Statics

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Introduction to Statics

- Mechanics is the science that deals with the action of forces on bodies.

- The branch of Mechanics is called Statics which is concerned with the conditions under which bodies remain at rest when forces acted on it.

- We may define force as any cause which produces or tends to produce a change in the existing state of rest of a body or of its uniform motion in a straight line.

- A force will be completely known when we know (i) its magnitude (ii) its direction and (iii) its point of application (i.e) the point of the body at which the force acts.

Resultant and components:Definition

If two or more forces $F_1, F_2, F_3, ...$ etc. act on a rigid body and if a single force R can be found whose effect on the body is the same as that of all the forces $F_1, F_2, F_3, ...$ etc. put together, then the single force R is called the Resultant of the forces $F_1, F_2, F_3, ...$ etc. and the forces $F_1, F_2, F_3, ...$ etc. are called the components of the force R.

Simple cases of finding the resultant

- If two forces P and Q act in the same direction on a particle the resultant is equal to a force $P + Q$ acting in the same direction on it.
- If two forces P and Q act in the opposite direction on a particle the resultant is equal to a force $P \sim Q$ and acts in direction of the greater force.

- When two forces acting at a point are in different directions (i.e) are inclined to each other, their resultant can be found with the help of a fundamental theorem in statics known as the law of the parallelogram of forces.

Parallelogram of Forces:Theorem

If two forces acting at a point be represented in magnitude and direction, by the sides of a parallelogram drawn from the point, their resultant is represented both in magnitude and direction, by the diagonal of the parallelogram drawn through that point.

- If two forces P and Q acting at a point then the magnitude and direction of the resultant forces $R = \sqrt{P^2 + 2PQcos\alpha + Q^2}$ and $tan\ \phi = \dfrac{Qsin\alpha}{P + Qcos\alpha}$.

Problem

The resultant of two forces P and Q is at right angles to P. Show that the angle between the forces is $cos^{-1}(-\dfrac{P}{Q})$.

Thank You