

## Quarter 2, Week 9, Day 1, Monday

### Science and Critical Reading - Grade 11 - Chemistry

Opening Question: Why don't oil and water mix? (answer on the next page)

Today, there is no instructional video, as you are preparing for the test, you should be able to follow the instructions on your own and complete the lab without guidance. The answer key with expected results should follow tomorrow, but based on the concepts you will likely already know what to expect.

We have been learning about IMF (intermolecular forces) for several weeks and what we have learned is that the presence of high electronegativity differences between atoms (like Hydrogen and Oxygen), and good symmetry (like in ethanol), make it easier for molecules that are attracted together to form neat patterns and scaffold together. In the previous labs on surface tension and flammability, the pattern was that the higher the IMF, i.e. the stronger attraction between the two molecules, the harder to split them apart. This generally means that molecules with higher IMF will be more physically stable, and therefore have higher boiling points, melting points, surface tension, and lower volatility/flammability. Because of their attraction to each other, they stick closer together, and that means more energy (like heat) is required to break them apart.

Today we will be testing the relationship between IMF and solubility. Some questions to think about is how IMF will affect solubility in general, and how the different types of IMF affect solubility in different types of solutes. Remember, there are three types of IMF:

1. London Dispersion Forces (relevant for non-polar molecules), which are temporary dipoles in non-polar molecules.
2. Dipole-dipole interactions, which are permanent dipoles
3. Hydrogen bonding, which is a type of strong dipole-dipole interaction only present in covalently bonded hydrogen-based molecules

There are also two broad types of molecules:

1. Polar - with a strong dipole caused by electronegativity differences between atoms
2. Nonpolar - with no strong dipoles

Try this lab today to test out the relationship between polar and nonpolar molecules.

Lab file: [http://polaris.study/SolventsLab\(11\).pdf](http://polaris.study/SolventsLab(11).pdf)

Lab notes:

1. Be very careful handling solvents. Take care not to inhale too much.
2. Check solvents and solutes to make sure that you have enough of each.
3. Test each combination, and wash glassware after use to prevent contamination.

Opening question answers:

1. Easy answer: Water is polar and therefore can not mix with a non-polar substance, like oil.
2. Deeper answer: Water molecules attract each other very strongly because they form extensive hydrogen-bond networks. When a non-polar substance like oil enters water, it cannot form similarly strong attractions with water molecules. To mix evenly, water would have to break many of its hydrogen bonds and replace them with much weaker interactions between water and the oil molecules. That substitution is energetically unfavorable: the water molecules prefer to stay bonded to one another rather than surround and separate the non-polar molecules. As a result, the system arranges itself to keep disruption of the hydrogen-bond network as small as possible. Water molecules cluster together, and the non-polar molecules cluster together, producing two distinct layers rather than one uniform mixture. This behavior is often called the hydrophobic effect. It is not caused by the water "repelling" the oil, but by the water trying to maintain its strongest, most stable intermolecular attractions.