

Paper copy of "Appendix: Property Tables and Charts" and a collection of mathematical formulas on a sheet of A4 is allowed to the exam.

NOTE! Return the question paper with your answers.

- Consider the properties of H_2O and explain why do frozen water pipes tend to burst? (2 p)
 - Show that water vapor can be accurately modeled as an ideal gas at temperatures below about 60°C . (1 p)
 - Check the applicability of the ideal gas model for Refrigerant-134a at a temperature of 80°C and a pressure of (i) 1.6 MPa and (ii) 0.10 MPa. (2 p)
- Simplify the general forms of the mass and energy rate balances to describe the process of blowing up a balloon. List all of your modeling assumptions. (5 p)
- Figure 1 provides steady-operating data for a well-insulated device with air entering at one location and exiting at another with a mass flow rate of 10 kg/s. Assuming ideal behaviour and negligible potential energy effects, determine the direction of flow and the power, in kilowatts. (5 p)

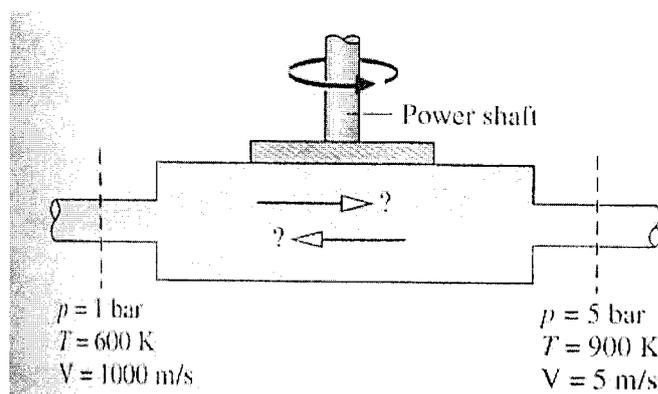


Figure 1.

- An ideal gas with constant specific heat ratio k enters a turbine operating at steady state at T_1 and p_1 and expands adiabatically to T_2 and p_2 . When would the value of the second law (exergetic) turbine efficiency exceed the value of the isentropic turbine efficiency? Ignore the effects of motion and gravity. (5 p)