

Perpendicular Vectors: Planes, Trains, Boats and Automobiles

- 1) Glorfindel is riding on his stallion going 60. m/s due North. He pulls out an arrow and notches it. Determine the velocity of his arrow **over the ground** if he fires it at 80. m/s **relative to the horse**, in the following directions...
 - a) straight ahead (due north)
 - b) To the rear (due south)
- 2) You are down at the railyard at 4:30 AM to watch a taping of an *Alias* episode. You watch as a train goes by at 5.0 m/s south. On top of the train, Agent Sydney Bristow is running north. You see Sydney moving at 8.0 m/s north. At what speed does the camera crew on the train see Sydney running, and in what direction?
- 3) Later during the same shoot the train goes by you at 10.0 m/s south while Sydney runs across a flat bed car at 6.0 m/s west, as far as the camera crew on board is concerned. You are watching from a platform above the train. What is Sydney's velocity from your perspective?
- 4) The Qualicum river flows due west at 4.7 m/s at the spot where Benji, the dog, jumps in and swims at 3.0 m/s, heading straight across, always looking directly at the south bank. Determine the dog's velocity relative to a stationary observer.
- 5) Sir Isaac Newton is bumping along on his pony going 22 m/s due east when he sees his arch-nemesis, Robert Hooke. Newton pulls an apple out of his pocket and hurls it at 40.0 m/s to the north, as far as he is concerned. What is the apple's velocity over the ground?
- 6) Huck Finn's river boat can go 40.0 km/h through the water. The Mississippi River flows due west at 20.0 km/h at the spot where Huck wishes to make a direct crossing to the north side. Determine the heading Huck must take, and the time it will take him to cross the 2.0 km wide Mississippi River.
- 7) Bobo, the clown, can swim at 2.0 m/s. He must make a landing directly across to the north side of the Styx river, which is 100. m wide. The river flows at 6.0 m/s due east at this point. Bobo's biggest problem is that he can only swim while facing due north. How can he possibly make a landing at the desired location?
- 8) You are in the back of a pickup truck on a warm summer day and you have just finished eating an apple. The core is in your hand and you notice the truck is just passing an open dumpster 7.0 m due west of you. The truck is going 30.0 km/h due north and you can throw that core at 60.0 km/h. In what direction should you throw it to put it in the dumpster, and how long will it take it to reach its destination?

1) a. 140. m/s N b. 20. m/s S 2) 13 m/s, N 3) 12 m/s, 31 W of S 4) 5.6 m/s, 33 S of W 5) 46 m/s, 61 N of E
6) 30.0 E of N, 210. S 7) He must start swimming 300 m upstream. 8) 30.0 S of W, 0.48 s