$0.001580 \times 0.55 = 0.000869$ lb = weight of vapor per cubic foot at 55 per cent relative humidity.

Pressure of saturated vapor at 80 F = 1.0314 in. Hg.

Pressure of the vapor in the mixture = $1.0314 \times 0.55 = 0.567$ in. Hg.

Pressure of the dry air in the mixture = $29.92 - 0.567 = 29.353$ in. Hg.

Weight of 1 cu ft of dry air at 80 F = $\frac{1}{13.60} = 0.073529$ lb.

Weight of dry air in 1 cu ft of the mixture = $0.073529 \times \frac{29.353}{29.92} = 0.072136$ lb.

$0.072136 + 0.000869 = 0.073005$ lb = weight of 1 cu ft of the mixture.

3 ● Given air with a dry-bulb temperature of 75 F, a relative humidity of 60 per cent, and a barometric pressure of 29.92 in. Hg, calculate the volume of 1 lb of the mixture.

Weight of saturated vapor per cubic foot = 0.001352 lb (Table 5).

$0.001352 \times 0.6 = 0.0008112$ lb = weight of vapor per cubic foot at 60 per cent relative humidity.

Pressure of saturated vapor at 75 F = 0.8744 in. Hg.

Pressure of vapor in the mixture = $0.8744 \times 0.6 = 0.525$ in. Hg.

Pressure of dry air in the mixture = $29.92 - 0.525 = 29.395$ in. Hg.

Volume of 1 lb of dry air at 75 F = 13.48 cu ft.

Volume of 1 lb of dry air in the mixture = $13.48 \times \frac{29.92}{29.395} = 13.72$ cu ft.

Weight of dry air in 1 cu ft of the mixture = $\frac{1}{13.72} = 0.072886$ lb.

$0.072886 + 0.000811 = 0.073697$ lb = weight of 1 cu ft of the mixture.

$\frac{1}{0.073697} = 13.57$ cu ft = volume of 1 lb of the mixture.

Approximate Method:

Volume of 1 lb of saturated air at 75 F	= 13.88 cu ft.
Volume of 1 lb of dry air at 75 F	= 13.48 cu ft.
Difference in volume	= 0.40 cu ft.

Relative humidity = 60 per cent.

$0.40 \times 0.6 = 0.24$ cu ft.

$13.48 + 0.24 = 13.72$ cu ft = volume of 1 lb of the mixture.

The degree of approximation is evident.

4 ● Given saturated air at a temperature of 75 F and a barometric pressure of 29.92 in. Hg, determine the total heat of the mixture per pound of dry air.

From Equation 11 and Table 5,

Cp_a = mean specific heat at constant pressure of dry air = 0.24.

h_{fg} = latent heat of vaporization at the wet-bulb temperature = 1050.1 Btu per lb.

W_t' = weight of water vapor mixed with each pound of dry air = 0.01877 lb.

$\Sigma = 0.24\ (75 - 0) + (0.01877)\ (1050.1)$.

$\Sigma = 37.71$ Btu per lb of dry air.

5 ● Given air at 85 F dry-bulb temperature, 75 F wet-bulb temperature, and a barometric pressure of 29.92 in. Hg; determine the total heat of the mixture per pound of dry air.

From Equation 10 and Table 5,

$Cp_a = 0.24$.

$h'_{fg} = 1050.1$ Btu.

Relative humidity = 62.3 per cent (from psychrometric chart).

$W = 0.02634 \times 0.623 = 0.01641$ grains of moisture per lb of dry air.

$\Sigma = 0.24\ (85 - 0) + 0.01641\ [1050.1 + 0.45\ (85 - 75)]$.

$\Sigma = 37.71$ Btu per pound of dry air.

It will be seen from *Questions* 4 and 5 that the total heat content is a function of the wet-bulb temperature.

6 ● It is desired to maintain a temperature of 80 F and a relative humidity of 50 per cent in a factory where the equipment gives off 6,000 Btu per hour. If the entering air is at 70 F, determine the relative humidity, and the pounds of air required per hour.

Air at 80 F and 50 per cent relative humidity contains 77 grains of moisture per pound.

At 70 F and 77 grains of moisture per pound, the *relative humidity* is 70 per cent.

Total heat above zero in the mixture at 80 F and 50 per cent relative humidity = 31.2 Btu per pound.

Total heat above zero in the mixture at 70 F and 70 per cent relative humidity = 28.8 Btu per pound.

$31.2 - 28.8 = 2.4$ Btu to be removed per pound of air.

6000 Btu = heat given off by equipment per hour.

$\frac{6000}{2.4} = 2500$ lb of air required per hour.

7 ● From the data given in Question 6, calculate the approximate cubic feet of air required per minute.

Volume of 1 lb of saturated air at 70 F	= 13.69 cu ft (Table 5)
Volume of 1 lb of dry air at 70 F	= 13.35 cu ft.
Difference in volume	= 0.34 cu ft.

Relative humidity = 70 per cent.

$0.34 \times 0.7 = 0.24$ cu ft.

$13.35 + 0.24 = 13.59$ cu ft, volume of 1 lb of mixture at 70 F and 70 per cent relative humidity (approximate).

From Question 6 the air required per hour = 2500 lb.

$\frac{2500 \times 13.59}{60} = 566.25$ cu ft per minute required.

8 ● Given 1 lb of dry air at 78 F and a barometric pressure of 29.92 in. Hg; calculate the volume. If the temperature is raised to 96 F and the volume remains constant, what will be the new pressure, P_2, in in. Hg?

$PV = WRT$.

R (for air) = 53.34.

$W = 1$ lb.

P = absolute pressure, pounds per square foot.

$$V = \frac{1 \times 53.34 \times (78 + 460)}{29.92 \times 0.491 \times 144}$$

$V = 13.57$ cu ft = volume of 1 lb.

$$\frac{P_2}{P_1} = \frac{T_2}{T_1};\quad P_2 = \frac{T_2 P_1}{T_1}$$

$$P_2 = \frac{(96 + 460)\ (29.92 \times 0.491 \times 144)}{(78 + 460)\ (0.491 \times 144)}$$

$P_2 = 30.90$ in. Hg.