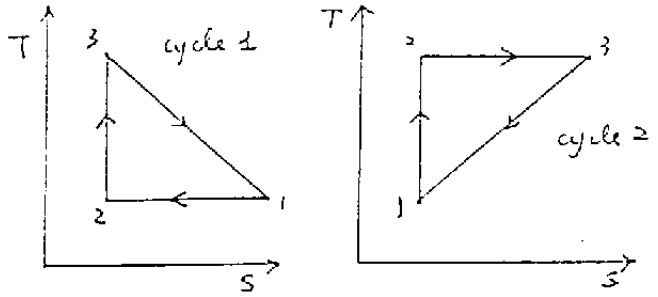
1) 20% The two power cycles shown in the following figure are composed of internally reversible processes, where the temperatures and entropys at each state (1, 2, 3) of the two cycles are the same

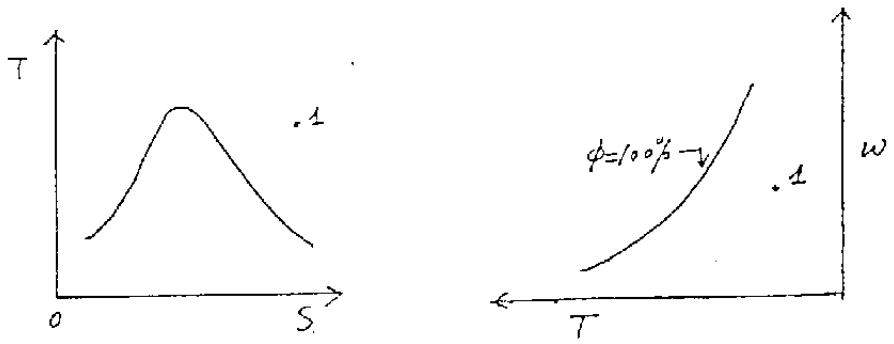
(a) Find the expression for the output work, the receing heat transfer and the thermal efficiency of each cycle in terms of the temperatures and entropy (T_1, T_2, s_1, s_3)

(b) Find the expression for the irreversibility of the two cycles in terms of temperatures and entropys (T_1, T_3, s_1, s_3)

(c) Explain which cycle has more advantage to use



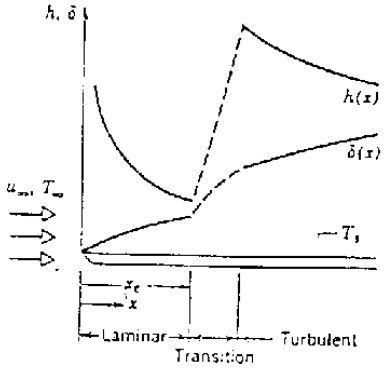
2) 15% Explain the process of cooling and dehumidification in an air conditioner by plotting the process on the following psychrometric chart ($T - w$ diagram) and the $T - s$ diagram. The designated symbols are: T=temperature, w=specific humidity, ϕ=relative humidity, s=entropy, 1 = initial state



3) 15% . A piston-cylinder machine contains nitrogen initially at 3.0 bars, 107 °C and 0.3 m^3. The piston moves with negligible friction until the pressure rises to 7 bars. the process is described by the relation V= 0.45- 0.05P, where V is in cubic meters and P is in bars. Determine (a) the work done, in N-m, (b) the heat transfer in kJ, and (c) discuss the validity of the assumption (if any) you used.

4) An electric current of 700 A flows through a stainless steel cable 20% having a diameter of 5 mm and an electrical resistance of 6×10^{-4} Ω/m (i.e. per meter of cable length) .The cable is in an environment having a temperature of 30 °C and the total coefficient associated with convection and radiation between the cable and the environment is approximately 25 W/m^2-K. If a thin coating of electrical insulation (k= 1.0 W/m-K) is applied to the cable, with a contact resistance of 0.02 m^2-K/W. What thickness of this insulation will yield the lowest value of the maximum insulation temperature?

5). Figure shows the variation of the local heat transfer coefficient h for 15% flow over an isothermal flat plate. Comment the results based on the nature of the boundary layer development.



6). (a) In dealing with free convection problem, it is often to use so called 15% "Boussinesq approximation". What is it? Briefly explain.

(b) Explain the difference between bodies which are semitransparent to radiation and those which are opaque.

(c) What is definition of an view factor for radiation exchange?