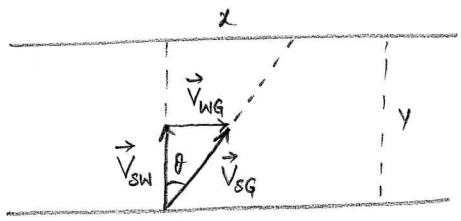
Solutions PHYS-203A (Midterm Exam 02) Spring 2018

Prob. 1

$|\vec{V}_{SW}| = 1.0 \frac{m}{s}$ $\quad \vec{V}_{SG} = \vec{V}_{SW} + \vec{V}_{WG}$

$|\vec{V}_{WG}| = 0.40 \frac{m}{s}$



S-Swimmer
W-Water
G-Ground.

$$\tan\theta = \frac{|\vec{V}_{WG}|}{|\vec{V}_{SW}|} = \frac{x}{y}$$

$$\frac{0.40}{1.0} = \frac{x}{2.0\ km} \qquad x = 800\ m$$

Prob. 2

$M_E = 81\, M_{moon}$

$R_E = 3.6\, R_{moon}$

$$g_E = \frac{G M_E}{R_E^2}$$

$$g_{moon} = \frac{G M_{moon}}{R_{moon}^2} = \frac{G(M_E/81)}{(R_E/3.6)^2} = \frac{(3.6)^2}{81} g_E = 0.16\, g_E = (0.16)(9.8) = 1.6 \frac{m}{s^2}$$

Prob. 3

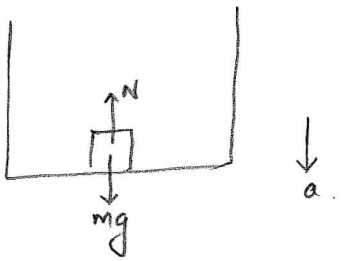
$$m\vec{a} = m\vec{g} + \vec{N}$$

$$-ma = -mg + N$$

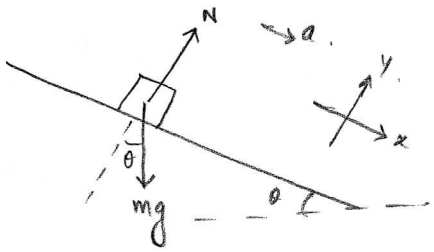
$$N = mg - ma$$

$$= (75)(9.8) - (75)(2.0)$$

$$= 585\ Newtons$$



Prob. 4



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

x: $ma = mg\sin\theta \Rightarrow a = g\sin\theta$

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

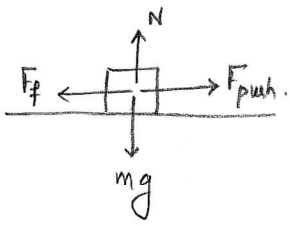
$v_i = 3.0\ \frac{m}{s}$ $\quad \Delta x = 6.0\ m$ $\quad a = g\sin\theta = (9.8)\sin 15 = 2.54\ \frac{m}{s^2}$.

$v_f = ?$ $\quad \Delta t =$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$v_f = \sqrt{(3.0)^2 + 2(2.54)(6.0)} = 6.3\ \frac{m}{s}$$

Prob. 5



(a) gravity, normal force, friction, and force pushing it.

(b) $$m\vec{a} = m\vec{g} + \vec{N} + \vec{F}_f + \vec{F}_{push}$$

x: $ma = F_{push} - F_f \rightarrow ma = F_{push} - \mu_k N$

y: $0 = -mg + N \rightarrow N = mg$.

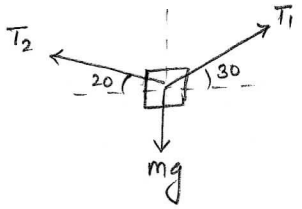
at constant velocity $a = 0$.

$\Rightarrow F_{push} = \mu_k N = \mu_k mg = (0.40)(50.0)(9.8)$

$= 196$ Newtons

Prob. 6

$$m\vec{a} = m\vec{g} + \vec{T}_1 + \vec{T}_2$$



x: $\quad 0 = 0 + T_1 \cos 30 - T_2 \cos 20$

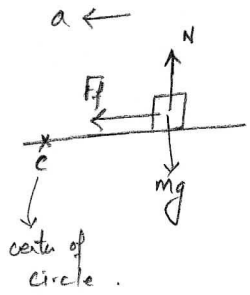
y: $\quad 0 = -150 + T_1 \sin 30 + T_2 \sin 20$

$$T_2 = \frac{150 \cos 30}{\sin(20+30)} = 170.\ N$$

$$T_1 = \frac{150 \cos 20}{\sin(20+30)} = 184\ N$$

Prob. 7

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



x: $\quad \frac{mv^2}{R} = F_f = \mu_s N \Rightarrow \frac{mv^2}{R} = \mu_s N$

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

$$\frac{mv^2}{R} = \mu_s N = \mu_s mg$$

$$v^2 = \mu_s g R$$

$$\frac{v^2}{v'^2} = \frac{\mu_s g R}{\mu_s' g R}$$

$$\frac{(25)^2}{(v')^2} = \frac{\mu_s}{(\mu_s/4)} = 4$$

$$(v')^2 = \frac{(25)^2}{4}$$

$$v' = \frac{25}{2} = 13\ \frac{m}{s}.$$