AS1300: Thermodynamics for Aerospace Engineers
Tutorial 2 (28/01/2020)

1. The following table gives data , in kJ, for a system undergoing a thermodynamic cycle. Detremine (a) the missing table entries and (b) whether the cycle is work producing or work absorbing.

Process	ΔU	Q	W
1-2	?	?	-610
2-3	670	?	230
3-4	?	0	920
4-1	-360	?	0

2. Two kg of air expanded in a piston-cylinder system from a specific volume v = 0.4 m^3/kg and temperature of 650 K to a specific volume v = 1.1 m^3 kg and a temperature of 310 K. The expansion process can be assumed to follow $Pv^{1.7} = 0.8$ (p is in bar, v is in m^3/kg). Determine the work and heat interaction.Assume the specific heats at constant volume is 0.718 kJ/kg-K.

3. 3 kg of air is contained in a vertical piston-cylinder assembly with the top end open to the atmosphere. The piston weighs 40 kg and has a face area of 0.01 m^2. The air initially occupies a volume of 0.004 m^3. The air now undergoes a process wherein its volume decreases to 0.002 m^3 and 2 kJ of heat is lost to the surroundings. Determine the change in the specific internal energy of the air. Take the atmospheric pressure as 100 kPa.

4. Consider the insulated vesssel, with compartment A (initially evacuated) of volume 0.4 m^3 and separated by a thin membrane from compartment B of volume 0.3 m^3 which contains 3 kg of a pure substance (C_v = 700 J/kg/K and Pv = 200 T; P is in Pa, v is in m^3/kg) at a pressure of 750 kPa. The pure substance in compartment B is stirred by a fan until the membrane ruptures. The membrane is designed to rupture at a pressure of 2.5 Mpa. Determine (a) the temperature in B when the membrane ruptures (b) the work done by the fan (c) the final equilibrium temperature and pressure when the pure substance fills the entire vessel.