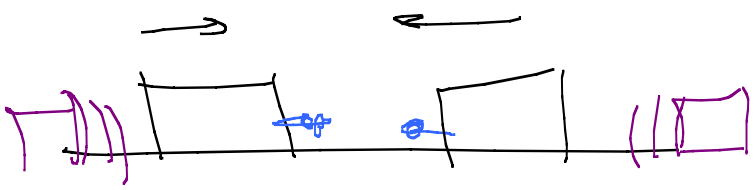
Phys 2110-3 10/25/10

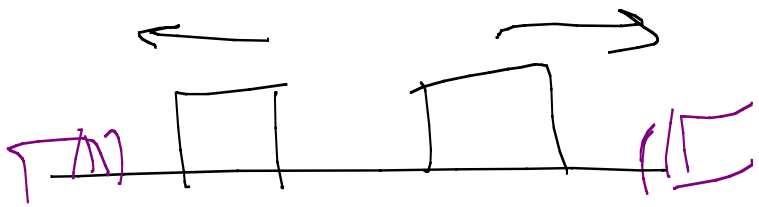
Note Title 10/25/2010

Cons. of Momentum:

Isolated system ($\vec{F}_{ext\,(net)} = 0$)

$\vec{P} = \text{const}$ $\quad m\vec{v}$ $\quad \vec{P} = \sum m\vec{v}_i$

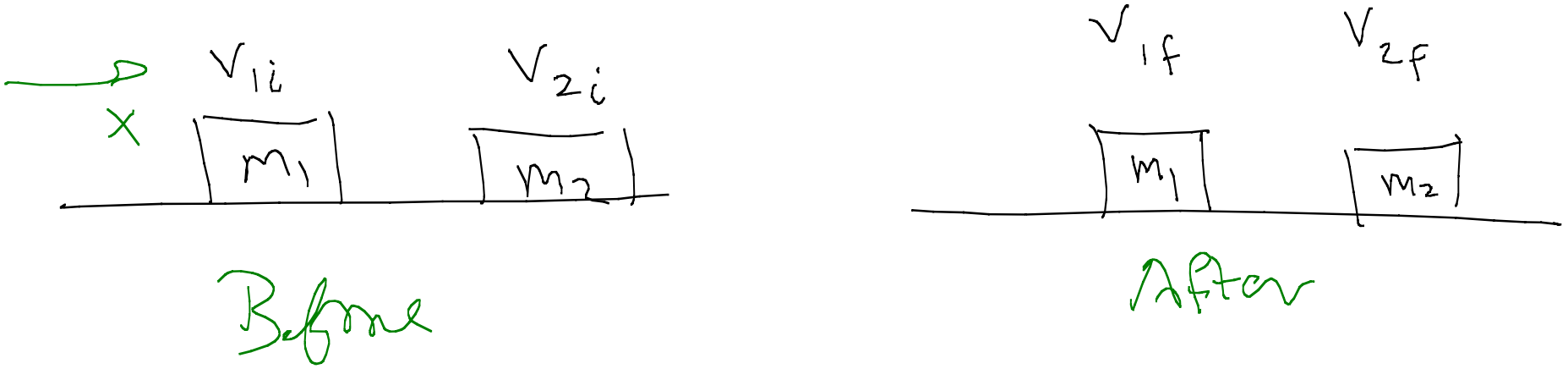




Momentum conserved

Energy may be conserved.

Consider



Before

After

Mom is cons!

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_f$$

If Collision is elastic

$$\frac{1}{2} m_1 v_{1i}^2 + \frac{1}{2} m_2 v_{2i}^2 = \frac{1}{2} m_1 v_{1f}^2 + \frac{1}{2} m_2 v_{2f}^2$$

If m_1, m_2 known v_{1i}, v_{2i} known

Can solve for v_{1f}, v_{2f}

Bad algebra

One answer

$v_{1f} = v_{1i}$ $\quad v_{2f} = v_{2i}$

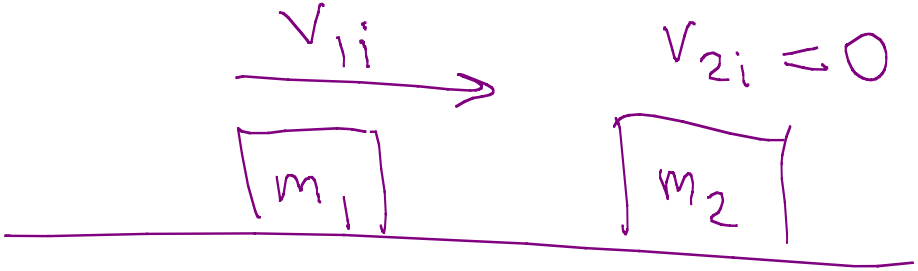
Bad solution! Throw it out.

(9.15):

$$v_{1f} = \frac{m_1 - m_2}{m_1 + m_2} v_{1i} + \frac{2m_2}{m_1 + m_2} v_{2i}$$

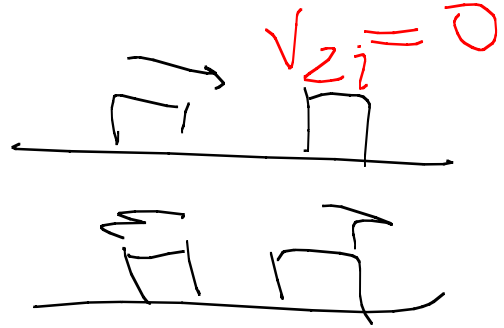
etc.

Special case



$V_{2i} = 0$

$$V_{1f} = \frac{m_1 - m_2}{m_1 + m_2} V_{1i} \qquad V_{2f} = \frac{2m_1}{m_1 + m_2} V_{1i}$$



Consider cases

$m_1 = m_2$ $\quad V_{1f} = 0 \quad V_{2f} = V_{1i}$

$m_1 << m_2$

$m_1 + m_2 \approx m_2 \quad V_{1f} = -V_{1i} \quad V_2 \cong \frac{2m_1}{m_2} V_{1i}$

$m_1 >> m_2$ $\quad V_{1f} \cong V_{1i} \quad V_{2f} = 2V_{1i}$

9.31 While playing ball in street, child accidently tosses ball at $18\frac{m}{s}$ toward front of car moving toward him at $14\frac{m}{s}$. What is speed of ball after it rebounds elastically from car.

$m \ll M$

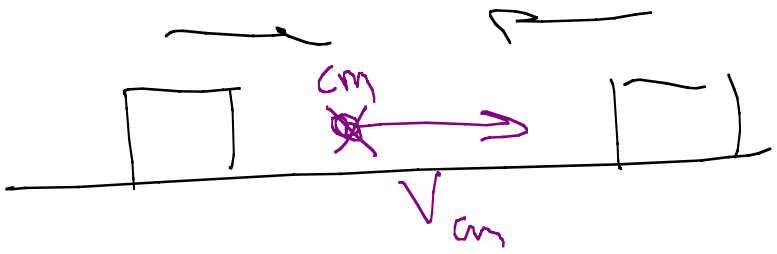
Make replacement, approx

$$v_{1f} = \frac{m_1 - m_2}{m_1 + m_2} v_{1i} + \frac{2m_2}{m_1 + m_2} v_{2i}$$

$$\approx -1 \qquad \approx 2$$

$-18 \qquad -28$

$\approx 46\frac{m}{s}$ (?)



$$v_{cm} = \frac{1}{M}\left(m_1\vec{v}_1 + m_2\vec{v}_2\right)$$

$$= \frac{\vec{p}}{M}$$

CM frame

why?

$\vec{p} = 0$ in this frame

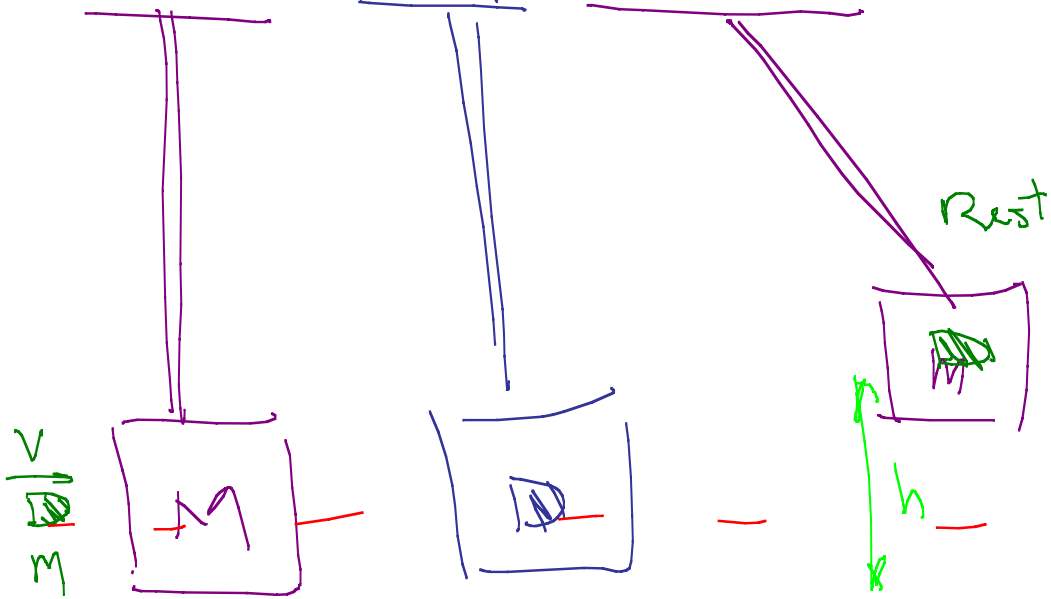
Velocities reverse

conserves momentum & energy.

Important (?) example.

Ballistic pendulum

Include another picture



Measure h, gives you speed v.

Mom cons'd

$$mv = (M+m)V$$

Energy cons'd

$$\frac{1}{2}(M+m)V^2 = (M+m)gh$$

Know $M, m, h \longrightarrow$ V

V → E cons'd

Mom is conserved

Chap 10