Solution for HW 2

2.77 $\begin{cases} v_0 \sin\theta t - \frac{1}{2} g t^2 = -7 & ② \\ v_0 \cos\theta t = 150 & ① \end{cases}$ $v_0 = 130\ ft/s$ $g = 9.8 m/s^2 = 9.8 \times 3.28\ ft/s^2 = 32.144\ ft/s^2$

from ①, $t = \frac{150}{v_0 \cos\theta}$, insert it into ②:

$v_0 \sin\theta \frac{150}{v_0 \cos\theta} - \frac{1}{2} g \frac{150^2}{v_0^2 \cos^2\theta} = -7$

$\Rightarrow 1808 \tan^2\theta - 126750 \tan\theta + 12166 = 0$

$\Rightarrow \tan\theta \approx 0.0973$ or $\tan\theta \approx 69128$

For the best angle, fly time should be smaller, so $\tan\theta \approx 0.0973$

$\Rightarrow \theta \approx \tan^{-1}(0.0973) \doteq 5.6°$

2.85. From symmetry ~~property~~ property of the motion.

$\frac{2 v_0 \cos\theta}{9.8} = \frac{2 \cdot v_0 \sin\theta}{0.4}$ $\Rightarrow \tan\theta = \frac{0.4}{9.8}$ $\Rightarrow \theta \doteq 2.3°$

2.87 $\begin{cases} v_0 \cos\theta \cdot t = 800 + s \cdot \cos 20° & ① \\ v_0 \sin\theta t - \frac{1}{2} g t^2 = s \cdot \sin 20° & ② \end{cases}$ $\theta = 40°$ $v_0 = 120 m/s$ $g = 9.8 m/s^2$

from ①: $s = \frac{v_0 \cos\theta t - 800}{\cos\theta \cos 20°}$, insert it into ②:

$\Rightarrow v_0 \sin\theta t - \frac{1}{2} g t^2 = \frac{v_0 \cos\theta t - 800}{\cos\theta \cos 20°} \cdot \sin 20°$

$\Rightarrow \frac{1}{2} g t^2 + (v_0 (\cos\theta \tan 20° - \sin\theta) t - 800 \tan 20° = 0$

$\Rightarrow 4.9 t^2 - 43.676 t - 800 \tan 20° = 0$

$\Rightarrow t = 13.36 s$ or $t = -4.455 s$ (舍弃, time cannot be negative)

$\Rightarrow s = \frac{v_0 \cos\theta \cdot t - 800}{\cos 20°} = \frac{120 \cos 40° \times 13.36 - 800}{\cos 20°} m \doteq 455.6 m$