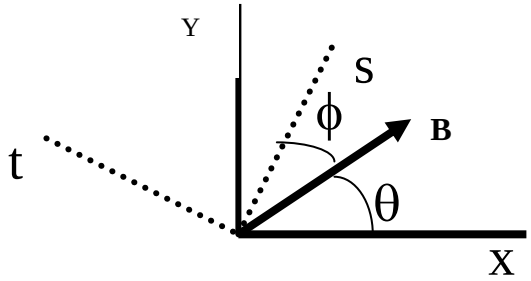
Physics 113 - Fall 2012 - workshop module 2
Vectors and multidimensional kinematics

1. Consider the vector B, drawn below on two different sets of coordinates. Find the x and y components of B in terms of theta. Find the s and t components of B in terms of phi. How many ways can you express B in terms of unit vectors?

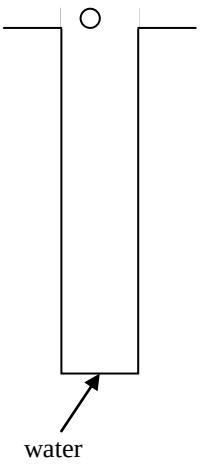


2. A football player gets hit rather hard during a game. He isn't so steady when he first gets up. Initially he is hit in the center of the field. Assume the field is oriented with the endzones aligned along the north-south direction. When he first gets up, the player walks 10 yards south. Then he turns sharply and walks 5 yards at an angle of 20 degrees north of east. Then he walks 20 yards north and collapses. Where does the player end up relative to the place where he was hit initially? What is the name of the vector that gives this information?

3. A player kicks a football at an angle of 40 degrees above the horizontal with an initial speed of 14 m/s. Air resistance may be ignored. A second player standing at a distance of 26 m from the first (in the direction of the kick) starts running to meet the ball at the instant it is kicked. How fast must the second player run in order to catch the ball just before it hits the ground? How would this answer change if the football game took place on the moon? (Assume "g" on the moon is 1/6 that on the surface of the earth. Can you calculate that on your own?)

4. A basketball player jumps straight up into the air a distance of 76 cm. How long is the player in the air? Why does a great basketball player seem to hang in the air during a jump shot? Justify your answer analytically.

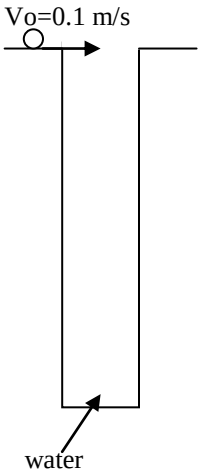
5. A moving sidewalk in an airport terminal building moves at 1.0 m/s and is 40.0 m long. If a woman steps on at one end and walks at 2.0 m/s relative to the moving sidewalk, how much time does she require to reach the opposite end if she walks a) in the same direction the sidewalk is moving? b) in the opposite direction? Suppose this is an escalator instead of a moving sidewalk. Suppose the escalator rises at an angle of 30 degrees with the floor. Suppose a woman walks up the escalator with a speed of 2 m/s, what is her horizontal speed with respect to the floor? What is her vertical speed with respect to the floor?



6. In a fit of frustration Eggburt Lowder decided that his newly developed skill at beer pong was not going to help him solve projectile problems. So, he prayed for a while and then walked to a nearby wishing well. Eggburt dropped several coins down the well and wished to do well on his physics exams. Suddenly, in a fit of physics euphoria he decided to use his physics knowledge to determine the depth of the well.

   Eggburt dropped a coin into the well and determined the depth of the well from the time between the release of the coin and hearing the splash of the coin in the water at the bottom. (Here "depth" is defined as the distance from the lip of the well to the top of the water surface at the bottom of the well.) He measures a time difference of 2.5 s.

What is the depth of the well? (Assume the speed of sound in air is a constant 340 m/s.)



Next Eggburt slides the coin off the side of the well with a horizontal velocity of 0.1 m/s. In this case, what time difference does he measure between the release of the coin and hearing the sound of the splash at the bottom of the well? Assume the well is wide enough that the coin does not hit the side of the well as it descends.