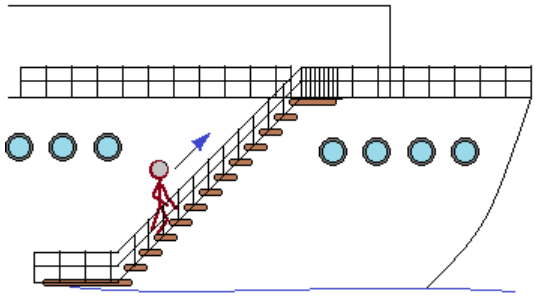
Physics I

More kinematics problems

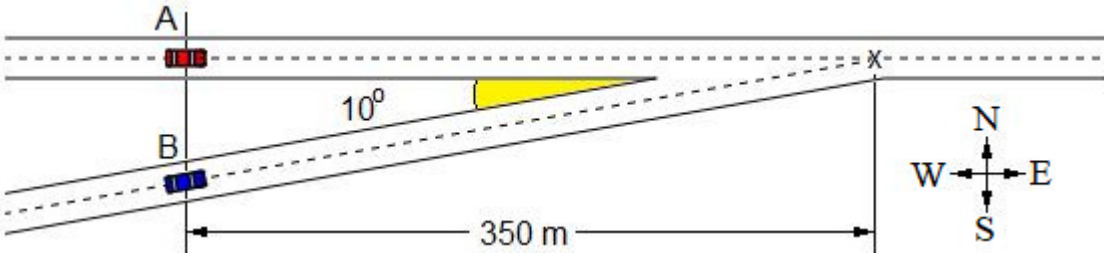
Problem 1.- A passenger in a cruise ship that travels at 1 m/s in steady waters climb stairs at a speed of 0.5 m/s with respect to the ship. The stairs make an angle of 45º over the horizontal and points in the same direction as the ship motion, as shown below. What is the velocity of the passenger?



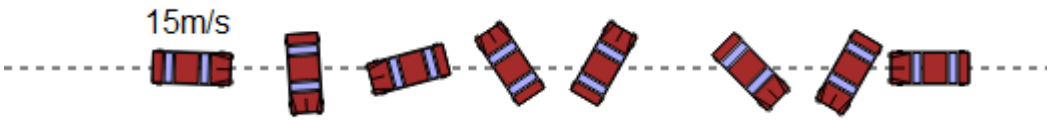
Problem 2.- The velocity of an object in a horizontal plane is given by the function:
$\vec{v} = (-2,4t)$
The position of the object at t = 0 is $\boldsymbol{r}$ = (1.5, 3).

a) Find the instantaneous position and acceleration.
b) Make a graph of the trajectory and describe it.
c) Calculate the average speed between 0 and 2 seconds.
d) Find the tangential and radial accelerations at t = 1 second.
e) Find the average acceleration and velocity between 0 and 1 second.
f) If a second object has a velocity $\vec{v} = (-2,4)m/s$ and at t=0 is at the origin of coordinates, what is its trajectory? And, will it collide with the first object?
g) Graph the position, velocity, and acceleration components of each object.

Problem 3.- A car A is traveling along a highway towards the east at a constant velocity 35m/s. Another car B is entering the highway by a ramp pointing 10º north of east at a speed *v*. The point marked X in the figure is 350m from A.
Using a coordinate system x-y for east-north, calculate how the distance between the cars changes over time and find the safe values of *v* that will avoid a collision.



Problem 4.- A car rotates 1.5 revolutions while it slides until it stops. Initially, its center of mass was moving at 15m/s, but due to friction with the ice, its speed reduced at a rate of $1.5 m/s^2$. Seen from above, the car rotated clockwise. Find its average angular velocity during the slide.



Problem 5.- An axe hits a log with initial velocity v_0. The deceleration produced by the wood can be described by the function $a = -kx^3$. Calculate how deep the axe will penetrate in the wood.