Thermodynamics - ME 366 Hw 4 Will Boziak

1. yes, the abs. error's of the two temperature's were

$1300°C \approx \%14$, $550°C \approx \%1.4$

When comparing on a graph to the information from the tables, the information is practically indistinguishable.

2.

$k = 1.4$ $M_m = 28$ kg/kmol

$c_p = \frac{1.4}{.4}\left(\frac{8314.46}{28}\right)$

$= 1039.3075$

$c_v = c_p/1.4 = 742.3625$

a) $0°C = 273.15\,K$

$h = c_p T = 1039.3075(273.15)$

$= 283{,}886.8$

$u = c_v T = 742.3625(273.15)$

$= 202{,}776$

b) $1000°C = 1273.15\,K$

$h = 1039.3075(1273.15)$

$= 1{,}323{,}194$

$u = 742.3625(1273.15) = 945{,}138.8$

c) $2000°C = 2273.15\,K$

$h = 1039.3075(2273.15)$

$= 2{,}362{,}501.8$

$u = 1{,}687{,}501$

3. $T = 32\,°C = 305.15\,K$ $M_m = 29$ kg/kmol $\rho = 997$ kg/m^3

$R = 286.7055$ $A = .15\,m^2$ $H = 7\,m$ $g = 9.81$ $P_a = 101325\,Pa$

$R_u = 8314.46$ $V = hA$ $N = .01$

$$PA = P_aA + \rho g(H-h)A \Rightarrow P = P_a + \rho g(H-h)$$

$$PV = NRT$$

$$\frac{NRT}{V} = P_aA + \rho gHA - \rho ghA = \frac{NRT}{hA} \Rightarrow P = P_a + \rho g(H-h) = \underline{\underline{114530}}$$

$$\Rightarrow h = 5.64985 \Rightarrow v = \frac{RT}{P} = \frac{286.7055(305.15)}{114530} = \underline{\underline{.76388879}}$$

$$V = .15(5.64985) = \underline{\underline{.8474775}}\ m^3$$

4. $k = 2000\,N/m$ $h_1 = .4\,m$ $h_2 = .6\,m$ $m = 45\,kg$, $A = .012$

$M_m = 28.97$ (tables) $T_i = 298.15\,K$ $P_a = 101325\,Pa$

$$P_i = P_a + mg + kh_1 = 102{,}566.45\,Pa$$

$$102{,}566.45\left(\frac{.012(.4)}{m}\right) = \frac{8314.46(298.15)}{28.97}$$

$$\Rightarrow m = \underline{\underline{.00575}}\ kg$$

b) $102{,}566.45(1.254429) = RT$

$$\Rightarrow T = \underline{\underline{447.225}}\ K$$

c) $h_m = H = Q$

$298.18(.00575) = \underline{\underline{1.716}}\ kJ$

5. $T_i = 300K$, $P_i = 101300\ Pa$, $M_m = 32\ kg/kmol$, $M = .07\ kg$

$k = 1.4$

1) $101300\,v = \frac{8314.46}{32}(300) \Rightarrow V = .7695(.07) = \underline{.053865\ m^3}$

2) $P_2 = \frac{259.826(T_2)}{.7695}$ $\quad C_v T_2 - C_v T_1 = 13\ kJ$

$\Rightarrow \underline{T_2 = 320K}$

$\Rightarrow P_2 = \underline{108,055\ Pa}$ $\quad \underline{V_2 = V_1}$

3. $v_3 = \frac{259.826(320)}{101300} = .8207759 \Rightarrow V_3 = \underline{.05745\ m^3}$

b) $W_{tot} = \Sigma W = 0 + (RT \ln(\frac{v_3}{v_2})) + (P_1(V_3 - V_1))$

$W_{tot} = 5720.5377$

$\Rightarrow \underline{\underline{5.72\ kJ}}$

6. $m = 5$ kg $\quad T_1 = 325\ ^{\circ}C \quad P_1 = 3{,}000{,}000$ Pa

$v_2 = .5\, v_1$

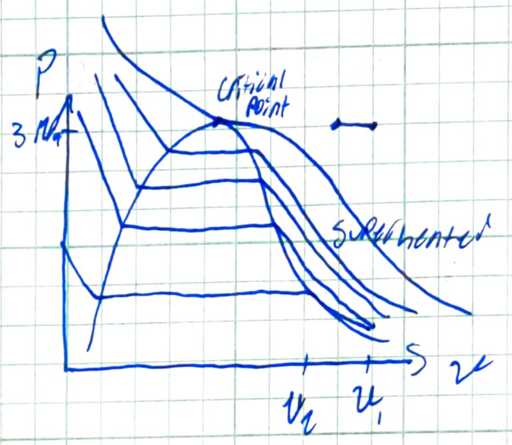
a) superheated

$v_1 \Rightarrow .0859$ (interpolated w/ matlab tables)

$v_2 = .5 v_1 = .04295$

b) $P(v_2) = RT_2 \Rightarrow T_2 = 274.18$ K

b) $Q = u_2 - u_1 = 2750.8 - 2797.6 = -46.8$ kJ



* not to scale