Conservation of Momentum in Two Dimensions

During a **glancing collision**, the objects involved are deflected in more than one dimension. In a typical curling shot, for example, the stones that collide move away at various angles because the collision was not a **head-on collision**.

Example 1

Two identical curling stones of mass $19.5\ kg$ collide. The first stone hits the stationary second stone with a velocity of $5.0\ m/s\ [N]$. If the velocity of the first stone is $3.2\ m/s\ [30°\ W\ of\ N]$ after the collision, find the velocity of the second stone after the collision. Assume friction is not a factor.

Example 2

A $5.0\ kg$ bomb at rest explodes into three pieces, each of which travels parallel to the ground. The first piece, with a mass of $1.2\ kg$, travels at $5.5\ m/s$ at an angle of $20°\ S\ of\ E$. The second piece has a mass of $2.5\ kg$ and travels $4.1\ m/s$ at an angle of $25°\ N\ of\ E$. Determine the velocity of the third piece.

Momentum Worksheet #4

1. A $2.0\ kg$ steel ball rolling at $5.0\ m/s\ [W]$ strikes a second steel ball of equal mass at rest. After a glancing collision, the first ball is deflected $[35°\ W\ of\ N]$ at $3.0\ m/s$. Determine the velocity of the second ball. ($4.1\ m/s\ [37°\ S\ of\ W]$)

2. A hockey player of mass $85\ kg$, traveling at $15\ m/s\ [N]$, collides with another hockey player of mass $70\ kg$ traveling at $5.0\ m/s\ [E]$. If the two players lock skates during the collision and are held together, find the resultant velocity of the pair. ($8.3\ m/s\ [16°\ E\ of\ N]$)

3. A $0.5\ kg$ grenade explodes horizontally into three pieces. The first piece has a velocity of $10\ m/s\ [N]$ and a mass of $0.10\ kg$. The second piece has a velocity of $5.0\ m/s\ [10°\ E\ of\ S]$ and a mass of $0.20\ kg$. Find the velocity of the third piece. ($0.87\ m/s\ [5°\ S\ of\ W]$)

4. A billiard ball of mass $0.50\ kg$, moving with a velocity of $2.0\ m/s\ [forward]$, strikes a second ball of mass $0.30\ kg$, initially at rest. A glancing collision causes the first ball to be deflected at an angle $30°$ to the left of its original direction with a speed of $1.5\ m/s$. Determine the velocity of the second ball after collision. ($1.7\ m/s\ [47°\ Right\ of\ Forward]$)