MAE 2600 (SP2016) **Homework #3 Solutions**

H3-1.

For the solution, *h* should be the maximum height ($v_y = 0$ at A), when the water was projected from the hose at the angle θ.

At A:

horizontal motion:

$\rightarrow+$ $x = x_o + (v_o)_x t \rightarrow 18 = 0 + (20 \cos\theta) t$ (1)

vertical motion:

$\uparrow+$ $v_y = (v_o)_y + (-g) t \rightarrow 0 = 20 \sin\theta - 9.81 t$ (2)

(1) $\rightarrow t = (18)/(20 \cos\theta)$

(2) $\rightarrow 0 = 20 \sin\theta - (9.81)(18)/(20 \cos\theta) \rightarrow (\sin\theta)(\cos\theta) = 0.4415$

$\rightarrow 2(\sin\theta)(\cos\theta) = \sin 2\theta = 0.8830 \rightarrow \theta = 31.0°$

(1) $\rightarrow t = (18)/(20 \cos 31°) = 1.05$

$\uparrow+$ $y = y_o + (v_o)_y t + (1/2)(-g) t^2$

$h = 1.2 + (20 \sin 31°)(1.05) + (1/2)(-9.81)(1.05)^2 =$ **6.61 m** **Ans.**

H3-2.

horizontal motion: (tower $\rightarrow$ slope)

$\rightarrow+$ $x = x_o + (v_o)_x t \rightarrow x = 0 + (3/5)(35) t = 21 t$ (1)

vertical motion: (tower $\rightarrow$ slope)

$\uparrow+$ $y = y_o + (v_o)_y t + (1/2)(-g) t^2$

$y = 85 + (4/5)(35) t + (1/2)(-32.2) t^2 = 85 + 28 t - 16.1 t^2$ (2)

Equation of slope: using the slope (1/1.4) and a point (21, 0)

$y = (1/1.4)x + C \rightarrow 0 = (1/1.4)(21) + C \rightarrow C = -15$

$y = (5/7)x - 15$ (3)

From Eqs. (1) - (3): $85 + 28 t - 16.1 t^2 = (5/7)(21 t) - 15$

$16.1 t^2 - 13 t - 100 = 0 \rightarrow t = 2.928$ s or $t = -2.121$ (no solution)

(1) $\rightarrow$ $x = 21(2.928) = 61.49 =$ **61.5 ft** **Ans.**

(2) $\rightarrow$ $y = 85 + 28(2.928) - 16.1(2.928)^2 = 28.96 =$ **29.0 ft** **Ans.**

$(v_o)_x = (3/5)(35) = 21 \rightarrow v_x = (v_o)_x = 21$ ft/s

$(v_o)_y = (4/5)(35) = 28$

$v_y = (v_o)_y + (-g) t \rightarrow v_y = 28 - 32.2(2.928) = -66.28$ ft/s

$v = [(v_x)^2 + (v_y)^2]^{1/2} = [(21)^2 + (-66.28)^2]^{1/2} =$ **69.5 ft/s** **Ans.**