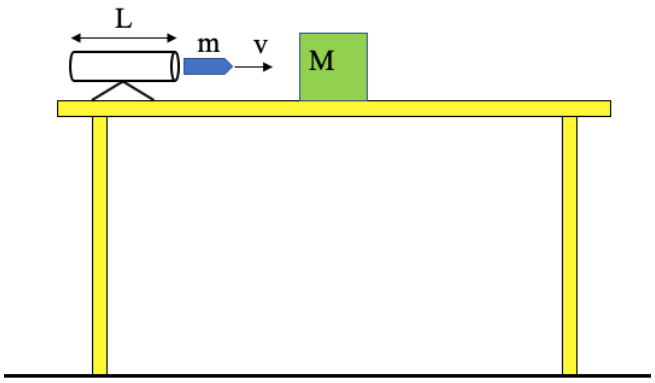
A dart of mass m moving through a tube of length L experiences a constant force F. After leaving the tube the dart strikes a box of mass M sitting on a table whose coefficient of friction is $\mu_k$. The dart/block system then moves a distance D before coming to rest.




a.) Ignoring air resistance, and assuming all other parts of the experiment remains the same, if you want to maximize the stopping distance D, do you want the length of the tube to be long or short. Justify your response.

b.) Someone derives an expression for the stopping distance to be $\frac{FLm}{(m+M)^2 \mu_k g}$. Without algebraic manipulation of equations, explain whether this equation accurately matches your explanation in Part a. Justify your response.

c.) The tube-force is changed so that it can be described as a function of position F(x) = 12x. Explain how this equation can be used to find the launch speed of the dart if the length of the tube is 2.0 meters.

d.) Assuming the force function defined in Part c, predict what would happen to the launch velocity of the dart if the length of the tube was doubled. Justify your response.

e.) What does the solution to Part d tell us about double the length of the tube in a situation in which the force was constant?

f.) It is claimed that the launch velocity is $v = \left( \frac{12L^2}{m} \right)$. Without algebraic manipulation of equation, explain whether this equations accurately matches your explanation of Part d. Justify your answer.