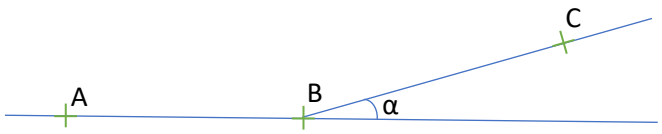
Exercise Set 4 - Mechanics

Work and Energy

Exercise 1: Motion on an inclined plane

A ball with mass m starts moving from point A with initial velocity v_A, passes through point B, and then moves up on an inclined plane up to point C, as shown in the figure below. We will assume that friction is negligible along the AB segment.



Data given: $v_A = 6\ \mathrm{m/s}$, $\alpha = 30°$, $m = 200\ \mathrm{g}$, and $g = 10\ \mathrm{m/s^2}$.

1. Motion along the AB segment

a. Draw all the external forces that are exerted on the ball along the AB segment.

b. Using the work-kinetic energy theorem between points A and B, calculate the velocity of the ball at point B.

2. Motion along the BC segment

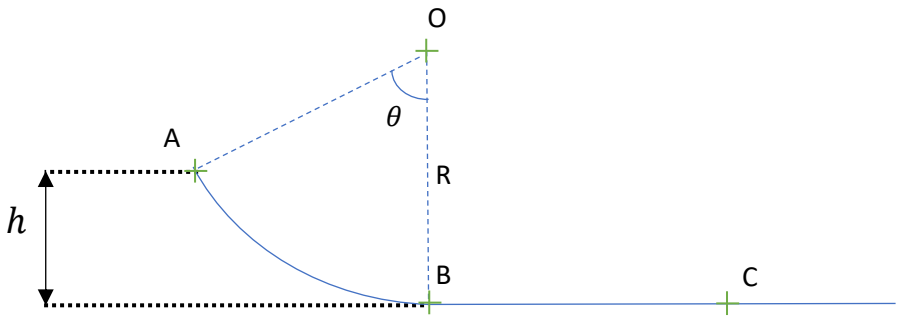
a. Draw all the external forces that are exerted on the ball along the BC segment. The force of fiction is constant in this section, with value $f = 0.2\ \mathrm{N}$.

b. Using the work-kinetic energy theorem between points B and C, calculate the distance BC, given that the ball **stops** at point C before coming back down.

Exercise 2: Motion on a circular arc

A solid with mass m is moving along the path ABC shown in the figure below. AB is an arc of a circle with radius R and angle θ, centered at point O, while BC is a horizontal segment. Along the AB arc, friction is negligeable, while along the BC segment, friction is a constant force of magnitude f, collinear to the velocity vector. The solid starts moving at point A with an initial velocity v_A, that is tangent to the circle.

Data given: $m = 0.1\ \mathrm{kg}$, $g = 10\ \mathrm{m/s^2}$, $R = 1.6\ \mathrm{m}$, $v_C = v_A = 3\ \mathrm{m/s}$, $\theta = 60°$, $BC = 2\ \mathrm{m}$.



1. How do the kinetic and the potential energies change during motion on the arc AB? What can we say about the mechanical energy?
2. If h is the difference in height between points A and B, show that
$$h = R\,(1 - cos\theta)$$
3. Express v_B, the velocity at point B, in terms of R, g, v_A and θ. Calculate its numerical value.
4. Express the force of friction f along the BC segment in terms of m, v_B, v_C and BC. Calculate its numerical value.