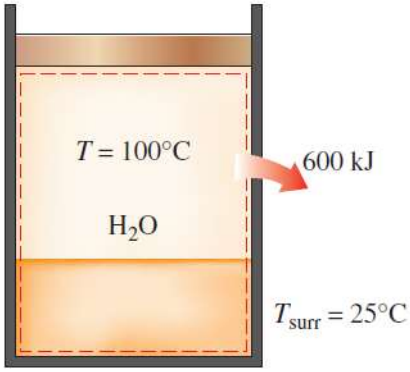
Given:

A frictionless piston-cylinder device contains a saturate liquid-vapor mixture of water 100°C. During a constant pressure process, 600 kJ of heat is transferred to the surrounding air at 25°C. As a result, part of the vapor condenses.

$T_w := 100\ °C \qquad Q := 600\ kJ \qquad T_{surr} := 25\ °C$



Required:

Determine the entropy change of the water and the entropy generation during the heat transfer process.

Solution:

Since the water is isothermal and piston-cylinder is frictionless (i.e., externally reversible), the entropy change of the water is given by

$$\Delta S_w := -\frac{Q}{T_w} = -1.608\ \frac{kJ}{K}$$

The total entropy generated may then be found by starting with an entropy balance shown below.

$$\Delta S_{sys} = \Sigma S_{in} - \Sigma S_{out} + S_{gen}$$

Since there is no entropy entering the system, the entropy generated becomes

$$S_{gen} = \Delta S_{sys} + S_{out} = \Delta S_w + S_{out}$$

The entropy that exits the system is found by

$$S_{out} := \frac{Q}{T_{surr}} = 2.012\ \frac{kJ}{K}$$

The entropy generated is then found to be

$$S_{gen} := \Delta S_w + S_{out} = 0.4045\ \frac{kJ}{K}$$