Student's Name: Student's Name:

_____ _____

Lab day & time: _____ Date: _____

Impulse and Momentum (M5) - Data Sheets

Activity 1: Inelastic Collision *(1 p.)*

First, make sure that the track is properly leveled.

Mass of dynamics (plunger) cart m_d = _____ ( )

Mass of collision cart m_c = _____ ( )

Total mass = $m_d + m_c$ = _____ ( )

Print a copy of the velocity vs. time graph.

	Before Collision	Before Collision	After Collision
	Dynamics Cart	Collision Cart	Both Carts
Velocity 1 ( )			
Velocity 2 ( )			
Velocity 3 ( )			
Velocity 4 ( )			
Velocity 5 ( )			
Average Velocity v ( )			
Momentum p ( )			
Total Momentum (both carts) p_T ( )			

Find the selected data points on the printout and clearly mark these points with a pen (for example, circle them).

The percentage of the momentum change (absolute value):

$|\ 100\%*(\ p_T$ after - p_T before) / p_T before $|\ =$ _____ (%)

Activity 2: Simulated Explosion *(1 p.)*

Mass of dynamics (plunger) cart m_d = _____( ) *(see Activity 1)*

Mass of collision cart m_c = _____ ( ) *(see Activity 1)*

	Before Explosion	Before Explosion	After Explosion	After Explosion
	Dynamics Cart	Collision Cart	Dynamics Cart	Collision Cart
Velocity 1 ( )				
Velocity 2 ( )				
Velocity 3 ( )				
Velocity 4 ( )				
Velocity 5 ( )				
Average Velocity ( )				
Momentum p ( )				
Total Momentum (both carts) p_T ( )				

What value of the total momentum would you expect after the "explosion"?

_____

Are there any external forces acting along in the horizontal direction of the track?

YES / NO _____

After explosion, both carts move with some velocity. Therefore, both have kinetic energy. What is the source of that kinetic energy?

_____

_____

_____

Activity 3: Elastic Collision *(0.5 p.)*

Mass of dynamics (plunger) cart m_d = _____( ) *(see Activity 1)*

Mass of collision cart m_c = _____( ) *(see Activity 1)*

Release the plunger from its locked position by pushing on the small tab located at the top of the bumper on the dynamics cart. Record data and **print** a copy of the velocity vs. time graph.

	Before Collision	Before Collision	After Collision	After Collision
	Dynamics Cart	Collision Cart	Dynamics Cart	Collision Cart
Velocity 1 ( )				
Velocity 2 ( )				
Velocity 3 ( )				
Velocity 4 ( )				
Velocity 5 ( )				
Average Velocity ( )				
Momentum p ( )				
Total Momentum (both carts) p_T ( )				

Find the selected data points on the printout and clearly mark these points with a pen (for example, circle them).

The percentage of the momentum change (absolute value):

$$\left|100\%*(p_T \text{ after} - p_T \text{ before}) / p_T \text{ before}\right| = \_\_\_\_\_ (\%)$$

Activity 4: Soft Collision and Impulse *(0.5 p.)*

Mass of the "Force Sensor" (model CI-6537) = 0.333 kg or 0.085 kg if you are using the "Economy Force Sensor" (model CI-6746).

Mass of the collision cart with the attached force sensor:

$m_{coll.\ cart\ with\ the\ force\ sensor}$ = _____ ( )

	Before Collision	**After Collision**
Velocity ( )		
Momentum ( )		

Change of momentum during the collision (= impulse):

$|p_{change}| = |p_{after} - p_{before}|$ = _____ ( )

Width of the force vs. time peak (i.e., how long does the collision last?)

Δt = _____ (ms)

Maximum force (max. of the force vs. time graph) = _____ ( )

What was the maximum value of acceleration experienced by the collision cart? How many times this is larger than the acceleration due to gravity? *Hint:* $F = m_{coll.\ cart\ with\ the\ force\ sensor} * a$

a = _____ (m/s^2) a/g = _____

Activity 5: Hard Collision *(0.5 p.)*

Proceed in a similar way as for *Activity* 4, but this time use a small rubber bumper instead of the spring. **Print** the force vs. time graph.

Width of the force vs. time peak (i.e., how long does the collision last?)

Δt = _____ (ms)

Maximum force (max. of the force vs. time graph) = _____ ( )

What was the <u>maximum</u> value of acceleration experienced by the collision cart? How many times this is larger than the acceleration due to gravity? *Hint:* $F = m_{coll.\ cart\ with\ the\ force\ sensor} * a$

a = _____ (m/s^2) a/g = _____

Describe the difference between soft and hard collisions.

_____

_____

_____

_____

_____

_____

Using the small screwdriver, **unscrew** the force probe from the top of the collision cart.

Remove the rubber bumper from the front of the force sensor and attach the **spring** to the force sensor.

Complete the lab report and return it to the lab TA.