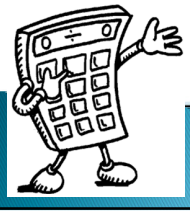
Momentum (Part II)
(Impulse)

Mr. Sudbury



Change in Momentum

- The change in momentum is called ***impulse***.
- The impulse is equal to the force x time interval

  impulse = Ft
- Time interval is total time that the force acted to change the momentum

Acceleration Review

acceleration

$$a = \frac{F}{m} \quad \& \quad a = \frac{\Delta V}{t} \quad \frac{\text{nge in V}}{t}$$

Acceleration Review

$$a = \frac{F}{m} \quad \& \quad a = \frac{\Delta V}{t}$$

Acceleration Review

$$\frac{F}{m} = \frac{\Delta V}{t}$$

Change in Momentum

- Remember momentum

  $p = mv$
- So CHANGE in momentum is $\Delta(mv)$
- A change in momentum is caused by a Force applied over an amount of time (IMPULSE)

  $Ft = \Delta(mv)$

Change in Momentum

- For momentum to change ($\Delta p = \Delta(mv)$) either mass or velocity has to change.
- The mass of an object usually does not change.
- The velocity is what typically changes
  - Acceleration–speeding up, slowing down, or turning.
    - Remember that acceleration is caused by applying a force.
- The greater the force acting on an object, the greater the change in velocity, which means the greater the change in momentum.
  - Remember that Force causes acceleration… Acceleration means changing velocity…

Change in Momentum

- Impulse is the change in momentum
- The change in momentum is the product of the force applied and the time the force is applied.

$$Ft = \Delta(mv)$$

Using force to Increase Momentum

$$\Delta(mv) = Ft$$

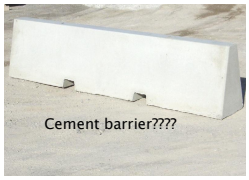
- To **increase** *momentum*:
- Apply the greatest F for the longest t possible.
- Follow through on sports swings.

Increasing Momentum

- The tennis ball is in contact with the racket for only a short time with a large force applied.

Decreasing Momentum

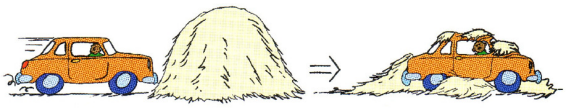
- If you are driving along and your brakes fail… what do you want to stop you…



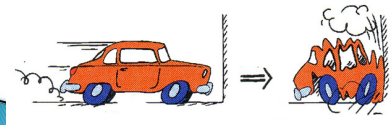
OR

- The cement barrier stops you in almost no time, the haystack stops you over a greater amount of time.

Decreasing momentum



- Both cars have the same velocity and the same momentum…



Momentum

1,000 kg * 10 m/s

mv = **Ft**

10,000 kg*m/s

100,000 N * .1 s

10,000 N*s

1,000 kg * 10 m/s

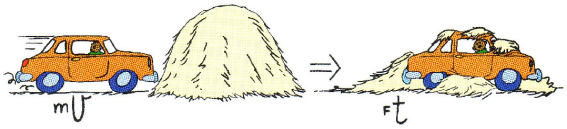
mv = **Ft**

10,000 kg*m/s

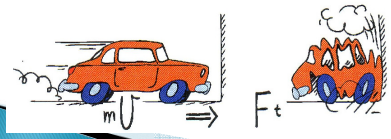
1,000 N * 10 s

10,000 N*s

Decreasing momentum

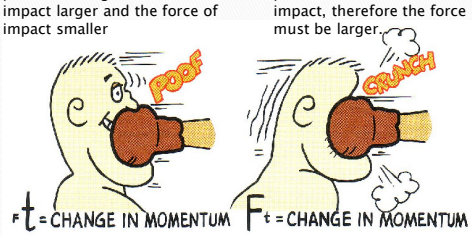


- Haystack car had larger time period and a smaller force.
- Cement wall car had shorter time and therefore more force.



Decreasing Momentum

- Boxer moves back with the punch, making the time of impact larger and the force of impact smaller
- A boxer moving towards a punch decreases the time of impact, therefore the force must be larger.



Impulse = 10
10 = 1 sec x 10 N

Impulse = 10
10 = .1 sec x 100 N

Impulse Demonstration

- Throwing Eggs.

Bungee Jumping

- The rubber cord stretches during the jump which extends.
- The long time helps the jumper feel only a small force.

- To break the boards or cement, the Karate Kid must strike with a lot of force for a very short time.

The End

- Impulse = Ft
- Ft = Δmv