

Thurs: Discussion / quiz

Ex 264, 267, 268, 269, 270, 273, 274

Conservation of momentum

Situations where multiple objects interact can be analyzed in terms of momentum

Momentum

Total (net) momentum

$$\vec{p} = \vec{p}_1 + \vec{p}_2 + \dots$$

where

$$\vec{p}_i = m_i \vec{v}_i$$


Conservation of momentum

If the net external force on a system is zero, then the total momentum stays constant.

This is particularly useful for systems of objects that are isolated (then there will be no net external force)

Warm Up!

Quiz! 20%

DEMO: Happy / sad ball

We can analyze this with some (invented) numbers.

Happy

Momentum

	Ball	Block	Total
Before	15kg m/s	+ 0 kg m/s	= 15kg m/s
After	-15kg m/s	+ 30 kg m/s	= 15kg m/s



Sad

Momentum

	Ball	Block	Total
Before	15kg m/s	+ 0 kg m/s	= 15kg m/s
After	0 kg m/s	+ 15 kg m/s	= 15kg m/s

### Elastic and inelastic collisions

Although momentum is conserved in collisions between parts of a system that is effectively isolated, this does not determine exactly how a collision will unfold.

In some collisions the total kinetic energy will be the same after as before. Such a collision is called elastic.

DEMO: PhET Collision Lab - show various types of collisions  
- use same masses, vary elasticity

Any other collision is called inelastic. An extreme version of an inelastic collision is where two objects stick together.

Warm Up 2

## Rocket propulsion

Momentum conservation explains how rockets can be propelled. The rocket operates by burning fuel and ejecting the resulting gas.



Demo: Mentos Rocket video

Demo: Swimming scallop video