Practice Problems **For this assignment you can choose to do problems by hand (using tables for property references), or to use the EES software. This will be true for almost all future homework assignments (unless specifically indicating what method to use)**

1. 0.1 lbm of air (ideal gas) initially at 50 psia and 100 F in a cylinder with a movable piston undergoes the following two-part process. First the air is expanded adiabatically to 30 [psia] and 24 [°F], then it is compressed isobarically to half of its initial volume. Calculate the temperature at State 3 (after the isobaric compression). Then, use the air tables in your supplement to calculate the work and heat from:
   1. State 1 to State 2
   2. State 2 to State 3
   3. Total for whole process (State 1 to State 3)

Note: Your temperature at State 3 is going to be really low. If you’re using the Air Tables, the temperature will be lower than the tables go. You can still use linear interpolation to approximate u3 by using the slope of u(T) between 220 °R and 200 °R.  
If you are going to use EES, you will need to decide if you are going to use ‘air’ or ‘air\_ha’ as your working fluid.

1. 3.7 kg of nitrogen gas at 0 C and .1 MPa is put into a cylinder with a piston and compressed in a process with a polytropic exponent of 2.0. When the final pressure in the cylinder reaches 10 MPa, and assuming ideal gas behavior, determine (a) the amount of work done on the nitrogen by the piston and (b) the final temperature of the nitrogen.

If you are going to use EES, decide if you are going to use ‘N2’ or ‘nitrogen’ as your working fluid.

## Preparatory Reading Questions

1. Identify each of the terms in equation (6.4). How does this equation differ from that for a closed system?
2. Outline the circumstances which equation (6.4) reduces to the open system modified energy rate balance (MERB).
3. Under what circumstances can the kinetic energy terms in the open system energy rate balance be neglected?
4. Under what circumstances can the potential energy terms in the open system energy rate balance be neglected?
5. What are three examples of steady-state, steady-flow (SSSF) devices?
6. What is an example of an unsteady state flow process?

## Answers

1. W\_12 = 1.3 Btu, and Q\_12 = 0   
   W\_23 = -2.17 Btu, and Q\_23 = -7.58 Btu  
   Net for both processes: W\_13 = -0.865 Btu, Q\_13 = -7.58 Btu
2. W\_12 = -2.69 MJ, and T\_2 = 2730 K, or 2457 °C