Physic² 121:
Phundament°ls of Phy²ics I

October 20, 2006

Momentum

Chapter 6

Momentum

- From before:
  - $F\Delta t$ is called Impulse, I
  - mv is called momentum
  - Momentum usually denoted as p

$$\vec{I} = \vec{F}\Delta t$$

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

$$\vec{I} = \Delta\vec{p} \qquad \vec{F}\Delta t = \Delta\vec{p}$$

- Note: This is really just N2 written in a different way
- Momentum is conserved in collisions

$$\vec{p}_{Total,i} = \vec{p}_{Total,f}$$

Glancing Collisions

- For a general collision of two objects in three-dimensional space, the conservation of momentum principle implies that the *total momentum of the system in each direction is conserved*
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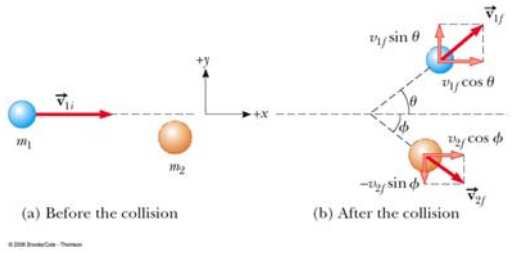
  - Use subscripts for identifying the object, initial and final velocities, and components

$$m_1 v_{1ix} + m_2 v_{2ix} = m_1 v_{1fx} + m_2 v_{2fx} \text{ and}$$
$$m_1 v_{1iy} + m_2 v_{2iy} = m_1 v_{1fy} + m_2 v_{2fy}$$

Glancing Collisions



- The “after” velocities have x and y components
- Momentum is conserved in the x direction and in the y direction
- Apply conservation of momentum separately to each direction

Problem Solving for 2-D Collisions

- **Coordinates:** Set up coordinate axes and define your velocities with respect to these axes
  - It is convenient to choose the x- or y- axis to coincide with one of the initial velocities
- **Draw:** In your sketch, draw and label all the velocities and masses

Problem Solving for 2-D Collisions, 2

- **Conservation of Momentum:** Write expressions for the x and y components of the momentum of each object before and after the collision
- Write expressions for the total momentum before and after the collision in the x-direction and in the y-direction

Example Problem 6.45

- A billiard ball moving at 5.00 m/s strikes a stationary ball of the same mass. After the collision, the first ball moves at 4.33 m/s at an angle of 30° with respect to the original line of motion.
- Find the velocity (magnitude and direction) of the second ball after the collision.