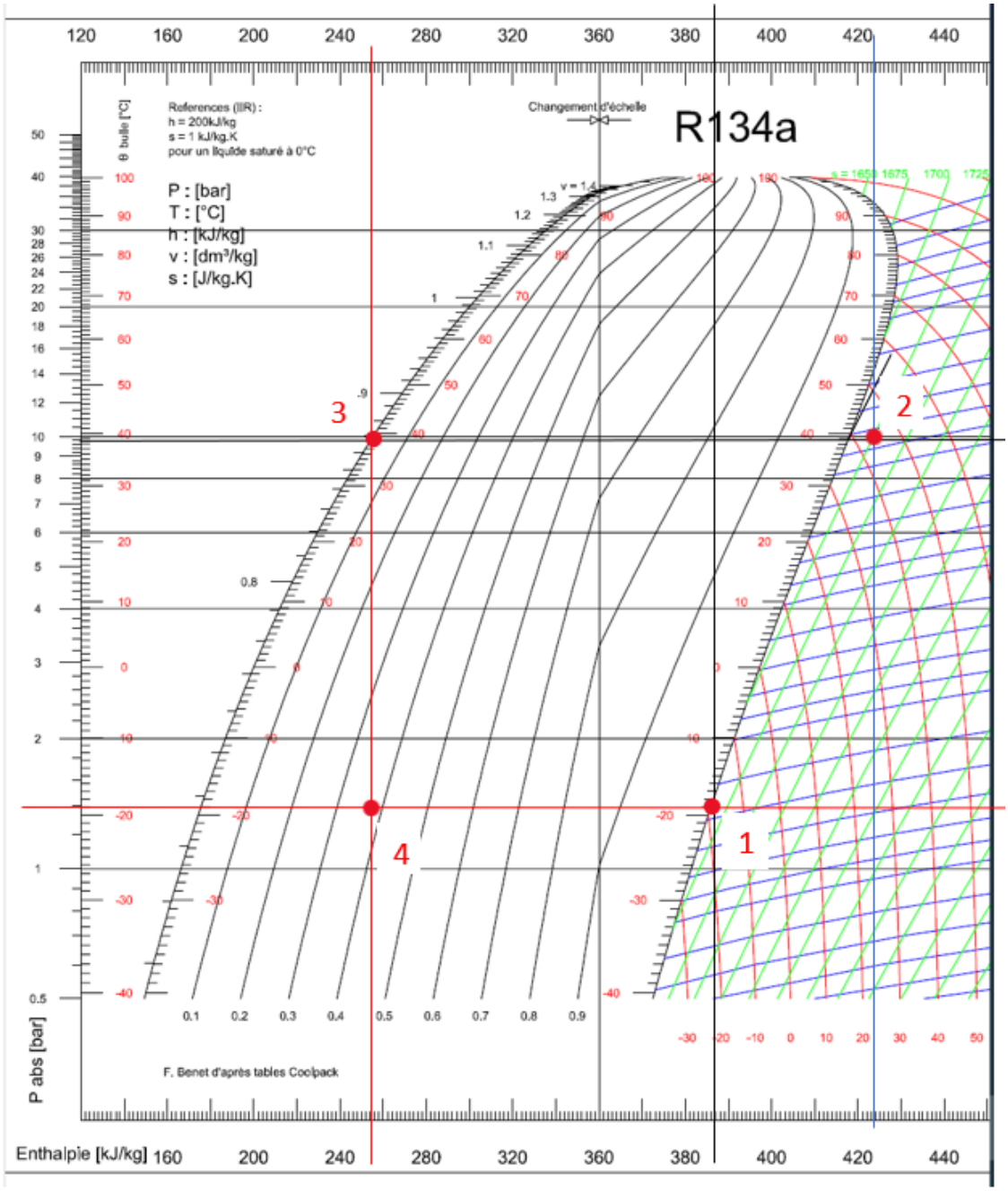
e.g. A refrigeration cycle uses refrigerant R-134a and operates between a low-side pressure of 0.14MPa and high side pressure of 1MPa. The refrigerant mass flow rate is 0.05kg/sec. find the cooling effect, work input and cop of this machine.

Solution:

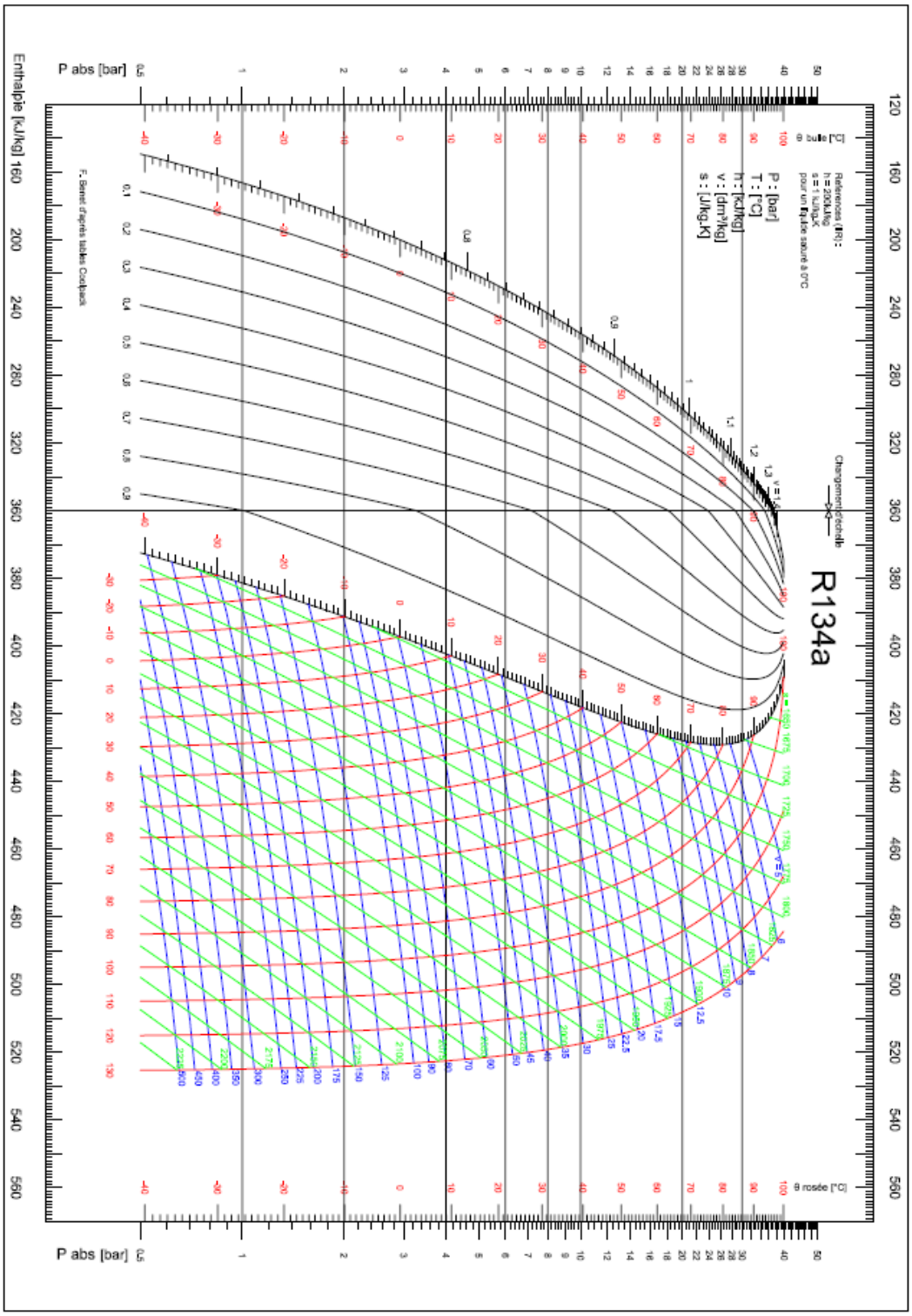


From P-h diagram and table we find the enthalpies of each point as follows:

Point	P MPa	h kJ/sec
1 (table)	0.14	387
2 (chart)	1	424
3 (table)	1	256
4	0.14	256

Work input to compressor $W_c = h_2 - h_1 = 424 - 387 = 37$ kJ/kg.
Power input to the compressor = m $(h_2 - h_1) = 0.05\ (424 - 387) = 1.85$kW.
Refrigeration effect $(Q_{evap}) = h_1 - h_4 = 387 - 256 = 131$ kJ/kg.
Refrigeration effect in kW = m ($h_1 - h_4$) = 0.05 (387 – 256) =6.55 kW.

$$\text{COP} = \frac{Q_{evap}}{W_{comp}} = \frac{131}{37} = 3.54$$


R134a
P abs [bar]
Enthalpie [kJ/kg]
θ bulle [°C]
θ rosée [°C]
P : [bar]
T : [°C]
h : [kJ/kg]
v : [dm³/kg]
s : [J/kg.K]
Changement d'échelle
F. Bennet d'après tables Cooljacks

Tutorial sheet

1. *the temperature in evaporator coil is -6 °C and that in the condenser coil is 22 °C. assuming that the machine operates on the reversed Carnot cycle. Calculate the COP the refrigeration effect per kW of input work, and the heat rejected to the condenser. (9.54;9.54kW;10.4kW)*
2. *a Carnot refrigeration cycle absorbs heat at (-12 °C) and rejects it at 40 °C a- calculate the COP of this cycle d- If the cycle is absorbing 15 kW at (-12 °C) temperature, how much power is required. C- if the Carnot heat pump operates between the same temperature, what is the performance factor d- what is the rate of heat rejection at 40 °C if the heat pump absorbs 15 kW at the (-12 °C) temperature. (18kW)*
3. *in a standard vapour compression cycle using R-22 the evaporation temperature is (-5 °C) and the condensing temperature is 30 °C, calculate a-the work of compression b- the refrigeration effect c-the heat rejected in the condenser d- COP*
   (6.47)
4. *a refrigeration system using R-22 is to have a refrigerating capacity of 80 kW. The cycle is standard vapour compression cycle in which the evaporation temperature is (-8 °C) and the condensing temperature 42 °C a- determine the volume flow of refrigerant measured in cubic meter per second at the inlet to the compressor. B- calculate the power required by the compressor. C-at the entrance to the evaporator what is the fraction of vapour in the mixture expressed both on mass basis and volume basis(0.292,0.971)*
5. *a refrigerant R-22 vapour compression system includes a liquid to suction heat exchanger in the system. The heat exchanger warms saturated vapour coming from evaporator from (-10 °C) to 5 °C with liquid which comes from the condenser at 30 °C. the compression are isentropic in both cases below. A – calculate the COP of the system without the heat exchanger but with condensing temperature at 30 °C and evaporator temperature of (-10 °C)(5.46) b- calculate the COP with the heat exchanger (5.37) c- if the compressor is capable of pumping 12 lit/s measured at the compressor suction, what is the refrigeration capacity of the system without heat exchanger and with heat exchanger(30.3kW, 29.9kW)*