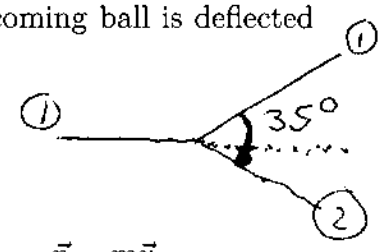
Quiz 5 – PH241 **Name**_____ ☐ **Pledged**

A ball moving at 5.8 m/s (ball 1) makes an off center **elastic** collision with a ball which is at rest (ball 2) and twice the mass of the moving ball. The incoming ball is deflected at an angle of 35° from its original direction of motion.

(A) Set up the three equations of conservation for this problem

(B) What is the speed of ball 1 after the collision?

(C) What is the velocity components of ball 2 after the collision?



Draw picture, label axis, etc... $K = \frac{1}{2}mv^2 = \frac{1}{2}mv_x^2 + \frac{1}{2}mv_y^2$ $\vec{p} = m\vec{v}$

A) $\vec{P}_i = \vec{P}_f$

(1) x: $m(5.8\,m/s) = mV_1'\cos 35^\circ + 2m(V_{2x}')$

(2) y: $0 = mV_1'\sin 35^\circ + 2m(V_{2y}')$

$E_i = E_f$

(3) $\frac{1}{2}m(5.8\,m/s)^2 = \frac{1}{2}mV_1'^2 + \frac{1}{2}(2m)V_2'^2 = \frac{1}{2}mV_1'^2 + \frac{1}{2}(2m)V_{2x}'^2 + \frac{1}{2}(2m)V_{2y}'^2$

(2) $V_1' = -\frac{2V_{2y}'}{\sin 35^\circ}$ or $V_{2y}' = -\frac{V_1'\sin 35^\circ}{2}$

(1) $V_{2x}' = \frac{(5.8\,m/s - V_1'\cos 35^\circ)}{2}$

Now Plug into (3)

(3) $(5.8\,m/s)^2 = V_1'^2 + \frac{(5.8\,m/s - V_1'\cos 35^\circ)^2}{4} + \frac{V_1'^2\sin^2 35^\circ}{4}$

$(5.8\,m/s)^2 = \frac{5}{4}V_1'^2 - \frac{5.8\,m/s\,V_1'\cos 35^\circ}{2} + \frac{(5.8\,m/s)^2}{4}$

$3(5.8\,m/s)^2 + 2(5.8\,m/s)\cos 35^\circ V_1' - 5V_1'^2 = 0$

Quadratic Eq.! ⇒

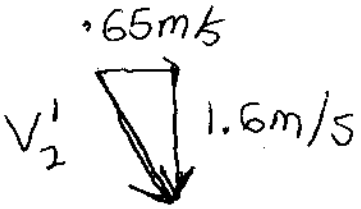
$$101 + 9.5V_1' - 5V_1'^2 = 0$$

$$\frac{-9.5 \pm \sqrt{(9.5)^2 + 4(5)(101)}}{-10} = V_1$$

$\boxed{V_1 = 5.5\ m/s}$ (neg ans is not physical)

① $V_{2x}' = \frac{(5.8\ m/s - 5.5\ m/s \cos 35^\circ)}{2} = \boxed{.65\ m/s}$

② $V_{2y}' = \frac{(-5.5\ m/s)\sin 35^\circ}{2} = \boxed{-1.6\ m/s}$



helpful math

$$\frac{-b \pm \sqrt{b^2-4ac}}{2a} = x$$

$$\sin^2 35 + \cos^2 35 = 1$$