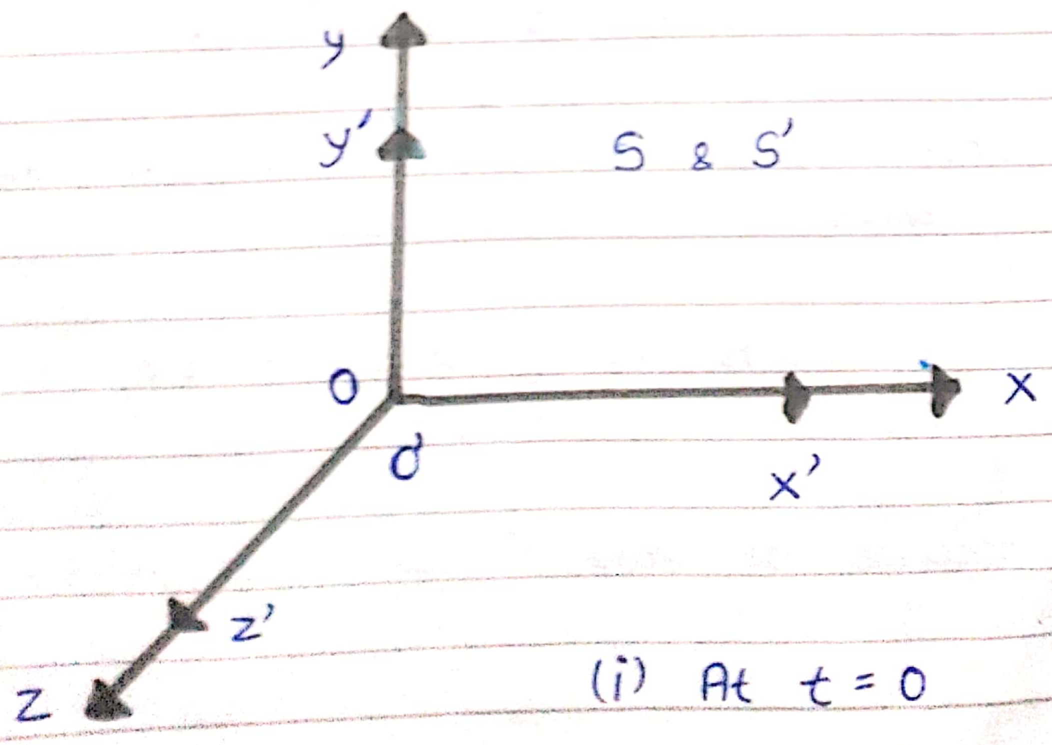
The set of equation which relate space and time Co-ordinate of an event with respect to two inertial frame of references having relative motion between them are called galilean transformation equations.

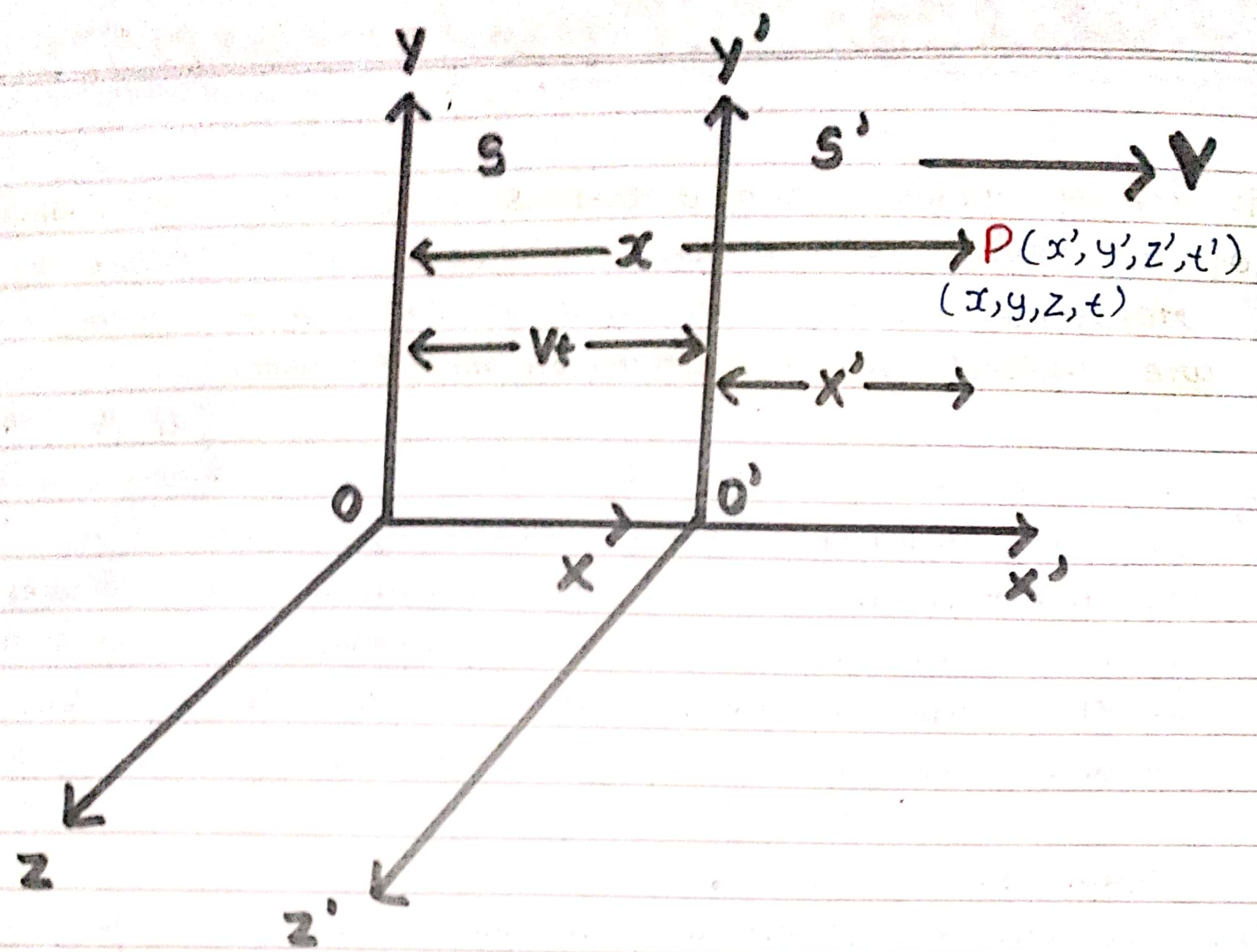
(at the Same t

if an event be observed by two observers Simultaneously in two different inertial frames of reference, it will naturally have a set of observation (Co-ordinates such as the three mutually prependicular x, y, z axes in one, different from that in other. The equations relating the two set of observation of an event in two different frame of reference are transforma equations.

In classical or Newtonian mechanics where the speed of th observer or object is very small as compared to the speed of light these relevant transformation equation are called galilean transformation.



(i) At $t = 0$



• Let us consider two inertial frame of reference S & S' having Cartesian co-ordinates axis as x, y, z and x', y', z' and origin O & O' respectively.

At time $t=0$, both frame are at rest so that their origin O and O' coincides with each other.

Now let frame S' starts moving with constant velocity V along +ve direction of X-axis.

Let an event occures at point 'p' at any instant of time.

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- Let the (x, y, z, t) be the space and time co-ordinates of an event occuring at P for an observer on the frame S.

- Let the space and time co-ordinates of same event P for an observer on the frame S' be (x', y', z', t')

- Suppose the co-ordinates recorded by an observer in frame S is x, y, z and t and that by an observer in frame S' is x', y', z', and t'.

- As there is no relative motion along y and z axes, the co-ordinates in the two frames of reference along y and z-axes are same

From fig we have

$$x' = x - Vt$$
$$y' = y$$
$$z' = z$$

and

$$t' = t \quad \text{——} \ (1)$$

and similarly

$$x = x' + Vt$$
$$y = y'$$
$$z = z'$$

and

$$t = t' \quad \text{——} \ (2)$$

As time is considered to be absolute in nature time remains same in all initial frames of reference.

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These equations are known as Galilean Transformation equations for Space and time or for position of a particle.

For Velocity Transformation

We have from above eq

(Differentiating equation w.r.t. time)

we get,

$$\frac{dx'}{dt'} = \frac{dx}{dt'} - V\frac{dt}{dt} \quad \text{but} \quad dt = dt'$$

$$\therefore \frac{dx'}{dt'} = \frac{dx}{dt} - V\frac{dt}{dt}$$

$$\therefore V'_x = V_x - V \text{ , } \frac{dy'}{dt'} = \frac{dy}{dt} \text{ and } \frac{dz'}{dt'} = \frac{dz}{dt}$$

Hence, Galilean transformation equations for velocity of particles are

$$V'_x = V_x - V \text{ , } V'_y = V_y \text{ and } V'_z = V_z \quad \text{—— (3)}$$

For acceleration transformation equations

Differentiating equation (3) with respect to time, we get

$$\frac{dv_x'}{dt'} = \frac{dv_x}{dt} - 0 \quad , \text{ because } V \text{ is Constant}$$

$$\frac{dv_y'}{dt'} = \frac{dV_y}{dt}$$

and

$$\frac{dv_z'}{dt'} = \frac{dv_z}{dt}$$

$$\boxed{\alpha_x' = \alpha_x \quad , \quad \alpha_y' = \alpha_y \quad , \text{ and } \alpha_z' = \alpha_z}$$