
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

S O L U T I O N S

This is an example header named `example_head-12345678.tex`.

1. (15 pts)

This is an example problem named `example_problem_template-12345678.tex`.

Determine the product of 5 and 8.

SOLUTION

$$5 \times 8 = 40$$

The serial number is 12345678. This is labeled as question number 1.

2. (16 pts)

This is an example problem named `example_problem2_template-12345678.tex`.

Determine the quotient of 3.9 and 357.0.

SOLUTION

$$3.9 \div 357.0 = 0.011$$

The serial number is 12345678. This is labeled as question number 2.

3. (17 pts)

Superheated steam at 3 MPa and 347.0°C is to be converted to saturated steam at 3 MPa in a desuperheater. This desuperheater is supplied with inlet liquid water at 47.0°C. The unit should produce saturated steam at a rate of 15.0 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 347.0°C and 3 MPa: $\hat{H} = 3,101.04$ kJ/kg;

Saturated liquid water at 47.0°C: $\hat{H}^L = 196.80$ kJ/kg; and

Saturated water vapor at 3 MPa: $\hat{H}^V = 2,803.76$ kJ/kg.

SOLUTION

Let stream 1 be the liquid water stream, which we assume is saturated liquid, stream 2 be the superheated steam inlet, and stream 3 be the saturated steam outlet. Hence, $\dot{m}_3 = 15 \text{ kg s}^{-1}$ as given. The mass and energy balance yield the two unknowns \dot{m}_1 and \dot{m}_2 :

$$\begin{aligned}\dot{m}_1 + \dot{m}_2 &= \dot{m}_3 \\ \dot{m}_1 \hat{H}_1 + \dot{m}_2 \hat{H}_2 &= \dot{m}_3 \hat{H}_3\end{aligned}$$

Solving these two simultaneously yields

$$\begin{aligned}\dot{m}_1 &= \dot{m}_3 \left(\frac{\hat{H}_2 - \hat{H}_3}{\hat{H}_2 - \hat{H}_1} \right) \\ &= (15) \left(\frac{3,101.04 - 2,803.76}{3,101.04 - 196.80} \right) = \boxed{1.54 \text{ kg s}^{-1}}.\end{aligned}$$

This is an example tail named `example_tail-12345678.tex`.
Answers are compiled in `solutions-12345678.yaml`.