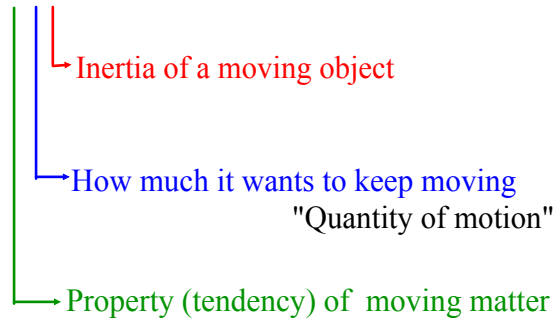


Momentum



<https://www.youtube.com/watch?v=Lg38jFCU87Q>

Completes our understanding of Newton's 1st Law

Momentum

$$p = mv$$

$$p = \text{kg} \times \text{m/s}$$

speeding bullet

$$v_b = 500. \text{ m/s}$$

$$m_b = 30.0 \text{ g}$$

$$p = mv$$

$$p = .0300 \text{ kg} \times 500. \text{ m/s}$$

$$p = 15.0 \text{ kg} \times \text{m/s}$$

a walking
Geo

$$p = mv$$

$$p = 75.0. \text{ kg} \times 1.5 \text{ m/s}$$

$$p = 110 \text{ kg} \times \text{m/s}$$



speeding car:

$$v_c = 65 \text{ km/hr}$$

$$\quad \quad \quad \hookrightarrow 18 \text{ m/s}$$

$$m_c = 1000. \text{ kg}$$

$$p = mv$$

$$p = 1000. \text{ kg} \times 18 \text{ m/s}$$

$$p = 18,000 \text{ kg} \times \text{m/s}$$

2nd Law

$$\Sigma F = ma$$

$$a = \Delta v/t$$

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

$$Ft = mv$$

impulse *momentum*

$$Ft = mv$$

$$N \cdot s = kg \cdot m/s$$

$$kg \cdot m/s^2 (s) = kg \cdot m/s$$

$$kg \cdot m/s = kg \cdot m/s$$

bullet from slide #3 The gun pushes the bullet with 3750 N of force. What time did the gun act on the bullet?

$$Ft = mv$$

$$t = mv/F$$

$$t = \frac{.0300 \text{ kg}(500. \text{ m/s})}{3750 \text{ N}}$$

$$t = 0.00400 \text{ s}$$

speeding bullet

$$v_b = 500. \text{ m/s}$$

$$m_b = 30.0 \text{ g}$$

$$d_g = 1.0 \text{ m}$$

Impulse - Momentum Theorem

$$Ft = \Delta p$$

$$Ft = p_2 - p_1$$

$m_b = 400.0 \text{ g}$ Baseball thrown and hit

$v_{b1} = 76.0 \text{ mph}$
 $\hookrightarrow ? \text{ m/s}$

$v_{b2} = -130.0 \text{ mph}$
 $\hookrightarrow ? \text{ m/s}$

$Ft = ?$

$F = ?$

$Ft = \Delta mv$

A 400 g baseball is thrown at 76 mph and then hit at 130 mph in the opposite direction.



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$m_b = 400.0 \text{ g}$ Baseball thrown and hit

$v_{b1} = 76.0 \text{ mph}$
 $\hookrightarrow 34.0 \text{ m/s}$

$v_{b2} = 130.0 \text{ mph}$
 $\hookrightarrow -58.0 \text{ m/s}$

$Ft = ?$

$Ft = \Delta mv$

$Ft = mv_{b2} - mv_{b1}$

$Ft = m(v_{b2} - v_{b1})$

A 400 g baseball is thrown at 76 mph and then hit at 130 mph in the opposite direction.

$m_{b2} = m_{b1}$

Your book (2.6 kg) falls off the table and hits the floor (-4.4 m/s) and does not bounce. What impulse does the floor apply?



Your book (2.6 kg) falls off the table and hits the floor (-4.4 m/s) and does not bounce. What impulse does the floor apply?



$$Ft = \Delta mv$$

$$Ft = mv_{b2} - mv_{b1}$$

$$Ft = m(v_{b2} - v_{b1})$$

$$Ft = 2.600 \text{ kg}[(0 \text{ m/s}) - (-4.4 \text{ m/s})]$$

$$Ft = 11.4 \text{ kg m/s}$$

contact time = 0.060s ... F = ?

$$F = \Delta mv/t = 11.4 \text{ kg m/s} / 0.060 \text{ s}$$

$$F = 190 \text{ N}$$