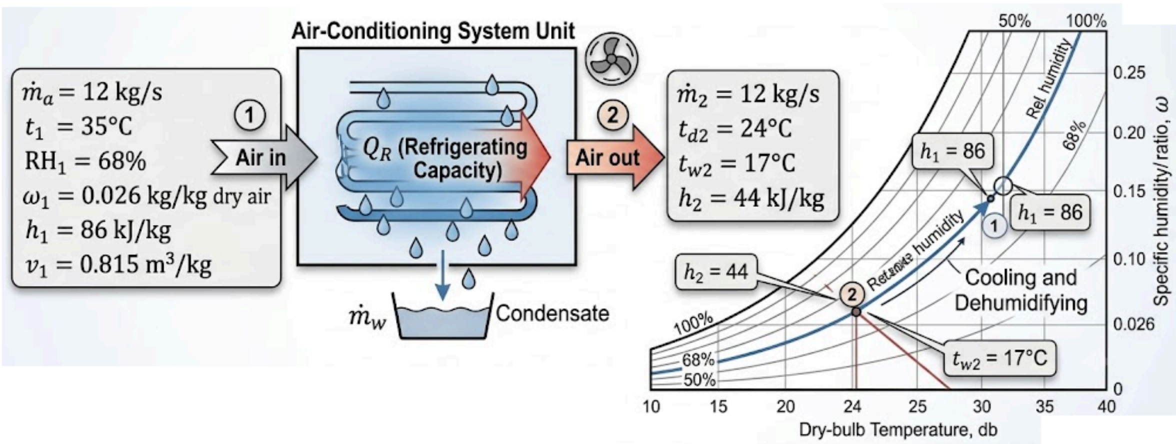
Step 1: Identify the Thermodynamic States and Given Properties

In psychrometric analysis, we treat the moving stream as a steady-flow system. The air enters at State 1 and leaves at State 2. The mass flow rate of dry air remains constant throughout the process ($m_a = 12\ kg/s$).



Step 2: Apply the Conservation of Energy (Cooling Capacity in kW)

The rate of heat removal from the air stream by the cooling coil is equal to the mass flow rate of the dry air multiplied by the drop in specific enthalpy from the inlet to the outlet state. This accounts for both sensible cooling (temperature drop) and latent cooling (moisture condensation).

$$Q_R = m_a\left(h_1 - h_2\right)$$

Substituting the given values:

$$Q_R = \left(12\ \frac{kg}{s}\right)(86\ -\ 44)\frac{kJ}{kg} = 504\ kW$$

This indicates that the cooling coil must continuously extract 504 kW of thermal energy from the passing air stream.

Step 3: Convert Cooling Capacity to Tons of Refrigeration (TR)

In commercial HVAC and refrigeration engineering, capacity is standardly rated in Tons of Refrigeration (TR). One ton of refrigeration is defined as the rate of heat transfer required to melt 1 ton (2000lbs) of pure ice at 32ºF (0ºC) in 24 hours.

The standard metric conversion factor for this is 1 TR = 3.516 kW (or 3.517 kW depending on standard rounding). Using the standard board exam constant (3.516 kW):

$$Refrigerating\ Capacity\ (TR)\ = \frac{504\ kW}{3.516\ kW\ /\ TR} =\ 143.3447\ TR$$

A capacity of over 143 tons of refrigeration indicates a very massive system. For context, a typical single-family residential home requires about 2 to 5 tons of air conditioning. A system of this magnitude is designed for a large facility, such as a multi-story commercial office building, a cleanroom, an auditorium, or a manufacturing plant layout.