

## Sample Lab Reports: **Excellent Lab Report**

### Impulse and Momentum

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**Purpose:** The purpose of this lab is to analyze the forces and changes in velocity of a cart attached to a string. A cart will be pushed along a track in one dimension, while a motion detector will plot the cart's distance and velocity vs. time. Simultaneously, a string is attached to the opposite end of the cart, and when it becomes taut, a force sensor will measure the force acting on the cart and plot a graph of force vs. time. By comparing the force exerted over some time interval to the change in momentum of the cart, one can test the impulse-momentum theorem.

**Background:** The law of conservation of momentum states that in the absence of an external net force, the momentum of a system will remain unchanged. Therefore, in order to change an object's momentum, an external net force must act on the system for some finite period of time. The impulse-momentum theorem states that the product of the average force acting on a system and the time over which it acts is equal to the change in momentum of the object. In equation form, this is:

$$\int f(t)dt = \bar{F}\Delta t = \Delta p = mv_f - mv_i \text{ (for constant mass)}$$

Essentially, this is the same as Newton's 2<sup>nd</sup> law, which states that an external net force will cause an acceleration directly proportional to and in the same direction as the net force. Using the LoggerPro program, one can find the change in momentum of a dynamics cart by analyzing the velocity vs. time graphs produced by a motion detector. Also, the impulse can be determined by measuring the area under the force vs. time curve created by the force sensor.

#### **Materials:**

Dynamics Cart and Track	LabPro Interface	PC w/ Loggerpro software
Motion Detector	Dual-Range Force Sensor	Clamp
String	Rubber Band	Mass Set

#### **Preliminary Questions:**

1. In a car collision, the driver's body must change speed from a high value to zero. This is true whether or not an airbag is used, so why use an airbag? How does it reduce injuries?