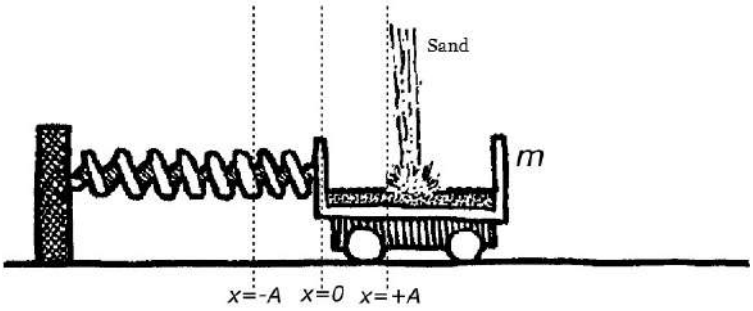
NAME _____ DATE _____

Scenario

A cart of mass m that rolls on frictionless bearings is connected to a spring that can both compress and expand. The cart is displaced to position $x = +A$ (measured at the point where the spring connects to the cart) and released so that the cart oscillates with period T. At time $t = 0$, when the cart is again at position $x = +A$, sand begins to be poured into the cart from a spout; the sand falls directly down into the cart.



Quantitative Analysis

PART A: Suppose the mass of the cart is $m = 0.5$ kg and the sand enters the cart at a rate of 0.1 kg/s. At what time after $t = 0$ is the period of the oscillation $2T$? Explain how you arrived at your answer.

Argumentation

PART B: As sand falls straight down into the cart, the mechanical energy of the system consisting of the spring, the cart, and the sand in the cart decreases with time. Explain why this is the case. (Hint: This is a collision. What type of collision is it?)

Using Representations

PART C: On the grid below, sketch a graph of the position x of the point where the spring connects to the cart as a function of time t, considering that mechanical energy decreases and the mass being oscillated is increasing.