Quiz #3

MEMS 0051 - Introduction to Thermodynamics

Assigned: June 4th, 2020
Due: June 5th, 2020, 11:59 pm

Problem #1

A piston-cylinder device contains 1 [kg] of water with a quality of $x = 1$ at a pressure of 1,000 [kPa]. The water is now compressed isobarically until it becomes a saturated liquid. Determine the following:

a) the polytropic index, n, of the process;
Since the process is isobaric, i.e. constant pressure, the polytropic index of the process is:

$$\boxed{n = 0}$$

Note that while the process will also be isothermal since it moving through the vapor dome at a constant pressure, from the definition of work, the polytropic index must be for constant pressure and not constant temperature.

b) the work performed during the process;
The work can be calculated from:

$$W_{1\to 2} = \int P d\forall = Pm \int_{\nu_1}^{\nu_2} d\nu = Pm(\nu_2 - \nu_1)$$

We need the values for the specific volume at states 1 and 2. These can be found in Table B.1.2 on page 782:

$$\nu_1 = \nu_g = 0.194\,44 \text{ [m}^3\text{/kg]} \qquad \nu_2 = \nu_f = 0.001\,127 \text{ [m}^3\text{/kg]}$$

The work then is:

$$W_{1\to 2} = Pm(\nu_2 - \nu_1) = (1{,}000 \text{ [kPa]})(1 \text{ [kg]})((0.001\,127 - 0.194\,44) \text{ [m}^3\text{/kg]})$$

$$\boxed{W_{1\to 2} = -193.3 \text{ [kJ]}}$$

Academic Integrity Statement:

I hereby attest that I have received no assistance (from a friend, from another student, from an on-line resource, such as Chegg, etc.), and that I have provided no assistance to another student, during this examination. All the work presented within is solely my own work.

Signature: _____

Date: _____