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)

1. 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?
2. 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?
3. 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.
4. 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?
5. 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.
6. 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?
7. 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