Momentum and Impulse

Tuesday, January 3, 2017 10:30 AM

Momentum - a combination of mass and velocity

$p = mv$ units $kg\,m/s$

- a vector (mag & direction)

Ex 1 find the p of a 1000 kg car travelling at 100 ~~km/H~~ $\left(\frac{1\,\text{H}}{3600\,s}\right)\left(\frac{1000\,m}{1\,\text{km}}\right) = 27.8\,m/s$

$p = mv$

$= (1000kg)(27.8\,m/s) = 27,800\,kg\,m/s$

Ex 2 A base ball of mass 0.14kg is moving at 35 m/s [E]

a) $p = 4.9\,kgm/s\,[E]$

b) if a 7.6 kg bowling ball had the same momentum, what would be its velocity

$p = mv$ $\quad V = .64\,m/s\,[E]$

$4.9 = 7.6\,v$

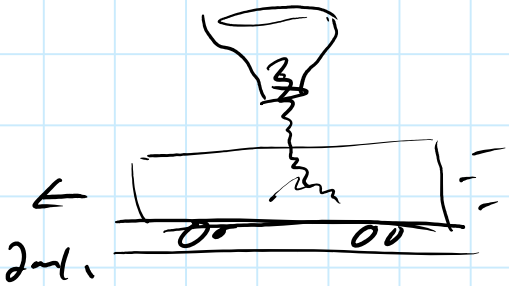
Change in Momentum

$\Delta p = p_2 - p_1$ $\quad \Delta p = m\Delta v = m(v_2 - v_1)$

Change in momentum

$\Delta p = p_f - p_0$ $\quad \Delta p = m\Delta v = \Delta m \cdot v$

Ex A 10,000kg grain car travelling at 2m/s [s] is slowly filled to 17,000kg. Find Δp.

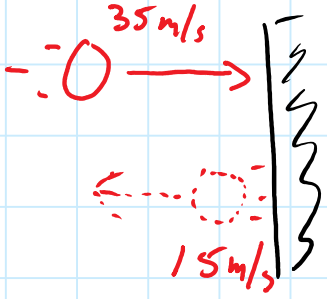


$\Delta p = \Delta m \cdot v$

$= (7{,}000\text{kg})(2\text{m/s})$

$= 14\,000\ \text{kgm/s}\ [s]$

Ex: A 0.14kg baseball at 35m/s [E] hits a wall and bounces back at 15m/s [W]. Find the change in momentum



$\Delta p = p_f - p_0$

$=$

$\Delta p = m\Delta v$ $\quad v_f - v_0$

$= (.14)(15\text{m/s} - {-35\text{m/s}})$

$= .14(50\text{m/s})$

$= 7.0\ \text{kgm/s}\ [W]$

Impulse - A change in momentum is caused by an Impulse being applied to an object

$\Delta p = m \Delta v$

$= m a t$

$I = F \cdot t$ ← units N·s

$V_f = V_0 + at$

$-V_0 \quad -V_0$

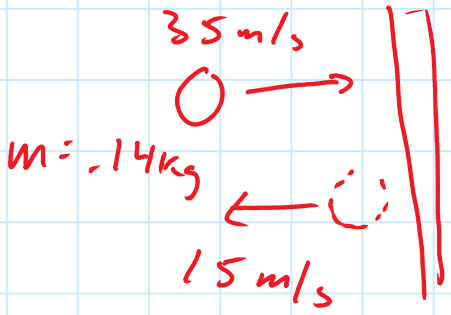
$V_f - V_0 = at$

$\Delta v = at$

$\Delta p = m \Delta v = I = F \Delta t$

12 = 3.4

Ex Baseball hits wall. What force does the wall exert if contact time is 0.05 s



$\Delta p = m \Delta v = I = F \Delta t$

$7 kg\,m/s = F(.05 s)$

$F = 140 N [W]$

$\Delta p = m \underbrace{\Delta v}_{0-30} = F \Delta t$