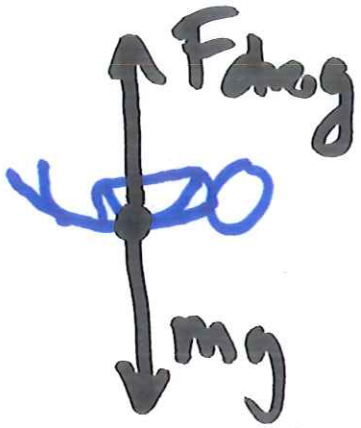
NYU Physics I – 2016-10-04.

Agenda — Reading: momentum & energy
collisions
elastic & inelastic
impulse.



— Problem sets – help.

— Exam 2: ps 3, 4; ~~09-22~~ to today.
(& cumulative).

— Qs.

— elastic collision.

linear momentum of a particle

$$\vec{p} = \gamma m \vec{v}$$

$$\gamma \equiv \sqrt{\frac{1}{1 - \frac{v^2}{c^2}}}$$

$$\vec{p} \approx m\vec{v}$$

for our purposes

kinetic energy of a particle is $\approx \frac{1}{2} m v^2$

$$E^2 = m^2c^4 + p^2c^2$$

$$KE = \sqrt{m^2c^4 + p^2c^2} - mc^2$$

$$= mc^2 \sqrt{1 + \frac{p^2c^2}{m^2c^4}} - mc^2$$

$$\approx mc^2 \left(1 + \frac{1}{2}\frac{p^2c^2}{m^2c^4}\right) - mc^2$$

if moving @ $v \ll c$

$pc \ll mc^2$

$(1+\epsilon)^n \approx 1 + n\epsilon + \ldots$

Fact! Taylor Series.

$$KE \approx \cancel{mc^2} + \frac{1}{2}\frac{p^2c^2\cancel{mc^2}}{\cancel{m^2c^4}} - \cancel{mc^2}$$

$$\approx \frac{p^2}{2m} = \frac{1}{2}mv^2$$

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① conservation vs invariance

always true — sometimes.

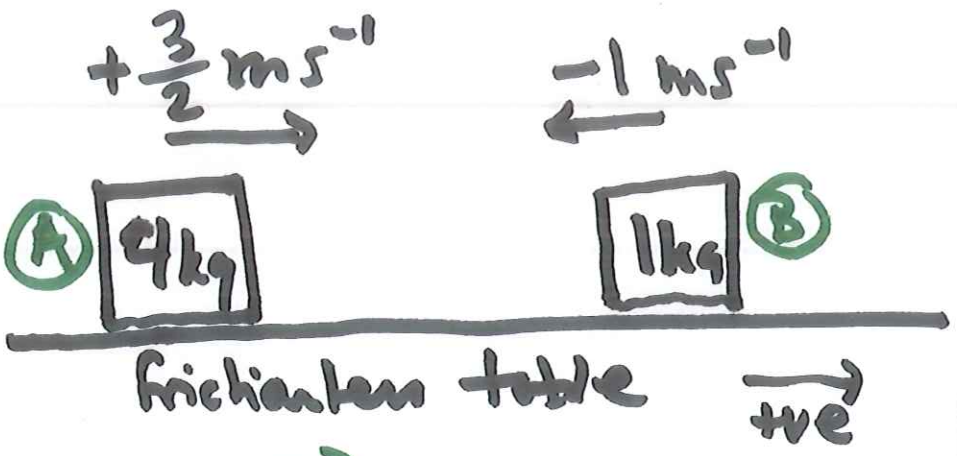
② conservation happens in a well-defined reference frame

- coordinate axes
- zero of velocity

Newtonian.

before | LAB | vacuum

after | LAB



$$\vec{V}_{com} = \frac{\vec{p}_{total}}{m_{total}} = +1\,\frac{m}{s}$$

$$\vec{p}_A = m_A\vec{v}_A = +6\,kg\,\frac{m}{s}$$

$$\vec{p}_B = m_B\vec{v}_B = -1\,kg\,\frac{m}{s}$$

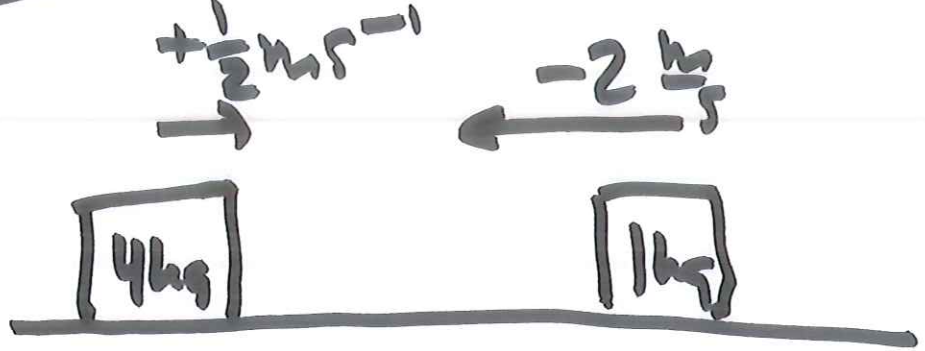
total $\boxed{\vec{p} = +5\,kg\,\frac{m}{s}}$ invariant

$$K_A = \frac{9}{2}\,kg\,\frac{m^2}{s^2} = \frac{9}{2}\,J$$

$$K_B = \frac{1}{2}\,J$$

total $\boxed{K = 5\,J}$ invariant

before com



$\vec{p}_A = +2\,kg\,m\,s^{-1}$

$\vec{p}_B = -2\,kg\,m\,s^{-1}$

$\vec{p} = 0\,kg\,m\,s^{-1}$ inv.

$K_A = \frac{1}{2}\,kg\,\frac{m^2}{s^2}$

$K_B = 2\,kg\,\frac{m^2}{s^2}$

$K = \frac{5}{2}\,kg\,\frac{m^2}{s^2}$ inv.

after com

$\vec{p} = 0\,kg\,m\,s^{-1}$