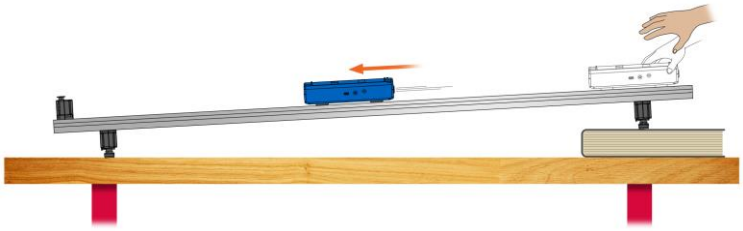
Materials: Smart Cart, Track, iPad with SparkVue App, Book
Time:

Investigation 4A: Acceleration on a ramp

Essential Question: What is acceleration and how does it relate to speed and velocity?

A car rolling down a ramp accelerates. A car given an initial velocity *up* a ramp accelerates at the same rate! The Smart Cart allows us to quantitatively investigate acceleration and its relationship to speed and velocity.



Part 1: Acceleration down a ramp

1. Open the experiment file **04A_Acceleration**, and then power-on the Smart Cart and connect it wirelessly to your software.
2. Set up the track at a low angle. Attach the End Stop at the bottom to catch the Smart Cart.
3. Hold the Smart Cart at the top of the ramp, Velcro® facing up the ramp. Begin collecting data and release the Smart Cart. Stop data collection just after the cart reaches the bottom of the track.

Questions

a. Determine the acceleration in m/s^2 from the slope of the velocity graph. Does this value match with the acceleration recorded in the acceleration versus time graph?

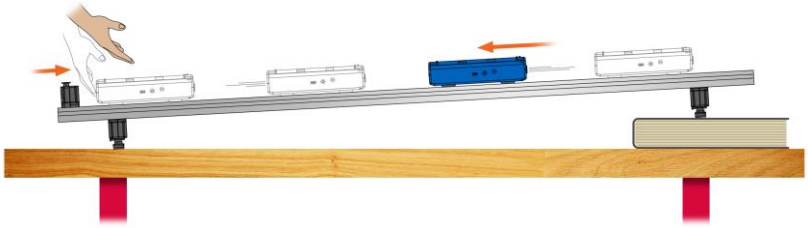
b. What is the total elapsed time from the moment you release the Smart Cart until it reaches the bottom of the ramp?

c. Calculate the expected final velocity using acceleration from part (a) and time from part (b). Show your work, including units. What is the final velocity recorded on the velocity versus time graph?

d. Change the ramp angle and run the experiment again. Explain in one sentence the effect of increasing the angle on the acceleration of the Smart Cart.

e. How can you infer changes in acceleration from the Smart Cart velocity vs. time graph?

Part 2: Comparing acceleration up and down a ramp



1. Reset the ramp angle to its original value. Set the Smart Cart at the bottom of the track, Velcro still facing *up* the ramp.
2. Start recording data. Give the Smart Cart a push so it rolls up the track and back down again. Stop recording data just before the cart reaches the bottom of the track.
3. Observe the velocity and acceleration graphs during a complete round trip.

Questions

a. Describe the velocity during the motion. Does the velocity change sign?

b. At what point in the motion is velocity zero? How is this shown graphically?

c. Describe the acceleration during the motion. Does the acceleration change sign?

d. Determine the acceleration in m/s^2 from the slope of the velocity graph. Show data and units.

e. Compare the acceleration from Part 2 to the acceleration you calculated in Part 1. Do the accelerations have the same magnitude? The same sign? Explain.