

Problem Solving with Vectors

Problems involving force, velocity, or displacement can often be solved using vector operations (e.g. vector addition/subtraction, vector components).

Example 1

The airspeed of a small plane is 200 km/h . The wind speed is 50 km/h from the west. Determine the velocity of the plane relative to the ground if the pilot keeps the plane pointing in each of the following directions.

a) East

b) West

c) North

Vector Problems Worksheet

1. An airplane flies due south at 175 km/h with respect to the air. There is a wind blowing at 85 km/h to the east relative to the ground. What are the plane's speed and direction with respect to the ground? (195 km/h [64° S of E])
2. You walk 30 m south and 30 m east. Find the magnitude and direction of the resultant displacement. (42 m [SE])
3. A ship leaves its home port expecting to travel to a port 500 km due south. Before it moves even 1 km , a sever storm blows it 100 km due east. How far is the ship from its destination? In what direction must it travel to reach its destination? (510 km , 79° S of W)
4. A descent vehicle landing on Mars has a vertical velocity toward the surface of Mars of 5.5 m/s . At the same time, it has a horizontal velocity of 3.5 m/s .
 - a) At what speed does the vehicle move along its descent path? (6.5 m/s)
 - b) At what angle with the vertical is this path? (32°)
5. You are piloting a small plane, and you want to reach an airport 450 km due south in 3.0 hours. A wind is blowing from the west at 50 km/h . What heading and airspeed should you choose to reach your destination? (158 km/h [18° W of S])
6. A hiker leaves camp and, using a compass, walks 4 km east, then 6 km south, 3 km east, 5 km north, 10 km west, 8 km north, and finally 3 km south. At the end of three days, the hiker is lost. By drawing a diagram, compute how far the hiker is from camp and which direction should be taken to get back to camp. (5 km , 53° S of E)
7. You row a boat perpendicular to the shore of a river that flows at 3.0 m/s . The velocity of your boat is 4.0 m/s relative to the water.
 - a) What s the velocity of your boat relative to the shore? (5.0 m/s [$53^\circ \text{ to the shore}$])
 - b) What is the component of your velocity parallel to the shore? Perpendicular to it? (3.0 m/s , 4.0 m/s)
8. A weather station releases a balloon that rises at a constant 15 m/s relative to the air, but there is a wind blowing at 6.5 m/s toward the west. What are the magnitude and direction of the velocity of the balloon? (16.3 m/s [$23^\circ \text{ west of vertical}$])