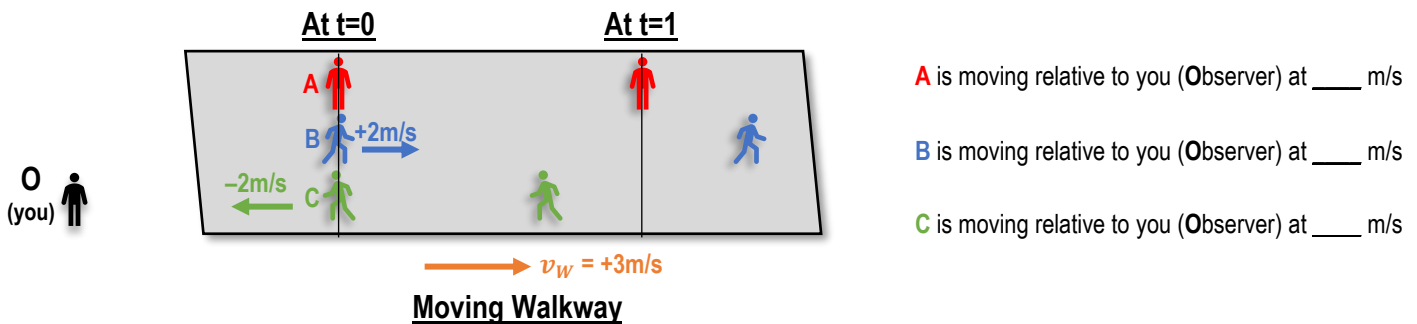


CONCEPT: INTRO TO RELATIVE MOTION (RELATIVE VELOCITY)

- We always measure velocity relative to some _____, called a **Frame of Reference**.
 - Frame of Reference is always the ground or the Earth unless otherwise stated.

EXAMPLE: You are an **Observer** measuring the velocities of **A**, **B**, & **C** (using a speed gun) on a moving walkway (like the ones in airports) moving at 3m/s. If **A** stands still, **B** walks RIGHT at 2m/s, **C** walks LEFT at 2m/s, what does your speed gun measure their velocities to be?



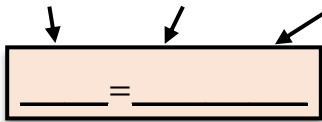
- Whenever a **stationary** (not moving) object is inside/within/on top of a moving object, they have the _____ velocity.
 - In other words, their velocities relative to all other reference frames is **the same**.
 - Also, their velocities relative to each other is _____.
- Relative Velocity is really just the _____ of velocities.

CONCEPT: SOLVING RELATIVE VELOCITY PROBLEMS IN 1D

- To solve Relative Velocity problems, just add/subtract velocities in different reference frames:

Relative Velocity Equation

$$\begin{array}{c} \text{Velocity of } A \\ \text{relative to } C \end{array} = \begin{array}{c} \text{Velocity of } A \\ \text{relative to } B \end{array} + \begin{array}{c} \text{Velocity of } B \\ \text{relative to } C \end{array}$$



→ Always set up so:

- 1) Inner subscripts of terms on right side of equation are the _____
- 2) Outer subscripts of terms on right side = subscripts of term on left side

EXAMPLE: You're in a car moving at 45m/s east, relative to the ground. A truck is ahead of you, also moving east at 60m/s. What is the velocity of the truck relative to your car?

RELATIVE VELOCITY IN 1D

- 1) Draw diagram, identify all objects & references
- 2) Write each given velocities w/ subscript notation
- 3) Write relative velocity equation according to rules
- 4) Solve

- If you're given a velocity with the **correct** subscripts but in the opposite order, you can _____ the subscripts
 - When you flip the subscripts, the sign of the number flips (positive ↔ negative): $v_{AB} = -v_{BA}$

PROBLEM: A boat on a river is traveling from a pier to a point 500 m upstream (against the river's current). The current flows at 4 m/s. If the boat makes the trip in 250 s, what is the speed of the boat relative to the water?

- A) 2 m/s
- B) 0 m/s
- C) 6 m/s
- D) 12 m/s

<u>RELATIVE VELOCITY IN 1D</u>
1) Draw diagram, identify all objects & references
2) Write each given velocities w/ subscript notation
3) Write relative velocity equation according to rules
4) Solve

PROBLEM: City B lies directly east of city A. Without any wind, an airliner makes the 2775-km flight between them in 3.30h. If a steady 225-km/h wind blows from west to east and the airliner has the same speed relative to the air as before, how long will the trip from A to B take?

- A) 7.1 hrs
- B) 2.6 hrs
- C) 9.0 hrs
- D) 5.2 hrs

RELATIVE VELOCITY IN 1D
1) Draw diagram, identify all objects & references
2) Write each given velocities w/ subscript notation
3) Write relative velocity equation according to rules
4) Solve