

Honors Physics – Impulse, Momentum, and Collisions

Class Examples

Sections Covered – Honors Physics

Chapter 9: pages 198 - 216

*Additional Reading

Topics Covered

- Linear Momentum
- Impulse
- Conservation of Momentum
- Collisions
 - Elastic
 - Inelastic
 - Total inelastic
- Angular Momentum

Working Definition of Momentum:

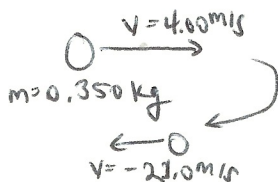
your definition here

*SIGNS
MATTER*

Example 1:

So _____ is standing around in the small commons, minding his/her business when a _____ (mass = 0.350 kg) comes flying towards him/her with an initial velocity of 4.00 m/s. _____ swats it away, giving the object an outgoing velocity of -21.0 m/s.

- A. What is the change in momentum of the object?
- B. If all this was done in 0.300 s, what was the force applied?



$$\begin{aligned}
 \text{A.) } \Delta p &= mv_f - mv_i \\
 \Delta p &= (0.350)(-21.0) - (0.350)(4.00) \\
 \Delta p &= -7.35 - 1.4 \\
 \Delta p &= -8.75 \text{ kg}\cdot\text{m/s}
 \end{aligned}$$

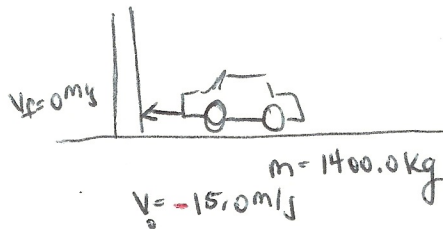
$$\begin{aligned}
 \text{B.) } \Delta p &= F \Delta t \\
 J &= F \cdot \Delta t \\
 \text{Impulse-Momentum Theory} \\
 -8.75 &= F(0.300) \\
 \boxed{F = -29.2 \text{ N}}
 \end{aligned}$$

** force was in a negative direction*

Example 2:

A 1400.0 kg car is moving to the west (to the left) with the magnitude of its velocity at 15.0 m/s. It collides with a utility pole and is brought to rest in 0.100 s?

- A. What is the change in momentum of the car?
- B. What is the force exerted on the car during this collision?



$$\begin{aligned}
 \text{A.) } \Delta p &= mv_f - mv_i \\
 \Delta p &= (1400)(0) - (1400)(-15) \\
 \Delta p &= 0 - (-21,000) \\
 \boxed{\Delta p = 21,000 \text{ kg}\cdot\text{m/s}}
 \end{aligned}$$

$$\begin{aligned}
 \text{B.) } \text{Impulse} &= \Delta p \\
 J &= \Delta p \\
 F \Delta t &= \Delta p \\
 F(0.100) &= 21,000 \text{ A ton!} \\
 \boxed{F = 210,000 \text{ N}}
 \end{aligned}$$

With more time

$$\begin{aligned}
 \text{C.) } F \cdot \Delta t &= \Delta p \\
 F \cdot \Delta t &= 21,000 \\
 F(0.400) &= 21,000 \\
 \boxed{F = 52,500 \text{ N}}
 \end{aligned}$$

**much less*