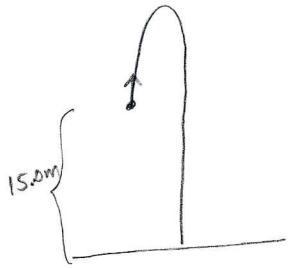
Solutions PHYS-203A (Final Exam) Spring 2018

Prob. 1

$\Delta x = -15.0\,m$ $\quad V_i = +3.50\,\frac{m}{s}$ $\quad a = -9.8\,\frac{m}{s^2}$.

$\Delta t = ?$ $\quad V_f =$



$$\Delta x = V_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-15.0 = 3.50\,\Delta t - \frac{1}{2} 9.8\,\Delta t^2$$

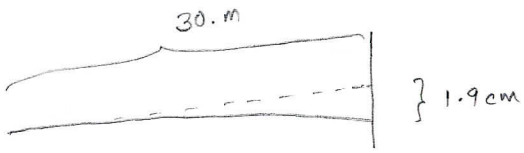
$$4.9\,\Delta t^2 - 3.50\,\Delta t - 15.0 = 0$$

$$\Delta t = \frac{3.50 \pm \sqrt{(3.50)^2 - 4(4.9)(-15.0)}}{2(4.9)}$$

$$= +2.1\ sec \quad (OR) \quad -1.4\ sec.$$

↳ correct answer.

Prob. 2



$\Delta x = 30.0\,m$

$\Delta t = 0.0623\,s$

$V_{xi} =$

$\Delta y = -0.019\,m$

$\Delta t =$

$V_{yi} = 0$

$V_{yf} =$

$a_y = -9.8\,\frac{m}{s^2}$

$$V_{xi} = \frac{\Delta x}{\Delta t}$$

$$= \frac{30.0}{0.0623}$$

$$= 482\,\frac{m}{s}$$

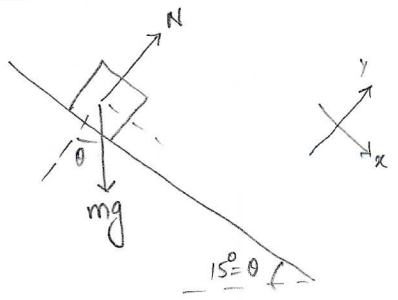
↓ Answer.

$$\Delta y = V_{yi} \Delta t + \frac{1}{2} a \Delta t^2$$

$$-0.019 = 0 - \frac{1}{2} 9.8\,\Delta t^2$$

$$\Delta t = \sqrt{\frac{2(0.019)}{9.8}} = 0.0623\ sec.$$

Prob. 3



$$m\vec{g} + \vec{N} = m\vec{a}$$

x: $\quad mg\sin\theta + 0 = ma \Rightarrow a = g\sin\theta$.

y: $\quad -mg\cos\theta + N = 0 \Rightarrow N = mg\cos\theta$.

$a = g\sin\theta = 9.8\sin 15 = 2.5\ \frac{m}{s}$

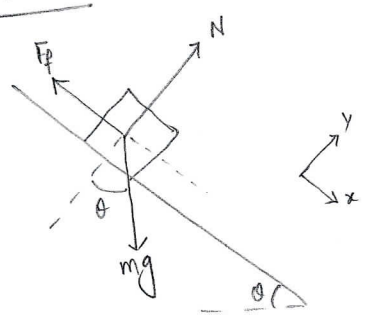
$\Delta x = +6.0\,m \qquad V_i = +3.0\ \frac{m}{s}$

$\Delta t = \qquad V_f =$

$$V_f^2 = V_i^2 + 2a\Delta x.$$

$$V_f = \sqrt{(3.0)^2 + 2(2.5)(6.0)} = 6.2\ \frac{m}{s}.$$

Prob. 4

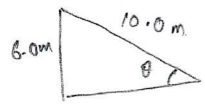


$$m\vec{g} + \vec{N} + \vec{F}_f = m\vec{a}$$

x: $\quad +mg\sin\theta + 0 - F_f = ma_x$

y: $\quad -mg\cos\theta + N + 0 = 0$

begins to slide $\Rightarrow \quad F_f = \mu_s N \quad$ and $\quad a_x = 0$



$$mg\sin\theta - \mu_s N = 0$$

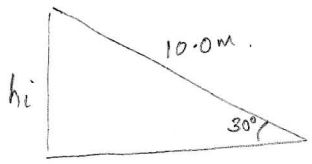
$$mg\sin\theta = \mu_s mg\cos\theta.$$

$$\mu_s = \tan\theta = \frac{6.0}{\sqrt{10.0^2 - 6.0^2}}$$

$$= \frac{6.0}{8.0} = 0.75$$

Prob. 5

$$W = -\Delta U$$
$$= -(U_f - U_i)$$
$$= -(mgh_f - mgh_i) \quad (h_f = 0)$$
$$= +mgh_i = (25.0)(9.8)(5.0)$$
$$= 1220\ \text{J}$$



$h_i = 10.0 \sin 30$
$= 5.0\ \text{m}$

Prob. 6

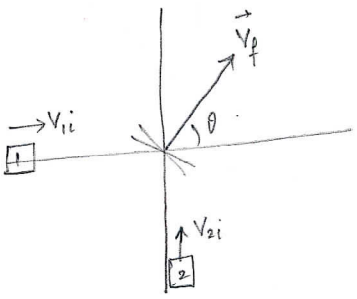
$$m_1\vec{V}_{1i} + m_2\vec{V}_{2i} = (m_1 + m_2)\vec{V}_f$$

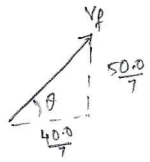
$$(2000.0)(20.0)\,\hat{i} + (5000.0)(10.0\,\hat{j}) = 7000.0\,\vec{V}_f$$

$$\vec{V}_f = \frac{40.0}{7}\,\hat{i} + \frac{50.0}{7}\,\hat{j}$$

magnitude: $|\vec{V}_f| = \sqrt{\left(\frac{40.0}{7}\right)^2 + \left(\frac{50.0}{7}\right)^2} = 9.2\ \frac{\text{m}}{\text{s}}$

direction: $\theta = \tan^{-1}\left(\frac{50.0/7}{40.0/7}\right) = 51°$





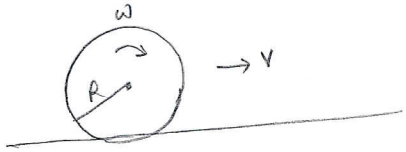
Prob. 7

$V_i = 25\ \frac{\text{m}}{\text{s}}$ $\quad a = 2.0\ \frac{\text{m}}{\text{s}^2}$.

$\Delta x =$

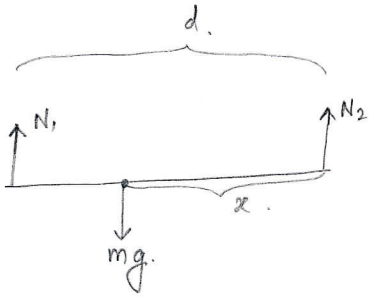
$\Delta t = 7.0\ \text{s}$ $\quad V_f =$

$$\Delta x = V_i\,\Delta t + \frac{1}{2}a\,\Delta t^2$$
$$= (25)(7.0) + \frac{1}{2}(2.0)(7.0)^2$$
$$= 224\ \text{m}$$



$$\Delta\theta = \frac{\Delta x}{R}$$
$$= \frac{224\ \text{m}}{0.30\ \text{m}}$$
$$= 747\ \text{radian}$$

Prob. 8



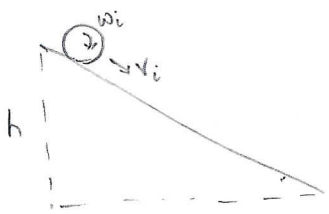
Force: $N_1 + N_2 = mg$

Torque: $+ N_2 x - N_1 (d-x) = 0$

$300\, x - 500\,(1.80 - x) = 0$

$800.0\, x = 900.0 \quad \Rightarrow \quad x = 1.13\ m$

Prob. 9



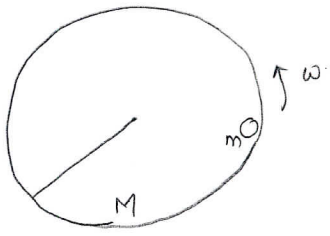
$K_i^L + K_i^R + U_i = K_f^L + K_f^R + U_f$

$\frac{1}{2} m v_i^2 + \frac{1}{2}\left(\frac{2}{5} m R^2\right) \underbrace{\omega_i^2}_{v_i^2} + mgh_i = \frac{1}{2} m v_f^2 + \frac{1}{2}\left(\frac{2}{5} m R^2\right) \underbrace{\omega_f^2}_{v_f^2} + mgh_f$

$\frac{7}{10} m v_i^2 + mgh_i = \frac{7}{10} m v_f^2 + 0$ ($v_i = 0$)

$v_f = \sqrt{\frac{10}{7} g h_i} = \sqrt{\frac{10}{7}(9.8)(10.0)} = 12\ \frac{m}{s}$

Prob. 10



$L_i^{disc} + L_i^{kid} = L_f^{disc} + L_f^{kid}$

$I_i^{disc}\,\omega_i + I_i^{kid}\,\omega_i = I_f^{disc}\,\omega_f + I_f^{kid}\,\omega_f$

$I_i^{disc} = I_f^{disc} = \frac{1}{2} M R^2 = \frac{1}{2}(100.0)(2.00)^2 = 200.\ kg\,m^2$

$I_i^{kid} = m R^2 = (25.0)(2.00)^2 = 100.\ kg\,m^2$

$I_f^{kid} = 0$

$200.\,\omega_i + 100.\,\omega_i = 200.\,\omega_f + 0$

$200.\,(0.30) + 100.\,(0.30) = 200.\,\omega_f$

$\omega_f = 0.45\ \frac{rev}{s}$