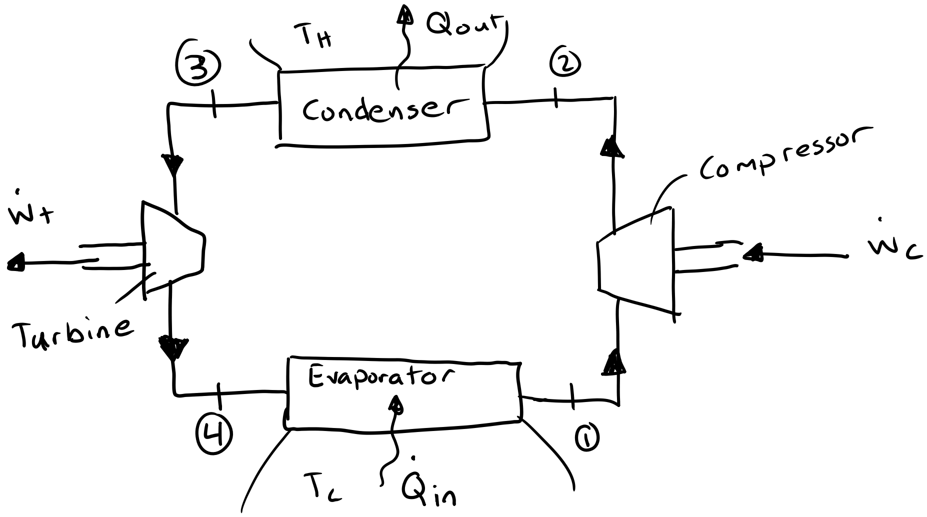
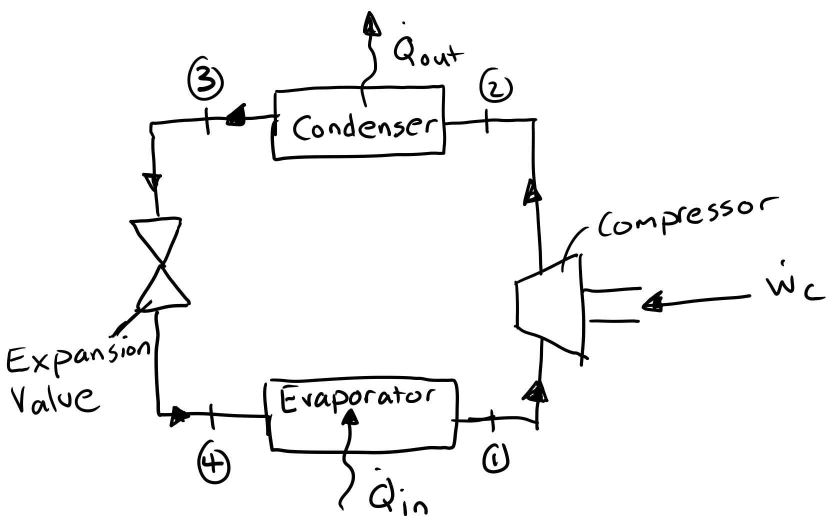
<u>Carnot Refrigeration Cycle</u>

- Reverse the Carnot Power Cycle



<u>Vapor Compression Refrigeration Cycle</u>



<u>Ideal Vapor Compression Cycle</u>

- All processes are internally reversible except 3-4

<u>Process 1-2</u>

- Compressor
- Isentropic compression from saturated vapor to superheated vapor

$$0 = \dot{Q}_{cv}^{\nearrow 0} - \dot{W}_{cv} + \dot{m}(h_1 - h_2)$$

$$\dot{W}_{cv} = -\dot{W}_c$$

$$\boxed{\frac{\dot{W}_c}{\dot{m}} = h_2 - h_1}$$

<u>Process 2-3</u>
- Condenser
- Heat transfer from the refrigerant to saturated liquid at constant pressure

$$0 = \dot{Q}_{cv} - \cancel{\dot{W}_{cv}}^{0} + \dot{m}(h_2 - h_3) \qquad \dot{Q}_{cv} = -\dot{Q}_{out}$$

$$\boxed{\frac{\dot{Q}_{out}}{\dot{m}} = h_2 - h_3}$$

<u>Process 3-4</u>
- Expansion Valve
- Throttling process to a two-phase liquid-vapor mixture

$$0 = \cancel{\dot{Q}_{cv}}^{0} - \cancel{\dot{W}_{cv}}^{0} + \dot{m}(h_3 - h_4)$$

$$\boxed{h_4 = h_3}$$

<u>Process 4-1</u>
- Evaporator
- Heat transfer to the refrigerant at constant pressure

$$0 = \dot{Q}_{cv} - \cancel{\dot{W}_{cv}}^{0} + \dot{m}(h_4 - h_1)$$

$$\dot{Q}_{cv} = \dot{Q}_{in}$$

$$\boxed{\frac{\dot{Q}_{in}}{\dot{m}} = h_1 - h_4}$$

<u>Coefficient of Performance</u>

$$\beta = \frac{\dot{Q}_{in}/\dot{m}}{\dot{W}_c/\dot{m}}$$

<u>Units</u>
1 ton of refrigeration = 200 Btu/min = 211 kJ/min