1. Since we will be dealing with partial derivatives later in the semester, this is a good opportunity to review this topic. Section 4.3 in Barrante covers partial derivatives (which you probably haven’t encountered yet) so read that section, and review the rest of chapter 4. Then evaluate the following partial derivatives

(a) \( PV = nRT, \) \( P \) with respect to \( V \) (i.e. evaluate \( \left( \frac{\partial P}{\partial V} \right)_T \)).

(b) \( r = \sqrt{x^2 + y^2 + z^2}; \) \( r \) with respect to \( y \).  Hint: use the chain rule (p. 33 in Barrante)

2. At 273 K, experimental measurements for the gas argon gave values of \( B = -21.7 \text{ cm}^3 \text{ mol}^{-1} \) and \( C = 1.200 \times 10^3 \text{ cm}^6 \text{ mol}^{-2} \), where \( B \) and \( C \) are the second and third virial coefficients in the expansion of \( Z \) in powers of \( 1/V_m \). Assuming that the ideal gas law holds sufficiently well for the estimation of the second and third terms of the expansion, calculate the compression factor (\( Z \)) of argon at a pressure of \( 1.00 \times 10^2 \text{ atm} \) and 273 K. From your result, estimate the molar volume (\( V_m \)) of argon under these conditions.

3. A sample of oxygen (\( \text{O}_2 \)) gas is kept in a 1.50 L container at 168 kPa and at a temperature of 25.00°C. Calculate:
   (a) the root-mean-square speed of the entire group of molecules,
   (b) the average translational kinetic energy of each molecule,
   (c) the total translational kinetic energy of the system

4. It’s informative in Physical Chemistry to explore the underlying significance of mathematical equations by thinking about what those equations tell you under certain conditions. Developing this skill will help you to make connections and to see the physical meaning of the concepts we are discussing rather than seeing PChem as a series of seemingly unrelated mathematical expressions. Without doing any calculations, but with reference to appropriate equations, explain what the effect on the highlighted properties will be under the given conditions. Make sure you give a clear rationalization for each of the effects.
   (a) the average speed of a collection of molecules if the temperature is increased from 300 K to 1000 K?
   (b) the mean free path of a collection of molecules at a given temperature as the size of the container in which the molecules are enclosed is decreased?
   (c) the compression factor of a gas as the pressure of that gas approaches zero?
   (d) the observed pressure of a gas enclosed in a container of fixed volume as the temperature of the gas is increased?

You can put the completed assignments in my mailbox in the Department office (3150), give them to me in class or shove them under my office door (3420) if I’m not there.