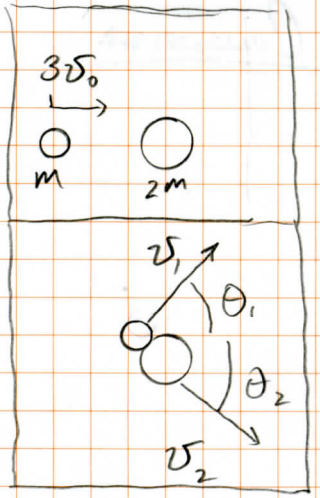
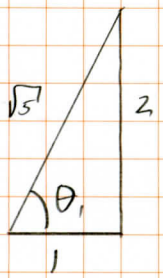
T4 Pr 8.89

TWO OBJECTS COLLIDE AS SHOWN
a) FIND v_2, THE SPEED OF THE LARGE MASS AND THE ANGLE θ_2
b) SHOW THE COLLISION IS ELASTIC.



$v_1 = \sqrt{5}\,v_0$

$\tan\theta_1 = 2$



a) MOMENTUM IS CONSERVED

$$\vec{p}_i = \vec{p}_f$$

$$\Rightarrow m(3v_0) = (m)v_1\cos\theta_1 + (2m)v_2\cos\theta_2$$

USING THE TRIANGLE

$$3v_0 = \sqrt{5}v_0\left(\frac{1}{\sqrt{5}}\right) + 2v_2\cos\theta_2$$

$$2v_0 = 2v_2\cos\theta_2$$

$$\Rightarrow v_2\cos\theta_2 = v_0$$

AND $\quad 0 = (m)v_1\sin\theta_1 - (2m)v_2\sin\theta_2$

$$\sqrt{5}v_0\left(\frac{2}{\sqrt{5}}\right) = 2v_2\sin\theta_2$$

$$2v_0 = 2v_2\sin\theta_2$$

$$\Rightarrow \quad v_0 = v_2\sin\theta$$

EQUATE v_0's

$$v_2\cos\theta_2 = v_2\sin\theta_2$$

$$\cos\theta_2 = \sin\theta_2$$

$$\Rightarrow \boxed{\theta_2 = \frac{\pi}{4} = 45^\circ}$$

$$\Rightarrow v_2 = \frac{v_0}{\cos\theta_2} = \boxed{\sqrt{2}v_0 = v_2}$$

b) IF ENERGY IS CONSERVED, (NO POTENTIAL ENERGY)

$$\Rightarrow T_i = T_f$$

$$\tfrac{1}{2}m(3v_0)^2 = \tfrac{1}{2}m\left(\sqrt{5}v_0\right)^2 + \tfrac{1}{2}(2m)\left(\sqrt{2}v_0\right)^2$$

T4 PR 8.89 CONTINUED

$$9v_0^2 = 5v_0^2 + 4v_0^2$$

$$\boxed{9v_0^2 = 9v_0^2}$$ YEA! $\vec{L}$ IS CONSERVED