Note Taking Guide – Episode 601 **Momentum Notes**

Momentum - motion inertia ↑ velocity

Symbol p Equation $p = m \cdot v$ (mass) Unit $kg \cdot m/s$

Problem Set #1: (1-2)

(1) $m = 2500\,kg$
a) $v_1 = 18\,m/s$
b) $v_2 = 0$
a) $p_1 = ?$
b) $p_2 = ?$

$p = m \cdot v$
a) $p_1 = 2500\,kg \cdot 18\,m/s = 45000\,kg \cdot m/s$
b) $p_2 = 0\,kg \cdot m/s$

(2) $m_1 = 0.13\,kg$
$v = 36\,m/s$
a) $p_1 = ?$
b) $m_2 = 7.3\,kg$
$v_2 = ?$
$p_1 = p_2$

a) $p = m \cdot v$
$p_1 = 4.68\,kg \cdot m/s$
$v_2 = \frac{p_1}{m_2}$
$v_2 = \frac{4.68\,kg \cdot m/s}{7.3\,kg} = 0.64\,m/s$

Impulse Equation: $F \cdot t = \Delta m v$

Impulse = change in momentum

An impulse is required to change the momentum of an object.
A change in momentum creates an impulse.

A golfer follows through on a swing to increase the ball's velocity and make it travel farther.

$$F\,t = m\,\Delta v$$

Following through keeps the club head on the ball for a longer period of time.
Since time and velocity are directly proportional, increasing time of contact increases velocity.

Answer using words and the impulse equation:
Why does a batter stop the bat when bunting?

To decrease the time on contact and decrease the velocity of the ball so it won't travel so far.

Which would do more damage- stopping a truck, moving at 60 mi/h, by running into:

a brick wall? a haystack?

$F t = m \Delta v$ $F t = m \Delta v$

The mass and change in velocity of the truck are held constant. To decrease force, the time it takes the truck to stop must be increased.

more examples of extending time to decrease force:

- air bags
- padded boxing gloves
- bending knees when jumping or landing

Physics Challenge: Which is more likely to break a window?

a. a rubber ball b. a clay ball c. neither

Use the impulse equation to explain:

The change in momentum is double for the rubber ball because is bouncing back

$F \cdot t = \Delta m v = m \cdot 2v$

Law of Conservation of Momentum:

The momentum of a closed, isolated object or system of objects does not change

system - A collection of objects interacting with each other

closed system - no objects enter or leave the system

isolated system - no net, external force acts on it

Notes on Collisions:

elastic collisions - objects bounce off each other without lasting deforming or losing energy, momentum and energy are conserved

Examples: pool balls, bumper cars, gas molecules

inelastic collisions - objects stick together or are deformed there is loss of energy, but momentum is conserved

Examples: collision car - tree, train car, football player tackling another player

Momentum is conserved in all types of collisions.

"Show What You Know" (on back)

1. A massive football player sitting on the bench has...
   a. a large momentum.
   b. a small momentum.
   c. no momentum.

2. An impulse...
   a. equals the force applies times the time of application.
   b. creates a change in momentum.
   c. both a and b.
   d. neither a nor b.

3. When the time of an impact is extended, the force exerted is...
   a. increased. b. decreased. c. not affected.

4. In a closed, isolated system of objects...
   a. no objects enter or leave.
   b. no external forces are exerted.
   c. the total momentum cannot change.
   d. all of these.

Answers:
1. c
2. c
3. b
4. d