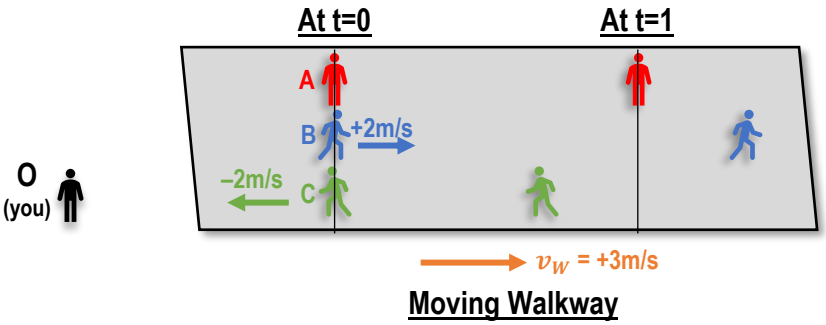
CONCEPT: INTRO TO RELATIVE MOTION (RELATIVE VELOCITY)

- 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 **O**bserver 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?



A is moving relative to you (**O**bserver) at ____ m/s

B is moving relative to you (**O**bserver) at ____ m/s

C is moving relative to you (**O**bserver) at ____ m/s

- 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 _____.

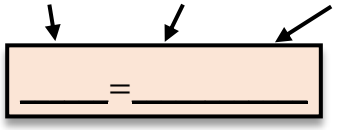
- Relative Velocity is really just the _____ of velocities.

CONCEPT: SOLVING RELATIVE VELOCITY PROBLEMS IN 1D

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

Relative Velocity Equation

Velocity of ***A*** relative *to* ***C*** = Velocity of ***A*** relative *to* ***B*** + Velocity of ***B*** relative *to* ***C***



_____ = _____ → 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): $\boldsymbol{v_{AB} = -v_{BA}}$

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

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

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