1- Consider an ideal refrigeration cycle which uses R-12 as working fluid. The temperature of the refrigerant in the evaporator is -20 °C and in the condenser is 40 °C. The refrigerant is circulated at the rate of 0.03 kg/s. Determine the coefficient of performance and refrigeration capacity. (COP = 3.18, $\dot{Q}$ = 3.12 kW)

2- Refrigerant 134a is the working fluid in an ideal vapor compression refrigeration cycle that communicates thermally with a cold region at 0 °C and a warm region at 26 °C. Saturated vapor enters the compressor at 0 °C and saturated liquid leaves the condenser at 26 °C. The mass flow rate of the refrigerant is 0.08 kg/s. Determine (a) the compressor power, in kW, [1.4 kW] (b) the refrigeration capacity, in kW and TR, [12.92 kW, 3.67 TR] (c) the COP [9.24], and (d) the COP of a Carnot refrigeration cycle operating between warm and cold regions at 26 and 0 °C, respectively [10.5].

3- Modify problem 2 to allow for temperature differences between the refrigerant and the warm and cold regions as follows. Saturated vapor enters the compressor at -10 °C. Saturated liquid leaves the condenser at a pressure of 9 bar. Determine for the modified cycle (a) the compressor power, in kW, [2.48 kW] (b) refrigeration capacity, in kW and TR [11.34 kW, 3.23 TR], (c) the COP [4.57]. Compare results with those of problem 2.

4- Reconsider the vapor compression refrigeration cycle of problem 3, but include in the analysis that the compressor has an efficiency of 80%. Also, let the temperature of the liquid leaving the condenser equal 30 °C. Determine for the modified cycle (a) the compressor power, in kW, [3.1 kW] (b) the refrigeration capacity, in kW and TR [11.99 kW, 3.41 TR], and (c) the COP [3.86].

5- A refrigerator has a steady flow of R-22 as saturated vapor at -20°C into the adiabatic compressor that brings it to 1.0 MPa. After the compressor, the temperature is measured to be 60°C. Sketch the cycle on T-s diagram and determine:

a- the actual compressor work. (- 45 kJ/kg)
b- the actual cycle coefficient of performance. (3.75)
c- the compressor isentropic efficiency. (78 %)

6- A heat pump using refrigerant 134a heats a house. The house is losing heat at a rate of 60,000 kJ/h. The refrigerant enters the compressor at 280 kPaand 0°C, and it leaves at 1 MPa and 60°C. The refrigerant exits the condenser at 30°C. Determine (a) the mass flow rate [0.08341 kg/s], (b) the power input to the heat pump [3.55 kW], and (c) the heat absorbed from environment [13.12 kW].

7- Consider the simple air standard refrigeration cycle. Air enters the compressor at 0.1 MPa, -20 °C, and leaves at 0.5 MPa. Air enters the expander at 15 °C. Determine:

a- The coefficient of performance of this cycle. ($\beta = 1.71$, $\dot{m} = 0.014$ kg/s)

b- The rate at which air must enter the compressor to provide 1 kW of refrigeration.

With my best regards
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