10-3
The Ideal Vapor-Compression Refrigeration Cycle

presented by:
Linda Manning
02/22/01

Topics of Discussion

- Household Refrigerators
- Processes of Ideal Vapor-Compression Refrigeration Cycle
- Steady Flow Analysis
- Carnot Cycle vs. Ideal Vapor-Compression Refrigeration Cycle
- Practice Problem

Household Refrigerator

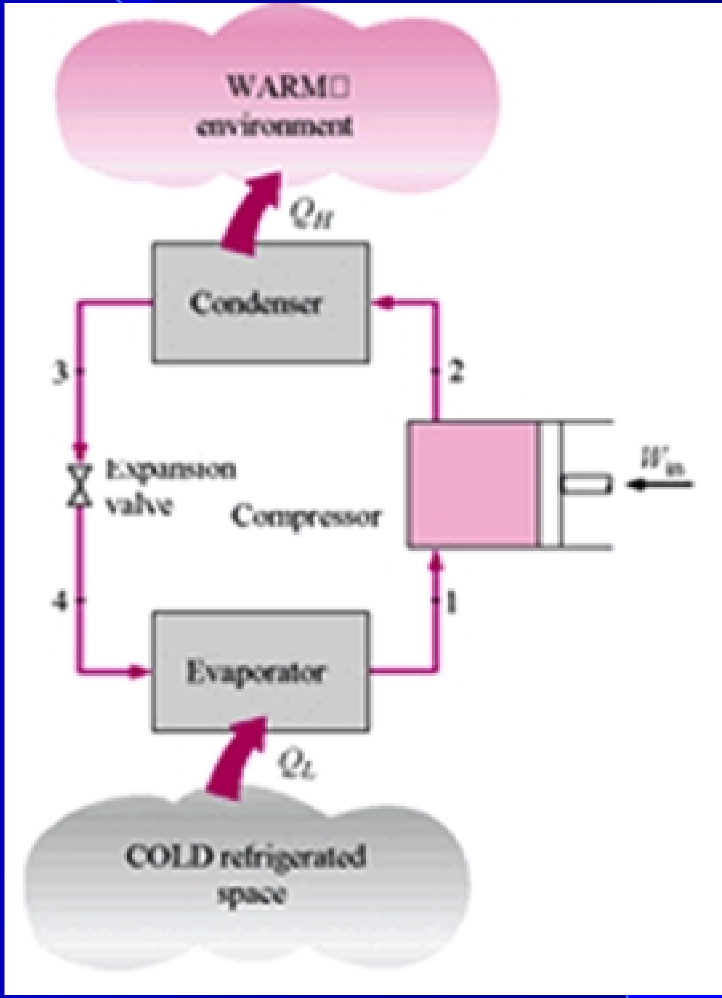
Encarta Deluxe 2001

Four Processes

- 1-2 Isentropic compression in a compressor
- 2-3 Constant pressure heat rejection in a condenser
- 3-4 Throttling in an expansion device
- 4-1 Constant pressure heat absorption in an evaporator

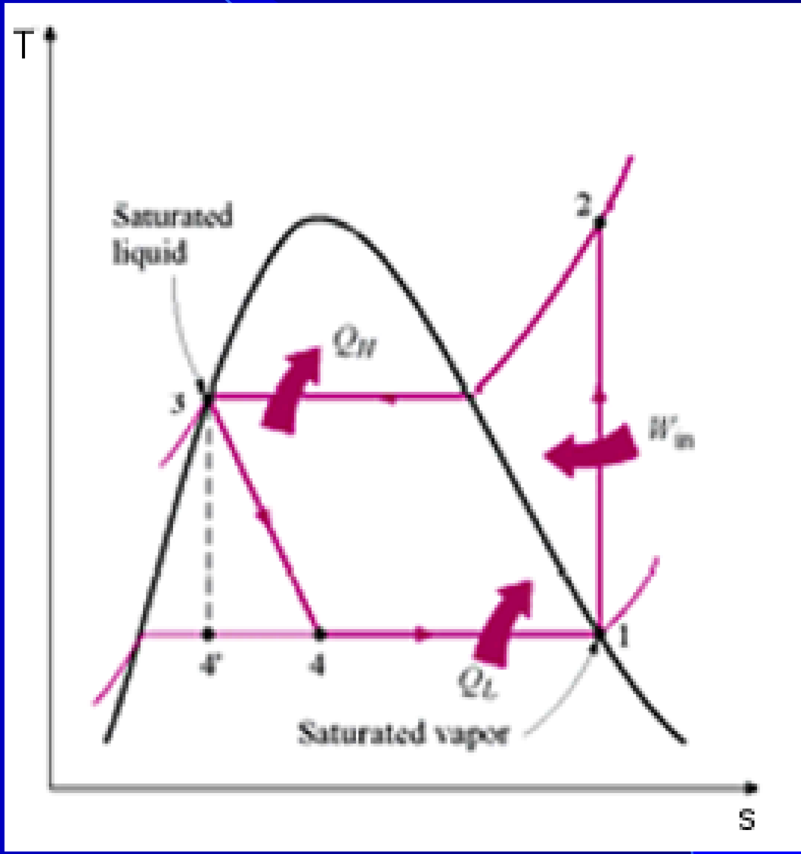
Ideal Vapor-Compression Refrigeration Cycle Schematic

- 1-Enters Compressor
  Sat. Vapor
- 2-Enters Condenser
  Super. Vapor
- 3-Throttled
  Sat. Liquid
- 4-Enters Evaporator
  Sat. Mixture



T-s Diagram

- Area under process curve = heat transfer
- Area under 4-1 = heat absorbed
- Area under 2-3 = heat rejected

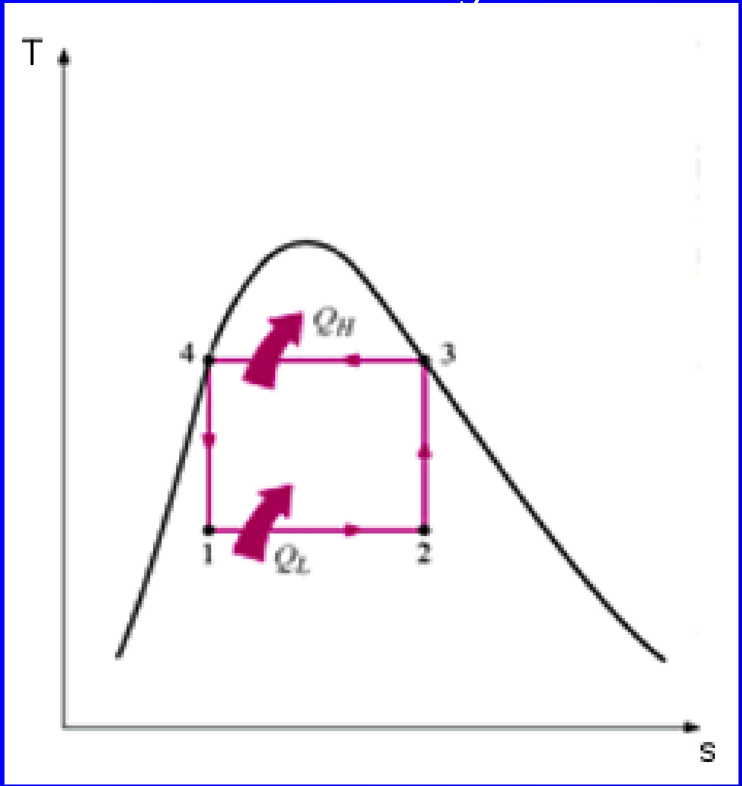


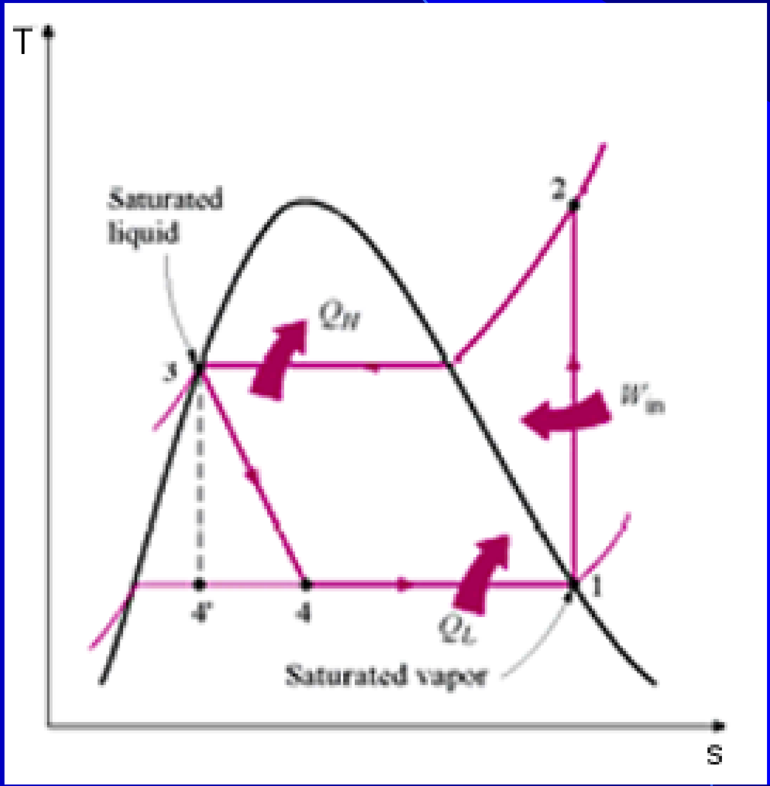
Steady Flow Process

- PE and KE small relative to work and heat transfer.
- $q_L = h_1 - h_4$
- w_{net},in$= h_2 - h_1$
- $q_H = h_2 - h_3$
- $COP_R = q_L / w_{net,in}$
- $COP_{HP} = q_H / w_{net,in}$

Carnot Cycle vs. Ideal Vapor-Compression Refrigeration Cycle

- Two phase after evaporation
- Turbine, not throttling device
- Internally reversible





Practice Problem

10-12

Given: Refrigerant-134a $\quad m_{dot} = 0.05$ kg/s

$P_1 = 120$ kPa $\quad P_2 = 0.7$ Mpa

Find: (a) rate of heat removal from refrigerated space & power input into compressor

(b) rate of heat rejection to the environment

(c) coefficient of performance