**Write an object oriented Python program to analyze the following air standard Otto cycle and output T-s and p-v plots.**

Specifications for the cycle: compression ratio = 8, v1=0.02ft3, T1=540oR, P1=1atm, T3=3600oR

Your plots should display the states as circle icons much like the Rankine program and lines for the four processes of the Otto cycle. Also, your plots should show the work for the cycle and the cycle efficiency.

\*You may work in teams of four or less. Your code should be uploaded as a single zip file by only one group member and should have a submission comment identifying the team members.

Otto cycle refresher:

The *air standard Otto cycle* is a four-step thermodynamic cycle where air modeled as an ideal gas is the working fluid in a piston-cylinder arrangement. This mimics the behavior of a four-stroke internal combustion engine (i.c.e.). We assume the cycle starts at bottom-dead-center for the piston (i.e., largest volume). The four processes of an Otto cycle are:

1. Isentropic compression from State 1 to State 2 (i.e., piston moves from bottom-dead-center to top-dead-center.)
2. Constant volume heat transfer from State 2 to State 3 (i.e., piston is fixed at top-dead-center)
3. Isentropic expansion from State 3 to State 4 (i.e., piston moves from top-dead-center to bottom-dead-center)
4. Constant volume heat transfer from State 4 to State 1 (i.e., piston is fixed at bottom-dead-center)

Analysis of an Otto cycle requires a given compression ratio (v1/v2), initial volume and temperature (v1, T1) and a maximum temperature (T3). Since we are treating the air as an ideal gas, we can use (the ideal gas law) at all states. Our task is to find *u1*, *u2*, *u3*, & *u4* because:

Compression stroke work:

Power stroke work:

Constant volume heat addition:

Constant volume heat rejection:

∴ and and

I recommend using griddata to interpolate ideal gas properties of air. I found a nice table of air properties at: <https://www.engineeringtoolbox.com/air-properties-d_1067.html>

Tentative sections:

1. Data retrieval and interpolation (recreate steam but using the new air table data)
2. Calculation of outputs
3. Plotting

Inputs

1. v\_1/v\_2
2. v\_1
3. T\_1
4. T\_3 = T\_max

Outputs

1. U\_1
2. U\_2
3. U\_3
4. U\_4

