PHYS 123, Lab 9 Questions

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(a) For the two experiments, create data tables for the different cart masses (M1, M2), the initial cart velocities, the final velocities, the initial and final momentums and kinetic energies. Give a brief description of the collisions.

**Part 1:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **m1 (kg)** | **m2 (kg)** | **v1 → (m/s)** | **v2 → (m/s)** | **v1 ← (m/s)** |
| 0.257 | 0.257 | 0.62 | 0.47 | 0.44 |
| 0.257 | 0.257 | 1.03 | 0.67 | 0.62 |
| 0.257 | 0.257 | 1.03 | 0.67 | 0.62 |
| 0.297 | 0.257 | 0.82 | 0.63 | 0.51 |
| 0.297 | 0.257 | 0.97 | 0.69 | 0.58 |
| 0.297 | 0.257 | 0.73 | 0.56 | 0.47 |
| 0.257 | 0.297 | 0.84 | 0.56 | 0.47 |
| 0.257 | 0.297 | 1.13 | 0.62 | 0.62 |
| 0.257 | 0.297 | 1.15 | 0.62 | 0.61 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **m1v1** | **m1v1'** | **m2v2** | **m2v2'** | **Pi (both)** | **Pf (both)** | **Ki (m1)** | **Ki (m2)** | **Kf (m1)** | **Kf (m2)** | **Ki (both)** | **Kf (both)** |
| 0.16 | 0.11 | 0 | 0.12 | **0.16** | **0.23** | 0.05 | 0 | 0.02 | 0.03 | **0.05** | **0.05** |
| 0.26 | 0.16 | 0 | 0.17 | **0.26** | **0.33** | 0.14 | 0 | 0.05 | 0.06 | **0.14** | **0.11** |
| 0.26 | 0.16 | 0 | 0.17 | **0.26** | **0.33** | 0.14 | 0 | 0.05 | 0.06 | **0.14** | **0.11** |
| 0.24 | 0.15 | 0 | 0.16 | **0.24** | **0.31** | 0.1 | 0 | 0.04 | 0.05 | **0.1** | **0.09** |
| 0.29 | 0.17 | 0 | 0.18 | **0.29** | **0.35** | 0.14 | 0 | 0.05 | 0.06 | **0.14** | **0.11** |
| 0.22 | 0.14 | 0 | 0.14 | **0.22** | **0.28** | 0.08 | 0 | 0.03 | 0.04 | **0.08** | **0.07** |
| 0.22 | 0.12 | 0 | 0.17 | **0.22** | **0.29** | 0.09 | 0 | 0.03 | 0.05 | **0.09** | **0.08** |
| 0.29 | 0.16 | 0 | 0.18 | **0.29** | **0.34** | 0.16 | 0 | 0.05 | 0.06 | **0.16** | **0.11** |
| 0.3 | 0.16 | 0 | 0.18 | **0.3** | **0.34** | 0.17 | 0 | 0.05 | 0.06 | **0.17** | **0.11** |

**Collisions**: When m1=m2, m1 stopped during the collision and m2 continued at same speed. When m1>m2, m1 continued in direction of m2, but with less speed. When m1<m2, m1 continued in the opposite direction of m2, but with less speed.

**Part 2:**

|  |  |  |  |
| --- | --- | --- | --- |
| m1 (kg) | m2 (kg) | v1 → (m/s) | v2 → (m/s) |
| 0.257 | 0.257 | 1.17 | 0.54 |
| 0.257 | 0.257 | 1.07 | 0.5 |
| 0.257 | 0.257 | 1.19 | 0.56 |
| 0.297 | 0.257 | 1.18 | 0.52 |
| 0.297 | 0.257 | 0.83 | 0.3 |
| 0.297 | 0.257 | 0.99 | 0.38 |
| 0.257 | 0.297 | 1.31 | 0.58 |
| 0.257 | 0.297 | 0.9 | 0.31 |
| 0.257 | 0.297 | 1.31 | 0.57 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Pi (m1)** | **Pi (m2)** | **Pf (both)** | **Ki (m1)** | **Ki (m2)** | **Kf (both)** |
| 0.3 | 0 | 0.28 | 0.18 | 0 | 0.07 |
| 0.27 | 0 | 0.26 | 0.15 | 0 | 0.06 |
| 0.31 | 0 | 0.29 | 0.18 | 0 | 0.08 |
| 0.35 | 0 | 0.29 | 0.21 | 0 | 0.07 |
| 0.25 | 0 | 0.17 | 0.1 | 0 | 0.02 |
| 0.29 | 0 | 0.21 | 0.15 | 0 | 0.04 |
| 0.34 | 0 | 0.32 | 0.22 | 0 | 0.09 |
| 0.23 | 0 | 0.17 | 0.1 | 0 | 0.03 |
| 0.34 | 0 | 0.32 | 0.22 | 0 | 0.09 |

**Collisions**: When m1 collided with m2, they both stuck together and continued at the same velocity.

*(b) Explain if momentum and kinetic energy are conserved in the collisions. What are the sources of error?*

Momentum is conserved in both cases, however the final momentums are slightly different for both cases because of factors such as friction or the incline of the air track. In the elastic collision, the kinetic energy is conserved, while that is not true for the inelastic collision, as seen from the data. There is a slight different between the initial and final kinetic energies for the first experiment due to the factors stated previously.

*(c) Determine if the collisions are perfectly elastic or inelastic by using the concept of the coefficient of restitution.*

**Part 1:**

The collisions were elastic, but not perfectly elastic, since the coefficient of restitution is 0< e <1.

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| --- |
| **e (Coefficient of Restitution)** |
| 0.71 |
| 0.6 |
| 0.6 |
| 0.62 |
| 0.6 |
| 0.64 |
| 0.56 |
| 0.55 |
| 0.53 |

**Part 2:**

The collisions were inelastic as the coefficient of restitution is 0.

|  |
| --- |
| **e (Coefficient of Restitution)** |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |