* What are inertial and non-inertial frames of reference ?
Discuss Galilean relativity or Galilean transformation.

A frame of reference in which a static body or the body moving uniformely along a straight line is not accelerated without application of force, is called inertial frame of reference. The simplest example is; the stars including the Sun. ~~is an example of inertial frame~~. 'Newton's third law of motion holds in such a frame.'

A frame of reference in which a static or uniformely moving body along straight line is accelerated without an applied force is called non-inertial. The

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Earth is a good example, where ~~Corialis~~ force and centrifugal force are automaticaly generated due to its rotation. 'In such a frame Newton's third law of motion is violated.'

Galilean relativity principle is valid for much small motions compared to that of light. Here time is considered as absolute. The principle states that the uniform motion of a body along a straight line with reference to an inertial frame has no effect on the mechanical processes happening in the system.

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To establish the invarjence of

invariance

mechanical laws, let us consider a static reference system S(Oxyz) and moving reference system S'(O'x'y'z') with common x-axis. This is shown in figure-1.

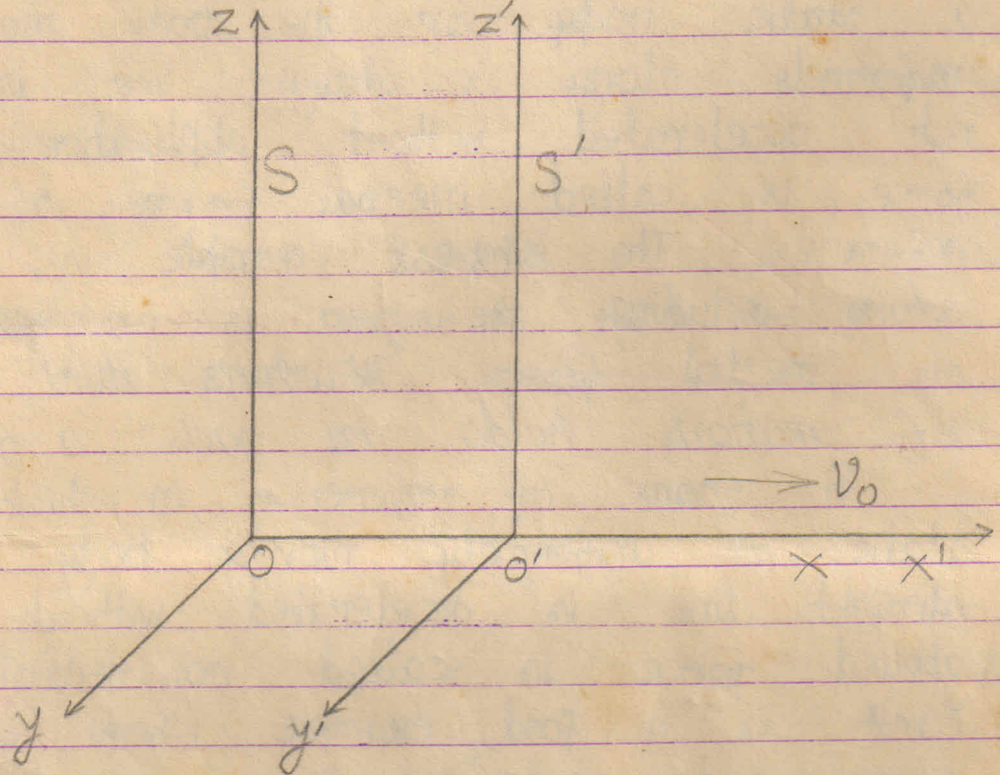


Figure → 1

Let us consider a particle A (an ant) in the moving inertial frame. For ~~convenion~~ convenience we consider two dimensional diagram with static reference frame S(Oxy) and moving reference frame S'(O'x'y').

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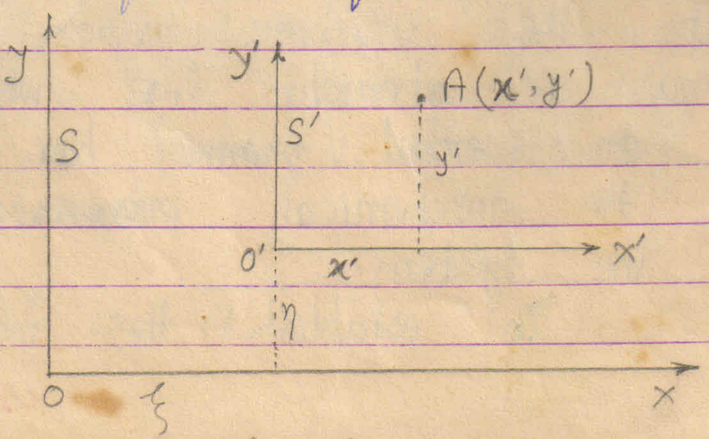


figure-2 Static S(Oxy) & Moving S'(O'x'y')

Let the position of the particle in $S'$ frame be $A(x', y')$. ~~the~~ The origin of $S'$ frame has co-ordinates $O'(\xi, \eta)$ relative to static frame.

As indicated in figure, the $x$ and $y$ velocity components of frame $S'$ relative to $S$ is expressed by time derivatives i.e.,

$$\left.\begin{aligned} \frac{d\xi}{dt} &= \dot{\xi} = \vec{U_x} \\ \text{and,} \quad \frac{d\eta}{dt} &= \dot{\eta} = \vec{U_y} \end{aligned}\right\} \quad \ldots\ldots\ldots \text{(i)}$$

The resultant of the two vector is,

$$\vec{U_x} + \vec{U_y} = \vec{V_0} \quad \ldots\ldots\ldots\ldots \text{(ii)}$$

In $S'$ frame the velocity of the particle (i.e, an ant) is given by,

$$V' = \frac{\overrightarrow{dx'}}{dt} + \frac{\overrightarrow{dy'}}{dt}$$

$$\Rightarrow V' = \vec{\dot{x}'} + \vec{\dot{y}'} \quad \ldots\ldots\ldots\ldots\ldots \text{(iii)}$$

This is an observation from a point in $S'$.

As observe from static frame $S$ the co-ordinates of point $A$ is,

$$\left.\begin{aligned} x &= \xi + x' \\ y &= \eta + y' \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots \text{(iv)}$$

The velocity components are given by their time derivatives and we obtain,

$$\left.\begin{aligned} \frac{dx}{dt} &= \dot{x} = \dot{\xi} + \dot{x}' \\ \text{and} \quad \frac{dy}{dt} &= \dot{y} = \dot{\eta} + \dot{y}' \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots \text{(v)}$$