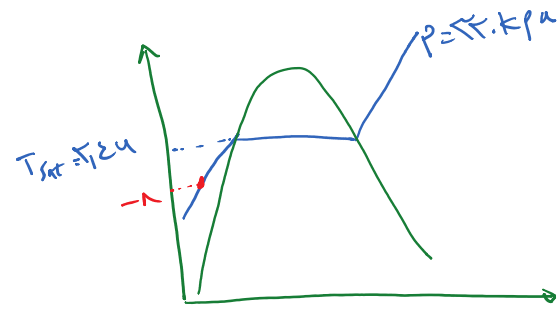


R-134a

3-31 Complete this table for refrigerant-134a:

T, °C	P, kPa	v, m³/kg	Phase description
-8	320		
30		0.015	
	180		Saturated vapor
80	600		



① $T = -8^{\circ}\text{C} \rightarrow T < T_{\text{sat}} \rightarrow$ صالح موائف ✓ \rightarrow
 $P = 320 \text{ kPa} \rightarrow T_{\text{sat}} = 21.56^{\circ}\text{C}$
 $v = v_f = 0.0007571 \text{ m}^3/\text{kg}$
 $T_2 = -8^{\circ}\text{C}$

320	2.46	0.0007772	0.063604	54.92	176.61	231.52	55.16	196.71	251.88	0.21637	0.71369	0.93006
-8	217.08	<u>0.0007571</u>	0.092352	41.03	184.64	225.67	41.19	204.52	245.72	0.16498	0.77130	0.93629

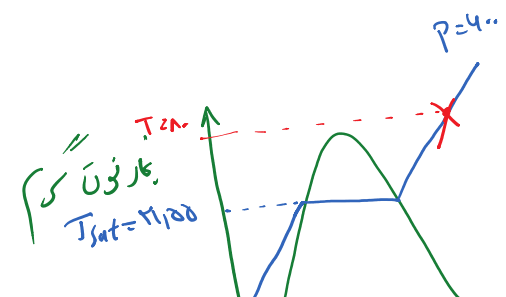
② $T = 20^{\circ}\text{C} \rightarrow v_f = 0.0008421 \text{ m}^3/\text{kg} \quad v_g = 0.026622 \text{ m}^3/\text{kg}$
 $P = P_{\text{sat}} = 770.142 \text{ kPa}$
 $v = 0.010 \text{ m}^3/\text{kg} \rightarrow v_f < v < v_g \rightarrow$ $\text{مخلوط مائج - بخار آبج}$

0.0008421 0.026622

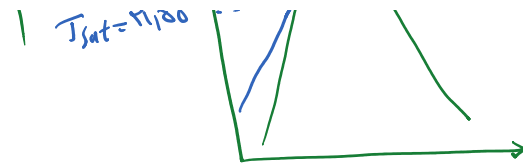
$v = v_f + x(v_g - v_f) \rightarrow 0.010 = 0.0008421 + x(0.026622 - 0.0008421) \rightarrow x =$

$P = 1 \text{ MPa} \rightarrow T = T_{\text{sat}} = 12.73^{\circ}\text{C}$
 $v = v_g = 0.011081 \text{ m}^3/\text{kg}$
 فازج: بخار آبج


$T = 20^{\circ}\text{C} \rightarrow T > T_{\text{sat}} \rightarrow$



$$\left\{ \begin{array}{l} T = 10^\circ\text{C} \\ P = 400 \text{ kPa} = 0.4 \text{ MPa} \end{array} \right. \rightarrow T_{\text{sat}} = 111.28^\circ\text{C}$$



$$v = 0.22 \text{ m}^3/\text{kg}$$

3-55  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.

- What is the initial temperature of the water?
- Determine the total mass of the water.
- Calculate the final volume.
- Show the process on a P-v diagram with respect to saturation lines.

$$v_f = 0.1 \text{ m}^3$$

$$v_t = 1 \text{ m}^3 = v_f + v_g =$$

$$v_g = 0.9 \text{ m}^3$$

$$P = 800 \text{ kPa}$$

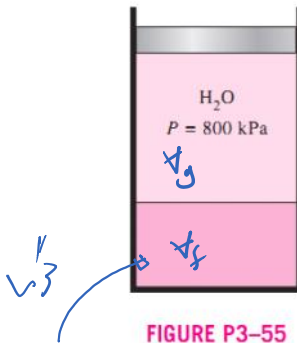


FIGURE P3-55

در فشار ثابت، تا آنکه گرمای درجه برساند. $T = 350^\circ\text{C}$

(ب) بر اساس جدول اشباع

(الف) دمای اولیه آب بر حسب جدول اشباع

$$\textcircled{1} \left\{ \begin{array}{l} P_1 = 800 \text{ kPa} \\ \text{شرایط اشباع} \end{array} \right. \rightarrow T_1 = T_{\text{sat}} = 170.121^\circ\text{C}$$

$$v_f = \frac{v_f}{m_f} \rightarrow m_f = \frac{v_f}{v_f} = \frac{0.1}{0.001115} = 89.14 \text{ kg}$$

$$m_g = \frac{v_g}{v_g} = \frac{0.9}{0.22} = 4.09 \text{ kg}$$

$$v_f = 0.001115, v_g = 0.22$$

$$m_t = 89.14 + 4.09 = 93.23 \text{ kg}$$

Saturated water—Pressure table (Concluded)

Press., P kPa	Sat. temp., T_{sat} °C	Specific volume, m ³ /kg		Internal energy, kJ/kg			Enthalpy, kJ/kg			Entropy, kJ/kg·K		
		Sat. liquid, v_f	Sat. vapor, v_g	Sat. liquid, u_f	Evap., u_{fg}	Sat. vapor, u_g	Sat. liquid, h_f	Evap., h_{fg}	Sat. vapor, h_g	Sat. liquid, s_f	Evap., s_{fg}	Sat. vapor, s_g
800	170.41	0.001115	0.24035	719.97	1856.1	2576.0	720.87	2047.5	2768.3	2.0457	4.6160	6.6616

کیمیائی لہجہ اور

$$\lambda = \frac{m_g}{m_t} = \frac{217}{9213} = 0.0235$$

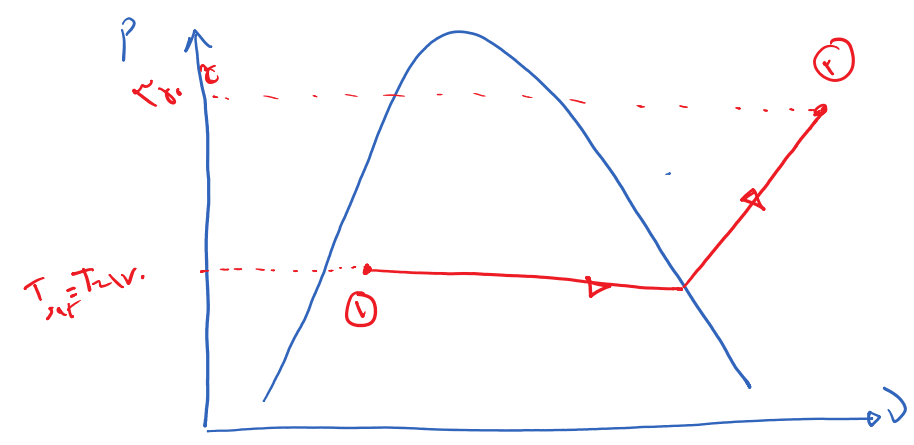
(c) حجم بخار لیڈر - سیٹون

$$P_r = 18 \text{ MPa}$$

$$\textcircled{2} \begin{cases} P_r = P_i = 180 \text{ kPa} \rightarrow T_{sat} = 170.141 \\ T_r = 250^\circ\text{C} \rightarrow T_r > T_{sat} \end{cases}$$

بخار نون گرم

$$v_r = \frac{v_t}{m_t} = \frac{v_r}{m_t} \Rightarrow v_r = m_t \cdot v_r = 9213 \times 0.0235 = 216.5 \text{ m}^3$$

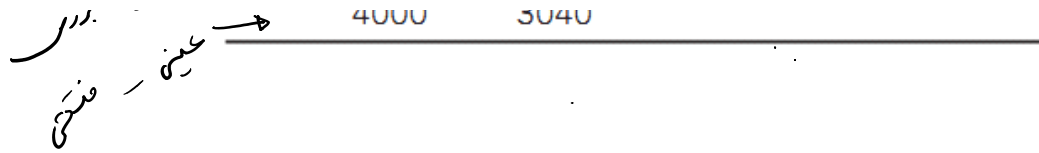


حجم مقدار

3-35 Complete this table for H₂O:

T, °C	P, kPa	u, kJ/kg	Phase description
	400	1450	
220			Saturated vapor
190	2500		
	4000	3040	

حعیبریا - الیا لی
قویکی - ساروی
کناک - بونر
عینی - فند



3-67 A rigid tank initially contains 1.4-kg saturated liquid water at 200°C. At this state, 25 percent of the volume is occupied by water and the rest by air. Now heat is supplied to the water until the tank contains saturated vapor only. Determine (a) the volume of the tank, (b) the final temperature and pressure, and (c) the internal energy change of the water.



FIGURE P3-67

یک تانک صلب حاوی ۱.۴ کیلوگرم آب اشباع در ۲۰۰ درجه سانتیگراد است. ۲۵ درصد از حجم تانک آب و بقیه هوای بادگرم است.

دارای سوراخ‌ها آبی تبدیل به بخار اشباع شود.

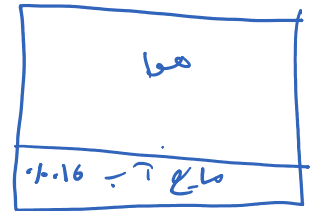
الف) حجم تانک

ب) دما و فشار عین

ج) تغییرات انرژی داخلی آب

200 1554.9 0.001157 0.12721 850.46 1743.7 2594.2 852.26 1939.8 2792.0 2.3305 4.0997 6.4302

$$\textcircled{1} \left\{ \begin{array}{l} T_1 = 200^\circ\text{C} \\ \text{مایع اشباع: فاز مایع} \\ m = 1.4 \text{ kg} \end{array} \right. \Rightarrow \left\{ \begin{array}{l} P_1 = 1554.9 \text{ kPa} \\ u_1 = u_f = 850.46 \\ v_1 = v_f = 0.001157 \\ h_1 = h_f = 852.26 \end{array} \right.$$



$$v_1 = \frac{V_1}{m} \Rightarrow V_1 = m \cdot v_1 = 1.4 \times 0.001157 = 0.0016 \text{ m}^3$$

$$V_t = V_{\text{مایع}} + V_{\text{هوا}} = 0.16 + 3 \times 0.16 = 0.64$$

بخار اشباع = فاز مایع

$$v_{r2} = \frac{V_t}{m} = \frac{0.64}{1.4} = 0.4571$$

$$\hookrightarrow V_{r2} = \frac{\dot{m}}{1 \text{ s}} = \frac{\dot{m}}{1 \text{ s}} = -100 \text{ \AA} \delta V$$

21,000	369.83	0.002207	0.004994
22,000	373.71	0.002703	0.003644

$$\frac{P}{\gamma_{\text{loss}}}$$

$$\frac{I}{349,12}$$

$$\frac{V_g}{100 \text{ \AA} \delta}$$

$$\frac{u_g}{\checkmark}$$

$$\frac{\gamma_{\text{loss}}}{100 \text{ \AA}} = \delta_1$$

$$\kappa_1 = \frac{\gamma_{\text{loss}}}{100 \text{ \AA}}$$

$$100 \text{ \AA} \delta V$$

$$\kappa_2$$

$$100 \text{ \AA} \delta \delta$$

✓