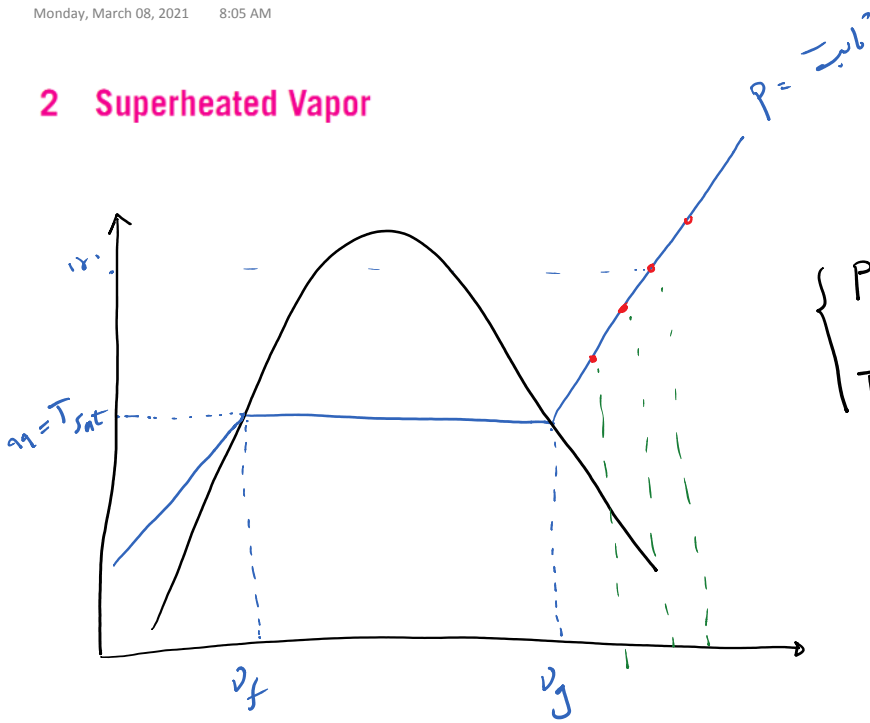


2 Superheated Vapor

فاز بخار فونگی



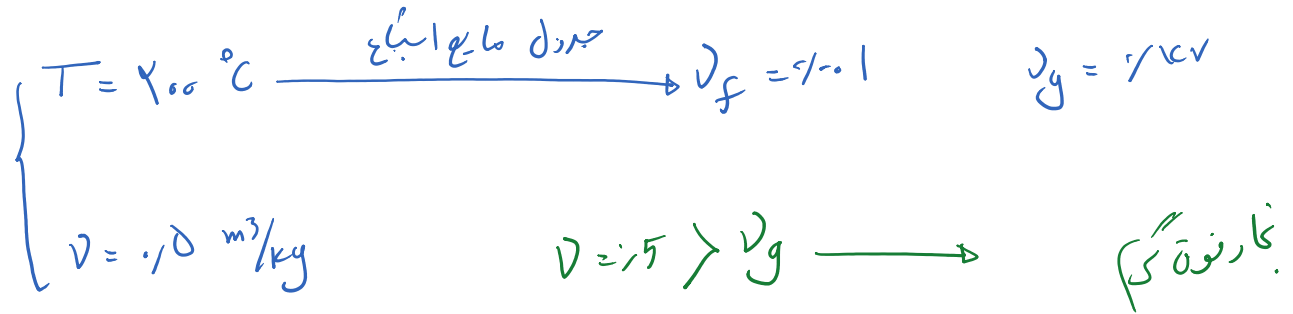
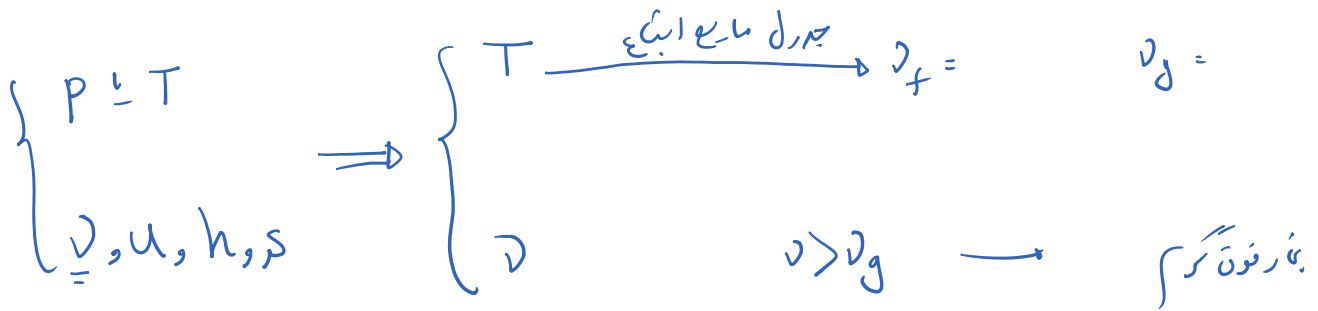
$\left\{ \begin{array}{l} P \xrightarrow{\text{ثابت}} T_{sat} = \\ T \end{array} \right. \quad T > T_{sat} \rightarrow \text{بخار فونگی}$

مسئله: اگر دمای بخار در ۱۰۰ kPa و ۱۵۰°C باشد، فاز بخار را مشخص کنید؟ (آی:)

$\left\{ \begin{array}{l} P = 100 \text{ kPa} \xrightarrow{\text{ثابت}} T_{sat} = 99.61 \\ T = 150^\circ\text{C} \end{array} \right. \quad T > T_{sat} \rightarrow \text{بخار فونگی}$

$\left\{ \begin{array}{l} P = 100 \text{ kPa} = 0.1 \text{ MPa} \\ T = 150^\circ\text{C} \end{array} \right. \xrightarrow{\text{جدول بخار فونگی}} \left\{ \begin{array}{l} v = 2.1842 \\ u = 2780 \\ h = 2972 \\ s = 7.6754 \end{array} \right.$

	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg·K
T °C				
	$P = 0.10 \text{ MPa (99.61}^\circ\text{C)}$			
	1.6941	2505.6	2675.0	7.3589
Sat.†	1.6959	2506.2	2675.8	7.3611
50	1.9367	2582.9	2776.6	7.6148
100	2.1724	2658.2	2875.5	7.8356
150	2.4062	2733.9	2974.5	8.0346
200	2.6389	2810.7	3074.5	8.2172
250	3.1027	2968.3	3278.6	8.5452
300	3.5655	3132.2	3488.7	8.8362
400	4.0279	3302.8	3705.6	9.0999
500	4.4900	3480.4	3929.4	9.3424
600	4.9519	3665.0	4160.2	9.5682



	$P = 0.40 \text{ MPa (143.61}^\circ\text{C)}$			
Sat.	0.46242	2553.1	2738.1	6.8955
150	0.47088	2564.4	2752.8	6.9306
200	0.53434	2647.2	2860.9	7.1723
250	0.59520	2726.4	2964.5	7.3804
300	0.65489	2805.1	3067.1	7.5677
400	0.77265	2964.9	3273.9	7.9003
500	0.88936	3129.8	3485.5	8.1933
600	1.00558	3301.0	3703.3	8.4580
700	1.12152	3479.0	3927.6	8.7012
800	1.23730	3663.9	4158.9	8.9274
900	1.35298	3855.7	4396.9	9.1394
1000	1.46859	4054.3	4641.7	9.3396
1100	1.58414	4259.2	4892.9	9.5295
1200	1.69966	4470.2	5150.0	9.7102
1300	1.81516	4686.7	5412.8	9.8828

$$v = 0.5 > 0.517$$

$$u = 2447$$

$$h = 2840$$

$$s = 7.117$$

EXAMPLE 3-7 Temperature of Superheated Vapor

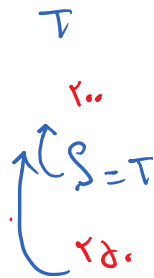
Determine the temperature of water at a state of $P = 0.5 \text{ MPa}$ and $h = 2890 \text{ kJ/kg}$.

640.09 2108.0 2748.1

500 kPa
 $P = 0.5 \text{ MPa}$ $\xrightarrow{\text{جبرود (ببغ)}}$ $h_f = 48.$ $h_g = 2748$
 $h = 2890 \text{ kJ/kg}$
 $T = ?$

$h > h_g \rightarrow$ بخارزده کف

$$\frac{2890 - 2180.1}{2941 - 2180.1} = \frac{x - 2445}{2748 - 2445}$$

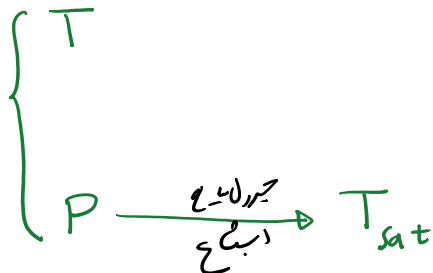


$P = 0.50 \text{ MPa (151.83}^\circ\text{C)}$

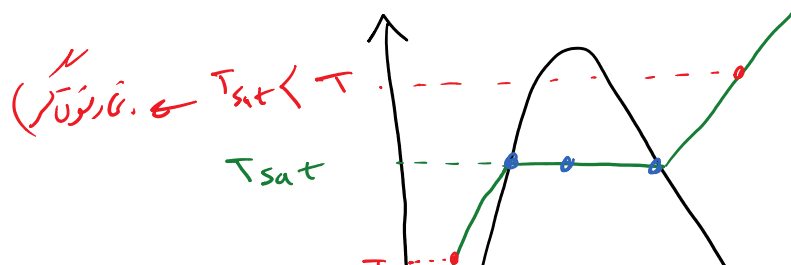
Sat.	0.37483	2560.7	2748.1	6.8207
200	0.42503	2643.3	2855.8	7.0610
250	0.47443	2723.8	2961.0	7.2725
300	0.52261	2803.3	3064.6	7.4614
350	0.57015	2883.0	3168.1	7.6346
400	0.61731	2963.7	3272.4	7.7956
500	0.71095	3129.0	3484.5	8.0893
600	0.80409	3300.4	3702.5	8.3544
700	0.89696	3478.6	3927.0	8.5978
800	0.98966	3663.6	4158.4	8.8240
900	1.08227	3855.4	4396.6	9.0362
1000	1.17480	4054.0	4641.4	9.2364
1100	1.26728	4259.0	4892.6	9.4263
1200	1.35972	4470.0	5149.8	9.6071
1300	1.45214	4686.6	5412.6	9.7797

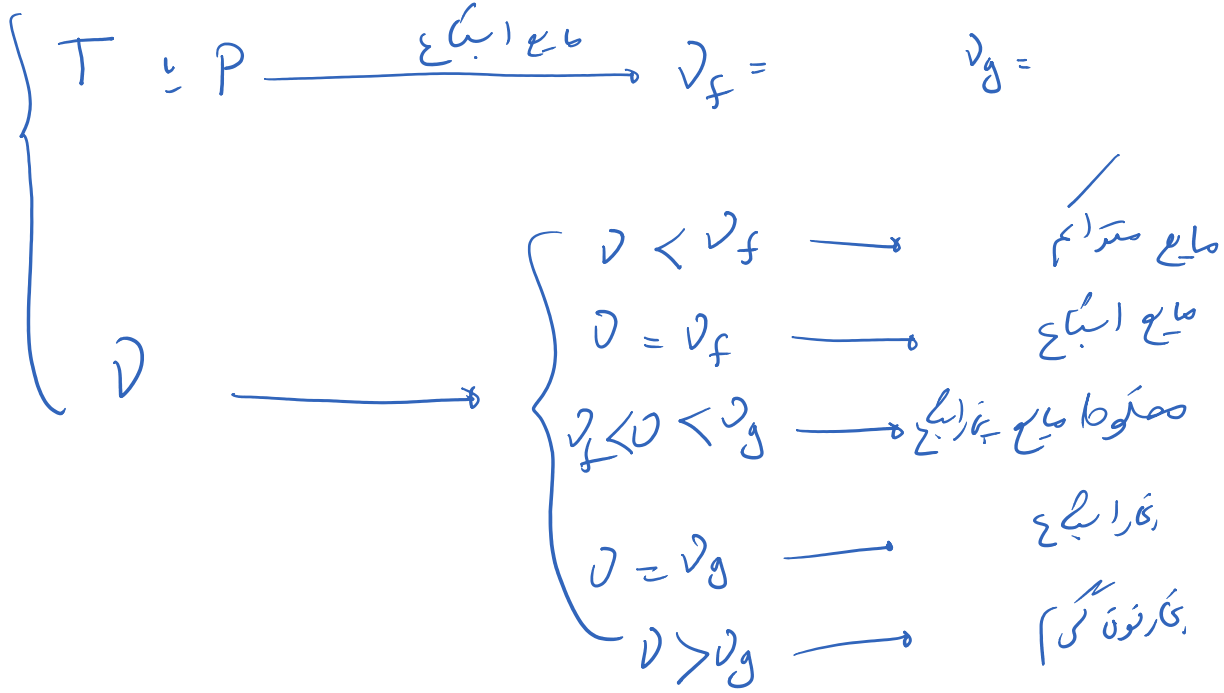
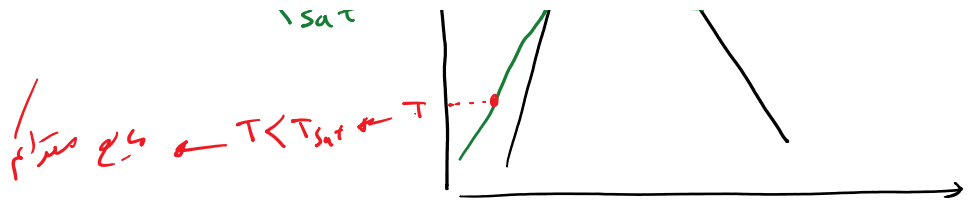
$$\frac{T - 200}{250 - 200} = \frac{2890 - 2180.1}{2941 - 2180.1} \Rightarrow T = ?$$

3 Compressed Liquid

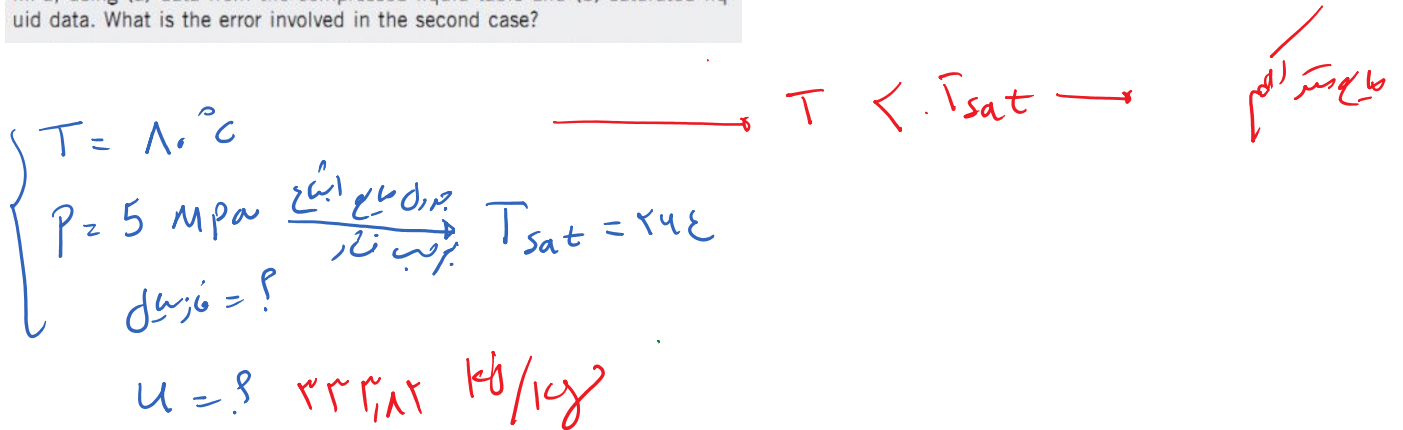


$T > T_{sat} \rightarrow$ بخارزده کف
 $T = T_{sat} \rightarrow$ مایع اشباع - بخار اشباع - مخلوط
 $T < T_{sat} \rightarrow$ مایع متراکم





Determine the internal energy of compressed liquid water at 80°C and 5 MPa, using (a) data from the compressed liquid table and (b) saturated liquid data. What is the error involved in the second case?



اگر مایع متراکم در دمای داده شده ($T = 80^\circ\text{C}$) که بصورت مایع اشباع فرض کنیم، انرژی درونی
 اگر متراکم است؟
 $u = 335$

EXAMPLE 3-9 The Use of Steam Tables to Determine Properties

Determine the missing properties and the phase descriptions in the following table for water:

	$T, ^\circ\text{C}$	P, kPa	$u, \text{kJ/kg}$	x	Phase description
(a)	✓	200	✓	0.6	✓
(b)	125		1600		✓
(c)		1000	2950		
(d)	75	500			
(e)		850		0.0	

a) $\left\{ \begin{array}{l} P = 200 \text{ kPa} \\ x = 0.6 \end{array} \right.$ فازيل معلوم مع جابج

$T = T_{\text{sat}} = 116.06^\circ\text{C}$

$u = u_f + x(u_g - u_f)$
 $= 504.50 + 0.6(2024.6 - 504.50)$

$\frac{504.50}{u_f} \quad \frac{2024.6}{u_g} \quad \frac{2529.1}{u}$

b:) $\left\{ \begin{array}{l} T = 125 \\ u_{\text{av}} = 1400 \end{array} \right. \rightarrow u_f = 523.3 \quad u_g = 2015.3$

$u_f < u < u_g \rightarrow$ معلوم مع جابج

$T = 125 \rightarrow P = P_{\text{sat}} = 1013.2 \text{ kPa}$

$u_{\text{av}} = u_f + x(u_g - u_f) \rightarrow x = \frac{u_{\text{av}} - u_f}{u_g - u_f} =$
 $= \frac{1400 - 523.3}{2015.3 - 523.3}$

d: $\left\{ \begin{array}{l} T = 75 \\ P = 500 \text{ kPa} \end{array} \right.$ u :
 x :
جارج:

$P = 500 \text{ kPa}$ $\rightarrow T_{\text{sat}} = 151.1 \text{ K}$ $\rightarrow T < T_{\text{sat}} \rightarrow$ مائع متراکم
 $= 5 \text{ MPa}$

75	38.597	<u>0.001026</u>	4.1291	<u>313.99</u>	2161.3	2475.3	<u>314.03</u>	2320.6	2634.6	<u>1.0158</u>	6.6655	7.6812
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فشار و دما معلوم
مائع متراکم $\rightarrow T = 70^\circ \text{C}$ $\xrightarrow{\text{معیار دما و فشار}}$

Properties:

- $v_f = 1.001$
- $u_f = 214.19$
- $h_f = 292.02$
- $s_f = 1.0158$

$P = 150 \text{ kPa}$
 $x = 0$

\rightarrow

- T
- u
- h