

# Preparation of an ester

## MATERIALS

*As selected by student, may include:*

- alcohol and organic acid
- 1 M sodium carbonate solution
- reflux apparatus
- 250 mL separating funnel
- distillation apparatus
- solid calcium chloride
- filter paper
- filter funnel
- beakers



## Syllabus

*Identify data, plan select equipment and perform first-hand investigations to prepare an ester using reflux.*

## Introduction

One of the most important reactions of organic acids is their reaction with alkanols to form esters. Esters are usually responsible for the scent and taste of fruits, perfumes and flowers. Several compounds usually contribute to the aroma, but often only one ester is mainly responsible.

The reaction between an acid and an alcohol to produce an ester is called esterification. The preparation requires a special technique called refluxing.

In this activity you will select appropriate reagents and equipment and prepare an ester of your choice.

On completion of this investigation, you will be able to:

- select appropriate reactants for the preparation of an ester
- set up reflux apparatus and draw the labelled diagram
- use the appropriate technique and apparatus to separate an ester from the reaction mixture
- justify the purpose of using concentrated sulfuric acid in esterification
- justify the need for refluxing during esterification
- prepare a full risk assessment for the investigation.

## INVESTIGATION 34: Preparation of an ester

### Pre-lab safety information

Access Material Safety Data Sheets (MSDS) for the chemicals to be used and complete the safety table.

Material used	Hazard	Control

Please indicate by signing that you have understood the information in the safety table.

Name (print): \_\_\_\_\_

I understand the safety information (signature): \_\_\_\_\_



## Procedure

- 1 Using secondary sources, find out about the physical properties (such as boiling point and density) of the ester you wish to prepare.
- 2 Using secondary sources, find out what reagents you need, their boiling points (these should not be too close to the boiling point of the ester you wish to prepare), and the procedure for the preparation and separation of the ester from the reaction mixture.
- 3 Carry out a full risk assessment for the investigation.
- 4 Calculate the quantities of each reagent required.
- 5 Carry out the preparation of an ester.
- 6 (Optional) Calculate the percentage yield of your ester.
- 7 Write a scientific report that includes a labelled diagram of your reflux apparatus, references to secondary sources of information and the answers to the Discussion and Follow-up questions.
- 8 Present your report using appropriate media (PowerPoint presentation or similar).

## Discussion

- 1 Write a balanced equation to represent the reaction between your selected alcohol and alkanoic acid in the formation of the ester. Indicate clearly which functional groups are involved in the formation of the ester.
- 2 What was the aroma of your ester? Where in nature is it most likely to be found?
- 3 What was the function of the reflux apparatus?
- 4 Identify the catalyst that you used in the preparation of the ester, and outline its function.
- 5 List the factors that could increase the yield of your reaction.
- 6 What experimental evidence was there to indicate that the esterification reaction did not go to completion?
- 7 Describe the chemical and physical processes involved in the separation and purification of your ester.

## FOLLOW-UP

Study Table 1 to answer questions 1 and 2.

TABLE 1

Organic compound	Density ( $\text{g cm}^{-3}$ )	Boiling point ( $^{\circ}\text{C}$ )
1-butanol	0.806	117
ethanoic acid	1.044	118
butyl ethanoate	0.876	126.5



## FOLLOW-UP

- 1 Explain why:
  - a ethanoic acid has the highest density
  - b butyl ethanoate has the highest boiling point
  - c 1-butanol has the lowest density and boiling point.
- 2 Outline the procedure and the basis for separation of the following mixtures:
  - a 1-butanol and water
  - b 1-butanol and ethanoic acid
  - c butyl ethanoate from a mixture of 1-butanol and ethanoic acid
- 3 Give examples from secondary sources of the following:
  - a two naturally occurring esters and where they are found
  - b two industrially produced esters and their uses.