

Chap 3 Examples

1. A system undergoes a thermodynamic cycle following the sequence 1-2-1. Process 1-2 follows path A while process 2-1 follows path B. Heat and work transfers are determined to be $W_{12} = -23$ kJ, $Q_{12} = 11$ kJ and $W_{21} = -46$ kJ. If the system energy at state 1, E_1 is 32 kJ, calculate Q_{21} .

2. Water in a piston cylinder device undergoes 2 processes in series. The initial state is 1 MPa, 400 °C.

Process 1 – 2 : Water is cooled at constant pressure until it becomes saturated vapor at 1 MPa

Process 2- 3 : Water is cooled further at constant volume until the pressure reaches 0.5 MPa

Sketch the processes on the T-v and p-v diagrams.

Determine total work and heat transfer.

3. 2 kg of steam at 1 MPa is cooled at constant volume, $V = 0.45$ m³, to the pressure of 0.5 MPa. It then expands at constant pressure until the volume reaches 0.95 m³.

Determine the specific volume and specific internal energy at each state, and also the work and heat involved in the process. Sketch the p-v diagram of the processes.

4. A piston cylinder device contains air at 150 kPa and 27 °C. At this state, the piston sits on a set of stops and the cylinder volume is 400 L. To move the piston, a pressure of 350 kPa is needed. Air is heated until the volume increases to twice the original size. Determine

- a. Final temperature
- b. Work done by the air
- c. Heat supplied to the air

- 5 3kg of air undergoes a thermodynamic cycle that consists of 3 processes. Process 1 to 2 is a polytropic compression with $n = 1.2$ from an initial state of 150 kPa, 360 K to the pressure of 750 kPa. This is followed by cooling at constant pressure from 2 to 3. This is then followed by an isothermal heating back to the initial state.

Sketch the p-v diagram of the cycle and determine heat and work for each process and also the total heat and work for the cycle.