Relative Motion

Previously, we defined motion as position changing with respect to a reference point, but all motion is relative. Motion is relative to the reference point and the frame of reference of the observer. Observers in different frames of reference can view motion differently.

Motion of automobiles is usually with respect to the ground, but a stationary observer views the motion of a car differently than a moving observer.

For example, what is the observed speed of a car moving at 60 mph by:

a.) a stationary observer

b.) an observer in another car moving at 20 mph in the same direction

c.) an observer in another car moving at 20 mph in the opposite direction

A boat is moving down a river at 8 m/s to the north and a person on the boat is walking to the front of the boat at 2 m/s to the north. What does the person on the boat view his/her velocity as? What does an observer on shore view the person's velocity to be?

A boat is crossing a river at 8 m/s to the north and the current is pushing the boat downstream at 3 m/s to the west. What is the overall velocity of the boat (as viewed from an observer on shore)?

Independence of Vectors

In our previous example with the boat, what would happen to the overall velocity of the boat if the current increased to 5 m/s [W]?

Would the increase in the velocity of the current and the overall velocity affect the time it would take to cross the river?

Perpendicular vectors are independent.

Perpendicular vectors are independent of one another. If one component vector changes, it affects the resultant vector, but not the other perpendicular component vector.

ex.
A boat is crossing a river at 8.0 m/s at the same time the current is pushing it downstream at 5.0 m/s.

a.) What is the overall velocity of the boat?

b.) If the river is 80 m wide, how long will it take to cross the river?

c.) How far downstream will the boat go in this time?

d.) What is the boat's overall displacement?

e.) What angle should the boat head to end up directly across the river from where it started?