Abstract

The change in temperature during evaporation of five hexanes was used to determine the strength of intermolecular forces of the hexanes compared to each other. London dispersion forces, dipole-dipole bonds, and hydrogen bonds were considered. The hexanes ordered from weakest to strongest bonds were found to be as follows: n-pentane, 2-pentanone, 1-propanol, 1-butanol, and 1-pentanol.

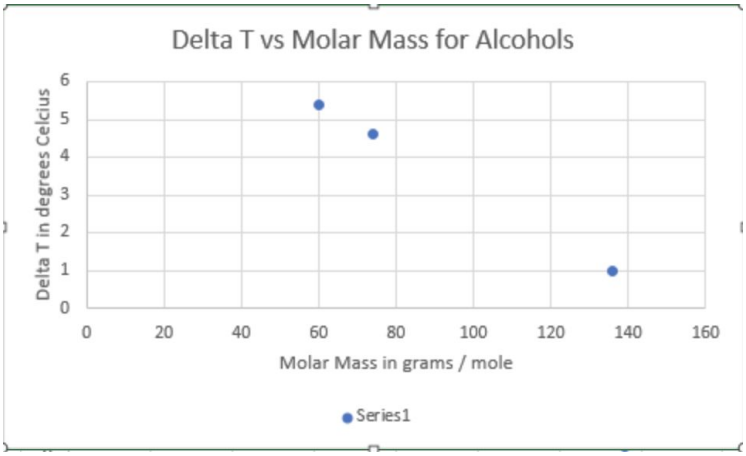
Introduction

This lab investigated the relationship between intermolecular forces and the change in temperature during evaporation of five hexanes: n-pentane, 2-pentanone, 1-propanol, 1-butanol, and 1-pentanol. The relationship found was consistent with the information learned about intermolecular forces learned in class. The relationship of alcohol, 1-propanol, 1-butanol, and 1-pentanol, was graphed and could be used to predict the change in temperature for other alcohols based on molar mass. The main interest was to develop a greater understanding of intermolecular forces.

Procedure

The temperature probe was connected to the computer interface and logger lite software was opened. The probe was automatically detected. To prepare the computer for data collection, the collection mode was changed to a custom time base of 120 seconds. The probe collected data continuously for 120 seconds during the trial. The probe was wrapped with a square piece of filter paper and secured by a small rubber band. The probe was put into the hexane solution. Data collection was started. After 30 seconds, the probe was removed from the solution and held in a horizontal position. When the temperature reached a minimum and began to increase, the data collection was stopped. This process of data collection, with a new piece of filter paper, was repeated for all the hexanes. The maximum and minimum temperatures for each hexane were subtracted to get the change in temperature during evaporation.

Results



* indicates the alcohol is included in the graph above

Hexane	Molar Mass in g/mol	Change in Temperature in Degrees Celsius
*1-propanol	60.01	5.40
*1-butanol	74.12	4.60
*1-pentanol	136.00	1.00
n-pentane	72.15	25.40
2-pentanone	87.14	8.10

Discussion

The n-pentane had only london dispersion forces (LDF) which are weak compared to the LDF, dipole-dipole bonds and hydrogen bonds in 1-pentanol. The stronger bonds in 1-pentanol explain its lower change in temperature, because the bonds were not as easy to break. The intermolecular forces were the largest for n-pentane and the smallest for 1-pentanol. The larger the change in temperature, the weaker intermolecular forces. Based on the graph included in the results section, it can be predicted that CH_3OH has a change in temperature of 8.50 degrees Celsius and $C_6H_{13}OH$ has a change in temperature of 3.50 degrees Celsius. Based on the experiment the hexanes ordered from weakest to strongest intermolecular forces are n-pentane, 2-pentanone, 1-propanol, 1-butanol, and 1-pentanol. This is because n-pentane only has LDF, and 2-pentanone has LDF and dipole-dipole bonds. The remaining hexanes have LDF, dipole-dipole bonds, and hydrogen bonds. Since hydrogen bonds are the strongest, compounds containing hydrogen bonds will have the strongest bonds.

Conclusion

The hexanes ordered from weakest to strongest bonds are as follows: n-pentane, 2-pentanone, 1-propanol, 1-butanol, and 1-pentanol. The results are consistent with the intermolecular forces in each hexane. The results may be skewed due to errors in data collection and mathematical errors such as rounding.