Title: Esters - Artificial Flavors

Introduction:
Many esters have the characteristic property of a pleasant odor. As such, they are used as artificial flavors and perfumes. Have you ever tasted peppermint gum or banana-flavored ice cream? These flavors are most likely due to an organic compound known as an ester. Not all esters have odors, some are odorless, too. An example of an odorless ester would be vegetable oil.

Esters are formed by the process of dehydration synthesis using an alcohol with an acid. Their names are formed from the very alcohol and acid used in their making. For example, when making the ester methyl salicylate (oil of wintergreen), the alcohol and acid used would be methanol and salicylic acid, respectively. This ester has an agreeable “peppermint” odor. Another example would be the ester butyl formate which is produced when reacting butyl alcohol with formic acid.

When an organic acid (RCOOH) reacts with an alcohol (R'OH), water is removed and an ester is formed. This process is an example of dehydration synthesis. More information about dehydration synthesis can be found in your text.

\[
\text{RCOOH} + \text{R'OH} \rightarrow \text{H}_2\text{O} + \text{RCOOR'}
\]

for example......

\[
\text{C}_6\text{H}_5\text{COOH} + \text{CH}_3\text{OH} \rightarrow \text{H}_2\text{O} + \text{C}_6\text{H}_5\text{COOCH}_3
\]

Some artificial flavors are formed by the mixing of esters in an attempt to duplicate the flavor or odor of a natural substance. For example, the odor of raspberries is due to a mixture of isobutyl formate and isobutyl acetate. In this experiment you will make four different esters having characteristic odors of banana, peppermint, fruit essences, and rum.

Purpose: 1. To create esters by adding alcohols and carboxylic acids together.
        2. To understand uses of esters.
        3. To understand the dehydration synthesis in creating an artificial ester.
        4. To identify odors of certain esters.

Procedure:
1. Prepare a hot water bath by filling a 250 mL beaker with 100 mL of water on a ring stand and gently heat with a Bunsen burner. The water should be between 70 and 80 degrees Celsius. Use a thermometer to monitor the temperature.

2. Take one small test tube. Add the ingredients listed in the table below to the test tube. Do one test tube at a time so that you do not get confused with which one is which. The sulfuric acid you can find in the fume hood. **BE VERY CAREFUL** for the sulfuric acid and acetic acid are 18 molar in concentration.
3. Record the odor as soon as they have been mixed together. Place the test tube in the hot water bath. After 5 - 10 minutes, take out the test tube and smell the odor. You may have to gently shake the test tube to produce an odor. To smell the test tube, hold the test tube and wave your hand across the top of the test tube to bring the odors up to your nose. Never stick a test tube directly under your nose. Record the smell of the new vapor. While the first test tube is warming you can start preparing the next set of chemicals.

4. Repeat the procedure with the three other test tubes but use the new ingredients.

Data Table:

<table>
<thead>
<tr>
<th>Acid used in reaction</th>
<th>Catalyst</th>
<th>Alcohol used in reaction</th>
<th>smell before reaction</th>
<th>smell after reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>T.T.1 glacial acetic acid - 10 drops</td>
<td>concentrated H₂SO₄ - 1 drop</td>
<td>isoamyl alcohol 10 drops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T.T.2 glacial acetic acid - 10 drops</td>
<td>concentrated H₂SO₄ - 1 drop</td>
<td>ethanol - 10 drops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T.T.3 salicylic acid 0.2 grams</td>
<td>concentrated H₂SO₄ - 1 drop</td>
<td>add enough methanol to dissolve the acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T.T.4 propanoic acid 10 drops</td>
<td>concentrated H₂SO₄ - 1 drop</td>
<td>ethanol - 8 drops</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

note: isoamyl alcohol is also isopentyl alcohol
acetic acid is also enthanoic acid

Findings:

1. Draw the general formula in a the creation of an ester.

2. Write equations for each of the esterfication reactions in this experiment. Use structural formulas in the equations and write the name of each compound below its structural formula.

3. List a few examples on where esters are found in everyday life. What are their functions?