## Real Gases: Deviations from Ideality

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

1. For the pair of gases below, predict which one would more closely follow the ideal gas law. Both gases are at -20 °C and 4.0 atm. Explain your answer.

   Propane, $C_3H_8$, boiling point = -45 °C

   Neon, Ne, boiling point = -246 °C

   Neon would more closely follow the ideal gas law. Propane has a boiling point of -45 °C and would be close to condensation at -20 °C. Deviations due to volume and interparticle attractions are most likely to be higher near the condensation point (boiling point) of the substance.

2. Use both the van der Waals equation and the ideal gas law to calculate the pressure, in atm, of 6.75 moles of methane ($CH_4$) gas at a temperature of 525 °C, in a 4.86 L container.

   T = 525 °C + 273 = 796 K

   $$P = \frac{6.75\ mol \times 0.0821 \frac{L \cdot atm}{mol \cdot K} \times 796\ K}{4.86\ L} = \mathbf{90.8\ atm}$$

   $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$ Solve for P

   $$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2} = \frac{6.75\ mol \times 0.0821 \frac{L \cdot atm}{mol \cdot K} \times 796\ K}{4.86\ L - 6.75\ mol \times 0.0428 \frac{L}{mol}} - \frac{2.25 \frac{L^2 \cdot atm}{mol^2} \times (6.75\ mol)^2}{(4.86\ L)^2} = \mathbf{91.7\ atm}$$

3. Would you expect Ar or $CO_2$ gas to behave more like an ideal gas at higher pressures? (Hint: Look at their van der Waal constants)

   **Ar would behave more like an ideal gas.**

4. Explain the differences between the van der Waal constants, a and b.

   The constant, a, corrects for the interparticle attractions. The constant, b, corrects for the volume of the particles. Both increase with increasing molar mass and complexity of the structure.