

Capítulo 2

21,24,27,29,42,45,48,57,60,64,66,69,75,82,88,101,102,109,114,122,124

21 - Dry ice is the name of solid carbon dioxide. How cold must it be at atmospheric (100 kPa) pressure? If it is heated at 100 kPa, what eventually happens?

R: 190K

24 - Give the phase for the following states:

a. CO₂ at T = 40° C and P = 0.5 MPa

b. Air at T = 20° C and P = 200 kPa

c. NH₃ at T = 170° C and P = 600 kPa

R: Todos são vapor super aquecidos

27 - Give the missing property of P-v-T and x for water at

a. 10 MPa, 0.003 m³/kg R: L+v

b. 1 MPa, 190° C R: Vapor

c. 200° C, 0.1 m³/kg R: L+V

d. 10 kPa, 10° C R: Liquido

29 - Determine whether refrigerant R-410a in each of the following states is a compressed liquid, a superheated vapor, or a mixture of saturated liquid and vapor.

a. 50° C, 0.05 m³/kg

b. 1.0 MPa, 20° C

c. 0.1 MPa, 0.1 m³/kg

d. -20° C, 200 kPa

42 - You want a pot of water to boil at 105° C. How heavy a lid should you put on the 15-cm diameter pot when P_{atm} = 101 kPa?

R: 35,7 kg

45 - Saturated water vapor at 200 kPa is in a constant-pressure piston/cylinder assembly. At this state the piston is 0.1 m from the cylinder bottom. How much is this distance, and what is the temperature if the water is cooled to occupy half of the original volume?

R: 0,05 m , 120,2°C

48 - In your refrigerator, the working substance evaporates from liquid to vapor at -20° C inside a pipe around the cold section. Outside (on the back or below) is a black grille, inside of which the working substance condenses from vapor to liquid at +45° C. For each location, find the pressure and the change in specific volume (v) if the substance is ammonia.

R: (190, 1782) kPa, (0,622, 0,0707) m³/kg

57 - A sealed, rigid vessel of 2 m³ contains a saturated mixture of liquid and vapor R-134a at 10° C. If it is heated to 50° C, the liquid phase disappears. Find the pressure at 50° C and the initial mass of the liquid.

R: 1.32MPa, 93,3kg

60 - A 400-m³ storage tank is being constructed to hold liquified natural gas (LNG), which may be assumed to be essentially pure methane. If the tank is to contain 90% liquid and 10% vapor, by volume, at 100 kPa, what mass of LNG (kg) will the tank hold? What is the quality in the tank?

R: 152227kg, 4.72*10⁻⁴

64 - A pressure cooker has the lid screwed on tight. A small opening with A = 5 mm² is covered with a petcock that can be lifted to let steam escape. How much mass should the petcock have to allow boiling at 120° C with an outside atmosphere at 101.3 kPa?

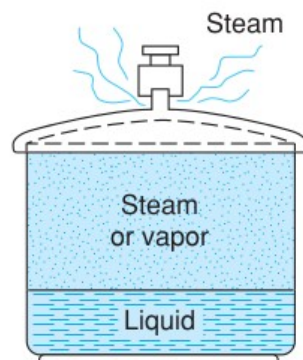


FIGURE P2.64

66 - A 1-m³ tank is filled with a gas at room temperature (20° C) and pressure (200 kPa). How much mass is there if the gas is (a) air, (b) neon, or (c) propane?

R: 2.377 kg, 1.656 kg, 3.618 kg

69 - Is it reasonable to assume that at the given states the substance behaves as an ideal gas?

- a. Oxygen at 30° C, 3 MPa Y
- b. Methane at 30° C, 3 MPa Y
- c. Water at 30° C, 3 MPa N
- d. R-134a at 30° C, 3 MPa N
- e. R-134a at 30° C, 100 kPa Y

75 - Air in an automobile tire is initially at -10° C and 190 kPa. After the automobile is driven awhile, the temperature rises to 10° C. Find the new pressure. You must make one assumption on your own. R: 204 kPa

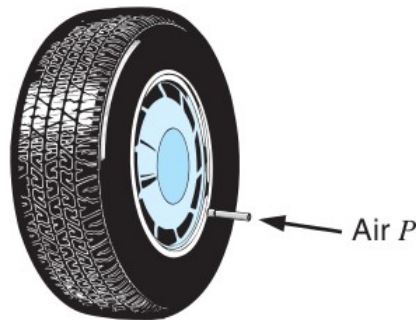


FIGURE P2.75

82 - A 1-m³ rigid tank with air at 1 MPa and 400 K is connected to an air line as shown in Fig. P2.82. The valve is opened and air flows into the tank until the pressure reaches 5 MPa, at which point the valve is closed and the temperature inside is 450 K.

- a. What is the mass of air in the tank before and after the process?
- b. The tank eventually cools to room temperature, 300 K. What is the pressure inside the tank then?

88 - What is the percent error in specific volume if the ideal gas model is used to represent the behavior of superheated ammonia at 40° C and 500 kPa? What if the generalized compressibility chart, Fig. D.1, is used instead?

101 - Carbon dioxide at 60° C is pumped at a very high pressure, 10 MPa, into an oil well to reduce the viscosity of oil for better flow. Find its specific volume from the carbon dioxide table, ideal gas, and van der Waals EOS by iteration.

102 - Solve the previous problem using the Redlich-Kwong EOS. Notice that this becomes a trial-and-error process.

R: 0.00333 m³ /kg

109 - Find the phase, the quality x if applicable, and the missing property P or T .

- a. H₂O at $T = 120^\circ \text{C}$ with $v = 0.5 \text{ m}^3/\text{kg}$
- b. H₂O at $P = 100 \text{ kPa}$ with $v = 1.8 \text{ m}^3/\text{kg}$
- c. H₂O at $T = 263 \text{ K}$ with $v = 200 \text{ m}^3/\text{kg}$

114 - Water in a piston/cylinder is at 90° C, 100 kPa, and the piston loading is such that pressure is proportional to volume, $P = CV$. Heat is now added until the temperature reaches 200° C. Find the final pressure and also the quality if the water is in the two-phase region.

R: 1554 kPa, $x = 0.118$

122 - A cylinder has a thick piston initially held by a pin, as shown in Fig. P2.122. The cylinder contains carbon dioxide at 200 kPa and ambient temperature of 290 K. The metal piston has a density of 8000 kg/m³ and the atmospheric pressure is 101 kPa. The pin is now removed, allowing the piston to move, and after a while the gas returns to ambient temperature. Is the piston against the stops?

124 - An initially deflated and now flat balloon is connected by a valve to a 12-m³ storage tank containing helium gas at 2 MPa and ambient temperature, 20° C. The valve is opened and the balloon is inflated at constant pressure, $P_0 = 100 \text{ kPa}$, equal to ambient pressure, until it becomes

spherical at $D_1 = 1$ m. If the balloon is larger than this, the balloon material is stretched, giving an inside pressure of

$$P = P_0 + C \left(1 - \frac{D_1}{D}\right) \frac{D_1}{D}$$

The balloon is inflated to a final diameter of 4 m, at which point the pressure inside is 400 kPa. The temperature remains constant at 20° C. What is the maximum pressure inside the balloon at any time during the inflation process? What is the pressure inside the helium storage tank at this time?

Exercício correspondente da 7ª edição: Capítulo 3 com a mesma numeração

3.48 R: (190, 1555) kPa, (0,622, 00814) m³/kg

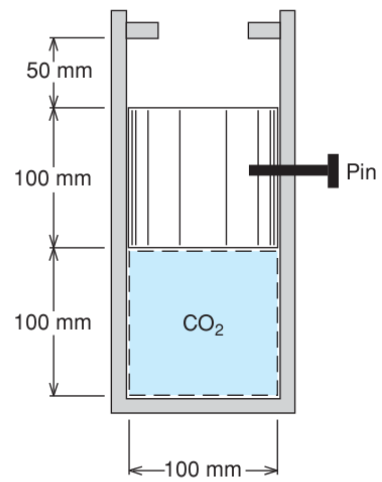


FIGURE P2.122