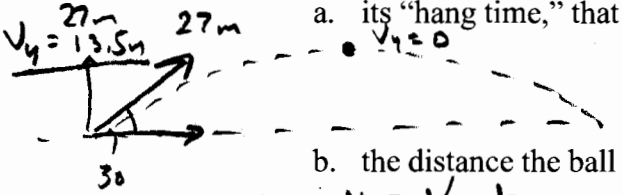
9/9

Projectile Motion II

$\cos 30 = \frac{V_x}{27m}$ $V_x = 23.38m$

$\sin 30 = \frac{V_y}{27m}$ $V_y = 13.5m$



1. A player kicks a football from ground level with a velocity of magnitude 27 m/s at an angle of 30 o above the horizontal.
   a. its "hang time," that is, the time the ball is in the air

$V_y = V_{y_i} + at$

$0 = 13.5\frac{m}{s} + (-9.8\frac{m}{s^2})t$ $\quad 2(t_{\frac{1}{2}}) = \boxed{2.76s}$

$t_{\frac{1}{2}} = 1.38s$

   b. the distance the ball travels before it hits the ground

$x = V_x t$

$x = 23.38m(2.76s) = \boxed{6.45 \times 10^1 m}$

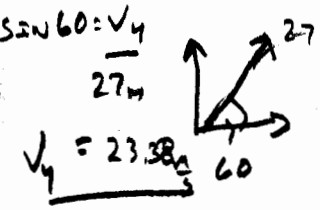
   c. its maximum height

$y = V_{y_i} t + \frac{1}{2} g t^2$

$= (13.5\frac{m}{s})1.38s + \frac{1}{2}(-9.8\frac{m}{s^2})(1.38s)^2 = 18.63m - 9.33 = \boxed{9.3m}$

$\cos 60 = \frac{V_x}{27m}$ $V_x = 13.5\frac{m}{s}$

$\sin 60 = \frac{V_y}{27m}$ $V_y = 23.38\frac{m}{s}$



2. The kicker now kicks the ball with the same speed, but at 60 o from the horizontal, find:
   a. the "hang time"

$V_y = V_{y_i} + at$

$0 = 23.38\frac{m}{s} + -9.8\frac{m}{s^2} t$ $\quad 2(t_{\frac{1}{2}}) = \boxed{4.78s}$

$t_{\frac{1}{2}} = 2.39s$

   b. the distance the ball travels before it hits the ground

$x = V_x t$

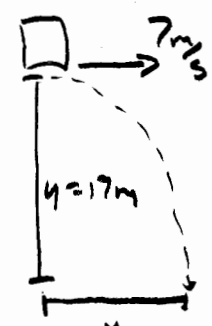
$= (13.5\frac{m}{s})4.78s = \boxed{6.45 \times 10^1 m}$

   c. its maximum height

$y = V_{y_i} t + \frac{1}{2} g t^2$

$= (23.38\frac{m}{s})2.39s + \frac{1}{2}(-9.8\frac{m}{s^2})(2.39s)^2 = 55.88m - 27.99m$

$= \boxed{2.79 \times 10^1 m}$



3. A rude tourist throws a peach pit horizontally with a 7 m/s velocity out of an elevator cage.
   a. If the elevator is not moving, how long will the pit take to reach the ground, 17 m below?

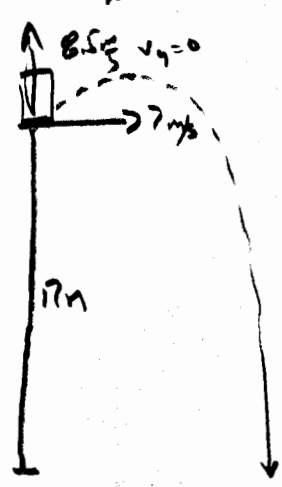
$y = V_{y_i} t + \frac{1}{2} g t^2$

$17m = 0 + \frac{1}{2}(9.8\frac{m}{s^2})t^2$ $\quad \boxed{t = 1.86s}$

   b. How far horizontally from the elevator will the pit land?

$x = V_x t$

$= 7\frac{m}{s}(1.86s) = \boxed{1.30 \times 10^1 m}$



   c. He throw the next pit when the elevator is at the same height but moving upward at a constant 8.5 m/s velocity. How long will it take this pit to land?

$V_y = V_{y_i} + at$

$0 = 8.5\frac{m}{s} + -9.8\frac{m}{s^2} t_{\frac{1}{2}}$

$t_{\frac{1}{2}} = 0.87s$

$y = V_{y_i} t_{\frac{1}{2}} + \frac{1}{2} g t_{\frac{1}{2}}^2$

$= (8.5\frac{m}{s})(0.87s) + \frac{1}{2}(-9.8\frac{m}{s^2})(0.87s)^2$

$= 7.40m - 3.71m$

$y = 3.69m$

$y = 17m + 3.69m = 20.69m$

$y = V_{y_i} t + \frac{1}{2} g t^2$

$20.69 = 0 + \frac{1}{2}(9.8\frac{m}{s^2})t^2$

$t_{\frac{1}{2}} = 2.05s$

$t = 0.87s + 2.05s = \boxed{2.92s}$