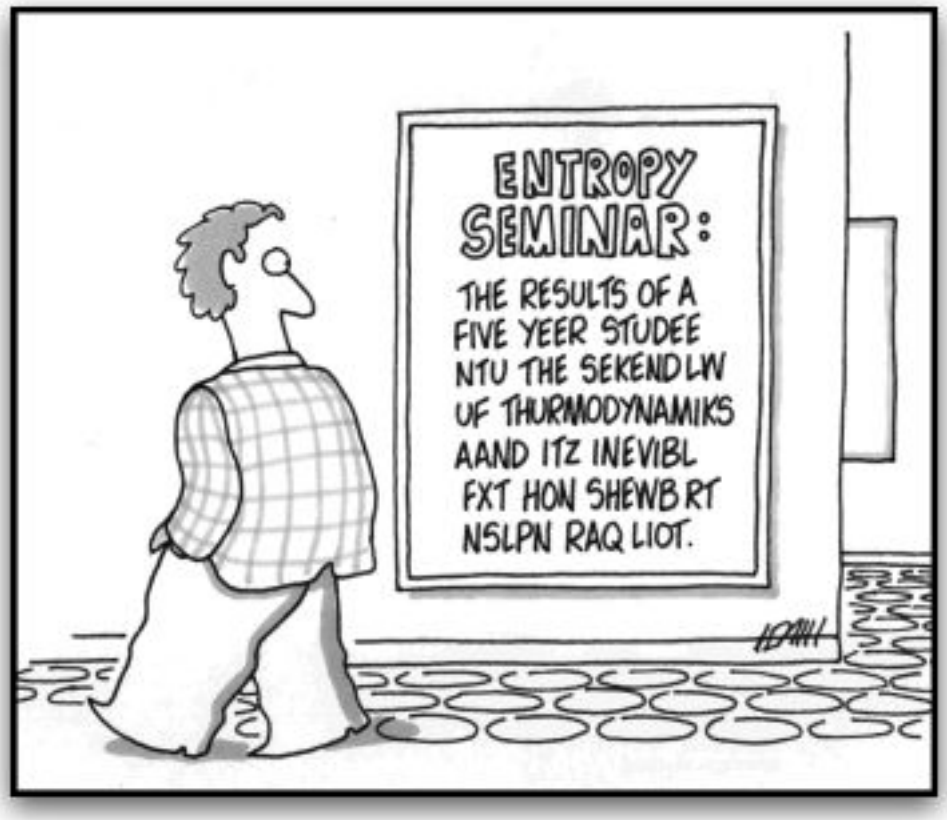


ME 200 (Thermodynamics I)
Lecture 28

Practice with the 2nd Law

"Tools" for thermodynamics problem solving

- Conservation of Mass
- 1st Law of Thermodynamics
- Entropy Equation (related to the 2nd Law of Thermodynamics)
- cycle performance measures
- (applied to CVs)

Supporting tools

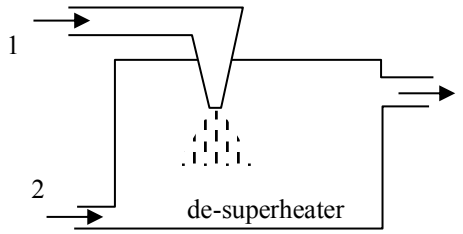
- property tables
- compressed liquid approximations
- incompressible substance model
- ideal gas model
- definition of specific enthalpy
- *Tds* relations
- work calculations

Common assumptions

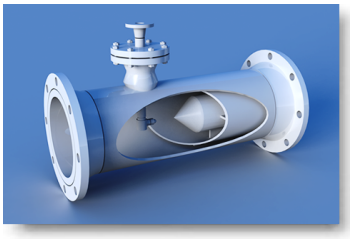
- quasi-equilibrium process
- 1D or uniform flow
- steady state, steady flow
- negligible KE and/or PE
- adiabatic
- passive
- isothermal, isobaric, isochoric (constant volume), isentropic
- incompressible
- ideal gas
- constant specific heat(s)
- internally reversible

Example (SecondLaw_27)
By injecting liquid water into superheated vapor, the de-superheater shown in the figure has a saturated vapor stream at its exit. Steady-state operating data are shown in the figure. Ignoring stray heat transfer and kinetic and potential energy effects, determine:

a. the mass flow rate of the superheated vapor stream, in kg/min, and
b. the rate of entropy production within the de-superheater, in kW/K.
c. Sketch the process on a *T*-*s* diagram.



1: liquid water
20 °C, 0.3 MPa (abs)
6.37 kg/min
2: superheated vapor
200 °C, 0.3 MPa (abs)
3: saturated vapor
0.3 MPa (abs)



https://www.enggcyclopedia.com/2011/07/steam-desuperheater/

Example (SecondLaw_28)

A 180 ft^3 tank initially filled with air at 1 atm (abs) and 70 °F is evacuated by a vacuum pump. During the process, the tank air is maintained at 70 °F. The vacuum pump discharges air to the surroundings at the surrounding's temperature and pressure, which are 70 °F and 1 atm (abs), respectively. Determine the minimum amount of work required to completely evacuate the tank, in Btu. Note that at the end of the discharge pipe downstream of the pump, the pressure is the same as the surroundings.

Image from: https://www.kwipped.com/rentals/power-utility/vacuum-trucktrailer/867