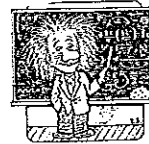


PHYSICSTALK

Force and Impulse

Newton's First Law states that an object in motion will remain in motion unless acted upon by a net external force. In this activity you were able to stop an object with a force. In all cases the object was traveling at the same speed before impact. Stopping the object was done quickly or gradually. The amount of damage is related to the time during which the force stopped the object. The air bag was able to stop the object with little damage by taking a long time. The hard surface stopped the object with more damage by taking a short time.

Physicists have a useful way to describe these observations. An **impulse** is needed to stop an object. That impulse is defined as the product (multiplication) of the force applied and the time that the force is applied. →



Physics Words

impulse: the product of force and the interval of time during which the force acts; impulse results in a change in momentum.

$$\text{Impulse} = F\Delta t$$

where F is force in newtons (N);

Δt is the time interval during which the force is applied in seconds (s).

Impulse is calculated in newton seconds (Ns).

An object of a specific mass and a specific speed will need a definite impulse to stop. Any forces acting for enough time can provide that impulse.

If the impulse required to stop is 60 Ns, a force of 60 N acting for 1 s has the required impulse. A force of 10 N acting for 6 s also has the required impulse.

Force F	Time Interval Δt	Impulse $F\Delta t$
60 N	1 s	60 Ns
10 N	6 s	60 Ns
6000 N	0.01 s	60 Ns

The greater the force and the smaller the time interval, the greater the damage that is done.

Sample Problem

A person requires an impulse of 1500 Ns to stop. What force must be applied to the person to stop in 0.05 s?

Strategy: You can use the equation for impulse and rearrange the terms to solve for the force required.

$$\text{Impulse} = F\Delta t$$

$$F = \frac{\text{Impulse}}{\Delta t}$$

Givens:

$$\text{Impulse} = 1500 \text{ Ns}$$

$$\Delta t = 0.05 \text{ s}$$

Solution:

$$F = \frac{\text{Impulse}}{\Delta t}$$

$$= \frac{1500 \text{ Ns}}{0.05 \text{ s}}$$

$$= 30,000 \text{ N}$$