# Collision Lab 2009-10

Up to now we have been describing the motion of one object. Now we start to consider two objects colliding with each other. We want to be able to describe the motion of the two objects after a collision if we know their motions before the collision. We are trying to make **predictions**. For now, we will limit ourselves to straight-line (one-dimensional) motion and "inelastic" collisions, where the two objects stick to each other and travel together after the collision.

In this lab, you will be given a number of collision situations. You will make predictions about what you think the results of the collision will be. Your choices for possible resulting magnitudes for your velocities will be :
***v*, 2*v*, 3*v*, 1/2*v*, 1/3*v*, 1/4*v*, 2/3*v*, 3/4*v***

## *Part I: Predictions - Data Table #1,2,3(Rough Draft)*

**(a) One moving, one at rest**

For each of the situations listed in the table here, you will be colliding a blue cart moving at speed *v* into a red cart at rest. The two carts will stick together after the collision. In some of the situations, the carts are identical; in others, the carts have different masses. On your own paper, draw each cart **before** and **after** they collide and stick together. **All Data tables in this lab should follow this same format**.

| Table 9-1 | Before | | After | |
|---|---|---|---|---|
| | Blue Cart | Red Cart | Blue Cart | Red cart |
| Collision 1 | | | | |
| Collision 2 | | | | |
| Collision 3 | | | | |
| Collision 4 | | | | |
| Collision 5 | | | | |

Your predictions should be written in terms of the initial speed *v* of the blue cart; that is, if you think one of the carts will be going three times its original speed, you would write down *3v*. If a cart is twice the mass, draw it twice as big. Draw arrows inside the carts to indicate their directions.

The following chart shows you the mass of each cart for each situation:

| Blue Cart | Red Cart |
|---|---|
| *m* | *m* |
| *m* | *2m* |
| *m* | *3m* |
| *2m* | *m* |
| *3m* | *m* |

Once you are done with situation **a**, repeat the same pattern for situation **b** and **c**. Situation **b** and **c** will each have their own data table. **Data Table 9-2** and **Data table 9-3** respectively.

**(b) Both moving, stopping after colliding**

Now let's consider a different question. For the same five mass combinations listed above, a blue cart will be moving at speed *v*. You will push a red cart in the opposite direction at *just the right speed* so that the two carts stick together and come to a complete stop. (It will obviously take some practice.) On your own paper, write down your predictions for the speed with which the red cart will have to be moving in order to have both carts come to a stop.

**(c) Initially at rest, pushing off each other**

What about a collision in reverse? Called an "explosion", you'll start two carts at rest right next to each other, then release the spring-loaded plunger *on the red cart* so that carts push off of each other in opposite directions. On your paper, write down your predictions for the same five mass combinations listed above. (Again, write down your predictions in terms of *v*, the speed of one of the carts- or in other words; How fast will one car be going compared to the other.)

## *Part II: Test Your Predictions - Data Table #4, 5, 6 (Rough Draft)*

Using fairly slow speeds, test your predictions and record your observations for each cart in your data table. Never let a cart bang into the stoppers on the tracks. Make sure 2 people in your group are in charge of gently catching the carts and making them stop. Some of the velocity comparisons are hard to see. For instance **v** and 3/4**v**. If you had access to two tracks, can you think of a way to distinguish between two velocities that are close to each other in magnitude?

## *Part III:*

Make a brief comment about each collision for all 3 situations. Make the comments **brief ,but powerful** (10 words or less). What strikes you most about the impact after a certain collision? What causes each car's motion to change or not change. Feel free to compare situations during your comments. Write your comments using the following format:

a)

| Collision | Comment |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

And so on...

## *Part IV: Locking down an idea - Data Table #7, 8, 9 (Rough Draft)*

Represent each cart as a product of its mass and velocity. For example a cart of mass 2m that is traveling 2v should be written 4mv. Do this for all 3 situations using the Data Table format suggested above. **What relationships do you see?** Be careful not to stray from descriptions into explanations. We will worry about **why** these things happen soon. For now, all we are trying to do is describe **what** happens. As soon as you find yourself saying something that includes "this happens because…", stop!

Our goal in this lab is to be able to make predictions about the motion of two objects after they collide if we know their motion before they collide. What we want is to be able to make **one general statement** that will cover all the cases you tested in Part II (and more). This should be in the form of a rule or formula: if the carts are doing X, then Y will happen.

Now try to write down one general rule that applies to all (inelastic) collisions that will allow us to predict the motion of two carts after they collide.