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 45° 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 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? 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 10° 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 1.5m/s². 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.

