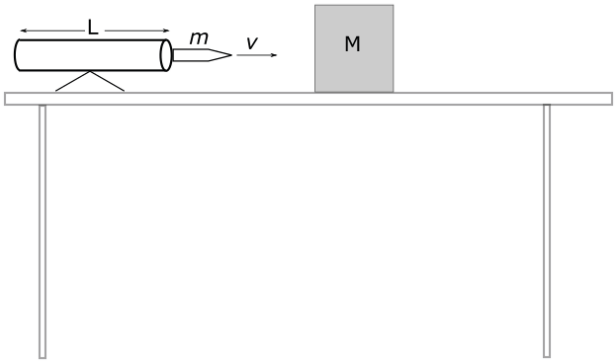
2020 Exam Sample Questions

AP® PHYSICS C: MECHANICS

2020 Sample Question 1

Allotted time: 25 minutes (+ 5 minutes to submit)



A constant force F is exerted on a dart of mass m in the horizontal direction as it moves through a tube of length L. After exiting the tube, the dart collides with a box of mass M that sits at rest on a table. The coefficient of kinetic friction between the box and the table is μ_k. The dart/block system then slides across the table and comes to rest after traveling a distance D.

(a) Students experiment with a variety of tubes. Assuming that air resistance is negligible, and that all other parts of the experiment remain the same, should the students use a long tube, or a short tube make the stopping distance D the longest? Justify your answer.

(b) Students derive the following equation for the stopping distance D.

$$D = \frac{FLm}{(m+M)^2 \mu_k g}$$

Without algebraic manipulation of equations explain whether this equation accurately matches your explanation in part (a). Justify your answer.

Students then change the force so that it can be described as a function of position $F(x) = 12x$.

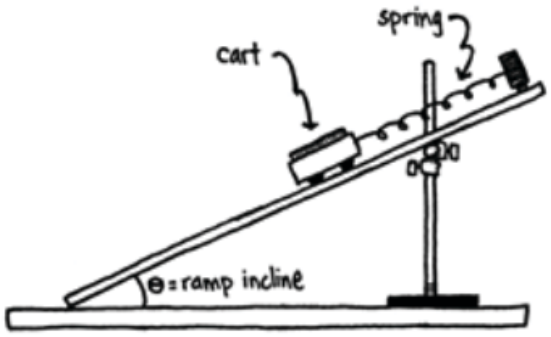
(c) Explain how the students could use the equation given above to find the launch speed of the dart, if the length of the tube is 2 meters.

(d) Predict what will happen to the launch velocity of the dart if the length of the tube was doubled. Justify your answer.

(e) Students are given an equation for the launch velocity of the block as follows. $v = \sqrt{\frac{12L^2}{m}}$. Without algebraic manipulation of equations explain whether this equation accurately matches your explanation in part (d). Justify your answer.

2020 Exam Sample Question 2

Allotted time: 15 minutes (+ 5 minutes to submit)



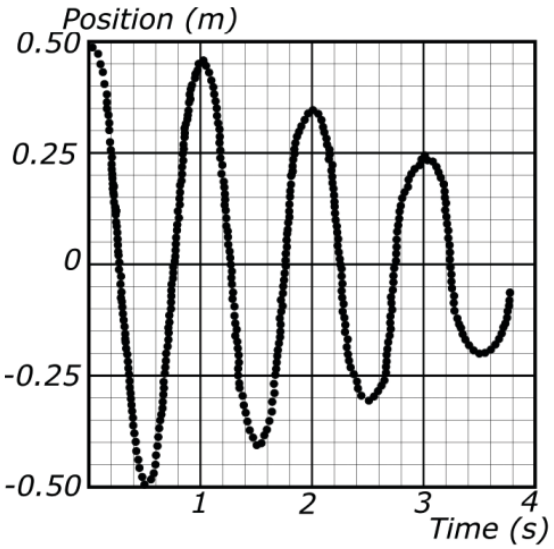
Students are asked to perform an experiment to determine g, the acceleration due to gravity, in the lab using the setup shown. They are expected to find g by plotting their data in a graph. The students have access to equipment commonly found in a high school physics laboratory, but the experiment must use the setup as shown above which includes a cart of mass M on an ramp which is set at an angle θ to the horizontal. The cart is held on the ramp by a spring of known constant k. There is negligible friction between the cart and the ramp.

(a) Briefly identify each quantity to be measured, the symbol used to represent that quantity, and the equipment that would be used to measure the quantity.

(b) Briefly describe the procedure to be used to determine the acceleration due to gravity. Provide enough detail so that another student could replicate the experiment, including any steps necessary to reduce experimental uncertainty. As needed, use the symbols defined in part (a).

(c) Which quantities that were measured in part (b) could be graphed on the horizontal and vertical axes to produce a graph that would be used to determine the acceleration due to gravity?

(d) Describe what information from the graph described in part (c) would be used and how it would be used to determine the acceleration due to gravity.



(e) In a second experiment students place a different cart of unknown mass on the ramp and attach it to the spring, letting the cart and spring come to rest. The cart is then displaced slightly down the ramp and released, causing the cart to oscillate on the ramp. The students create the position vs. time graph shown above using a motion sensor. Briefly describe how the students could use the graph to determine the mass of the new cart.