

Impulse

LEQ: How do forces and the time over which they act affect the momentum of an object?

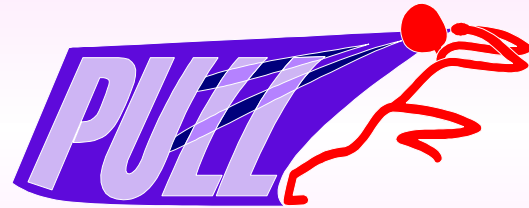
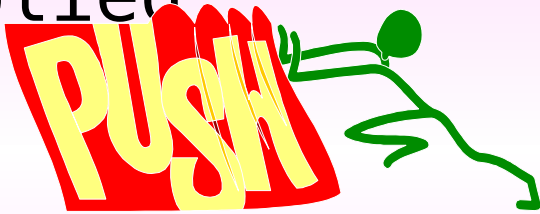
Objectives:

Define impulse and relate it to momentum.

Give examples of how both the size of the force and the length of the time interval affect the change in momentum.

Impulse

- To change an object's momentum, an **external** force must be applied



- The greater the force and the greater the time the force is applied, the **greater** the change in momentum.

Impulse

- Impulse is equal to the force applied to an object \times time interval during which it acts
- Impulse = $f \times t$
- Impulse-Momentum relationship:
The greater the impulse, the greater the change in momentum

Impulse

- $Ft = \text{change in } mv$
- $Ft = \Delta mv$
- To maximize the change in momentum



- Increase the force
- Increase the impact time

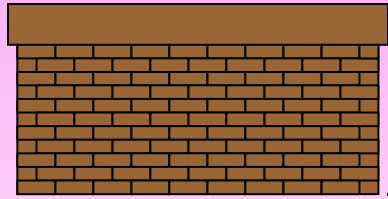
Impulse

- Example:
 - To maximize the change in momentum of a baseball, hit it with the maximum force over the longest period of time (follow through)



Impulse

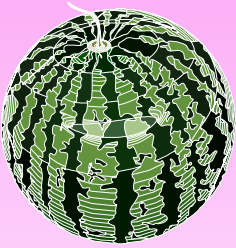
- Sometimes the momentum will be changed by the same amount regardless of the conditions applied. When this is the case,
- To minimize the force
 - Increase time



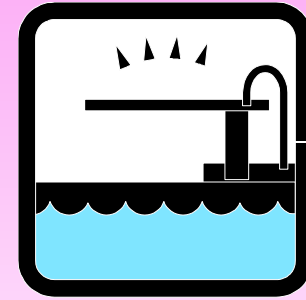
Impulse



- Example:
 - A truck driver would rather hit a haystack than a brick wall because the haystack will minimize the force by maximizing the impact time.
 - The momentum will be changed by the same amount regardless of if the driver hits the wall or the haystack.



Impulse

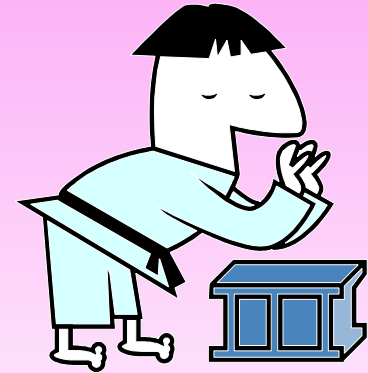


- Example:
 - A watermelon will become smashed if dropped onto cement, but will not be damaged if dropped into water because the water increases the impact time and decreases the force.
 - The momentum will be changed by the same amount regardless of if the watermelon comes to a stop on the cement or in the

Impulse

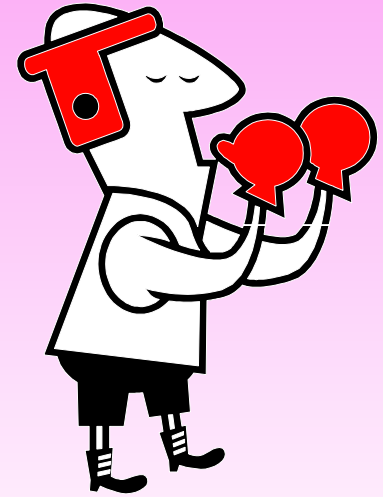
- Sometimes the momentum will be changed by the same amount regardless of the conditions applied. When this is the case,
- To maximize the force
 - Decrease time

Impulse



- Example:
 - To break through a cement block, a karate expert will bring his arm and hand down against the block.
 - The block will reduce his momentum by the same amount regardless of how fast he is moving, but if he moves fast enough, the force exerted on the block will be enough to break the block.

Impulse



- Example:
 - To increase the force exerted on an opponent, a boxer will use the least-padded gloves available.
 - These gloves will decrease the impact time, thereby increasing the force applied.

Momentum and Impulse

- http://www.batesville.k12.in.us/physics/PHYNET/Mechanics/Momentum/imp_mo_quiz.htm