## Practice Problems

**29-1** A vapor-compression cycle refrigerator originally used R-22 as the refrigerant, but is being converted to R-134a. In this system the evaporator temperature is -20 °C and the condenser temperature is 50 °C. For both systems the refrigerant enters the compressor as saturated vapor and exits the condenser as a saturated liquid. The mass flow rate of refrigerant is constant at 7.5 kg/min. The isentropic efficiency of the compressor is 82.5 %.

**Tip:** If you define your working fluid near the top of your code something like r$ = ‘R22’ you can then use that definition in each of the EES commands to look up a property. For instance, if you want the enthalpy at State 1 you would use: h[1] = enthalpy(r$, T=T[1], x=x[1])  
When finished with your code you can save your EES file, then make a copy of your EES file (or save as a different name) where you change the fluid definition to be r$ = ‘R134a’ and 90% of the effort in analyzing the second refrigerant will be done for you.

**For each of the refrigerants** do the following:

1. Determine the refrigeration capacity [tons]
2. Calculate the COP
3. Calculate the ideal (reverse Carnot) COP with the same temperature limits
4. Use EES to create a P-h diagram for the refrigerant, then do an ‘overlay plot’ to add each of the state points to the diagram. Make sure to label each of the points as something like “State 1” or some other descriptive label.
5. Discuss your results as a comment in the bottom of your code. You may want to include some discussion about

* Performance of two refrigerants
* Power requirements of two refrigerants
* Other implications of swapping refrigerants

## Answers

See the “Tips” for intermediate answers for a different refrigerant