



## Dean's Lecture

- Tomorrow (Thursday, March 5)
- deJong Concert Hall
- 11 am

**Innovation**  
Ramiro Calvo  
Engineering Manager, Apple

## Homework Hints

- 7-22. There is a typo in the problem statement. The first enthalpy should have units of kJ/kg, not J/kg
- 7-28. Assume that the total pressure is 1 bar

These hints are on the web page

## Steam Tables

Class 25

**Table B.5 Properties of Saturated Steam - Temperature Table\***

T(°C)	T(°F)		v(m³/kg)		u(kJ/kg)		h(kJ/kg)	
	Water	Steam	Water	Steam	Water	Steam	Water	Evaporation
0.01	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
5	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
10	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
15	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
20	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
25	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
30	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
35	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
40	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
45	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
50	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
55	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
60	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
65	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
70	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
75	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
80	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
85	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
90	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
95	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001
100	32.02	32.02	0.001000	206.1	0.0001	0.0001	0.0001	0.0001

**1. Liquid Water**

**2. Steam (vapor)**

**3. ΔH<sub>vap</sub>**

Reference Enthalpy for Steam Tables (H=0 at triple pt, 0.01°C and 0.00611 bar)

**Table B.6 Properties of Saturated Steam - Pressure Table\***

P(bar)	T(°C)	v(m³/kg)		u(kJ/kg)		h(kJ/kg)	
		Water	Steam	Water	Steam	Water	Evaporation
0.00611	0.01	0.001000	206.2	zero	2375.6	+0.0	2501.6
0.008	3.8	0.001000	159.7	15.8	2380.7	15.8	2492.6
0.010	7.0	0.001000	129.2	29.3	2385.2	29.3	2514.4
0.012	9.2	0.001000	108.7	40.6	2389.9	40.6	2478.7
0.014	12.0	0.001000	93.9	50.3	2392.0	50.3	2473.2
0.016	14.0	0.001001	82.8	58.9	2394.8	58.9	2468.4
0.018	15.9	0.001001	74.0	66.5	2397.4	66.5	2464.1
0.020	17.5	0.001001	67.0	73.5	2399.6	73.5	2460.2
0.022	19.0	0.001002	61.2	79.8	2401.7	79.8	2456.6
0.024	20.4	0.001002	56.4	85.7	2403.6	85.7	2453.3
0.026	21.7	0.001002	52.3	91.1	2405.4	91.1	2450.2
0.028	23.0	0.001002	48.7	96.2	2407.1	96.2	2447.3
0.030	24.1	0.001003	45.6	101.0	2408.7	101.0	2444.6
0.035	26.7	0.001003	38.9	111.8	2414.8	111.8	2438.5
0.040	29.0	0.001004	33.3	121.4	2421.1	121.4	2433.1
0.045	31.0	0.001005	28.9	130.0	2427.6	130.0	2428.2
0.050	32.9	0.001005	25.3	137.8	2434.3	137.8	2423.8
0.060	36.2	0.001006	19.7	151.5	2446.0	151.5	2416.0
0.070	39.0	0.001007	15.1	163.4	2459.9	163.4	2409.2
0.080	41.5	0.001008	11.4	173.9	2473.9	173.9	2403.2
0.090	43.8	0.001009	8.5	183.3	2487.9	183.3	2397.9
0.10	45.8	0.001010	6.3	191.8	2501.9	191.8	2393.9
0.11	47.7	0.001011	4.8	199.7	2515.8	199.7	2390.4
0.12	49.4	0.001012	3.6	206.9	2529.6	206.9	2387.4
0.13	51.1	0.001013	2.7	213.7	2542.8	213.7	2384.9
0.14	52.6	0.001013	2.0	220.0	2555.6	220.0	2382.7

**Table B.7 Properties of Refrigerant R-134a**

Table B.7 (Continued)

### Energy Equation Information Sheet

What they say...	What they mean...
Well insulated	$Q=0$
Adiabatic	$Q=0$
Rigid Container	Volume doesn't change $W_{PV}=0$
Isochoric	Constant Volume $W_{PV}=0$
No mechanical parts, or no moving parts	$W_S=0$
Isothermal	$\Delta T=0$ , but $Q \neq 0$

1. What is  $\Delta H_{vap}$  at 30 bar? 1793.9 kJ/kg (Table B.6)
2. What is  $P^*_{H_2O}$  at 311°C? 100 bar (Table B.6)
3. What is  $\hat{v}_{water}$  at 84°C? 0.001032 m³/kg (Table B.5)
4. What is  $\hat{h}_{water}$  at 200 bar and 100°C? 434.0 kJ/kg (Table B.7)
5. What is  $\hat{h}_{steam}$  at 80 bar and 600°C? 3640 kJ/kg (Table B.7)
6. What is the dew point temperature (Tdp) for question #5? 295.0°C (Table B.7)
7. What is the temperature and enthalpy of saturated steam at 80 bar? 295.0°C, 2759.9 kJ/kg (Table B.6)
8. What is the enthalpy of 10% quality steam at 30 atm? (Quality is defined as the wt% steam in a steam-water system).  
 $0.9 \cdot 1008.4 + 0.1 \cdot 2802.3 = 1187.8 \text{ kJ/kg (Table B.6)}$