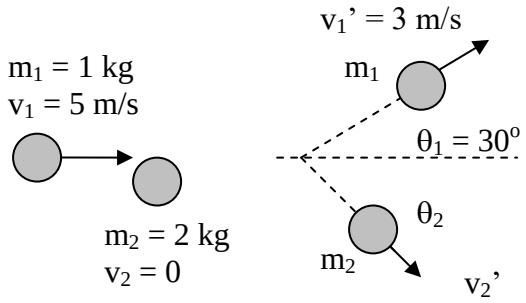
2D Elastic Collision Problem: Walkthrough

Name: _____ Date: _____

A mass m_1 traveling to the right with a speed v_1 makes a glancing collision with a mass m_2 initially at rest. After the collision the masses have speeds v_{1f} and v_{2f} and move in directions θ_1 and θ_2, as shown below.



The problem here is to find the final velocity of mass 2 after the collision. Proceed as follows:

(a) Is kinetic energy conserved? (You are not told that the collision is elastic, so don't make this assumption. The fact that the balls rebound doesn't make the collision perfectly elastic.)

(b) Is momentum conserved? (Momentum is always conserved if you can neglect *external* forces during the collision.)

(c) Momentum is a <u>vector</u>. This means that momentum must be conserved for the x-direction and for the y-direction. What is the total x-component of momentum before the collision? What is the total y-component before the collision?

p_x = _____

p_y = _____

(d) What are the total x- and y-components of momentum *after* the collision? (Think conservation of momentum.)

P_{xf} = _____

P_{yf} = _____

(e) What are the x- and y-components of momentum of mass 1 after the collision? (You know its speed and direction, so you can calculate its momentum.)

p_{1xf} = = _____

p_{1yf} = = _____

(f) What are the x- and y-components of the momentum of mass 2 after the collision? Use the fact that the total momentum is the sum of the momenta of each particle.

$p_{xf} = p_{1xf} + p_{2xf}$

$p_{yf} = p_{1yf} + p_{2yf}$

So,

p_{2xf} = _____

p_{2yf} = _____

(g) From p_{2xf} and p_{2yf}, find v_{2xf} and v_{2yf}.

$v_{2xf} = p_{2xf}/m_2$ = _____ , $v_{2yf} = p_{2yf}/m_2$ = _____

(h) Now find v_{2f} and θ_2. (include a diagram)

v_{2f} = _____

θ_2 = _____