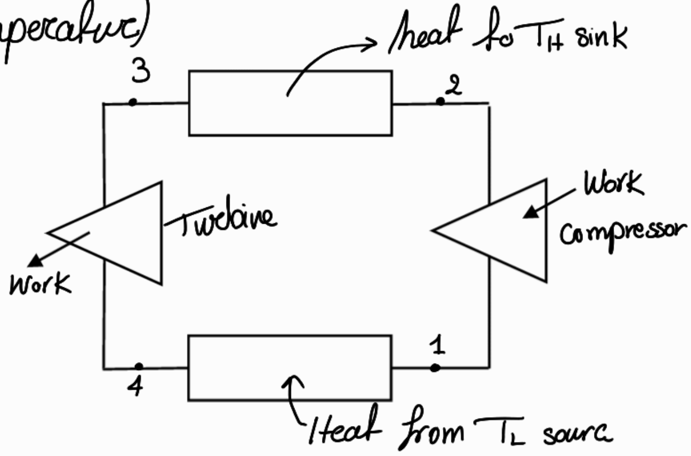
Chapter 10
Vapor compression cycle

Carnot Refrigeration cycle

It preforms the reverse effect of the heat engine

It transfers energy from low level of temperature to a high level of temperature (absorb heat at a low temperature)



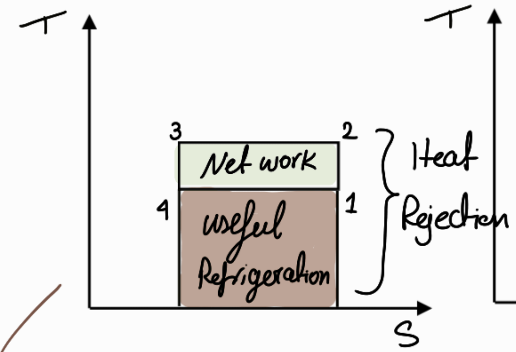
Processes of the cycle are:

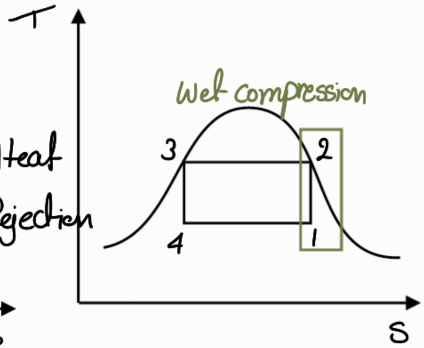
1-2 Adiabatic compression

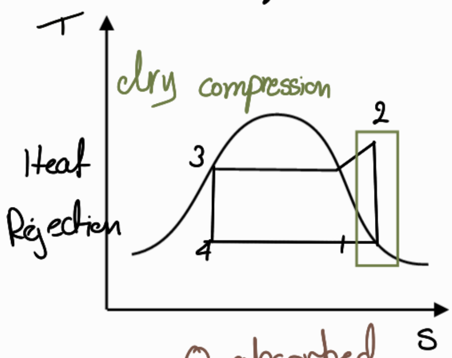
2-3 Isothermal rejection of heat

3-4 Adiabatic expansion

4-1 Isothermal addition of heat







$$\text{Coefficient of preformance} = \frac{\text{useful refrigeration}}{\text{net work}}$$

(compressor – turbine)

Q absorbed at T_L → useful refrigeration

power required → net work

For carnot Cycle $= \dfrac{T_1}{T_2 - T_1} = \dfrac{T_L}{T_H - T_L}$ ← in K

Carnot heat Pump

It delievers heat at a high level of temperature

$$\text{Performance factor} = \frac{T_2}{T_2 - T_1} = \text{coefficient of performance} + 1$$

T_2 → T_H in K; T_1 → T_L

Same figure But reversed path

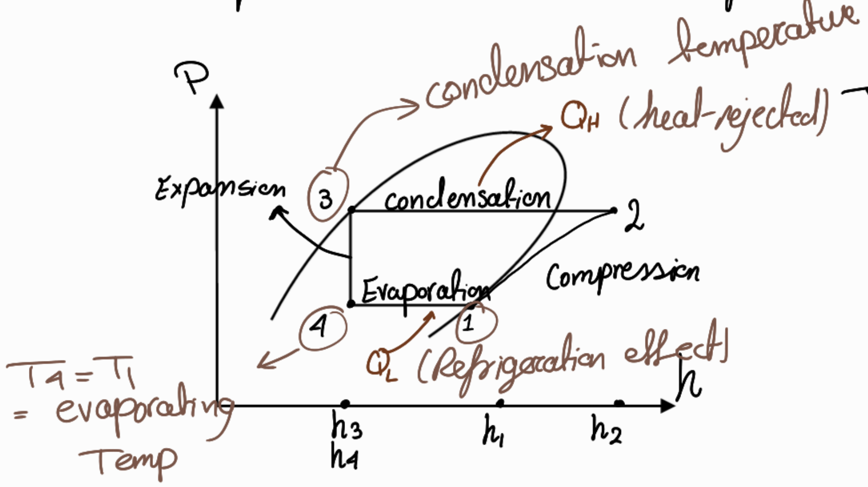
Standard vapor-compression cycle (heat pump)

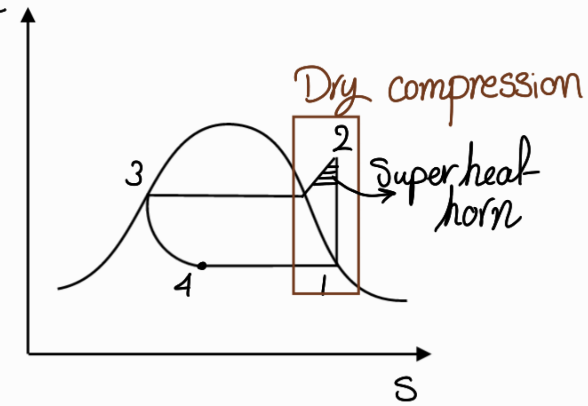
1-2 Reversible and adiabatic compression from saturated vapor to the condenser pressure (isentropic)

2-3 Reversible rejection of heat at constant pressure causing desuperheating and condensation of the refrigerant

3-4 Irreversible expansion at constant pressure from saturated liquid to the evaporator pressure

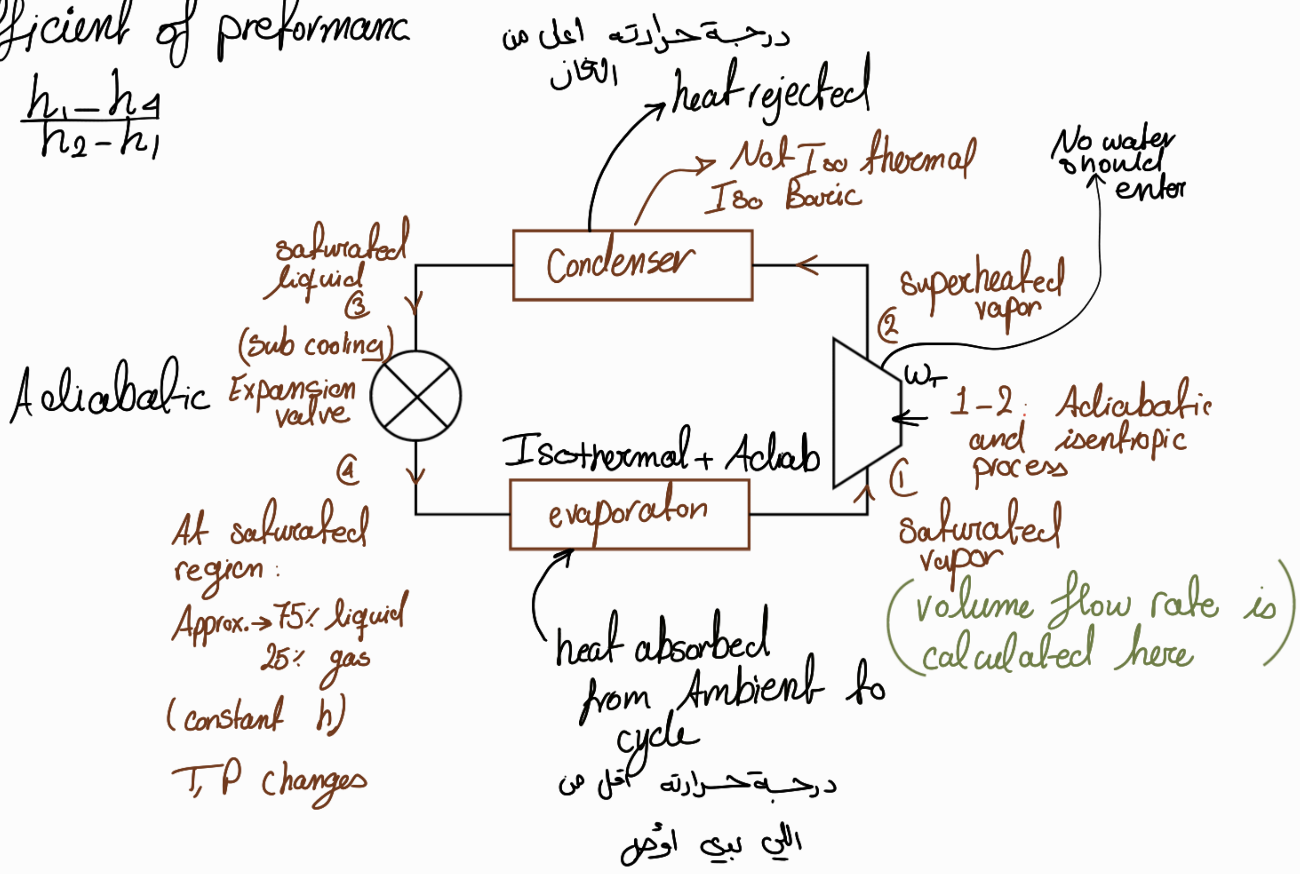
4-1 Reversible addition of heat at constant pressure causing evaporation to saturated vapor





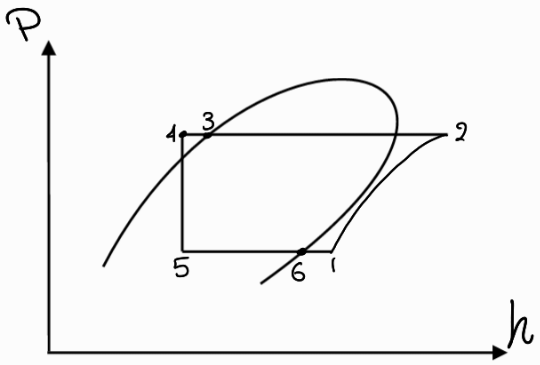
coefficient of preformanc

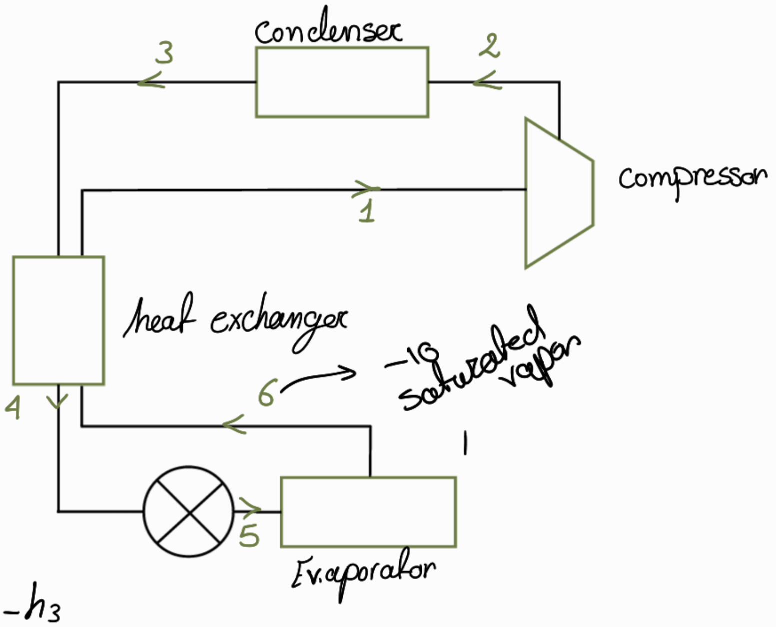
$$= \frac{h_1 - h_4}{h_2 - h_1}$$



Heat exchangers

Some refrigeration systems use a liquid to suction heat exchanger. This subcools the liquid from condenser with suction vapor coming from the evaporator



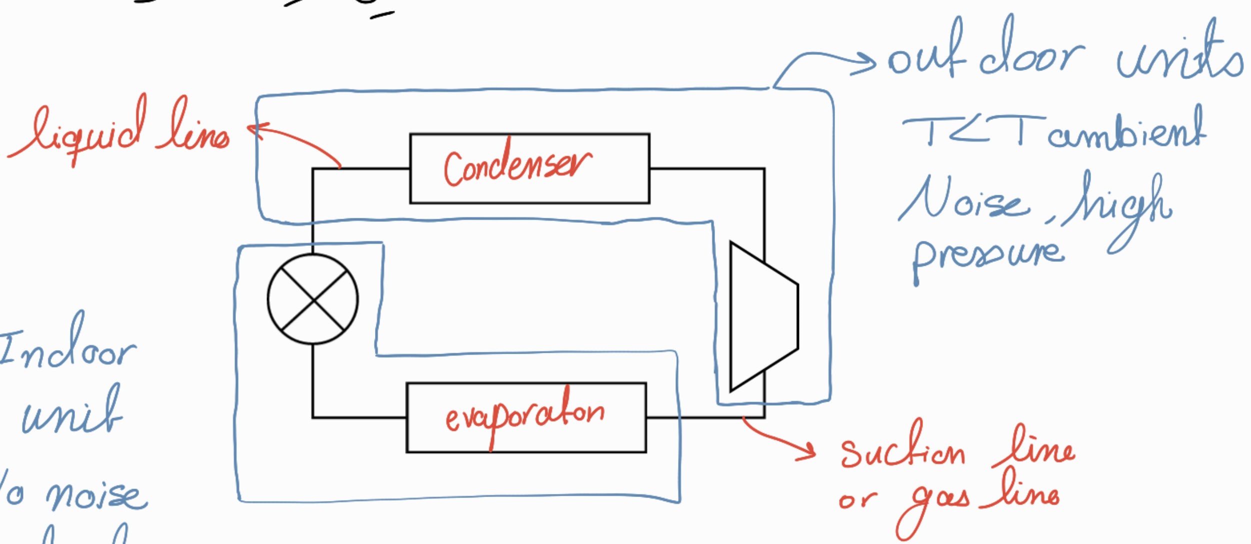


$h_3 - h_4 = h_1 - h_6$

Refrigeration effect $= h_6 - h_5 = h_1 - h_3$

The heat exchanger ensures that no liquid enters the compressor

Note في الحياة العملية



out door units: $T < T_{ambient}$, Noise, high pressure

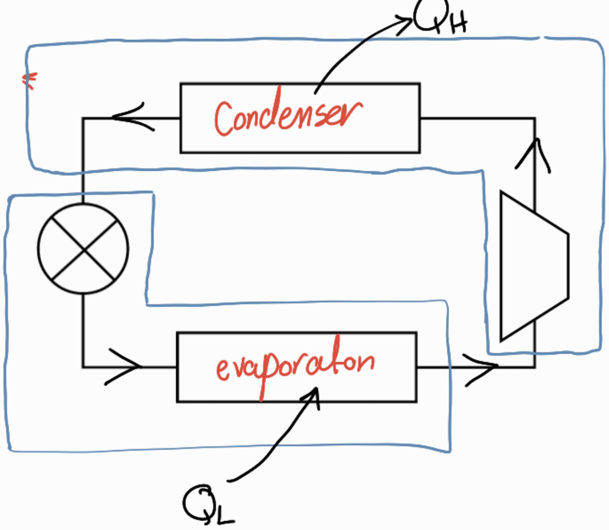
Indoor unit: No noise and low pressure

Gas line + liquid line ← بنعتبرهم بسلك واحد بس همي سلكين بتخلص مع الـ control

VRF: Variable refrigent flow

when cooling

حر الدنيا



when heating

بردالدنيا