Chapter R1: The Principle of Relativity

R1.3, R1.4: Events, Spacetime Coordinates, Reference Frames

These terms will be used in every chapter for the rest of the book. Make sure you have a good picture of what these words mean in this context.

R1.5: Inertial Reference Frames:

Inertial reference frames move at constant velocities relative to each other.

R1.7 Newtonian Relativity:

Consider a primed frame moving to the right at velocity β with respect to the unprimed frame. Then events in the different coordinate systems are related according to:

$$t' = t \quad (1)$$
$$x' = x - \beta t \quad (2)$$
$$y' = y \quad (3)$$
$$z' = z \quad (4)$$

Velocities are related by:

$$v'_x = v_x - \beta \quad (5)$$
$$v'_y = v_y \quad (6)$$
$$v'_z = v_z \quad (7)$$

Accelerations in the two frames are equal:

$$a'_x = a_x \quad (8)$$
$$a'_y = a_y \quad (9)$$
$$a'_z = a_z \quad (10)$$

These equations are known as the *Galilean Transformation Equations*.

Think of these equations as a **dictionary** that lets you translate observations made in one inertial reference from to those made in another.

Example:

A train moving with a speed of 100 m/s passes by you at $t = t' = 0$. Twenty seconds later, a firecracker explodes .5 km on the track, in the direction in which the train was moving. What are the coordinates of this event in both your frame and the train's frame?

Practice:

You are standing on the ground next to some train tracks when a 100 m long train car zips by at 30 m/s. Take the instant at which the rear of the car passes you to be $t = t' = 0$. Five seconds later, firecrackers explode simultaneously at both ends of the moving car. Find the coordinates of each of these events in each frame. Do observers on the train and on the ground agree that the events occur simultaneously?