Relative Velocity Part 2

Content

Relative motion allows us to compare the motion of an object from another observer. The observer can be another moving object or a stationary reference point. We use vector analysis to add all the components of a velocity and calculate a final velocity relative to the observer

Example

A boat is flowing on a river, parallel to the river bank. The boat has a velocity of 15m/s North but there is a current flowing in the river at 8m/s East. What is the velocity of the boat relative to the river bank?

* We begin by first drawing a diagram of the problem.

River bank

Boat velocity: 15m/s

Current: 8m/s

Relative velocity: ?m/s

* Using Pythagoras’ Theorem, we can calculate the magnitude of the relative velocity:
* So the boat is moving with a speed of 37m/s relative to the bank now we need to calculate the direction.
* So the boat is moving 17m/s 28 North East relative to the bank.

Example

Two cars are driving away from each other at right angles. The first car is driving West at a speed of 20m/s. The second car is driving North at a speed of 21m/s. What is the relative velocity of the second car? Qualitatively describe the motion of the second car as observed by the first.

* First we begin with a diagram of the problem.

Car 1: 20m/s

Car 2: 21m/s

* Next we add the negative velocity of car 1 to both velocities and calculate the new velocity using trigonometry.

Car 1: 20m/s

20m/s

Car 2: 21m/s

20m/s

* So the magnitude of the relative velocity is 29m/s. Now to calculate the direction using trigonometry.
* The second car has a relative velocity of 29m/s 44 North East. Qualitatively, to the first car it appears the second car is moving away at 29m/s 44North East.

Example

A plane is flying in a crosswind. The velocity of the plane is 220m/s East and the crosswind is 21m/s North. What is the velocity of the plane relative to the ground? Qualitatively describe what a person standing on the ground looking at the plane would see.

* As always, we will begin with a diagram of the problem.

Crosswind: 21m/s

Plane: 220m/s

Relative Velocity: ?m/s

* Using Pythagoras’ Theorem, we calculate the magnitude of the relative velocity.

So the magnitude of the velocity is 221m/s, now for the direction.

The relative velocity of the plane is 221m/s 085 North East. To an observer on the ground the plane appears to be moving 85 North East with a speed of 221m/s.