$v_o = 1000\frac{m}{s}$ $x = 2000m$ $y = 800m$

What is θ_o?

Method I

Using

$$y = x\cdot\tan\theta_o + \frac{g}{2\cdot v_o^{\,2}\cdot\cos\theta_o^{\,2}}x^2$$

$$800 = 2000\cdot\tan\theta_o - \frac{19.6}{\cos\theta_o^{\,2}}$$

$$800 = 2000\cdot\frac{\sin(\theta_o)}{\cos(\theta_o)} - \frac{19.6}{(\cos(\theta_o))^2}$$

$$A := \begin{pmatrix} -2.7512469174935126092 \\ -1.5806356857788123621 \\ 1.5609569678109808763 \\ .39034573609628062922 \end{pmatrix} \qquad \left(\frac{180}{\pi}\right)\cdot A = \begin{pmatrix} -157.635 \\ -90.564 \\ 89.436 \\ 22.365 \end{pmatrix}$$

Note: A numerical solution (*as mentioned in class*) works nicely. Note that we would get rid of teh 1st 2 solutions as they are negative values and would indicate and angle below the horizontal (*which makes no sense*). Thus the answers are 89.4º and 22.4º.

Method II

$$800\cdot(\cos(\theta_o))^2 = 2000\cdot\cos(\theta_o)\cdot\sin(\theta_o) - 19.6$$

Using $\sin\theta_o = \sqrt{1-(\cos(\theta_o))^2}$

$$800\cdot(\cos(\theta_o))^2 = 2000\cdot\cos(\theta_o)\cdot\sqrt{1-(\cos(\theta_o))^2} - 19.6$$

Simplifying

$$\cos(\theta_o)^4 - .85531\cdot(\cos(\theta_o))^2 + .0000827586 = 0$$

Using the Quadratic Equation:

$$(\cos(\theta_o))^2 = \frac{.85531 + \sqrt{(.85531)^2 - 4\cdot 1\cdot(.0000827586)}}{2} = .85521323044937399500$$

$$\cos(\theta_o) = \sqrt{.85521323044937399500} = .925$$

$$\theta_o = 22.4^o$$

$$(\cos(\theta_o))^2 = \frac{.85531 - \sqrt{(.85531)^2 - 4\cdot 1\cdot(.0000827586)}}{2} = 9.67695506260050250001\cdot 10^{-5}$$

$$\cos(\theta_o) = \sqrt{9.67695506260050250001\cdot 10^{-5}} = .009837$$

$$\theta_o = 89.4^o$$

Note again here we have left out the negative roots as they do not provide meaningful information. The answers again are as previously calculated, except without numerical integration.