Reminders 10-11-10:
-Turn in "Momentum" Worksheet Wednesday
-Exam 2 Ch 4-6 Mon. Oct. 18
-No QUIZ THIS WEEK

Objectives:
-Impulse
-Impulse Momentum Theorem
-Conservation of Momentum

$\boxed{F\Delta t = m\Delta v}$

Example

- Why do airbags help to protect us from serious injury in a collision?

  Increases Δt

- Suppose you jump from a height of 3.0 m. Why is it advisable to land with your legs bent instead of stiff-legged?

  Increases Δt

In both cases

Example

$F \Delta t$ is same because $V_f = 0$ $V_i = V$

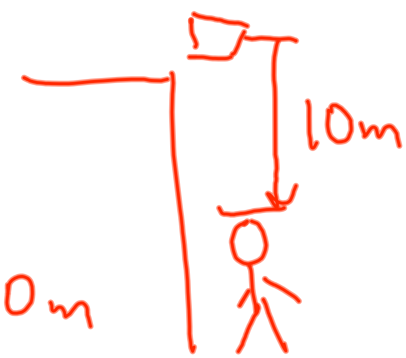
- Which will cause more damage $\Delta p = mV$
  - driving your car into a brick wall or
  - driving your car into an oncoming vehicle that has the same mass and speed but is moving in the opposite direction?

Hint: What is FΔt in both cases?

- A mischievous child drops a 1 kg flowe
the head of a person 10 m below. What
momentum of the pot upon impact?

$p = mv$

$a_y = -9.80 \frac{m}{s^2}$



$v_i = 0 \quad \Delta y = -10m$

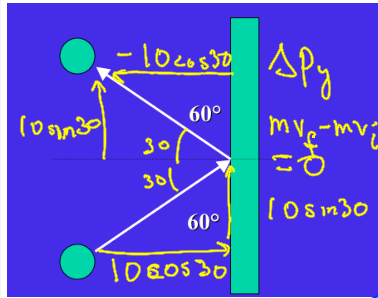
$v_f^2 = v_i^2 + 2a\Delta y$

$v_f = \sqrt{2a\Delta y} = \sqrt{2(-9.8)(-10)}$

$= -14 m/s$

$\vec{p} = (1 kg)(-14 m/s) = -14 kg\,m/s$

or $14 kg\,m/s$ down



$m = 3.0\,kg$

$|\vec{v}| = 10\,m/s$

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

$$F_x = \frac{\Delta p_x}{\Delta t} \qquad F_y = \frac{\Delta p_y}{\Delta t}$$

$$F = \sqrt{F_x^2 + F_y^2} \qquad \theta = \tan^{-1}\frac{F_y}{F_x}$$

$F_y = 0$ because $\Delta p_y = 0$
speed doesn't change
in y-dir.

$$F_x = \frac{\Delta p_x}{\Delta t} = \frac{m v_{x_f} - m v_{x_i}}{\Delta t}$$

$$= \frac{m(v_{x_f} - v_{x_i})}{\Delta t}$$

$$= \frac{3\,kg(-10\cos 30 - 10\cos 30)\,\frac{m}{s}}{0.2\,s}$$

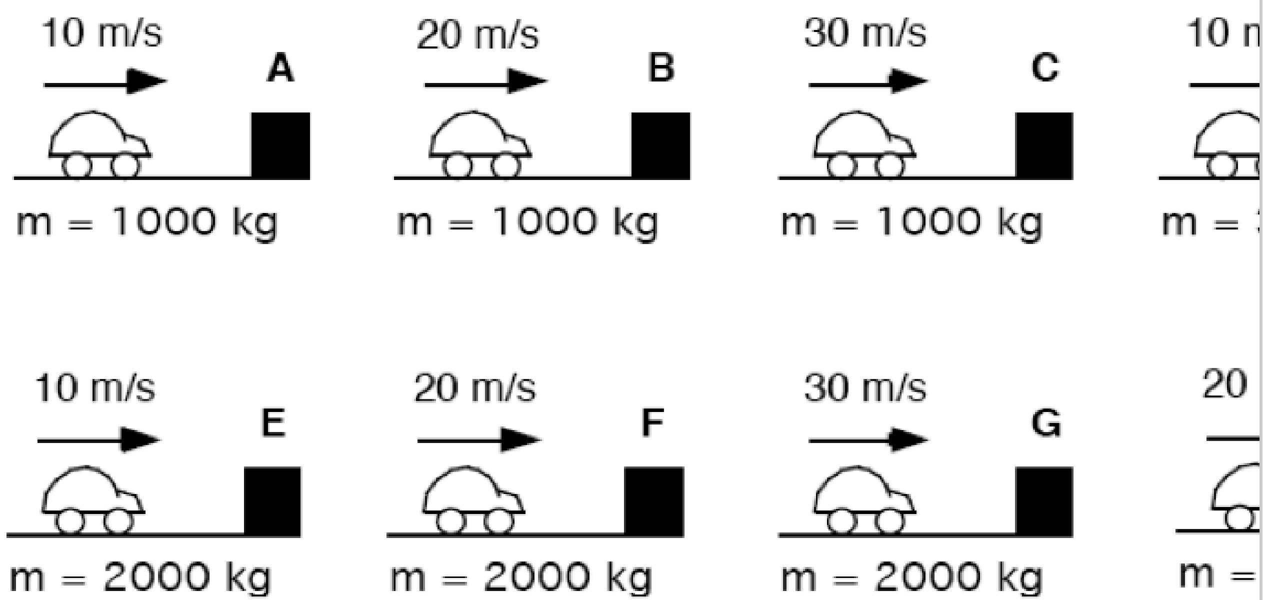
$= -260\,N =$ Force of wall on ball in -~~y~~x-dir

Force of ball on wall is 260 N in +~~y~~x-direction due to Newton's 3rd law.

Shown below are eight cars that are moving along horizontal roads at specified spe
masses of the cars. All of the cars are the same size and shape, but they are carryi
masses. All of these cars are going to be stopped by plowing into identical barri
going to be stopped by the same constant force by the barrier.

Criteria Want Biggest ΔP

Rank these situations from greatest to least on the basis of the stopping time that
he cars with the same force. That is, put first the car that requires the longest ti
hat requires the shortest time to stop the car with the same force.



G H, F, C D, B E, A

Longest 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ 7 ____ 8 ____ Shortes

PowerPoint (76)

Or, all cars require the same time.__________

Please carefully explain your reasoning.

$$m_g \vec{a}_g = -m_o \vec{a}_o$$

$$m_g \frac{\Delta \vec{v}_g}{\Delta t} = -m_o \frac{\Delta \vec{v}_o}{\Delta t}$$

$$m_g \left(\vec{v}_{fg} - \vec{v}_{ig}\right) = -m_o \left(\vec{v}_{fo} - \vec{v}_{io}\right)$$

$$\underbrace{m_g \vec{v}_{fg} + m_o \vec{v}_{fo}}_{\text{Total final momentum}} = \underbrace{m_g \vec{v}_{ig} + m_o \vec{v}_{io}}_{\text{total initial momentum}}$$

$\Sigma p_i = \Sigma p_f$;a constant!

Linear momentum is conserved in a collision as long as no external forces are present.

$$m_g \vec{a}_g = -m_o \vec{a}_o$$

$$m_g \frac{\Delta \vec{v}_g}{\Delta t} = -m_o \frac{\Delta \vec{v}_o}{\Delta t}$$

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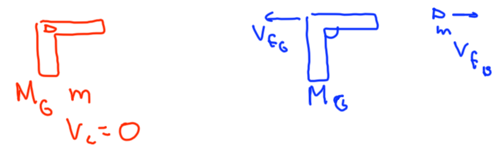
$$\Sigma \vec{p}_i = \Sigma \vec{p}_f \text{ ;a constant!}$$

Linear momentum is **conserved** in a collision as long as no external forces are present.

PowerPoint (78)

- A 2.0 kg gun fires a 5.0 g bullet. The bullet has a velocity of 6.0x10² m/s. Find the recoil velocity of the gun. Note that the momentum of the bullet is equal to the momentum of the the gun. Why does the bullet cause more damage than the gun?



$-\longleftarrow \qquad \longrightarrow +$

$$\sum \vec{p}_i = \sum \vec{p}_f$$

$$0 = M_G V_{f_G} + m V_{f_B}$$

$$M_G V_{f_G} = -m V_{f_B}$$

$$V_{f_G} = \frac{-m V_{f_B}}{M_G}$$

$$= \frac{(.005\,kg)(600\,\frac{m}{s})}{2.0\,kg}$$

$$= \underline{1.5\,m/s}$$

$$\Delta KE_G = \frac{1}{2}(2.0)(1.5\,m/s)^2 = 2\,J$$

$$\Delta KE_B = \frac{1}{2}(.005)(600)^2 = 900\,J$$

$$W = Fd$$

Bullet requires more work to stop it. So it causes more damage