

Thermodynamic tables are allowed

1. Steam at a rate of 1.5 kg/s expands in a turbine adiabatically from 20 bar and 500°C to 2 bar. Assuming the process was conducted with an isentropic efficiency of 90%, find Outlet temperature, Mechanical power, Heat exchanged, Rate of entropy change. Is the process reversible?
2. A rigid tank of volume 0.5 m<sup>3</sup> contains CO<sub>2</sub> at 327°C and 10 bar is cooled down to 27°C. Find the mass of CO<sub>2</sub>, the final pressure, the work, the change in internal energy, the heat exchanged and the change in entropy.
3. Air is compressed in a frictionless piston and cylinder arrangement from 1 bar and 300K to 7 bar in a polytropic process:  $Pv^{1.3} = \text{Constant}$ . Find the final temperature, change in internal energy, work, heat and change in entropy.
4. Steam at a rate of 3kg/s at 5bar, 300°C enters an insulated desuperheater. Water at 5bar and 50°C also enters the desuperheater. At the exit, saturated steam leaves at 5 bar. Find the specific enthalpy of inlet and exit steam as well as water. Find also the rate of water addition, as well as the rate of entropy increase
5. An inventor claims designing a new engine absorbing 1200 kJ of heat from a heat reservoir at 627°C and rejects heat to atmosphere at 27°C.
  - a. The inventor claims the engine will produce 700 kJ of work. Is that possible?
  - b. The inventor claims the engine will reject 400 kJ of heat to surroundings. Is that possible?

	$R$ (J/kg.K)	$c_v$ (J/Kg.K)	$c_p/c_v$
CO <sub>2</sub>	189	567	1.33
Air	289	722	1.4

GOOD LUCK