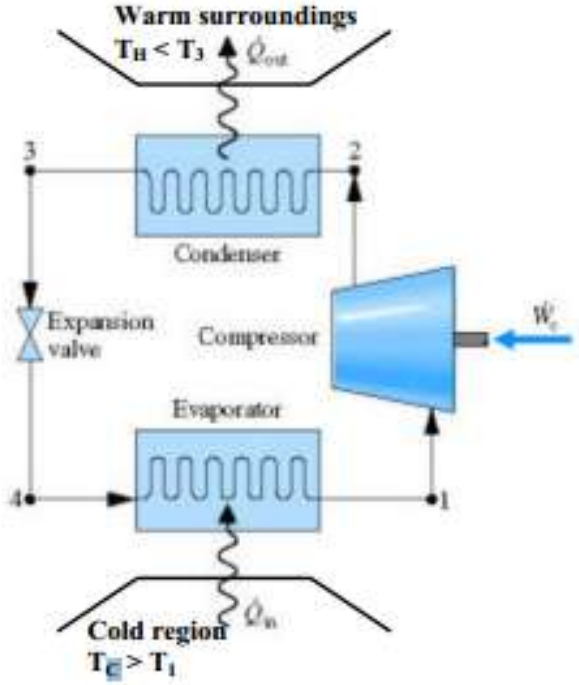
Vapor Compression Refrigeration System

Purpose of the system is to maintain a cold region at a temperature below the temperature of its surroundings



Note: $\dot{Q}_{in}$ referred to as the **refrigeration capacity, W** (units: 1 ton = 711 KJ/min)

Working fluid: up to 1990's most common refrigerants were chlorinated fluorocarbons (CFCs), e.g., Freon-12 (CCl_2F_2), Freon-22 ($CHClF_2$)
→ chlorine destroys earth's ozone layer so CFCs banned

A common refrigerant used in most hockey rinks in Canada is ammonia (NH_3)

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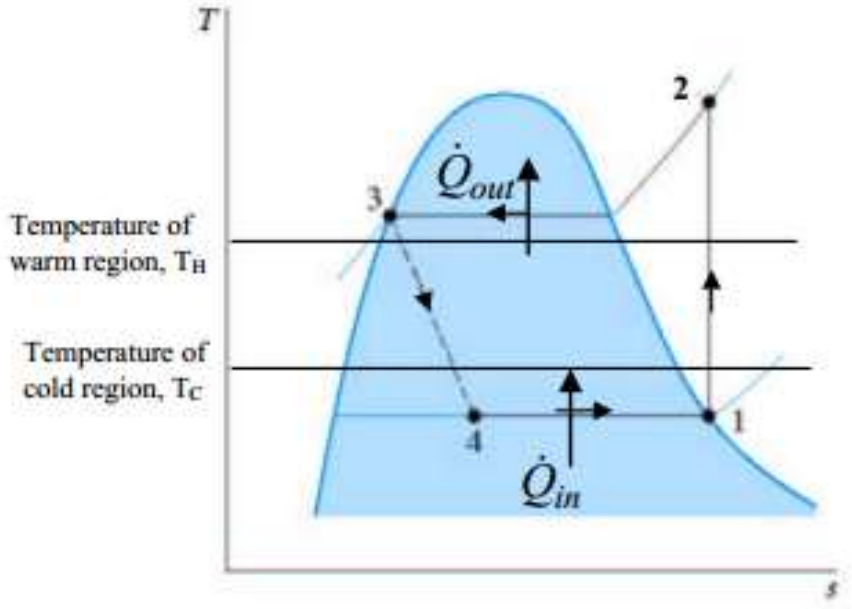
Ideal refrigeration cycle:

1 → 2 Isentropic compression

2 → 3 Constant pressure heat removal

3 → 4 Constant enthalpy (throttling)

4 → 1 Constant pressure heat addition



1 → 2 $\dot{W}_{in} = \dot{m}(h_1 - h_4)$ 2 → 3 $\dot{Q}_{out} = \dot{m}(h_2 - h_3)$

3 → 4 Throttling process $h_3 = h_4$

4 → 1 $\dot{Q}_{in} = \dot{m}(h_1 - h_4)$

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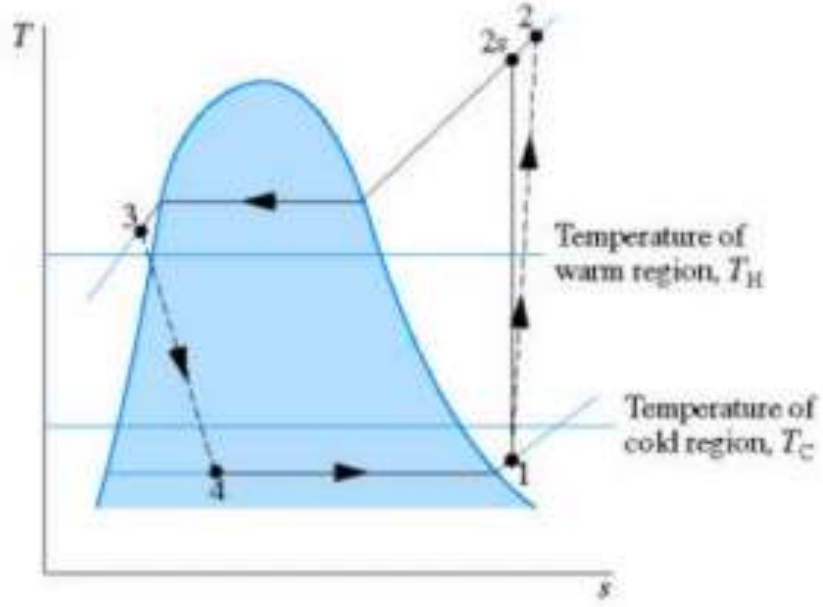
Coefficient of Performance (COP):

$$\beta = \frac{\dot{Q}_{in}/\dot{m}}{\dot{W}_C/\dot{m}} = \frac{h_1 - h_4}{h_2 - h_1} > 1$$

Actual vapor-compression cycle may include:
state 1 in superheated vapor region and
state 3 in the compressed liquid region



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