SOLUTIONS MANUAL

THERMAL ENVIRONMENTAL ENGINEERING

THIRD EDITION

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2.1

a) $28.75 \text{ in Hg} \left(\dfrac{1.450 \times 10^{-4} \text{ psia}}{2.961 \times 10^{-4} \text{ in Hg}} \right) = 14.08 \text{ psia}$

b) $28.75 \text{ in Hg} \left(\dfrac{4.019 \times 10^{-3} \text{ in } H_2O}{2.961 \times 10^{-4} \text{ in Hg}} \right) = 390.2 \text{ in } H_2O$

c) $\dfrac{390.23 \text{ in } H_2O}{0.8} \left(\dfrac{1 \text{ m}}{39.37 \text{ in}} \right) = 12.39 \text{ m fluid}$

d) $28.75 \text{ in Hg} \left(\dfrac{1 \text{ Pa}}{2.961 \times 10^{-4} \text{ in Hg}} \right) = 97.10 \text{ kPa}$

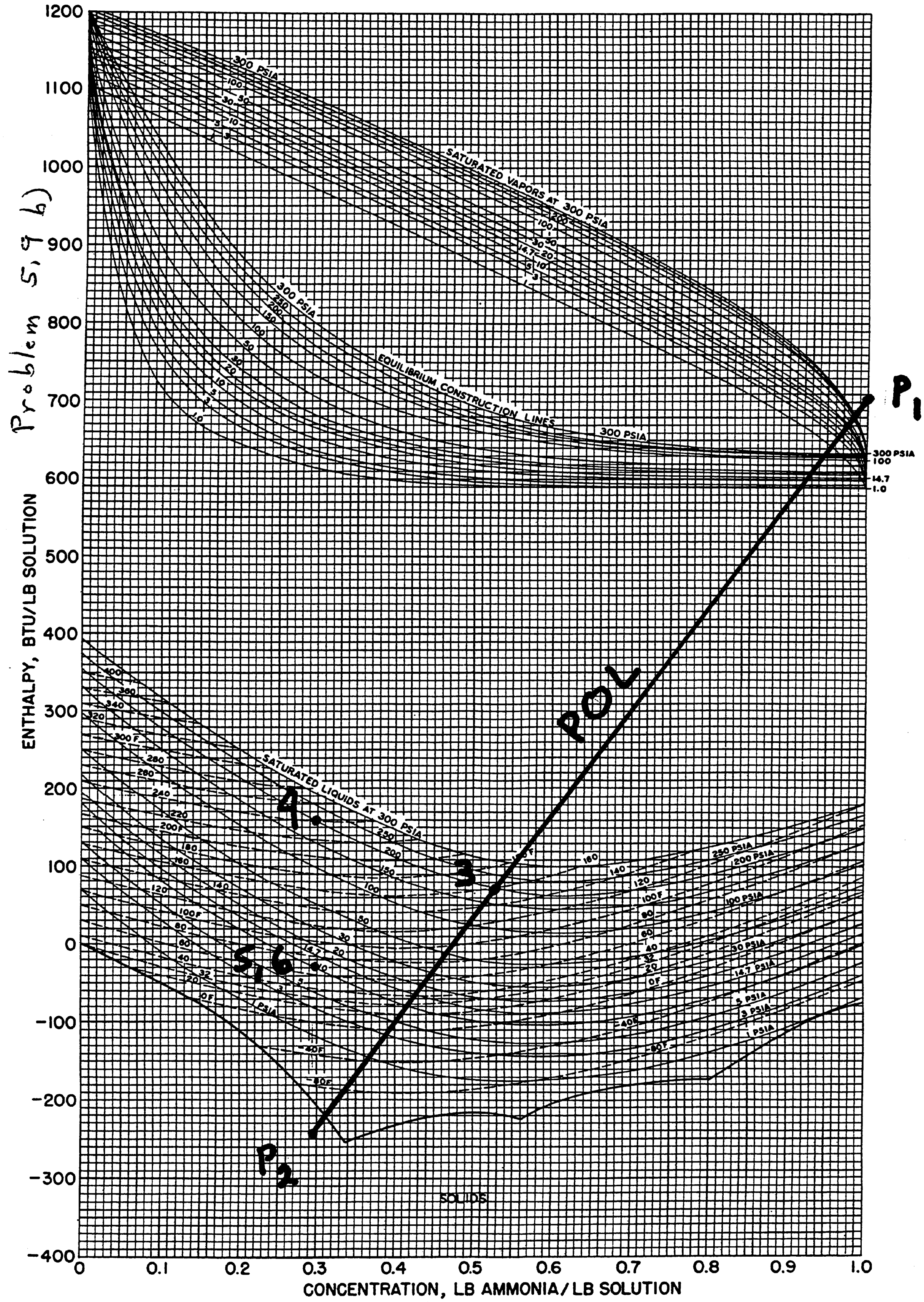
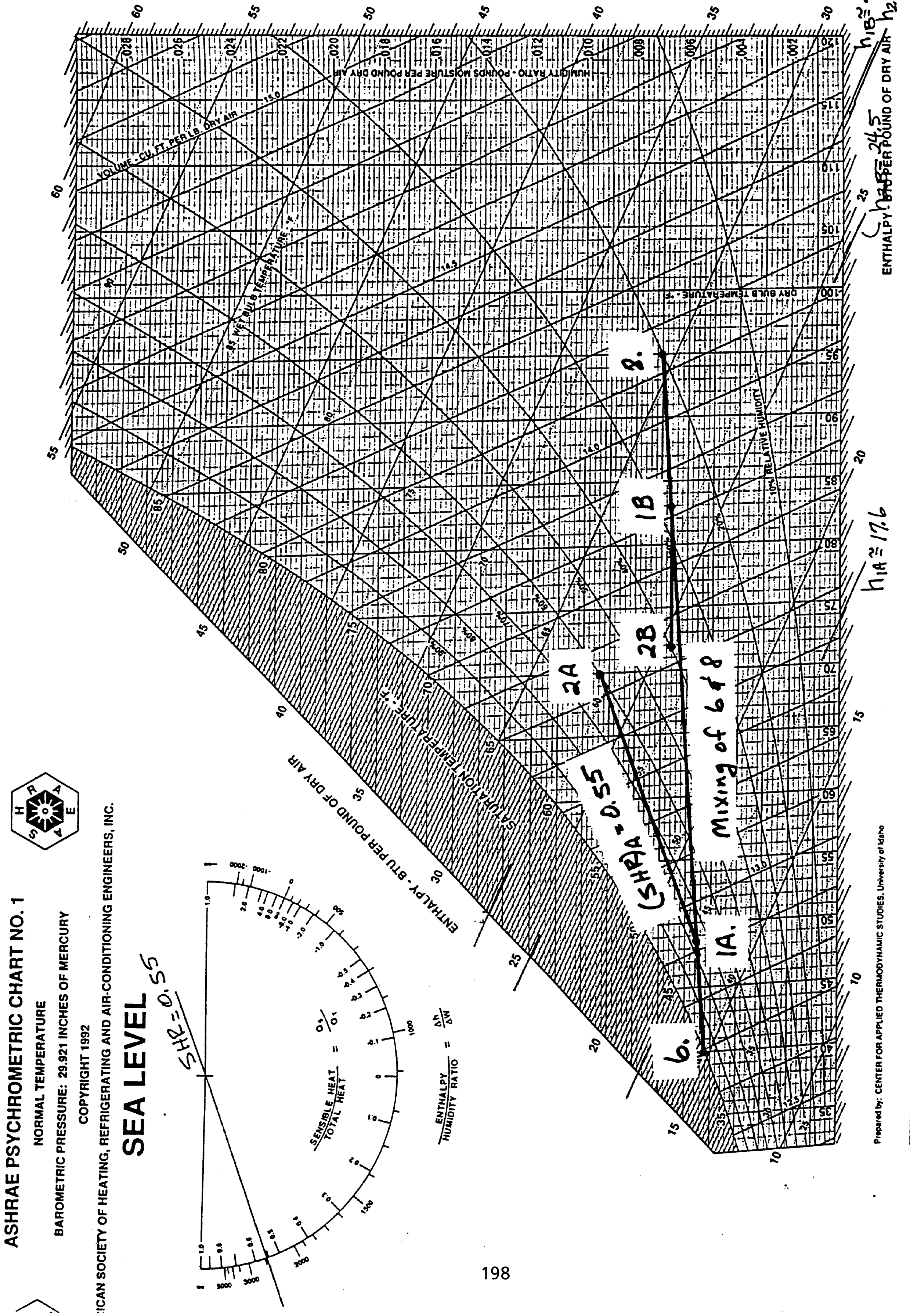

ENTHALPY, BTU/LB SOLUTION
CONCENTRATION, LB AMMONIA/LB SOLUTION
SATURATED VAPORS AT 300 PSIA
EQUILIBRIUM CONSTRUCTION LINES
SATURATED LIQUIDS AT 300 PSIA
SOLIDS
Problem 5.9 b)
P1
P2
POL
3
4
5,6

Chart C-3E

Problem 8.29


ASHRAE PSYCHROMETRIC CHART NO. 1
NORMAL TEMPERATURE
BAROMETRIC PRESSURE: 29.921 INCHES OF MERCURY
COPYRIGHT 1992
ICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.
SEA LEVEL
ENTHALPY - BTU PER POUND OF DRY AIR
SATURATION TEMPERATURE - °F
DRY BULB TEMPERATURE - °F
HUMIDITY RATIO - POUNDS MOISTURE PER POUND OF DRY AIR
VOLUME - CU. FT. PER LB. DRY AIR
WET BULB TEMPERATURE - °F
RELATIVE HUMIDITY
SENSIBLE HEAT / TOTAL HEAT
ENTHALPY / HUMIDITY RATIO = Δh/ΔW
Prepared by: CENTER FOR APPLIED THERMODYNAMIC STUDIES, University of Idaho
SHR = 0.55
(SHR)A = 0.55
Mixing of 6 & 8
1A.
1B
2A
2B
6.
8.
h1A ≅ 17.6
h2B ≅ 24.5
h1B ≅ 27.2
h2A ≅ 27.0

11.18

Summary of results

Component	Part (a)	Part (b)
$R_{i,w}$ hr ft^2/lb$_{ma}$	0.00923	0.00923
$R_{F,w}$ "	0.01157	0.01174
$R_{o,w}$ "	0.03417	0.03001
$R_{t,w}$ "	0.05497	0.05098
$R_{i,w} / R_{t,w}$	16.8%	18.1%
$R_{F,w} / R_{t,w}$	21.0%	23.0%
$R_{o,w} / R_{t,w}$	62.2%	58.9%
$U_{o,w}$ Btu/hr ft^2(Btu/lb$_{ma}$)	18.2	19.6

14.20 The 97.5% design temp. for Chicago is $-4\,^\circ F$ (Table B.1)

a.) Walls

	Thermal Resistances, $\frac{hr\text{-}ft^2\text{-}^\circ F}{Btu}$	
Source	At studs	Between Studs
Inside air film	0.68	0.68
3/8-inch gypsum	0.32	0.32
Studs	6.875	—
Insulation	—	19
25/32-inch sheathing	2.06	2.06
1.5-inch polystyrene*	7.5	7.5
4-inch brick **	0.6	0.6
Outside air film	0.17	0.17
Totals.	18.21	30.33

* Arbitrarily selected extruded polystyrene
** Arbitrarily selected lowest R-value/inch

Using the parallel path method, By Eqns 14.18 and 14.12

$$(U_{av})_{walls} = \frac{0.25}{18.21} + \frac{0.75}{30.33} = 0.038 \text{ Btu/hr-ft}^2\text{-}^\circ F$$

Windows: $U_o = 0.33$ from Table 14.5

Roof: $U_R = 1/9.0 = 0.111$ Btu/hr-ft^2-°F

Doors: $U_D = 0.20$ from Table 14.7

$A_{windows} = 700\ ft^2$, $A_{doors} = 40.5\ ft^2$

$A_{walls,\,frame} = (50)(10)(4) - 700 - 40.5 = 1259.5\ ft^2$

$A_{Roof} = 2500\ ft^2$

Problem 17.13 Bin Calculation, Denver Weather Data, Air to Air Heat Pump Heating

(UA)effective = Btu/hr	1122	This is the effective (UA)-value for the building
ti, °F=	68	Indoor temperature
internal gain= Btu/hr	9000	This is the sum of internal gains expected
Heat Pump Capacity=	$Q_{cond} = 17,200 + 385t_o + 2.54t_o^2$ Btu / hr	
Dc=	0.25	This is the part load degredation coefficient
Power Requirement=	$W_{comp} = 1.28 + 0.0093t_o - 0.000085t_o^2$ kW	
tz, °F=	60.0	This is the calcuated Zero-load temp.

A	B	C	D	E	F	G	H	I
Avg. Bin Temp	Annual Hours	Heating Systen	Heat Pump	Part Load facto	Run Time	Compressor Power	Backup Energy	Energy Input
°F	From Bin Data	Load, Btu/hr	Capacity, Btu/hr	PLF	Hrs	kW	kWh	kWh
		(can't be <0)		PLF eqn	B*C/(D*E)		(C-D)/B)/3412	(F*G)+H
				(can't be > 1)	(can't be > col. B)		(can't be < 0)	
62	794	0	50834	0.750	0	1.53	0	0
57	776	3342	47397	0.768	71	1.53	0	109
52	739	8952	44088	0.801	187	1.53	0	287
47	729	14562	40906	0.839	309	1.53	0	473
42	752	20172	37851	0.883	454	1.52	0	690
37	724	25782	34922	0.935	572	1.51	0	862
32	704	31392	32121	0.994	692	1.49	0	1031
27	555	37002	29447	1.000	555	1.47	1229	2044
22	394	42612	26899	1.000	394	1.44	1814	2383
17	243	48222	24479	1.000	243	1.41	1691	2034
12	137	53832	22186	1.000	137	1.38	1271	1460
7	84	59442	20019	1.000	84	1.34	971	1083
2	54	65052	17980	1.000	54	1.30	745	815
-3	22	70662	16068	1.000	22	1.25	352	380
-8	13	76272	14283	1.000	13	1.20	236	252
-13	5	81882	12624	1.000	5	1.14	101	107
-18	3	87492	11093	1.000	3	1.09	67	70
-23	1	93102	9689	1.000	1	1.02	24	25
							Annual Energy Input in kWh=	14108