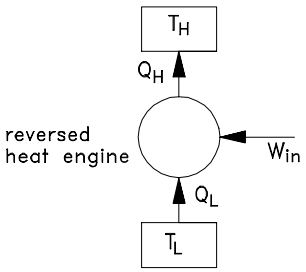
Week 5: Lecture 1

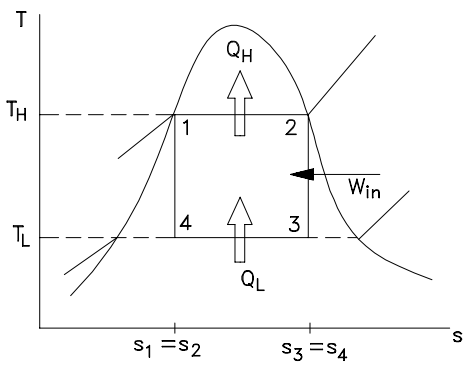
Refrigeration Cycle

A refrigeration system removes thermal energy from a low-temperature region and transfers heat to a high-temperature region.

The Carnot cycle can serve as the initial model of the ideal refrigeration cycle.

- operates as a reversed heat cycle engine
- transfer a quantity of heat, Q_L from a cold source at temperature, T_L





where:

$$Q_L = T_L(s_3 - s_2)$$

$$Q_H = T_H(s_4 - s_1)$$

$$W_{in} = Q_{net}$$

$$= (T_H - T_L)(s_3 - s_2)$$

Coefficient of Performance

$$COP = \frac{benefit}{cost}$$

$$COP_{refrig} = \frac{Q_L}{W_{in}} = \frac{1}{\frac{T_H}{T_L} - 1} = \frac{T_L}{T_H - T_L}$$

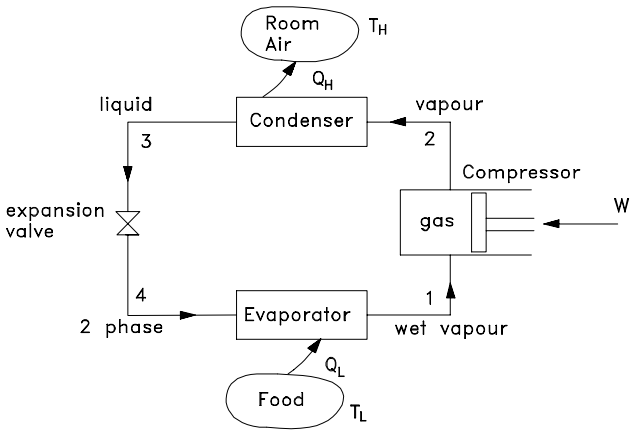
$$COP_{heat\ pump} = \frac{Q_H}{W_{in}} = \frac{1}{1 - \frac{T_L}{T_H}} = \frac{T_H}{T_H - T_L}$$

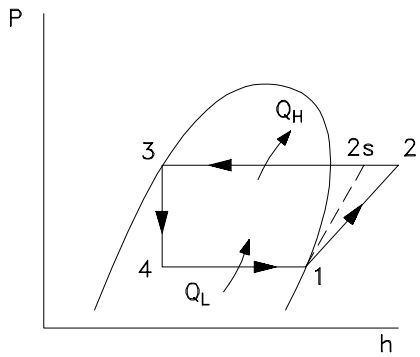
Week 5: Lecture 1

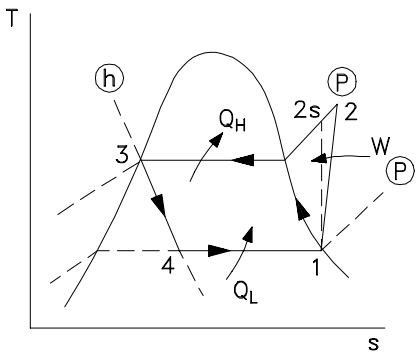
Vapour Compression Refrigeration Cycle

Assumptions for Ideal VCRC

- irreversibilities within the evaporator, condenser and compressor are ignored
- no frictional pressure drops
- refrigerant flows at constant pressure through the two heat exchangers
- stray heat losses to the surroundings are ignored
- compression process is isentropic







1-2s: isentropic compression of the refrigerant

2s-3: heat transfer from the refrigerant as it flows at constant pressure through the condenser

3-4 throttling process from state 3 to a two phase liquid-vapour mixture at state 4

4-1 heat transfer to the refrigerant as it flows at constant pressure through the evaporator

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