PHY1002 Physics Laboratory
Short Report

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Group:	8	Date of Experiment:	Nov. 9th, 2021

Experiment 3. Conservation of Momentum

1. Calculate the initial and the final momentum of the system for the collisions below:
   a) Completely Inelastic Collision for both equal mass carts and unequal mass carts

   Equal Mass Carts Case:

$$p_{\text{initial}} = 0.26529kg \times 0.313m/s + 0.27429kg \times 0m/s$$
$$= (8.304 \pm 0.001) \times 10^{-2} kg \cdot m/s$$
$$p_{\text{final}} = 0.26529kg \times 0.143m/s + 0.27429kg \times 0.143m/s$$
$$= (7.716 \pm 0.001) \times 10^{-2} kg \cdot m/s$$

   Unequal Mass Carts Case:

$$p_{\text{initial}} = 0.26529kg \times 0.532m/s + 0.52747kg \times 0m/s$$
$$= 0.14113 \pm 0.00002kg \cdot m/s$$
$$p_{\text{final}} = 0.26529kg \times 0.173m/s + 0.52747kg \times 0.173m/s$$
$$= 0.13715 \pm 0.00001kg \cdot m/s$$

   b) Elastic Collisions for both equal mass carts and unequal mass carts

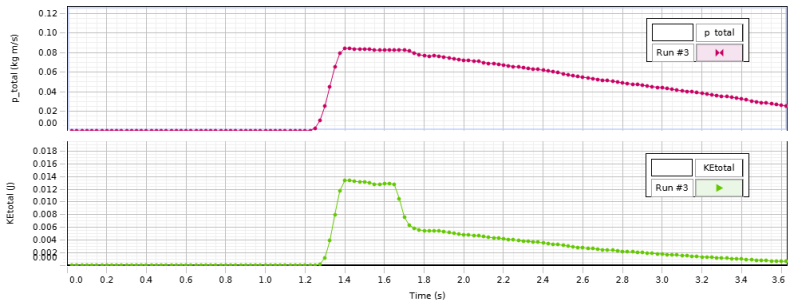
   Equal Mass Carts Case:

$$p_{\text{initial}} = 0.26529kg \times 0.522m/s + 0.27429kg \times 0m/s$$
$$= 0.13848 \pm 0.00002kg \cdot m/s$$
$$p_{\text{final}} = 0.26529kg \times (-0.0018m/s) + 0.27429kg \times 0.485m/s$$
$$= 0.13255 \pm 0.00001kg \cdot m/s$$

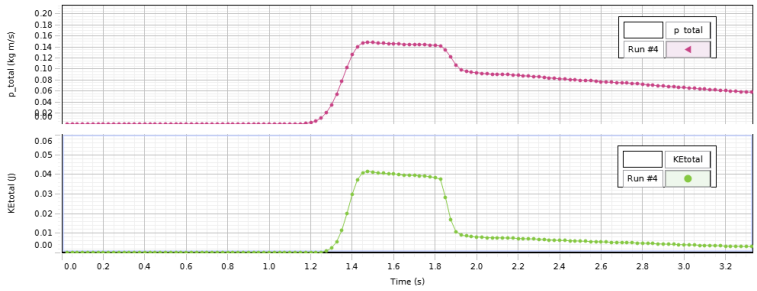
   Unequal Mass Carts Case:

$$p_{\text{initial}} = 0.26529kg \times 0.446m/s + 0.52747kg \times 0m/s$$
$$= 0.11832 \pm 0.00001kg \cdot m/s$$
$$p_{\text{final}} = 0.26529kg \times (-0.141m/s) + 0.52747kg \times 0.280m/s$$
$$= 0.11029 \pm 0.00001kg \cdot m/s$$

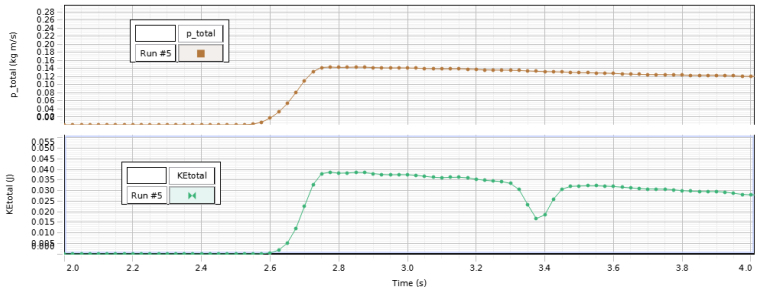
2. Plot the Graphs of total momentum (P_{total}) vs. time and total kinetic energy (KE_{total}) vs. time for all the cases mentioned in Question 1. (Two Graphs required. (a)P_{total} vs. time; and (b) KE_{total} vs. time for all the collisions)
   Inelastic with Equal Mass:



Inelastic with Unequal Mass:



Elastic with Equal Mass:



Elastic with Unequal Mass:

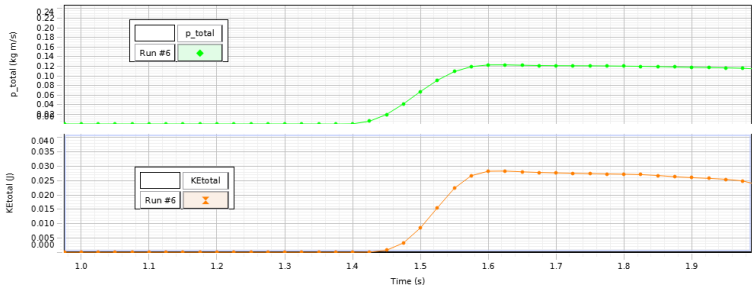


Figure 9: Total Momentum and Total Kinetic Energy Before, During, and After the Collisions

3. Explain the Graphs in Question 2. What happens before, during, and after the collisions in terms of momentum, velocity, and kinetic energy?

For inelastic collisions, the momentum of the system preserves but the kinetic energy of the system decreases after collisions. And the red one and the blue one will have the same slower velocity.

For elastic collisions, the momentum and the kinetic energy of the system preserves. If the red cart weights equal to the blue cart, they will exchange the velocity. If the blue cart is heavier than the red one, the red one will go back forward, and the blue go ahead.

Appendix:
Attach the table in Procedure explosions, Inelastic collisions, elastic collisions. (you should write a clear and detailed caption for each table.)

Table I. Masses and Velocities

Set	Set	Set	Set	Set	Set	Set
Collision Type	Red Mass (kg)	Blue Mass (kg)	Init. Red v (m/s)	Init. Blue v (m/s)	Final Red v (m/s)	Final Blue v (m/s)
Equal Mass Explosion	0.26529	0.27429	0.000	0	-0.5710	0.5420
Unequal Mass Explosion	0.26529	0.52747	0.000	0	-0.6330	0.3250
Equal Mass Inelastic	0.26529	0.27429	0.313	0	0.1430	0.1430
Unequal Mass Inelastic	0.26529	0.52747	0.532	0	0.1730	0.1730
Equal Mass Elastic	0.26529	0.27429	0.522	0	-0.0018	0.4850
Unequal Mass Elastic	0.26529	0.52747	0.446	0	-0.1410	0.2800

For Explosion, we first conducted the equal mass one. Set the plunger on red cart to position #2 and put two carts contacted with each other at the center. Start recording and tap the trigger to launch the plunger. And stop recording before either of them hits the edge. Then, we put a $250g$ mass on the blue cart and repeat previous steps.

For inelastic collision, we first place the blue one at the center and the red one is on the left of blue with certain distance, with the Velcro® bumpers facing with each other. Then, we start recording and give a short push to the red cart. Stop recording after collision and before either of them hits the rim. And we put a $250g$ mass on the blue to repeat the previous steps.

For elastic collision, we place them like the inelastic collision but with the magnetic sides facing with each other. Then, we record, push, stop recording. And, add a $250g$ mass, do it again.

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Notes:

- **Submit soft copies online.**
- **No further modification allowed after deadline.**
- **Please don't exceed 2 pages (exclude appendix), with normal margin and 1.0 line space.**
- **No figure is required if not specified.**