SP06
Refrigerant-134a at 120 kPa with a quality of 0.3 enters an evaporator section of a window air conditioner at a rate of 2 kg/min and leaves as saturated vapor at the same pressure. Air enters the evaporator at 100 kPa and 27°C with a volume flow rate of 6 m³/min. Determine the exit temperature of the air and the rate of entropy generation for this process, assuming (a) the outer surfaces of the air conditioner are insulated and (b) heat is transferred to the evaporator of the air conditioner from the surrounding medium at 32°C at a rate of 30 kJ/min. Assume constant specific heat for air.

State 3: Air, 100 kPa, 27°C

State 1: R-134a = 120 kPa, x=0.3

State 2: Saturated vapor

State 4

Answers: (a) -15.5°C, 0.00193kW/K; (b) -11.2°C, 0.00223kW/K

SP07
(1) “Is the exergy of a system different in different environments?” (a) Yes, (b) No, (c) Not enough information.

(2) “If a process involves no irreversibilities and no surrounding work, which is the following answer correct? (a) actual useful work is larger than reversible work, (b) reversible work is larger than actual useful work, and (c) actual useful work is the same as reversible work.

(3) Assume the reference environment is on the ground at 25°C, 1 atm, and g = 9.81 m/s². Which has the greater exergy: (a) 100 kg mass at 100 m above the ground or (b) 100 kg liquid water at 50°C?

SP08
An insulated piston-cylinder device contains 2 L of saturated liquid water at pressure of 150 kPa. An electric resistance heater inside the cylinder is turned on, and electrical work is done on the water in the amount of 2200 kJ at constant pressure. Assuming the surrounding to be 25°C and
100 kPa, determine (a) the minimum work with which this process could be accomplished and (b) the exergy destroyed during this process.

Answer: (a) 437.7 kJ, (b) 1704 kJ