CHEM352: PHYSICAL CHEMISTRY I
HOMEWORK SET III - DUE 30^{th} OF OCT, 5.00 PM

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Lecture: Tue, 2.10-3.25 pm & Fri 2.10-3.25 pm, **C111**
Office hours: Thu, 4-6 pm, **HB - 1321B**

Problem 1 — CH7/5pts

Warm up. Show that:

1. $P\kappa = 1 - P\left(\frac{\partial \ln z}{\partial P}\right)_T$, where κ is the isothermal compressibility.
2. $P\beta = 1 - P\left(\frac{\partial \ln z}{\partial T}\right)_P$, where β is the thermal expansion.
3. Show that T_c, P_c and $V_{m.c}$ for van der Waals equation of state depends on parameters a and b and that the parameters a and b can be expressed using critical values for these variables.

Problem 2 — CH7/5pts

A 1.75 mole sample of Argon undergoes an isothermal reversible expansion from an initial volume of 2.00 L to a final volume of 100.0 L at 325 K. Calculate the heat transfer and the work done in this process using the ideal gas and van der Waals equations of state. What percentage of the work done by the nad der Waals gas arises from the attractive potential?

Problem 3 — CH8/5pts

he vapor pressure of a solid and a liquid of the same substance is given by following equations:

$$\ln\left(\frac{P}{Torr}\right) = 22.413 - 2112(K/T) \tag{1a}$$

$$\ln\left(\frac{P}{Torr}\right) = 18.352 - 1736(K/T) \tag{1b}$$

- Calculate $\Delta H_{vaporization}$, ΔH_{fusion} and $\Delta H_{sublimation}$.
- Write respective expressions for ΔS's in terms of temperature.
- Calculate the triple point temperature and pressure.

Problem 4 — CH9/5pts

1. The heat of fusion of water is 6.008 kJ/mol at its normal melting point of 273.15 K. Calcualte freezing point depression constant K_f.
2. Calculate the solubility of H_2S in 1L of water if its pressure above the solution is 2.75 Pa.
3. A and B form an ideal solution. A total pressure of 0.720 bar, y_A and x_A are 0.510 and 0.420 respectively. Calculate the vapor pressure of pure substance A and B.

Problem 5 — CH8/5pts

The skater problem is too cool to not list it here:
It has been suggested that the surface melting of ice plays a role in enabling speed skaters to achieve peak performance. Please test this hypothesis. You can follow some physical parameters and estimates from problem 8.8, however the problem adopts a limiting case of a skater balancing on one skate. In addition please consider a skater accelerating (you can use some data for times/masses etc from the last Winter Olympic Games finals).