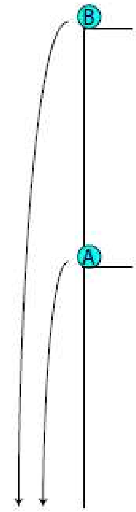
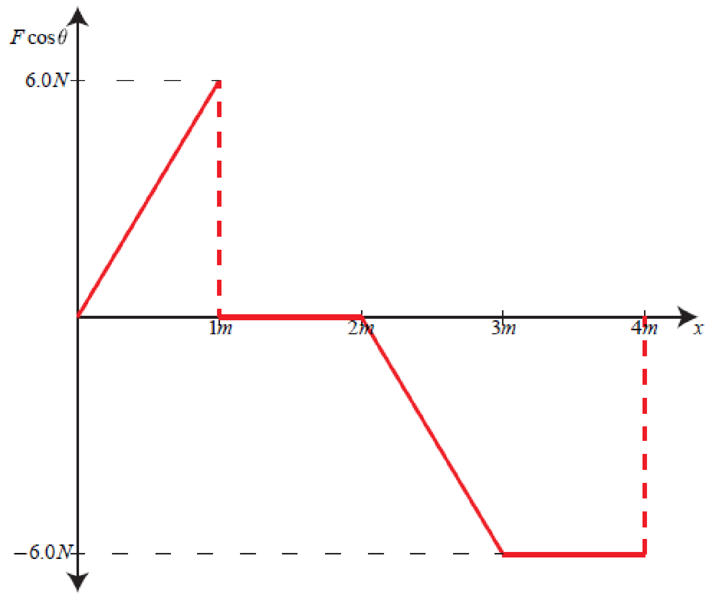


1. Bowling Ball A is dropped from a point halfway up a cliff. A second identical bowling ball, B, is dropped simultaneously from the top of the cliff. Comparing the bowling balls at the instant they reach the ground, which of the following are correct? Neglect air resistance.

(A) Ball A has half the kinetic energy and takes half the time to hit the ground as Ball B.
(B) Ball A has half the kinetic energy and takes one-fourth the time to hit the ground as Ball B.
(C) Ball A has half the final velocity and takes half the time to hit the ground as Ball B.
(D) Ball A has one-fourth the final velocity and takes one-fourth the time to hit the ground as Ball B.
(E) None of these are correct.

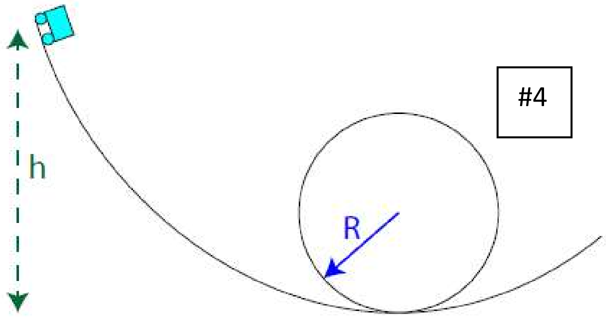
2. A net force ($F\cos\theta$) acts on an object in the x-direction while moving over a distance of 4 meters along the axis, depicted in the graph at right.



(a) Find the work done by the force in the interval from 0.0 to 1.0 m.
(b) Find the work done by the force in the interval from 1.0 to 2.0 m.
(c) Find the work done by the force in the interval from 2.0 to 4.0 m.
(d) At what position(s) is the object moving with the largest speed? Explain your answer.

3. Bob pushes a box across a horizontal surface at a constant speed of 1 m/s. If the box has a mass of 30 kg, find the power Bob supplies given the coefficient of kinetic friction is 0.3.

4. A roller coaster car begins at rest at height h above the ground and completes a loop along its path. In order for the car to remain on the track throughout the loop, what is the minimum value for h in terms of the radius of the loop, R? Assume frictionless.



5. If you throw a rock straight up outside, it eventually returns to your hand with the same speed that it had when it left, neglecting air resistance.

What would happen if you were to throw the rock straight up in the same way, but while inside the classroom? Compared to the speed with which it left your hand, after rebounding off of the ceiling it would return to your hand with...

(A) a higher speed.
(B) a lower speed.
(C) the same speed, just like when you are outside.
(D) more information needed

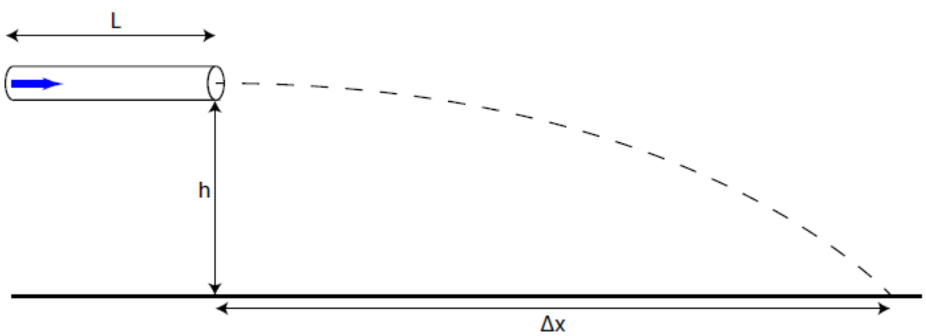
Explain your reasoning.

6. Is it possible to give a block a push and then have it slide up an incline at a constant speed (without you continuing to push on it)? Explain your reasoning.

(A) No.
(B) Yes, but only if there is friction between the block and the incline.
(C) Yes, but only if there is no friction between the block and the incline.

Explain your reasoning.

8. A dart of mass m is accelerated horizontally through a tube of length L situated a height h above the ground by a constant force F. Upon exiting the tube, the dart travels a horizontal distance Δx before striking the ground, as depicted in the diagram below.



(a) Develop an expression for the velocity of the dart, v, as it leaves the tube in terms of Δx, h, and any fundamental constants.

(b) Derive an expression for the kinetic energy of the dart as it leaves the tube in terms of m, Δx, h, and any fundamental constants.

(c) Derive an expression for the work done on the dart in the tube in terms of F and L.

(d) Derive an expression for the height of the tube above the ground in terms of m, Δx, L, F, and any fundamental constants.

An experiment is then performed in which the length of the tube, L, is varied, resulting in the dart traveling various horizontal distances Δx which are recorded in the table below.

Trial	1	2	3	4	5	6
Tube Length L (m)	0.2	0.5	0.8	1.2	1.7	2.0
Horizontal Distance Δx (m)	3.5	5.5	7.0	8.6	10.2	11.1

(e) Use the grid on the next page to plot a linear graph of Δx^2 as a function of L. Use the empty boxes in the data table, as appropriate, to record the calculated values you are graphing. Label the axes as appropriate, and place numbers on both axes.

(f) From the graph, obtain the height of the tube given the mass of the dart is 20 grams and the constant force applied in the tube is 2 newtons.