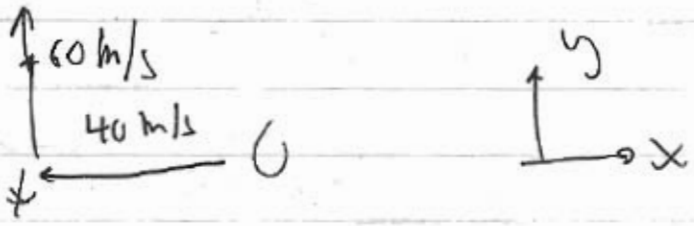
Ph 2004 Exam 3 Spring 2008

Solutions

(1)



$$\vec{F}\Delta t = m\Delta\vec{v}$$

x: $\bar{F}_x \Delta t = m\Delta v_x = m(0-(-40))$

$$\bar{F}_x = \frac{m\times 40}{\Delta t} = \frac{0.1\times 40}{10^{-2}} = 400\,N$$

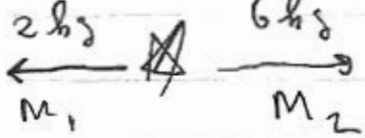
y $\bar{F}_y \Delta t = m\Delta v_y = m(60-0)$

$$\bar{F}_y = \frac{m\times 60}{\Delta t} = \frac{0.1\times 60}{10^{-2}} = \boxed{600\,N}$$

$$\bar{F} = \sqrt{(4\times 10^2)^2 + (6\times 10^2)^2} = \sqrt{16+36}\times 10^2\,N$$

$$\boxed{\bar{F} = 721\,N}$$

(2)



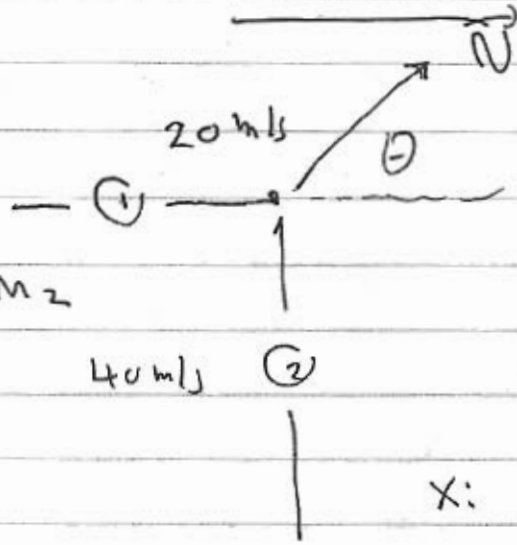
$\frac{1}{2} m_2 v_2^2 = 300\,J \Rightarrow v_2 = \sqrt{2\times 300/m_2}$

$= \sqrt{2\times 300/6} = 10\,m/s$

$m_1 v_1 = m_2 v_2 \Rightarrow v_1 = \frac{m_2}{m_1} v_2 = \frac{6}{2}\times 10\,\frac{m}{s} = \boxed{30\,m/s}$

Solutions

(3)



x: $m_1 v_{1I} = (m_1 + m_2) v_{Fx}$

$= (m_1 + m_2) v_F \cos\theta$

y: $m_2 v_{2I} = (m_1 + m_2) v_F \sin\theta$

x: $v_{1I} = \frac{1}{2} v_F \cos\theta \Rightarrow v_F = \frac{2 v_{1I}}{\cos\theta}$

y: $v_{2I} = \frac{1}{2} v_F \sin\theta$

$$v_{2I} = \frac{1}{2} \times 2 \frac{v_{1I}}{\cos\theta} \sin\theta = v_{1I} \tan\theta$$

$\tan\theta = v_{2I} / v_{1I} = 40/20 = 2 \Rightarrow \boxed{\theta = 63.4^\circ}$

$|v_{1I}| = 20$ m/s $\quad |v_{2I}| = 10$ m/s

(4)

(1) $\longrightarrow$ $\quad \longleftarrow$ (2)

(2) $\longrightarrow$ $|v_{2F}| = 40$ m/s $\quad \longrightarrow x$

$$v_{1I} + v_{1F} = v_{2I} + v_{2F}$$

$$v_{1F} = v_{2I} + v_{2F} - v_{1I} = -10 + 40 - (-20)$$

$$v_{1F} = \boxed{+10 \text{ m/s}}$$

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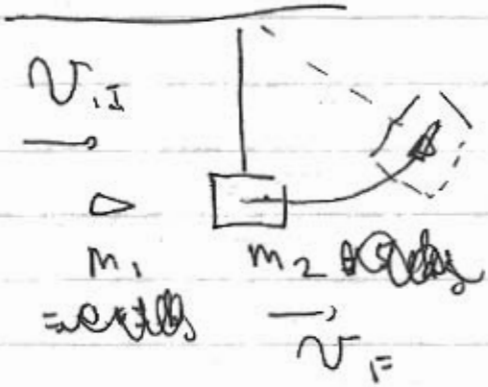
(5) Solutions



$m_1 = 0.05\ kg$

$m_2 = 5\ kg$

$v_{1I} = 10^3\ m/s$

$$m_1 v_{1I} = (m_1 + m_2) v_F \Rightarrow v_F = \left(\frac{m_1}{m_1+m_2}\right) v_{1I}$$

$$\frac{1}{2}(m_1+m_2) v_F^2 = (m_1+m_2) g \Delta h$$

$$\Delta h = \frac{v_F^2}{2g} = \frac{\left(\frac{m_1}{m_1+m_2}\right)^2 v_{1I}^2}{2g}$$

$$\left(\frac{m_1}{m_1+m_2}\right)^2 = \left(\frac{1}{1+m_2/m_1}\right)^2 = \left(\frac{1}{1+\frac{5}{0.05}}\right)^2$$

$$= \left(\frac{1}{1+100}\right)^2 \sim 10^{-4}$$

$$\Delta h \approx \frac{10^{-4} \times 10^6}{2 \times 9.8}\ m = \frac{100}{19.6}\ m \approx 5\ m$$