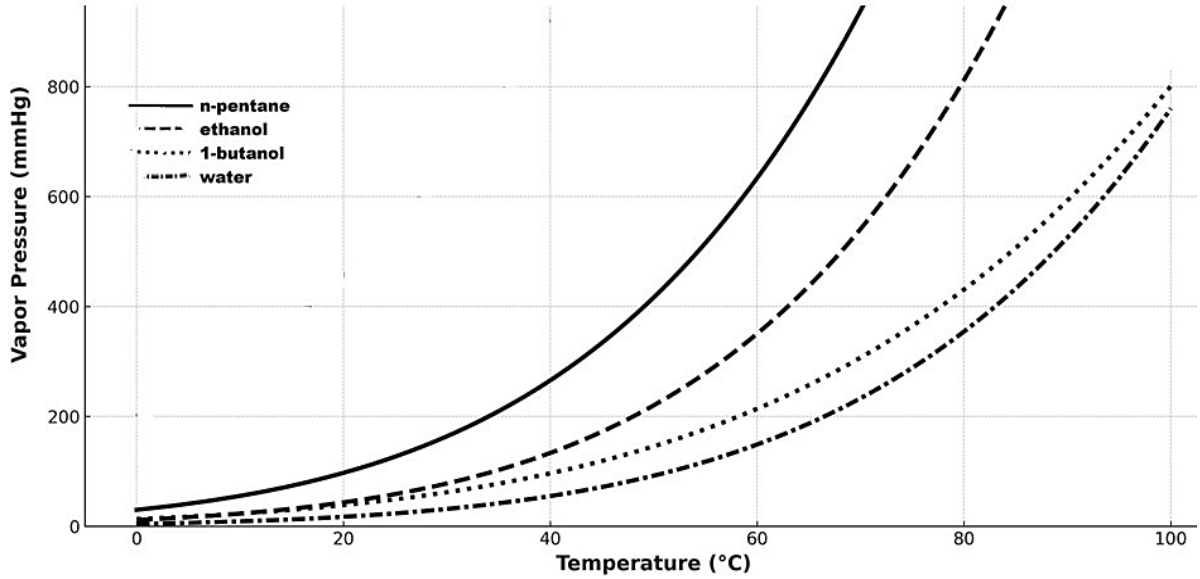
Vapor Pressure

Read from Lesson 2b: Vapor Pressure in the Chemistry Tutorial Section, Chapter 11 of The Physics Classroom

Vapor pressure is the pressure exerted by a vapor in equilibrium with its liquid at a given temperature. It reflects how easily molecules escape from the liquid phase to the gas phase. This is strongly influenced by the strength of intermolecular forces within the liquid. Liquids with weaker intermolecular forces exhibit a higher vapor pressure, as these weaker forces enable molecules to escape more readily into the gas phase, thereby increasing the pressure exerted by the vapor above the liquid.

Vapor Pressure Lab

Molly Cule and Adam Splidda studied the vapor pressures of n-pentane, ethanol, 1-butanol, and water in lab. A flask containing each liquid (in equilibrium with its vapor) was placed in separate beakers filled with water at varying temperatures. A pressure sensor measured the pressure inside the flask, while a thermometer recorded the temperature of the water bath in each beaker. Data was collected and the results were graphed. Vapor pressure is plotted versus temperature on the graph shown below.



1. Which liquid has the highest vapor pressure at 20°C?

2. Which liquid has the lowest vapor pressure at 60°C?

3. Which liquid would boil at 80°C?

4. As temperature increases, vapor pressure _____ for most liquids. Explain in terms of kinetic energy.

5. Using the graph, determine the approximate normal boiling point for n-pentane. How does this compare to the normal boiling point of water?

Solids, Liquids, and Intermolecular Forces

6. Draw the Lewis structure of n-pentane (C_5H_{12}), ethanol (C_2H_5OH), 1-butanol (C_4H_9OH), and water. List the types of intermolecular forces that each compound experiences.

7. Both ethanol and 1-butanol are alcohols. Which compound has the larger vapor pressure value at room temperature? Explain why in terms of the intermolecular forces each compound experiences.

8. Although n-pentane and 1-butanol have similar molar masses, their vapor pressures differ when measured at the same temperature. Based on question 6, explain how this difference in vapor pressure occurs.

9. The term ”volatile" describes a compound’s ability to easily evaporate or turn into a gas at a specific temperature. Compare the vapor pressure curves of each compound to your list of each compound’s intermolecular forces. What conclusions can you make about the relationship between intermolecular forces and volatility?