Name: ______________________________ **Date**: ___________

Partner(s): __________________________ **Period**: __________

Constant Acceleration Lab

(2022)

Object:

The object of this experiment is to study the motion of an object moving with a constant acceleration.

Theory:

1. In this experiment putting wooden blocks under one end has lifted the track up. The cart will move down the track if it is released at the high end. The cart will undergo acceleration, although it is not clear at this point why this should be so. Galileo first did this experiment in the seventeenth century. It is one of the classic experiments in all of physics.
2. We are going to find the acceleration in true units of meters and seconds squared. In order to do so we will need to know both the real time and the real distance traveled. We knew neither in the last experiment.
3. Before we find the true time and true distance we will have to define two terms.
   a) Frequency (f) is the number of cycles per unit time. It is measured in hertz (Hz). One hertz is equal to one cycle per second, or
   1 Hz = 1 cycle /second.
   b) Period (T) is the time for one complete cycle. It is a time and therefore has units of time, i.e., seconds.
   c) There is a relationship between frequency and period. They are reciprocals of each other. $f = 1/T$ or $T = 1/f$.
4. The rotational rate of the motor is the determining factor in the time between dots on the photograph. The rotational speed is given as the number of revolutions per unit time. This is the frequency of the motor. It will be expressed in rotations per minute and we will convert it to hertz.
5. The relationship between the real dimensions and the photo dimensions depends on two things: a) the optics of the system, and b) the distance the object is from the camera.
6. We do not know enough about the optics of the camera to be able to make any relationships determine the true size. Fortunately, we can use a more direct method. If we know the real dimensions of some object in the photograph, then we can use this to calculate the scaling factor (sf).
7. The scaling factor is defined as: $sf = \text{dimensions}_{(real)}/\text{dimensions}_{(photo)}$
8. It is not necessary that the dimensions be in the same units in the two systems. In our experiment we will use the real dimensions as one meter since we will have a meter stick in the photo and we will measure its apparent length in centimeters.

Procedure:

1. Turn on the strobe and wait for it to come up to speed.
2. Push the shutter release button on the camera.
3. Tell your partner to release the cart. Do not push the cart.
4. Measure the length of the meter stick in the photo. Express the length in centimeters.
5. Measure both the interval distance and the cumulative distance in the photo. The interval distance is the distance between the first and second dots, the second and third dots, the third and fourth dots, etc. The cumulative distance is between the first and second dots, the first and third dots, the first and fourth dots, etc.
6. Record all information in the chart below.

Data:

The rotational speed of the strobe is 300 revolutions per minute.

The length of the meter stick in the photo is _________________ cm.

Interval	Real time (s)	Photo cumulative distance (cm)	Real cumulative distance (m)	Photo interval distance (cm)	Real interval distance (m)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

<u>Analysis and Questions</u>: (Answer on loose-leaf paper. Be sure to show your calculations.)

1. Define, with an equation, acceleration.
2. Define average velocity.
3. Determine the frequency of the strobe in hertz.
4. Determine the period of rotation in seconds.
5. Determine the scaling factor in meters/centimeter.
6. If the real interval distance is divided by the period (not the real time) we will determine the average interval speed. We are using speed here because everything is going in the same direction and so the vector nature of events can be ignored.
7. Record the average interval speed in the chart given.

Interval	Average interval speed (m/s)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

8. Plot a graph of real cumulative distance versus time. The time is on the horizontal axis.
9. Plot the average interval speed versus time. Time is on the horizontal axis.
10. Determine the acceleration of the glider in m/s^2 .
11. Was this a constant acceleration? Explain your answer.
12. What type of graph did you obtain for the cumulative distance versus time?