<u>CSC 2262, Fall 2021, Lab 8</u>

A projectile is fired from the top of a cliff of height h with a muzzle velocity v_0 at an angle θ with respect to the horizontal. The angle θ that produces the maximum horizontal range is given by the equation

$$\frac{2gh}{V_0}\sin(2\theta) - \frac{V_0}{2}\sin(4\theta) = \cos(2\theta)\sqrt{V_0^2\sin^2(2\theta) + 8gh\cos^2(\theta)}$$

The maximum horizontal range, x, is given by

$$x = V_0\cos\theta\left(\frac{V_0\sin\theta}{g} + \sqrt{\frac{V_0^2\sin^2(\theta)}{g^2} + \frac{2h}{g}}\right)$$

and the maximum height of the projectile with respect to the ground, y_{max}, is given by

$$y_{max} = h + \frac{V_0^2\sin^2\theta}{2g}$$

where h = 2500 m and g = 9.81 m/s^2 .

Write a MATLAB program as follows:

1) v0 will go from 100 m/s to 400 m/s in steps of 50 m/s.

2) For each value of v0, first <u>call the MATLAB function fzero</u> to calculate the angle θ that gives the maximum horizontal range x, and then use this value of θ to calculate x and y_{max}. Then print v0, θ, x and y_{max}. Use 40° as the initial guess for θ.

The output of this program should look like this:

```
v0=100   theta=22.36810   x= 2477.08519   ymax=2573.81376
v0=150   theta=29.28249   x= 4090.03544   ymax=2774.35143
v0=200   theta=33.83052   x= 6083.84233   ymax=3131.92127
v0=250   theta=36.81570   x= 8511.49383   ymax=3643.89722
v0=300   theta=38.81730   x=11403.48889   ymax=4302.41885
v0=350   theta=40.19885   x=14777.27645   ymax=5101.06970
v0=400   theta=41.18114   x=18643.01160   ymax=6035.53998
```