

1) i) An inertial frame (of reference) is defined to be a frame of reference in which Newton's first law applies: a particle not subject to external forces (a free particle) does not accelerate but moves with constant velocity, or constant speed in a straight line. It is the only type of reference frame in which Newton's three Laws of Motion all apply, so a particle will also accelerate in proportion to the vector sum of applied forces and reactions will be equal and opposite.

All inertial frames are equivalent and can be related to each other by the Galilean transformation, which relates velocities, by translations in time or space, rotations or reflections in space, or a combination of these.

The reason for the concept's importance in Newtonian Physics is because the Laws of Physics can be expressed in the same form in any inertial frame. The Laws of Conservation of Energy, Momentum and Angular Momentum all apply, and only apply in inertial frames; these express the homogeneity of time and the homogeneity and isotropy of space, respectively and make any inertial frame physically indistinguishable from any other.

An inertial frame can be constructed by sending out three free particles in mutually perpendicular directions from a single point such that they move with equal speeds in straight lines. The point defines the origin, and the paths of the particles the coordinate axes of the inertial frame, calibrated so that the particles travel equal distances in equal time intervals.