

---

D R E X E L U N I V E R S I T Y  
Department of Chemical and Biological Engineering  
CHE 230 – Chemical Engineering Thermodynamics I  
Winter 2024-2025 (202425)  
Prof. Abrams – cfa22@drexel.edu  
Midterm Exam – February 11, 2025

This is an example header named [example\\_head-33246253.tex](#).

1. (17 pts) Superheated steam at 3 MPa and 348.0°C is to be converted to saturated steam at 3 MPa in a desuperheater. This desuperheater is supplied with inlet liquid water at 53.0°C. The unit should produce saturated steam at a rate of 42.0 kg s<sup>-1</sup>. Assuming adiabatic operation, and assuming the liquid inlet is saturated, what is the mass flowrate of the inlet water?

The following enthalpies will be useful:

$$\begin{aligned} \text{Superheated steam at } 348.0^\circ\text{C and } 3 \text{ MPa: } \hat{H} &= 3,110.43 \text{ kJ/kg;} \\ \text{Saturated liquid water at } 53.0^\circ\text{C: } \hat{H}^L &= 221.87 \text{ kJ/kg;} \text{ and} \\ \text{Saturated water vapor at } 3 \text{ MPa: } \hat{H}^V &= 2,803.80 \text{ kJ/kg.} \end{aligned}$$

2. (21 pts)

A stream of air at 14.14 bar and 1000 K (labeled “stream 1”) is to be cooled to 600 K by mixing with another stream of air at 10.08 bar and 450 K (labeled “stream 2”). Let  $\alpha$  be the ratio of the molar flow rate of the hotter stream to that of the cooler stream. Compute (1)  $\alpha$ , and (2) the pressure  $P$  of the mixed stream (labeled “stream 3”). You may assume this is carried out adiabatically and that air is an ideal gas for which  $C_P = \frac{15}{2}R$ .

It may be helpful for you to remember, **for the ideal gas**, that a change of state from  $(T_A, P_A)$  to  $(T_B, P_B)$  results in the following enthalpy and entropy changes, respectively:

$$\begin{aligned} \Delta H &\equiv H_B - H_A = \int_{T_A}^{T_B} C_P dT \\ \Delta S &\equiv S_B - S_A = \int_{T_A}^{T_B} \frac{C_P}{T} dT - R \ln \frac{P_B}{P_A}. \end{aligned}$$

3. (19 pts) True/False questions. Write “T” for “True” or “F” for “False” in the blank space.

- \_\_\_\_\_ A bear shits in the woods.  
\_\_\_\_\_ Entropy is delicious.  
\_\_\_\_\_ The sky is blue.  
\_\_\_\_\_ The pope is Freewill Southern Baptist.

---

This is an example tail named [`example\_tail-33246253.tex`](#).