Unit 1: Partial Derivatives and Equations of State

Date issued: Friday, January 25, 2008
Date due back: Friday, February 1, 2007, before 5 pm.

1. Write down the total differential of P (i.e. dP) for an ideal gas. Make the approximation the $dP \approx \Delta P$, $dV \approx \Delta V$, $dT \approx \Delta T$, and $dn \approx \Delta n$. Use the approximate expression for ΔP to calculate the change in pressure of an ideal gas if the volume is changed from 20.000 L to 19.800 L, the temperature is changed from 298.15 K to 299 K, and the number of moles is changed from 1.0000 to 1.0015.

2. Show that $\left(\frac{\partial^2 P}{\partial V \partial T}\right)_n = \left(\frac{\partial^2 P}{\partial T \partial V}\right)_n$ for an ideal gas and a van der Waals gas.

3. Answer the following questions from Math Chapter H: 3, 5, 8, 11 and 13.

4. Using the van der Waals equation of state, calculate the pressure exerted by 1 mol of carbon dioxide at 0 ^{o}C in a volume of 0.05 L. Obtain the pressure using the ideal gas law and the Redlich-Kwong equation. You will need to look up some parameters in Table 16.3 and Table 16.4.

5. Use the cubic form of the van der Waals equation to calculate the molar volume of ethane at 310 K and 205 atm.

6. Use the van der Waals equation and the Redlich-Kwong equation to calculate the molar density of one mole of methane at 500 K and 500 bar. Compare your results to the experimental value of 10.06 mol L^{-1}. You will need to look up some parameters in Table 16.3 and Table 16.4.