(18)

Momentum | gpb video: Physics 601 | Phys Std:

- What is momentum?
  - Mass in motion
- What is the equation for momentum?
  - $\vec{p} = \vec{v}m$ units: kg*m/s

    (Direction comes from velocity → direction of motion)
- How is momentum changed?
  - An impulse is needed
    → an impulse changes momentum; likewise, a change in momentum causes an impulse
- What is impulse?
  - Impulse is "force applied over a time interval" (i.e. hitting a golf ball exerts a force on the ball for a certain time. "Following through" increases the time interval and therefore increases the impulse. This increases the momentum of the ball by making it travel faster)

    impulse = Force x time
    impulse = a change in momentum

    $\vec{F}t = \Delta\vec{v}m$ ← impulse eqn

    units: kg*m/s or N*s

    ex #1: If the contact time doubles (force remaining constant), the impulse doubles, and the change in momentum doubles

    Padding increases the time interval during collisions, thereby decreasing the impact force.

    ex #2: Quadrupling the time interval, decreases the impact force by 4.

    ex #3: A 20 kg object is moving at 5 m/s when a force brings it to a stop in 0.05 seconds. If brought to a stop in 0.1 seconds instead, the required force to stop it would be halved the resulting impulse would be same & the resulting change in momentum would be same.

ex #4: A 2 kg object moving at 3 m/s encounters a 20 N force over a 0.1 second time interval.

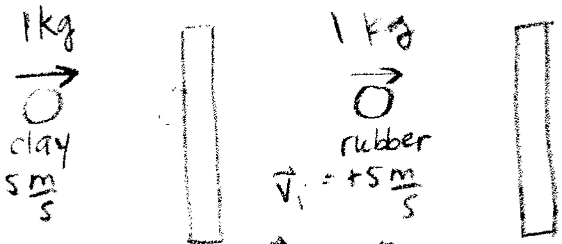
a) The impulse experienced by the object is 2 N·s

b) The momentum change experienced by the object is 2 kg·m/s

c) The final momentum is 4 kg·m/s

- Why do bouncing objects experience a greater momentum change?
  - because of the direction change

Example:



Clay: $\vec{v}_i = +5\,\frac{m}{s}$, $\vec{v}_f = 0\,\frac{m}{s}$

$\Delta\vec{v}m = \left(0\frac{m}{s} - 5\frac{m}{s}\right)(1\,kg) = -5\,kg\cdot\frac{m}{s}$

Rubber: $\vec{v}_i = +5\,\frac{m}{s}$, $\vec{v}_f = -5\,\frac{m}{s}$

$\Delta\vec{v}m = \left(-5\frac{m}{s} - 5\frac{m}{s}\right)(1\,kg) = -10\,kg\cdot\frac{m}{s}$

**Since Δvm is greater, impact force is greater

- Is momentum conserved during collisions?
  - Yes, as long as the system is closed and isolated from external forces.

- Is energy conserved during collisions?
  - Only in ELASTIC COLLISIONS, where objects bounce off of each other
  - Energy is <u>not</u> conserved in INELASTIC COLLISIONS, where objects stick to each other