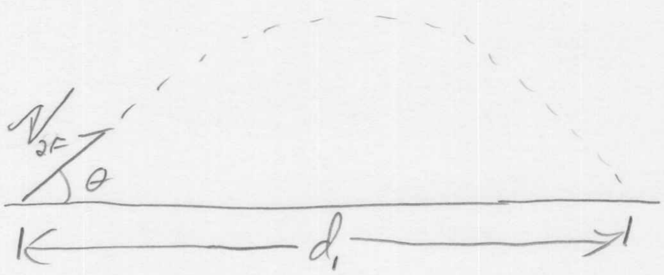
Physics 111
Homework

9-52

$m_1 = 65\,kg$
$m_2 = 4.5\,kg$
$V_2 = 12.0\,m/s$
$d = 15.2\,m$

Conserve momentum in the x, but not the y because "normal" force is external

Have to solve trajectory to get angle



x	y
$d_1 = V_{2F}\cos\theta\, t$	$0 = V_{2F}\sin\theta\, t - \frac{1}{2}gt^2$

$$t = \frac{2V_{2F}\sin\theta}{g}$$

$$d_1 = \frac{1}{g}2V_{2F}^2\sin\theta\cos\theta$$

Now, $d_T = d_1 + d_2$ where d_2 is how far you have moved since throwing the rock:

continued

9-52 continued

① $d_T = \frac{1}{g} 2 v_{2F}^2 \sin\theta\cos\theta + v_{1F} \frac{2 v_{2F}\sin\theta}{g}$

conserve x-momentum

$m_1 v_{1F} = m_2 v_{2F} \cos\theta$

$$v_{1F} = \frac{m_2}{m_1} v_{2F} \cos\theta$$

$d_T = \frac{2}{g}\left(v_{2F}^2 \sin\theta\cos\theta + \frac{m_1}{m_2} v_{2F}^2 \sin\theta\cos\theta \right)$

$\frac{g\, d_T}{2 v_{2F}^2} = \sin\theta\cos\theta \left(1 + \frac{m_1}{m_2}\right)$

$2\sin\theta\cos\theta = \frac{m_2}{m_1 + m_2} \frac{g\, d_T}{2 v_F^2}$

note: $2\sin\theta\cos\theta = \sin(2\theta)$ Famous trig ID

$\sin(2\theta) = \frac{m_2}{m_1 + m_2} \frac{g\, d_T}{v_F^2}$

$\theta = \frac{1}{2}\sin^{-1}\left(\frac{4.5}{65 + 4.5} \frac{(9.8)(15.2)}{12^2} \right)$ 1.03

$\theta = \underline{2^\circ}$

$v_{1F} = \frac{4.5}{65}(12)\cos(2^\circ) = 0.83 \cdot \cos(2) = \boxed{.82\ m/s}$