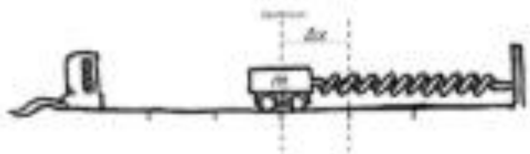
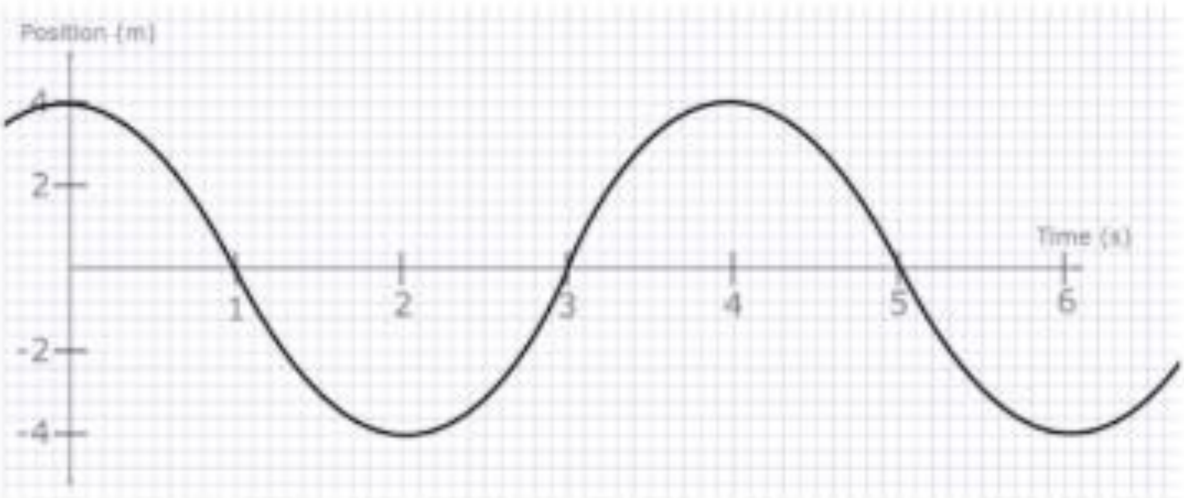
NAME ______________________ DATE ____________

Scenario

A cart of mass m, resting on a smooth surface, is attached to an ideal spring. The cart is displaced to the right a distance Δx from equilibrium and released. While the cart oscillates around the equilibrium position, a motion detector collects data to make the following graph of position as a function of time.





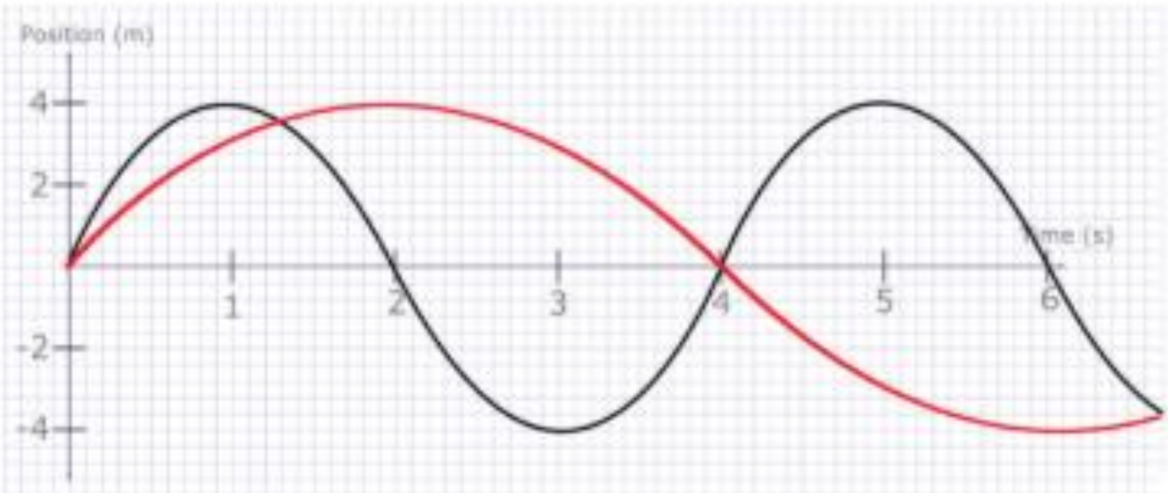
Data Analysis

PART A: Using the graph above, determine the following:

T	f	ω	*Time(s) of maximum positive velocity*	*Time(s) of maximum negative velocity*	*Time(s) when velocity is zero*	*Time(s) of maximum positive acceleration*	*Time(s) of maximum negative acceleration*	*Time(s) when acceleration is zero*
4 s	0.25 Hz	$\frac{\pi}{2}\ \frac{\text{rad}}{\text{s}}$	3 s	1 s, 5 s	0 s, 2 s, 4 s, 6 s	2 s, 6 s	0 s, 4 s	1 s, 3 s, 5 s

PART B: Remember from math class that the equation to describe a cosine wave is $x = A\cos(2\pi ft)$, where A is the amplitude, f is the frequency, and x is the position as a function of time t. In terms of the data you collected in Part A, write the equation for the position of the cart as a function of time.

$x =$ $x = 4\cos(2\pi(0.25\ \text{Hz})t)$ $\quad x = 4\cos(\frac{\pi}{2}t)$



PART C: Another group of students collected the following data from their motion sensor. What is one possible explanation for the differences in the graphs created by the two groups?

They started their timer as their cart was passing through the equilibrium instead of when the cart was at its maximum positive amplitude.

PART D: Write the equation that describes the position vs. time of the second group's cart.

$x =$ $x = 4\sin(\frac{\pi}{2}t)$

Using Representations

PART E: The second group repeated their procedure thinking that perhaps if they added mass to the cart, it would help their analysis. On the graph in Part C above, sketch what the position vs. time graph would look like for a cart with a mass of $4m$.