Lab 7 : Momentum

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**Objective :** To quantify the momentum relationships between elastic, inelastic, and explosive collisions

**Part 1 (Elastic Collisions) :**

**Data :**

| M1 (g) | M2 (g) | V1i (m/s) | V2i (m/s) | V1f (m/s) | V2f (m/s) | (V1i-V2f) = loss |
| --- | --- | --- | --- | --- | --- | --- |
| 280 | 280 | 0.51 | 0.00 | 0.00 | 0.50 | 0.010 |
| 280 | 280 | 0.362 | 0.00 | 0.00 | 0.125 | 0.237 |
| 280 | 280 | 0.35 | 0.00 | 0.00 | 0.19 | 0.54 |
| 280 | 280 | 0.483 | 0.00 | 0.00 | 0.28 | 0.203 |
| 280 | 280 | 0.291 | 0.00 | 0.00 | 0.122 | 0.169 |
| Mean: | | 1.7632 | 0 | 0 | 1.1194 |  |
| Kinetic Energy | | 435.2423936 | 0 | 0 | 175.4278904 |  |

| M1 (g) | M2 (g) | V1i (m/s) | V2i (m/s) | V1f (m/s) | V2f (m/s) | [M1(Vi-Vf) - M2(Vi-Vf)] loss |
| --- | --- | --- | --- | --- | --- | --- |
| 480 | 280 | 0.50 | 0.00 | 0.147 | 0.630 | 345.84 |
| 480 | 280 | 0.23 | 0.00 | 0.119 | 0.212 | 112.64 |
| 480 | 280 | 0.384 | 0.00 | 0.229 | 0.366 | 176.88 |
| 480 | 280 | 0.475 | 0.00 | 0.286 | 0.477 | 224.28 |
| 480 | 280 | 0.26 | 0.00 | 0.158 | 0.235 | 114.76 |

| M1 (g) | M2 (g) | V1i (m/s) | V2i (m/s) | V1f (m/s) | V2f (m/s) | [M1(vi-vf) - M2(vi-vf)] loss |
| --- | --- | --- | --- | --- | --- | --- |
| 280 | 480 | 0.497 | 0.00 | 0.013 | 0.174 | 219.04 |
| 280 | 480 | 0.33 | 0.00 | 0.055 | 0.094 | 122.96 |
| 280 | 480 | 0.361 | 0.00 | 0.067 | 0.095 | 127.92 |
| 280 | 480 | 0.519 | 0.00 | 0.069 | 0.142 | 194.16 |
| 280 | 480 | 0.33 | 0.00 | 0.019 | 0.105 | 137.48 |

**Analysis :**

1. **How does the total momentum of the system after the collision compare with that before the collision? Do your results agree with your expectation? Explain.** In each of the different trials, there is a significant loss in energy, this is because the experiment was not a “closed system”. There are many other factors that decrease the overall energy in the system, such as friction, sound, heat transfer, and other energy transactions.
2. **Calculate the total kinetic energy of the system both before and after each of the collisions. How do these quantities compare?** The total kinetic energy loses a lot of energy in the first trials, starting at 435N, and ending at 175N, this is probably due to the factors mentioned.

**Part 2 (Inelastic Collisions) :**

**Data :**

| M1 (g) | M2 (g) | V1i (m/s) | V2i (m/s) | V1f (m/s) | V2f (m/s) | V1i - (V1f+V2f) = loss due to friction |
| --- | --- | --- | --- | --- | --- | --- |
| 280 | 280 | 0.53 | 0.00 | 0.261 | 0.260 | 0.009 |
| 280 | 280 | 0.285 | 0.00 | 0.102 | 0.102 | 0.081 |
| 280 | 280 | 0.281 | 0.00 | 0.119 | 0.125 | 0.037 |
| 280 | 280 | 0.245 | 0.00 | 0.10 | 0.111 | 0.034 |
| 280 | 280 | 0.451 | 0.00 | 0.201 | 0.216 | 0.034 |

| M1 (g) | M2 (g) | V1i (m/s) | V2i (m/s) | V1f (m/s) | V2f (m/s) | [M1(Vi-Vf) - M2(Vi-Vf)] loss |
| --- | --- | --- | --- | --- | --- | --- |
| 480 | 280 | 0.338 | 0.00 | 0.226 | 0.217 | 114.52 |
| 480 | 280 | 0.390 | 0.00 | 0.264 | 0.267 | 135.24 |
| 480 | 280 | 0.363 | 0.00 | 0.250 | 0.263 | 127.88 |
| 480 | 280 | 0.783 | 0.00 | 0.571 | 0.541 | 253.24 |
| 480 | 280 | 0.302 | 0.00 | 0.204 | 0.217 | 107.80 |

| M1 (g) | M2 (g) | V1i (m/s) | V2i (m/s) | V1f (m/s) | V2f (m/s) | [M1(Vi-Vf) - M2(Vi-Vf)] loss |
| --- | --- | --- | --- | --- | --- | --- |
| 780 | 280 | 0.328 | 0.00 | 0.231 | 0.225 | 138.66 |
| 780 | 280 | 0.371 | 0.00 | 0.245 | 0.227 | 161.84 |
| 780 | 280 | 0.426 | 0.00 | 0.332 | 0.310 | 160.12 |
| 780 | 280 | 0.254 | 0.00 | 0.189 | 0.187 | 103.06 |
| 780 | 280 | 0.361 | 0.00 | 0.278 | 0.273 | 141.18 |

**Analysis :**

1. **How does the total momentum of the system after the collision compare to that before the collision? Is the agreement in these inelastic collisions as good as that in the elastic collisions? Try to account for any differences.**

***T***he loss in each of the trials of the inelastic collisions is about the same as elastic collisions.

1. **Calculate the total kinetic energy of the system both before and after each of the collisions. How do these quantities compare?**

Trial 1 :

Trial 2 :

Trial 3 :

1. **We have used “elastic” to describe collisions in which the objects bounce, and “inelastic” to describe collisions in which the objects stick. Based on your comparison of the kinetic energy before and after the collisions, provide a more conceptual definition of these descriptors.**

Elastic could be more accurately described as saying that after the collision, one object moves in the opposite direction of the other. Inelastic is the opposite, where both objects move in the same direction after the collision.

**Part 3 (Explosive Collisions) :**

| M1 (g) | M2 (g) | V1 (m/s) | V2 (m/s) | KE1 | KE2 | △KE |
| --- | --- | --- | --- | --- | --- | --- |
| 280 | 280 | 0.518 | -0.525 | 37.57 | 38.59 | 1.02 |
| 280 | 280 | 0.434 | -0.486 | 26.37 | 33.07 | 6.70 |
| 280 | 280 | 0.466 | -0.532 | 30.40 | 39.62 | 9.22 |

**Analysis :**

1. **How does KE (1/2mv^2) of Cart 1 compare to Cart 2?** The KE we measured for Cart 1 always seemed to be fairly lower than the KE we measured for Cart 2. While the △KE seemed to vary amongst trials, it is evident that the KE we measured for Cart 1 was always lower than the KE we measured for Cart 2.
2. **What is the difference (in terms of △KE)?** In terms of △KE, there was an average value of 5.65 for the difference in KE from Cart 1 to Cart 2
3. **How would you explain the increase of KE in Cart 2 over Cart 1?** Cart 2 has a greater KE value because Cart 1 has the “explosive” mechanism that repels Cart 2. With that, because this mechanism on Cart 1 repels Cart 2, it ends up giving a higher velocity to Cart 2, which then ultimately leads to a higher KE value.

**Conclusion :**

For elastic collisions, the loss of momentum increased as we added mass to either cart. For inelastic collisions, the loss of momentum increases as the mass on either cart increases, signifying that the loss of momentum is inversely proportional to the mass.