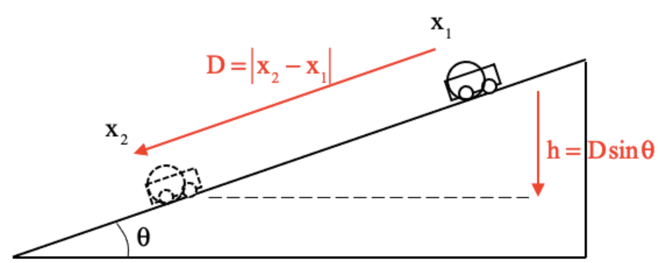
HOOP AND CART INCLINE LAB

Background: Which will make it to the bottom of a ramp first, a cart or a hoop? This lab is going to give you the opportunity to take a very quick look at that problem through the lens of energy. (Note that you will need to skim through the entire lab to understand what is happening, but will only need to actually do the Calculations in the sections written in blue.

Equipment: Although the information you'll need to do this lab should be included below, [the video] for this lab can be found at https://youtu.be/ZSkjLoaNHLc .

In the set-up, you will find an incline of angle $\theta = 12.2^{o}$ upon which a cart and a hoop will travel a distance *D* dropping a vertical distance *h* in the process. A sketch of the system is shown to the right

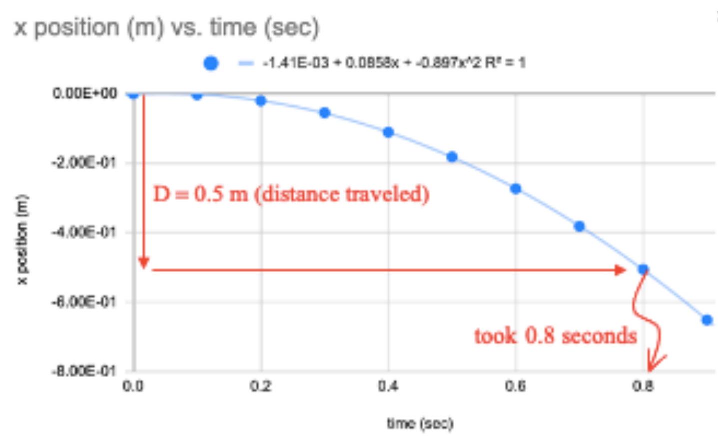


Procedure and Calculations:

1.) Under normal circumstances, you would be instructed to look at the video, then use the Tracker software to generate a *position vs time* and *velocity vs. time* graph for the motion of both the cart and the hoop, then extract a ton of information from the graphs. Because this is going to be an encapsulated lab, all of that is being done for you below. Read carefully:

2.) For the cart, whose mass was $m_c = 0.495$ kg :

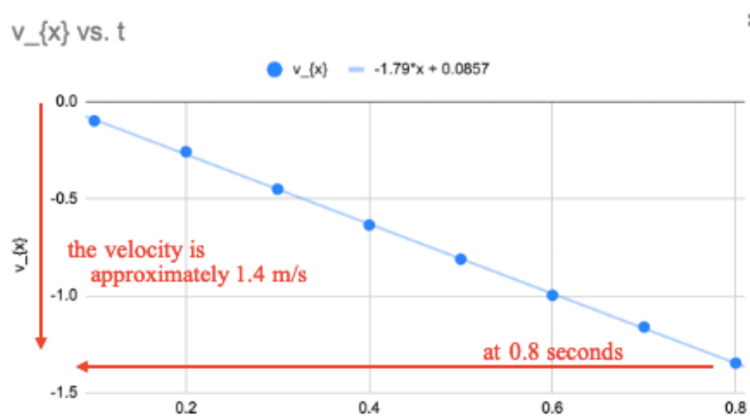
a.) Look at the *position vs time* graph first. Notice that for the cart to travel D = 0.5 meters down the incline (that's along the incline, not the vertical drop), it took 0.8 second.



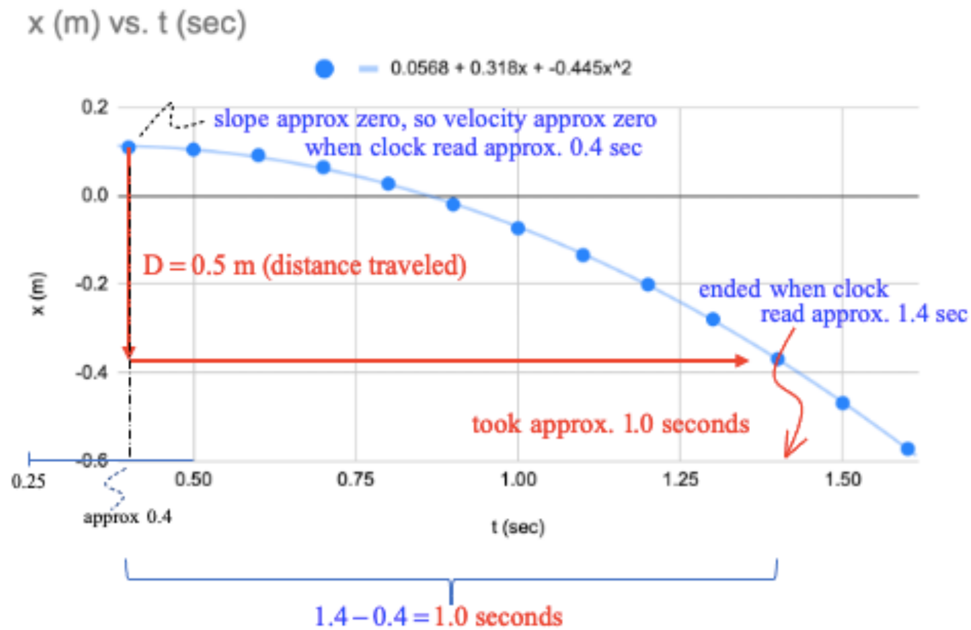
b.) Now look at the *velocity vs time* graph. After 0.8 seconds, the cart's velocity is seen to be approximately 1.4 m/s.

c.) Use *conservation of energy* to derive an expression for the theorical velocity of the cart after it has dropped (from rest) a distance *h* units (note that h = d sin θ). Once you have your relationship, put in your numbers.

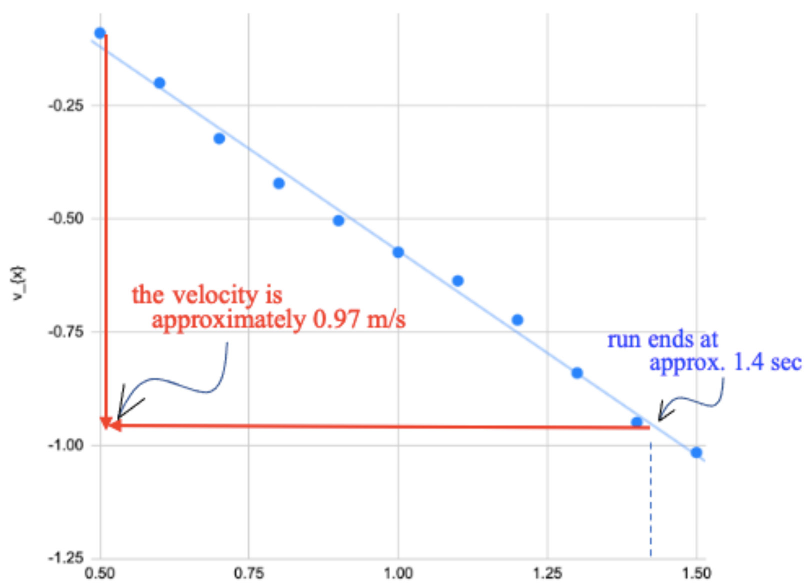
d.) Compare the theoretically determined value with the experimentally determined 1.4 m/s.



3.) We are going to do a similar thing with our hoop, whose mass was $m_h = 0.485$ kg, radius was r = 0.075 m and whose moment of inertia can be assumed to be $m_h R^2$:



e.) Look at the *position vs time* graph first. Notice that for the hoop to travel D = 0.5 meters down the incline (that's along the incline, not the vertical drop), it took 1.0 seconds (clearly the hoop got to the bottom after the cart). What's more, the hoop ends its 0.5 meter romp at the 1.4 second time on the clock.



f.) Now look at the *velocity vs time* graph. Tracking back to see what the velocity was at the 1.4 second time on the clock and we find approximately 0.97 m/s.

g.) Use *conservation of energy* to derive an expression for the theorical velocity of the hoop after it has dropped (from rest) a distance *h* units (note that h = d sin θ). Once you have your relationship, put in your numbers.

h.) Compare the theoretically determined value with the experimentally determined 0.97 m/s.

Summary:

The idea behind this lab was to get you back in the swing of rotational motion, and of doing problems from the perspective of energy considerations. How did it succeed?