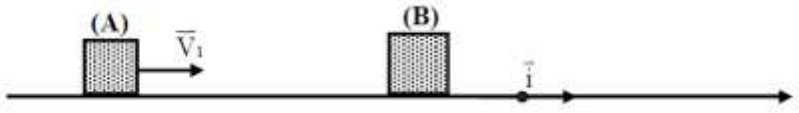
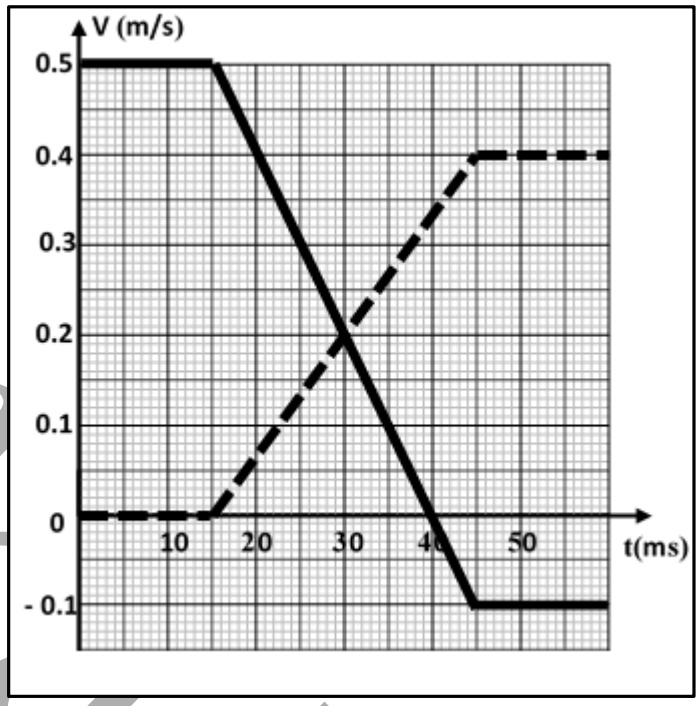
Exercise 1 Collision and interaction

In order to study the collision between two bodies, we consider a horizontal air table equipped with a launcher and two pucks (A) and (B) of respective masses $m_A = 0.4$ kg and $m_B = 0.6$ kg. (A), launched with the velocity $\vec{V}_1$, collides with (B) initially at rest as shown in below figure. Neglect all frictional forces.



The adjacent grapgh shows the variation of velocities of pucks (A) and (B) after and before collision.



1- Center of mass and linear momentum

1.1) Determine, graphically, the velocities $\vec{V}_A$ and $\vec{V}_B$ of pucks (A) and (B) before the collision respectively. Deduce the velocity $\vec{V}_G$ of center of mass of the system [(A),(B)] before the collision.

1.2) Deduce the linear momenta $\vec{P}_A$ and $\vec{P}_B$ of pucks (A) and (B) before the collision respectively.

1.3) Indicate, graphically, the velocities $\vec{V}'_A$ and $\vec{V}'_B$ of pucks (A) and (B) after the collision respectively. Deduce the velocity $\vec{V}'_G$ of center of mass of the system [(A),(B)] after the collision.

1.4) Deduce the linear momenta $\vec{P}'_A$ and $\vec{P}'_B$ of pucks (A) and (B) after the collision respectively.

1.5) Compare $\vec{V}_G$ and $\vec{V}'_G$.

1.6) Calculate the linear momentums $\vec{P}$ and $\overrightarrow{P'}$ of the system $[(A),(B)]$ before and after collision respectively.

1.7) Compare $\vec{P}$ and $\overrightarrow{P'}$. Conclude.

2- Type of collision

2.1) Determine the kinetic energy of the system $[(A),(B)]$ before and after collision.

2.2) Deduce the type of the collision.

3- Principle of interaction

3.1) Indicate, graphically, the duration of collision Δt.

3.2) Name the external forces acting on each puck (A) and (B) during Δt.

3.3) We can consider that $\frac{\Delta\vec{P}}{\Delta t} \approx \frac{d\vec{P}}{dt}$. Applying Newton's second law $\Sigma\vec{F}_{ext} = \frac{d\vec{P}}{dt}$ on each puck, determine during Δt the sum of the external forces $(\sum \vec{F}_{ex})$ acting each puck.

3.4) Deduce that the principle of interaction is verified.