Engr 292 - Fluids and Thermodynamics

Assignment 4 - Vapour Compression Refrigeration

Please make sure you include the following in your solutions:

- *A diagram of the refrigeration system; and,*
- *A T-S diagram. Diagrams must be labeled to provide reference for solution.*

Question 1

Consider a 300 kJ/min refrigeration system that operates as an ideal vapor-compression refrigeration cycle with refrigerant 134a as the working fluid. The refrigerant enters the compressor as a saturated vapor at 160 kPa and is compressed to 900 kPa.

Determine:

a. The mass flow rate of refrigerant;
b. The power input to the compressor;
c. The coefficient of performance (COP); and,
d. The quality of the refrigerant at the discharge of the valve.

Question 2

A heat pump is used to provide heat for a house in the winter time. The house requires 75,000 kJ/hour of heat to keep the air temperature within the house at a reasonable level. The heat pump operates on the ideal vapor-compression cycle with refrigerant R134a. The evaporator and condenser pressures are 320 kPa and 800 kPa respectively.

Determine:

a. The mass flow rate of refrigerant;
b. The compressor work input to the heat pump;
c. The COP of the Heat Pump System; and,
d. The electric power saved by using a heat pump instead of baseboard electric heaters.
e. If the heat pump system were fitted with a water/refrigerant heat exchanger on the evaporator side and well water were circulated through this heat exchanger … what would the flowrate of well water need to be to satisfy the heating requirements of the house (kg/s)? Take the acceptable temperature drop in well water as it passed through the evaporator heat exchanger to be 8°C. (Recall: $\dot{q} = \dot{m} C_P \Delta T$)