Name:_____Date:_____Block:_____

Three Colorless Liquids…Three Different Strengths of Attraction

1. Each card represents one of three substances, sort the cards into three groups. Each group should consist of cards representing the same substance.

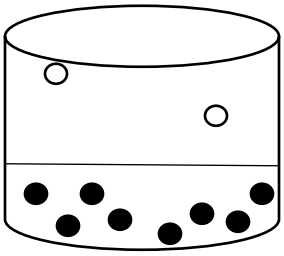
2. Determine the chemical formula for each substance.

3. Determine whether each substance is polar or nonpolar.

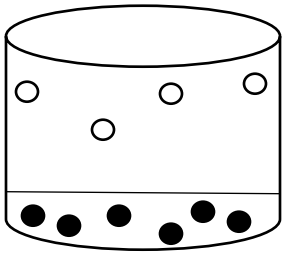
4. Imagine a sample of each substance. In each sample there are multiple identical particles of the substance present. In each substance, the particles are attracted to one another to some extent. Rank the three substances in order of increasing strength of attractions between the particles.

5. What factors determine how strongly particles are attracted to one another?

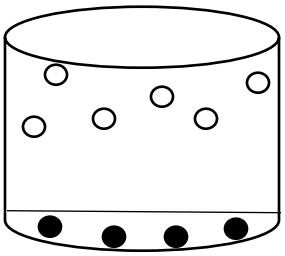
6. All three substances are liquids at room temperature. Liquid surface particles evaporate into gaseous particles. The amount of gas pressure coming from the surface of the liquid is referred to as **vapor pressure**. Below are three representations of the relative number of liquid and vapor particles in each substance. Label each container with the correct chemical formula of the substance. Key: ● = Liquid ○ = Vapor



Beaker A



Beaker B

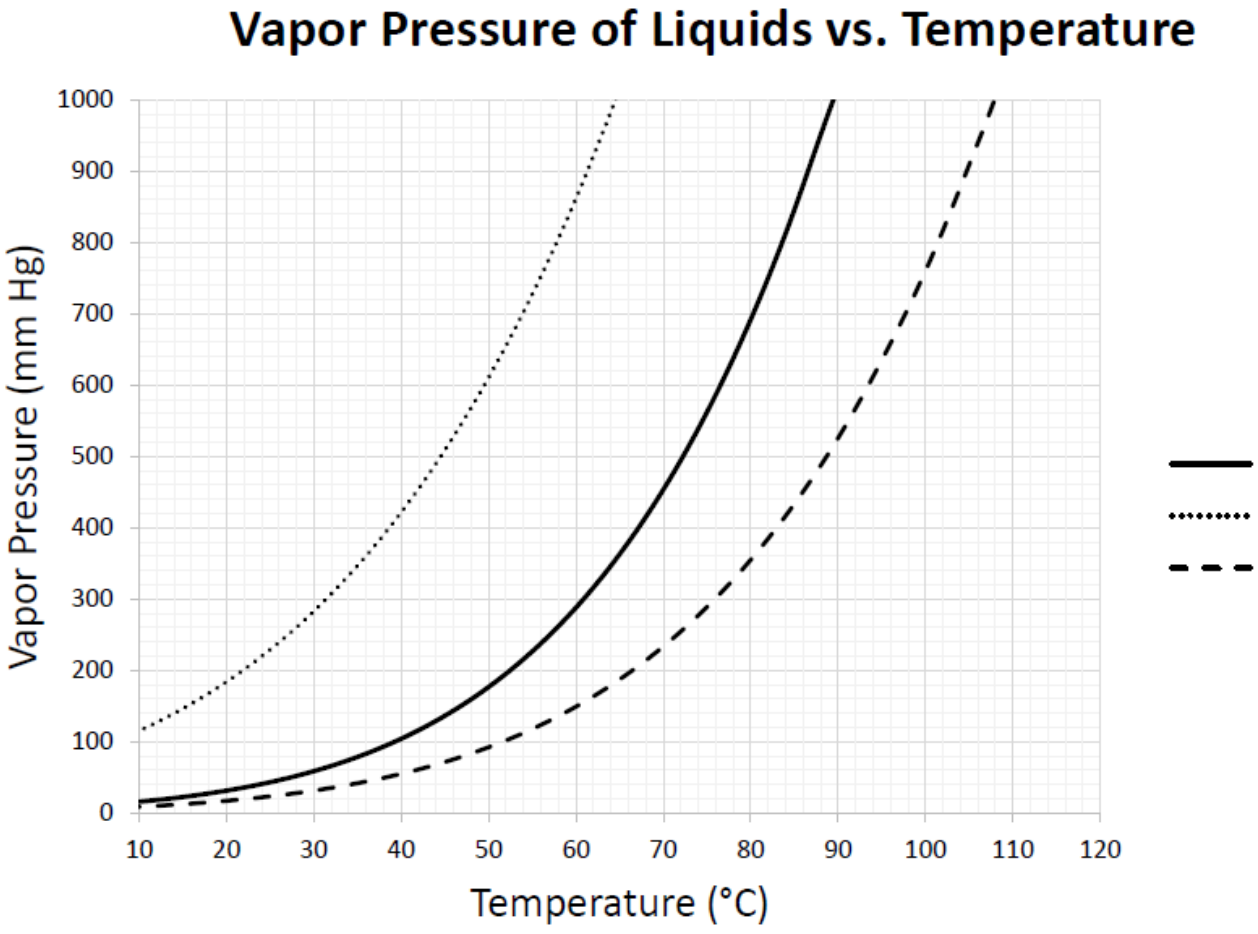


Beaker C

7. Which of the three substances would produce the most vapor pressure at room temperature? Explain your reasoning.

8. If the substances are heated then the particles begin to move faster and become less attracted to one another, eventually turning into a gas. Thus, as temperature increases the vapor pressure of the liquid increases. Once the vapor pressure of a liquid equals the atmospheric pressure, the liquid begins to boil. The temperature at which a liquid boils is called **boiling point**. Which of the three substances would have the highest boiling point? Explain your reasoning.

9. Below are vapor pressure curves for the three substances. Label each curve with the correct chemical formula of the substance.



10. Using the vapor pressure curves above, determine the normal boiling point of each substance. Normal boiling point occurs at an atmospheric pressure of 1 atm.

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Making a Case for Intermolecular Forces

Station 1

1. Each substance is nonpolar and experiences only London Dispersion Forces (LDF's) of attraction between its molecules. Using the data, synthesize a rule that can be used to predict relative strengths of LDF's.

Station 2

2. The compound butane, C_4H_{10}, occurs in two isomeric forms, *n*-butane and isobutane. **Isomers** are compounds that have the same molecular formula, but different arrangement of atoms.
   Both *n*-butane and isobutane exist as gases at 25°C and 1.0 atm. Examine the Lewis structures and molecular models. Explain why *n*-butane (– 0.5°C) has a higher boiling point than isobutane (– 11.5°C).

Station 3

3. The polarity of a molecule can be quantified as the dipole moment. The dipole moment is measured in debyes (D). The more polar a molecule, the larger its dipole moment. Examine the dipole moment values of the three molecules. Considering that dipole moments can result from bond polarities or lone electron pairs, propose some possible explanations for the dipole moment differences between the three molecules.

4. Which substance would you expect to have the highest boiling point? Explain your reasoning.

Station 4

5. Examine the molecules. Rank the compounds in order of increasing boiling point. Explain your reasoning.