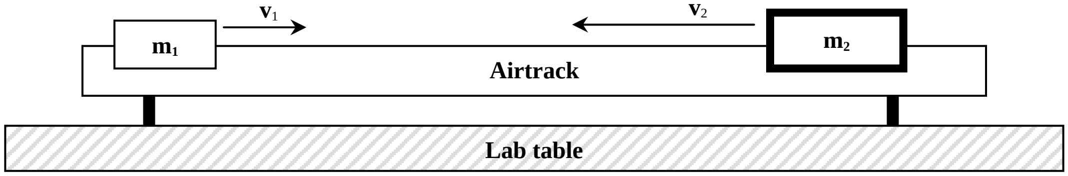
Lab #6 **Momentum—Collisions and Explosions**
Physics 111 Name: ________________

I. External and internal forces

Consider two aircarts initially sliding along an airtrack towards each other at ***constant speed*** with ***no*** friction. Their relative masses and velocities are **not** the same, as indicated by the arrows below.



[12 pts] In the spaces below, draw the free body diagrams for each aircart at the three instances described. Assume $m_2 > m_1$. Be ***precise*** with your drawings.

Before the collision, moving towards each other at constant speed	At the moment of collision	After the collision, moving away from each other at constant speed
● ●	● ●	● ●

Newton's 2nd Law can be written as $\Delta\vec{p}_{system} = \vec{F}_{net,\ external}\Delta t$. Only forces external to the system change the overall momentum of the system. For example, friction by a road on a pair of crashed, bumper-locked cars will rob the system (the two cars) of their momentum and cause them to skid to a stop.

[12 pts] Classify all of the forces on your free body diagrams as either internal or external forces.

Before collision	During collision	After collision
Internal:	Internal:	Internal:
External:	External:	External:

II. Measurement—elastic collisions

- Place one aircart on the track between the two photogates—this aircart should be ***stationary***. Add 100g to another aircart. Send this ***heavier*** aircart to crash into the stationary one.
- Place the banana plugs with the ***rubber bands*** attached on the "collision" end of each aircart.
- Measure the time for the aircarts to pass through the photogates before **and** after the collision.

Lab #6 **Conservation of Momentum**:

Physics 111 Name: ___________________

Use your data from the ***elastic*** collision to answer the following questions.

Aircart 1	**Aircart 2**
m_1 = kg	m_2 = kg
$t_{1,i}$ = sec	$t_{2,i}$ = sec
$t_{1,f}$ = sec	$t_{2,f}$ = sec

width w of flag on aircart:

w = ____________

(i) [6 pts] Calculate the initial and final velocity vectors for each aircart. Include the correct signs.

Aircart 1	**Aircart 2**
$v_{1,i}$ =	$v_{2,i}$ =
$v_{1,f}$ =	$v_{2,f}$ =

(ii) [4 pts] Determine the initial ***total*** momentum vector for the ***system*** consisting of ***both*** aircarts. Be sure to include the correct signs throughout.

(iii) [4 pts] Determine the final ***total*** momentum vector for the ***system*** consisting of ***both*** aircarts.

(iv) [4 pts] Was the momentum of the system conserved during the course of this ***elastic*** collision? Justify your answer with ***numbers***.

(v) [8 pts] Was the kinetic energy of the system conserved during this ***elastic*** collision? Justify your answer by calculating relevant ***numbers*** and then answering the question.

III. Measurement—inelastic collisions

Now place the banana plugs with the ***velcro*** attached on the forward end of each aircart. This will ensure that the collision is ***inelastic***. Again have the lighter aircart stationary, and send the heavier one crashing into the lighter one.

Aircart 1	**Aircart 2**
m_1 = kg	m_2 = kg
$t_{1,i}$ = sec	$t_{2,i}$ = sec
$t_{1,f}$ = sec	$t_{2,f}$ = sec

width w of flag on aircart:

w = ____________

(vi) [6 pts] Calculate the initial and final velocity vectors for each aircart. Include the correct signs.

Aircart 1	**Aircart 2**
$v_{1,i}$ =	$v_{2,i}$ =
$v_{1,f}$ =	$v_{2,f}$ =

(vii) [4 pts] Determine the initial ***total*** momentum vector for the ***system*** consisting of ***both*** aircarts. Be sure to include the correct signs throughout.

(viii) [4 pts] Determine the final ***total*** momentum vector for the ***system*** consisting of ***both*** aircarts.

(ix) [4 pts] Was the momentum of the system conserved during the course of this ***inelastic*** collision? Justify your answer with ***numbers***.

(x) [8 pts] Was the kinetic energy of the system conserved during this ***inelastic*** collision? Justify your answer by calculating relevant ***numbers*** and then answering the question.

IV. Impulse ($\Delta\vec{p}$) and recoil in explosions

[12 pts] In this part of the lab, you will have to figure out some things on your own. This is not a “cookbook” setup.

Go out the front of the building to where we have the air cannon set up. We have some instruments set up whose numbers should allow you to calculate the speed with which a projectile leaves the end of the air cannon.

You will have to ask for the specific numbers that you need. We will not simply list the numbers that you need to get from us.

List your relevant data below in a clear format. Show all of your work below for calculating the speed of the projectile as it comes out of the muzzle.