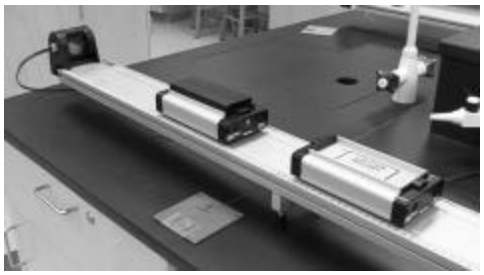
**Honors Physics Lab**
**Elastic Collisions - Mr. Ward – 03-01-04**

_____

Name Period



**PROCEDURE:**

1. Open Data Studio and the file "Collisions".
2. Number the two carts $m_1$ and $m_2$ on the masking tape. Find the mass of each cart and RECORD it in the data table and also on tape on the cart.
3. Number the two bars $m_3$ and $m_4$ on the masking tape. Find the mass of each bar and RECORD it in the data table and also on tape on the bar.
4. Notice there is a silver letter 'M' on one end of each cart. This is the magnetic end. Place the two carts, empty, with the 'Ms' facing each other on the track. Gently push one toward the other and watch them repel. If you push them harder, you may hear a slight 'tic' sound as the Velcro pieces catch and release. This is to be avoided in this lab. If the carts stick even slightly, the collisions are not completely elastic.
5. Place one cart so it is about 30 cm from the left motion sensor. This will be the incident car, which will be indicated by **red** data points on the velocity graph.
6. Place the other cart so it is about 90 cm from the left motion sensor. This will be the target car, which will be indicated by **green** data points on the velocity graph.
7. Click Start and push the red incident car toward the green target car. After the velocity plots have leveled off, click Stop. Catch the green car before it hits the right sensor.
8. Click on the red legend. Click on the smart cursor. Move the cursor to the last red data point before the collision. RECORD the velocity.
9. Move the smart cursor to the first red point after the collision is over. RECORD the velocity. Move the cursor out of the way. You don't have to turn it off.
10. Now click on the green legend. Click on the smart cursor. Move the cursor to the last green data point before the collision. RECORD the velocity.
11. Move the smart cursor to the first green point after the collision is over. RECORD the velocity as positive because it is moving to the right. Ignore the negative sign. Move the cursor out of the way. You don't have to turn it off. Make three runs.
12. Next repeat steps 5-11 for a one-passenger incident car colliding with an empty target car. Make three runs.
13. Next repeat steps 5-11 for a two-passenger incident car colliding with an empty target car. Make three runs.
14. Next repeat steps 5-11 for an empty incident car colliding with a one-passenger target car. Record velocity to the left as negative. Make three runs.
15. Next repeat steps 5-11 for an empty incident car colliding with a two-passenger target car. Record velocity to the left as negative. Make three runs.

**CALCULATIONS:**

13. Calculate and RECORD the momentums $m_1v_1$, $m_2v_2$, $m_1v_{1f}$, and $m_2v_{2f}$ for each run in each trial.
14. Come up with a momentum rule for elastic collisions. Write the rule in the space provided.
15. Test your rule by calculating a % error and RECORD it. You will need to determine what is the accepted value and what is the experimental value.

**DATA TABLE for Elastic Collisions**

**$m_1$ of red cart 1 (g) = _____ $m_2$ of green cart 2 (g) = _____**

**$m_3$ of bar 1 (g) = _____ $m_4$ of bar 2 (g) = _____**

**Trial 1 – empty cart hitting empty cart**

| Run | $m_1$ (g) | $m_2$ (g) | $v_{1i}$ (m/s) | $v_{2i}$ (m/s) | $v_{1f}$ (m/s) | $v_{2f}$ (m/s) |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | " | " | | | | |
| 3 | " | " | | | | |

**Trial 2 – one-passenger cart hitting empty cart**

| Run | $m_1$ (g) | $m_3$ (g) | $m_2$ (g) | $v_{1i}$ (m/s) | $v_{2i}$ (m/s) | $v_{1f}$ (m/s) | $v_{2f}$ (m/s) |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | " | " | " | | | | |
| 3 | " | " | " | | | | |

**Trial 3 – two-passenger cart hitting empty cart**

| Run | $m_1$ (g) | $m_3$ (g) | $m_4$ (g) | $m_2$ (g) | $v_{1i}$ (m/s) | $v_{2i}$ (m/s) | $v_{1f}$ (m/s) | $v_{2f}$ (m/s) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | " | " | " | " | | | | |
| 3 | " | " | " | " | | | | |

**Trial 4 – empty cart hitting one-passenger cart**

| Run | $m_1$ (g) | $m_2$ (g) | $m_3$ (g) | $v_{1i}$ (m/s) | $v_{2i}$ (m/s) | $v_{1f}$ (m/s) | $v_{2f}$ (m/s) |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | " | " | " | | | | |
| 3 | " | " | " | | | | |

**Trial 5 – empty cart hitting two-passenger cart**

| Run | $m_1$ (g) | $m_2$ (g) | $m_3$ (g) | $m_4$ (g) | $v_{1i}$ (m/s) | $v_{2i}$ (m/s) | $v_{1f}$ (m/s) | $v_{2f}$ (m/s) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | " | " | " | " | | | | |
| 3 | " | " | " | " | | | | |

**RESULTS TABLE for Elastic Collisions**

**Trial 1 – empty cart hitting empty cart**

| Run | $p_{1i}$ (kg m/s) | $p_{2i}$ (kg m/s) | $p_{1f}$ (kg m/s) | $p_{2f}$ (kg m/s) | | | % error |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |

**Trial 2 – one-passenger cart hitting empty cart**

| Run | $p_{1i}$ (kg m/s) | $p_{2i}$ (kg m/s) | $p_{1f}$ (kg m/s) | $p_{2f}$ (kg m/s) | | | % error |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |

**Trial 3 – two-passenger cart hitting empty cart**

| Run | $p_{1i}$ (kg m/s) | $p_{2i}$ (kg m/s) | $p_{1f}$ (kg m/s) | $p_{2f}$ (kg m/s) | | | % error |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |

**Trial 4 – empty cart hitting one-passenger cart**

| Run | $p_{1i}$ (kg m/s) | $p_{2i}$ (kg m/s) | $p_{1f}$ (kg m/s) | $p_{2f}$ (kg m/s) | | | % error |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |

**Trial 5 – empty cart hitting two-passenger cart**

| Run | $p_{1i}$ (kg m/s) | $p_{2i}$ (kg m/s) | $p_{1f}$ (kg m/s) | $p_{2f}$ (kg m/s) | | | % error |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |

**What did you learn? What is the rule you discovered? Use the blank columns above. Put in proper headings and fill in results.**