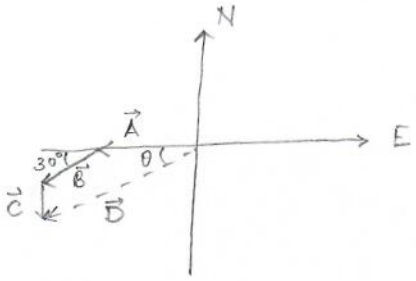
Solutions PHYS-203A (Final Exam) Fall 2018

Prob. 1



$\vec{D} = \vec{A} + \vec{B} + \vec{C}$

$\vec{A} = -4.0\,\hat{i} + 0\,\hat{j}$

$\vec{B} = -2.0\cos 30\,\hat{i} - 2.0\sin 30\,\hat{j}$

$\vec{C} = 0\,\hat{i} - 1.0\,\hat{j}$

$\vec{D} = -5.73\,\hat{i} - 2.0\,\hat{j}$

magnitude : $\sqrt{(-5.73)^2 + (-2.0)^2} = 6.1\ m$

direction : $\theta = \tan^{-1}\left(\frac{2.0}{5.73}\right) = 19°$ South of West.

Prob. 2

$\Delta y = +10.0\ m$ $\quad v_i = ?$ $\quad a = -9.8\ \frac{m}{s^2}$.

$\Delta t =$ $\quad v_f = 0$

$2a\Delta y = v_f^2 - v_i^2$

$2(-9.8)(10.0) = 0^2 - v_i^2$

$v_i = 14\ \frac{m}{s}$.

Prob. 3

$\Delta x = 20.0\,m$

$\Delta t = \boxed{0.80\,s}$

$V_{ix} = 25\,\frac{m}{s}$

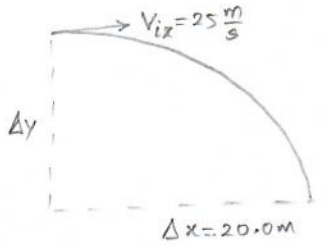
$\Delta y = ?$

$\Delta t = \boxed{0.80\,s}$

$V_{iy} = 0$

$V_{fy} =$

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



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

$$= \frac{20.0}{25}$$

$$= 0.80\,s$$

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

$$= 0 + \frac{1}{2}(-9.8)(0.80)^2$$

$$= -3.1\,m$$

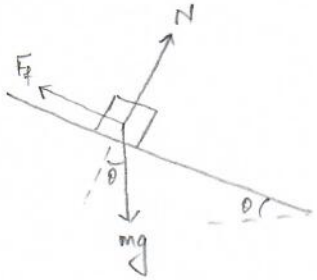
The ball is 3.1 m high.

Prob. 4

$$\frac{g_{mars}}{g_E} = \frac{\left(\frac{G\,M_{mars}}{R_{mars}^2}\right)}{\left(\frac{G\,M_E}{R_E^2}\right)} = \left(\frac{M_{mars}}{M_E}\right)\frac{1}{\left(\frac{R_{mars}}{R_E}\right)^2} = \frac{0.11}{(0.53)^2} = 0.39$$

$$g_{mars} = 0.39\,(9.8) = 3.8\,\frac{m}{s^2}$$

Prob 5



$$m\vec{g} + \vec{N} + \vec{F}_f = m\vec{a} \to = 0 \text{ (standing)}$$

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

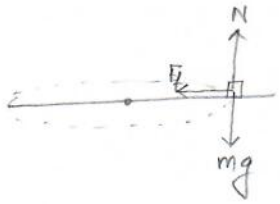
$$N = mg\cos\theta$$

$$= 540\cos 30$$

$$= 470\,N.$$

Prob. 6

(a) gravity, normal force, friction



(b) friction

(c) $N = mg$ $\qquad m\omega^2 R = F_f \leq \mu_s N$

$$m\omega^2 R = \mu_s m g$$

$$R = \frac{\mu_s g}{\omega^2} = \frac{(0.40)(9.8)}{(6.4)^2} = 0.096\ m = 9.6\ cm$$

Prob. 7

1 – person
2 – arrow

$$(m_1 + m_2)\ v_i = m_1 v_{1f} + m_2 v_{2f}$$

($v_i = 0$)

$$v_{1f} = -\frac{m_2}{m_1} v_{2f}$$

$$= -\frac{0.020}{90.0}\left(60.0\ \frac{m}{s}\right) = -0.013\ \frac{m}{s} = -1.3\ \frac{cm}{s}$$

Prob. 8

$$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2)\ v_f$$

($v_{2i} = 0$)

$$(20.0)(5.0) + 0 = (20.0 + 60.0)\ v_f$$

$$\Rightarrow \quad v_f = 1.25\ \frac{m}{s}$$

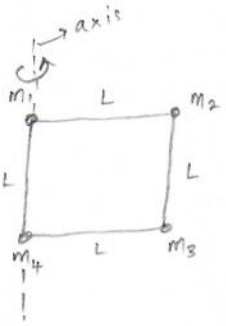
$$\Delta K = \left(\frac{1}{2} m_1 v_{1i}^2 + \frac{1}{2} m_2 v_{2i}^2\right) - \left(\frac{1}{2}(m_1 + m_2)\ v_f^2\right)$$

$$= \frac{1}{2}(20.0)(5.0)^2 + 0 - \frac{1}{2}(20.0 + 80.0)(1.25)^2$$

$$= 250\ J - 78\ J$$

$$= 172\ J$$

Prob. 9



$L = 1.0\,m$

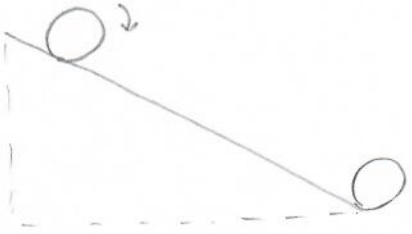
$$I = m_1 R_1^2 + m_2 R_2^2 + m_3 R_3^2 + m_4 R_4^2$$

$$R_1 = 0, \quad R_2 = L, \quad R_3 = L, \quad R_4 = 0$$

$$I = (1.00)\,0^2 + (1.00)(1.0)^2 + (1.00)(1.0)^2 + (1.00)\,0^2$$

$$I = 2.0\ kg\ m^2$$

Prob. 10



$$\frac{1}{2} m v_i^2 + \frac{1}{2} I \omega_i^2 + mgh = \frac{1}{2} m v_f^2 + \frac{1}{2} I \omega_f^2$$

$$\frac{1}{2} m v_i^2 + \frac{1}{2}\frac{1}{2} m \underbrace{R^2 \omega_i^2}_{v_i^2} + mgh = \frac{1}{2} m v_f^2 + \frac{1}{2}\frac{1}{2} m \underbrace{R^2 \omega_f^2}_{v_f^2}$$

$$\frac{3}{4} \cancel{m} v_i^2 + \cancel{m} gh = \frac{3}{4} \cancel{m} v_f^2$$

$$v_f^2 = \underbrace{v_i^2}_{=0} + \frac{4}{3} gh$$

$$v_f = \sqrt{\frac{4}{3} gh} = \sqrt{\frac{4}{3}(9.8)(1.00)} = 3.6\ \frac{m}{s}$$