

**Tutorial Sheet - First Law of Thermodynamics**

1. The specific internal energy of a system is increased from 120 kJ/kg to 180 kJ/kg during a constant volume process. Determine the heat energy transfer to cause this increase for 2 kg.  
( 120 kJ (to the system))
  
2. During an adiabatic expansion, 0.5 kg of fluid produce a work transfer of 43.5 kJ to the surroundings. Determine the change in specific internal energy of the fluid during the process.  
( 87 kJ/kg)
  
3. A fluid contained in a cylinder undergoes an adiabatic process in which 40 kJ of energy are transferred to the surroundings as work, followed by a constant volume process in which 53 kJ of energy are transferred to the surroundings as heat. If the mass of fluid in the cylinder as 2 kg, calculate the change in specific internal energy during each process, and also the overall change in internal energy of the fluid.  
( -20kJ/kg; -26.5kJ/kg : -93 kJ)
  
4. A mass of 0.01 kg of air at 27<sup>0</sup>C and a pressure of 100 kN/m<sup>2</sup> is heated at constant pressure until the temperature is 327<sup>0</sup>C.  $R_{\text{air}} = 287 \text{ J/kgK}$ .  $C_{v \text{ air}} = 718 \text{ J/kgK}$ . Find the:
  - a) specific volume of the air at the beginning (0.861 m<sup>3</sup>/kg)
  - b) density of the air at the beginning (1.16 kg/m<sup>3</sup>)
  - c) volume of the air at the beginning (0.00861 m<sup>3</sup>)
  - d) volume of air at the end of the process (0.0172 m<sup>3</sup>)
  - e) change in internal energy (2154 J)
  - f) work done (from force x distance) (861 J)
  - g) heat supplied (3015 J)