MOMENTUM
UNIT 11

Impulse and Momentum

Learning Target	Description
11.1	I can define, analyze, and solve problems involving impulse and linear momentum.

What is momentum?

Headlines

"The Broncs are gaining momentum as they head to the state tournament."

Momentum

Momentum is mass in motion!

$$p = m v$$

Momentum is equal to the mass of an object times the object's velocity.

Momentum

Vector or Scalar?

$$\vec{p} = m \vec{v}$$

Units? $kg \cdot \frac{m}{s} = \frac{kg \cdot m}{s}$

Relationship?

Direct Proportional

Changing Momentum

Changing Momentum

Impulse = Change in Momentum

$$\text{Impulse} = \Delta p = p_f - p_i$$

Impulse-Momentum Theorem

$$F = m\,a$$

$$a = \frac{\Delta V}{t} = \frac{V_f - V_0}{t}$$

$$F = \frac{m}{1}\left(\frac{V_f - V_0}{t}\right)$$

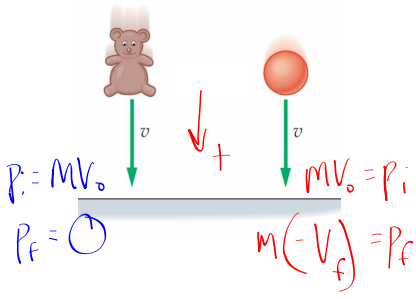
$$F = \frac{mV_f - mV_0}{t}$$

Impulse-Momentum Theorem

$$F\,\Delta t = p_f - p_i$$

$$\vec{F}\cdot t = \vec{p}_f - \vec{p}_i$$

Bear and Bouncy Ball



$\Delta p = P_f - P_i$ $\Delta p = P_f - P_i$

$\Delta p = -mV$ $= m(-V) - mV$

$\Delta p = -2mV$

IN CLASS PROBLEMS

1. Calculate the momentum of the following objects:
   a) 110-kg football player running at 8.00 m/s. $P = mv = 880\ \frac{kg\cdot m}{s}$
   b) How fast would you need to throw a 0.410-kg football so that it has the same momentum as the football player?
   $P = mv$ $V = \frac{P}{m} = \frac{880}{0.41} = 2100\ m/s$
2. A hockey puck has a mass of 0.115 kg and strikes the pole of the net at 37 m/s. It bounces off in the opposite direction at 25 m/s.
   a) What is the impulse on the puck?
   b) If the collision takes 5.0 x 10^{-4} s, what is the average force on the puck?

$\Delta P = P_f - P$

IN CLASS PROBLEMS

Calculate the momentum of the following objects:

1. 110-kg football player running at 8.00 m/s.

2. How fast would you need to throw a 0.410-kg football so that it has the same momentum as the football player?

PRACTICE PROBLEMS

(1-8)

IN CLASS PROBLEMS

3. A hockey puck has a mass of 0.115 kg and strikes the pole of the net at 37 m/s. It bounces off in the opposite direction at 25 m/s.

a) What is the impulse on the puck?

$\Delta p = p_f - p_i = mv_f - mv_i = (0.115)(-25) - (0.115)(37)$

$\Delta p = 7.1 \frac{kgm}{s}$

b) If the collision takes 5.0×10^{-4} s, what is the average force on the puck?

$F \cdot t = \Delta p$

$F = \frac{\Delta p}{t} = -14 \times 10^{4} N$