

Momentum in Isolated Systems

Video lesson: www.physicsbydiscovery.com → 12th Physics → Unit 4: Momentum

Continuing Example 3 from the “Momentum and Impulse” lesson:

C . System: Ball, Justin with Skateboard

Net external force on system? ____ Is momentum of the system constant? ____

Key Ideas:

1. What is an isolated system?

A system is isolated if the net external force on the system is ____.

- The net external force on a system will be zero if (a) there are no external forces on the system at all, or (b) there are external forces, but they add up to zero.

2. What is true about the net impulse on an isolated system?

The net impulse on an isolated system is always ____.

- From the definition of impulse: net impulse = (net external force)(time interval)
- Since the net external force is zero, the net impulse must also be zero.

3. What is true about the momentum of an isolated system?

The momentum of an isolated system is _____. It does not change.

- From the momentum principle: $p_i + \text{impulse} = p_f$
- Since the net impulse on the system is zero, $p_i = p_f$.

4. How can the momentum principle be applied to systems that include more than one object?

In vector form:

$$(\vec{p}_i)_{\text{system}} + (\Sigma F_{\text{external}})(\Delta t) = (\vec{p}_f)_{\text{system}}$$

In component form: (Replace x with y or z to get an equation for other directions.)

$$[m_1(v_{ix})_1 + m_2(v_{ix})_2 + \dots] + (\Sigma F_{\text{external}})_x(\Delta t) = [m_1(v_{fx})_1 + m_2(v_{fx})_2 + \dots]$$