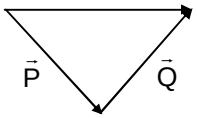
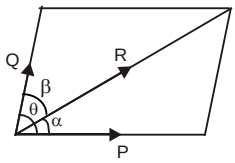
ADDITION OF VECTORS:

1. Addition of vectors is also called resultant of vectors.
2. **Resultant** is a single vector that gives the total effect of number of vectors.
   Resultant can be found by using
   a) Triangle law of vectors
   b) Parallelogram law of vectors
   c) Polygon law of vectors
3. Two vectors can be added either by triangle law or parallelogram law of vectors.
4. **Triangle law :** If two vectors are represented in magnitude and direction by the two sides of a triangle taken in order, then the third side taken in the reverse order represents their sum or resultant in magnitude as well as in direction.



5. **Parallelogram law :**

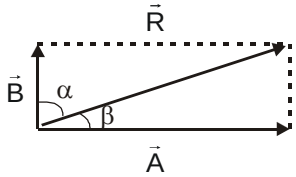
   If two vectors $\vec{P}$ and $\vec{Q}$ are represented by the two sides of a parallelogram drawn from a point, then their resultant is represented in magnitude and direction by the diagonal of the parallelogram passing through that point.



   $R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$

   $\text{Tan}\,\alpha = \dfrac{Q\sin\theta}{P + Q\cos\theta}$; $\tan\beta = \dfrac{P\sin\theta}{Q + P\cos\theta}$

6. The resultant of two vectors is the vectorial addition of two vectors.
7. The resultant of any two vectors makes lesser angle with the greater vector.
8. If $|\vec{A}| > |\vec{B}|$ $\alpha < \beta$
9. The magnitude of the resultant of two vectors of magnitudes a and b with arbitrary directions must be in the range (a – b) to (a + b).



10. $\vec{a}$ and $\vec{b}$ are two vectors which when added give a vector $\vec{c}$ (i.e.,) $\vec{a} + \vec{b} = \vec{c}$ and if
    i) $|\vec{a}| + |\vec{b}| = |\vec{c}|$ then $\vec{a}$ and $\vec{b}$ are parallel vectors ($\theta = 0°$)
    ii) $|\vec{a}|^2 + |\vec{b}|^2 = |\vec{c}|^2$ then $\vec{a}$ and $\vec{b}$ are perpendicular vectors ($\theta = 90°$)
    iii) $|\vec{a}| - |\vec{b}| = |\vec{c}|$ then $\vec{a}$ and $\vec{b}$ are antiparallel vectors ($\theta = 180°$)
    iv) $|\vec{a}| = |\vec{b}| = |\vec{c}|$ then $\vec{a}$ and $\vec{b}$ are inclined to each other at 120°
    v) If $|\vec{A}| = |\vec{B}|$ and $|\vec{A} + \vec{B}| = |\vec{A}|$, then $\theta = 120°$.
    vi) If $|\vec{A}| = |\vec{B}|$ and $|\vec{A} - \vec{B}| = |\vec{A}|$, then $\theta = 60°$.
    vii) If $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$, then $\theta = 90°$.
11. If two vectors each of magnitude F act at a point, the magnitude of their resultant (R) depends on the angle θ between them.
    $R = 2F\cos(\theta/2)$.

Angle between forces (θ)	Magnitude of resultant
0°	2F
60°	$\sqrt{3}$ F
90°	$\sqrt{2}$ F
120°	F
180°	0

12. Minimum number of equal vectors to give a zero resultant is 2.
13. The minimum number of unequal vectors to give a zero resultant is 3.
14. There are three laws of addition of vectors.
    a) Commutative law: $\vec{A} + \vec{B} = \vec{B} + \vec{A}$
    b) Associative law: $\vec{A} + (\vec{B} + \vec{C}) = (\vec{A} + \vec{B}) + \vec{C}$
    c) Distributive law: $m(\vec{A} + \vec{B}) = m\vec{A} + m\vec{B}$ where m is a scalar.
15. If the number of vectors is more than two, polygon law of vectors is used.
16. **Polygon law :** If a number of vectors are represented by the sides of a polygon taken in the same order, the resultant is represented by the closing side of the polygon taken in the reverse order.

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