1.10) (a) $\left(60 \frac{mi}{h}\right)\left(\frac{1h}{3600s}\right)\left(\frac{5280ft}{1mi}\right) = 88 \frac{ft}{s}$

(b) $\left(32 \frac{ft}{s^2}\right)\left(30.48 \frac{cm}{ft}\right)\left(\frac{1m}{100cm}\right) = 9.8 \frac{m}{s^2}$

(c) $\left(1.0 \frac{g}{cm^3}\right)\left(\frac{100cm}{1m}\right)^3\left(\frac{1kg}{1000g}\right) = 10^3 \frac{kg}{m^3}$

1.29) Want surface area of US divided by surface area of a dollar bill.

Approx area of US is 2600 mi × 1300 mi or 3,380,000 mi^2

Population of US is ~ 3×10^8

A dollar bill, as measured with a ruler is $6\frac{1}{8}$" × $2\frac{5}{8}$"

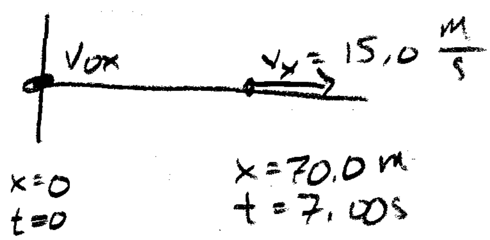
$$A_{us} = (3,380,000\, mi^2)\left[5280 \frac{ft}{mi}\right]^2\left(12 \frac{in}{ft}\right)^2 = 1.4 \times 10^{16}\, in^2$$

$$A_{bill} = (6.125\, in)(2.625\, in) = 16.1\, in^2$$

$$\Rightarrow N_{bills} = A_{us} / A_{bill} = 9.4 \times 10^{14} \text{ bills}$$

$$\text{Cost / person} = N_{bills} / N_{pers} = \$3 \times 10^6 / \text{person}$$

2.21)



$x - x_0 = 70.0$ m

$t = 7.00$ s

$v_x = 15.0 \frac{m}{s}$

(a) $x - x_0 = \left(\frac{v_{0x} + v_x}{2}\right) t \Rightarrow v_{0x} = \frac{2(x-x_0)}{t} - v_x$

$$= \frac{2(70.0\, m)}{7.00\, s} - 15.0 \frac{m}{s} = \underline{5.0 \frac{m}{s}}$$

(b) $v_x = v_{0x} + a_x t \Rightarrow a_x = \frac{v_x - v_{0x}}{t}$

$$= \frac{15.0 \frac{m}{s} - 5.0 \frac{m}{s}}{7.00s} = \underline{1.43 \frac{m}{s^2}}.$$

2.27 a) first convert speeds to $\frac{m}{s}$

$$161 \frac{km}{h} = 44.72 \frac{m}{s} \qquad 1610 \frac{km}{h} = 447.2 \frac{m}{s}$$

(i) $$a_{av,x} = \frac{\Delta v_x}{\Delta t} = \frac{44.72 \frac{m}{s} - 0}{8.00 s} = 5.59 \frac{m}{s^2}$$

(ii) $$a_{av,x} = \frac{\Delta v_x}{\Delta t} = \frac{447.2 \frac{m}{s} - 44.72 \frac{m}{s}}{60.0 s - 8.00 s} = 7.74 \frac{m}{s^2}$$

(b)(i) @ t = 8.00s $$x - x_0 = \left(\frac{v_{0x} + v_x}{2}\right) t$$

$$= \left(\frac{0 + 44.72 \frac{m}{s}}{2}\right)(8.00 s) = \underline{179 m}$$

(ii) @ 60.0 s

$$x - x_0 = \left(\frac{v_{0x} + v_x}{2}\right) t = \left(\frac{44.72 \frac{m}{s} + 447.2 \frac{m}{s}}{2}\right)(52.0 s)$$

$$= \boxed{1.28 \times 10^4 m}$$

Flea in flight

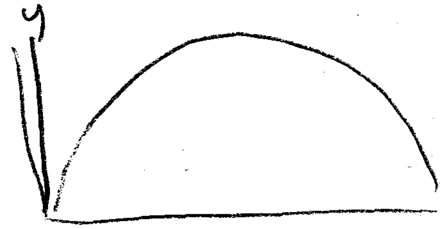
(a) use $$\frac{v_y^2 - v_{0y}^2}{2(y - y_0)} = a_y = \frac{v_y^2}{2(0.390 m)} \Rightarrow v_y = \sqrt{(0.390)(9.8 \frac{m}{s^2}) 2}$$

$$\boxed{v_y = 2.76 \frac{m}{s}}$$

(b) use $$\frac{v_y - v_{0y}}{2} = a_y t \therefore t = 2\frac{v_{0y}}{a_y} = 2\left(\frac{2.76 \frac{m}{s}}{9.8 \frac{m}{s^2}}\right) = (0.282 s)2$$

$$\boxed{= 0.564 s}$$

3.16



$a_x = 0$
$a_y = g$

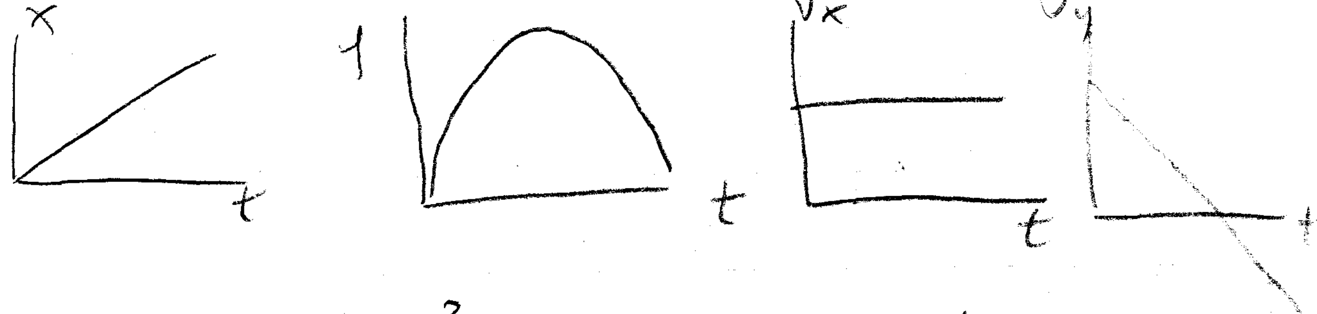
(a) $v_y = v_{0y} + a_y t \Rightarrow t = \frac{v_{0y}}{g} = \frac{16.0\,\frac{m}{s}}{9.80\,\frac{m}{s^2}} = 1.63s$

(b) $\frac{1}{2} g t^2 = \frac{1}{2} v_{y0} t = \frac{v_{0y}^2}{2g} = 13.1\,m$

(c) Twice the answer in (a) — i.e. 3.27 s

(d) $a_x = 0 \Rightarrow x - x_0 = v_{0x} t = (20.0\,\frac{m}{s})(3.27s) = 65.3\,m$

(e)



3.35 Know $a_{rad} = \frac{v^2}{R}$ Speed in $\frac{rev}{s} = \frac{1}{T}$

Head $R = 8.84\,m$
Feet $R = 6.84\,m$

(a) $v = \sqrt{R a_{rad}} = \sqrt{(8.84\,m)(125)(9.80\,\frac{m}{s^2})} = 32.9\,\frac{m}{s}$

(b) $a_{rad} = \frac{4\pi^2 R}{T^2} \rightarrow T = 2\pi\sqrt{\frac{R}{a_{rad}}} = 2\pi\sqrt{\frac{8.84\,m}{(12.5)(9.80\,\frac{m}{s^2})}} = 1.688\,s$

feet have $a_{rad} = \frac{4\pi^2 R}{T^2} = \frac{4\pi^2 (6.84\,m)}{(1.688\,s)^2} = 94.8\,\frac{m}{s^2} = 9.67g$

Difference between the two is $12.5g - 9.67g = 2.83g = 27.7\,\frac{m}{s^2}$

(c) $\frac{1}{T} = \frac{1}{1.69\,s} = 0.592\,\frac{rev}{s} = 35.5$ rpm.

3.48 from ex 3.8, $t = \frac{2v_0 \sin\alpha_0}{g}$

max height $\Rightarrow h = \frac{v_0^2 \sin^2\alpha_0}{2g}$ Same v_0, α_0 on E, Mars

Range $D = \frac{v_0^2 \sin 2\alpha_0}{g}$

$tg = 2v_0 \sin\alpha_0 = \text{const} \Rightarrow t_E g_E = t_M g_M$

$t_M = \frac{g_E}{g_M} t_E = \left(\frac{g_E}{0.379 g_E}\right) t_E$

$= 2.64 t_E$

$hg = \frac{v_0^2 \sin^2\alpha_0}{2} = \text{const}$

$\Rightarrow h_E g_E = h_M g_M \Rightarrow h_M = \frac{g_E}{g_M} h_E = 2.64 h_E$

Similarly $D_M = \frac{g_E}{g_M} D_E = 2.64\, D_E$

Two hanging Masses

(a) $T_2 = M_2 g$ (b) $T_1 = (M_1 + M_2) g$

(c) $T_2 = M_2(g + a)$ (c) $T_1 = (M_1 + M_2)(g + a)$

4.1 (a) $a_x = \frac{F_x}{m} = \frac{0.250\ N}{0.160\ kg} = 1.562\ \frac{m}{s^2}$

$x - x_0 = v_{0x}t + \frac{1}{2} a_x t^2 = 0 + \frac{1}{2}(1.562\ \frac{m}{s^2})(2.00\ s)^2$

$\Rightarrow x = 3.12\ m$

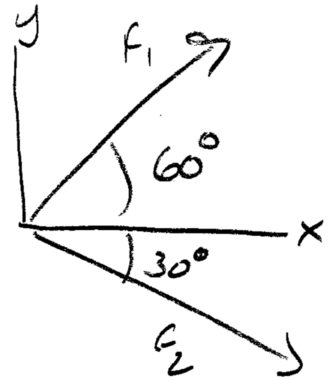
(b) $t = 2 \to 5\ s$ $a = 0 \Rightarrow v_x = 3.12 \frac{m}{s}$, $x - x_0 = 9.36\ m \Rightarrow$ at $12.5\ m$ after $5\ s$

$t = 5 \to 7\ s$ $a = 1.562 \frac{m}{s^2}$ $x - x_0 = v_{0x}t + \frac{1}{2} a_x t^2$

$v_x = v_{0x} + a_x t = 6.24 \frac{m}{s}$ $= (3.12 \frac{m}{s})(2.00\ s) + \frac{1}{2}(1.562)(2.00)^2$

$= 21.9\ m.$

4.37



F_3 = force by child

$\Sigma F_y = ma_y \Rightarrow F_{1y} + F_{2y} + F_{3y} = 0$

$\Rightarrow F_{3y} = -(F_{1y} + F_{2y})$

(a) $F_{1y} = 100\,N \sin 60° = 86.6°$

$F_{2y} = F_2 \sin(-30°) = -70.0\,N$

$\Rightarrow F_{3y} = -(F_{1y} + F_{2y}) = -16.6\,N$

$F_{3x} = 0$ (work it out!)

(b) $F_{1x} = F_1 \cos 60° = 50\,N$

$F_{2x} = F_2 \cos 30° = 121.2\,N$

$\Sigma F_x = F_{1x} + F_{2x} = 50\,N + 121.2\,N = 171.2\,N$

$m = \dfrac{\Sigma F_x}{a_x} = \dfrac{171.2\,N}{2.00\,\frac{m}{s^2}} = 85.6\,kg$

$w = mg = 840\,N.$

4.51 a) $v_{0y} = 0$

$y - y_0 = 3.10\,m$

$a_y = 9.80\,\frac{m}{s^2}$

$v_y^2 = v_{0y}^2 + 2a_y(y - y_0)$

$\Rightarrow v_y = \sqrt{2a_y(y - y_0)}$

$= \sqrt{2(9.80\,\frac{m}{s^2})(3.10\,m)} = 7.79\,\frac{m}{s}$

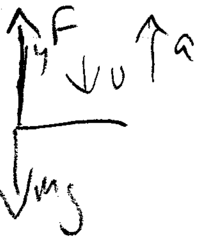
(b) Now $y - y_0 = 0.60\,m$

$v_y = 0$

so $a_y = \dfrac{v_y^2 - v_{0y}^2}{2(y - y_0)} = \dfrac{0 - (7.79\,\frac{m}{s})^2}{2(0.60\,m)} = -50.6\,\frac{m}{s^2}$

upward

(c)



$\Sigma F_y = ma_y$ gives $mg - F = -ma$

$F = m(g + a) = 75.0\,kg(9.80\,\frac{m}{s^2} + 50.6\,\frac{m}{s^2})$

$= 4.53 \times 10^3\,N$ upward

$\dfrac{F}{w} = \dfrac{4.53 \times 10^3\,N}{(75.0\,kg)(9.80\,\frac{m}{s^2})} = \boxed{6.16}$