Chemistry 230 -- PS 3

1. $\alpha = a + b\theta + c\theta^2 = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$

$\int \alpha\, dT = \int \frac{dV}{V} + \text{const} \Rightarrow \boxed{a\theta + \frac{b}{2}\theta^2 + \frac{c}{3}\theta^3 = \ln(V/V_0)}$

$\theta_{app} = \frac{V_{30} - V_0}{V_{50} - V_0} \times 50°C = \frac{V_{30}/V_0 - 1}{V_{50}/V_0 - 1} \times 50° = \underline{28.51°C}$

2. $w = -P_{ext}\Delta V = -0.500 \times 10^5 \text{ Pa} \times 4.00 \times 10^{-3} \text{ m}^3$
$= -2.00 \times 10^2 \text{ J}$

3. $\mu_{JT} \equiv \left(\frac{\partial T}{\partial P}\right)_H \approx \left(\frac{\Delta T}{\Delta P}\right)_H = 0.2°/\text{bar} \Rightarrow \Delta T \approx \Delta P \cdot \mu_{JT} = -49 \text{ bar} \times 0.2 \frac{°}{\text{bar}}$
$\Rightarrow T = 25° + \Delta T = 15°C$

4. $\left(\frac{\partial U_m}{\partial V_m}\right)_T = \left(\frac{\partial U_m}{\partial P}\right)_T \left(\frac{\partial P}{\partial V_m}\right)_T = \left(\frac{\partial U_m}{\partial P}\right)_T \left(-\frac{P^2}{RT}\right) =$ (a) 0.246 J/L
(×4) (b) 0.984 J/L

5. See soln manual or me.

6. (a) $q = 0$ (adiabatic); $\Delta U = \int C_V dT$ (perfect gas assumption)
also $\Delta U = w$; $\Delta H = \Delta U + \Delta(PV) = \Delta U + nR\Delta T$
(also $\Delta H = \int C_P dT = C_P \Delta T$ here)

Use $C_{V,m} \ln(T_2/T_1) = nR \ln(V_1/V_2)$, etc.

7. Note that in (a) $q = q_P = \Delta H$, while in (b) $q = q_V = \Delta U$.

8. K, C_P, & ΔH_f are all ∝ mass (extensive). $v = 351 \frac{m}{s}$

9. (a) $w = n^2 B\left[c_1 \ln\left(\frac{V_1}{V_2}\right) + c_2\left(\frac{1}{V_2} - \frac{1}{V_1}\right)\right]$ (b) $c_1 = \frac{T_2 - T_1}{V_2 - V_1}$

$c_2 = \frac{V_2 T_1 - V_1 T_2}{V_2 - V_1}$