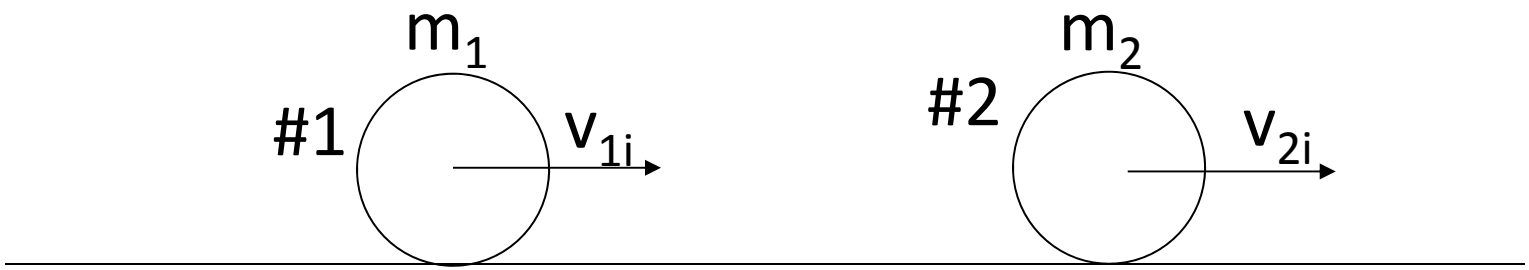
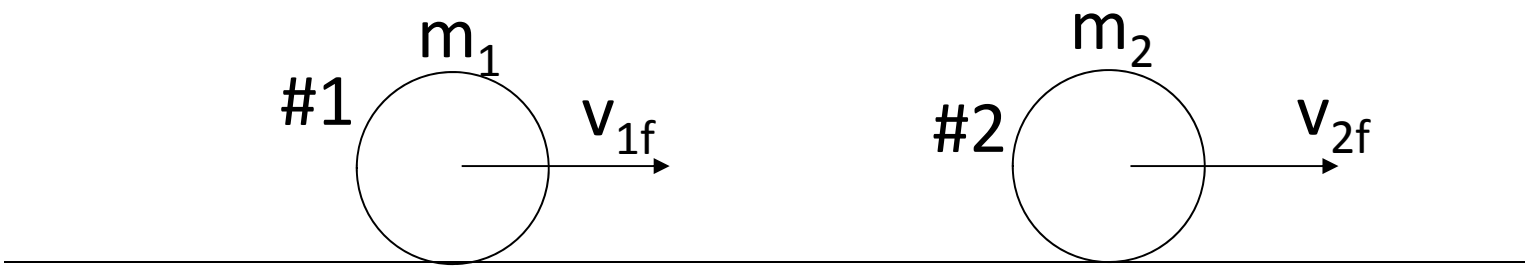
Class 29: More collisions

Simple collision problem in 1D

Before collision:



After collision:



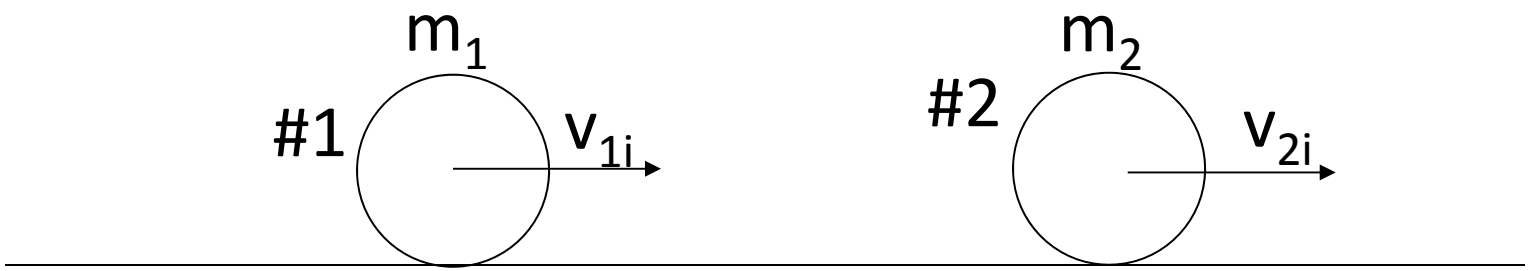
Equation of motion:

$$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$$

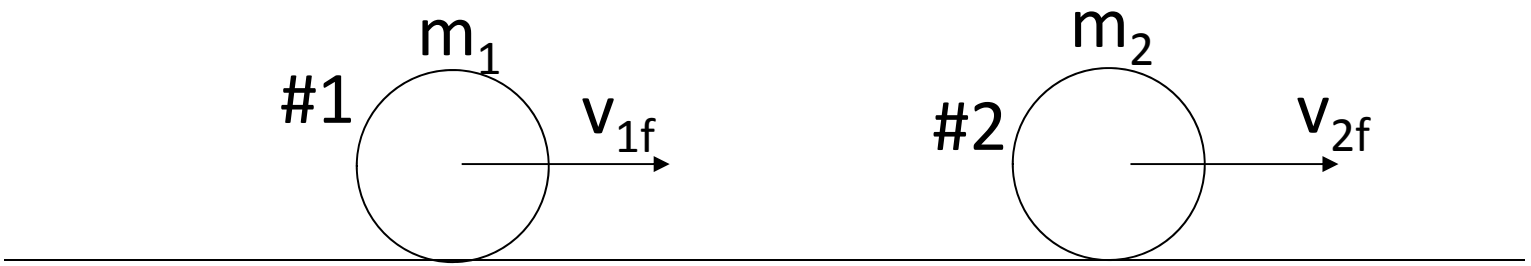
Can solve for any one unknown from v_{1i}, v_{2i}, v_{1f} and v_{2f} .

Warning: not in textbook, we are using a different approach here.

"Quality" of collision (coefficient of restitution)



After collision:



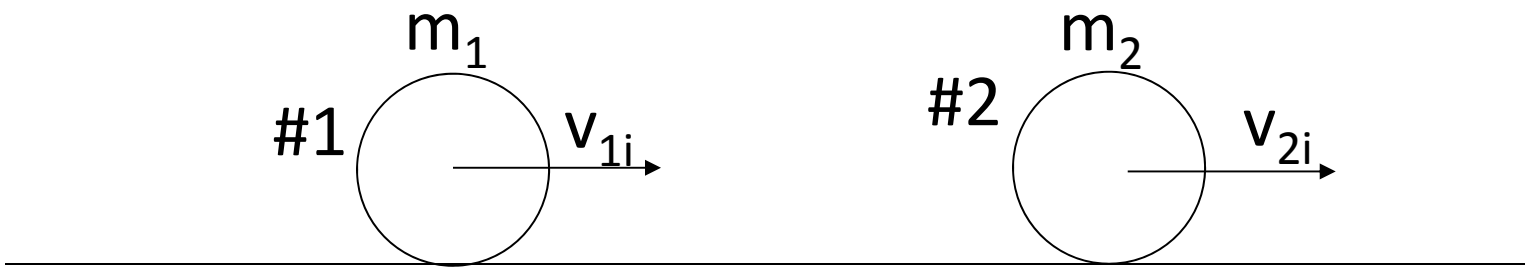
Coefficient of restitution

$$e = -\frac{v_{2f} - v_{1f}}{v_{2i} - v_{1i}} = -\frac{v_{1f} - v_{2f}}{v_{1i} - v_{2i}}$$

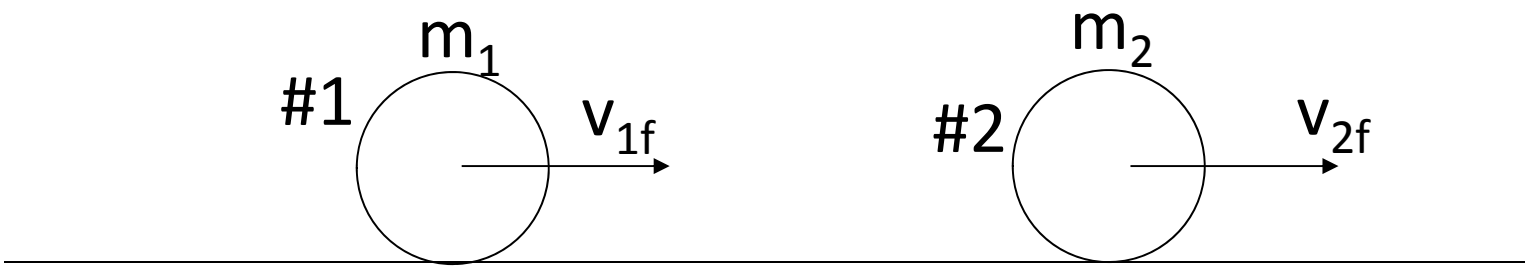
$$= -\frac{\text{relative velocity after collision}}{\text{relative velocity before collision}}$$

Simple collision problem in 1D

Before collision:



After collision:



Equation of motion:

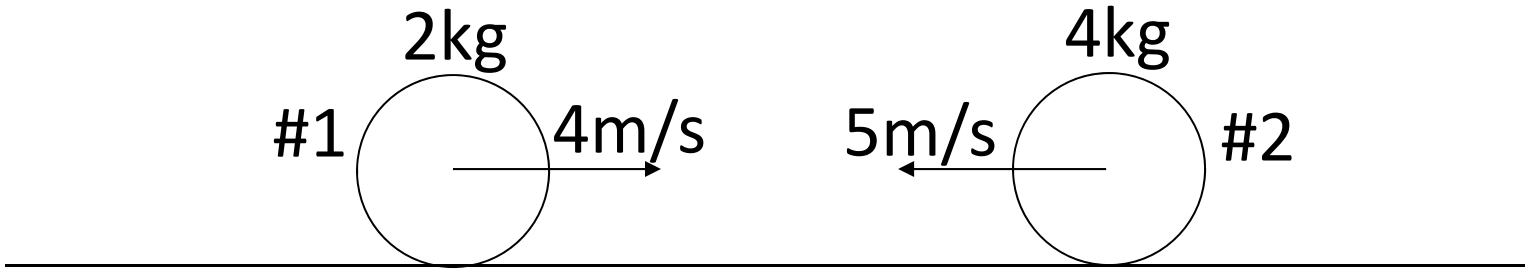
$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$e = -\frac{v_{2f} - v_{1f}}{v_{2i} - v_{1i}}$$

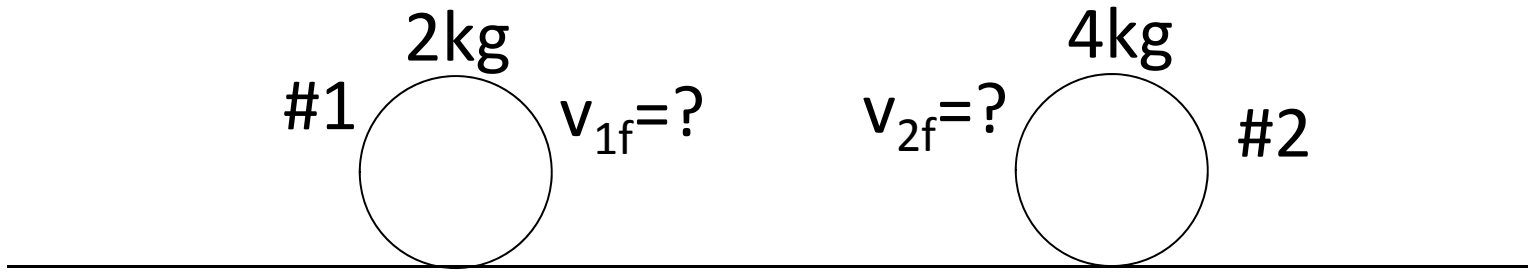
With e given, can solve for any two unknowns from v_{1i}, v_{2i}, v_{1f} and v_{2f}.

Example 2

Before collision:



After collision:

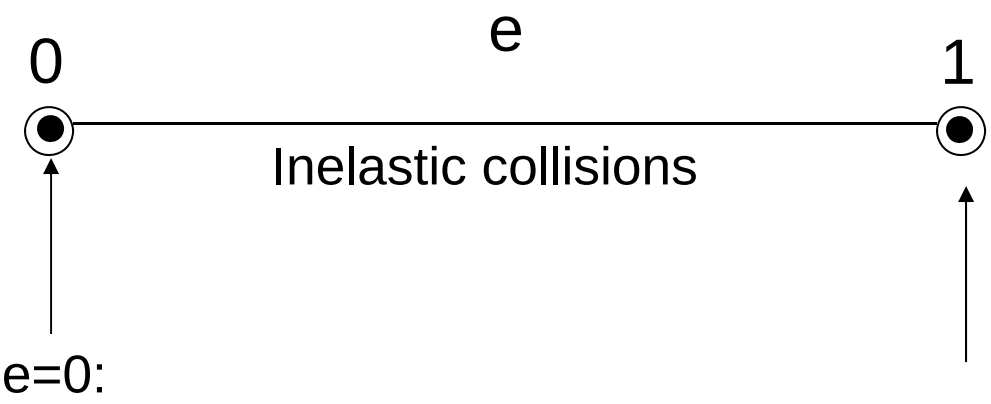


What are V_{1f} and V_{2f} if e = 1/3 ?

Warning: not in textbook, we are using a different approach here.

Meaning of e

1. $0 \leq e \leq 1$
2. e is related to the mechanical energy lost in the collision.

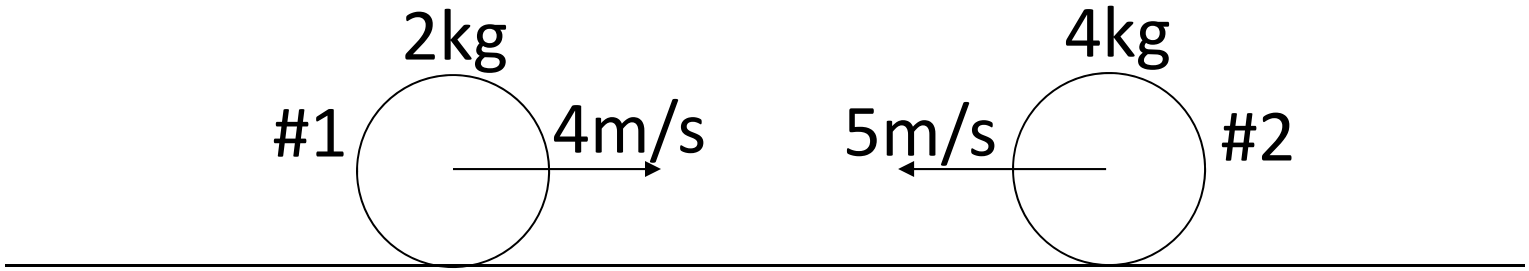


e=0:
Maximum mechanical energy is lost.
Completely inelastic collision.
Objects stick together after collision.

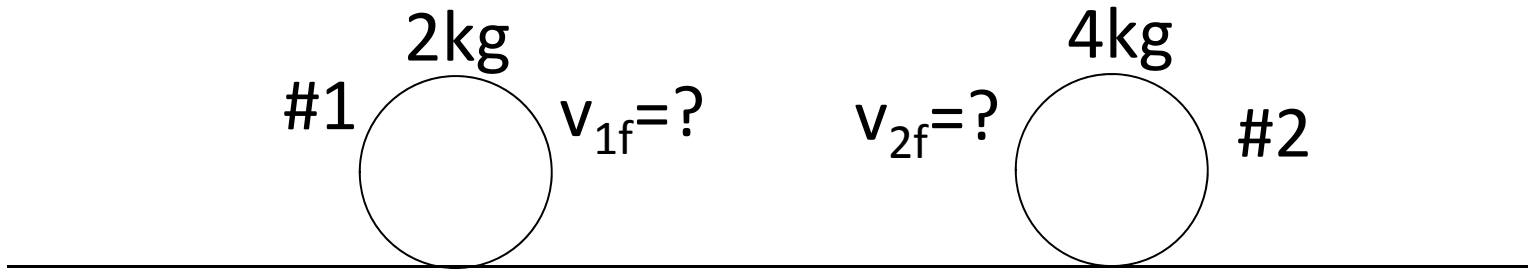
e=1:
No mechanical energy is lost.
Elastic collision.

Example 3

Before collision:



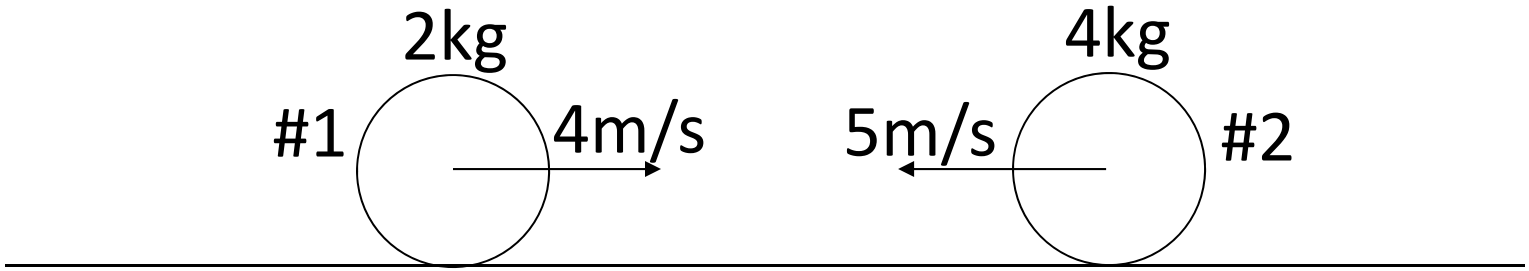
After collision:



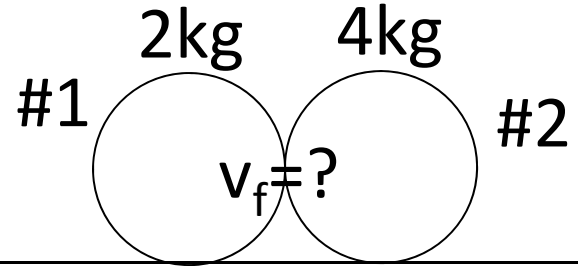
What are V_{1f} and V_{2f} if this is an elastic collision?

Example 5

Before collision:



After collision:



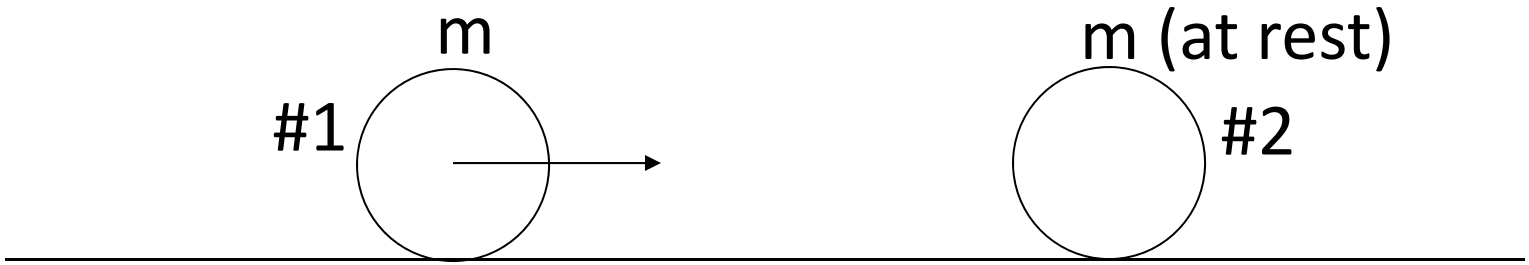
What is V_f if the balls stick together and move with the same velocity after the collision?

How much energy is lost during collision?

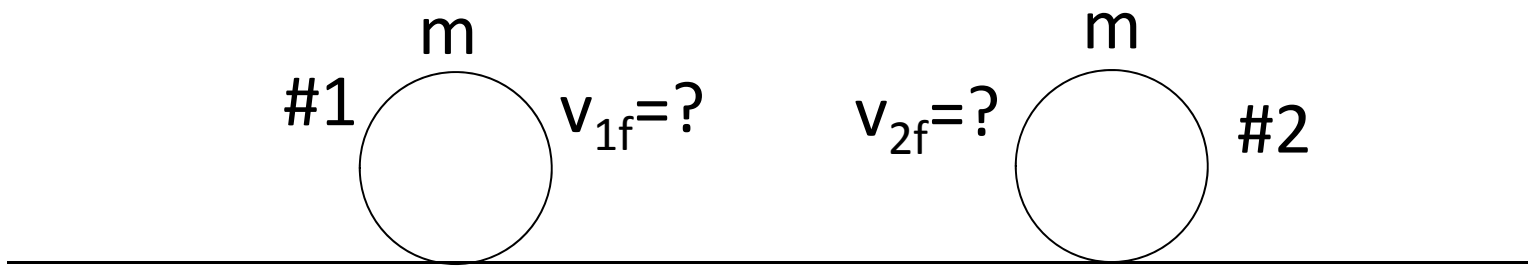
Example 4

Balls have equal mass

Before collision:



After collision:



What are V_{1f} and V_{2f} if this is an elastic collision?