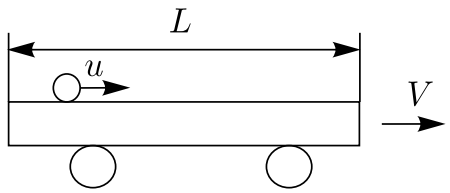
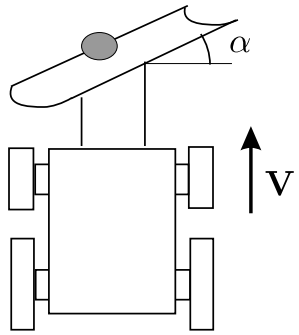
1. A ball rolls back and forth on a frictionless cart and bounces of the side walls absolutely elastically. The velocity of the ball relative to the cart is u, the velocity of the cart with respect to ground if V. Plot the graph of the balls position (with respect to ground) vs time. Consider three cases:

a) $u = 2V$, b) $u = V$, c) $u = V/2$



2. Two bicyclists began moving toward each other: one from station A to station B, the other one from B to A. The first met at point 9km away from A and continued their motion. When each of the reached their destination they turned around and met the second time at a point 6km from B. Find the distance from A to B and the bicyclists speed ratio.

3. A bulldozer is cleaning a road. It is moving with a velocity V and is pushing an ice chunk (see figure). The bulldozer's shield is rotated by angle α. Neglect friction and find the sideways velocity of the ice chunk.



4. A train passes a station at a constant velocity. The total time interval (counting from when the head car of the train reaches the station until the tail of the train passes the end of the station) is 18 s. Another train, going toward the first one, takes 14 s to pass by the station. Each train is exactly half as long as the station. How long will it take for the two trains pass each other?

5. Two trains simultaneously leave stations A & B and move toward each other. The first train accelerates with $+a_1$ for the first 1/3 of its *path*, moves uniformly during the second 1/3 of its *path*, and slows down with $-a_1$ for the last 1/3 of its *path*. The second train accelerates with $+a_2$ for the first 1/3 of the *time*, moves uniformly during the second 1/3 of the *time*, and slows down with $-a_2$ for the last 1/3 of the *time*. The velocity of the uniform part of the motion were equal to 70 km/hr for both trains. The whole trip took 2 minutes longer for the first train. Find the distance between the stations.

6. A particle, acted upon by a constant force, moves along the trajectory governed by $y = 0.04x^2$ (x and y are measured in meters). It passes point $x = 0$ with a velocity of 10 m/s. Find the particle's velocity 2 seconds later.

7. A particle begins its motion from the origin in the positive x-direction. The particle's position and velocity are related according to $x = Av^2 + B$, where $A = -2$ s^2/m, $B = 2$m. After what time will the particle return to the origin?

8. A series of experiments involve a puck that is pushed up a frictionless ramp with an initial speed of 5 m/s. The total pathlength of the puck over the first 2 seconds is then recorded. The experiments are repeated for different ramp angles that range from 0 to 90^0. Note that the puck may slide below its initial position without leaving the ramp. Predict the minimum possible value of the puck pathlength in these experiments.

9. A block is pushed with an initial speed of 4 m/s along a wooden slab lying on a table (see the figure below). Due to friction, the block is decelerating at 3 m/s^2, while the slab is accelerating at 1 m/s^2. After some time, when the speeds of the block and slab equalize, the decelerate as a whole at 1 m/s^2. Find the total displacement of the block and the total displacement of the slab relative to the table since the beginning of motion until the complete stop.