
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)
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Midterm Exam – February 11, 2025

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1. (17 pts)

Superheated steam at 4 MPa and 349.0°C is to be converted to saturated steam at 3 MPa in a desuperheater. This desuperheater is supplied with inlet liquid water at 52.0°C. The unit should produce saturated steam at a rate of 13.0 kg s⁻¹. 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:

Superheated steam at 349.0°C and 4 MPa: $\hat{H} = 3,099.15 \text{ kJ/kg}$;

Saturated liquid water at 52.0°C: $\hat{H}^L = 217.69 \text{ kJ/kg}$; and

Saturated water vapor at 3 MPa: $\hat{H}^V = 2,803.60 \text{ kJ/kg}$.

2. (21 pts)

A stream of air at 13.12 bar and 950 K (labeled “stream 1”) is to be cooled to 700 K by mixing with another stream of air at 10.26 bar and 350 K (labeled “stream 2”). Let α be the ratio of the molar flow rate of the hotter stream to that of the cooler stream. Compute (1) α , 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 $C_P = 7R$.

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:

$$\Delta\underline{H} \equiv \underline{H}_B - \underline{H}_A = \int_{T_A}^{T_B} C_P dT$$
$$\Delta\underline{S} \equiv \underline{S}_B - \underline{S}_A = \int_{T_A}^{T_B} \frac{C_P}{T} dT - R \ln \frac{P_B}{P_A}.$$

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

____ The pope is Freewill Southern Baptist.

____ A bear shits in the woods.

____ Entropy is delicious.

____ The sky is blue.

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