Announcements 21 Apr 09

- Homework #10
  - Online and written homework assignments due tomorrow
  - When using momentum conservation to solve a collision problem, remember that some velocities (and thus momenta) can be negative!
  - Girl on a trampoline problem: consider girl grabbing box like a collision
- Monday schedule will be observed today:
  - Lecture at 9:05 am
  - Early office hours (2:00 to 3:30 pm)
  - SI session @ LRC (7:15 to 8:30 pm)

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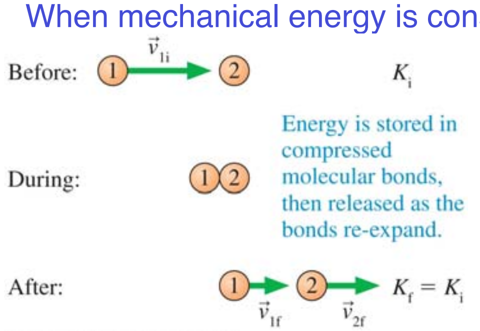
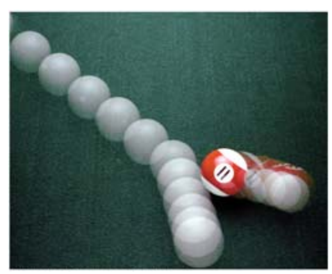
Elastic vs. inelastic collisions

(Perfectly) Elastic collision:

When mechanical energy is conserved

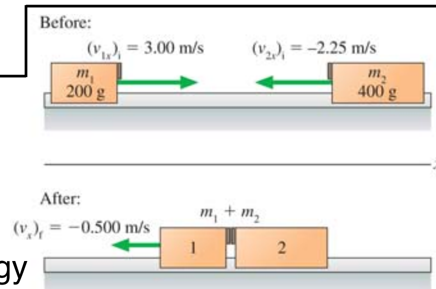




(Perfectly) Inelastic collision:

When colliding objects "stick" together after the collision

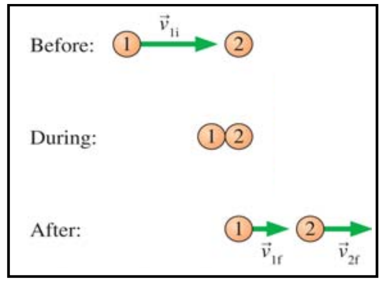
Some of the mechanical energy is transformed into thermal energy



Elastic collisions

Perfectly Elastic collision:

here we have $(v_{2x})_i = 0$



Momentum conservation along x axis:

$$m_1(v_{1x})_i = m_1(v_{1x})_f + m_2(v_{2x})_f$$

Cannot determine the final velocities even if the initial velocities are known, but…

Mechanical energy conservation ($\Delta E_{th} = 0$):

$$\tfrac{1}{2}m_1(v_{1x})_i^2 = \tfrac{1}{2}m_1(v_{1x})_f^2 + \tfrac{1}{2}m_2(v_{2x})_f^2$$

Momentum conservation + energy conservation yield:

$$(v_{1x})_f = \frac{m_1 - m_2}{m_1 + m_2}(v_{1x})_i$$

$$(v_{2x})_f = \frac{2m_1}{m_1 + m_2}(v_{1x})_i$$

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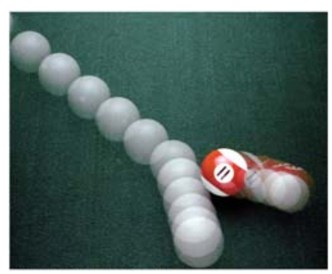
Elastic vs. inelastic collisions

Note:



Momentum conservation applies to both elastic and inelastic collisions if there is no external force (or this force can be neglected during the short time over which a collision occurs)

DEMOS: gliders on air track

Newton's cradle

double ball drop

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Power

- Two cars with the same mass...
- Both reach 60 mph...

Same final kinetic energy, but **different times mean different powers**

$$P = \frac{W}{\Delta t}$$

Unit of power:
1 Watt = 1 J / s

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Power question

PRS

Five toy cars accelerate from rest to their top speed in a certain amount of time. The masses of the cars, the final speeds, and the time to reach this speed are noted in the table. Which car has the greatest power?

Car	Mass (g)	Speed (m/s)	Time (s)
A	100	3	2
B	200	2	2
C	200	2	3
D	300	2	3
E	300	1	4

$$P = \frac{W}{\Delta t}$$

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Power question

PRS

Car	Mass (g)	Speed (m/s)	Time (s)
A	100	3	2
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D	300	2	3
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$$P = \frac{W}{\Delta t}$$

$$\Delta K + \Delta U = W$$

Treat engine as applying a force external to the system (= car), thereby doing work on the system (transferring energy to the system)

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Muscle power problem

A 58 kg female athlete raised a 78 kg bar by a vertical distance of 1.5 m in 2.4 s. What is the power output of the weightlifter?

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Muscle power problem

A 58 kg female athlete raised a 78 kg bar by a vertical distance of 1.5 m in 2.4 s. What is the power output of the weightlifter?

System: bar + earth
Environment: weightlifter does work on the system

Energy conservation:

$$\Delta K + \Delta U = W$$

$$0 + (U_f - U_i) = W$$

$$0 + (mgh - 0) = W$$

$$\Rightarrow W = (78kg)\times(9.8m/s^2)\times(1.5m) = 1150J$$

Power output:

$$P = \frac{W}{\Delta t} = \frac{1150J}{2.4s} = 480W$$

Know:

$m = 78kg$

$h = 1.5m$

$\Delta t = 2.4s$

Find:

$P = ?$

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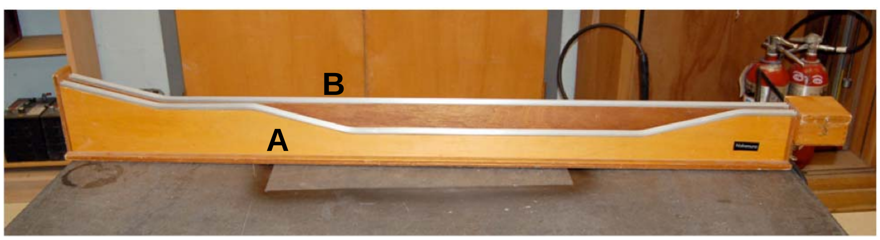
Racing track question

PRS

Two identical balls roll down separate tracks. They are released at the same time from the highest point. Which of the two balls will first arrive at the end of its track? Neglect friction.



A. Ball rolling down track A (in front) will arrive first.
B. Ball rolling down track B (in back) will arrive first.
C. The two balls will arrive at the same time.

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Racing track question

PRS

Two identical balls roll down separate tracks. They are released at the same time from the highest point. Which of the two balls will first arrive at the end of its track? Neglect friction.

A. Ball rolling down track A (in front) will arrive first.
B. Ball rolling down track B (in back) will arrive first.
C. The two balls will arrive at the same time.

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