A. (13) Bomb Calorimetry.

1. (4) Combustion of 1.473 g of substance A raises the temperature of 0.931 kg of water by 2.143 K. Therefore, combustion of 1.910 g of A will raise the temperature of 1.095 kg of water by how much?

2. (6) In experiments run at ~25°C, 1.038 g of BA and 47 mg of Fe fuse wire yield a temperature rise of 2.119 K. Then 1.272 g of unknown and 58 mg of fuse wire yield ΔT = 1.822 K. In each case the calorimeter pail is filled with the same volume of water. Calculate (a) the calorimeter constant, and (b) q_{specific} for the unknown. [q_{specific} (BA) = -26.413 kJ/g; q_{specific} (Fe) = -6.68 kJ/g]

3. (3) If the masses just above are considered exact and the ΔT values are uncertain by 0.016 K, what are the % uncertainties in (a) the calorimeter constant, and (b) q_{specific} for the unknown.
B. (14) Phase Equilibria and the Triple Point.

1. The normal boiling point of water is 100.0°C, and $\Delta H_{m,vap} = 40.66 \text{ kJ/mol}$ at that $T$. Taking $\Delta H_{m,vap}$ to be constant, calculate the boiling point of water at the top of Pike's Peak on a day when the atmospheric pressure is its average value of 446 torr.

2. I. B. Alwette and U. P. Water run the TP experiment and analyze their data to obtain $\Delta H_{m,vap} = 44.74 \pm 0.12 \text{ kJ/mol}$ and $\Delta H_{m,sub} = 52.39 \pm 0.07 \text{ kJ/mol}$. Calculate from these results $\Delta H_{fus}$ and its uncertainty. State the results with the proper numbers of significant figures.

3. In analyzing our vapor pressure data for water, we assumed that $\Delta H_{m,vap}$ was independent of temperature. Over an extended $T$ range, this becomes a poor approximation. Suppose we include the $T$-dependence in $\Delta H_{m,vap}$ by treating $\Delta C_P (= C_{P,m,g} - C_{P,m,l})$ as independent of $T$.

   (a) Give an expression for $\Delta H_{m,vap}(T)$, in terms of $\Delta C_P$ and $\Delta H_{m,vap}$ at the triple point ($T_0$). [If need be, you can derive this using $(\partial H/\partial T)_P = C_P$.]

   (b) Use this expression to obtain a version of the integrated Claussius-Clapeyron equation that could be used to analyze vapor pressure data to obtain $\Delta C_P$ and $\Delta H_{m,vap}$ at $T_0$. [Hint: You may start here with the differential equation, $d \ln P/dT = \Delta H_{m,vap}/(RT^2)$.]