Sample

Experiment 3: identification of an unknown liquid.

This is the purpose

[i]In this lab, I attempted to identify an unknown pure liquid based on several physical tests- the solubility of the liquid in water, the relative density (if the unknown is insoluble) compared to water, the boiling point, and the relative freezing point compared to the temperature of an acetone/dry ice bath.

My unknown, #12, was a clear liquid with an oily, gasoline like smell. In part 1 of the lab, I determined the solubility of unknown #12 in water. I put a small sample of #12 (about 2 mL) in a test tube and added an equal amount of water. After swirling the test tube, I noticed that there were two layers. Since they are both clear, I added a small amount of copper(II) sulfate solution to the tube. The bottom layer turned sky blue. This told me that the bottom layer was water, because copper(II) sulfate is soluble in water and not in organic compounds. The relative density of my liquid was less then water because it floated above the water.

Observations and results. I also included procedure for clarity.

In part 2, I determined the boiling point of the liquid using a neat boiling point apparatus. I put a small amount of #12 in a small test tube. I put a capillary tube upside down in the liquid. I strapped this to a thermometer and placed the whole thing in a warm water bath. I gently warmed the water bath with a Bunsen burner. Occasionally, I would gently stir the water with a stirring rod to distribute the hot water evenly. After about 10 minutes, a fast stream of bubbles started leaving the open end of the capillary tube. When I observed the bubbles leaving the tube, I turned off the heat and watched the capillary tube. The bubbles slowed down and eventually stopped. At this point, liquid was drawn up the tube and I read the thermometer. The boiling point was 79.0-80.0 °C ± 5°C. I really don't understand how this apparatus works, but I think the gas in the bubbles that are escaping is trapped air and maybe some of the vapor from the liquid. The gases expand when heated and are forced out of the bottom of the capillary tube, so I see bubbles. The liquid is probably pushed in by atmospheric pressure. This is also a place in the experiment where I can have the most error, because the temperature range is wide. It could lead me to the wrong conclusion about my unknown.

The grey part is extra and I added it for fun.

In part 3, I determined the relative freezing point by immersing a small amount of #12 in a test tube into a dry ice-acetone bath. The bath has a temperature of –78°C. It's really cold, so I made sure not to freeze my fingers by not handling the test tube-I used a test tube clamp. The sample froze almost immediately! So, I knew that the freezing point is above –78°C. This technique measures only the relative melting point not the actual melting point. Therefore, I don't know the precise melting point of my unknown.

In the lab manual, we are given 10 possibilities for the unknown. Acetone, acetonitrile, ethanol, and of course water, were eliminated because they are soluble in water, and #12 is not. This left me with carbon tetrachloride, cyclohexane, cyclopentane, methylene chloride, t-butyl chloride and Freon-113. Of these, I eliminated carbon tetrachloride, methylene chloride, and Freon –113 because they are all denser than water, and #12 is less dense than water. This left me with cyclohexane, cyclopentane, and t-butyl chloride. Both cyclopentane, and t-butyl chloride have boiling points way below the range I measured of 79.0-80.0*C. From these results, I identified cyclohexane as the likely identity of my unknown.

Conclusions and discussion. Some of this is an error analysis-not necessary for this Exp.

Most of the identification process uses relative identifications, so there are places that I could have made errors which would have lead me to the wrong conclusion My unknown has relative properties similar to (but not exactly like) ethanol, acetonitrile, and carbon tetrachloride. If I was not careful checking solubility, I might have acetonitrile as an unknown. Acetonitrile and #12 have the same relative freezing points, densities, and are very close in boiling points. Unknown #12 and carbon tetrachloride having also very similar boiling points, relative freezing points, and solubilities, but the relative densities are different; carbon tetrachloride is denser than #12, it would be on the bottom layer in the test tube. There is really no way of positively identifying #12 unless I determine the experimental values for melting point, density, and solubility.

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[i] [This conclusion, although not double space and is in font 9 pt, is an example of a summary. It is 750 words long. It is long because I had a lot to say. Maybe you will too!]