Lab: Uniform Accelerated Motion—(picket fence method)

Purpose: To determine the acceleration of the cart along the ramp through graphical analysis of the motion of the cart as it freely rolls down an inclined track.

Variables:

- **Manipulated Variable→ Position along the track,** measured in meters relative to the top of the track. (i.e. the top of the track would be equivalent to 0.000 m). Using the ruler attached to the track to determine each position, and measuring to the nearest millimeter.
- **Responding Variable → Velocity at each position**, calculated in meters per second. Using the photogate timer attached to the track and the picket fence attached to the car, the velocity of the car while it passes through the gate will be noted in the LoggerPro computer program. The average velocity, with uncertainties, can be deduced from the data supplied in the program. The gate will trigger the start of the timer when picket fence enters the gate, and will stop timing when the picket fence leaves the gate.

- **Controlled Variables:**
    - **Starting position of the car**, relative to the top of the track
    - **Angle of the track**
    - **Number of "pickets" in the picket fence used for data collection**

Materials:

- 1 Vernier dynamics system: 1.2 m long steel track, 1 leveling foot, end-stop barrier, ring stand support and stand clamp, photogate support stand
- 1 Vernier collision cart
- 1 plastic picket fence with solid black bar
- 1 Vernier Photogate Timer
- 1 LabQuest with USB cord
- 1 Laptop with LoggerPro
- 1 angle-measuring device (you may need to share with a neighboring group)

Set-up Procedure:

1. Attach the photogate to the support stand on the track . Make sure the height of the photogate's light beam is positioned so that it will pass through the picket fence (the side with 10 vertical bars) on the cart and so the cart will still be able to pass by under the gate.
2. Connect the photogate to the DIG 1 port on the LabQuest using the gate's cord
3. Connect the LabQuest to the computer using the USB cable
4. Open LoggerPro on your computer and go to Resources on your teacher's website to find the file you are to use.
5. Right-click and save the file; open LoggerPro and open that file. Once it's open, **save the file as something you'll be able to access later and with a new file name.** You will not be able to save the file unless you choose "save as…" and select a new location and new name.

Data Collection Procedure

6. Measure and record the angle of track.
7. Place the cart at the top of the track, in the position from which you'd like to consistently release. Measure and record the starting position of the front of the cart (the downhill side of the cart). Be certain to start at this same position each trial.
8. Position the photogate so that it is about 1 cm in front of the cart's starting position. Measure and record this position of the gate
9. Place the cart at its starting position at the top of the track. Clear all data from the previous set of trials.
10. Click the green "collect" button in LoggerPro
11. Release the cart and let it roll freely through the gate. You may want to catch it before it hits the bottom.
12. Highlight **the middle 5 data points** (i.e. points 3-7 or 4-8), then complete the "STATS" analysis function for those 5 points.
13. In your data tables (in your journal), record the average velocity, including uncertainty, for that trial of that position. Try to go to at least 2 decimal places for the velocity in each trial.
14. Pick up the cart, remove it from the track and replace it at the starting position.
15. Repeat steps 9-13 until you have 5 trials for that gate position.
16. Move the photogate to a new position approximately 6-7 cm further along the track. Measure and record this new position relative to the top of the track. Re-measure the track's angle.
17. Repeat steps 9-15 for this new gate position.
18. Repeat steps 16 – 17 until you have reached a position that is a little more than a cart's length from the bottom of the track. You may need to catch the cart at the bottom to prevent it from bouncing back through the gate for some of the later runs.

***Note: the accepted value for the acceleration of your cart is given by the equation: $a = g \cdot \sin\theta$, where $g = 9.81\ m \cdot s^{-2}$ and θ is the angle of the track's incline (use your averaged angle measurements)**

Due for this report:

Data collection and analysis (like you did for the Aluminum Density analysis—follow the same general guidelines)

As part of your summary statement at the end, please make sure to both state your cart's acceleration (and how you know), and calculate a % difference between your experimentally determined value and the accepted (expected) value for the acceleration.

Your report is due on November 21, 2018. Submit a final copy to www.turnitin.com, and bring in a final copy to class.