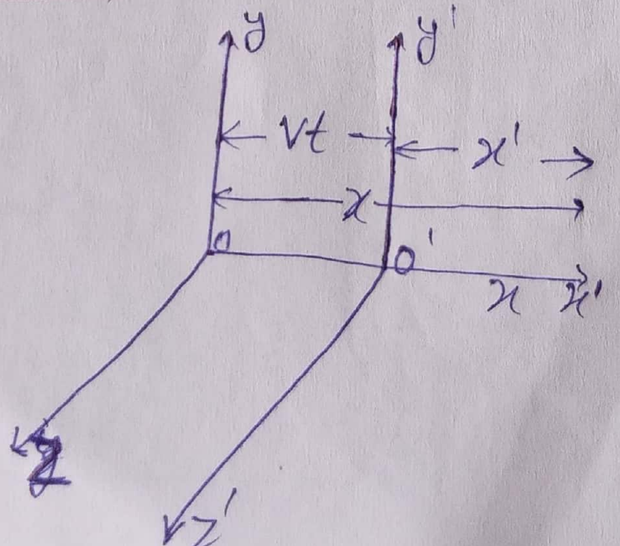
Sec-7

Q.1 obtain Galilean transformation equation. Show that length and acceleration are invariant under Galilean transformation

Ans The coordinates of a body or an event are known in frome then its coordinates in second frame of reference moving uniformly relative to first frome the equations showing the relation b/w the coordinates are know as Galilean transformation

1. when second frome moves with respect to first.



$P(x, y, z, t)$

(x', y', z', t')

let us consider that two frame of reference S & S' the frame S' is moving V velocity in (+x) direction with respect to S and O & O' are the origin of frame S, & S' respectively At an event happining we have denoted (x, y, z, t) in frame S & (by x', y', z', t') in frame S' from figure

$$x = x' + vt$$

$$x' = x - vt \rightarrow (1)$$

$$y' = y$$

$$z' = z$$

$$t' = t$$

2 When the second frame is moving along the straight line relative to S. —

$$x' = x = vxt$$

$$\vec{V} = vx\hat{i} + vy\hat{j} + vz\hat{k}$$

$$\left.\begin{aligned} x' &= x - vxt \\ y' &= y - vyt \\ z' &= z - vzt \end{aligned}\right\} \rightarrow (1)$$

Now diff of eq^n w.r.t (t)

$$\left.\begin{aligned} \frac{dx'}{dt'} &= \frac{dx}{dt} - vx \\ \frac{dy'}{dt'} &= \frac{dy}{dt} - vy \\ \frac{dz'}{dt'} &= \frac{dz}{dt} - vz \end{aligned}\right\} \rightarrow (2)$$

Now again diff. of eq^n (2)

$$\frac{d^2x'}{dt'^2} = \frac{d^2x}{dt^2} - 0$$

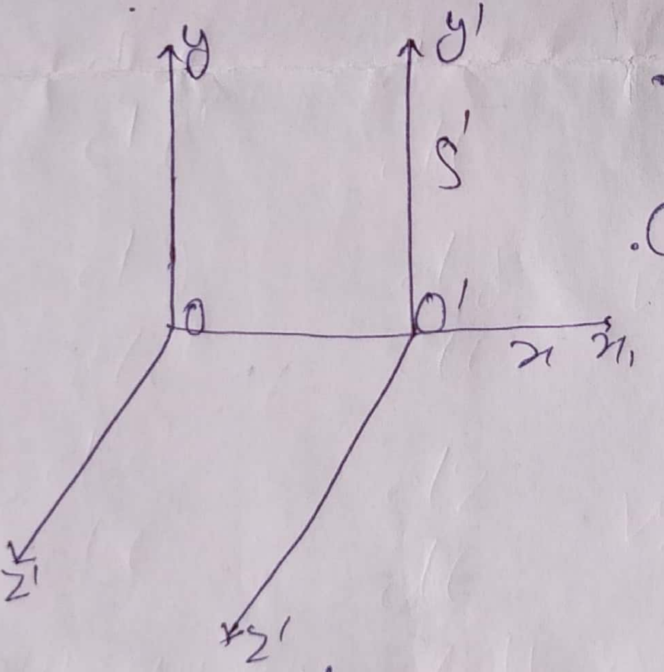
$$\frac{d^2y'}{dt'^2} = \frac{d^2y}{dt^2} - 0$$

$$\frac{d^2z'}{dt'^2} = \frac{d^2z}{dt^2} - 0$$

$a_{x'} = a_x$

$a_{y'} = a_y$ $\boxed{a' = a}$

$a_{z'} = a_z$



$P\,(x, y, z, t)$

(x', y', z', t')

$Q.\,(x_2, y_2, z_2, t_2)$

(x_2', y_2', z_2', t_2')

Suppose that a frame of reference S' is moving with velocity v relative to S the frame is at and the coordinates of two points is frame S(x, y, z,) and (x_2, y_2, z_2) and in S is (x_1', y_1', z_1') & (x_2', y_2', z_2')

respectivly from Galilean transformation

$x_1' = x_1 - vxt$ | $x_2' = x_2 - vxt$

$y_1' = y_1 - vyt$ | $y_2' = y_2 - vyt$

$z_1' = z_1 = vzt$ | $z_2' = z_2 = vzt$

the distance b/w two points in moving frame's

$$d^2 = \sqrt{(x_2' - x_1')^2 + (y_2' - y_1')^2 + (z_2' - z_1')^2}$$

$$d = \sqrt{[(x_2 - vxt) - (x_1 - vxt)]^2 + [(y_2 - vyt) - (y_1 - vyt)]^2 + [(z_2 - vzt) - (z_1 - vzt)]^2}$$

$$d = \sqrt{(x_2 - \cancel{vxt} - x_1 + \cancel{vxt})^2 + (y_2 - \cancel{vyt} - y_1 + \cancel{vyt})^2 + (z_2 - \cancel{vzt} - z_1 + \cancel{vzt})^2}$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

it Conclude that the distance b/w two Point is invarient under Galilean transformation.

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