Lab 9-2: 1D Momentum

Purpose: 1. To determine if momentum is conserved in a variety of one-dimensional interactions.
2. To examine how energy is conserved in those situations.

Materials:

1 track	1 cart with plunger	1 cart with no plunger
2 500 gram bars	2 motion detectors	1 LabQuest

Procedure:

1. Setup the carts and motion detectors as shown in each diagram. Make sure the track is level. Startup Logger Pro and open the file "18 Momentum Energy Coll" (this is set up nicely for two motion detectors.) Determine which motion detector is **1** and which is **2**.

2. For all situations, record the masses of the carts. Determine and record the velocities of each cart before and after each interaction. (This is probably best done using the *Examine* tool and inspecting the velocity graphs just before and just after each interaction. Include any negative signs! Each situation has two or three slightly different trials, so pay attention.

3. For all situations, determine if momentum was conserved (i.e. is the total initial momentum the same as the total final momentum?) Show the calculations.

Data:

Situation 1: Explosion

A compressed spring is released – causing the two carts to push apart. Use a meter stick to tap the button to release the spring.

both carts initially at rest

Cart B with 1 Bar

Cart A	Mass:	Initial velocity:	Final velocity:
Cart B	Mass:	Initial velocity:	Final velocity:

Cart B with 2 Bars

Cart A	Mass:	Initial velocity:	Final velocity:
Cart B	Mass:	Initial velocity:	Final velocity:

Was momentum conserved? Show your calculations.

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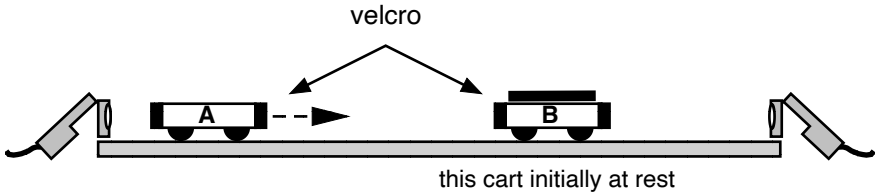
Situation 2: Collision with Velcro
A cart is moving along and then collides and sticks to a second cart initially at rest.



Mass of Cart A < Mass of Cart B

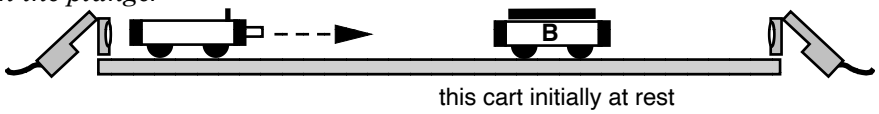
Cart A	Mass:	Initial velocity:	Final velocity:
Cart B	Mass:	Initial velocity:	Final velocity:

Mass of Cart A > Mass of Cart B

Cart A	Mass:	Initial velocity:	Final velocity:
Cart B	Mass:	Initial velocity:	Final velocity:

Was momentum conserved? Show your calculations.

Situation 3: Collision with Plungers
A cart is moving along and then collides and bounces off a second cart initially at rest. The twoccarts interact through the plunger



Mass of Cart A < Mass of Cart B

Cart A	Mass:	Initial velocity:	Final velocity:
Cart B	Mass:	Initial velocity:	Final velocity:

Mass of Cart A > Mass of Cart B

Cart A	Mass:	Initial velocity:	Final velocity:
Cart B	Mass:	Initial velocity:	Final velocity:

Was momentum conserved? Show your calculations.

Situation 4: Collision with Magnets

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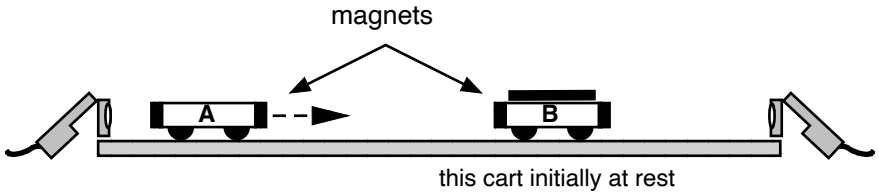
A cart is moving along and then collides and bounces off a second cart initially at rest. The two carts do not physically touch – they push apart because of strong magnets in each cart.



Mass of Cart A < Mass of Cart B

Cart A	Mass:	Initial velocity:	Final velocity:
Cart B	Mass:	Initial velocity:	Final velocity:

Mass of Cart A > Mass of Cart B

Cart A	Mass:	Initial velocity:	Final velocity:
Cart B	Mass:	Initial velocity:	Final velocity:

Head-On Collision – (give both carts a slight push towards each other)
Either: two carts with the same mass and different speeds OR two different masses and same speeds

Cart A	Mass:	Initial velocity:	Final velocity:
Cart B	Mass:	Initial velocity:	Final velocity:

Copy and Paste the Velocity vs Time graph for this head-on collision into question 6 below.

Was momentum conserved? Show your calculations.

Follow up Questions:

Situation 1: Explosion

1. Was kinetic energy conserved in this situation? Show your calculations and then make a qualitative argument about what happened to energy in this interaction.

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2. The momentums of each cart were (hopefully) equal and opposite after the explosion. What was true about the kinetic energies of the two carts? Does this make sense?

Situation 2: Collision with Velcro

3. Was kinetic energy conserved in this situation? Show your calculations and then make a qualitative argument about what happened to energy in this interaction.

Situation 3: Collision with Plunger

4. Was kinetic energy conserved in this situation? Show your calculations and then make a qualitative argument about what happened to energy in this interaction.

Situation 4: Collision with Magnets

5. Was kinetic energy conserved in this situation? Show your calculations and then make a qualitative argument about what happened to energy in this interaction.

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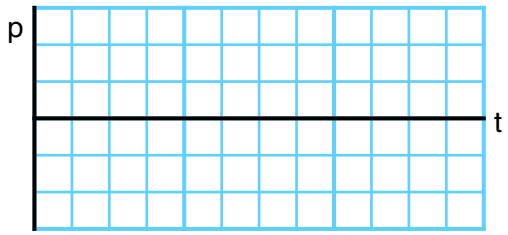
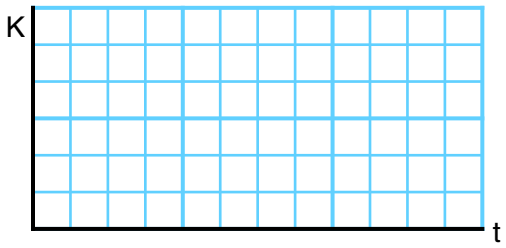
6. Paste the Velocity vs Time graph for the head-on collision below:

PASTE VELOCITY GRAPH HERE

7. Based on your velocity graph, sketch the Momentum vs time and the Kinetic Energy vs time graphs for your collision. Please use different colors for each object.





8. Now sketch the Total Momentum vs time and the Total Kinetic Energy vs time graphs for your collision. Be careful, this can be tricky!