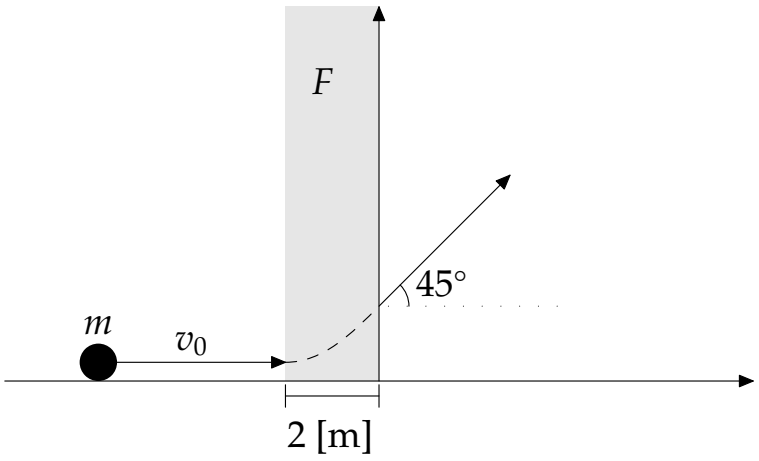
PHY 9A Discussion 4, Spring 2018

1. Changing the Direction by Force

A point mass of $m = 3$ [kg] is currently moving on a frictionless ground into the positive x-direction with constant speed $v_0 = 7$ [m/s]. In an x-interval of 2 [m] lies ahead, there will be a chance to apply constant force (over the interval) on the mass to change its direction so that it will be launched with an angle of 45° to the horizontal after passing the interval.



i. If the force can only be in the y-direction, what should the magnitude of the force be? (Don't forget gravity!)

ii. Find the direction and the magnitude of the force when you want the launching speed to be the same as the traveling speed.

2. Box on a Slope with Friction

A box of mass $m = 10$ [kg] is moving on a frictionless ground in the horizontal direction with constant speed $v_0 = 8$ [m/s], and starts to climb up a slope with an angle, θ, to the horizontal at $t = 0$ [s]. Unlike the ground, the slope has the static frictional coefficient of $\mu_s = 0.4$ and the kinetic frictional coefficient of $\mu_k = 0.1$.

i. What is the maximum angle, θ_{max}, with which the box stops at the highest position? Also find the height to the position of the box (measured from the ground) when it stops with $\theta = \theta_{max}$.

3. Circular Motion

Consider a ball of 0.2 [kg] and a massless string attached to the ball. The ball is in a circular motion with radius 3 [m] due to the string tension, and the circular path is in a perpendicular plane.

i. The frequency of the motion is measured to be 1 [rev./s]. What is the speed of the ball at that time?

ii. There is gravity in nature, and we cannot just ignore it in general. Qualitatively discuss the effect of gravity to the circular motion; what if the speed of the ball is high/low? What is the criterion for determining whether the speed is high or low?