Exercise 9.7
Ideal and Nonideal Gases

1.

(a) Under what conditions is it reasonable to treat a gas as "ideal"?

(b) Consider water and silane (SiH_4) as nonideal gases.

(i) For water, $a = 0.5537$ Pa m^6 mol^{-2}. For silane, $a = 0.437$ Pa m^6 mol^{-2}. Explain why a is larger for water. The purpose of the van der Waals constant a must be clear from your explanation.

(ii) For water, $b = 3.05 \times 10^{-5}$ m^3 mol^{-1}. For silane, $b = 5.79 \times 10^{-5}$ m^3 mol^{-1}. Explain why b is larger for silane. The purpose of the van der Waals constant b must be clear from your explanation.

(c) What is the pressure that is exerted by 2.5 moles of $SiH_{4(g)}$ in a 2.5 m^3 container at 25°C when it is considered to behave as an ideal gas? Is it likely that this pressure is approximately accurate, or should SiH_4 behave as a nonideal gas under these conditions? Briefly, justify your answer.

2. A 5.00 L flask contains 450 g CH_4 at 0 °C. Use the van der Waals equation of state to predict the pressure in this flask.

The van der Waals parameters for CH_4 are $a = 0.2303 \frac{Pa \cdot m^6}{mol^2}$ and $b = 4.31 \times 10^{-5} \frac{m^3}{mol}$.