RELATIVE MOTION IN ONE DIMENSION

1. If two bodies A and B are moving in straight line same direction with velocity VA and VB, then relative velocity of A with respect to B is vAB = vA – vB. Similarly, vBA = vB – vA

2. If two bodies A and B are moving in straight line in opposite direction then

$v_{AB} = v_A + v_B$ (towards B)

$v_{BA} = v_B + v_A$ (towards A)

$v_{AB} = -v_{BA}$

Same concept is used for acceleration also.

3. If two cars A and B are moving in same direction with velocity vA and vB (vA > vB) when A is behind B at a distance d, driver in car A applies brake which causes retardation a in car A, then minimum value of d to avoid collision is

$$\frac{(v_A - v_B)^2}{2a} \text{ i.e., } d > \frac{(v_A - v_B)^2}{2a}$$

4. A particle is dropped and another particle is thrown downward with initial velocity u, then Relative acceleration is always zero Relative velocity is always u.
Time at which their separation is x is $\frac{x}{u}$.

5. Two bodies are thrown upwards with same initial velocity with time gap τ. They will meet after a time t from projection of first body.

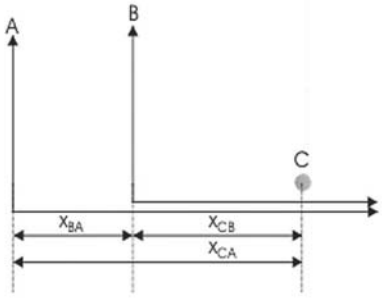
$$t = \frac{\tau}{2} + \frac{u}{g}$$

Relative position

Let's examine two observers, labeled A and B. Observer A remains stationary relative to Earth, while observer B moves at a velocity v_{BA} relative to observer A. Both observers observe the motion of a point-like object C. The motions of observers B and object C occur along the same straight line.

Note: -

It's beneficial to establish a convention for writing subscripted symbols like v_{BA}. In this convention, the first subscript denotes the entity possessing the attribute (in this case, velocity), while the second subscript indicates the entity with respect to which the measurement is taken. Consequently, a velocity such as v_{BA} signifies the velocity of observer B relative to observer A.
The object C's position, as observed by both observers A and B, is denoted as x_{CA} and x_{CB} respectively, as illustrated in the figure. Each observer is depicted within their own frame of reference in the diagram.



$$x_{CA} = x_{BA} + x_{CB}$$

Relative motion parameters

Relative motion parameters refer to the characteristics that describe the motion of an object or observer relative to another object or reference frame. These parameters include:

Relative velocity:

The velocity of one object or observer relative to another. It describes how fast one is moving in relation to the other.

Relative acceleration:

The rate at which the velocity of one object changes relative to another. It indicates how quickly the relative velocity is changing over time.

Relative position:

The position of one object or observer with respect to another. It gives the location of one object relative to a reference point or frame.

Relative distance:

The distance between two objects or observers measured along the line of sight or along the path of relative motion.

Relative displacement:

The change in position of one object relative to another over a certain period of time. It accounts for both direction and distance traveled.

Relative angle:

The angle between the velocity vectors of two moving objects or observers. It provides information about the direction of motion relative to each other.

Relative angular velocity:

The rate of change of the relative angle between two moving objects or observers. It describes how quickly the direction of motion is changing relative to each other.

These parameters are crucial in various fields such as physics, engineering, and navigation, as they help describe and predict the motion of objects in relation to each other or to a fixed reference frame.