1. Think about the plots of $C_{V,m}$ in Fig. 3.2 (3.1 in 1st edition), and make certain you understand the behavior (i.e., the constancy, and the numerical values, of $C_{V,m}$) around room temperature (300K) for He and CO. Similarly, think about and try to understand the increase in $C_{V,m}$ for CO$_2$ and C$_2$H$_4$ at higher temperatures.

2. Calculate the constant-pressure thermal expansivity $\beta$ and the isothermal compressibility $\kappa$ of an ideal gas.

3. Study EXAMPLE PROBLEM 3.5, where it is shown for the van der Waals gas that the change in internal energy at constant temperature, $\Delta U_T$, is equal to $n^2 a \left( \frac{1}{V_i} - \frac{1}{V_f} \right)$. Show that this quantity is small compared to the average internal energy itself, $U_i$ or $U_f$, i.e., that the change in internal energy, with volume, at constant temperature, is small.

4. Study EXAMPLE PROBLEM 3.7. Plot $C_{P,m}(T)$ vs $T$ over the range 300 – 600K. What is the average value of $C_{P,m}(T)$? Use this average value to calculate the heat absorbed upon heating 143.0g of the sample (solid elemental Carbon) from 300 to 600K at constant pressure (1 atm). What is the % error in your estimate?

5. Calculate, and analyze (picking typical values of $a$ and $b$), the isothermal compressibility $\kappa$ for a van der Waals gas, over some interesting ranges of $T$ and $V_m$. As one of these “interesting ranges of $T$ and $V_m$”, consider in particular the ideal gas limit, i.e., $V_m >> b$ and $RTV_m >> a$.

6. Express the hard-to-measure quantity $\left( \frac{\partial U}{\partial V} \right)_T$ in terms of the easy-to-measure $\beta$, $\kappa$, $T$ and $P$.

7. Calculate the isothermal compressibility $\kappa$ for a van der Waals gas, and study its behavior as the critical point ($T_c=8a/27Rb$, $V_{mc}=3b$ and $P_c=a/27b^2$) of the gas is approached.

8. Calculate the Joule-Thomson coefficient for the van der Waals gas, and study its behavior in interesting limits, e.g., in the ideal gas limit, near the critical point, etc.

9. Express $\left( \frac{\partial U}{\partial V} \right)_T$ in terms of the Joule-Thomson coefficient, $\mu_{J-T} = \left( \frac{\partial T}{\partial P} \right)_H$. 