UNIVERSITY OF MANITOBA
DEPARTMENT OF CHEMISTRY

Chemistry 2290, Winter 2012, G. Schreckenbach

PROBLEM SET 1, Jan. 11, 2012

Due date: The solved problem set is due on Wednesday, January 18, 2011, at the time of the lecture.

Questions to be marked: A *pre-selected* (by me!) set of **five** (5) out of the seven questions will be marked.

Comment regarding course website: As announced in class, I have posted a number of sample problems on the course website. There is a lot more to come, so please check back regularly.

1. For the van der Waals equation of state, calculate the partial derivatives:

$$\left(\frac{\partial P}{\partial V_m}\right)_T \quad \text{and} \quad \left(\frac{\partial P}{\partial T}\right)_{V_m}$$

(Hint: Solve for *P* first; write the equation for 1 mol, i.e. in terms of molar quantities such as V_m.)

2. A sample of gas occupies 1.90L at 30.0°C and 1.00atm. What pressure is needed to compress the gas to 257cm^3 at this temperature?

3. An ideal gas at 315K is heated at constant pressure until its volume has increased by 26%. What is the final temperature of the gas?

4. A sample of 255mg of neon occupies 3.30L at 122K. Assuming ideal behavior, calculate the pressure of the gas.

5. A gas at 275.0K and 14.5atm has a molar volume 12.5 per cent smaller than that calculated from the ideal gas law. Calculate **(a)** the compression factor under these conditions and **(b)** the molar volume of the gas. **(c)** Which are dominating in this gas sample, the attractive or repulsive forces?

6. A sample of ammonia is fully decomposed to nitrogen and hydrogen gases over heated iron wool. If the total pressure is 886 Torr, calculate the partial pressures of N_2 and H_2 <u>in units of Pa</u>.

7. Calculate the pressure exerted by 1.00mol of helium gas behaving **(a)** as an ideal gas, **(b)** as a van der Waals gas, under the following conditions: **(i)** at 273.15K with a volume of 22.414L and **(ii)** at 1000K in 100cm^3. *(All values taken as at least three significant figures.)* Use the constants as listed in the Engle/Reid textbook.
(c) Briefly comment on the origin of any discrepancies between (a) and (b) *(not more than 2–3 sentences, please!)*