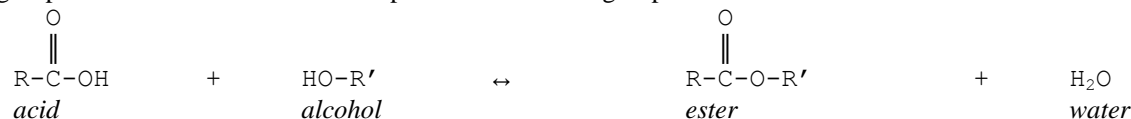


## Artificial Aroma Experiment (Esters Lab)

Many foods such as ice cream, candy, syrup, and others contain artificial flavors. Many of these flavouring additives are esters. An ester is an organic compound that is produced when an organic acid reacts with an alcohol. Esters are named by combining the names of the alcohol and the acid from which they are synthesized. For example, ethyl alcohol and benzoic acid produce the ester ethyl benzoate. Ethyl alcohol and decanoic acid produce ethyl decanoate. Methyl alcohol and salicylic acid produce methyl salicylate. The following general reaction shows the formation of an ester. R represents the carbon group characteristic of the acid. R' represents the carbon group of the alcohol.



Esters have pleasant odors that help to identify them. Some esters occur naturally and others are produced artificially. The chart lists some common esters and their odors.

Ester	Odor
Ethyl benzoate	Fruity
Ethyl butyrate	Pineapple
Ethyl cinnamate	Peach
Ethyl decanoate	Grape
Ethyl hexanoate	Pineapple/Banana
Ethyl isobutyrate	Apple
Isoamyl butyrate	Apricot
Isoamyl salicylate	Pineapple
Methyl salicylate	Wintergreen
Methyl butyrate	Apple/Banana

### Problem

To prepare several esters and note their characteristic odors.

### Materials

Salicylic acid	Beaker
Glacial acetic acid	Eye dropper
H <sub>2</sub> SO <sub>4</sub> (18M)	Aluminum foil
Butanoic acid	Test Tubes
Ethyl alcohol	Hotplate/Bunsen burner
Amyl alcohol (1-pentanol)	
Methyl alcohol	
Isoamyl alcohol (2-methyl-1-butanol)	

\*\*\* Caution: H<sub>2</sub>SO<sub>4</sub> is very corrosive \*\*\*  
\*\*\* Caution: Alcohols are flammable \*\*\*

### Procedure

1. Add 375 mL of water to a 500-mL beaker. Bring the water to a boil.
2. Turn off the burner and set aside the 100°C for later use.
3. Place 5 test tubes in a test tube rack. Number the tubes 1 to 5.
4. Place 10 drops of each reagent into the appropriate tube using an eyedropper, as indicated in the following chart.
5. Remembering the rules for smelling reagents, carefully note the odor of each reagent as you add it.

Tube	Alcohol	Acid
1	Methanol	Salicylic acid
2		
3		
4		
5		

6. Carefully add 3 drops of 18M H<sub>2</sub>SO<sub>4</sub> to each tube.
7. Stir each mixture slightly by tapping the bottom of the tube with your finger.

8. Place tubes 1 and 2 into the beaker of hot water.
9. After a few minutes, remove the tubes from the water bath. Stir each mixture by slightly tapping the bottom of the test tube with your finger.
10. Check each tube for the presence of an odor. Record your observations. (remember smelling rules)
11. If no odor is detected in a tube, cover the top with aluminum foil. Set the tube aside in a warm place for 15 minutes. Record your observations.
12. Repeat steps 8 through 11 for the remaining tubes.
13. Clean up and dispose of all chemicals down the drain with copious amounts of water.

**Questions:**

1. Complete a lab report in your lab book.
2. Complete an observation table describing the odour of each ester produced.
3. Write the reaction for preparing one of the esters using structural formulas.
4. Name all the esters produced.
5. What was the role of the sulfuric acid.
6.
  - a) Assuming you produced ethyl ethanoate (ethyl acetate) by using 5.0 mL of ethanol and 6.0 mL of glacial acetic acid, and given that the density of ethanol is 0.79 g/mL and the density of glacial acetic acid is 1.05 g/mL, calculate the number of moles of ethanol and acetic acid that was used.
  - b) Which reactant was in excess? Include your reasoning.
  - c) Calculate the mass of the ester produced by the above reaction.
  - d) Describe one way in which the product could be purified.