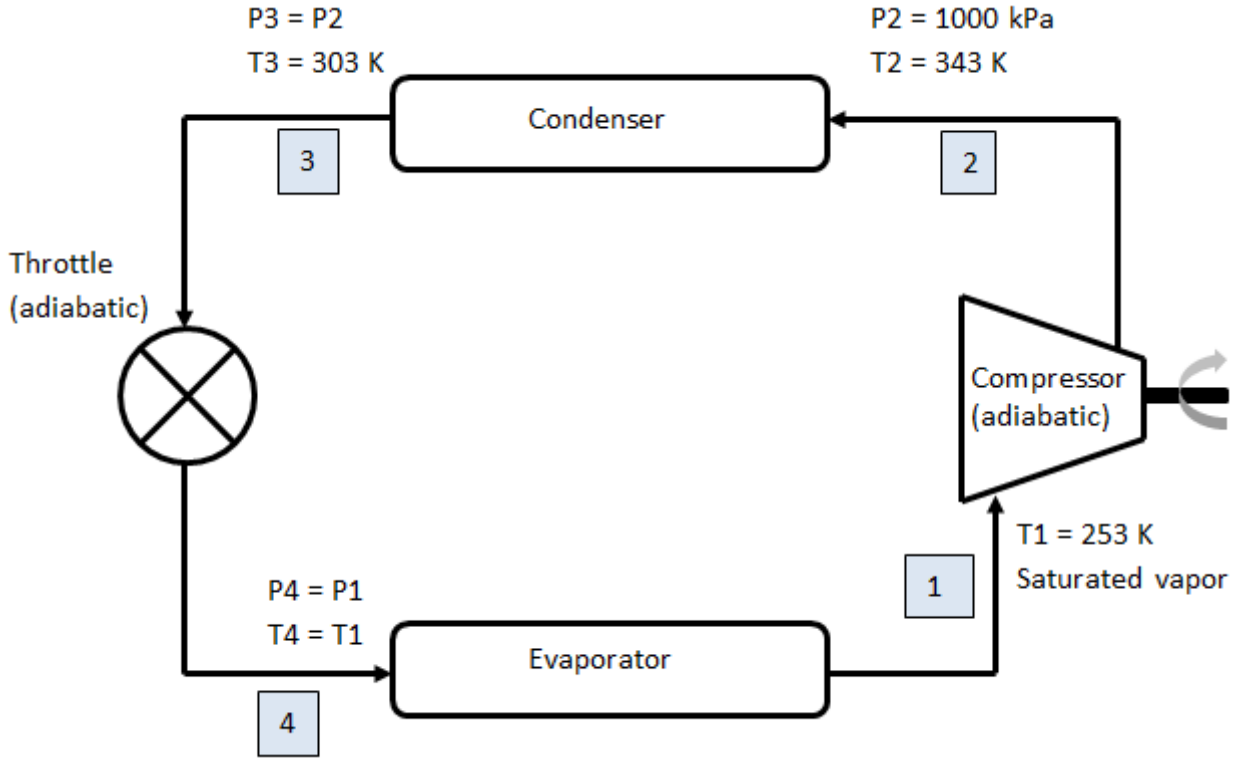
Analysis of a Vapor Compression Refrigeration Cycle

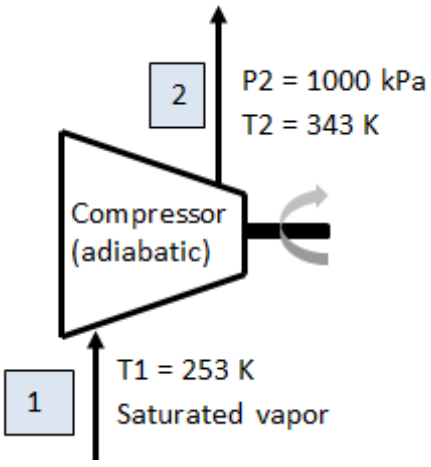
This application analyzes this refrigeration cycle and calculates its coefficient of performance.



Additionally, the thermodynamic cycle will be plotted on a pressure-enthalpy-temperature chart.

fluid := "R134a"

Compressor



Enthalpies at points 1 and 2

P2 := 1.1 MPa

h1 := ThermophysicalData:-Property(enthalpy, temp

h2 := ThermophysicalData:-Property(enthalpy, temp

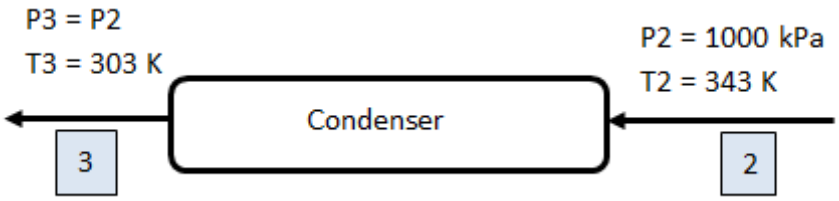
Pressure at point 1

P1 := ThermophysicalData:-Property(pressure, tem

Work done by the compressor

workCompressor := h1 − h2 = −63.79 $\frac{kJ}{kg}$

Condenser



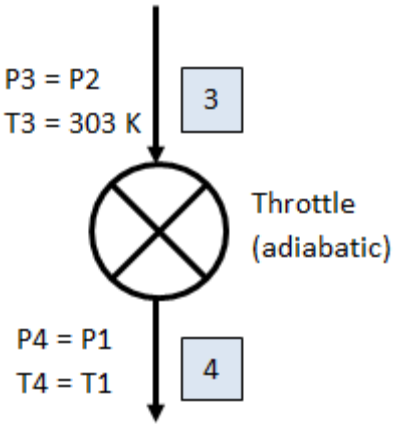
Enthalpy at point 3

h3 := ThermophysicalData:-Property(enthalpy, temperature = 303 K, pressure = P2, fluid) =

Enthalpy change over the condenser

h3 − h2 = −208.752 $\frac{kJ}{kg}$

Throttle



Enthalpy at point 4

h4 := h3 = 241.498 $\frac{kJ}{kg}$

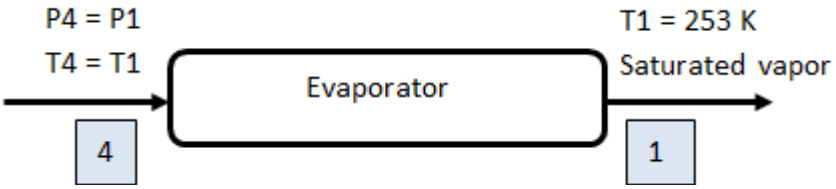
Saturation pressure at 253 K

P4 := P1 = 0.132 MPa

Quality at point 4

ThermophysicalData:-Property(Q, pressure = P4, ent

Evaporator



Heat extracted by the evaporator

heatEvaporator := h4 − h1 = −144.964 $\frac{kJ}{kg}$

Coefficient of Performance

$$COP := \frac{heatEvaporator}{workCompressor} = 2.273$$

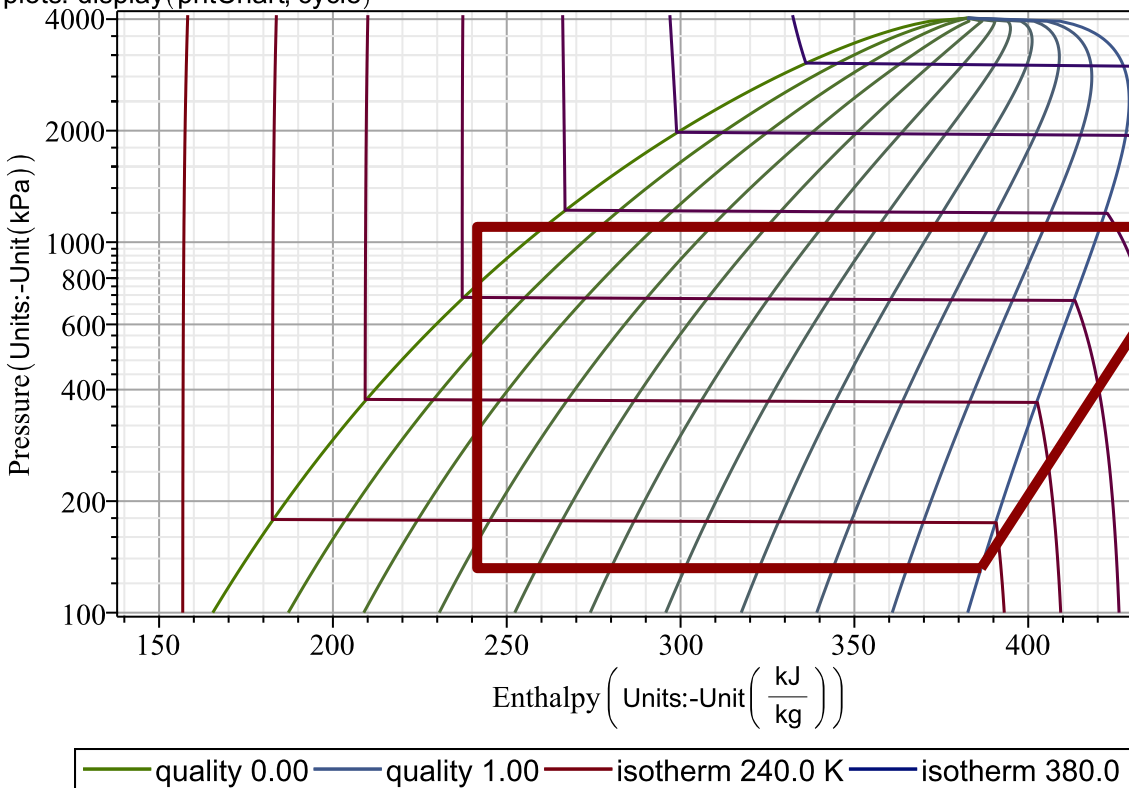
Plot the Thermodynamic Cycle

```
phtChart := ThermophysicalData:-PHTChart(fluid, 100 kPa..4100 kPa)

pts := 0.001·~[[h1, P1], [h2, P2], [h3, P2], [h3, P4], [h1, P1]]

cycle := plots:-pointplot(pts, connect = true, color = "DarkRed", thickness = 5)
```

plots:-display(phtChart, cycle) =



$$\text{erature} = 253\ \text{K},\ Q = 1,\ \text{fluid}) = 386.462\ \frac{\text{kJ}}{\text{kg}}$$

$$\text{erature} = 343\ \text{K},\ \text{pressure} = \text{P2},\ \text{fluid}) = 450.250\ \frac{\text{kJ}}{\text{kg}}$$

perature = 253 K, Q = 1, fluid) = 0.132 MPa

241.498 $\frac{\text{kJ}}{\text{kg}}$

thalpy = h4, fluid) = 0.319

450
K