Homework

i

$$\Sigma \Delta P = 0$$

$$\Sigma P_i = \Sigma P_f$$

$$P_{Bi} - P_{Ri} = P_{BRf}$$

$$m_B v_{Bi} - m_R v_{Ri} = (m_B + m_R) v_f$$

$$(5kg)(3m/s) - (2kg)(4m/s) = (5kg + 2kg) v_f$$

$$7 kg\,m/s = (7 kg) v_f$$

$$v_f = 1 m/s$$

Collisions

During a collision momentum is transferred from one object to another.

During any event momentum is conserved, meaning:

- the amount of momentum at any time is the same

$$\Sigma P_i = \Sigma P_f$$

- there is no net change in the momentum of a system

$$\Sigma \Delta P = 0$$

Impulse

- During a collision, momentum is transferred from one object to another. This changes the momentum for that object.

- Impulse is a measure of the change in momentum an object experiences. (Impulse equals change in momentum)

$$J = \Delta p$$

Like momentum, we find the mathematical definition for impulse from Newton's Second Law.

$$\Sigma F = ma = m\frac{\Delta v}{\Delta t}$$

$$\Sigma F = \frac{\Delta p}{\Delta t} \quad //$$

$$\Sigma F \Delta t = \Delta p = J$$

$$\begin{array}{ccc} \Sigma F \Delta t & = & m\Delta v \\ \| & & \| \\ J & = & \Delta p \end{array}$$

Example

You apply a force of 5 N on an object for 3 seconds. What is the impulse? What is the object's change in momentum?

$J = \Sigma F \Delta t$

$= (5N)(3s)$

$= 15\ Ns$

$1\ Ns = 1\ kg\ m/s$

$J = \Delta p$

$\therefore \Delta p = 15\ Ns$

A 200 g tennis ball, moving 25 m/s, is struck by a tennis player, causing the ball to move 30 m/s in the opposite direction. If the tennis racket makes contact with the ball for 0.65 s, what is the average force the tennis player exerts on the ball?

$\Delta v = v_f - v_i$

$= 30\ m/s - (-25\ m/s)$

$= 55\ m/s$

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

$\Sigma F (0.65s) = (0.2kg)(55\ m/s)$

$\Sigma F = \frac{11\ N.s}{0.65s}$

$= 16.9\ N$

$v_i = 25\ m/s \rightarrow$

$\leftarrow v_f = 30\ m/s$

"+"

The Conceptual Value of Impulse

Impulse is defined to be the change in momentum. The momentum of an object is changed when a net force is applied on an object over a period of time.

Varying the time an object experiences a force over affects the amount of force the object experiences for a given impulse.

Conceptual Questions for Impulse

Why does it hurt less to fall on the grass than on the concrete?

Explain how a hammer can be used to push a nail into a board?

Homework

Momentum/Impulse sheet. You can do all the questions now.