

$\vec{R}$ = Resultant vector.

$\vec{R} = \vec{A} + \vec{B}$







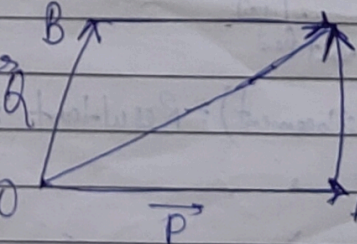
(2) Parallelogram law of vectors

If two vectors, acting simultaneously at a point, can be represented both in magnitude and direction by the two adjacent sides of a parallelogram, the resultant is represented completely both in magnitude and dir by the diagonal of the parallelogram passing through that point.

Let $\vec{P}$ and $\vec{Q}$ are two vectors

$\vec{P} + \vec{Q} = \vec{OA} + \vec{OB} = \vec{OA} + \vec{AC}$

(as $\vec{AC}$ and $\vec{OB}$ are parallel vectors)

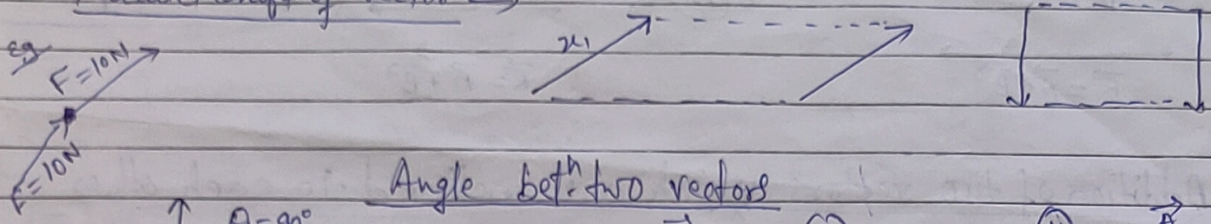


$\vec{P} + \vec{Q} = \vec{OC}$ (from vector traingle law)

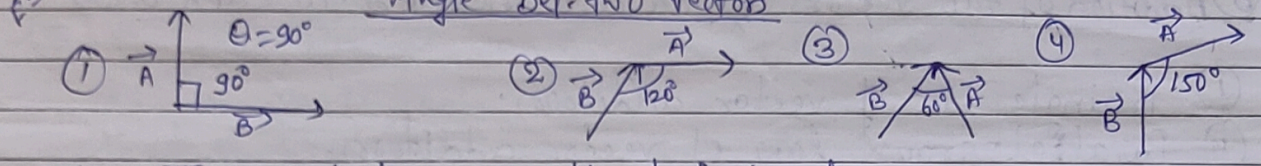
$\vec{P} + \vec{Q} = \vec{R}$ = Resultant vector.

Any two vectors always co-planar. three vector may or may not coplanar vector

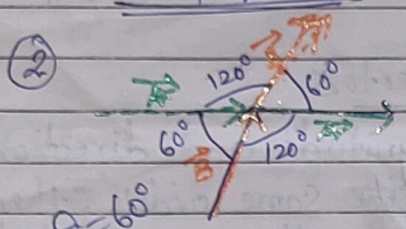
Parallel shift of vector ⟹

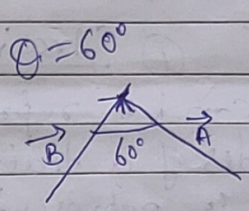


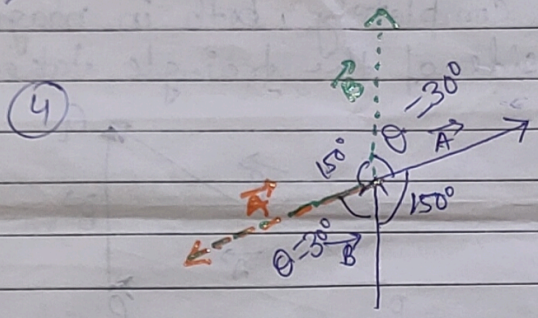
Angle bet^{n} two vectors

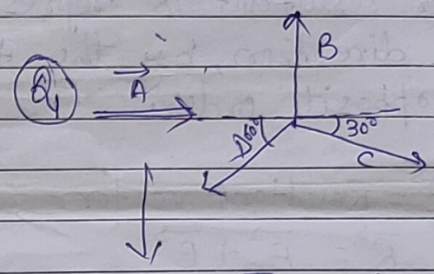


* Tail to tail or Head to Head









Tail to tail

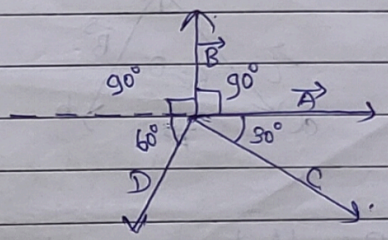
$\angle AB = 90°$

$\angle BC = (30° + 90°) = 120°$

$\angle AC = 30°$

$\angle AD = 90°$

$\angle DB = 150°\ (90+60°)$

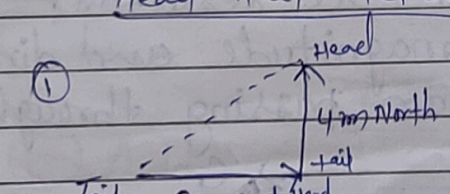


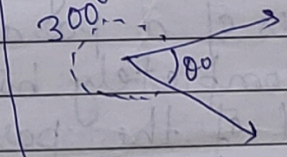
* i.e $0 \le \theta \le 180°$

दो vector के बीच 180° से के बराबर या छोटा ही 180 से बड़ा नहीं होगा।

Addition and subtraction

Head-tail method





We take smallas an bet^{n} vectors.

Answer (displacement) = Resultant = Pahle vector का tail + दूसरे vector का head

Last vector का head