Physics 121 – October 16, 2009

Today:
- Collisions -- examples
- Homework problems due today
  Chap 9, # 16, 17, 19, 21, 26, 29, 30, 51, 60, 66

Over the weekend:
- Start reading Chapter 10 – Rotation
- Mastering Physics #7 due Sunday Oct 18.

Next week:
- Finish reading & review Chapter 10 – Rotation
- Homework problems due Friday, Oct 23
- Chap 10, # 17, 19, 23, 25, 33, 34, 35, 40

Inelastic Collisions

1. Momentum is conserved $\vec{P}_i = \vec{P}_f$

Note: in 2-dimensions, you get separate eq's for x and y components, e.g.

$$m_1 v_{1xi} + m_2 v_{2xi} + ... = m_1 v_{1xf} + m_2 v_{2xf} + ...$$
$$m_1 v_{1yi} + m_2 v_{2yi} + ... = m_1 v_{1yf} + m_2 v_{2yf} + ...$$

2. Kinetic energy is ***not*** conserved $K_i \neq K_f$

(energy is dissipated as heat, sound or permanent deformation)

Totally Inelastic Collisions

1. Same as above: momentum is conserved, kinetic energy is not conserved
2. Two objects stick together (have the *same* final velocity), so

$$m_1 \vec{v}_1 + m_2 \vec{v}_2 = (m_1 + m_2)\vec{v}_f \quad \text{(totally inelastic collision)} \qquad (9.11)$$

Note: this usually makes the problem a little simpler

Elastic Collisions

1. Momentum is conserved $\vec{P}_i = \vec{P}_f$

Again, you will get two equations if this is a 2-D collision

2. Kinetic energy is conserved $K_i = K_f$

You only get *one* equation here because this is a scalar relation

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

Good practices for solving collision problems:

1. Draw 2 cartoons showing the positions of your objects:
   - One *before* the collision (for setting up equations with *initial* subscripts)
   - One *after* the collision (for setting up equations with *final* subscripts)
2. Figure out what kind of collision you are dealing with (inelastic, totally inelastic, or elastic)
3. See if you can reduce it to a one-dimensional problem. If not, set up your x and y axis in a way that is most convenient.

Elastic collisions in one dimension

Note that the collision must be **head-on** to be 1-D

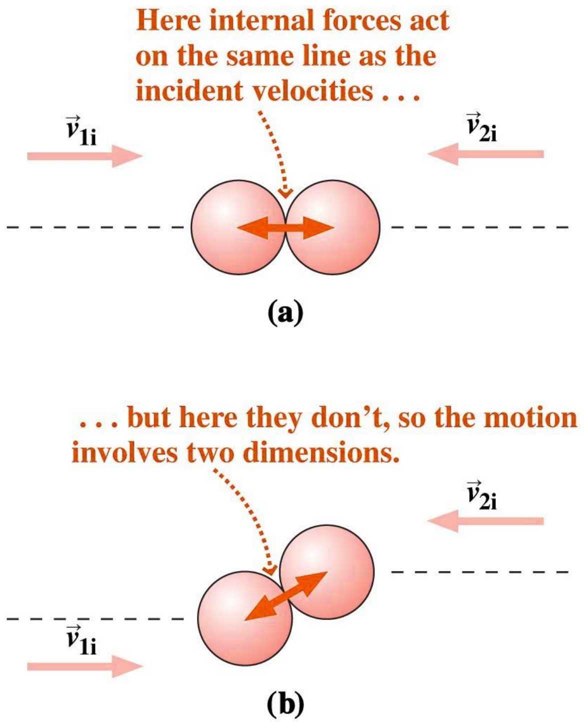
Final velocities given by eq's 9.15a and 9.15b

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

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

The collision must be 1-D, just 2 particles!

Pay attention to the signs of the velocities!

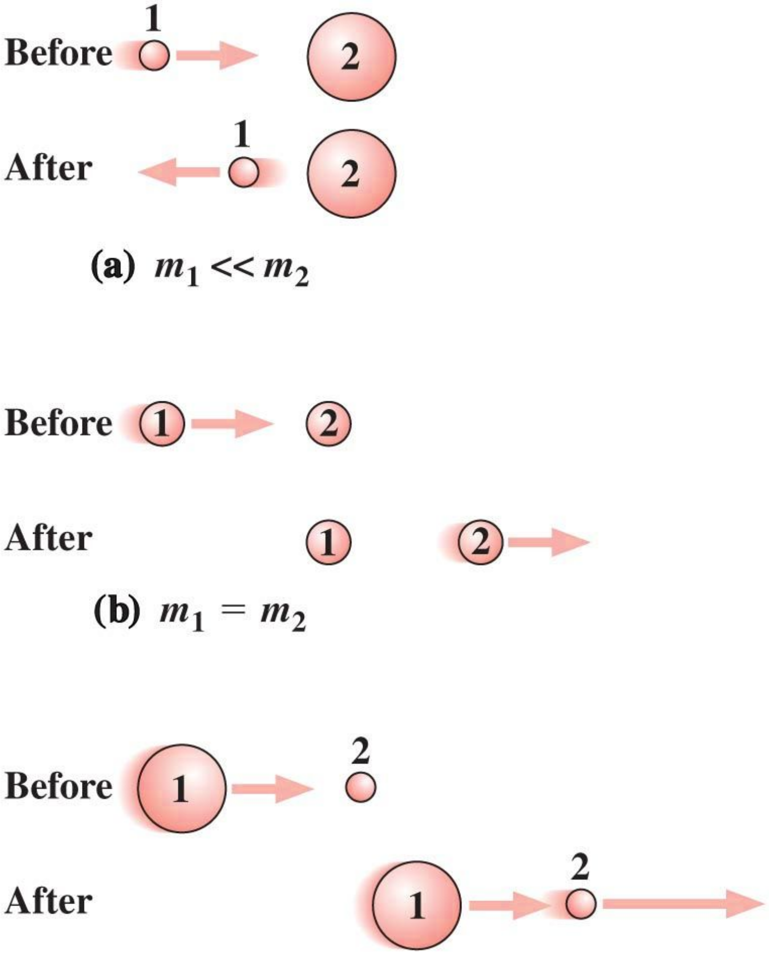


Iclicker:

One ball is at rest on a level floor. A second ball collides elastically with the first, and the two move off separately but **in the same direction**. What can you say about masses of the two balls?

A. not enough information to say anything.
B. the masses are **equal**
C. the mass of the first ball is much **less** than the mass of the second ball
D. the mass of the first ball is much **greater** than the mass of the second ball

Special cases of elastic collisions in 1-D, where $v_{2i} = 0$



(a) $m_1 << m_2$

(b) $m_1 = m_2$

(c) $m_1 >> m_2$