ME 3310 Thermodynamics I Homework Handout #2: 2.26, 33E, 38, 43, 53, 70, 81

**2–26** EES Complete the following table for $H_2O$:

| T, °C | P, kPa | v, m³/kg | Phase description |
|---|---|---|---|
| 50 | | 4.16 | |
| | 200 | | Saturated vapor |
| 250 | 400 | | |
| 110 | 600 | | |

**2–28E** Complete the following table for $H_2O$:

| T, °F | P, psia | u, Btu/lbm | Phase description |
|---|---|---|---|
| 300 | | 782 | |
| | 40 | | Saturated liquid |
| 500 | 120 | | |
| 400 | 400 | | |

**2–30** Complete the following table for $H_2O$:

| T, °C | P, kPa | h, kJ/kg | x | Phase description |
|---|---|---|---|---|
| | 200 | | 0.7 | |
| 140 | | 1800 | | |
| | 950 | | 0.0 | |
| 80 | 500 | | | |
| | 800 | 3161.7 | | |

**2–33E** Complete the following table for refrigerant-134a:

| T, °F | P, psia | h, Btu/lbm | x | Phase description |
|-------|---------|------------|-----|-------------------|
|       | 80      | 78         |     |                   |
| 15    |         |            | 0.6 |                   |
| 10    | 70      |            |     |                   |
|       | 180     | 128.77     |     |                   |
| 110   |         |            | 1.0 |                   |

**2–38** A person cooks a meal in a 30-cm-diameter pot that is covered with a well-fitting lid and lets the food cool to the room temperature of 20°C. The total mass of the food and the pot is 8 kg. Now the person tries to open the pan by lifting the lid up. Assuming no air has leaked into the pan during cooling, determine if the lid will open or the pan will move up together with the lid.

**2–43** Saturated steam coming off the turbine of a steam power plant at 30°C condenses on the outside of a 4-cm-outer-diameter, 20-m-long tube at a rate of 45 kg/h. Determine the rate of heat transfer from the steam to the cooling water flowing through the pipe.

**2–46** A cooking pan whose inner diameter is 20 cm is filled with water and covered with a 4-kg lid. If the local atmospheric pressure is 101 kPa, determine the temperature at which the water will start boiling when it is heated.  *Answer:* 100.2°C
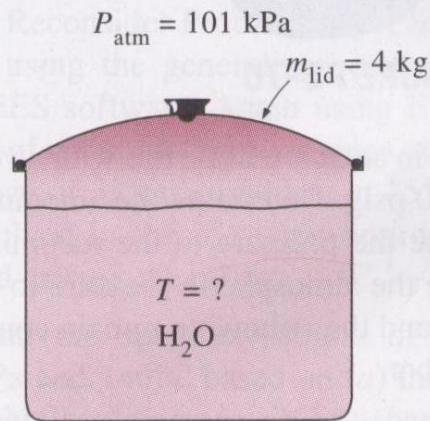
$$P_{atm} = 101 \text{ kPa}$$

$$m_{lid} = 4 \text{ kg}$$

$$T = ?$$
$$H_2O$$

**FIGURE P2–46**

**2–53** **EES** A piston-cylinder device contains 0.1 m³ of liquid water and 0.9 m³ of water vapor in equilibrium at 800 kPa. Heat is transferred at constant pressure until the temperature reaches 350°C.
(a)  What is the initial temperature of the water?
(b)  Determine the total mass of the water.
(c)  Calculate the final volume.
(d)  Show the process on a *P-v* diagram with respect to saturation lines.
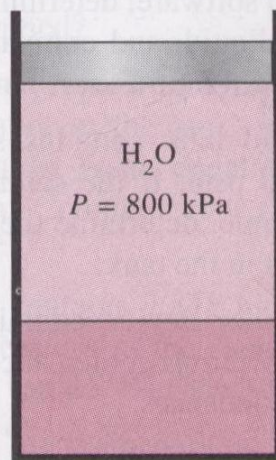
$$H_2O$$
$$P = 800 \text{ kPa}$$

**FIGURE P2–53**

**2–57** A piston-cylinder device initially contains 50 L of liquid water at 25°C and 300 kPa. Heat is added to the water at constant pressure until the entire liquid is vaporized.

(a) What is the mass of the water?
(b) What is the final temperature?
(c) Determine the total enthalpy change.

(d) Show the process on a T-v diagram with respect to saturation lines.

*Answers: (a) 49.85 kg, (b) 133.55°C, (c) 130,627 kJ*

**2–61E** A 15-ft³ rigid tank contains saturated mixture of refrigerant-134a at 30 psia. If the saturated liquid occupies 10 percent of the volume, determine the quality and the total mass of the refrigerant in the tank.

**2–63** A rigid tank contains water vapor at 300°C and an unknown pressure. When the tank is cooled to 180°C, the vapor starts condensing. Estimate the initial pressure in the tank.

*Answer: 1.325 MPa*

**2–70**   The pressure in an automobile tire depends on the temperature of the air in the tire. When the air temperature is 25°C, the pressure gage reads 210 kPa. If the volume of the tire is 0.025 m³, determine the pressure rise in the tire when the air temperature in the tire rises to 50°C. Also, determine the amount of air that must be bled off to restore pressure to its original value at this temperature. Assume the atmospheric pressure to be 100 kPa.
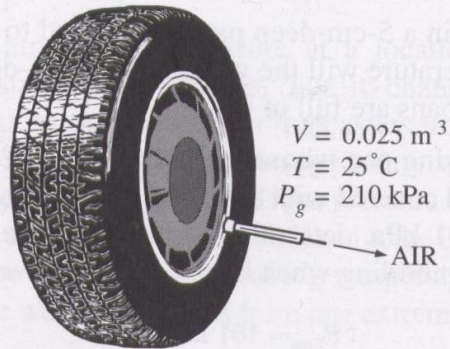


$V = 0.025 \text{ m}^3$
$T = 25°C$
$P_g = 210 \text{ kPa}$

AIR

**FIGURE P2–70**

**2–71E**   The air in an automobile tire with a volume of 0.53 ft³ is at 90°F and 20 psig. Determine the amount of air that must be added to raise the pressure to the recommended value of 30 psig. Assume the atmospheric pressure to be 14.6 psia and the temperature and the volume to remain constant. *Answer:* 0.0260 lbm

**2–79**   Determine the specific volume of superheated water vapor at 10 MPa and 400°C, using (a) the ideal-gas equation, (b) the generalized compressibility chart, and (c) the steam tables. Also determine the error involved in the first two cases. *Answers:* (a) 0.03106 m³/kg, 17.6 percent; (b) 0.02609 m³/kg, 1.2 percent; (c) 0.02641 m³/kg

**2–81**   Determine the specific volume of refrigerant-134a vapor at 1.4 MPa and 140°C based on (a) the ideal-gas equation, (b) the generalized compressibility chart, and (c) the experimental data from tables. Also, determine the error involved in the first two cases.

**2–83** Determine the specific volume of superheated water vapor at 1.6 MPa and 225°C based on (*a*) the ideal-gas equation, (*b*) the generalized compressibility chart, and (*c*) the steam tables. Determine the error involved in the first two cases.

**2–115** The gage pressure of an automobile tire is measured to be 200 kPa before a trip and 220 kPa after the trip at a location where the atmospheric pressure is 90 kPa. Assuming the volume of the tire remains constant at 0.022 $m^3$, determine the percent increase in the absolute temperature of the air in the tire.

**2–120** A rigid tank with a volume of 0.07 $m^3$ contains 1 kg of refrigerant-134a vapor at 400 kPa. The refrigerant is now allowed to cool. Determine the pressure when the refrigerant first starts condensing. Also, show the process on a *P-v* diagram with respect to saturation lines.