

ME 201

Thermodynamics

Homework 14, Due Wednesday, 3/22/2006

1. Consider the Carnot cycle occurring in a piston-cylinder device containing refrigerant-134a with operating conditions given below:

Process A: Isothermal heat addition at $T_H = 30^\circ\text{C}$ to convert saturated liquid to saturated vapor

Process B: Isentropic and adiabatic expansion to $T_L = -20^\circ\text{C}$

Process C: Isothermal heat removal at -20°C

Process D: Isentropic and adiabatic compression back to the initial state

With R-134a as the working fluid for this cycle calculate the thermal efficiency using

$$\eta_{\text{th}} = \frac{W_{\text{net}}}{Q_{\text{in}}}$$

Compare this to the ideal Carnot cycle efficiency given by

$$\eta_{\text{Carnot}} = 1 - \frac{T_L}{T_H}$$