1. Oil and water don't mix because __________.

(A) an oil's covalent bonds cannot be broken by water molecules
water's polar covalent bonds cannot be broken by oil's London dispersion forces (C) water's polar covalent bonds cannot be broken by oil's covalent bonds
(D) water's hydrogen bonds cannot be broken by oil's London dispersion forces

Hint: Polar covalent and covalent bonds are intramolecular bonds.

Water's hydrogen bonds are intermolecular bonds that can only be broken by another, stronger intermolecular bond, which London dispersion forces are not.

2. Micelles are formed by __________.

(A) the non-polar tails of soap molecules
(B) the polar heads of soap molecules
(C) tiny drops of oil molecules
(D) bits of oily dirt being trapped inside pockets of oil molecules

Hint: Micelles are non-polar lakes amidst a sea of polar molecules.

Soap molecules have a polar head and a non-polar tail.

Micelles are formed as the non-polar tails of soap molecules congregate together.

3. Viscosity is higher in motor oil than water because __________.

(A) oil has more London dispersion forces than water
(B) the total strength of oil's London dispersion forces is greater than the total strength of water's hydrogen bonds
(C) the total strength of oil's covalent bonds is stronger than the total strength of water's polar covalent bonds
(D) oil's long hydrogen chains exert more mechanical friction that water molecules

Hint: The hydrogen bond between any two water molecules is stronger than the London dispersion force between any two small non-polar molecules.

However, the hydrocarbons in motor oil can generate a stronger London dispersion force than water molecules, because long-chain hydrocarbons bonding to each other involve many more London dispersion forces than the hydrogen bonds between individual water molecules.

The total strength between all the hydrocarbons in motor oil is thus greater than the strength of the hydrogen bonds between individual water molecules.

4. Surface tension results from __________.

(A) air pressure on the surface of water
(B) the gravitational pull on water molecules at the surface
(C) the absence of hydrogen bonds above water molecules at the surface
(D) the outward pressure exerted by the kinetic energy of water molecules

Hint: With no water molecules above water's surface, water molecules at the surface hydrogen bond to other water molecules along the water's surface.

This horizontal force along the surface of water create a firmness to the surface called surface tension.

5. Strong surface tension allows __________.

(A) Gerris bugs to stand on water
(B) airplanes with pontoons to rest on the surface of a lake
(C) soap bubbles to form
(D) beads of water to form on waterproof surfaces

Hint: The attraction of surface water molecules for its horizontal neighbors, and for the water molecules below the surface, causes water droplets to round up as beads of water.

6. Soap breaks up surface tension by ________.

(A) lying flat on the surface of water and separating water molecules
(B) using their heads to separate water molecules at the surface
(C) using their tails to separate water molecules at the surface
(D) forming micelles to separate water molecules at the surface

Hint: Soap molecules separate water molecules at the surface so that the water molecules cannot link arms and firmly hold on to each other at the surface.

At the water's surface, soap molecules use their polar heads to poke between water molecules.

Since their non-polar tails cannot separate water molecules under the water's surface, the tails of the soap molecules poke upright out of the water.

7. Ice is less dense than water because __________.

(A) the same number of frozen water molecules occupy less space than liquid water molecules
(B) water released its heat of fusion during the freezing process
(C) six-sided ice crystals are hollow
(D) water molecules lose a small amount of mass in the process of freezing

Hint: Density is mass per unit volume.
By being hollow, ice crystals are able to occupy more volume that the same number of liquid water molecules randomly rolling and bumping into each other.

By occupying more space, ice crystals have a lower mass per volume ratio and are thus less dense than liquid water.

8. An iceberg sticks up out of the water because __________.

(A) the weight of the ice above and below the water weighs the same as the water displaced
(B) the weight of the ice below water weighs more than the water displaced
(C) the volume of the ice below water equals the volume of water displaced
(D) ice is less dense than water

Hint: Objects sink until their entire mass - above and below the water -- equals the mass of the water displaced.

The volume of water displaced by the iceberg always equals the volume of the submerged part of the iceberg.

As an iceberg is lowered into the water, it stops sinking when the iceberg displaces a volume of water equal in weight to the entire iceberg.

Some of the iceberg has to stick up out of the water so that the mass of entire iceberg equals the mass of the water displaced.

9. Things that increase the upward buoyancy force of water include __________.

(A) heating the water
(B) adding salt to the water
(C) lowering the air pressure over the water
(D) adding air to the water

Hint: Buoyancy is an upward force exerted by water.

Force is mass times acceleration.

Since the acceleration of gravity is constant, the only way to increase buoyancy force is to increase the mass of water, which can be done by adding salt to the water.

10. Water density increases __________.

(A) from about 2 miles below to the surface of the ocean to the bottom of the ocean
(B) when water is heated from 0^o Celsius to 4^o Celsius
(C) when water is cooled from 4^o Celsius to 0^o Celsius
(D) soap is added

Hint: Water is densest at 4^o Celsius, so while most liquids continue to become denser the colder they become, water does not.

Once the temperature of water drops to 4^o Celsius where water is densest, anything cooler is less dense than 4^o Celsius water.

Because water molecules are so close together already, even the weight of ocean cannot squeeze them closer together.

So from about 1 mile below the ocean's surface to the bottom of the ocean, the density of water remains pretty constant.

11. Strong intermolecular bonding suggests __________.

(A) polar molecules, low boiling points, crystal solids
(B) ionic molecules, high boiling points, soluble in water
(C) hydrophobic compounds, high density, high boiling points
(D) high viscosity, small non-polar compounds, low freezing point

Hint: Strong intermolecular bonding means very sticky molecules as you might see in ionic molecules like table salt, NaCl.

Strong intermolecular bonding resists any attempt by heat to break molecules apart, so boiling points will be high.

Non-polar molecules depend on weak London dispersion forces to attract other non-polar molecules.