**Level: 1st Year ST-Engineer**

**Module: PW Physics 1**

**Group :** ……..

**Date :** …….

**Members of the Group:**

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# Practical Work Report 4: Elastic and Inelastic Collisions

## a. Elastic collision:

1-Fill in the table. (δt is the time that takes for the tab to pass from δx=2cm, through the optical barrier).

| | | | |
|---|---|---|---|
| $m_B$ (gr) | | | |
| $t_A$ (s) | | | |
| $t'_A$ (s) | | | |
| $t'_B$ (s) | | | |
| $v_A = \delta x / t_A$ (m/s) | | | |
| $v'_A = \delta x / t'_A$ (m/s) | | | |
| $v'_B = \delta x / t'_B$ (m/s) | | | |
| $E_{cA} = m_A v_A^2/2$ (J) | | | |
| $E'_{cA} = m_A v'^2_A/2$ (J) | | | |
| $E'_{cB} = m_B v'^2_B/2$ (J) | | | |
| $P_A = m_A.v_A$ | | | |
| $P'_A = m_A.v'_A$ | | | |
| $P'_B = m_B.v'_B$ | | | |
| $(\vec{p}_A+\vec{p}_B)/(\vec{p}'_A+\vec{p}'_B)$ | | | |
| $(E_{cA}+E_{cB})/(E'_{cA}+E'_{cB})$ | | | |

2- According to the results of the table, is there conservation of momentum and kinetic energy?.....

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**b. <u>Inelastic Collision</u> :**

1-Fill in the table.

| | | | |
|---|---|---|---|
| $m_B$ (gr) | | | |
| $t_A$ (s) | | | |
| $t'_B$ (s) | | | |
| $v_A = \delta x / t_A$ (m/s) | | | |
| $v'_A = \delta x / t'_B = v'_B$ (m/s) | | | |
| $E_{cA} = m_A v_A^2/2$ (J) | | | |
| $E'_{cA} = m_A v'^2_A/2$ (J) | | | |
| $E'_{cB} = m_B v'^2_B/2$ (J) | | | |
| $P_A = m_A.v_A$ | | | |
| $P'_A = m_A.v'_A$ | | | |
| $P'_B = m_B.v'_B$ | | | |
| $(\vec{P}_A+\vec{P}_B)/(\vec{P'}_A+\vec{P'}_B)$ | | | |
| $(E_{cA}+E_{cB})/(E'_{cA}+E'_{cB})$ | | | |

2- According to the results of the table, is there conservation of momentum and kinetic energy?.....

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**4. Conclusion:**

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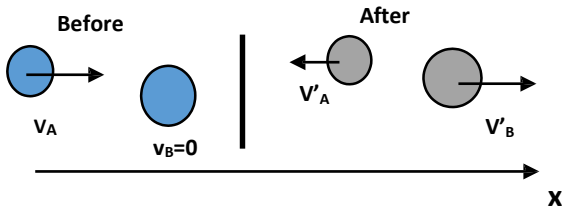
# Practical Work N°4: Elastic and Inelastic Collisions

## 1. Objective of the experiment:

The objective of this experiment is to verify that momentum is saved as well as kinetic energy by measuring the velocities of bodies in collision before and after.

## 2. Collisions:

Fig.1




In this experiment, we will verify the laws of conservation of momentum and mechanical energy. In collisions, the sum of the **external forces** to the study system (consisting of two carts) is zero: $\sum \vec{F}_{ext} = \vec{0} = d\vec{p}/dt$. As a consequence, the momentum p = m v is conserved. Figure 4 shows the diagram of the experiment, where cart A (velocity $v_A$) impacts cart B initially at timeout ($v_B = 0$) . Under these conditions, the law of conservation of momentum give:
In this experiment, we will verify the laws of conservation of momentum and mechanical

$$m_A.v_A = m_A.v'_A + m_B.v'_B \qquad (1)$$

Where $v'_A$ and $v'_B$ indicate the velocities of carts A and B respectively after the collision.

### Elastic collisions

In addition to conserving momentum, elastic collisions also conserve energy mechanics. In our case study (with $v_B = 0$):

$$m_A.v^2_A/2 = m_A.v'^2_A/2 + m_B.v'^2_B/2 \qquad (2)$$

The solution of equations 1 and 2 are given in 3 and 4:

$$v'_A = [(m_A - m_B)/(m_A+m_B)] . v_A \qquad (3)$$

$$v'_B = [2 m_A/(m_A + m_B)] . v_A \qquad (4)$$

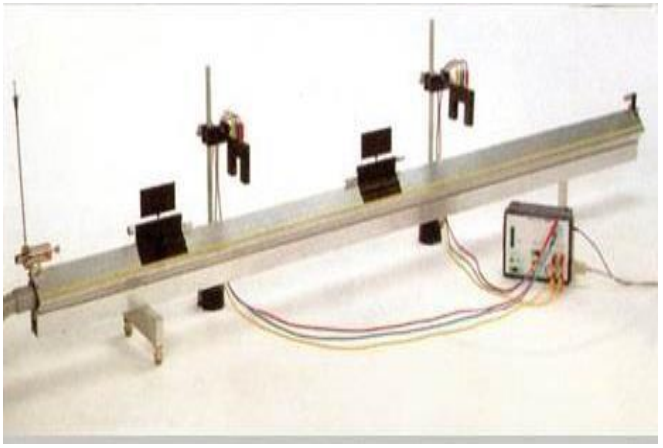
### Inelastic collisions

Collisions with snagging are the extreme case among inelastic collisions. Both carts will remain close together after the collisions ($v'_A = v'_B = v'$). With this condition, we can calculate the velocities after the collision:

$$v' = [ m_A/(m_A + m_B) ] .v_A \qquad (5)$$

**3. <u>Manipulation</u> :**

**Elastic Collision:** **Fig.2**



- Assemble the experiment bench as shown.
- Adjust the distance between the optic barriers Such as the collisions occur between them.
- Before the collisions one of the carts with a Fixed mass $m_A$ = g, is in motion; while the other cart with a variable mass $m_B$ is at rest.

When passing, the chronometer records the corresponding time $\delta t_A$.

-After the collisions, the two moving carts go in opposite directions and each one passes through optic barrier. The chronometer records the two times $\delta t'_A$ and $\delta t'_B$.

- Repeat the previous steps by varying the mass $m_B$ of the cart.

**Note:** δt is the time it takes for the tab to pass from δx=2cm, through the optical barrier.

**Inelastic collision:**

After the collisions, the two moving carts adhere and go in the same direction and pass through a L.B. The stopwatch still records the lap time. Wear it on the board.