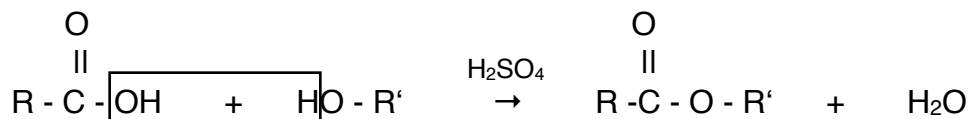


## Lab: Esterification

### Introduction

Esters are a group of organic compound best known for their interesting odors. Many perfumes and artificial flavorings are esters. Esters are formed when a carboxylic acid reacts with an alcohol in the presence of a strong acid. The general reaction can be seen below.



Esters are named from the compounds from which they are formed. The first part of the name comes from the alcohol, the second part from the carboxylic acid.

### Purpose:

The purpose of this lab is to produce an ester on a small scale, using relatively non-hazardous starting materials.

### Materials per Ester:

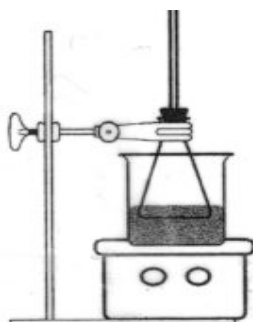
#### Equipment

hot plate, 1  
retort stand, 1  
retort clamp, 1  
beaker, 600 mL, 1  
Erlenmeyer flask, 250 mL, 1  
graduated cylinder, 25 mL, 1  
rubber stopper fitted with a glass tube  
(15 cm or longer), 1  
scoopula, 1 (labelled)

#### Chemicals

water, hot, for water bath 300 mL  
acid, as determined for your ester  
alcohol, as determined for your ester  
water, distilled 20 mL  
sulfuric acid,  $\text{H}_2\text{SO}_{4(\text{aq})}$  (18 mol/L) 8 drops  
**TEACHER USE ONLY**

### Material Set-up



**Safety Precautions:**

- Review ALL safety cautions and precautions, including those on any applicable SDS and/or workplace labels, for this lab with your teacher. Be sure you clearly understand these before proceeding with the lab procedure.
- Review all other applicable safety procedures pertaining to this lab with your teacher. Be sure you clearly understand these before proceeding with the lab procedure.
- PPE: chemical splash goggles, nitrile gloves, lab apron, heat-proof gloves
- REMOVE nitrile gloves during heating
- All alcohols are flammable and toxic. Avoid direct contact and open flames.
- All acids are corrosive and toxic. Avoid direct contact.
- Concentrated sulfuric acid is extremely corrosive and must be handled ONLY by the teacher.
- The hot plate will get very hot - use caution!
- Students must NOT taste any samples!
- Use the proper wafting technique when identifying an odour.
- Follow the proper waste disposal methods, as instructed by your teacher.

**Prelab:**

- Each group has been assigned an ester to produce.
- Determine the starting materials for the ester assigned to your group.
- Draw the structure and name the starting materials and the product for your ester.

Alcohol:

Acid:

Product (Ester):

**Procedure:**

- 1) Clear the desk and put on PPE - do not remove until all students have cleaned up.
- 2) Half fill a 600 mL beaker with hot water from the tap.
- 3) Place the beaker with water on a hot plate and begin heating the water.
- 4) Pipettes have been provided for each reagent - do not mix up the pipettes.
- 5) Use the labelled graduated cylinder provided for your alcohol to measure 10 mL into a clean and dry 250 mL erlenmeyer flask.
- 6) Use the labelled graduated cylinder or labelled scoopula provided for your acid to add 10 mL, or 3 small scoops, of your acid to the erlenmeyer flask.
- 7) The teacher will carefully add 8 drops of concentrated sulfuric acid to the flask.
- 8) Stopper the flask firmly with the stopper/glass tube combination.
- 9) Remove nitrile gloves.
- 10) Heat the flask in the water bath, as shown in the diagram. The contents should be kept just below their boiling point. If boiling occurs, or if liquid begins to rise up the glass tubing, adjust the flask so it is not as deep in the water - using great caution and heat-proof gloves.
- 11) Heat for 10 minutes, then remove the flask from the hot water bath and allow the flask to cool. Put on nitrile gloves.
- 12) Add about 15 - 20 mL of distilled water to dilute and sequester the acid reactant. Swirl to mix.
- 13) Smell the product by wafting the odour towards your nose. DO NOT inhale directly over the flask!
- 14) Carefully, circulate the room and note the odour of the other esters.
- 15) Clean up. Dispose of all materials as directed by the teacher. Wash glassware with soap and water, as instructed by the teacher. Rinse well. Wash your hands.

**Observations:**

<b>Ester</b>	<b>Odour</b>	<b>Color</b>
Methyl Salicylate		
Isoamyl Salicylate		
Isobutyl Propionate		
Isoamyl Acetate		

**Analysis:**

1) For each esterification reaction that took place during the lab:

a) write a word equation (4 marks)

b) write a structural diagram equation (8 marks)

**Conclusion** (3 marks)

**LAB SKILL MARK**

/10