

# Momentum + Impulse

momentum:  $\vec{p} = m\vec{v}$

impulse:  $\vec{J} = \vec{F}\Delta t$

impulse - momentum:  $\vec{J} = \Delta\vec{p}$  (concept)

Theorem  $\vec{F}\Delta t = m\Delta\vec{v}$  (more practical)

PP/200

32.  $\vec{F} = 1.23 \times 10^7 \text{ N [s]}$

$\Delta t = 21.0 \text{ ms}$

new  $\Delta t = 57.1 \text{ ms}$

new  $\vec{F} = ?$

$\vec{J} = \vec{F}\Delta t$

$\vec{J} = (1.23 \times 10^7 \text{ N [s]}) (21.0 \times 10^{-3} \text{ s})$

$\vec{J} = 258300 \text{ N}\cdot\text{s [s]}$

$\vec{J} = 2.58 \times 10^5 \text{ N}\cdot\text{s [s]}$

$\vec{J} = \vec{F}\Delta t$

$\vec{F} = \frac{\vec{J}}{\Delta t}$

$\vec{F} = \frac{258300 \text{ N}\cdot\text{s [s]}}{(57.1 \times 10^{-3} \text{ s})}$

$\vec{F} = 4.52 \times 10^6 \text{ N [s]}$

force is smaller since  $\Delta t$  got bigger (same impulse)

PP/203

33.  $v_1 = 0 \text{ m/s}$   
 $v_2 = 43 \text{ m/s}$   
 $m = 0.060 \text{ kg}$   
 $\vec{J} = ?$

$$\vec{J} = \Delta \vec{p}$$

$$\vec{J} = m \Delta \vec{v}$$

$$\vec{J} = m(\vec{v}_2 - \vec{v}_1)$$

$$\vec{J} = 0.060 \text{ kg} (43 \text{ m/s} - 0)$$

$$\vec{J} = 2.5 \text{ kg} \cdot \text{m/s} \text{ [forward]}$$

35.

$m = 1.5 \text{ kg}$   
 $\Delta d = -1.75 \text{ m}$   
 $a = -9.81 \text{ m/s}^2$   
 $\vec{J}_{\text{floor on book}} = ?$

Falling:  $v_1 = 0$   $v_2 = ?$   $\Delta d = -1.75 \text{ m}$   
 $a = -9.81 \text{ m/s}^2$

$$v_2^2 = v_1^2 + 2a\Delta d$$

$$v_2^2 = 0 + 2(-9.81 \text{ m/s}^2)(-1.75 \text{ m})$$

$$v_2 = \pm 5.86 \text{ m/s}$$

use:  $v_2 = -5.86 \text{ m/s}$   
 ↑ down

Stopping:

$v_1 = -5.86 \text{ m/s}$   
 $v_2 = 0$   
 $m = 1.5 \text{ kg}$   
 $\vec{J} = ?$

$$\vec{J} = \Delta \vec{p}$$

$$\vec{J} = m \Delta \vec{v}$$

$$\vec{J} = (1.5 \text{ kg})(0 - (-5.86 \text{ m/s}))$$

$$\vec{J} = (1.5 \text{ kg})(5.86 \text{ m/s})$$

impulse of floor on the book →

$\vec{J} = +8.8 \text{ kg} \cdot \text{m/s}$   
 $\vec{J} = 8.8 \text{ kg} \cdot \text{m/s} \text{ [up]}$

Impulse of book on floor is  $8.8 \text{ kg} \cdot \text{m/s}$  [down]

Review of Impulse & Momentum:

p208/37-40

p210/39-47

HW Probe  
 WED - Nov 13