

## **Relative Motion**

**Frame of Reference** - a place from which motion is observed.

### **Example:**

An ant travels 10 cm to the right on a plate (relative to the plate) as a disgusted picnicker pushes the plate a distance of 40 cm to the right (relative to the earth). What is the displacement of the ant relative to the earth?

### **Example:**

As a picnicker pushes a plate 30 cm to the left with respect to the earth, it is noticed that the ant's displacement relative to the earth was only 20 cm to the left. Determine the ant's displacement relative to the plate.

**Example:**

An ant crawls a distance of 10 cm to the east on a plate (relative to the plate) as a disgusted picnicker pushes the plate a distance of 40 cm due north (relative to earth). What is the displacement of the ant with respect to the earth?

**Example:**

Car A is moving north at 60 km/h and car B is moving north at 50 km/h along the same road (each with respect to earth). Determine the velocity of car A with respect to car B.

**Example:**

John can run at 7.0 km/h. Anna can run at 4.0 km/h. If Anna is initially 0.40 km ahead of John, how long will it take him to catch her?

**Example:**

A boat can travel at 4 m/s in still water. If a current moves at 3 m/s, find the velocity of the boat if it goes

- a) downstream (with the current)
- b) upstream (against the current)
- c) across stream

**Example:**

A duck is flying due south at 30 km/h with respect to earth. A photographer is driving due north at 60 km/h with respect to earth. Determine:

- a) the velocity of the duck with respect to the photographer.
- b) the velocity of the photographer with respect to the duck.

**Example:**

Mark rode his personal watercraft at a constant speed of 30 km/h directly across a river running at 5 km/h downstream. What is Mark's velocity relative to the riverbank?

**Example:**

A wildlife crew spot a herd of moose 4.0 km due west and running directly away from a helicopter moving at 10 m/s west with respect to earth. The helicopter follows the herd at 42 m/s (W) with respect to earth.

- a) What is the velocity of the helicopter relative to the moose?
- b) What is the velocity of the moose relative to the helicopter?
- c) How long will it take the helicopter to reach the herd's original location?
- d) How long from the time of first sighting will it take the helicopter to catch the herd?

**Example:**

A plane can fly at 120 km/h in still air. If the plane heads due north in a wind that is blowing 50 km/h (E), what is the plane's velocity with respect to the ground?

**Example:**

A boat can travel at 80 km/h in still water. The water current is 20 km/h (W). If the boat wants to head directly across the river (north) in which direction should it head and what will be its velocity? If it is 500 m directly across the river, how long will it take the boat to cross?