Assignment: Volatility and Surface Tension of Liquids

1. What is the difference between evaporation and boiling?

Boiling takes place within the whole liquid and always at the same temperature, called the boiling point, whereas evaporation occurs only at the surface of a liquid and can occur at any temperature but is increased by weaker intermolecular forces or a higher temperature.

How can volatility be tested in a laboratory?

Because, volatility is directly related to vapour pressure, the volatility can be tested by measuring the vapour pressure. Measuring the vapour pressure can be done in a laboratory with a manometer as shown in this picture. This picture shows a mercury manometer being used to determine the vapour pressure of acetone.



. What are some differences between liquids and gases?

- Gases can be easily compressed
- Liquids have a definite volume
- The particles in a gas have weaker forces of attraction, move randomly, and are farther apart

4. A liquid that has a strong surface tension is likely to behave in what manner when placed in a narrow graduated cylinder?

In this occasion, due to the cohesive force caused by the high surface tension overpowering the adhesive forces of the graduated cylinder, a convex meniscus would be <u>formed</u> as shown in the diagram.



Why does water "bead up" on a newly waxed car instead of forming a sheet over it?

This is due to the cohesive properties of water (due to the polarity of water molecules) and the hydrophobic property of car wax. Because the car wax is hydrophobic, it greatly decreases the adhesive forces on the car causing the cohesive forces in the water to be stronger. This causes the water to stick to itself more than it sticks to the car which is why the water beads up.

6. How is surface tension of a liquid related to the intermolecular forces in a liquid? Predict which of the following liquids has the greater surface tension; ethanol C_2H_5OH or dimethyl ether CH_3OCH_3 . Explain your answer.

The intermolecular forces in a liquid are what cause surface tension, as in greater intermolecular forces cause greater cohesive forces and greater cohesive forces are what cause greater surface tensions. Ethanol will have a greater surface tension than dimethyl ether. This can be seen by their molecular structure. Ethanol has an oxygen bonded with a hydrogen meaning that one of the forces is hydrogen bonding whereas dimethyl ether's intermolecular forces are dipole-dipole. Hydrogen bonding is a much stronger intermolecular force so ethanol has a greater surface tension.

7. How does the vapour pressure of a liquid vary with temperature? At any given temperature would you expect the vapour pressure of acetone, CH₃COCH₃, to be greater or less than the vapour pressure of water? Explain your answer.

Vapour pressure of liquids increase as you increase temperature. The vapour pressure of acetone is expected to be higher than the vapour pressure of water because the intermolecular forces in acetone are weaker (no hydrogen bond force) which means that they move around more freely than water molecules which allows them to vaporize easier.

8. Viscosity is defined as a measure of a fluid's resistance to flow. Using this definition explain the relationship between the intermolecular forces that exist in a liquid and its viscosity.

Arrange the following liquids in increasing order of viscosity: water, ethanol (C_2H_5OH), ethylether ($C_2H_5OC_2H_5$), and glycerol.

Using this definition, it can be seen that greater intermolecular forces cause greater viscosity. This is because when a fluid has more attractive forces within itself, it will want to stay closer together which will cause it to resist flow more. Glycerol, water, ethanol, ethylether.

Explain the expression "slow as molasses in January" (definitely not what would describe Mrs. Pall's classes!) as related to physical properties of liquids. (Consider viscosity!).

This expression is saying that molasses in January is slow which is true because molasses is an extremely viscous fluid and January is typically cold which also increases the viscosity of fluids (high viscosity means low flow rate so it's slower).

COM