PHYSICS 4AL

EXPERIMENT 4: MOMENTUM AND IMPULSE

Terrence Ho | ID: 804793446
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T.A.: David Bauer
Lab Partners: Robathan Harries

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Discussion

Measured Values

The mass of the glider used in the experiment was 203 ± 0.5 g. The length of the flag 38 ± 0.5 mm. CHECK!

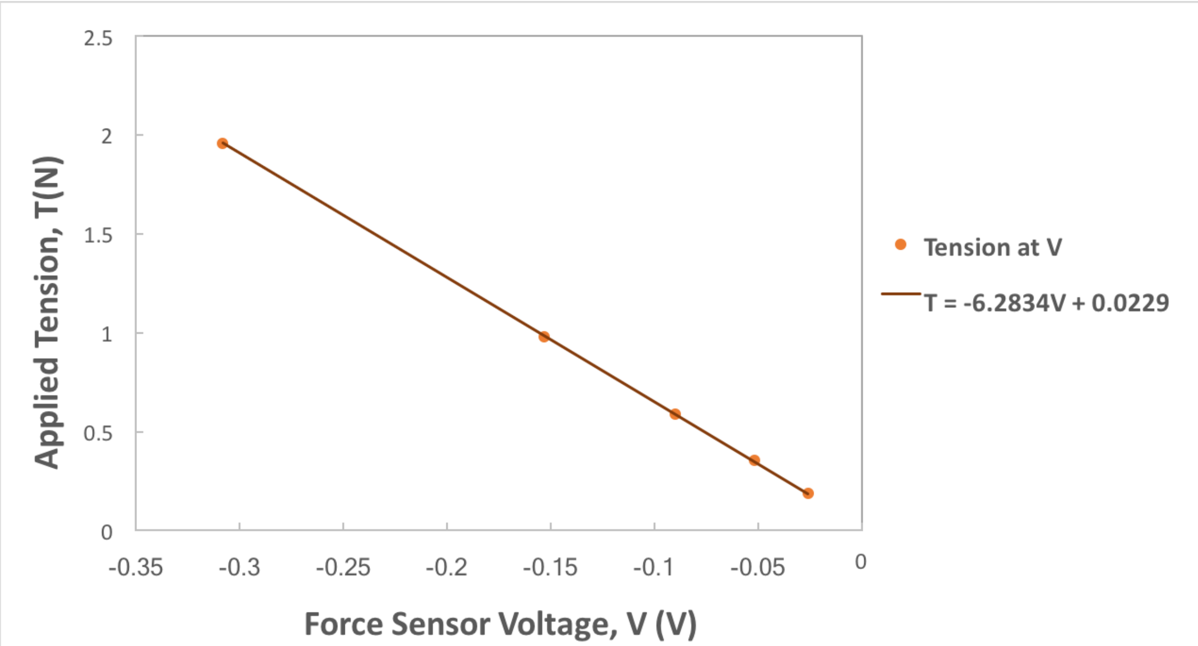

Figure 4.1 Voltage due to applied Tension. The best fit line has the equation $T = (-6.28 \pm 0.01)V + (0.023 \pm 0.002)$. The slope of the best fit line is the calibration constant: -6.28 ± 0.01 N/V.

Trial	Initial Velocity (m/s)	Final Velocity (m/s)
1	-0.207980 ±	0.082125
2	-0.171560 ±	0.077422

Table 4.1 Initial and final velocities recorded by the photogate for two trials.

Impulse Calculation - Method 1

Momentum, given by P, is the product of mass m and velocity v, or $P = mv$. The change in momentum is known as impulse, or $\Delta P = P_f - P_i = m(v_f - v_i)$. Using this formula and the mass of the glider, for trial one, the impulse $\Delta P_1 = \pm$. For trial two, the impulse $\Delta P_2 = \pm$.

Impulse Calculation - Method 2

Impulse can also be known as the force F over time interval t. This can be put into the form $\Delta P = \int_{t_i}^{t_f} F(t)dt$. We can approximate this impulse using Riemann sums, or $\Delta P \approx \Delta t \sum_{i=1}^{n} \bar{F}(t_i)$, where Δt is

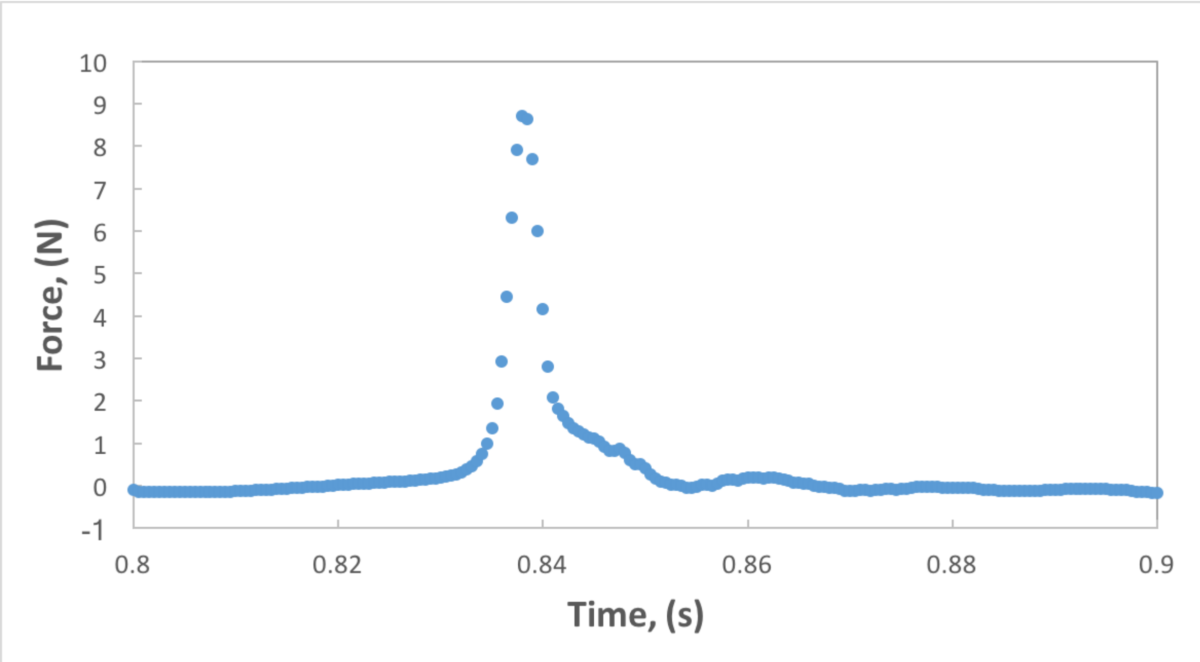

Figure 4.2

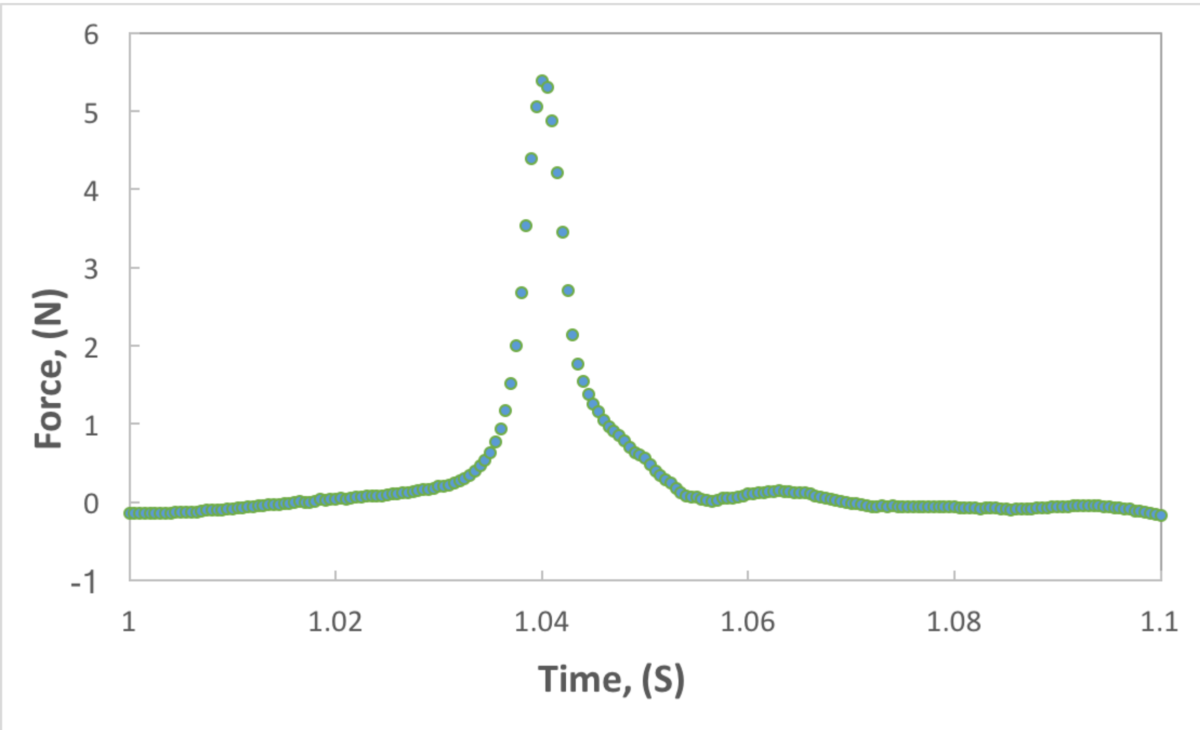

Figure 4.3

the time interval between each data point, and $\bar{F}(t_i)$ is the average force between t_i and t_{i+1}. For our numerical integration, Δt was 0.0005 s, and $\bar{F}(t_i) = \frac{F(t_i)+F(t_{i+1})}{2}$.

To obtain our impulse calculations, we multipled the voltage read by the force sensor by our calibration coefficient found previously in **Figure 4.1**, then subtracted the average background noise of the force sensor. Finding the range where the force detected went above zero (to signify the cart hitting the force sensor), we calculated the area under the curve with the formula involving Riemann sums derived previously. For Trial 1, $\Delta P_1 = \pm$, and for Trial 2, $\Delta P_2 = \pm$. The fractional uncertainty for the impulse is the same as the fractional uncertainty of the coefficient calibration.

Trial	Impulse (Method 1 Change in Momentum) (Ns)	Impulse (Riemann Sums) (Ns)

Table 4.2

Extra Credit

Presentation