**Data Table**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Substance** | **Tmax** | **Tmin** | **∆T (°C)** |  |
|  |  | **(°C)** | **(°C)** | **(Tmax–Tmin)** |  |
|  |  |  |  |
|  |  | methanol | 21.7 |  8 | 13.7 |  |
|  |  |  |  |  |  |  |
| **Explanation** | **Predicted** | 1-propanol |  |  |  |  |
| **∆T (°C)** | 22.7 |  18 | 4.7 |  |
|  |  |  |  |  |
|  |  |  |  |  |  |  |
| Butanol is a larger molecule than propanol with the same –OH group at the end of the molecule, hence it will exhibit greater IMF. | ~4.1 | 1-butanol |  |  |  |  |
|  |  |  |  |  |  |  |
| Pentane is a larger molecule than methanol but exhibits only London dispersion forces | >>13.7 | pentane |  |  |  |  |
|  |  |  |  |  |  |  |
| Ethanol falls in between methanol and propanol in terms of size and happens to have the same –OH group | < 13.7, >4.7 | ethanol |  |  |  |  |
|  |  |  |  |  |  |  |
| Hexane has only London dispersion forces but since it is a larger molecule than pentane it will exhibit less temperature change | >13.7 | hexane |  |  |  |  |
|  |  |  |  |  |  |  |

**Questions**

1. Take a moment to look at your **∆**T values. In the space below, organize your samples from smallest **∆**T to largest **∆**T for your alkanes, and again for your alcohols:

Alkanes: hexane < pentane

Alcohols: butanol < propanol < ethanol < methanol



1. Discover what the **∆**T “tells” you about how readily a sample evaporates. Circle the appropriate response to each statement below.



|  |  |  |  |
| --- | --- | --- | --- |
| Large **∆**T values mean that the sample | does | does not | evaporate readily. |
| Small **∆**T values mean that the sample | does | does not | evaporate readily. |

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1. Correlate your answers to how readily a sample evaporates to the strength of the intermolecular forces in that molecule. (again, circle the appropriate response to complete the statement.)

If the sample evaporates readily, then the relative strength of the IMFs in the molecule is: (circle one)



strong weak.

If the sample does not evaporate, then the relative strength of the IMFs in the molecule is: (circle one)



strong weak.

1. Looking at the formulas for your alkanes, what is the only difference between formulas?

**The only difference would be the number of molecules of carbon and hydrogen.**

1. What IMF(s) are present in the alkanes (list all present)?

**The only IMFs present in the alkane group is the London Dispersion Force.**

1. Looking at the formulas for your alcohols, what is the only difference between the formulas?

**The only difference between the alcohols is also the number of carbons and hydrogen atoms.**

1. What IMF(s) are present in the alcohols (list all present)?

**The IMFs present in the alcohol include hydrogen bonding between hydrogen and oxygen and London Dispersion forces on the carbon chain.**

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Using your answers to the guided questions on page 5, answer the following questions:

* 1. Using Excel, plot a graph of ∆T values of the four alcohols versus their respective molecular weights. Plot molecular weight on the x-axis and ∆T on the y-axis. Label each point with the identity of the alcohol. From the graph, comments on the relationship between the strengths of intermolecular forces and a molecule’s molecular weight:

**As molecular weight increases, the strength of a molecule’s IMF should increase.**

**Explanation: Since there are more electrons throughout the molecule, the momentary dipole that forms when electrons are located in greater concentration at an end of the molecule is also stronger.**

1. Two of the liquids, pentane and 1-butanol, had nearly the same molecular weights, but significantly different ∆T values. Based on their intermolecular forces, explain why there was a difference in ∆T values of these substances. Be specific.

**The difference in temperature occurs as a result of the significantly stronger IMFs that exist between butanol molecules. This is since butanol has permanent dipole-dipole interaction while pentane only has London dispersion forces to keep it from changing states.**

1. Which of the alkanes studied has the stronger intermolecular forces of attraction? The weaker intermolecular forces? Explain using the results of this experiment. Include in your explanation comments about the strengths of their IMFs.

**Hexane should have stronger intermolecular forces while pentane should have weaker ones. This is since hexane is the larger molecule and thus exhibits stronger London dispersion forces.**

1. Which of the alcohols studied has the strongest intermolecular forces of attraction? The weakest intermolecular forces? Explain using the results of this experiment. Include in your explanation comments about the strengths of their IMFs.

**Butanol has the strongest intermolecular forces while methanol has the weakest ones. This is since methanol is significantly smaller than butanol, despite having the same type of dipole-dipole force. Consequently, the London dispersion forces of butanol are also far stronger.**