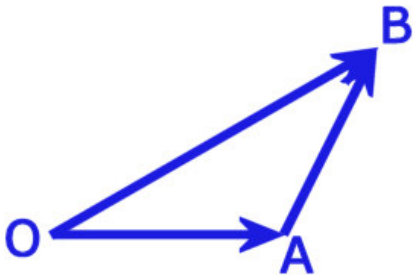
M1

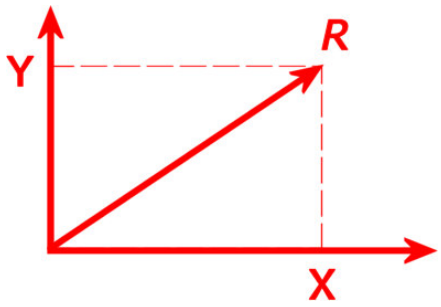
Vectors and their applications in Mechanics

If a particle A has position vector $\mathbf{r}_A$ and a particle B has a position vector $\mathbf{r}_B$ then the position vector of B, relative to A is $\mathbf{r}_B - \mathbf{r}_A$

$OB = OA + AB$



$\mathbf{R} = x\mathbf{i} + y\mathbf{j}$



Kinematics of a particle

$v = u + at$

$s = 0.5\ t\ (u + v)$

$s = ut + 0.5at^2$

$v^2 = u^2 + 2as$

Statics of a particle

1. Force is a vector quantity
2. Forces can be added by using the triangle law or parallelogram rule
3. The resultant of a system of forces is most easily found by using components
4. A system of forces is in equilibrium is their lines of action pass through a single point and if their resultant is the zero vector
5. The magnitude of the frictional surface is just sufficient to precent relative motion
6. For a smooth surface there is no frictional force (F = 0)
7. When sliding occurs the frictional force takes its limiting value, μR and opposes the relative motion.

Dynamics of a particle moving in a straight line or plane

Newton's first law

A particle will remain at rest or will continue to move at a constant velocity in a straight line unless acted upon by a resultant force

Newton's second law

F = ma where F is the force, m is the mass and a is the acceleration

Newton's third law

Every action has an opposite and equal reaction

Momentum and Impulse

Impulse = change of momentum

Conservation of momentum

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Moments

The moment is the force times the perpendicular distance from the point at which it acts.

For a rod or lamina to be in equilibrium, the resultant forces in any direction must be zero, the component of the resultant force in any direction must be zero and the algebraic sum or the moments about any point must be zero.