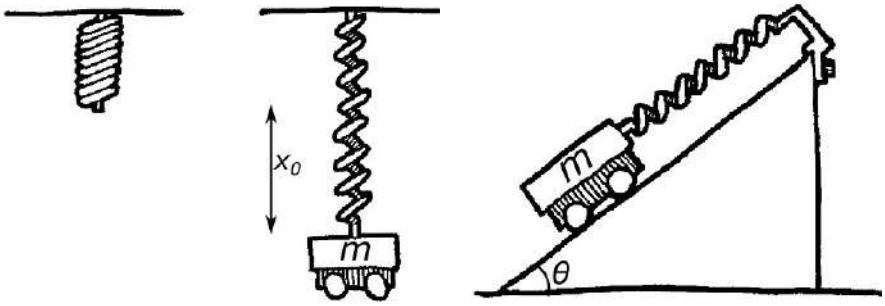
NAME _____ DATE _____

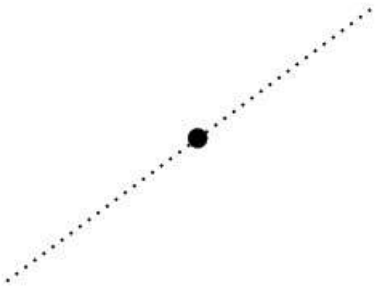
Scenario

A cart of mass m is attached to a vertical spring of spring constant k so that the spring stretches a distance x_0. When the cart is set into oscillatory motion on the vertical spring, the period of oscillation is T. The cart is then set on a smooth incline angled at θ above the horizontal and reattached to the spring.



Using Representations

PART A: The dot at right represents the cart at rest on the incline. Draw a free-body diagram showing and labeling the forces (not components) exerted on the block. Draw the relative lengths of all vectors to reflect the relative magnitudes of all the forces. Each force must be represented by a distinct arrow starting on and pointing away from the dot. (The dotted line represents the incline.)



Quantitative Analysis

PART B: Derive an expression for the stretch of the spring (L) while the cart is on the incline in terms of x_0, θ, and physical constants as necessary.

PART C: Does your equation make physical sense for $\theta = 0°$? Explain.

Does your equation make physical sense for $\theta = 90°$? Explain.

PART D: How does the new period of oscillatory motion that the cart could undergo on the incline compare to the original period T when hanging vertically? Explain your reasoning.

PART E: The cart is pulled down the ramp so that it has been stretched a distance L past equilibrium. The cart is released and oscillates. A graph of the position of the cart as a function of time is sketched below. Sketch the following graphs for the cart as it oscillates on the incline: velocity vs. time and acceleration vs. time.