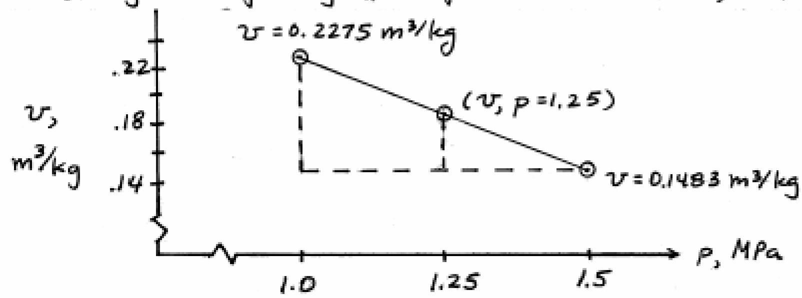
PROBLEM 1.29

(a) At a temperature of 240°C, the specified pressure of 1.25 MPa falls between the tabe values of 1.0 and 1.5 MPa. To determine the specific volume corresponding to 1.25 MPa, we think of the slope of a straight line joining the adjacent table states, as follows:

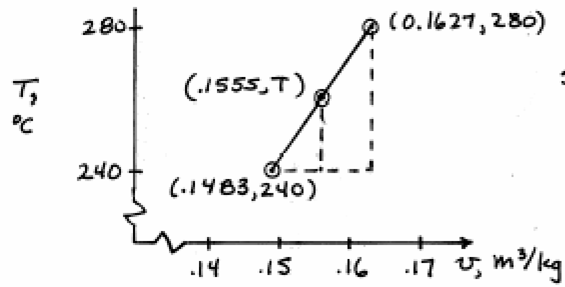


similar triangles:

$$|\text{slope}| = \frac{v - 0.1483}{1.5 - 1.25} = \frac{0.2275 - 0.1483}{1.5 - 1.0} \Rightarrow v = 0.1483 + \left(\frac{0.25}{0.50}\right)(0.2275 - 0.1483)$$

$$= 0.1879 \text{ m}^3/\text{kg} \quad \text{(a)}$$

(b) At a pressure of 1.5 MPa, the given specific volume of 0.1555 m³/kg falls between the table values of 240 and 280°C. To determine the temperature corresponding to the given specific volume, we think of the slope of a straight line joining the adjacent table states, as follows:



$$\text{Slope} = \frac{T - 240}{.1555 - .1483} = \frac{280 - 240}{.1627 - .1483}$$

$$\Rightarrow T = 240 + \left[\frac{.1555 - .1483}{.1627 - .1483}\right](40)$$

$$= 260°\text{C} \quad \text{(b)}$$

(c) In this case, the specified pressure falls between the table values of 1.0 and 1.5 MPa <u>and</u> the specified temperature falls between the table values of 200 and 240°C. Thus, <u>double</u> interpolation is required.

- At 220°C, the specific volume at each pressure is simply the average over the interval:

at 1.0 MPa, 220°C; $v = \frac{.2060 + .2275}{2} = 0.21675 \text{ m}^3/\text{kg}$

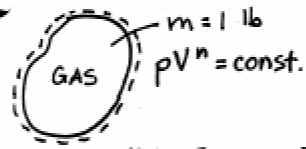
at 1.5 MPa, 220°C $v = \frac{.1325 + .1483}{2} = 0.1404 \text{ m}^3/\text{kg}$

- Thus, with the same approach as in (a)

$$\frac{v - 0.1404}{1.5 - 1.4} = \frac{0.21675 - 0.1404}{1.5 - 1.0} \Rightarrow v = 0.1404 + \left(\frac{0.1}{0.5}\right)(0.21675 - 0.1404)$$

$$= 0.15567 \text{ m}^3/\text{kg} \quad \text{(c)}$$

PROBLEM 1.32



$p_1 = 20\ \text{lbf/in}^2$, $V_1 = 10\ \text{ft}^3$

$p_2 = 100\ \text{lbf/in}^2$

From the pressure-volume relation

$$V_2 = \left(\frac{p_1}{p_2}\right)^{\frac{1}{n}} V_1 = \left(\frac{20}{100}\right)^{\frac{1}{n}} (10\ \text{ft}^3)$$

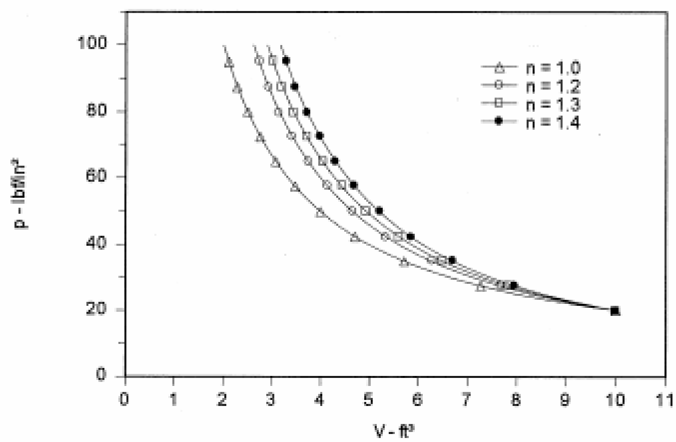
$n = 1$; $V_2 = 2\ \text{ft}^3$

$n = 1.2$; $V_2 = 2.615\ \text{ft}^3$

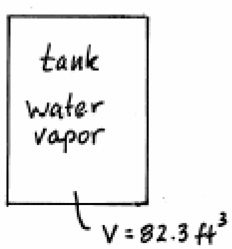
$n = 1.3$; $V_2 = 2.900\ \text{ft}^3$

$n = 1.4$; $V_2 = 3.168\ \text{ft}^3$

} ← V_2



PROBLEM 1.49



For the water vapor in the tank, the p-v-T relation is

$$p = [(0.5954)T/(v - 0.2708)] - 63.36/v^2$$

where v is in ft³/lb, T is in °R, and p is in lbf/in²

Solving iteratively for v at $p = 1500$ lbf/in², $T = 1140$ °R we get

$$v = 0.686\ \text{ft}^3/\text{lb}$$

Thus, with the given value for V

$$m = V/v = 82.3/0.686 = 120\ \text{lb}$$ ← m

The following plots can be constructed for $T = 1200$, 1400, 1600 °R: